Horsham District Council

Strategic Flood Risk Assessment

Final Report – Revised 2010

Revised April 2010

Prepared for:

Horsham District Council

Prepared for:

Horsham District Council

Revision Schedule

Horsham District Council Strategic Flood Risk Assessment – Final Report
April 2010

Rev	Date	Details	Prepared by	Reviewed by	Approved by
D01	26/02/07	Draft Report	**Michael Timmins** Senior Flood Risk Engineer	**Dr Rob Sweet** Flood Risk Specialist	
D02	25/04/07	Draft Report	**Michael Timmins** Senior Flood Risk Engineer	**Dr Rob Sweet** Flood Risk Specialist	**Dr Damon O'Brien** Technical Director
D03	07/06/07	Final Draft Report	**Fay Tivey** Flood Risk Specialist	**Dr Rob Sweet** Flood Risk Specialist	**David Dales** Director
F01	19/06/07	Final Report	**Michael Timmins** Senior Flood Risk Engineer	**Dr Rob Sweet** Flood Risk Specialist	**David Dales** Director
F02	10/02/10	Update - Draft Report	**Sarah Littlewood** Graduate Hydrologist	**Emily Blanco** Senior Flood Risk Consultant	**Jon Robinson** Associate Director
F03	20/04/10	Update - Final Report	**Sarah Littlewood** Graduate Hydrologist	**Emily Blanco** Senior Flood Risk Consultant	**Jon Robinson** Associate Director

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Abbreviations

ACRONYM	DEFINITION
AONB	Area of Outstanding Natural Beauty
CFMP	Catchment Flood Management Plan
DEM	Digital Elevation Model
DPD	Development Plan Documents
EA	Environment Agency
EP	English Partnerships
FRA	Flood Risk Assessment
GIS	Geographical Information Systems
IDB	Internal Drainage Board
LDDs	Local Development Documents
LDF	Local Development Framework
LDS	Local Development Scheme
LiDAR	Light Detection and Ranging
LPA	Local Planning Authority
ODPM	Office of the Deputy Prime Minister
PCPA	Planning and Compulsory Purchase Act 2004
PPG25	Planning Policy Guidance Note 25: Development and Flood Risk
PPS25	Planning Policy Statement 25: Development and Flood Risk
RFRA	Regional Flood Risk Assessment
RPG	Regional Planning Guidance
RSS	Regional Spatial Strategy
SAR	Synthetic Aperture Radar
SA	Sustainability Assessment
SFRA	Strategic Flood Risk Assessment
SPG	Supplementary Planning Guidance
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems

Glossary

TERM	DEFINITION
Aquifer	A source of groundwater comprising water-bearing rock, sand or gravel capable of yielding significant quantities of water.
Catchment Flood Management Plan	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Climate Change	Both natural and human actions causing long term variations in global temperature and weather patterns.
Culvert	A channel or pipe that carries water below the level of the ground.
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood plain	Area adjacent to river, coast or estuary that is naturally susceptible to flooding.
Flood storage	A temporary area that stores excess runoff or river flow often ponds or reservoirs.
Fluvial flooding	Flooding by a river or a watercourse.
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
Indicative flood plain map	A map that delineates the areas that have been predicted to be at risk of being flooded during an event of specified probability.
Internal Drainage Board	Independent bodies with responsibility of ordinary watercourses within a specified District.
Inundation	Flooding.
Local Development Framework (LDF)	The core of the updated planning system (introduced by the Planning and Compulsory Purchase Act 2004). The LDF comprises the Local Development Documents, including the Development Plan Documents that expand on policies and provide greater detail. The development plan includes a core strategy, site allocations and a proposals map.
Local Planning Authority	Body that is responsible for controlling planning and development through the planning system.
Mitigation measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.
Risk	The probability or likelihood of an event occurring.
Sequential Test	A risk based approach in to assessing flood risk, which gives priority in ascending order of flood risk, i.e. lowest risk first.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
Stakeholder	A person or organisation that has an interest in, or affected by the decisions made within a site.
Sustainability Appraisal	A process used to identify if policies, strategies or plans promote sustainable development and further used for improving policies. It is a requirement for Regional Spatial Strategies under the *Planning and Compulsory Purchase Act 2004.*

TERM	DEFINITION
Sustainable Drainage Systems	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations meeting their own needs.
1 in 100 year event	Event that on average will occur once every 100 years. Also expressed as an event, which has a 1% probability of occurring in any one year.
1 in 100 year design standard	Flood defence that is designed for an event, which has an annual probability of 1%. In events more severe than this the defence would be expected to fail or to allow flooding.

1 Introduction

1.1 Horsham District Council SFRA

Planning Policy Statement 25: Development and Flood Risk (CLG 2010) emphasises the active role Local Authorities should have in ensuring flood risk is considered throughout the strategic land use planning process. PPS25 encourages Local Planning Authorities to undertake Strategic Flood Risk Assessments (SFRAs) to be used as the evidence base for planning decisions and to supply a key component of the SA process that should be used in the review of Local Development Documents or in their production.

To assist Local Authorities in their strategic land use planning, SFRAs should present sufficient information to enable Local Authorities to apply the Sequential Test to their proposed development sites (i.e. to steer development towards areas of lowest risk first). The SFRA should have regard to river catchment wide flood issues and also involve a:

> *"Process which allows the Local Planning Authority to determine the variations in flood risk across and from their area as the basis for preparing appropriate policies for flood risk management for these areas".*

In addition, where development sites cannot be located in accordance with the Sequential Test as set out in PPS25 (i.e. to steer development to low risk sites):

> *"The scope of the SFRA should be increased to provide the information necessary for the application of the Exception Test."*

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

The SFRA for Horsham District Council (HDC) was first published in June 2007 and was used by HDC to sequentially test potential development allocation sites identified within the initial Core Strategy which was adopted in 2007.

A review of the Core Strategy is being undertaken as a response to the housing requirements of the Regional Spatial Strategy for the area, the South East Plan. The Core Strategy Review Consultation Document is called 'Leading Change in Partnership to 2026 and Beyond' and was published in September 2009. This document identifies 9 potential strategic sites allocations through which the development requirements for the district could be achieved.

In order to inform the preparation of the Core Strategy Review, HDC have commissioned a revision of their SFRA. This report (revision F03) forms the first update to the original report and has been commissioned to ensure that the most up to date flood risk information is available to assist in the decision making process and sequential selection of development sites through the HDC Core Strategy Review.

1.2 SFRA Objectives

The objectives of the original Horsham DC SFRA as set out in the brief dated December 2006 are:

1. Undertake an SFRA in line with the policies and guidance presented in PPS25 for the administrative areas of HDC falling within the Rivers Adur and Arun Catchments. Part of the administrative areas for HDC fall under the River Mole Catchment to the west of Crawley. This area will be covered under a separate SFRA;
2. Identify the extent of all PPS25 Flood Zones to provide sufficient information to allow the Sequential Test to be carried out. As part of the Level 2 SFRA, particular attention will be given to areas within Flood Zone 3 and areas where new development is likely to be concentrated;
3. To identify flood defences including their condition and standard of protection;
4. To identify significant historical flooding within the Arun and Adur catchments and to engage stakeholders in the discussion of flooding issues;
5. Ensure that the Authority meets its obligations under emerging planning guidance: PPS25 as well as the Water Framework Directive and DEFRA's 'Making Space for Water';
6. Recommendations of suitable mitigation measures including Sustainable Drainage Systems (SuDS).
7. Provide an evidence-based report to inform the Horsham Local Development Framework and other Development Planning Documents about managing potential flood risk.

In September 2009, Horsham DC requested an update to the SFRA. The objectives of this update are:

1. Include 9 new potential strategic development sites highlighted by Horsham DC.
2. Review the Level 1 SFRA to ensure it provides an assessment of the impact of all potential sources of flooding in accordance with PPS25 (DCLG 2006) and the Practice Guide (DCLG 2009), including appropriate considerations for climate change.
3. Review new and existing SFRA data.
4. Review and update where necessary all mapping layers including revisions to the PPS25 Flood Zones.
5. Incorporate the Environment Agency's newly released 'Areas Susceptible to Surface Water Flooding' mapping to gain an appreciation of the risk of surface water flooding and preliminary assessment of Critical Drainage Areas.
6. If possible, obtain British Geological Survey groundwater flooding mapping, to further inform on groundwater flooding.
7. Update the report text to reflect changes in policy including PPS25 and the associated Practice Guide (DCLG 2009), recommendations from the Pitt Review (Pitt 2008) and the draft Flood and Water Management Bill (2009).

1.3 SFRA Structure

The PPS25 Practice Guide (DCLG 2009) recommends that SFRAs are completed in two consecutive stages; this follows the iterative approach encouraged by PPS25 and provides Local Planning Authorities with tools throughout the LDF and SFRA process sufficient to inform and update decisions regarding development sites. The two stages are: -

- Level 1 SFRA – Enables application of the Sequential Test
- Level 2 SFRA – Increases scope of SFRA for sites where the Exception Test is required

The results of the Level 1 SFRA will enable HDC to review the current preliminary site allocations and to inform the scope of the Sustainability Appraisal. Following consultation with HDC, the findings of the Level 1 assessment will also enable the scope of the Level 2 SFRA to be defined.

Level 1 SFRA

The objective of the Level 1 SFRA is to collate and review available information on flood risk for the study area. Information has been sought from a variety of stakeholders including the Environment Agency, Horsham DC, West Sussex County Council, the Highways Agency, Southern Water and Thames Water. In addition to the review of data and consultation with local stakeholders, Level 1 also reviews the available data to meet the requirements of a Level 2 SFRA where required. Where necessary the report also identifies works beyond the critical scope that may benefit the assessment.

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

Level 2 SFRA

Where necessary, a Level 2 SFRA provides sufficient information to facilitate the application of the Exception Test. This is based upon information collected for the Level 1 SFRA and additional works where necessary.

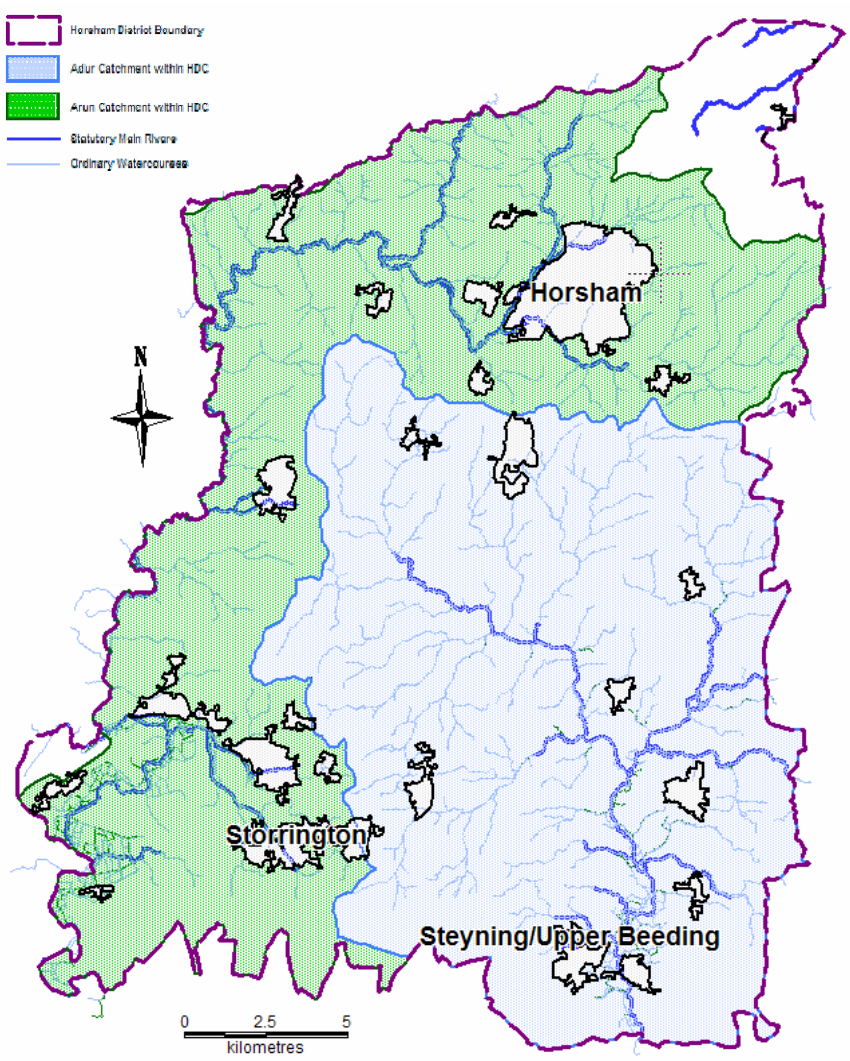
For an SFRA to serve as a practical planning tool now and in the future, it should be viewed as a ‘Living Document’ and should be subject to periodic updates in the light of emerging policy directives and an improved understanding of flood risk within the area.

This document forms a Level 1 Assessment, sufficient for HDC to apply the Sequential Test to the potential strategic allocations put forward as part of the Core Strategy Review.

2 Study Area

The study area is defined by the administrative boundaries of Horsham DC and the Arun and Adur River catchments (Figure 2-1). This results in a total study area of 529km².

Figure 2-1: Horsham District Council SFRA Hydrological Map



2.1 Hydrology and Flood Sources

The main river catchments within the study area are: -

- The River Arun and tributaries;
- The River Adur and tributaries;

The River Arun & Tributaries

The catchment of the River Arun covers the north and eastern sections of the study area (Figure 2-1). Its source is located at St Leonard's Forest near Horsham, approximately 120m AOD and, like much of the River Adur in Horsham District, it has a flashy nature and responds quickly to heavy rainfall events due to the underlying impermeable Weald Clay and steep topography.

The Upper Arun collects water from the High and Low Weald, which mainly comprises of low permeability Weald Clay, and transfers it downstream to the confluence with the River Rother at Pulborough, which is also the tidal limit. The Upper and Eastern Arun is the reach of the river that covers the majority of the study area. There are few or no flood defences within this reach of the Arun and no major urban areas are at risk, however, a number of properties in rural areas and in parts of Horsham have been flooded in the past.

The Lower Arun extends from the confluence with the Rother at Pulborough downstream as far as Littlehampton and is influenced by the tide throughout its length. Flood defences exist on both banks of the river along the whole of this section, which currently prevent flooding during events with a return period less than about 3% per year (that is about 1 in 30 years on average). The embankments are overtopped during more severe events, leading to widespread inundation of the floodplain. At Pulborough, floodplain flows are complicated by the presence of road and rail crossings on embankments with culverts/bridge openings as well as abrupt bends in both the rivers and the flanking defences. Overall, there is little risk of property flooding in this middle part of the catchment, although there can be local problems where drains are blocked or pumps fail in parts of Pulborough where the surface water is pumped into the river (the IDB is now operated by the Environment Agency). There is, however; considerable disruption to transport and extensive flooding of agricultural land during severe events[1].

The River Adur & Tributaries

The River Adur and its tributaries are situated in the High Weald, Low Weald and South Downs natural conservation areas (as defined by Natural England and previously the Countryside Agency). The catchment is largely rural with a few urban centres such as Horsham and the urbanised coastal strip of Brighton and Hove, Shoreham and Worthing.

The entire catchment of the River Adur is in excess of 600km^2 and extends from the south coast at Littlehampton in the west, Brighton and Hove in the east, northwards to Horsham and Haywards Heath. The upper and western branch of the Adur catchment spans most of Horsham District and is underlain by the Weald Clay. As a result, the watercourses respond rapidly to rainfall causing the water to run-off the impermeable surface. However the District Council Drainage Team, particularly in the last 10 years is becoming increasingly aware that during and after heavy rainfall, areas just outside the various flood zones have experienced flooding. This is due in part, as mentioned above to the prevailing surrounding impermeable surfaces discharging quickly into the already overloaded watercourses. Although there is little history of flooding in this sub catchment of the Adur and consequently a low risk to people and property in this area, it should be noted that increasingly the existing land drainage network over the whole area is struggling to cope with the current and predicted rainfall.

This differs from the lower, more permeable chalk areas, which respond more slowly and can be a source of groundwater flooding from the chalk aquifers. Flooding occurs from a number of sources

[1] Arun and Western Streams CFMP –Summary Report Environment Agency, December 2009

such as rivers overtopping their defences (fluvial flooding), urban surface water run-off and inadequate local drainage, run-off from fields and groundwater flooding as well as a mixture of tidal and fluvial flooding[2].

2.2 Hydrogeology

The geology of the study area is varied. The High Weald, covering most of the study area, consists of sandstones and mudstones overlain by the relatively impermeable Weald Clay. The High Weald then drops down to the Low Weald to the south where the geology is comprised predominantly of chalk and softer sandstones and mudstones. This geological group tends to underlie the southern edge of the study area with parts being classified as a Groundwater Emergence Zone[3].

The chalk areas to the south of the study area are classified as Major Aquifers by the Environment Agency and provide an important resource for local population centres. However, due to the nature of the chalk and high permeability of the overlying soils, this area may also be prone to groundwater flooding.

2.3 Tidal Influences

Tidal flooding affects both the River Arun and River Adur within the southern areas of the study area. On the River Arun, the tidal limit is at Pallingham Locks, where defences currently provide a standard of protection of 3% (1 in 30 years). The River Adur has its normal tidal limit near Partridge Green. Again, defences in the area are thought to have a standard of protection of around 3% (1 in 30 years).

2.4 Sewers

Before the introduction in 1981 of the National guidelines 'Sewers for Adoption', sewers were constructed and designed to a different standard. Although the majority of sewers would struggle and surcharge during rainstorm events with a return period greater than 30 years (e.g. 100 years) another major problem now being encountered is the failure of the construction materials employed previously.

Southern Water has provided point locations of sewer flooding incidents that have occurred in the last 10 years.

2.5 Groundwater

There are no records of groundwater flooding within the study area. However, the chalk areas to the south of the study area are classified as major aquifers with a high permeability. Many of the streams overlying this area are predominantly fed by groundwater and are dry for parts of the year. The high values of Base Flow Index (BFI) of these streams, coupled with the fact that they overly major aquifers leads to a potential for groundwater flooding in the area.

[2] River Adur Catchment Flood Management Plan – Consultation Draft Plan , Environment Agency, (August 2007)
[3] Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study (LDS 23), DEFRA – Making Space for Water, 2004.

2.6 Pluvial

Pluvial flooding typically arises when intense rainfall, often of short duration, is unable to soak into the ground and/or enter drainage systems. It can run quickly off land, resulting in localised flooding. The Pitt Review (2008) revealed that two-thirds of the flooding in summer 2007 was a result of surface runoff in urban areas, as rainwater runs over the surface of the ground or ponds in low lying areas, and there is a growing likelihood of similar flooding in the future.

Following extensive surface water flooding across England in July, the Environment Agency has undertaken a broad scale national mapping exercise of 'areas susceptible to surface water flooding'. When mapped against the national property database Defra reports that approximately 3440 properties within Horsham District are estimated to be susceptible to surface water flooding. The following table provides a summary of the number of properties that may be susceptible to surface water flooding in each of the key settlement areas in Horsham.

Table 2-1 Number of properties susceptible to surface water flooding in Horsham District (Defra 2009)

Rank	Settlement	Properties
193	Horsham	1800
527	Steyning/Upper Beeding	530
680	Storrington	370
698	Billingshurst	350
1297	Barns Green	120
1611	Ashington	80
1653	West Chiltington Common	70
1949	Pulborough	50
2242	Southwater	30
2562	Christ's Hospital	20
2626	Slinfold	20
2950	Henfield	Less than 10
3029	Warnham	Less than 10
3101	Coldwaltham	Less than 10
3132	Amberley	Less than 10
3180	Small Dole	Less than 10
3395	Rudgwick	Less than 10
3489	Partridge Green	Less than 10
3624	Cowfold	Less than 10
3868	Mannings Heath	None Identified
3962	Wisborough Green	None Identified
4184	Plaistow	None Identified

Pluvial flooding has been noted to have affected a large number of roads in Horsham, Pulborough, Southwater, Thakeham, Washington, Slinfold, Cowfold and Henfield during heavy rainfall events. During these events, rainfall flows along the road surface and ponds in topographic lows, causing disruption to transport and in some cases property flooding. The risk of surface water flooding is heightened where surface water sewers have insufficient capacity, where drains are susceptible to blockages and where the groundwater level is already high, thereby reducing the capacity for infiltration.

In addition, the geology of the District has a significant influence on the susceptibility to pluvial flooding. Drainage is poor in the north of the district which is underlain by impermeable Weald Clay. The overlying soils are prone to water logging and as a result these areas respond rapidly to rainfall and a much higher percentage of the rainfall becomes overland flow. On steeper slopes that consist of the Weald Clay within the north of the District, there could be potential for direct surface water runoff to occur during periods of prolonged rainfall.

2.7 Flood History

The Horsham DC administrative area is predominantly rural, with few major urban centres. Consequently, a relatively low level of flood risk exists when compared to some surrounding Districts. Environment Agency data, including Historical Flood Maps, CFMPs and flood event databases indicate that major flooding on the Arun and Adur has occurred in the past as a result of tidal and fluvial causes. Flooding from lesser sources is also important with stakeholder responses from Parish Councils, Southern Water and The Highways Agency indicating sporadic flooding hotspots across the District.

Table 2-2: Selected Historical Flooding from the Arun & Western Streams and the Adur Catchment Flood Management Plans

Event Date	Catchment	Details
1911	Adur	Heavy rains in November caused flooding of the Adur valley from Ashurst, Partridge Green, Henfield, and Steyning to Bramber. Lower floors of properties were inundated.
1925	Adur	Widespread flooding of Adur valley.
Feb-66	Adur	Roads and fields flooded at Cuckfield and Bolney.
Sep-68	Arun	Flood damage at Chiddingfold (15 properties), Horsham (up to 50 properties) and Pulborough (5 properties). A29 and several minor roads blocked.
11- 14 Nov-1974	Adur	Widespread flooding across catchment - Ashurst, Bramber, Coombes, Shipley, Twineham, Upper Beeding, West Grinstead, Lancing, Steyning. Properties flooded in Lancing. A281 closed at Henfield.
22-23 Nov-1974	Adur	Flooding in Burgess Hill, Ashurst, Clayton, Cuckfield, Ditchling, East Preston, Ferring, Findon, Fulking, Shipley and Henfield. Surface water flooding at Steyning High Street, river flooding at Steyning affected some properties. Road flooding at Burgess Hill. Shopping area in Findon covered in an inch of silt. Shoreham airport access disrupted. Kimp Barn Lane flooded cutting off access to properties and the sewage treatment works.
1977	Adur	Properties flooded in Ashington.
1979	Adur	Flooding in Henfield, Burgess Hill and Ashington.
Oct-80	Adur	Steyning - the High Street was closed.
1981	Arun/Adur	A significant event occurred in Billingshurst after heavy rains that caused flooding in the High Street and Rosehill area due to inadequate highway drainage and blockages of surface water flow to sewers. The same event affected Southwater Street in Pulborough and Southwater.
Dec-1993	Arun	Heavy rainfall throughout the autumn caused the River Larent to overtop. Flooding at Storrington damaged 15 properties. Storrington flood relief scheme implemented as a result.
1994	Adur	Heavy runoff from the downs caused property flooding in Sompting and North Lancing.

Autumn 2000	Adur	Flooding in Sayers Common and Steyning. Severe flooding in Bramber following overtopping of defences on the main river.
Autumn 2000	Arun	Flooding from main river/surface water and/or groundwater at Pulborough (5 properties) and Bury (3 properties). Flooding from groundwater and/or surface water at Chiddingfold (12 properties) and Midhurst (3 properties).

2.8 Future Growth and Development

Horsham District has been recognised in the South East Plan as operating at a pivotal point of a diamond of large urban communities between Crawley/Gatwick and Brighton and is identified in the Plan as one of 9 sub-regional centres. Whilst the District has an important and cherished rural and agricultural heritage, it is important to recognise and maintain a balanced and sustainable momentum for economic growth and prosperity. In order to seek to achieve a sustainable future for the District whilst meeting their housing requirements, Horsham District Council (HDC) have started their LDF process and have adopted a Core Strategy that sets out a vision for the District to 2018 and identifies areas suitable for growth and development. The strategic development locations identified in the current Core Strategy are primarily focused to the West of Horsham and to the West of Crawley.

A review of the Core Strategy is being undertaken as a response to the housing requirements of the Regional Spatial Strategy for the area, the South East Plan. The Core Strategy Review Consultation Document is called 'Leading Change in Partnership to 2026 and Beyond' and was published in September 2009. This document identifies 9 potential strategic sites allocations through which the development requirements for the district could be achieved:

1. West of Ifield
2. Faygate
3. Holbrook Park
4. Chennells Brook
5. Chesworth Farm
6. West of Southwater
7. East of Billingshurst
8. Adversane / North Heath
9. Pulborough Expansion

Mapping and assessments for each of these 9 sites in relation to flood risk can be found in Appendix B.

2.9 Administrative Areas

Environment Agency

The study area falls entirely in the Environment Agency's Southern Region. The Environment Agency's Southern Region has discretionary powers under the Water Resources Act (1991) for all Main Rivers and their associated flood defences within the study area.

The Environment Agency also administers the Internal Drainage Boards (IDB) to the south of the Horsham DC boundary along the River Arun and the River Adur.

Drainage

Southern Water and Thames Water are responsible for the designated public storm water and foul water management across the study area. The local Highway Authority, West Sussex County Council are responsible for the highway infrastructure drainage system. All other drainage systems (i.e. private) that operate prior to discharge either into a watercourse or into a public sewer is the collective responsibility of the property owners connected.

3 Level 1 SFRA – Methodology

3.1 Objective

As outlined in Section 1.2 the objective of the Level 1 SFRA is to collect, collate and review the information available relating to flooding in the study area. This information is then presented in a format to enable the Local Planning Authorities to apply the Sequential Test to their growth areas and where necessary to apply the Exception Test. Gaps in the data/information have also been identified in order to ascertain additional requirements needed to meet the objectives of a Level 2 SFRA, where required.

3.2 Tasks

The sequence of tasks undertaken in the preparation of the Level 1 SFRA was, in order: -

- Inception meeting with the Horsham DC on 9th January, 2006;
- Established the local stakeholders;
- Contacted stakeholders requesting data/information;
- Collated and reviewed data and populated data register;
- Presentation of available relevant information on flood sources and flood risk
- Reviewed received data against the SFRA objectives; and
- Identified gaps in data.

All tasks were completed between January 2007 and May 2007.

An update to the Level 1 SFRA was commissioned in November 2009 which entailed the following:

- Requested new and revised information from key stakeholders;
- Collated and reviewed data and amended data registers;
- Updated figures and maps to present available and relevant information on flood sources and flood risk; and
- Identified remaining data gaps and limitations.

These tasks were completed in between November 2009 and February 2010.

3.3 Stakeholders

The stakeholders that were contacted to provide the data/information for the SFRA were: -

- West Sussex County Council;
- Horsham District Council;
- Parish Councils,
- Thames Water;
- Southern Water;
- Environment Agency; and,
- Highways Agency.

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

3.4 Data / Information Collected

Information/data was requested from the stakeholders. The data was integrated with Scott Wilson's GIS system where possible to facilitate a review. The information/data requested from the stakeholders identified was based on the following categories: -

- Terrain Information e.g. LiDAR, SAR, river cross-sections;
- Hydrology e.g. the main and ordinary watercourses;
- Hydrogeology e.g. groundwater emergence zones and vulnerability maps;
- Flood Defence e.g. flood banks, sluices;
- Reservoirs Act (1975) Water Bodies within the District;
- Environment Agency Modelled Flood Levels;
- Flood Risk Assessments e.g. on previous development sites;
- Environment Agency Flood Zone Maps;
- Local Authority Information e.g. Local Development Schemes and allocation sites;
- Sewer flooding problems; and,
- Environment Agency Mapping "Areas Susceptible to Surface Water Flooding".

All received data was registered on receipt and its accuracy and relevance reviewed to assess a confidence levels for contribution to the SFRA (Table 3-1). Details of all the data collected at the time of production are presented in Appendix D.

Table 3-1: Method for qualitative confidence ranking of data received

		RELEVANCE		
		1 - VERY RELEVANT	2 - PARTLY RELEVANT	3 - NOT RELEVEANT
ACCURACY	1 - EXCELLENT	**VERY GOOD**	GOOD	GOOD
	2 - GOOD	GOOD	GOOD	FAIR
	3 - FAIR	GOOD	FAIR	FAIR
	4 - POOR	FAIR	FAIR	POOR
	5 - VERY POOR	FAIR	POOR	**VERY POOR**

3.5 GIS Layers

Using the data collected a series of GIS layers were collated to visually assist HDC in their site allocation decisions and Development Control activities. Using GIS, the data was analysed and interrogated to produce flood risk statistics to the District as a whole and individual settlements (See Appendix A and Appendix B).

Broadly, the layers can be classified into planning policy, informative and flood risk categories.

Table 3-2 Summarises the main GIS layers used in the SFRA. Appendix D includes a more detailed table highlighting the GIS layers that have been used and their limitations.

GIS Data Gaps & Assumptions

Some data that is necessary to satisfactorily complete an SFRA is either not available at all, or is not available in GIS format. In order to present complete and continuous flood zones for Horsham District, it has been necessary to make certain assumptions, in agreement with Horsham DC and the Environment Agency, so that data gaps could be filled. Summaries of each of the datasets used and assumptions made are presented in the following sections.

Table 3-2: GIS Layers used in SFRA

Planning Policy	Informative	Flood Risk
HDC Boundary	Tidal limits	Flood Zone Maps (Fluvial and Tidal)
Urban Areas	Main River Network & Catchments	Historical Flooding Maps
Potential Allocation Sites	Ordinary Watercourse Network	Storm water flooding areas
Alternative Allocation Sites	Major Water Bodies under the Reservoirs Act (1975)	Flood Defences
Potential Strategic Sites		Flood Warning Areas
		Groundwater Emergence Zones
		Groundwater Vulnerability maps
		River Network – BFI classified
		Areas Susceptible to Surface Water Flooding

Flood Risk GIS Layers

In order to present the most up-to-date and relevant flooding information available, the flood zones maps have been created using a variety of existing sources of data. Where detailed hydraulic modelling has been undertaken and flood outlines mapped, these have been used in preference to broad-scale modelled outlines. This results in a single map for each flood zone generated using a combination of data.
Meta-data has been provided within the GIS layer detailing the source of the data used to create the flood zone and the relative confidence in the data. For example, the flood outlines (both fluvial and tidal for FZ3a, FZ3b and FZ3 + Climate Change) for the Lower Adur have been derived from EA commissioned two-dimensional hydraulic modelling. These outlines have been used in preference to the EA broad-scale modelled outlines.

Summary of Source of Flood Outlines Mapped

In between the preparation of the original SFRA for Horsham DC (2007) and this update (2010), the Environment Agency commissioned a ‘uniforming exercise’ of the current day flood outlines across West Sussex as part of the West Sussex SFRA.

The flood outlines used for the West Sussex SFRA were obtained to update the SFRA for Horsham DC. The following table summarises the source of flood outlines that have been mapped across Horsham, in agreement with the Flood Risk Data and Mapping Team at the Environment Agency.

Table 3-3 Source of Flood Outlines

Flood Zone	Source of Data	
	River Arun	River Adur
Flood Zone 2 – Medium Probability	West Sussex SFRA Outlines, which use a composite of EA commissioned 2D modelling and EA broad scale modelling.	West Sussex SFRA Outlines, which use a composite of EA commissioned 2D modelling and EA broad scale modelling. N.B. Where extent of FZ2 is less than FZ3a, FZ3a with climate change was used as a surrogate.
Flood Zone 3a – High Probability	West Sussex SFRA Outlines, which use a composite of EA commissioned 2D modelling and EA broad scale modelling.	South of Henfield, outlines from the West Sussex SFRA were used which are based upon a composite of EA commissioned 2D hydraulic modelling and EA broad scale modelling. North of Henfield, EA commissioned 2D modelling (used in the original Horsham SFRA, 2007) was used.
Flood Zone 3a plus Climate Change	West Sussex SFRA Outlines, which use a composite of EA commissioned 2D modelling and EA broad scale modelling.	South of Henfield, outlines from the West Sussex SFRA were used which are based upon a composite of EA commissioned 2D hydraulic modelling and EA broad scale modelling. North of Henfield, EA commissioned 2D modelling (used in the original Horsham SFRA, 2007) was used.
Flood Zone 3b – Functional Floodplain	West Sussex SFRA Outlines, which use a composite of EA commissioned 2D modelling and EA broad scale modelling.	South of Henfield, outlines from the West Sussex SFRA were used which are based upon a composite of EA commissioned 2D hydraulic modelling and EA broad scale modelling. North of Henfield, EA commissioned 2D modelling (used in the original Horsham SFRA, 2007) was used.

Tidal & Fluvial Flooding

In addition to combining the flood outlines for detailed and broad-scale modelling results, the tidal and fluvial flood outlines have been combined. Therefore, the event 1 in 200 year (0.5% annual exceedence probability (AEP) tidal outlines have been merged with the 1 in 100 year (1% AEP) fluvial outline for Flood Zone 3a. This method results in a single map for each flood zone, making the task of allocating development more streamlined for HDC.

Functional Floodplain

One of the requirements of PPS25 is that the Functional Floodplain, Flood Zone 3b, should be identified and mapped to highlight those areas where only water-compatible development and land use is recommended. PPS25 defines Flood Zone 3b as the flood with an annual probability of 1 in

20 year (5% AEP) or greater. For the rivers Adur and Arun, the 1 in 20 year (5%) flood outline has not been delineated or modelled. However, the 1 in 25 year (4% AEP) flood event has been extensively modelled and mapped for both watercourses. As part of the West Sussex SFRA, the council and the Environment Agency agreed that adopting the 1 in 25 year outline was an acceptable, and more conservative, approach to representing functional floodplain. Where the 1 in 25 year flood outline is not available, it was agreed, that the whole of Flood Zone 3 should be assumed to be functional until such time that more detailed information is available, such as an EA Strategic Flood Risk Mapping (SFRM) study or a site specific FRA.

The Effects of Climate Change

To ensure sustainable development now and in the future, PPS25 requires that the effects of climate change should be taken into account in an SFRA and that flood outlines delineating climate change should be presented; where possible, modelled outlines for Flood Zone 3 including the effects of climate change have been presented. For tidal reaches, this includes the effects of sea level rise over and above the 1 in 200 year flood event using net sea levels rises recommended in PPS25. For fluvial reaches, climate change has been added to the 1 in 100 year flood event using a net increase of 20% over and above peak flows.

In areas where climate change has not been modelled or mapped, an increase in the depth and extents of the existing flood zones is likely. In order to take into this into account, it has been agreed with HDC and the EA that Flood Zone 2 should be used as a surrogate for Flood Zone 3 plus climate change until such time that more detailed information is available, such as an EA Strategic Flood Risk Mapping (SFRM) study or a site specific FRA.

Historical Flood Mapping

A historical flood outline layer was created using data from the EA, HDC and the Parish Councils that delineates approximate areas that have flooded in past. Much of the information used to create the outlines is estimated following a flood and some inaccuracies may exist. However the layer serves a useful purpose to highlight to HDC that there are areas – potentially outside the Flood Zone maps – that have experienced flooding in the past.

Storm Water Flooding

Incidents of storm water flooding due to a lack of hydraulic capacity at key local sites have been provided by Southern Water and also Parish Councils. The locations of flooding spots have been presented in a point GIS layer. This layer will help to highlight to HDC that there are certain areas where the drainage network can be overwhelmed during periods of high intensity rainfall and therefore new development in these areas must take this into account.

Areas Susceptible to Surface Water Flooding

The Environment Agency have undertaken national broad scale surface water mapping to provide an initial identification of areas susceptible to surface water flooding. This modelling is based on a simplified method that excludes urban sewerage and drainage systems, excludes buildings, and uses a single rainfall event. The mapping is primarily intended for use by Local Resilience Forums (LRFs) and to inform emergency planning, but has recently been released for use in SFRAs to inform the most strategic levels of land use planning. It is not intended for use in allocating individual sites or determining individual planning applications. The mapping has the following limitations:

- The mapping does not show the interface between the surface water network, the sewer systems and the watercourses;
- It does not show the susceptibility of individual properties to surface water flooding;
- The mapping has significant limitations for use in flat catchments

In the light of these limitations, it is recommended that the mapping be used only as an initial review of surface water flooding in order to identify areas requiring further investigation.

Flood Defences
EA maintained flood defences have been shown as a separate GIS layer. The information has been derived directly from NFCDD system and, as a result, layers also contain metadata detailing the general condition and a description of the defence. This will assist HDC in determining sites that potentially lie in defended areas.

Flood Warning Layers
Areas benefiting from an EA flood warning have been shown as a separate GIS layer. Emergency Planning Officers can use the flood warning layers in conjunction with the flood zone maps and flood defence information to assist in developing emergency plans for areas at risk of flooding within the District.

Groundwater Vulnerability Mapping & BFI Classified CEH Stream Network
The Environment Agency's groundwater vulnerability maps have been presented in a thematic map to highlight areas that overlie aquifers with a high vulnerability. Major Aquifers with a high vulnerability tend to have a more permeable surface geology. When combined with a thematically mapped stream network classified by BFI, it is possible to determine streams that are predominantly groundwater fed and broad areas that could potentially be at risk of groundwater flooding.

Groundwater Emergence Zones
A groundwater emergence zone layer has been presented from the DEFRA Groundwater Flooding Scoping Study[4]. This highlights a large area in the South Downs to the south of the district that is at risk of groundwater flooding.

Reservoir Act (1975) Water Bodies
A layer displaying major water bodies falling under the regulation of the Reservoir Act has been provided by the EA (Exeter). This can assist HDC in assessing sites immediately downstream of major water bodies. HDC may wish to undertake more detailed analysis of particular water bodies to determine any potential flood risk.

Planning Policy GIS Layers

Political and Urban Areas Boundaries
In addition to the flood zone and flood source GIS layers, a series of Planning and Policy GIS layers were provided by HDC. These include political and built up urban area boundaries derived from settlement sustainability studies and ensures that the SFRA is using the same information used in the rest of the HDC LDF process.

Core Strategy Potential Allocation Sites and Alternative Development Sites (2007)
In the first iteration of the SFRA, HDC provided GIS layers of potential allocation sites and alternative development sites under the Core Strategy. When overlain with flood risk GIS layers, it is possible to determine which sites are located in areas at risk of flooding and to what extent.

Core Strategy Review Potential Strategic Sites (2009)
HDC have provided a GIS layer of Potential Strategic Sites that are being considered for future development as part of their Core Strategy Review (2009-2010). These sites have been overlain with flood risk GIS layers to determine the risk and extent of flooding posed to each site.

[4] Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study (LDS 23), DEFRA – Making Space for Water, 2004.

4 Level 1 SFRA – Flood Risk Review

A suitable Level 1 SFRA will collate and review existing information on flood sources and flood risk to assist the Local Planning Authority in its obligation to consider flood risk in strategic land allocations and developing future policies. The Level 1 SFRA will achieve this by providing sufficient information to enable Local Planning Authorities to apply the Sequential Test (as set out in PPS25) to assist them in determining the suitability of sites for development. In accordance with PPS25 and its Practice Guide, where there are no reasonably available sites in Flood Zone 1 it may be necessary to locate development in Flood Zone 2, potentially through the successful application of the Exception Test. Only where there are no reasonably available sites in Flood Zones 1 and 2 should development be located in Flood Zone 3 and where necessary, successful application of the Exception Test will require information to be provided in a Level 2 SFRA.

4.1 Broad Scale Assessment

Broad-scale information, received from stakeholders, that is of use to the Local Planning Authorities in applying the Sequential Test at a District Level, is presented in Appendix A and in an accompanying GIS workspace. This data is summarised in Table 4-1. The broad-scale assessment has been based on the GIS layers highlighted in Section 3.5. Using GIS, the various layers were queried against one another to determine total areas of intersection for each flood zone (e.g. area of potential new developments in Flood Zone 3a).

Table 4-1: Horsham District-Level Broad-Scale Assessment

Question	Area (km^2)	% of Area	
Total Area of Horsham administrative Area	529	100%	
Area of Horsham in Zone 3b (Functional Floodplain)	34.27	6.48%	of total area
Area of Horsham in Zone 3a (High Flood Risk)	6.35	1.20%	of total area
Area of Horsham in Zone 2 (Moderate Flood Risk)	4.94	0.93%	of total area
Area of Zone 3 that is defended	0.00	0.00%	of Zone 3
Total Developed Area	33.46	6.36%	of total area
Existing Development in Flood Zone 3b	0.39	1.18%	of dev. area
Existing Development in Flood Zone 3a	0.06	0.19%	of dev. area
Existing Development in Flood Zone 2	0.13	0.39%	of dev. area
Potential New Development Required	16.86	3.19%	of total area
Potential New Development in Zones 3b	0.37	2.20%	of pot. dev.
Potential New Development in Zones 3a	0.00	0.00%	of pot. dev.
Potential New Development in Zones 2	0.12	0.74%	of pot. dev.
Drainage Problem Areas	Minimal Drainage Flooding – records show points rather than areas.		
Extent of Groundwater Emergence Zone	21.34	4.03%	of total area

4.2 Focussed Settlement Assessments

The Horsham District Council Core Strategy (Policy CP5) defines a Sustainable Settlement Hierarchy that identifies two levels of settlement with potential for future development.

- Category 1 Settlements represent towns and villages with a good range of services and facilities as well as some access to public transport – capable of sustaining some expansion, infilling and redevelopment.
- Category 2 Settlements represent villages with a more limited level of services which should accommodate only small-scale development or minor extensions that address specific local needs.

Table 4-2: Horsham District Council Category 1 Settlements

Category 1 Settlements	
Billingshurst	Pulborough
Broadbridge Heath	Southwater
Henfield	Steyning, Bramber and Upper Beeding
Horsham	Storrington/Sullington

Table 4-3: Horsham District Council Category 2 Settlements

Category 2 Settlements	
Amberley	Partridge Green
Ashington	Rudgwick & Bucks Green
Barns Green	Rusper
Christ's Hospital	Slinfold
Codmore Hill	Small Dole
Coldwatham	Thakeham (The Street & High Bar Lane)
Cowfold	Warnham
Faygate	Washington
Lower Beeding	West Chiltington Common & Village
Mannings Heath	

Following the Sustainable Settlement Categories, a more focussed, local-level assessment has been carried out for each of the Category 1 and Category 2 settlements within the District and is presented in Appendix B. This consists of the same information used in the District-level assessment, but at a smaller scale, allowing planners to assess flood risk information at a higher resolution. In addition, these assessments provide a table with information on development aspiration for housing and employment uses from the Horsham DC Core Strategy and other policies that influence development. They also provide a summary of reported incidents within the area, highlighting flooding sources and problem areas.

There are two maps included in the local-level assessment that do not cover settlements but potential employment areas identified in the Core Strategy – The Shoreham Cement Works and the Centre of Excellence at Brinsbury.

In addition, a further 9 Potential Strategic Sites have been identified for consideration through the review of the Core Strategy (2009 – 2010). These sites have been included in the focused are assessment in order to allow the planning team at HDC to make an informed decision as to their level of flood risk.

Table 4-4 Horsham District Council Potential Strategic Sites (Core Strategy Review)

Potential Strategic Sites	
West of Ifield	West of Southwater
Faygate	East of Billingshurst
Holbrook Park	Adversane / North Heath
Chennells Brook	Pulborough Expansion
Chesworth Farm	

The information presented at the Level 1 SFRA has predominately been provided by the Environment Agency from their high level hydraulic modelling programmes. Horsham DC, West Sussex County Council, the Highways Agency, Thames Water and Southern Water made additional contributions.

4.3 Summary

In line with PPS25, the Sequential Test should be applied at all stages of planning. The aim of this is to direct new development towards areas that have a low probability of flooding. The information provided in Table 4-1 and Appendix A and Appendix B indicate the geographical extent of Flood Zone 2 and Flood Zone 3 for the administrative area of Horsham DC (within the Arun and Adur River Catchments).

Horsham DC has a total administrative area of 529 km². Using the flood zone maps, it is apparent that 6.48% (34.27 km²) of the total administrative area is located within Flood Zone 3b (Functional Floodplain) whilst 1.20% (6.35 km^2) is located in Flood Zone 3a (High Risk) and 0.93% (4.94 km^2) is located in Flood Zone 2. Of the total area, approximately 6.36% (33.46 km²) is already developed with 1.18% (0.39km^2) falling within FZ3b, 0.19% (0.06km^2) within FZ3a, and 0.39% (0.13km^2) within FZ2.

Three of the strategic sites, Faygate, West of Southwater and Adversane / North Heath, are located entirely within Flood Zone 1 – Low Probability flood risk.

The West of Ifield strategic site is located predominantly within Flood Zone 1; Flood Zones associated with tributaries of the River Mole pass through the strategic site, and cover just 6.5% of the area.

A tributary of the Arun flows adjacent to the boundary of the Holbrook Farm strategic site, and 10.5% of the area is within either Flood Zone 2 or 3.

A tributary of the Arun flows through the Chennels Brook strategic site; Flood Zones associated with this watercourse cover 16.8% of the strategic area.

Chesworth Farm strategic site is bounded to the west by a tributary of the Arun. 23.5% of this strategic site is within Flood Zones 2 and 3.

Just 2.1% of the strategic site East of Billingshurst is located within Flood Zone 2 or 3, these Flood Zones are associated with Parbrook, a tributary of the Arun, which flows through the southern part of the site.

These assessments clearly show that, whilst flood risk exists in areas of the District, it does not pose a widespread and significant issue for the allocation of development sites. Where potential development sites are at risk from flooding, the planning authority must determine their suitability based on the Sequential Test and vulnerability classifications presented in Tables D1 and D2 of PPS25. Wherever possible the LPA should seek to direct development to low probability Flood Zones (Flood Zone 1). Where this is not possible, development should preferably be located in Flood Zone 2 and where this is not possible, sites in Flood Zone 3 can be considered. However, any development sites that are either wholly or partly situated in Flood Zone 2 or 3 will require, where necessary, the application of the Exception Test. Those areas requiring application of the Exception Test will require further assessment in a Level 2 SFRA. Information on the application of the Sequential Test, guidance on strategies for managing flood risk, guidance on site specific Flood Risk Assessments (FRAs) and guidance on the potential use of Sustainable Drainage Systems (SuDS) are provided in Sections 5, 6, 7 and Appendix G respectively.

A table of all potential development sites and their corresponding flood risk can be found in Appendix B. These tables should be used by HDC to identify those sites at risk of flooding in Flood Zones 2 and 3.

It is the responsibility of the Local Planning Authority to apply the Sequential Test to potential development sites. Section 8 provides details of the application of the Sequential Test by HDC for sites allocated under the original Core Strategy undertaken in June 2007, and the potential strategic sites that have come forward in the Core Strategy Review, which were sequentially tested in April 2010.

5 Sequential Test

5.1 Background

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

The Sequential Test refers to the application of the sequential approach by Local Planning Authorities (LPA). This allows the determination of site allocations based on flood risk and vulnerability (see Table 5-1 and Table 5-2, provided below). Development should be directed to Flood Zone 1 wherever possible, and then sequentially to Flood Zones 2 and 3. In addition, development should be directed to areas of least flood risk within Flood Zone 2 and then Flood Zone 3, as identified within this SFRA. A flow diagram for application of the Sequential Test from the PPS25 Practice Guide is also provided (Figure 4-1).

Table 5-1: Flood Zones as defined in Table D1, Annex D of PPS25 (full description provided in Appendix D of PPS25).

FLOOD ZONE	DEFINITION		PROBABILITY OF FLOODING
	FLUVIAL	TIDAL	
Flood Zone 1	< 1 in 1000 year (< 0.1%)	< 1 in 1000 year (< 0.1%)	Low Probability
Flood Zone 2	Between 1 in 1000 year (< 0.1%) and 1 in 100 year (1%)	Between 1 in 1000 year (< 0.1%) and 1 in 200 year (0.5%)	Medium Probability
Flood Zone 3a	> 1 in 100 year (> 1%)	> 1 in 200 year (> 0.5%)	High Probability
Flood Zone 3b	Either > 1 in 20 (5%) or as agreed by between the EA and LPA	Either > 1 in 20 (5%) or as agreed by between the EA and LPA	Functional Floodplain

The application of the sequential approach aims to manage the risk from flooding by avoidance. This will help avoid the promotion of sites that are inappropriate on flood risk grounds. The application of the Exception Test through a Level 2 SFRA will ensure that new developments in flood risk areas will only occur where flood risk is clearly outweighed by other sustainability drivers.

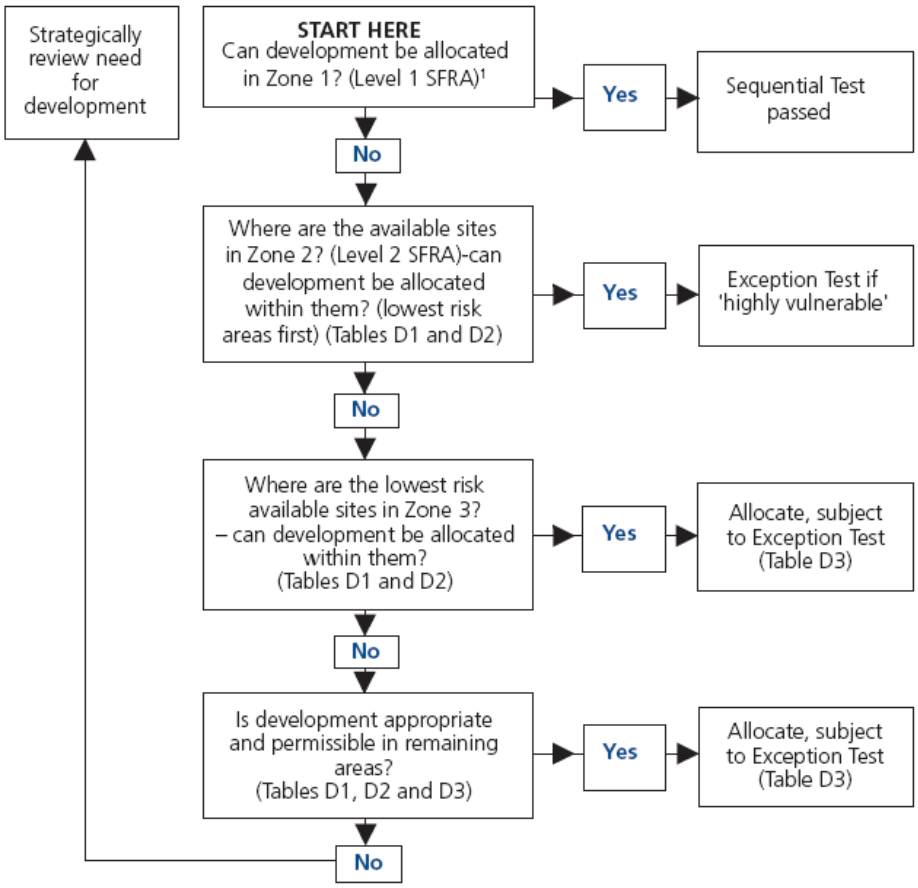
A LPA must demonstrate that it has considered a range of possible sites in conjunction with the Flood Zone information from the SFRA and applied the Sequential Test, and where necessary, the Exception Test (see Appendix D of PPS25), in the site allocation process. In cases where development cannot be fully met through the provision of site allocations, LPAs are expected to make a realistic allowance for windfall development, based on past trends.

Table 5-2: Flood Risk Vulnerability Classification (PPS25, DCLG 2009)

Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes), which has to cross the area at risk, • Essential utility infrastructure which has to be located in a flood risk area for critical operational reasons, including electricity generating power stations and grid and primary substations; water treatment plants; and sewage treatment plants if adequate measures to control pollution and manage sewage during flooding events are in place. • Wind turbines.
Highly Vulnerable	• Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent.5 (Where there is demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	• Police, ambulance and fire stations which are not required to be operational during flooding • Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non–residential institutions not included in 'more vulnerable'; and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment plants.
Water-compatible Development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel workings. • Docks, marinas and wharves. • Navigation facilities. • MOD defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

[5] DETR Circular 04/00, paragraph 18: *Planning controls for hazardous substances.*
See www.communities.gov.uk/index.asp?id=1144377

Figure 4.1 Application of the Sequential Test at the Local level for LDD preparation



Note

1 Other sources of flooding need to be considered in Flood Zone 1

Figure 5-1: Flow diagram illustrating the application of the Sequential Test (from PPS25 Practice Guide, DCLG 2009)

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

- Surface Water;
- Groundwater;
- Sewers; and
- Artificial Sources.

These sources (as sources of flooding) are typically less understood than tidal and fluvial sources. Data primarily exists as point source data or through interpretation of local conditions. In addition,

there is no guidance on suitable return periods to associate with floods arising from these sources. For example modern storm water drainage systems are constructed to a 1 in 30 year standard. Any storm event in excess of the 30 year return period storm would be expected to cause flooding. If a location is recorded as having experienced repeated flooding from the same source this should be acknowledged within the Sequential Test.

5.2 Using the SFRA to Apply the Sequential Test

The Sequential Test should be undertaken by the LPA and accurately documented to ensure decision processes are consistent and transparent. The Sequential Test should be carried out on potential development sites, seeking to balance the flood probability and development vulnerability of sites throughout the Local Planning Authority area.

A table of all potential development sites and their corresponding flood risk, as defined in the Level 1 SFRA, can be found in Appendix B. This table should be used by HDC to identify those sites at risk of flooding in Flood Zones 2 and 3.

Table 5-3: Flood Risk Vulnerability and Flood Zone 'Compatibility' from PPS25, Appendix D, Table D.3
(✓ - Development is appropriate, × - Development should not be permitted)

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

The recommended steps required in undertaking the Sequential Test are detailed below. This is based on the Flood Zone and Flood Risk Vulnerability and is summarised in Table 5-3.

Recommended stages for LPA application of the Sequential Test

The information required to address many of these steps is provided in the accompanying Level 1 GIS layers and maps presented in Appendix B.

1. Assign potential developments with a vulnerability classification (Table 5-2). Where development is mixed, this should be moved to the higher classification.
2. The location and identification of potential development should be recorded.
3. The Flood Zone classification of potential development sites should be determined based on a review of the Environment Agency Flood Zones for fluvial and tidal sources. Where these span more than one Flood Zone, all zones should be noted.
4. The design life of the development should be considered with respect to climate change:

- 75 years – up to 2085 for commercial / industrial developments; and
- 100 years – up to 2110 for residential developments

5. Identify existing flood defences serving the potential development sites. However, it should be noted that for the purposes of the Sequential Test, flood zones ignoring defences should be used.
6. Highly vulnerable developments to be accommodated within the LPA area should be located in those sites identified as being within Flood Zone 1. If these cannot be located in Flood Zone 1, because the identified sites are unsuitable or there are insufficient sites in Flood Zone 1, sites in Flood Zone 2 can then be considered. If sites in Flood Zone 2 are inadequate then the LPA may have to identify additional sites in Flood Zones 1 or 2 to accommodate development or seek opportunities to locate the development outside their administrative area.
7. Once all highly vulnerable developments have been allocated to a development site, the LPA can consider those development types defined as more vulnerable. In the first instance more vulnerable development should be located in any unallocated sites in Flood Zone 1. Where these sites are unsuitable or there are insufficient sites remaining, sites in Flood Zone 2 can be considered. If there are insufficient sites in Flood Zone 1 or 2 to accommodate more vulnerable development, sites in Flood Zone 3a can be considered. More vulnerable developments in Flood Zone 3a will require application of the Exception Test.
8. Once all more vulnerable developments have been allocated to a development site, the LPA can consider those development types defined as less vulnerable. In the first instance less vulnerable development should be located in any remaining unallocated sites in Flood Zone 1, continuing sequentially with Flood Zone 2, then 3a. Less vulnerable development types are not appropriate in Flood Zone 3b – Functional Floodplain.
9. Essential infrastructure should be preferentially located in the lowest flood risk zones, however this type of development may be located in Flood Zones 3a and 3b, provided the Exception Test is fulfilled.
10. Water compatible development has the least constraints with respect to flood risk and it is considered appropriate to allocate these sites last.
11. 11. On completion of the sequential test, the LPA may have to consider the risks posed to a site within a flood zone in more detail in a Level 2 SFRA. By undertaking the Exception Test, this more detailed study should consider the detailed nature of flood hazard to allow a sequential approach to site allocation within a flood zone. Consideration of flood hazard within a flood zone would include:
    - flood risk management measures,
    - the rate of flooding,
    - flood water depth and or,
    - flood water velocity.

Where the development type is highly vulnerable, more vulnerable, less vulnerable or essential infrastructure and a site is found to be impacted by a recurrent flood source (other than tidal or fluvial), the site and flood sources should be investigated further regardless of any requirement for the Exception Test. This should be discussed with the Environment Agency to establish the appropriate time for the assessment to be undertaken, (i.e. Exception Test through a Level 2 SFRA or assess through a site specific flood risk assessment).

The table presented in Appendix E is designed to assist Horsham DC in determining the flood risk classification for each site and in completing the Sequential Test. This will aid the determination of the most suitable type of development for each site based on development vulnerability and flood risk. Certain sites have been identified as lying within Flood Zones 2 and 3 and, if the sites cannot be relocated, it will be necessary to undertake an Exception Test.

Using the SFRA Maps, Data and GIS Layers

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

Section 8 provides a summary of the Sequential Test procedure carried out by HDC in June 2007 for the potential site allocations put forward in the Core Strategy.

Section 8 also provides a summary of the Sequential Test procedure that was undertaken by HDC in April 2010 as part of the Core Strategy Review (September 2009) for the 9 potential strategic allocation sites.

Appendix H summarises the steps required to maintain and update the SFRA together with a revision schedule. This should be checked to prior to the SFRA being used at a strategic land allocation scale or on a Development Control level to ensure the most current and up-to-date version of the SFRA is being used. In addition, close consultation with some of the key stakeholders, in particular the EA may highlight updated flood risk information that may reduce uncertainty and ensure the Sequential Test is as robust as it can be.

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

Category	GIS Layer	Example Questions
Development Vulnerability	Not applicable refer to Table D2 in PPS25	**Question 1** – Is the proposed development defined as 'highly vulnerable' according to Table D2 in Planning Policy Statement 25?
		Question 2 - Is the proposed development defined as 'more vulnerable' according to Table D2 in Planning Policy Statement 25?
		Question 3 - Is the proposed development defined as 'less vulnerable' according to Table D2 in Planning Policy Statement 25?
		Question 4 - Is the proposed development defined as 'essential infrastructure according to Table D2 in Planning Policy Statement 25?
		Question 5 - Is the proposed development defined as 'water compatible development' according to Table D2 in Planning Policy Statement 25?
Flood Zone Classification	SFRA combined fluvial & tidal FZ2, FZ3a & FZ3b layers. Also examine historical floodplain and take into consideration climate change outlines.	**Question 6** – Through consultation of the Environment Agency's flood zone maps, is the development site located in Flood Zone 1?
		Question 7 - Through consultation of the Environment Agency's flood zone maps, is the development site located in Flood Zone 2?
		Question 8 - Through consultation of the Environment Agency's flood zone maps, is the development site located in Flood Zone 3a?
		Question 9 - Through consultation of the Environment Agency's flood zone maps, is the development site located in Flood Zone 3b?
		Question 10 - Can the development be located in Flood Zone 1?
		Question 11 - Can the development be located in Flood Zone 2?
		Question 12 - Can the development be located in Flood Zone 3a?
	CEH watercourse network & EA main river maps.	**Question 13 -** Is the site located within 20m of a watercourse?

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

6 Policy Review & Recommendations

6.1 Catchment Flood Management Plans

The role of Catchment Flood Management Plans (CFMP) is to provide improved understanding of the scale and extent of flooding within a given catchment both now and in the future, and to establish flood risk management policies that will deliver sustainable flood risk management within the catchment for the long term.

There are two CFMPs of importance to the study area; the River Adur CFMP (Environment Agency 2009) and the River Arun and Western Streams CFMP (Environment Agency 2009). Final reports of both of these plans were published by the Environment Agency in 2009 and are available for reference on their website.

As part of these CFMPs, a number of policies have been adopted for various parts of the study area covered by this SFRA. These are summarised below.

River Adur Catchment Flood Management Plan

Figure 6-1 Map of the policies in the Adur Catchment

Upper Adur – Policy 6

"Areas of low to moderate flood risk where we will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits. This policy will tend to be applied where there may be opportunities in some locations to reduce flood risk

locally or more widely in a catchment by storing water or managing run-off. The policy has been applied to an area (where the potential to apply the policy exists), but would only be implemented in specific locations within the area, after more detailed appraisal and consultation".

The risk of flooding from the Adur in this sub-area is currently relatively low and future predictions for increases in flood risk are predicted to be relatively small. The majority of the land at risk is moderate grade agricultural land, and less than 10 residential properties are at risk.

The implementation of policy 6 will assist in controlling or reducing flood risk downstream in urban areas such as Steyning, Upper Beeding and Shoreham. The increased flooding could result in an increase of wetland around the River Adur Water Meadow and Wyckham Wood Site of Nature Conservation Interest.

A number of proposed actions to implement this approach in this sub-area are outlined in the CFMP, including a tidal strategy for the Adur to investigate the potential for large scale flood attenuation and wetland creation; encouraging the use of Whole Farm Plans to provide advice on better land use practice with respect to surface water runoff; a study to investigate the potential for flood defence removal, floodplain restoration and re-naturalisation and creation of floodplain storage.

Steyning and Upper Beeding – Policy 3

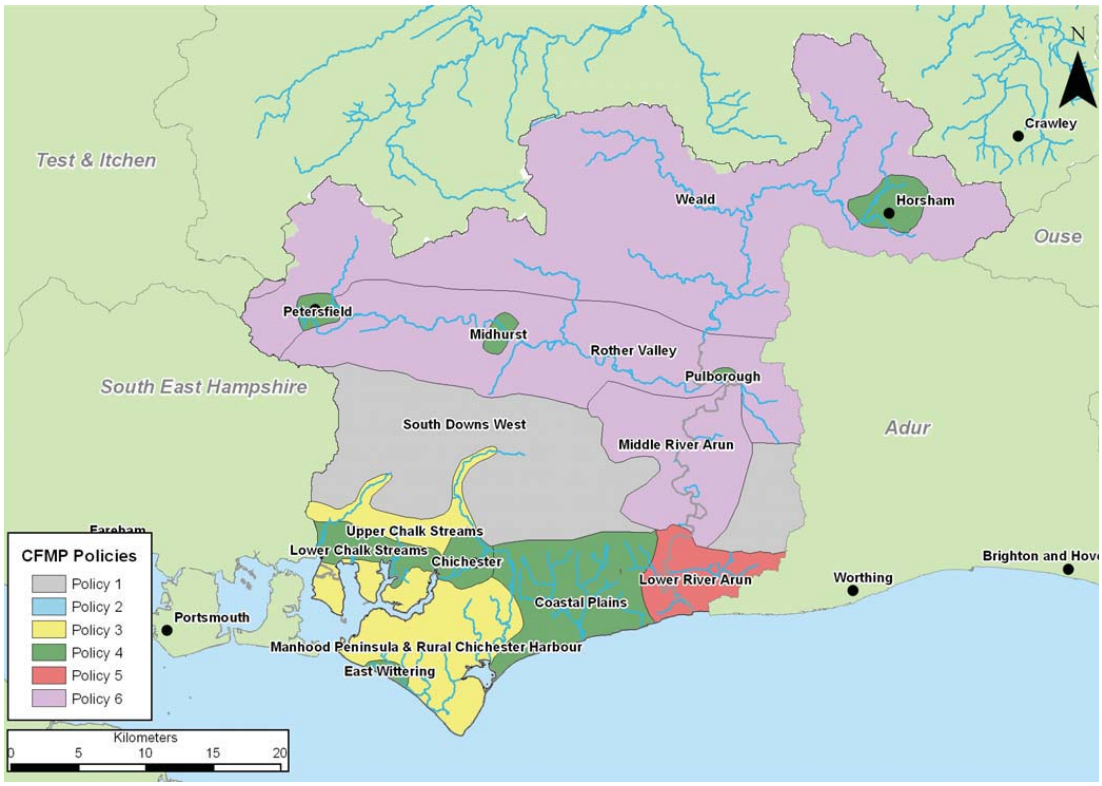
"Areas of low to moderate flood risk where we are generally managing existing flood risk effectively. This policy will tend to be applied where the risks are currently appropriately managed and where the risk of flooding is not expected to increase significantly in the future. However, we keep our approach under review, looking for improvements and responding to new challenges or information as they emerge. We may review our approach to managing flood defences and other flood risk management actions, to ensure that we are managing efficiently and taking the best approach to managing flood risk in the longer term".

The River Adur is tidally influenced in this area; high tides and increased river levels can lead to overtopping of flood defences and almost 100 residential properties are at risk during the 1 % annual probability flood event. Flood risk from surface water and urban drainage also causes localised flooding.

It is proposed to continue to work with HDC to apply government guidance in PPS25 and make sure that flood risk issues identified in the CFMP and the SFRA area used to allocate and manage development in Steyning and Bramber. In addition, it is proposed to continue with asset maintenance and provision of Flood Warning Direct services in Steyning and Upper Beeding to ensure continued management of flood risk in this area.

River Arun & Western Streams Catchment Flood Management Plan

Figure 6-2 Map of the policies in the Arun and Western Streams catchment



Rother Valley / Middle Arun / Weald – Policy 6

"Areas of low to moderate flood risk where we will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits. This policy will tend to be applied where there may be opportunities in some locations to reduce flood risk locally or more widely in a catchment by storing water or managing run-off. The policy has been applied to an area (where the potential to apply the policy exists), but would only be implemented in specific locations within the area, after more detailed appraisal and consultation".

This large rural area offers opportunities for changing land use and possible flood storage to reduce some of the current rapid runoff which results from the soils, slope and land use. The Middle Arun has raised defences in the form of embankments which were originally designed to protect the farmland and natural habitats on either side of the river up to a 2% annual probability flood event. This level is now considered to provide protection from 3% annual probability event.

It is emphasised that flooding often brings positive benefits to the environment and the policy adopted for this area supports increased flooding and keeping water on the land for longer. Application of this policy will contribute to reducing flood risk downstream.

Specific proposals for the area include investigating opportunities to work with landowners to create wetland habitat throughout the area; working with National Farmers Union and Natural England to develop a Land Management Plan exploring the possibilities for changes in land use and land management practices aiming to reduce run-off from surrounding countryside, to reduce

soil erosion and to achieve local flood risk benefits; and preparation of a tidal strategy for the Arun to address the gap in understanding of tidal flood risk in Lower and Middle Arun and to explore the feasibility of lowering the flood banks on the lower tidal Arun to allow more use of the extensive flood plain for flood storage.

Horsham – Policy 4

"Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change. This policy will tend to be applied where the risks are currently deemed to be appropriately-managed, but where the risk of flooding is expected to significantly rise in the future. In this case we would need to do more in the future to contain what would otherwise be increasing risk. Taking further action to reduce risk will require further appraisal to assess whether there are socially and environmentally sustainable, technically viable and economically justified options".

It is considered that urban development and increased flows will place more pressure on the existing drainage network in Horsham and will result in more surface water flooding, urban drainage capacity being exceeded with greater frequency, and more extensive flooding from urban watercourses. Flooding from surface water has not been quantified, but it is known to be significant and is predicted to increase in the future.

The adopted policy for this area is to take action to ensure that Horsham continues to be protected from flood risk to the same standard of protection in the face of climate change and continued urban development.

To ensure this policy is fulfilled, it is proposed to continue working alongside HDC to influence spatial development in the area with the aims of ensuring no increase in runoff from new developments and to encourage the use of SuDS. In addition, it is proposed to prepare a Surface Water Management Plan (SWMP) with HDC and the Water Companies to address the effects of climate change and development.

Pulborough – Policy 4

"Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change. This policy will tend to be applied where the risks are currently deemed to be appropriately-managed, but where the risk of flooding is expected to significantly rise in the future. In this case we would need to do more in the future to contain what would otherwise be increasing risk. Taking further action to reduce risk will require further appraisal to assess whether there are socially and environmentally sustainable, technically viable and economically justified options".

The River Arun flows through Pulborough; the watercourse is embanked and flood defence walls protect the town of Pulborough. The area is also served by a small pumping station which discharges excess water which is prone to collect behind the main river defences when water levels in the Arun are high.

In order to implement the preferred approach it is proposed to work with HDC to provide development control advice to ensure no increase in run-off from new developments and seek opportunities to reduce current run-off rates where possible; improve flood warning service to properties in Pulborough and surrounding villages through more accurate flood forecasting and more timely warnings; and as part of Lower Tidal River Arun Strategy, assess the integrity and long term sustainability of existing tidal defences in and around Pulborough.

6.2 Policy Recommendations

In order to encourage a holistic approach to flood risk management and ensure that flooding is taken into account at all stages of the planning process, the findings of this report should be considered through the Horsham District Core Strategy Review.

The following recommendations build upon national, regional and local policy with respect to flood risk; local flood risk issues and objectives identified by the Environment Agency in the Catchment Flood Management Plans (CFMPs) covering The River Adur and The River Arun and Western Streams; as well as emerging guidance and legislation incorporated into the Pitt Review and draft Flood and Water Management Bill.

Integration of these suggested policy recommendations into the review of Horsham DC's Core Strategy will help to ensure that the objectives and aspirations of the Environment Agency and national policy are met whilst strengthening the position of the Horsham DC with regard to flood risk.

Spatial Planning

1. Sites should be allocated in accordance with the Sequential Test to reduce the flood risk and ensure that the vulnerability classification of the proposed development is appropriate to the flood zone classification;
2. Greenfield floodplain areas, such as those identified in the Upper Adur and Middle Arun CFMP sub-areas, are an important flood risk management asset. Development proposals should ensure that remaining Greenfield floodplain areas are protected from future development.

Flood Risk Management

1. Flood Risk Assessments (FRAs) should be undertaken for all developments within Flood Zones 2 and 3 and sites with identified flooding sources (according to PPS25 Annex E) to assess the risk of flooding to the development and identify options to mitigate the flood risk to the development, site users and surrounding area;
2. FRAs are required for all major developments in Flood Zone 1 (according to PPS25 Annex E). These are residential developments consisting of sites greater than 0.5 ha or greater than 10 dwellings and commercial developments that are greater than 1 ha or have a floor area greater than 1000 m^2.
3. Flood Risk to development should be assessed for all forms of flooding;
4. Surface water flooding should be investigated in detail as part of site specific FRAs for future developments and early liaison with the Environment Agency and Horsham DC is recommended for appropriate management techniques.
5. Groundwater flooding should be investigated in more detail as part of site specific FRAs for developments located to the south of the District where a potential for groundwater flooding exists (see Level 1 GIS layers and mapping) or where a site is located within a defined groundwater emergence zone.
6. Where floodplain storage is removed, the development should provide compensatory storage on a level for level and volume for volume basis to ensure that there is no loss in flood storage capacity;
7. When re-developing existing buildings in flood risk areas, the use of flood resilient measures should be promoted at the individual property level.

Sustainable Drainage Systems & Surface Water Management

1. Sustainable Drainage Systems should be included in new developments unless it is demonstrably not possible to manage surface water using these techniques;
2. PPS25 requires the use of SuDS as an opportunity of managing flood risk, improving water quality and increasing amenity and biodiversity;
3. FRAs are required for all major developments in Flood Zone 1 (according to PPS25 Annex E). These are residential developments consisting of sites greater than 0.5 ha or greater than 10 dwellings and commercial developments that are greater than 1 ha or have a floor area greater than 1000 m^2;
4. Runoff rates from new developments on Greenfield sites should not exceed Greenfield runoff rates pre-development and should allow for climate change;
5. Runoff rates from previously developed developable land should not exceed existing rates of runoff and should seek betterment. In addition, an allowance should be made for climate change;
6. Runoff and/or discharge rates should be restricted to Greenfield runoff rates in areas known to have a history of sewer and/or surface water flooding;
7. Potential overland flow paths should be considered to ensure that buildings do not obstruct flows;
8. Where basements are proposed the risk of surface water flooding should be considered, with possible mitigation options including raised thresholds and inclusion of storage for surface water in such developments;
9. Opportunities should be sought to reduce the risk of flooding from the sewer network through consultation with Southern Water to determine key areas for maintenance and flood alleviation schemes;
10. At the site specific FRA level, the suitability of Sustainable Drainage Systems should be investigated for each development. Areas to north of the District (the High and Low Weald areas) may be more suited to attenuation systems;
11. The vulnerability and importance of local ecological resources, such as water quality and biodiversity, should also be considered when determining the suitability of SuDS.

A list of each development site (allocated under the original Core Strategy) highlighting the underlying geology and soil, together with site specific recommendations for SuDS and FRAs is presented in the Broad Scale Assessment of SuDS at the end of Appendix G.

Furthermore, given the high incidence of pluvial flooding in the district, and the susceptibility to groundwater flooding, it is recommended that Horsham DC undertake a Surface Water Management Plan (SWMP) inline with recommendations from the Pitt Review (2008), the draft Flood and Water Management Bill (2009) and the Arun and Western Streams CFMP. The purpose of the SWMP is to extend the identification of known localised problems to examine the causes, mechanism and impacts of surface water flooding events. Combined with knowledge of the fluvial and groundwater flood risks in the district, this will culminate in the identification and prioritisation of Critical Drainage Areas (CDAs). This information can then be used to establish a shared understanding of flood risk from all sources which will aid the LPA in future drainage asset management and will help with the coordination of future capital investments as well as the operational response to future flooding events.

Water Environment

1. Development should not have a detrimental impact on the water environment through changes to water chemistry or resource;
2. Where a development cannot be supplied with sufficient water resources, ensure that the phasing of development is in tandem with investment in resource infrastructure;
3. For larger schemes, it is recommended that a water cycle strategy is undertaken to determine whether there is sufficient water resources for the proposed increase in demand;
4. As climate change leads to changes in weather patterns, the prospect of drought may increase. New developments should seek to incorporate water efficiency measures such as grey water recycling rainwater harvesting and water use minimisation technologies. In so doing, knock-on benefits could be achieved for the sewer systems which will receive less wastewater from properties thereby providing additional capacity during heavy rainfall;
5. Any development should not be located within 8 metres of the river bank to ensure access for maintenance but amongst other things should ensure a riparian corridor for improvement of the riverine environment.

Residual Risk & Emergency Planning

1. Where development within flood risk areas is absolutely necessary, flood proof construction methods should be employed to reduce the impact of flooding;
2. Where development is within flood risk areas, emergency planning strategies should be put in place in order to direct people to safety during times of flooding;
3. Current emergency planning strategies should be reviewed to determine the suitability of refuge centres and evacuation routes based on the Flood Zone mapping produced in this study.

6.3 Summary

Through integration of these suggestions, the emerging LDF will comply with PPS25 and the aspirations and policies represented in following:

- Regional policy for the South East of England is split into three documents of which Regional Planning Guidance for the South East (RPG9) is relevant to the study area;
- South East England Regional Assembly – Regional Flood Risk Appraisal;
- Horsham DC: Local Development Framework;
- River Adur and River Arun & Western Streams Catchment Flood Management Plan;
- Biodiversity Action Plan for Sussex;
- Adur & Ouse and Arun & Western Streams Catchment Abstraction Management Strategies (CAMS);
- The Pitt Review (2008);
- The Draft Flood and Water Management Bill (2009).

7 Flood Risk Assessment Guidance

7.1 Site Specific Flood Risk Assessment Guidance

The assessment of flood risk is a fundamental consideration regardless of the scale or type of development. Understanding the flood risk to, and arising from a development, is key to managing the risk to people and property thereby reducing the risk of injury, property damage or even death. The effects of climate change may exacerbate future flood risk. Current predictions indicate that milder wetter winters and hotter drier summers will be experienced in the future and there will be a continued rise in sea levels. These changes will potentially lead to an increase in rainfall quantities thus altering the magnitude, frequency and intensity of flood events.

Flooding is not limited to just rivers and sea, in fact flooding can arise from a number of sources, each presenting their own type of risk and requiring management. In addition some areas currently defended from flooding may be at greater risk in the future as the effects of climate change take hold or defence condition deteriorates with age.

Opportunities to manage flooding whilst providing development exist through an understanding and mitigation of the risk. This includes the location, layout and design of developments to enable the management of flood risk through positive planning. This positive planning should consider the risks to a development from local flood sources but also the consequences a development may have on increasing flood risk to others. Early identification of flood risk constraints can ensure developments maximise development potential whilst achieving the principles of sustainability.

A Level 1 SFRA should present sufficient information to assist Local Planning Authorities to apply the Sequential Test and identify where the Exception Test may be required. These documents are predominately based on existing data. The scale of assessment undertaken for a SFRA is typically inadequate to accurately assess the risks at individual sites within the study area. The Environment Agency and SFRA Flood Zone Mapping do not account for all watercourses within Horsham District. Although, a watercourse may not have a flood zone mapped, as a precautionary principle, it is advised that a FRA should be requested for all development proposals within 20 m of a watercourse (the water environment). This will ensure that flood risk is managed and that flooding is not increased within or to the surrounding area.

Site specific FRAs are required to assess the flood risk posed to proposed developments and to ensure that, where necessary, appropriate mitigation measures are included in the development. This section presents the recommendations for site specific FRAs prepared for submission with planning applications to Horsham DC.

The guidance presented in the following sections has been based on:

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

When is a Flood Risk Assessment Required?

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

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

- The development site is located in Flood Zone 2 or 3;
- The proposed development is classed as a major development and located in Flood Zone 1. These are residential developments consisting of sites greater than 0.5 ha or greater than 10 dwellings and commercial developments that are greater than 1 ha or have a floor area greater than 1000 m^2;
- The development site is located in an area known to have experienced flooding problems from any flood source;
- The development is located within 20m (water environment) of any watercourse regardless of Flood Zone classification.

What does a Flood Risk Assessment require?

Annex E of PPS25 presents the minimum requirements for flood risk assessment. These include:

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

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

The staged approach comprises of three stages:

Level 1 - Screening Study

A level 1 Screening Study is intended to identify if a development site has any flood risk issues that warrant further investigation. This should be based on existing information such as that presented

in the Level 1 SFRA. Therefore this type of study can be undertaken by a development control officer in response to the developer query or by a developer where the Level 1 SFRA is available. Using the information presented in the Level 1 SFRA and associated GIS layers a development control officer could advise a developer of any flooding issues affecting the site. A developer can use this information to further their understanding of how flood risk could affect a development.

Level 2 - Scoping Study

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

Level 3 – Detailed Study

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

At all stages, the Local Planning Authority, and where necessary the Environment Agency and/or the Statutory Water Undertaker should be consulted to ensure the FRA provides the necessary information to fulfil the requirements for Planning Applications.

8 Summary and Results of Sequential Testing undertaken by Horsham DC

8.1 Summary

The following points provide a summary of this SFRA:

- The main watercourses within the Horsham DC administrative area are the Rivers Arun and Adur. These rivers are the predominant source of flood risk within the Horsham District with tidal flood sources affecting the south of the area. To a lesser extent, there is a risk of flooding from groundwater, surface water and sewer flooding.

- In 2007 Horsham DC commissioned the preparation of a SFRA for the progression of their Local Development Framework, to assist development control and provide information for emergency planning.

- The information provided within the first version of the SFRA enabled Horsham DC to perform the Sequential Test as defined in PPS25 for urban areas allocated for development. This process is presented in Section 8.2.

- As as response to the housing requirements of the Regional Spatial Strategy for the area, the South East Plan, a review of the Core Strategy for Horsham DC is being been undertaken. The Core Strategy Review Consultation Document, called 'Leading Change in Partnership to 2026 and Beyond', was published in September 2009 and identifies 9 potential strategic sites allocations through which the development requirements for the district could be achieved.

- This Revised SFRA (April 2010) provides an update to the original version to ensure the most up-to-date flood risk information is used throughout the decision-making processes associated with the Core Strategy Review.

- Information provided within this revised version of the SFRA has enabled Horsham DC to perform the Sequential Test in accordance with the PPS25 for the 9 new potential strategic sites. A summary of this Sequential Tests is provided in Section 8.3.

8.2 Sequential Test undertaken in June 2007

47 of the potential allocation sites lie within Flood Zone 1, 4 sites had areas within Flood Zones 2 and 3 (see Table 8-1 below).

Table 8-1: Potential allocations sites at risk of flooding identified following Sequential Test by HDC.

LDF Allocation		Grid Ref	Site Area	Flood Zone 2		Flood Zone 3 + CC		Flood Zone 3a		Flood Zone 3b	
Policy	Notes		(ha)	Area (Ha)	% of Area	Area (Ha)	% of Area	Area (Ha)	% of Area	Area (Ha)	% of Area
AL2	Lifestyle Ford Bishopric Horsham	E 516717.51 N 130656.25	1.400	0.074	5.26%	0.074	5.26%	0.074	5.25%	0.065	4.63%
CP7	Land west of Horsham west	E 515460.90 N 130191.74	50.580	0.548	1.08%	0.070	0.14%	0.025	0.05%	0.025	0.05%
	Land west of Horsham east	E 515460.90 N 130191.74	49.030	13.930	28.41%	9.829	20.05%	8.762	17.87%	7.421	15.14%
AL14	Brinsbury Centre of Excellence	E 506746.92 N 122558.29	58.760	1.444	2.46%	1.444	2.46%	1.205	2.05%	1.205	2.05%
AL15	Shoreham Cement Works	E 520351.71 N 108818.62	39.420	0.182	0.46%	0.215	0.55%	0.215	0.55%	0.215	0.55%

- Information presented within the SFRA allowed Horsham DC to redefine land use policies using the sequential approach. This has located all built environment within Flood Zone 1, allowing only informal open spaces and water compatible development within Flood Zones 2 and 3.

- It is recommended that a Level 2 SFRA is not required at present because all development can be located within Flood Zone 1. However, changes to the potential allocation sites would require revision of the Sequential Test and where required may facilitate the application of the Exception Test, thus requiring a Level 2 SFRA.

It is noted that CP7 is a strategically important site and has been adopted within the Core Strategy. Identification of alternative sites was therefore not possible. However, using the sequential approach, Horsham DC has reallocated areas within these sites to ensure that development is located within areas of lowest flood risk. Appendix F provides the revised site layouts proposed for those sites identified in Table 8-1.

Sites Identified for Development that fall within Flood Zones 2 & 3	Application of Sequential Test	Sequential Test – Passed or Failed?
Land West of Horsham Policy CP7 Core Strategy (2007).	The River Arun flows through the site, which lies on either side of the A24. The river flows to the south of the land allocated in CP7 to the west of the A24 and a small part (0.005 km^2 – 0.5ha) of its Flood Zone 2 floodplain extends within the development boundary. The river flows to the east of the land allocated in CP7 to the east of the A24 and flows across the site thereby dividing it into two. 0.139 km^2 (13.9ha) of this part of the site is affected by the river and its Flood Zone 2 floodplain. The site has been critically assessed for development but the following overriding factors have contributed to the decision to allocate the site for development in Policy CP7 of the Core Strategy (2007): • The development strategy for Horsham DC, as set out in the Core Strategy (2007), seeks to make the best use of previously-developed land in the most sustainable locations in the first instance, then identifies land for a strategic location for development as an urban extension to the most sustainable settlement in the District; Horsham. Horsham has a full range of facilities and services, a broad employment base and good transport links to the wider area. • Land to the north, east and south of the town has been assessed for its development potential to accommodate a strategic development of 2,000 homes and other uses but no other appropriate sites have been found. The A264 Northern Bypass has created a firm boundary to the north of the town and land to the east is designated as High Weald Area of Outstanding Natural Beauty. Further expansion to the south is severely constrained by significant landscape features such as Denne Hill. • Land to the west of Horsham is the most sustainable location for a strategic development and can be developed for a mix of uses including a substantial number of affordable homes where there is the greatest demand. This has been taken into account when assessing the site and, following review of the Level 1 SFRA, it is proposed to develop the land outside Flood Zones 2 and 3 and to allocate land adjacent to the River Arun for informal open space in the West of Horsham Masterplan Supplementary Planning Document that is due to be published for public consultation in Autumn 2007.	Passed

Sites Identified for Development that fall within Flood Zones 2 & 3	Application of Sequential Test	Sequential Test – Passed or Failed?
Lifestyle Ford, Bishopric, Horsham **Policy AL2 Site Specific Allocations of Land DPD**	The River Arun flows to the south of the site and a small part (0.0007 km^2 – 0.07ha) of its Flood Zone 2 floodplain extends within the development site boundary. The site has been critically assessed for development but the following overriding factors have contributed to the decision to allocate the site for development: • The development strategy for Horsham DC, as set out in the Core Strategy (2007), looks in the first instance to the re-use of suitable previously developed land in the most sustainable locations. • Horsham is the most sustainable location in the District and is identified as a Category 1 settlement. • The Lifestyle Ford site lies within walking distance of the town's services and facilities and close to sustainable travel choices. It is currently in commercial use but the business is looking to relocate possibly within the West of Horsham development area. • The site is in a highly sustainable location and can be developed for a mix of uses including affordable homes where there is the greatest demand. This has been taken into account when assessing the site and, following the Level 1 SFRA, it is proposed to develop the land outside Flood Zones 2 and 3 and to allocate land adjacent to the River Arun for informal open space. Such sustainable town centre sites rarely become available and a majority of the site (around 1.3ha) lies outside the floodplain. The site is allocated in the Site Specific Allocations of Land DPD for a mix of uses, including open space on land included within the floodplain, with the requirement that a detailed site specific FRA is prepared by the developer.	Passed

Sites Identified for Development that fall within Flood Zones 2 & 3	Application of Sequential Test	Sequential Test – Passed or Failed?
Centre of Rural Excellence at Brinsbury Policy AL14 Site Specific Allocations of Land DPD	A small tributary of the River Arun flows through the southern fringe of the Brinsbury College grounds. A small area (0.0144km2 – 1.44ha) of the site lies within Flood Zone 2 and 3. This equates to approximately 2.5% of the total allocation area of 0.58km2 (58ha). Although this site is classified as an employment site, it should be noted that the opportunities for the redevelopment and/or reorganisation of the Campus are not large scale and may include replacement and/or new buildings. The site has been critically assessed for its suitability to accommodate redevelopment of the Campus, but the following overriding factors have contributed to the decision to allocate the site: • To allow Brinsbury College to continue to develop its facilities as a focus for rural enterprise activities and a centre of excellence, a small amount of development is necessary. Developing the Brinsbury Campus as a centre of rural excellence would enable considerable potential gains for the college in the form of vocational training for students, in conjunction with on-site enterprises to help meet the demands of the rural economy. It is likely that any employment provision on the site would be ancillary to the predominant land use. • Although the site is in a rural location, detached from a full range of services and facilities, it has good access to the road network via the A29 and could potentially have improved public transport links via Pulborough and Billingshurst railway stations. • The nature of this site for a Centre of Rural Excellence would require sensitive design and development and should have regard to the rural location of the campus. Nevertheless, it is considered that there are considerable benefits to be gained for the college and its students and the rural economy as a whole. All these factors have been taken into account when assessing this site and it is proposed to develop the land outside Flood Zones 2 and 3 and to allocate land adjacent to the watercourse as informal open space. Within the Site Specific Allocations of Land DPD, Policy AL14, a detailed site specific flood risk assessment is required as a condition of planning permission.	Passed

Sites Identified for Development that fall within Flood Zones 2 & 3	Application of Sequential Test	Sequential Test – Passed or Failed?
Shoreham Cement Works Policy AL15 Site Specific Allocations of Land DPD	The River Adur flows through the Shoreham Cement Works site and marks the boundary between Horsham DC and Adur District. A majority of the site (45 of the overall 48 hectares) lies within Horsham DC and it is this land that is allocated in Policy AL15. The river flows to the east of the allocated site and part (0.0022 km^2 – 2.2ha) of its floodplain extends within the development site boundary. The site has been critically assessed for development but the following overriding factors have contributed to the decision to allocate the site for development: • Shoreham Cement Works is a large, unsightly disused cement works within the Sussex Downs Area of Outstanding Natural Beauty that is currently being considered for designation as a National Park. The cement works has been closed for over 10 years. • Horsham DC, together with Adur District Council and the Sussex Downs Joint Committee wish to see major environmental and landscape improvements that are compatible with the site's sensitive location. • It is recognised that in order to achieve this objective development, as part of a comprehensive scheme, will be needed. • The site is considered suitable for major employment use, leisure and/or tourism, limited residential development and a waste treatment facility. • The Core Strategy (2007) includes employment development as part of the restoration of this site (Policy CP10) as it will also contribute to the regeneration and economic needs of the Sussex Coast Sub-Region. • The proposal would help the management of resources through waste treatment facilities and help reduce greenhouse gas emissions. All these factors have been taken into account when assessing this site and it is proposed to develop the land outside Flood Zones 2 and 3 and to allocate land adjacent to the River Adur for informal open space, which will be set out in the Development Brief that is required in Policy AL15 of the Site Specific Allocations of Land DPD. Given the size of the site and the potential flood risk, a detailed site specific FRA will be required at Master Planning Stage.	Passed

8.3 Sequential Test undertaken in April 2010

Using the information provided within this revised SFRA, Horsham DC has applied the Sequential Test to the 9 potential strategic site allocations identified within the Core Strategy Review Consultation Document 'Leading Change in Partnership to 2026 and Beyond' (September 2009). The following points summarise the results from the application of the Sequential Test.

- 3 of the 9 potential strategic sites lie solely within Flood Zone 1; these are Faygate, West of Southwater and Adversane / North Heath. Development at these 3 sites therefore passes the Sequential Test.
- The remaining 6 sites have areas within Flood Zones 2 and 3 (see Table 8-2 below).

Table 8-2: Potential strategic site allocations at risk of flooding identified following Sequential Test by HDC

			Area	%	Area	%	Area	%	Area	%
Potential Strategic Allocations	West of Ifield	300	0.50	0.17%	1.85	0.62%	0.00	0.00%	17.117	5.71%
	Faygate	150.8	-	-	-	-	-	-	-	-
	Holbrook Park	57.78	5.48	9.49%	0.56	0.97%	0.00	0.00%	0	0.00%
	Chennels Brook	120.5	5.7	4.73%	0.00	0.00%	0.00	0.00%	14.59	12.11%
	Chesworth Farm	44.95	0.00	0.00%	7.86	17.59%	0.00	0.00%	2.68	5.97%
	West of Southwater	135.9	-	-	-	-	-	-	-	-
	East of Billingshurst	155.2	0.13	0.08%	2.07	1.34%	0.00	0.00%	0.99	0.64%
	Adversane / North Heath	544.1	-	-	-	-	-	-	-	-
	Pulborough Expansion	78.51	0.34	0.43%	0.02	0.02%	0.004	0.01%	0.27	0.35%

Table 8-3: Sequential Test for Potential Strategic Site Allocations undertaken by HDC

Answer	Response/ Suggested Action
Questions 1-2: For Sites Located in EA Flood Zone 1 – 'Low Probability' of Flood Risk	
1. Are the proposed broad locations in 'Flood Zone 1 – Low Probability' of flood risk?	
Yes	All potential strategic site options fall partially within Flood Zone 1. However, the following sites fall **ONLY** within Flood Zone 1: • Faygate • West of Southwater • Adversane/North Heath **These potential sites would be appropriate for development based only upon the low level of flood risk proposed**
No	Whilst largely located within Flood Zone 1, the following potential strategic site options also have areas located within Flood Zones 2 and 3; • West of Ifield • Holbrook Park • Chennels Brook • Chesworth Farm • East of Billingshurst • Pulborough
2. Could the proposed broad locations in Flood Zones 2 and 3 alternatively be located in an area at low risk of flooding?	
No	**2a. What alternative development sites were considered and why were they dismissed?** Development within the Horsham District is constrained by a number of factors, including AONB to the east of Horsham town and along the southern boundary. Development to the west of Horsham town is also constrained by firm physical boundaries identified though the previous West of Horsham allocation., these sites identified considering the constraints and land form to the West and South of Horsham, the sites to the West of Horsham are yet to be built out. The district is also very rural in nature, therefore the council have tried to focus on site options in the most sustainable locations with links to appropriate infrastructure, transport links, services and facilities. Taking all of this into consideration, the council undertook a Strategic Housing Land Availability Assessment (SHLAA), to identify and assess all

	potential development sites which may be suitable for housing within the plan period to 2026. Through this process a number of sites were identified which were considered large enough to deliver housing on a strategic scale. In order maximise the probability of meeting the housing targets identified through the South East Plan, the council put forward all such potential sites for consideration in their '*Leading Change in partnership to 2026 and* beyond' consultation document. As such there were was no alternative development sites considered and dismissed at this stage.
	2b. Why can the proposals/development sites not be redirected to Flood Zone 1? The overall housing allocation for the Horsham District, as identified through the South East Plan is 13,000 new homes to be delivered by 2026. Of this, 9,200 are to be delivered throughout the Gatwick Sub-Region, with the remaining 3,800 to be delivered throughout the rest of the District. In order to meet these targets all potential strategic sites need to be considered, including those with areas located within Flood Zones 2 and 3.
3. For sites located in EA Flood Zone 2 (Medium Probability of Flooding): (1.West of Ifield; 3.Holbrook Park; 4.Chennels Brook; 5.East of Billingshurst and 9.Pulborough)	
3a: Which category of the 'Flood Risk Vulnerability Classification' does each of the development site uses fall? 1. **Essential Infrastructure:** None 2. **Highly Vulnerable:** None 3. **More Vulnerable:** 1.West of Ifield; 3.Holbrook Park; 4.Chennels Brook; 7.East of Billingshurst; and 9.West of Pulborough will include housing provision whilst 3.Chennels Brook; 6.West of Southwater; and 7.East of Billingshurst are also likely to include educational establishments 4. **Less Vulnerable:** Potential strategic site options 3.Holbrook Park; 4.Chennels Brook and 7.East of Billingshurst will include neighbourhood centres and therefore buildings to be used for shops and other services. 5. **Water Compatible:** 1.West of Ifield; 3.Holbrook Park; 4.Chennels Brook; 7.East of Billingshurst and 9.Pulborough will include some element of green infrastructure/ public open space and where necessary SUDS features will be provided for the control of surface water drainage. Note: Not all development sites will have a single use; therefore many have been classified under more than one category.	

Yes	**3b: Can the 'More Vulnerable' aspects of proposals be directed to parts of the site where the risk of flooding is lower?** Yes, in all cases only a small portion of the total development site is located within Flood Zone 2, therefore it would be possible to direct the 'more vulnerable' aspects of development to parts of the site where there is a lower risk of flooding. Again in all cases a site specific Flood Risk Assessment (FRA) would be required to accompany specific development proposals in order to obtain a greater understanding of the specific type of flood risk on site and to outline and mitigation measures required to offset such risk. **The Exception Test would be required in all instances for 'More Vulnerable' aspects of development.**
4 For Sites Located in EA Flood Zone 3a (High Probability of Flooding): (9. Pulborough Expansion)	
Yes	**4a. Could any of the development be redirected to 'Zone 2 Medium Probability' of Flooding?** The Pulborough strategic site option is a combination of a number of smaller individual sites grouped together to form a potential strategic option and not all of these sites have areas located within Flood Zone 3a. It is therefore possible to bring forward only those sites that are located within Flood Zone 2.
Yes	**4b. Are any of the development proposals in the 'Water Compatible' or 'Less Vulnerable' classifications?** Water Compatible: The Pulborough Expansion potential strategic site option will include some form of green infrastructure and/or recreational space.
Yes	**4c. Are any of the development proposals classified as 'Highly Vulnerable?** It is proposed that the Pulborough Expansion potential strategic site option will include residential development.
Yes	**4d. Can the 'More Vulnerable' aspects of proposals be directed to parts of the site where the risk of flooding is lower?** In Pulborough a comprehensive strategic approach is needed to deliver the necessary infrastructure improvements required for growth. Only a small portion of the (0.004ha) of the potential site allocation is located within Flood Zone 3a. As such it would be possible to locate the more vulnerable aspects of development to areas where the risk of flooding is lower. **An Exception Test would be required for 'More Vulnerable' aspects of development.**
5. For Sites Located in EA Flood Zone 3b (Functional Floodplain): (1.West of Ifield; 3.Holbrook Park; 4.Chennels Brook; 7.East of Billingshurst and 9: Pulborough)	
	5a. Could any of the development proposals be redirected to 'Zone 2 Medium Probability' of Flooding?

No	The South East Plan housing allocation for the Horsham District is 13,000 new homes to be delivered by 2026. Of this 9,200 are to be delivered throughout the Gatwick Sub-Region, with the remaining 3,800 to be delivered throughout the rest of the District. In order to meet these targets all potential strategic sites need to be considered, including those with areas located within Flood Zones 2 and 3. The sites with areas located within Flood Zone 3b are substantial in size and are located in areas which offer the most benefits in terms of sustainability. As such it would be difficult to accommodate all development in 'Flood Zone 2' without compromising the sustainability of the site.
Yes	**5b. Could any of the development proposals be redirected to 'Zone 3a High Probability' of Flooding?** The five sites which have areas located within Flood Zone 3b are substantial in size with only a small portion of their total area located within the Flood Zone. It may therefore be possible to redirect development to parts of the site that fall within Flood Zones 1 or 2 (Other than Pulborough, none of the sites have areas within Flood Zone 3a). The **Exception Test would be required** to progress residential elements in areas of Flood Zone 3a.

- Information presented within this revised SFRA has enabled Horsham DC to sequentially test the 9 potential strategic allocations in accordance with the requirements of PPS25.
- The results from the application of the Sequential Test identify that all 9 potential strategic sites are sequentially appropriate.
- Three of the sites are located entirely within Flood Zone 1. The remaining 6 sites are located predominantly within Flood Zone 1 and it is possible for development within these strategic areas to be preferentially located within Flood Zone 1, thereby complying with the aspirations of PPS25.
- It is recommended that a Level 2 SFRA is not required at present. However, changes to the potential allocation sites would require revision of the Sequential Test and where required may facilitate the application of the Exception Test, thus requiring a Level 2 SFRA.

Appendix A: Broad Scale Assessment

Table A-1: Horsham DC SFRA - Level 1 coarse assessment table.

Question	Area (km^2)	% of Area	
Total Area of Horsham administrative Area	529	100%	
Area of Horsham in Zone 3b (Functional Floodplain)	34.27	6.48%	of total area
Area of Horsham in Zone 3a (High Flood Risk)	6.35	1.20%	of total area
Area of Horsham in Zone 2 (Moderate Flood Risk)	4.94	0.93%	of total area
Area of Zone 3 that is defended	0.00	0.00%	of Zone 3
Total Developed Area	33.46	6.36%	of total area
Existing Development in Flood Zone 3b	0.39	1.18%	of dev. area
Existing Development in Flood Zone 3a	0.06	0.19%	of dev. area
Existing Development in Flood Zone 2	0.13	0.39%	of dev. area
Potential New Development Required	16.86	3.19%	of total area
Potential New Development in Zones 3b	0.37	2.20%	of pot. dev.
Potential New Development in Zones 3a	0.00	0.00%	of pot. dev.
Potential New Development in Zones 2	0.12	0.74%	of pot. dev.
Drainage Problem Areas	Minimal Drainage Flooding – records show points rather than areas.		
Extent of Groundwater Emergence Zone	21.34	4.03%	of total area

Table A-2: Horsham DC SFRA– Category 1 settlements, flooding summary.

Settlement Name	Area (Ha)	FZ2		FZ3 + CC		FZ3a		FZ3b	
		Area	%	Area	%	Area	%	Area	%
Billingshurst	155.34	1.73	1.11%	15.67	10.09%	0	0.00%	1.51	0.97%
Broadbridge Heath	70.29	-	-	-	-	-	-	-	-
Henfield	124.56	-	-	-	-	-	-	-	-
Horsham	1,093.59	8.70	0.80%	63.80	5.83%		0.00%	14.55	1.33%
Pulborough	168.95	0.2	0.12%	0.55	0.32%	1.29	0.77%	4.36	2.58%
Southwater	180.10	-	-	-	-	-	-	-	-
Steyning, Bramber and Upper Beeding	251.29	0.24	0.10%	2.77	1.10%	4.45	1.77%	4.98	1.98%
Storrington/Sullington	364.85	0.67	0.18%	1.96	0.54%	0	0.00%	6.1	1.67%

Table A-3: Horsham DC SFRA– Category 2 settlements, flooding summary.

Settlement Name	Area (Ha)	FZ2		FZ3 + CC		FZ3a		FZ3b	
		Area	%	Area	%	Area	%	Area	%
Adversane	12.96	-	-	-	-	-	-	-	-
Amberley	20.82	0.07	0.32%	0	0.00%	0.75	3.59%	0.08	0.36%
Ashington	88.69	0.00	0.00%	0.27	0.31%	0.00	0.00%	3.17	3.57%
Barns Green	31.59	0.00	0.00%	0.08	0.25%	0.00	0.00%	0.00	0.00%
Bucks Green	9.43	-	-	-	-	-	-	-	-
Christ's Hospital	40.27	-	-	-	-	-	-	-	-
Codmore Hill	3.61	-	-	-	-	-	-	-	-
Coldwaltham	58.34	0.44	0.75%	0.05	0.09%	0.00	0.00%	0.00	0.00%
Cowfold	33.24	0.00	0.00%	0.07	0.22%	0.00	0.00%	0.1365	0.41%
Faygate	7.09	-	-	-	-	-	-	-	-
Lower Beeding	6.53	-	-	-	-	-	-	-	-
Mannings Heath	48.20	-	-	-	-	-	-	-	-
Partridge Green	48.32	-	-	-	-	-	-	-	-
Rudgwick	65.29	-	-	-	-	-	-	-	-
Rushfield	39.72	-	-	-	-	-	-	-	-
Rusper	15.83	-	-	-	-	-	-	-	-
Slinfold	44.63	-	-	-	-	-	-	-	-
Small Dole	44.25	-	-	-	-	-	-	-	-
Thakeham	14.67	-	-	-	-	-	-	-	-
Warnham	33.98	-	-	-	-	-	-	-	-
Washington	16.43	-	-	-	-	-	-	-	-
West Chiltington Common	253.10	1.12	0.44%	0.00	0.00%	0.00	0.00%	4.60	1.82%

Table A-4 Horsham DC SFRA– Non Categorised potential allocation sites, flooding summary.

Site Name		Area (Ha)	FZ2		FZ3 + CC		FZ3a		FZ3b	
			Area	%	Area	%	Area	%	Area	%
Not categorised	Centre of Excellence, Brinsbury	58.76	0.24	0.42%	0.00	0.00%	0.00	0.00%	1.20	2.05%
	Shoreham Cement Works	39.42	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.23	0.58%
Potential Strategic Allocations	West of Ifield	300	0.50	0.17%	1.85	0.62%	0.00	0.00%	17.117	5.71%
	Faygate	150.8	-	-	-	-	-	-	-	-
	Holbrook Park	57.78	5.48	9.49%	0.56	0.97%	0.00	0.00%	0	0.00%
	Chennels Brook	120.5	5.7	4.73%	0.00	0.00%	0.00	0.00%	14.59	12.11%
	Chesworth Farm	44.95	0.00	0.00%	7.86	17.59%	0.00	0.00%	2.68	5.97%
	West of Southwater	135.9	-	-	-	-	-	-	-	-
	East of Billingshurst	155.2	0.13	0.08%	2.07	1.34%	0.00	0.00%	0.99	0.64%
	Adversane / North Heath	544.1	-	-	-	-	-	-	-	-
	West of Pullborough	78.51	0.34	0.43%	0.02	0.02%	0.004	0.01%	0.27	0.35%

Appendix B: Settlement Level Coarse Assessments

Appendix C: List of Contacts

Organisation	Role	Tel	E-Mail
HDC			
Barbara Childs	Team Leader LDF	01403 215181	Barbara.Childs@horsham.gov.uk
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Chris Sepke	Drainage Engineer		Chris.sepke@horsham.gov.uk
Environment Agency			
Karen Harris	Sustainable Construction Technical Specialist	01903 703971	karen.harris@environment-agency.gov.uk
Keeley Mowatt	Flood Risk Mapping and Data Management	01903 703917	
Andy Strudwick	IDBs	01903 702583	
Jamie Fielding	Flood Risk Mapping and Data Management	01903 703833	Jamie.fielding@environment-agency.gov.uk
Hannah Hyland	Planning Liaison Technical Specialist	01903 703962	Hannah.hyland@environment-agency.gov.uk
Thames Water			
Steve Dummer	Sewer Flooding Coordinator	011892 37346	Steve.Dummer@thameswater.co.uk
Southern Water			
David Nuttall	Senior Engineer - coordinating SFRA Response		david.nuttall@southernwater.co.uk
Capita Symmonds			
Marc Pinnell	Project Manager West Sussex County SFRA	01342 333428	
West Sussex CC			
Gary Tucknott	Highways Flooding	01243 777560	gary.tucknott@westsussex.gov.uk
Neil Smith	Local Highway Manager @ Broadbridge Heath	01403 223912	
Maureen Vaughey	first point of contact for northern highways @ westsussex		highways.northern@westsussex.gov.uk

Appendix D: Data

TITLE	DESCRIPTION	CONFIDENCE
HDC Alternative Development Sites & Boundary Changes	This document sets out a number of sites for development as well as suggested boundary changes.	GOOD
HDC Alternative Development Sites & Boundary Changes - GIS Outputs	GIS Polygons for alternative site allocations	VERY GOOD
HDC Proposals Map (2006) Submission Document	HDC Local Plan, Submission Proposals Map & Next Steps. Appendix 1:Transition from HDC LDF	GOOD
HDC Proposals Map (2006) Submission Document - GIS Layers	GIS Polygons for site allocations	VERY GOOD
HDC Site Specific Allocations of Land. Submission Document (2005)	This document sets out sites allocated for development. It is one of the documents that will make up the LDF and which will govern the long-term spatial planning.	GOOD
25k & 50k Horsham Raster files	TIF and TFW file format Maps	VERY GOOD
Revised Flood Plain (Horsham)	EA agreed 100yr flood plain extent.	GOOD
Horsham DC SFRA DATA Provided by the E.A	Flood event files: lines, points & polygons.	GOOD
Parish Council Questionnaire Responses	Completed questionnaires from Horsham DCs consultation exercise, together with maps and photos of flooding in each Parish Council	FAIR
EA Flood Zone maps for HDC Dec 2006	GIS Polygons for flood zones, defences, area benefiting, flood storage area, historical flood maps:	GOOD
EA Flood Data & Height Data	ArcView format dtm (SAR) files. GIS polygons for Area Benefiting, Flood Zones, Historical Flood Maps	GOOD
EA data received from Horsham District Council. Data files	Model List (Excel), Watercourse data (GIS polygons), Defence Data (GIS polygons), Flood Warning Areas (GIS polygons) Horsham IDB (GIS polygons), Reaches (GIS polygons)	GOOD
Fluvial Depth Grid.	100yr, 1000yr, 1000cc, 100cc.adf files. JFLOW outputs	GOOD

TITLE	DESCRIPTION	CONFIDENCE
EABM's – River Adur Survey	E3&E1 Word docs, CAD & jpeg TBM files for Reach 1-13	GOOD
River Adur Model	Reach 5-8 .txt TEXT FILES ONLY, NO MODEL	FAIR
Tidal Depth Grid	J-Flow Broad-scale modelling - 100yr, 1000yr, 1000cc, 100cc.adf files	GOOD
Upper Arun River Survey	EABM .dgn files, EEBY files, LEV-DAT files, LEV-FIN files, LO .dwg & .xls, ls .dxf files, photo .mdb files, XS-dat folder, xs-db folder, Xs-dxf folder.	GOOD
Drawing Files	Reach 5 - 9 CAD drawings	GOOD
EA National Mapping 'Areas Susceptible to Surface Water Flooding'	Three GIS polygons that show areas that are less / intermediate / more susceptible to surface water flooding, produced from simplified national modelling	FAIR
Arun & Western Streams CFMP December 2009	"Arun & Western Streams Catchment Flood Management Plan – December 2009".	VERY GOOD
Horsham DC Wet Pond Flood Control Structures	This document gives details of some wet pond water bodies are large enough to come under the Reservoirs Act and those that have flood defences in poor condition.	GOOD
River Adur CFMP December 2009	" River Adur Catchment Flood Management Plan – December 2009".	VERY GOOD
Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study (LDS 23), DEFRA – Making Space for Water, 2004. Appendix - Volume 2	National study identifying types and sources of groundwater flooding. Mapping outputs at a national and regional scale	GOOD
EA Hydrometric Network	GIS layers showing location of river flow and rainfall gauges	GOOD
Southern Water Flooding information	Flooding information for Postcodes in Horsham District	GOOD
South East England Regional Assembly – Regional Flood Risk Appraisal	Regional Flood Risk Assessment for the South East	FAIR

Type	Layer	Source	Description of Layer	Included (Y/N)	Comment	Benefits	Limitations
Fluvial	Environment Agency Broad-scale Flood Zone Maps	Provided as GIS layer by EA	Polygon layer showing EA flood zone maps including Flood zone 2 and 3	Y		A quick and easy reference that can be used as an indication of flood risk.	Flood zones may not give an accurate representation of flood risk. The models do not take into account defences; are commonly based on 5m resolution DTM; JFLOW software is commonly used that is generally thought to have inaccuracies. Typically watercourses with a catchment area less than 3km^2 are omitted from Environment Agency mapping unless there is a history of flooding affecting a population. Consequently there will be some locations adjacent to watercourses that on first inspection, it is suggested there is no flood risk.
	CEH Watercourse Network	Centre for Ecology and Hydrology (CEH), Wallingford.	Polyline layer showing streams, ditches, drainage channels and rivers.	Y		Displays all of the watercourses in the study area.	Some minor water features in the query can be missed.
	Main Rivers Centrelines and Critical Ordinary Watercourses	Provided as GIS layer by EA	Polyline layer showing all watercourses designated Main Rivers or as Critical Ordinary Watercourses	Y		Identification of the watercourses for which the EA have discretionary and regulatory powers	There are other watercourses that may be a significant flood source.
	Hydraulic 1D Model Outputs - Upper Arun Model 25yr and 100yr outlines.	Provided as GIS layer by EA	Polyline and polygon data showing the 1D modelled outlines of the Upper Arun.	Y	Limited data	Detailed and calibrated hydraulic model outlines that have been mapped using LiDAR (1m and 2m resolution). These outlines provide a much greater degree of accuracy and therefore confidence than the broad-scale flood zones.	There are watercourses that have not been modelled and therefore the flood risk from these can not be as accurately assessed.
	Hydraulic Model Outputs and Node Locations - Lower Arun Model 100yr + Climate Change model results	Provided as GIS layer by EA	Labelled point data showing 100yr Plus Climate Change levels between Pallingham Weir and Houghton Bridge	Y			
	Hydraulic 1D and 2D Model Outputs - Lower Arun Model outlines for 25yr, 100yr and 100yr + Climate Change	Provided as GIS layer by EA	Polyline and polygon data showing the 1D modelled outlines of the Lower Arun.	Y		Modelled results for 100yr + CC between Pallingham Weir and Houghton Bridge have been coarsely mapped by SW using 5m SAR Data	Modelled results for 100yr + CC between Pallingham Weir and Houghton Bridge have been coarsely mapped by SW using 5m SAR Data - this is sufficient interim approach for use on a strategic and district scale, however, when outlines have been modelled by EA consultants to greater detail, these should be used instead.
	Hydraulic 1D Model Outputs - River Adur Model 25yr, 100yr and 100yr plus 20% peak flow Climate Change	Provided as GIS layer by EA	Polyline and polygon data showing the 1D modelled outlines of the Lower Arun.	Y			
	Hydraulic Model Outputs and Node Locations - Upper Arun to West of Horsham	Provided as CAD layer by HDC and WSP	Polyline and polygon layer showing high resolution 1D modelled outline for 100yr and 100yr plus climate change for reach of Arun immediately to West of Horsham	Y	Limited data	High resolution modelling and mapping for the reach of the River Arun in and around allocations to West of Horsham (CP7). Provides good accuracy and improved detail and confidence over EA broad-scale and EA SFRM modelling.	Only available for reach in and around allocations to West of Horsham (CP7).

Type	Layer	Source	Description of Layer	Included (Y/N)	Comment	Benefits	Limitations
Fluvial	Combined Flood Zone 3b - Functional Floodplain	EA Flood Zone Maps & EA Hydraulic Modelled Data	Polygon layer created using best available data for whole district. Where 1:25yr modelled outlines available, these have been used to represent FFP (with agreement from EA and HDC). Where modelled data is not available, EA broad-scale FZ3 has been used.	Y	Combined data	A single GIS layer created using best available information at time of publication.	Assumption made that where modelled data for 20/25yr event is not available, the 100yr FZ3 broad-scale outline has been used. This could be overly conservative and, where possible, data should be updated as and when available.
	Combined Flood Zone 3a	EA Flood Zone Maps & EA Hydraulic Modelled Data	Polygon layer created using best available data for whole district. Where 1:100yr modelled outlines available, these have been used to represent FZ3a (with agreement from EA and HDC). Where modelled data is not available, EA broad-scale FZ3 has been used.	Y	Combined data	A single GIS layer created using best available information at time of publication.	Assumption made that where modelled data for 100yr event is not available, the 100yr FZ3 broad-scale outline has been used. This could be overly conservative and, where possible, data should be updated as and when available.
	Combined Flood Zone 3 + CC	EA Flood Zone Maps & EA Hydraulic Modelled Data	Polygon layer created using best available data for whole district. Where 1:100yr + CC modelled outlines available, these have been used to represent FZ3 + CC (with agreement from EA and HDC). Where modelled data is not available, EA broad-scale FZ2 has been used.	Y	Combined data	A single GIS layer created using best available information at time of publication.	Assumption made that where modelled data for 100yr+CC event is not available; the 1000yr FZ2 broad-scale outline has been used. This could be overly conservative and, where possible, data should be updated as and when available.
	Combined Flood Zone 2	EA Flood Broad Scale Zone Maps	Polygon layer of 1:1000yr FZ2 outline created for whole district.	Y	Combined data	A single GIS layer created using best available information at time of publication.	All based on FZ2 broad-scale mapping
	Historical Flood Outlines	EA HFM and EA FERS data. Also, Parish council questionnaires	Polygon and point data for whole district showing historical flooding incidents and events	Y	Combined data	A single GIS layer created using best available information at time of publication.	Some of the data is based on circumstantial and subjective evidence.
	Digital Terrain Model	Provided by EA	Reference Only	Y			SAR 5m DTM
	Flood Defence Locations (NFCDD)	EA / DEFRA - National Flood & Coastal Defence Database.	Point and polyline data with meta-data showing defence locations, standard of service and condition	Y		Shows where there are existing defences, heights, type and design standard.	Dataset not fully completed or up-to-date. Many fields contain default values.
Tidal	Environment Agency Broad-Scale 200 year flood plain	Provided as GIS layer by EA	polygon layer showing the area that would be expected to flood from the 1 in 200 year still water tidal level assuming no defences	Y		Shows the zones of the study area at risk from the current 1 in 200 year tidal flood	All based on FZ3 broad-scale mapping
	Tidal Limits	Derived from OS Mapping and information provided by EA	Polyline layer delineating tidal limits on Adur and Arun	Y		Allows HDC to identify where areas may be subject to fluvial or tidal flooding	Does not take into account whether structures are tidal limits can accommodate climate change.
	200 year plus climate change 2060	Provided as GIS layer by EA	Polygon layer showing the area that would be expected to flood from the 1 in 200 year plus climate change allowances EA Extreme Flood Outline	Y		Shows the zones of the study area at risk from the 1 in 200 year tidal flood in 2060	High Resolution 2D modelled outlines. Assume no defences. 100yr Tidal Climate change outlines are being updated and remodelled by EA to PPS25. These were not ready at time of publication, but SFRA should be updated with information as soon as it becomes available.

Type	Layer	Source	Description of Layer	Included (Y/N)	Comment	Benefits	Limitations
Tidal	25 year flood plain (ignoring defences)	Provided as GIS layer by EA	Polygon layer showing the area that would be expected to flood from the 1 in 25 year still water tidal level assuming no defences	Y		Shows the zones of the study area at risk from the current 1 in 20 year tidal flood	These only show the flood zones without defences and therefore do not provide details of the defended flood plain
	1000 year flood plain	Provided as GIS layer by EA	Based on EA Broad-scale modelling Tidal FZ2	Y		Shows the zones of the study area at risk from the current 1 in 1000 year tidal flood.	All based on FZ2 broad-scale mapping
	1000 year flood plain 2060	Provided as GIS layer by EA	Polygon layer showing the area that would be expected to flood from the 1 in 1000 year still water tidal level assuming no defences	Y		Shows the zones of the study area at risk from the 1 in 1000 year tidal flood in 2060	High Resolution 2D modelled outlines. Assume no defences. 100yr Tidal Climate change outlines are being updated and remodelled by EA to PPS25. These were not ready at time of publication, but SFRA should be updated with information as soon as it becomes available.
	Digital Terrain Model	Provided by EA	Reference Only	Y			SAR 5m DTM
	Flood Defence Locations (NFCDD)	EA / DEFRA - National Flood & Coastal Defence Database.	Point and polyline data with meta-data showing defence locations, standard of service and condition	Y		Shows where there are existing defences, heights, type and design standard.	Dataset not fully completed or up-to-date. Many fields contain default values.
Groundwater	Groundwater Vulnerability Maps	Provided as GIS layer by EA	Polygon layers showing major aquifers and their vulnerability	Y		Broadly shows extents of aquifers in the district. Where aquifers are highly vulnerable, they often have a more permeable covering and, together with dry valley and watercourse networks, potential groundwater flooding areas can be identified.	Coarse assessment of potential areas where GW flooding could occur. This is not foolproof and is based on assumptions. Where necessary, detailed groundwater flooding studies should be undertaken at SSFRA.
	Dry Valleys	review of GWV maps and DTM & All watercourse layer	Polyline layer showing areas they may be susceptible to flooding from springhead resurgence	N	Limited data	Dry valleys can easily be seen alongside the rising trends in groundwater data.	Provides possible locations of groundwater resurgence however no frequency or magnitude can be assigned to any possible resurgence and flooding
	CEH Watercourse Network - BFI classification	Centre for Ecology and Hydrology (CEH), Wallingford. SW interpreted BFI classification using FEH CD-ROM (v1) and also outputs from Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study (LDS 23), DEFRA – Making Space for Water, 2004	Polyline layer showing watercourses that have a high BFI (Base Flow Index), i.e. watercourses that are predominantly fed by groundwater.	Y		Used in conjunction with GWV maps, dry valley data, and OS Mapping to identify stream and watercourses that may be susceptible to groundwater resurgence	
	Groundwater monitoring points	Locations of groundwater monitoring points provided by the EA	Point data layer for use in groundwater contouring	N	Limited data	Identification of groundwater monitoring points within HDC - potential for future use in gathering groundwater flooding data	There are limited GW monitoring boreholes in HDC.
	South Downs Groundwater Emergence Zone	Derived from Appendix Volume 2, Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study (LDS 23), DEFRA – Making Space for Water, 2004	Polygon Layer coarsely created from Groundwater Flooding Scoping Study	Y		Study identified several groundwater emergence zones in region. A more accurate representation of potential groundwater flooding area than methods above.	Very broad scale and no frequency or magnitude can be assigned to any possible resurgence and flooding
	OS Mapping	HDC provided OS Mapping under contractor license	1:25k and 1:50k OS raster maps for use in GIS	Y		Provides background mapping to other GIS layers.	Designed for use at 1:25k and 1:50k scales
	Historical records	From records provided by stakeholders showing evidence/anecdotal evidence of groundwater flooding only	Point data layer to be shown on dry valleys map	N	Very Limited Data	Shows areas that have experienced flooding in the past and therefore potential fro future flooding	Very limited evidence available and most is anecdotal.

Type	Layer	Source	Description of Layer	Included (Y/N)	Comment	Benefits	Limitations
Overland Flow	Dry Valleys	Review of GWV maps and DTM & All watercourse layer	Polyline layer showing areas they may be susceptible to flooding from springhead resurgence	N	Limited data	Dry valleys can easily be seen alongside the rising trends in groundwater data.	Provides possible locations of groundwater resurgence however no return period can be assigned to any possible resurgence and flooding
	OS Mapping	HDC provided OS Mapping under contractor license	1:25k and 1:50k OS raster maps for use in GIS	Y		Provides background mapping to other GIS layers.	Designed for use at 1:25k and 1:50k scales
	Historical records	From records provided by stakeholders showing evidence/anecdotal evidence of groundwater flooding only	Point polygon and polyline data showing areas of overland flow	Y	Limited data	Shows areas that have experienced overland flooding in the past and therefore is likely in the future without intervention.	Very limited dataset. Most instances recorded are circumstantial and subjective.
	Areas Susceptible to Surface Water Flooding	Provided as GIS layer to HDC by EA	Three polygon layers showing areas that are less / intermediate / more susceptible to surface water flooding	Y		Can be used to inform land use planning at a very high and strategic level.	The mapping is produced using a simplified method that does not account for the interface between surface water network, sewer systems and watercourses; it does not show the susceptibility of individual properties to surface water flooding; and it has significant limitations for use in flat catchments.
Other	Sewer Flooding History	Records of sewer flooding from Water company records.	Point data layer showing points of flooding with records of date of incident, location, extent, source, cause	Y		Indicates areas that are most prone to flooding as have experienced flooding in the last 10 years within a postcode area due to hydraulic incapacity.	The extent and source of the flooding is not known and cannot be displayed in this layer.
	OS Mapping	HDC provided OS Mapping under contractor license	1:25k and 1:50k OS raster maps for use in GIS	Y		Provides background mapping to other GIS layers.	Designed for use at 1:25k and 1:50k scales
	Tidal Limits	Derived from OS Mapping and information provided by EA	Polyline layer delineating tidal limits on Adur and Arun	Y		Allows HDC to identify where areas may be subject to fluvial or tidal flooding	Does not take into account whether structures are tidal limits can accommodate climate change.
	Reservoirs and Large Water Bodies	GIS Layer created from EA records (Exeter Office), HDC Drainage Dept. and OS Mapping	Polygon layer showing large water bodies including those falling under Reservoirs Act	Y		Allows identification of areas downstream of large reservoirs and water bodies. Delineation of residual risk to potential future sites.	Condition and capacity of water bodies not known at this time. Breach/overtopping scenarios not available.
Mitigation	Flood Warning areas	Provided as GIS layer by EA	Polygon layer showing areas benefiting from flood warning and emergency plans with query details presenting what is involved in each.	Y		Indicates which areas are covered by the flood warning system,	
	NFCDD	EA / DEFRA - National Flood & Coastal Defence Database.	Point & Polyline layer showing NFCDD entries within the study area protecting from all flood sources and unofficial defences, providing details of the type of structure, operating/responsible authority	Y		Shows where there are existing defences, heights, type and design standard.	Dataset not fully completed or up-to-date. Many fields contain default values.
	Unofficial defences	From a review of topographic data		Y		Indicates where natural landforms or engineered structures may act to provide an unofficial defence from tidal flooding	This can only provide a broad assessment of unofficial defences and may miss smaller features that could look to mitigate flood risk.
	Areas benefiting from defences	Provided as GIS layer by EA	Polygon layer showing areas benefiting from flood defences	N	No data for Horsham		The polygon data is not currently available for the HDC area.
	Groundwater Vulnerability Maps	Provided as GIS layer by EA	Polygon layers showing major aquifers and their vulnerability	Y		Broadly shows extents of aquifers in the district. Where aquifers are highly vulnerable, they often have a more permeable covering and, together with dry valley and watercourse networks, potential groundwater flooding areas can be identified.	Coarse assessment of potential areas where GW flooding could occur. This is not foolproof and is based on assumptions. Where necessary, detailed groundwater flooding studies should be undertaken at SSFRA.
	Source Protection Zones	From inform provided by EA	Polygon layer showing areas covered by Source Protection Zones for use in identifying where SuDS may be appropriate.	Y		Shows clearly the areas where the groundwater is protected by the Environment Agency.	The designation may not consider fractures in the strata at a greater radius where pollutants could reach the source protection zone.

Type	Layer	Source	Description of Layer	Included (Y/N)	Comment	Benefits	Limitations
Planning	LPA/study area Boundary	Provided as GIS Layer by HDC	Polygon layer showing Lap administrative area on 1:50,000 or 1:10,000 base mapping	Y		Clearly identifies the study boundary	
	Urban Areas	Provided as GIS Layer by HDC	Polygon Layer showing urban areas				
	OS Mapping	HDC provided OS Mapping under contractor license	1:25k and 1:50k OS raster maps for use in GIS	Y		Provides background mapping to other GIS layers.	Designed for use at 1:25k and 1:50k scales
	Allocations	Provided as GIS Layer by HDC	Polygon layer showing development site locations & boundaries	Y		Identifies proposed allocation sites	Any additional sites in the future must be added
	Potential Strategic Sites	Provided as GIS Layer by HDC	Polygon layer showing strategic development areas & boundaries	Y		Identifies possible strategic development areas	Any additional sites in the future must be added
	Alternative Allocations/Failed Sites	Provided as GIS Layer by HDC	Polygon layer showing alternative development site locations & boundaries	Y		Identifies alternative/failed allocation sites	
	Administrative Areas	Provided as GIS Layer by HDC	Polygon GIS layer showing areas administered by LPAs, EA Area offices, Utility companies. IDBs etc	Y		Clarifies the administrative areas covering the study area	
	Other land use pressures (AONB, SSSIs)	From records provided by stakeholders (English Nature, LPA etc)	Polygon GIS layer showing other land use pressures on Flood Zone 1.	Y		Clearly shows what other land use pressures must be considered when allocating development sites.	

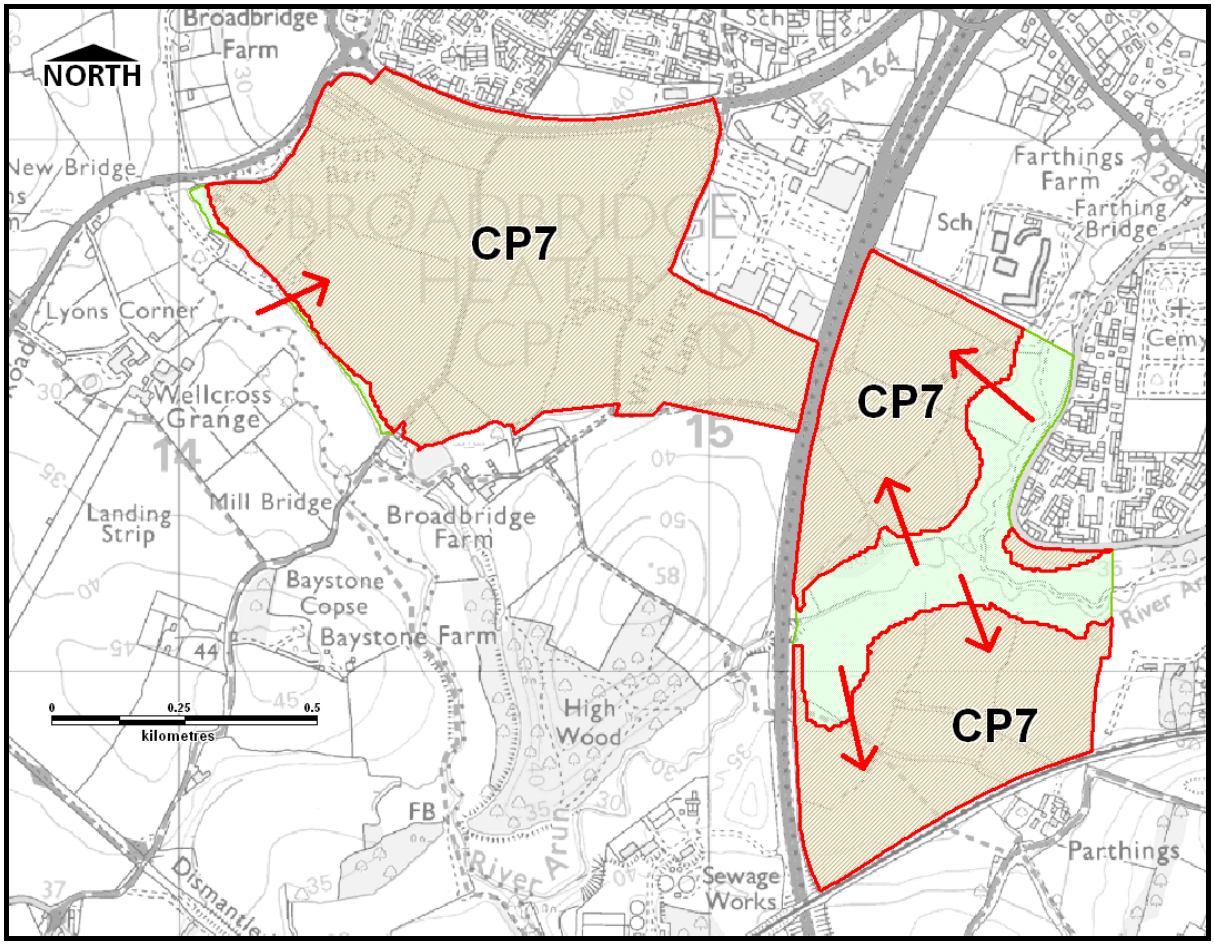
Appendix E: Site assessments for use in Sequential Test

Settlement	LDF Allocation		Easting	Northing	Site Area	Flood Zone 2		Flood Zone 3 CC		Flood Zone 3a		Flood Zone 3b	
	Policy	Notes			(ha)	Area (Ha)	% of Area	Area (Ha)	% of Area	Area (Ha)	% of Area	Area (Ha)	% of Area
Southwater	AL1	Southwater Village Centre	515787.030	126322.510	3.097	-	-	-	-	-	-	-	-
Upper Beeding	AL1	Greenfield Depot Upper Beeding	519675.410	110292.900	0.241	-	-	-	-	-	-	-	-
Pulborough	AL1	Oddstones Stane Street Codmore Hill	505341.180	119743.820	0.769	-	-	-	-	-	-	-	-
Billinghurst	AL1	Trees East Street Billingshurst	509140.010	125855.660	0.579	-	-	-	-	-	-	-	-
Billinghurst	AL1	Station Mills Daux Road Billingshurst	508833.340	125056.220	0.138	-	-	-	-	-	-	-	-
Pulborough	AL1	Wadey Builders Yard Stane Street Billingshurst	508277.890	125152.750	0.430	-	-	-	-	-	-	-	-
Ashington	AL1	Applegarth & Oak Tree Cottage Ashington	513199.340	116678.120	0.490	-	-	-	-	-	-	-	-
Storrington	AL1	Foxmead Meadowside Storrington	509000.660	114197.550	0.387	-	-	-	-	-	-	-	-
Storrington	AL1	Abbey House Ravenscroft Storrington	508853.590	113877.530	0.343	-	-	-	-	-	-	-	-
Storrington	AL1	Birklands Kithurst Lane Storrington	508152.270	114019.720	0.460	-	-	-	-	-	-	-	-
Storrington	AL1	Mogren House Amberley Road Storrington	508095.830	114344.500	0.527	-	-	-	-	-	-	-	-
Broadbridge Heath	AL1	Vauxhall Stevens Broadbridge Heath	514658.200	131554.810	0.889	-	-	-	-	-	-	-	-
Horsham	AL1	1 & 2 Works Cottages Hills Farm Lane Horsham	516108.210	130252.400	0.223	-	-	-	-	-	-	-	-
Horsham	AL1	137 Crawley Road Horsham	519080.910	131904.280	0.180	-	-	-	-	-	-	-	-
Horsham	AL1	183-186 Comptons Lane Horsham	518896.250	131167.330	0.684	-	-	-	-	-	-	-	-
Horsham	AL1	19-27 Forest Road Horsham	519743.990	132061.500	0.479	-	-	-	-	-	-	-	-
Horsham	AL1	64-68 Hurst Road Horsham	517700.680	131284.450	0.209	-	-	-	-	-	-	-	-
Horsham	AL1	9-13 Crawley Road Horsham	518658.770	131730.470	0.292	-	-	-	-	-	-	-	-
Horsham	AL1	Bryce Lodge New Street Horsham	517942.650	130795.190	0.298	-	-	-	-	-	-	-	-

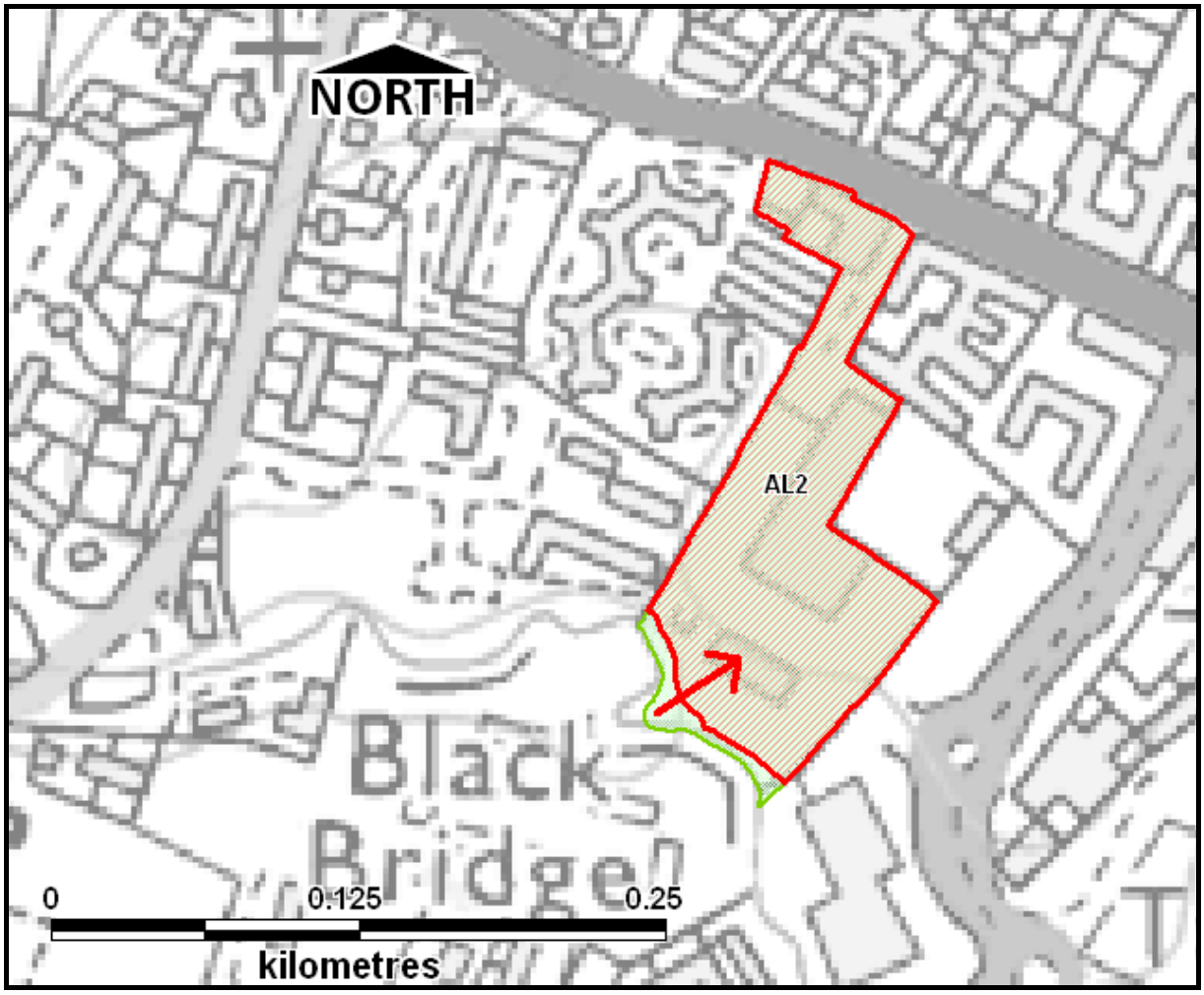
Settlement	LDF Allocation		Easting	Northing	Site Area	Flood Zone 2		Flood Zone 3 CC		Flood Zone 3a		Flood Zone 3b	
	Policy	Notes			(ha)	Area (Ha)	% of Area	Area (Ha)	% of Area	Area (Ha)	% of Area	Area (Ha)	% of Area
Horsham	AL1	Cats Protection League Kings Road Horsham	518195.920	131319.520	0.258	-	-	-	-	-	-	-	-
Horsham	AL1	Council Depot 68-70 East Street Horsham	517487.590	130381.630	0.225	-	-	-	-	-	-	-	-
Horsham	AL1	Grandford House 16 Carfax Horsham	517299.300	130669.480	0.146	-	-	-	-	-	-	-	-
Horsham	AL1	Horsham Football Club	517602.840	130169.800	1.745	-	-	-	-	-	-	-	-
Horsham	AL1	Laundry Site Arun Road Horsham	518114.270	130018.560	0.261	-	-	-	-	-	-	-	-
Horsham	AL1	Northbrook College Hurst Road Horsham	517352.750	131581.440	0.178	-	-	-	-	-	-	-	-
Horsham	AL1	Piggott Court Kennedy Road Horsham	518004.110	130140.080	0.519	-	-	-	-	-	-	-	-
Horsham	AL1	St Leonards School Horsham	518014.540	130695.610	0.473	-	-	-	-	-	-	-	-
Horsham	AL1	Star Reservoir Comptons Brow Lane Horsham	519090.900	131603.820	0.639	-	-	-	-	-	-	-	-
Horsham	AL1	Texaco Garage Crawley Road Horsham	519305.470	131876.370	0.390	-	-	-	-	-	-	-	-
Horsham	AL1	Tyre shop 39B Brighton Road Horsham	518074.700	130203.460	0.116	-	-	-	-	-	-	-	-
Washington	AL1	Bellamys Garage London Road Washington	512105.520	113310.300	0.524	-	-	-	-	-	-	-	-
Rudgwick	AL10	Land at Windacres Farm Rudgwick	509241.400	134122.770	0.524	-	-	-	-	-	-	-	-
Storrington	AL11	St Josephs Abbey Storrington	508704.080	114070.650	1.176	-	-	-	-	-	-	-	-
Sullington	AL12	RAFA Site Sullington	509520.910	114031.330	0.535	-	-	-	-	-	-	-	-
Henfield	AL13	Parsonage Farm Henfield	521042.850	116746.120	6.043	-	-	-	-	-	-	-	-
Horsham	**AL2**	**Lifestyle Ford Bishopric Horsham**	**516717.510**	**130656.250**	**1.400**	**0.074**	**0.053**	**0.074**	**0.053**	**0.074**	**0.053**	**0.065**	**0.046**
Horsham	AL3	Parsonage Farm Horsham	518375.110	131906.340	8.152	-	-	-	-	-	-	-	-
Horsham	AL4	Roffey Sports & Social Club	519200.210	132148.890	3.657	-	-	-	-	-	-	-	-

Settlement	LDF Allocation		Easting	Northing	Site Area	Flood Zone 2		Flood Zone 3 CC		Flood Zone 3a		Flood Zone 3b	
	Policy	Notes			(ha)	Area (Ha)	% of Area	Area (Ha)	% of Area	Area (Ha)	% of Area	Area (Ha)	% of Area
Pulborough	AL5	Riverside Concrete Stane Street Pulborough	505332.530	119496.050	3.720	-	-	-	-	-	-	-	-
Washington	AL6	RMC Engineering Works Sullington	510989.440	113914.260	10.930	-	-	-	-	-	-	-	-
Ashington	AL7	Land at Meiros Farm Ashington	512731.130	116411.320	1.021	-	-	-	-	-	-	-	-
Billinghurst	AL8	Land at Hammonds East Street Billingshurst	509090.720	125985.230	0.820	-	-	-	-	-	-	-	-
Lower Breeding	AL9	Land at the Plough Lower Beeding	521955.000	127250.040	1.215	-	-	-	-	-	-	-	-
Broadbridge Heath	**CP7**	**Land west of Horsham**	**515460.900**	**130191.740**	**50.580**	**0.548**	**0.011**	**0.070**	**0.001**	**0.025**	**0.000**	**-**	**-**
Broadbridge Heath	**CP7**	**Land west of Horsham**	**515460.900**	**130191.740**	**49.030**	**13.930**	**0.284**	**9.829**	**0.200**	**8.762**	**0.179**	**7.421**	**0.151**
Storrington	AL20	Sandgate	510110.080	114295.160	88.240	-	-	-	-	-	-	-	-
Billingshurst / Codmore Hill	**AL14**	**Brinsbury Centre of Excellence Adversane**	**506746.920**	**122558.290**	**58.760**	**1.444**	**0.025**	**1.444**	**0.025**	**1.205**	**0.021**	**1.205**	**0.021**
Steyning / Upper Beeding	**AL15**	**Shoreham Cement Works**	**520351.710**	**108818.620**	**39.420**	**0.182**	**0.005**	**0.215**	**0.005**	**0.215**	**0.005**	**0.215**	**0.005**
Horsham / Warnham	AL16	Warnham & Wealden Brickworks	517232.940	134381.340	23.040	-	-	-	-	-	-	-	-
Southwater	AL18	Fire Station Wilberforce Way Southwater	515996.450	127716.040	0.208	-	-	-	-	-	-	-	-
Billingshurst	AL17	Car Park Link Billingshurst	508644.530	126037.270	0.017	-	-	-	-	-	-	-	-
Storrington	AL19	Meadowside Storrington	509122.580	114081.970	0.080	-	-	-	-	-	-	-	-

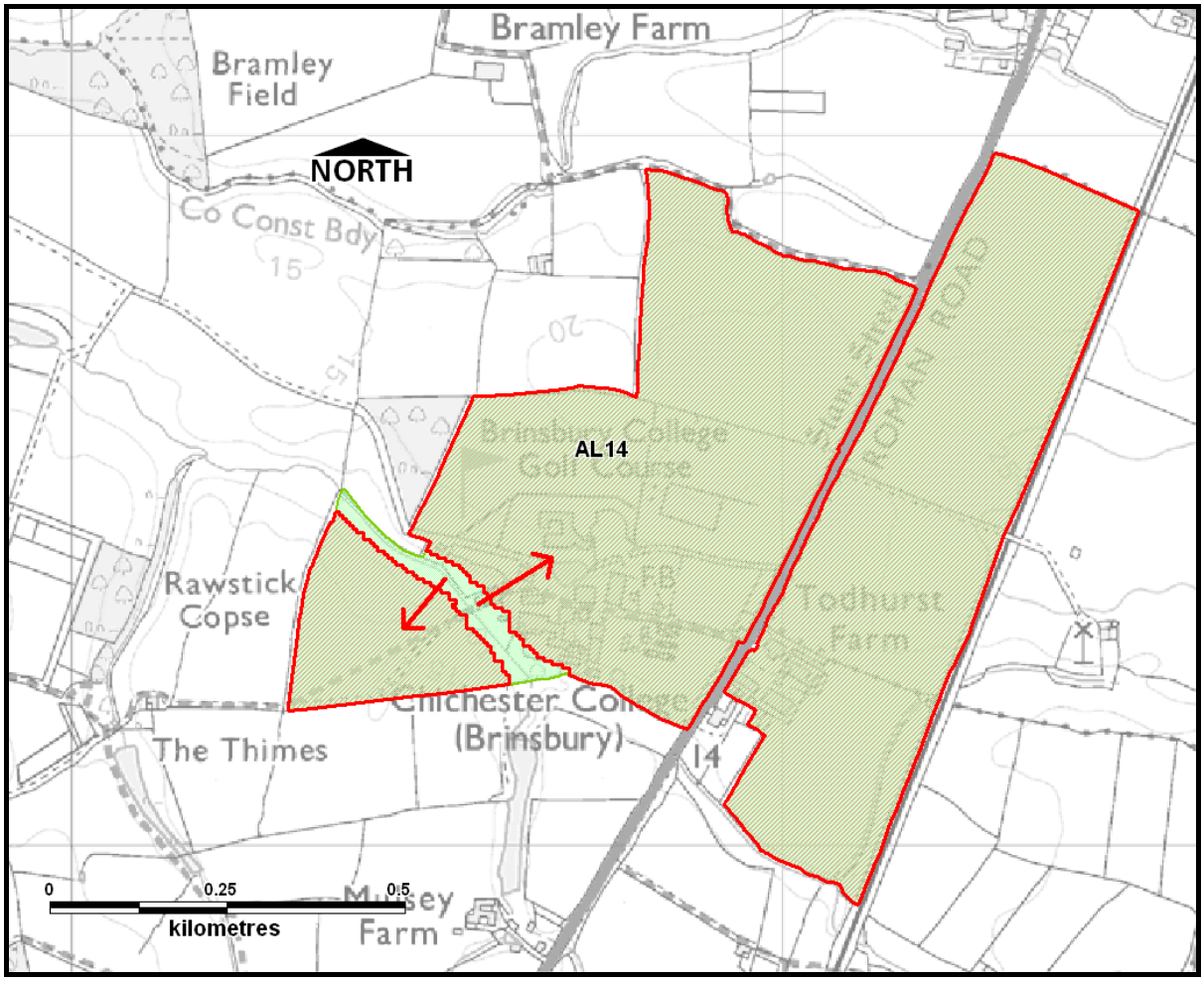
Appendix F: Redefinition of potential allocation site layouts



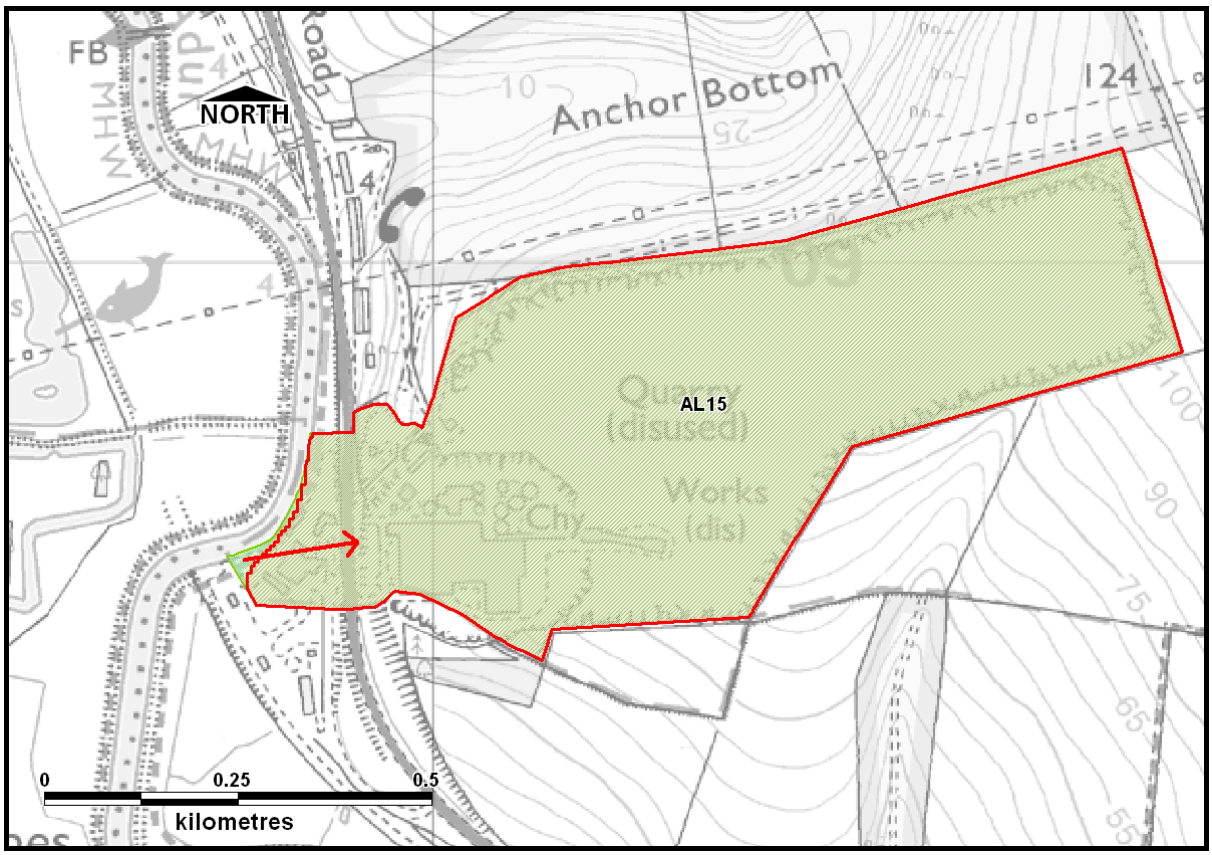
CP7	**Land west of Horsham**	**Part of site lies in FZ2 and FZ3**	**Following Sequential Test, only informal open space to be allocated to portion of site in FZ2 and FZ3. Detailed site specific FRA required to refine Flood Zones and determine overall risk.**



AL2	**Lifestyle Ford Bishopric Horsham**	**Part of site lies in FZ2 and FZ3**	**Following Sequential Test, only informal open space to be allocated to portion of site in FZ2 and FZ3. Detailed site specific FRA required to refine Flood Zones and determine overall risk.**



AL14	**Brinsbury Centre of Excellence Adversane**	**Part of site lies in FZ2 and FZ3**	**Following Sequential Test, only informal open space to be allocated to portion of site in FZ2 and FZ3. Detailed site specific FRA required to refine Flood Zones and determine overall risk.**



AL15	**Shoreham Cement Works**	**Part of site lies in FZ2 and FZ3**	**Following Sequential Test, only informal open space to be allocated to portion of site in FZ2 and FZ3. Detailed site specific FRA required to refine Flood Zones and determine overall risk.**

Appendix G: Sustainable Drainage Systems Review

Traditionally, built developments have utilised piped drainage systems to manage storm water and convey surface water run-off away from developed areas as quickly as possible. Typically, these systems connect to the public sewer system for treatment and/or disposal to local watercourses. Whilst this approach rapidly transfers storm water from developed areas, the alteration of natural drainage processes can potentially impact on downstream areas by increasing flood risk, reduction in water quality, loss of water resource and detriment to wildlife. Therefore, receiving watercourses have greater sensitivity to rainfall intensity, volume and catchment land uses post development.

The up rating of sewer systems to accommodate increased surface water from new development is constrained by existing development and cost. Therefore, the capacity of the system becomes inadequate for the increased volumes and rates of surface water runoff. This results in an increase in flood risk from sewer sources and pollution of watercourses. In addition, the implications of climate change on rainfall intensities, leading to flashier catchment/site responses and surcharging of piped systems may increase.

In addition, as flood risk has increased in importance within planning policy, a disparity has emerged between the design standard of conventional sewer systems (1 in 30 year) and the typical design standard flood (1 in 100 year). This results in drainage inadequacies for the flood return period developments need to consider, often resulting in potential flood risk from surface water/combined sewer systems.

A sustainable solution to these issues is to reduce the volume and/or rate of water entering the sewer system and watercourses.

What are Sustainable Drainage Systems?

PPS25 indicates that Regional Planning Bodies and Local Authorities should promote the use of Sustainable Drainage Systems (SuDS) for the management of surface water runoff generated by development. In addition, drainage of rainwater from roofs and paved areas around buildings should comply with the 2002 Amendment of Building Regulations Part H (3). The requirements are as follows:

1. Adequate provision shall be made for rainwater to be carried from the roof of the building.
2. Paved areas around the building shall be so constructed as to be adequately drained.
3. Rainwater from a system provided pursuant to sub-paragraphs (1) or (2) shall discharge to one of the following in order of priority:

    a) An adequate soakaway or some other adequate infiltration system; or where that is not reasonably practicable;
    b) A watercourse; or where that is not reasonably practicable
    c) A sewer.

SuDS seek to manage surface water as close to its source as possible, mimicking surface water flows arising from the site, prior to the proposed development. Typically this approach involves a move away from piped systems to softer engineering solutions inspired by natural drainage processes.

SuDS should be designed to take into account the surface run-off quantity, rates and also water quality ensuring their effective operation up to and including the 1 in 100 year design standard flood including an increase in peak rainfall up to 30% to account from climate change.

Wherever possible, a SuDS technique should seek to contribute to each of the three goals identified below with the favoured system contributing significantly to each objective. Where possible SuDS solutions for a site should seek to:

1. Reduce flood risk (to the site and neighbouring areas),
2. Reduce pollution, and,
3. Provide landscape and wildlife benefits.

These goals can be achieved by utilising a management plan incorporating a chain of techniques, (as outlined in Interim Code of Practice for Sustainable Drainage Systems 2004), where each component adds to the performance of the whole system:

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

This chapter presents a summary of the SuDS techniques currently available and a review of the soils and geology of the study area, enabling the local authorities to identify where SuDS techniques could be employed in development schemes.

The application of SuDS is not limited to a single technique per site. Often a successful SuDS solution will utilise a combination of techniques, providing flood risk, pollution and landscape/wildlife benefits. In addition, SuDS can be employed on a strategic scale, for example with a number of sites contributing to large scale jointly funded and managed SuDS. It should be noted, each development site must offset its own increase in runoff and attenuation cannot be “traded” between developments.

Planning

All relevant organisations should meet at an early stage to agree on the most appropriate drainage system for the particular development. These organisations may include the Local Authority, the Sewage Undertaker, Highways Authority, and the Environment Agency. There are, at present, no legally binding obligations relating to the provision and maintenance of SuDS. However, PPS25 states that:

‘where the surface water system is provided solely to serve any particular development, the construction and ongoing maintenance costs should be fully funded by the developer.’

The most appropriate agreement is under Section 106 of the Town and Country Planning Act. Under this agreement a SuDS maintenance procedure can be determined.

SuDS Techniques

SuDS techniques can be used to reduce the rate and volume and improve the water quality of surface water discharges from sites to the receiving environment (i.e. natural watercourse or public sewer etc). Various SuDS techniques are available and operate on two main principles:

- Infiltration
- Attenuation

All systems generally fall into one of these two categories, or a combination of the two.

The design of SuDS measures should be undertaken as part of the drainage strategy and design for a development site. A ground investigation will be required to access the suitability of using infiltration measures, with this information being used to assess the required volume of on-site storage. Hydrological analysis should be undertaken using industry approved procedures, to ensure a robust design storage volume is obtained.

During the design process, liaison should take place with the Local Planning Authority, the Environment Agency and if necessary, the Water Undertake to establish a satisfactory design methodology and permitted rate of discharge from the site.

Infiltration SuDS

This type of Sustainable Drainage System relies on discharges to ground, where suitable ground conditions are suitable. Therefore, infiltration SuDS are reliant on the local ground conditions (i.e. permeability of soils and geology, the groundwater table depth and the importance of underlying aquifers as a potable resource) for their successful operation.

Various infiltration SuDS techniques are available for directing the surface water run-off to ground. Development pressures and maximisation of the developable area may reduce the area available for infiltration systems but this should not be a limiting factor for the use of SuDS. Either sufficient area is required for infiltration or a combined approach with attenuation could be used to manage surface water runoff. Attenuation storage may be provided in the sub-base of a permeable surface, within the chamber of a soakaway or as a pond/water feature.

Infiltration measures include the use of permeable surfaces and other systems that are generally located below ground.

Permeable Surfaces

Permeable surfaces are designed to allow water to drain through to a sub-base at a rate greater than the predicted rainfall for a specified event. Permeable surfaces act by directly intercepting the rain where it falls and control runoff at source. Runoff during low intensity rainfall events is prevented by permeable surfaces. During intense rainfall events runoff generation may occur from permeable surfaces. The use of permeable sub-base can be used to temporarily store infiltrated run-off underneath the surface and allows the water to percolate into the underlying soils. Alternatively, stored water within the sub-base may be collected at a low point and discharged from the site at an agreed rate.

Programmes should be implemented to ensure that permeable surfaces are kept well maintained to ensure the performance of these systems is not reduced. The use of grit and salt during winter months may adversely affect the drainage potential of certain permeable surfaces.

Types of permeable surfaces include:

- Grass/landscaped areas
- Gravel
- Solid Paving with Void Spaces
- Permeable Pavements

Sub-surface Infiltration

Where permeable surfaces are not a practical option more defined infiltration systems are available. In order to infiltrate the generated run-off to ground, a storage system is provided that allows the infiltration of the stored water into the surrounding ground through both the sides and base of the storage. These systems are constructed below ground and therefore may be advantageous with regards to the developable area of the site. Consideration needs to be given to construction methods, maintenance access and depth to the water table. The provision of large volumes of infiltration/sub-surface storage has potential cost implications. In addition, these systems should not be built within 5 m of buildings, beneath roads or in soil that may dissolve or erode.

Various methods for providing infiltration below the ground include:

- Geocellular Systems
- Filter Drain
- Soakaway (Chamber)
- Soakaway (Trench)
- Soakaway (Granular Soakaway)

Table H-1: Suitability of Infiltration Methods towards with respect to the wider aims of SuDS.

INFILTRATION METHOD	REDUCE FLOOD RISK (Y/N)	REDUCE POLLUTION (Y/N)	LANDSCAPE AND WILDLIFE BENEFITS (Y/N)
Permeable Surface	Y	Y	N
Sub-surface Infiltration	Y	Y	N

Attenuation SuDS

If ground conditions are not suitable for infiltration techniques then management of surface water runoff prior to discharge should be undertaken using attenuation techniques. This technique attenuates discharge from a site to reduce flood risk both within and to the surrounding area. It is important to assess the volume of water required to be stored prior to discharge to ensure adequate provision is made for storage. The amount of storage required should be calculated prior to detailed design of the development to ensure that surface water flooding issues are not created within the site.

The rate of discharge from the site should be agreed with the Local Planning Authority and the Environment Agency. If surface water cannot be discharged to a local watercourse then liaison with the Sewer Undertaker should be undertaken to agree rates of discharge and the adoption of the SuDS system.

Large volumes of water may be required to be stored on site. Storage areas may be constructed above or below ground. Depending on the attenuation/storage systems implemented, appropriate maintenance procedures should be implemented to ensure continued performance of the system. On-site storage measures include basins, ponds, and other engineered forms consisting of underground storage.

Basins

Basins are areas that have been contoured (or alternatively embanked) to allow for the temporary storage of run-off from a developed site. Basins are designed to drain free of water and remain waterless in dry weather. These may form areas of public open space or recreational areas. Basins also provide areas for treatment of water by settlement of solids in ponded water and the absorption of pollutants by aquatic vegetation or biological activity. The construction of basins uses relatively simple techniques. Local varieties of vegetation should be used wherever possible and should be fully established before the basins are used. Access to the basin should be provided so that inspection and maintenance is not restricted. This may include inspections, regular cutting of grass, annual clearance of aquatic vegetation and silt removal as required.

Ponds

Ponds are designed to hold the additional surface water run-off generated by the site during rainfall events. The ponds are designed to control discharge rates by storing the collected run-off and releasing it slowly once the risk of flooding has passed. Ponds can provide wildlife habitats, water features to enhance the urban landscape and, where water quality and flooding risks are acceptable, they can be used for recreation. It may be possible to integrate ponds and wetlands into public areas to create new community ponds. Ponds and wetlands trap silt that may need to be removed periodically. Ideally, the contaminants should be removed at source to prevent silt from reaching the pond or wetland in the first place. In situations where this is not possible, consideration should be given to a small detention basin placed at the inlet to the pond in order to trap and subsequently remove the silt. Depending on the setting of a pond, health and safety issues may be important issues that need to be taken into consideration. The design of the pond can help to minimise any health and safety issues (i.e. shallower margins to the pond reduce the danger of falling in, fenced margins).

Various types of ponds are available for utilising as SuDS measures. These include:

- Balancing/Attenuating Ponds
- Flood Storage Reservoirs
- Lagoons
- Retention Ponds
- Wetlands

Table H-2: Suitability of Attenuation Methods towards the Three Goals of Sustainable Drainage Systems.

INFILTRATION METHOD	REDUCE FLOOD RISK (Y/N)	REDUCE POLLUTION (Y/N)	LANDSCAPE AND WILDLIFE BENEFITS (Y/N)
Basins	Y	Y	Y
Ponds	Y	Y	Y

Alternative Forms of Attenuation

Site constraints and limitations such as developable area, economic viability and contamination may require engineered solutions to be implemented. These methods predominantly require the provision of storage beneath the ground surface, which may be advantageous with regards to the developable area of the site but should be used only if methods in the previous section cannot be used. When implementing such approaches, consideration needs to be given to construction methods, maintenance access and to

any development that takes place over the storage facility. The provision of large volumes of storage underground also has potential cost implications.

Methods for providing alternative attenuation include:

- Deep Shafts
- Geocellular Systems
- Oversized Pipes
- Rainwater Harvesting
- Tanks
- Green Roofs

In some situations it may be preferable to combine infiltration and attenuation systems to maximise the management of surface water runoff, developable area and green open space.

Broad-scale assessment of SuDS suitability

The underlying ground conditions of a development site will often determine the type of SuDS approach to be used at development sites. This will need to be determined through ground investigations carried out on-site. A broad-scale assessment of the soils and underlying geology allow an initial assessment of SuDS techniques that may be implemented across Horsham DC.

Based on a review of the following maps SuDS techniques that are likely to be compatible with the underlying strata can be suggested:

- The Soil Survey of England and Wales 1983 – 1:250,000 Soils Maps (Sheet 6), and
- The Geological Survey of Great Britain (England and Wales) 1:625,000 Series Superficial and Bedrock Edition South of England (2000)
- The Soils Map Legend and Geological Survey Memoir were also consulted as part of this assessment.

In the design of any drainage system and SuDS approach, consideration should be given to site-specific characteristics and where possible be based on primary data from site investigations. The information presented in the following table is provided as a guide and should not be used to accept or refuse SuDS techniques.

NAME	NOTES	General Geology	General Drainage Assessment	Aquifer Type	Groundwater Vulnerability	SuDS Recommendation	Site Area (Ha)	FRA Requirements
AL1	1 & 2 Works Cottages Hills Farm Lane Horsham	Sandstone - Greensand/Gault with fine Sandy Loams	Moderately to well drained soils on gentle slopes			Infiltration and Combined Infiltration	0.22	N/A
AL1	137 Crawley Road Horsham	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils	MINOR	MINOR_H	Attenuation Systems	0.18	N/A
AL1	183-186 Comptons Lane Horsham	Sandstone	Moderately drained	MINOR	MINOR_H	Infiltration and Combined Infiltration/Attenuation Systems	0.68	The site is not presently as at risk of flooding, however, an FRA will be required to determine suitable drainage and SuDS arrangements
AL1	19-27 Forest Road Horsham	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils	MINOR	MINOR_H	Attenuation Systems	0.48	Site-specific FRA may be required to carefully consider suitable adoption of SuDS, though site area is less than 0.5Ha.
AL1	64-68 Hurst Road Horsham	Chalk with silty and clay soils	Poorly drained soils on steeper slopes	MINOR	MINOR_H	Attenuation Systems	0.21	N/A
AL1	9-13 Crawley Road Horsham	Sandstone - Greensand/Gault with fine Sandy Loams	Moderately to well drained soils on gentle slopes	MINOR	MINOR_H	Infiltration and Combined Infiltration	0.29	N/A
AL1	Abbey House Ravenscroft Storrington	Sandstone - Greensand/Gault with fine Sandy Loams	Moderately to well drained soils on gentle slopes	MAJOR	MAJOR_I	Infiltration and Combined Infiltration/Attenuation Systems	0.34	Site overlies a major aquifer with an intermediate leaching potential. Site-specific FRA may be required to carefully consider suitable adoption of SuDS, though site area is less than 0.5Ha.
AL1	Applegarth & Oak Tree Cottage Ashington	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils			Attenuation Systems	0.49	Site-specific FRA may be required to carefully consider suitable adoption of SuDS, though site area is less than 0.5Ha.
AL1	Bellamys Garage London Road Washington	Sandstone - Greensand/Gault with fine Sandy Loams	Moderately to well drained soils on gentle slopes	MAJOR	MAJOR_I	Infiltration and Combined Infiltration/Attenuation Systems	0.52	Groundwater fed streams nearby (BFI 0.7-0.9) therefore the potential for groundwater flooding should be considered in site specific FRA. Site overlies a major aquifer with an intermediate leaching potential. Site-specific FRA will need to carefully consider suitable adoption of SuDS.
AL1	Birklands Kithurst Lane Storrington	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils	MAJOR	MAJOR_I	Attenuation Systems	0.46	Site overlies a major aquifer with an intermediate leaching potential. Site-specific FRA will need to carefully consider suitable adoption of SuDS.
AL1	Bryce Lodge New Street Horsham	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils	MINOR	MINOR_H	Attenuation Systems	0.30	N/A
AL1	Cats Protection League Kings Road Horsham	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils	MINOR	MINOR_H	Attenuation Systems	0.26	N/A
AL1	Council Depot 68-70 East Street Horsham	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils	MINOR	MINOR_H	Attenuation Systems	0.22	N/A

NAME	NOTES	General Geology	General Drainage Assessment	Aquifer Type	Groundwater Vulnerability	SuDS Recommendation	Site Area (Ha)	FRA Requirements
AL1	Foxmead Meadowside Storrington	Sandstone - Greensand/Gault with fine Sandy Loams	Moderately to well drained soils on gentle slopes	MAJOR	MAJOR_I	Infiltration and Combined Infiltration/Attenuation Systems	0.39	Groundwater fed stream nearby (BFI >=0.7) therefore the potential for groundwater flooding should be considered in site specific FRA. Using best available information, the site is not presently shown at risk of flooding. However, given historical flooding, a detailed site specific FRA should be undertaken prior to development.
AL1	Grandford House 16 Carfax Horsham	Sandstone - Greensand/Gault with fine Sandy Loams	Moderately to well drained soils on gentle slopes	MINOR	MINOR_H	Infiltration and Combined Infiltration/Attenuation Systems	0.15	NA
AL1	Greenfield Depot Upper Beeding	Sandstone - Greensand/Gault with fine Sandy Loams	Moderately to well drained soils on gentle slopes	MAJOR	MAJOR_I	Attenuation Systems	0.24	NA
AL1	Horsham Football Club	Sandstone - Greensand/Gault with fine Sandy Loams	Moderately to well drained soils on gentle slopes	MINOR	MINOR_H	Infiltration and Combined Infiltration/Attenuation Systems	1.75	The site is not presently as at risk of flooding, however, an FRA will be required to determine suitable drainage and SuDS arrangements
AL1	Laundry Site Arun Road Horsham	Sandstone - Greensand/Gault with fine Sandy Loams	Moderately to well drained soils on gentle slopes	MINOR	MINOR_H	Infiltration and Combined Infiltration/Attenuation Systems	0.26	NA
AL1	Mogren House Amberley Road Storrington	Sandstone - Greensand/Gault with fine Sandy Loams	Moderately to well drained soils on gentle slopes	MAJOR	MAJOR_I	Attenuation Systems	0.53	Site overlies a major aquifer with an intermediate leaching potential. Site-specific FRA will need to carefully consider suitable adoption of SuDS.
AL1	Northbrook College Hurst Road Horsham	Sandstone - Greensand/Gault with fine Sandy Loams	Moderately to well drained soils on gentle slopes	MINOR	MINOR_H	Infiltration and Combined Infiltration/Attenuation Systems	0.18	NA
AL1	Oddstones Stane Street Codmore Hill	Sandstone - Greensand/Gault with fine Sandy Loams	Moderately to well drained soils on gentle slopes	MAJOR	MAJOR_I	Attenuation Systems	0.77	Site overlies a major aquifer with an intermediate leaching potential. Site specific FRA will need to carefully consider suitable adoption of SuDS.
AL1	Piggott Court Kennedy Road Horsham	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils	MINOR	MINOR_H	Attenuation Systems	0.52	Site has already been developed.
AL1	Southwater Village Centre	Sandstone	Moderately drained	MINOR	MINOR_L	Infiltration and Combined Infiltration	3.10	Site is located adjacent to a watercourse with no known flood records or risk category. Therefore, a detailed site FRA will be required to assess the potential risk from the watercourse and to determine the most suitable SUDS methods.
AL1	St Leonards School Horsham	Sandstone	Moderately drained	MINOR	MINOR_H	Infiltration and Combined Infiltration	0.47	Site-specific FRA may be required to carefully consider suitable adoption of SuDS, though site area is less than 0.5Ha.
AL1	Star Reservoir Comptons Brow Lane Horsham	Sandstone	Moderately drained			Infiltration and Combined Infiltration	0.64	Using the best available information, the site is not presently at risk of flooding. However, as site is located adjacent to a watercourse, the potential for future flooding should be considered at a site specific FRA together with suitable SuDS methods

NAME	NOTES	General Geology	General Drainage Assessment	Aquifer Type	Groundwater Vulnerability	SuDS Recommendation	Site Area (Ha)	FRA Requirements
AL1	Station Mills Daux Road Billingshurst	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils			Infiltration and Combined Infiltration	0.14	NA
AL1	Texaco Garage Crawley Road Horsham	Sandstone	Moderately drained	MINOR	MINOR_H	Infiltration and Combined Infiltration	0.39	Site-specific FRA may be required to carefully consider suitable adoption of SuDS, though site area is less than 0.5Ha.
AL1	Trees East Street Billingshurst	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils	MINOR	MINOR_L	Infiltration and Combined Infiltration	0.58	Consideration of suitable SuDS is necessary at Site Specific FRA.
AL1	Tyre shop 39B Brighton Road Horsham	Sandstone - Tunbridge well sands	Moderately drained			Infiltration and Combined Infiltration	0.12	NA
AL1	Vauxhall Stevens Broadbridge Heath	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils			Infiltration and Combined Infiltration	0.89	Consideration of suitable SuDS is necessary at Site Specific FRA.
AL1	Wadey Builders Yard Stane Street Billingshurst	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils			Infiltration and Combined Infiltration	0.43	Site-specific FRA may be required to carefully consider suitable adoption of SuDS, though site area is less than 0.5Ha.
AL10	Land at Windacres Farm Rudgwick	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils			Infiltration and Combined Infiltration/Attenuation Systems	0.52	Consideration of suitable SuDS is necessary at Site Specific FRA.
AL11	St Josephs Abbey Storrington	Sandstone - Greensand/Gault with fine Sandy Loams	Moderately drained soils on gentle slopes	MAJOR	MAJOR_I	Infiltration and Combined Infiltration/Attenuation Systems	1.18	Site overlies a major aquifer with an intermediate leaching potential. In addition, given high housing densities, site specific FRA will need to carefully consider suitable adoption of SuDS.
AL12	RAFA Site Sullington	Sandstone - Greensand/Gault with fine Sandy Loams	Moderately drained soils on gentle slopes	MAJOR	MAJOR_H	Attenuation Systems	0.54	Site overlies a major aquifer with an intermediate leaching potential. In addition, given high housing densities, site specific FRA will need to carefully consider suitable adoption of SuDS.
AL13	Parsonage Farm Henfield	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils	MINOR	MINOR_I	Infiltration and Combined Infiltration/Attenuation Systems	6.04	Consideration of suitable SuDS is necessary at Site Specific FRA.
AL14	Brinsbury Centre of Excellence Adversane	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils	MINOR	MINOR_L	Attenuation Systems	58.76	Following Sequential Test, only informal open space to be allocated to portion of site in FZ2 and FZ3. Detailed site specific FRA required to refine Flood Zones and determine overall risk and suitable SuDS methods.
AL15	Shoreham Cement Works	Chalk with silty and clay soils	poorly drained soils on steeper slopes	MAJOR	MAJOR_H	Attenuation Systems	39.42	Following Sequential Test, only informal open space to be allocated to portion of site in FZ2 and FZ3. Detailed site specific FRA required to refine Flood Zones and determine overall risk and suitable SuDS methods.
AL16	Warnham & Wealden Brickworks	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils	MINOR	MINOR_I	Infiltration and Combined Infiltration/Attenuation Systems	23.04	Consideration of suitable SuDS is necessary at Site Specific FRA.

NAME	NOTES	General Geology	General Drainage Assessment	Aquifer Type	Groundwater Vulnerability	SuDS Recommendation	Site Area (Ha)	FRA Requirements
AL17	Car Park Link Billingshurst	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils			Attenuation Systems	0.02	NA
AL18	Fire Station Wilberforce Way Southwater	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils	MINOR	MINOR_L	Attenuation Systems	0.21	Site-specific FRA may be required to carefully consider suitable adoption of SuDS, though site area is less than 0.5Ha.
AL19	Meadowside Storrington	Sandstone - Greensand/Gault with fine Sandy Loams	Moderately to well drained soils on gentle slopes	MAJOR	MAJOR_I	Attenuation Systems	0.08	NA
AL2	Lifestyle Ford Bishopric Horsham	Sandstone - Tunbridge well sands	Moderately drained	MINOR	MINOR_H	Infiltration and Combined Infiltration	1.40	Following Sequential Test, only informal open space to be allocated to portion of site in FZ2 and FZ3. Detailed site specific FRA required to refine Flood Zones and determine overall risk and suitable SuDS methods.
AL3	Parsonage Farm Horsham	Sandstone - Tunbridge well sands	Moderately drained	MINOR	MINOR_H	Infiltration and Combined Infiltration	8.15	Consideration of suitable SuDS is necessary at Site Specific FRA. Site adjacent to watercourse which should also be assessed in FRA to determine if there is any flood risk.
AL4	Roffey Sports & Social Club	Sandstone - Tunbridge well sands	Moderately drained	MINOR	MINOR_H	Infiltration and Combined Infiltration	3.66	Consideration of suitable SuDS is necessary at Site Specific FRA.
AL5	Riverside Concrete Stane Street Pulborough	Sandstone - Greensand/Gault with fine Sandy Loams	Moderately drained soils on gentle slopes	MAJOR	MAJOR_I	Attenuation Systems	3.72	Site overlies a major aquifer with an intermediate leaching potential. In addition, given high housing densities, site specific FRA will need to carefully consider suitable adoption of SuDS.
AL6	RMC Engineering Works Sullington	Sandstone - Greensand/Gault with fine Sandy Loams	Moderately drained soils on gentle slopes	MAJOR	MAJOR_H	Attenuation Systems	10.93	Site overlies a major aquifer with a high leaching potential. In addition, groundwater fed stream nearby (BFI >=0.8) therefore the potential for groundwater flooding should be considered in site specific FRA together with a careful consideration of suitable adoption of SuDS.
AL7	Land at Meiros Farm Ashington	Sandstone & Mudstone - Weald Clay with deep loamy soils	Moderately drained			Infiltration and Combined Infiltration	1.02	Site not currently shown at direct risk of flooding. Site FRA required to determine suitable SuDS for incorporation into development.
AL8	Land at Hammonds East Street Billingshurst	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils	MINOR	MINOR_L	Infiltration and Combined Infiltration	0.82	Site FRA required to determine suitable SuDS for incorporation into development.
AL9	Land at the Plough Lower Beeding	Sandstone - Tunbridge well sands	Moderately drained	MINOR	MINOR_I	Infiltration and Combined Infiltration	1.22	Site FRA required to determine suitable SuDS for incorporation into development.
CP7	Land west of Horsham	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils	MINOR	MINOR_L	Attenuation Systems	50.58	Sequential test has stated that all developed land should be located outside of FZ2 and FZ3. However, an FRA will still be required to assess the impacts of surface water and to carefully consider suitable adoption of SuDS.
CP7	Land west of Horsham	Sandstone & Mudstone - Weald Clay with deep loamy soils	Poorly Drained Soils	MINOR	MINOR_L	Attenuation Systems	49.03	Sequential test has stated that all developed land should be located outside of FZ2 and FZ3. However, an FRA will still be required to assess the impacts of surface water and to carefully consider suitable adoption of SuDS.

Appendix H: SFRA Maintenance and Updates

How to maintain and update the SFRA

For an SFRA to serve as a practical planning tool now and in the future, it will be necessary to undertake a periodic update and maintenance exercise. This section clarifies what specific actions are recommended to ensure correct maintenance and updating of the SFRA.

GIS Layers

As described in Section 3.5 and in the GIS section of Appendix D, the GIS layers used in the SFRA have been created from a number of different sources, using the best and most suitable information available at the time of publishing. Should new Flood Zone information become available, the data should be digitised and geo-referenced within a GIS system. A copy of the current dataset should be created and backed up and the new data should then be merged or combined with the current data set.

For example, should updated modelled outlines delineating the tidal FZ3a on the Adur become available, the current combined FZ3a outline should be edited to ensure that the newest data is displayed and that the old data is overwritten. Note that updating the Adur Tidal FZ3a will not involve replacing the entire combined FZ3a GIS layer, only the section that has changed.

For other GIS layers such as the Historical Flood Outlines or the Sewer Flooding Information, it is likely that data will be added rather than be replaced. For example, where a new sewer flooding incident is reported in the catchment, a point should be added to the sewer flooding GIS layer rather than creating a new layer.

All GIS layers used in the SFRA have meta-data attached to them. When updating the GIS information, it is important that the meta-data is updated in the process. Meta-data is additional information that lies behind the GIS polygons, lines and points. For example, the information behind the SFRA Flood Zone Maps describes where the information came from, what the intended use was together with a level of confidence.

For any new data or updated data, the data tables presented in Appendix D should be checked to ensure they are up-to-date.

Broad-Scale Assessment

If the flood zones are changed, it may be necessary to amend the broad-scale assessment presented in Table 4-1. This should be carried out by querying the relevant GIS layers to determine the areas and percentages at risk of flooding in the district.

Updates or Additions to Development Sites

Although unlikely at the time of publication, should any updates or additions to development sites become necessary (for example, due to new flooding information), a detailed Level 2 SFRA may be required. This should be carried out according to the guidance given in PPS25 and this document. Once a Level 2 Assessment has been completed, this should be appended to a new version of this document.

For any new or updated sites, the FRA and SuDS tables and recommendations presented in Appendix E and G should be updated.

OS Background Mapping

The SFRA has made use of the OS 1:25000 and 1:50000 digital raster maps. Periodically these maps are updated. Under the HDC OS License, it is likely that these maps will be updated throughout the whole of the HDC GIS system. Updated maps are unlikely to alter the findings of the SFRA.

CEH Watercourse Networks

The SFRA has made use of the CEH Digital Watercourse Network for the District. Periodic should be made to check if there have been any updates to the dataset. This is an important GIS layer as it locates most of the natural watercourses within the District.

Wey and Arun Canal

The Environment Agency have suggested that any further updates to the SFRA could consider the Wey and Arun Canal as a potential flood source.

Data Licensing Issues

Prior to any data being updated within the SFRA, it is important that the licensing information is also updated to ensure that the data used is not in breach of copyright. The principal licensing bodies relevant to the SFRA at the time of publishing were the Environment Agency (Southern Region), Ordnance Survey, Southern Water and the Centre for Ecology and Hydrology (CEH). Updated or new data may be based on datasets from other licensing authorities and may require additional licenses.

Flooding Policy and PPS25 Practice Guidance Updates

This SFRA was updated inline with policy and guidance that was current in December 2009, principally PPS25 (DCLG 2006) and the accompanying Practice Guide (December 2009). Furthermore, guidance and recommendations issued in the Pitt Review (Pitt 2008) and the subsequent draft Floods and Water Management Bill (2009) have been incorporated into this updated revision.

Should new flooding policy be adopted nationally, regionally or locally, the SFRA should be checked to ensure it is still relevant and updates made if necessary.

Stakeholder Consultation and Notification

The key stakeholders consulted in the SFRA were the District Council, Water Companies and the Environment Agency. It is recommended that a periodic consultation exercise is carried out with the key stakeholders to check for updates to their datasets and any relevant additional or updated information they may hold. If the SFRA is updated, it is recommended that the Environment Agency and the County Council Emergency Planning Department are notified of the changes and instructed to refer to the new version of the SFRA for future reference.

Frequency of Updates and Maintenance

It is recommended that the SFRA is maintained on an annual basis. Should any changes be necessary, the SFRA should be updated and re-issued.

SFRA Version Register

Version	Date Issued	Amendments Made	Stakeholders Notified	Amendments undertaken by:	Document Checked by:	Document Approved by:
1	June 2007	Original SFRA	-	-	-	-
2	April 2010	Update to SFRA with 9 new potential strategic areas; updated flood zone outlines; and EA mapping 'Areas Susceptible to Surface Water Flooding'.	Environment Agency Horsham DC	Sarah Littlewood Graduate Hydrologist Scott Wilson	Emily Blanco Senior Consultant Scott Wilson	Jon Robinson Associate Director Scott Wilson

Continue on new page if necessary