Strategic Flood Risk Assessment of Chichester District Council

VOLUME I
USER GUIDE

July 2008

CAPITA SYMONDS

successful people | successful projects | successful performance

Issue box

The Chichester District Council Strategic Flood Risk Assessment (SFRA) is a "live" document. The current version is developed using the best information and concepts available at the time.

As new information and concepts become available the document will be updated and so it is the responsibility of the reader to be satisfied that they are using the most up-to-date information and that the SFRA accounts for this information.

All revisions to this summary document are listed in the table below.

Version	Issue Date	Issued by	Issued to	Amendments from previous version
Draft v1	05/03/2007	Capita Symonds Ltd	Chichester District Council	N/A
Draft v2	18/04/2007	Capita Symonds Ltd	Chichester District Council	Minor revisions
Final v1	7/04/2008	Capita Symonds Ltd	Chichester District Council	Minor revisions and restructuring
Final v2	29/07/08	Capita Symonds Ltd	Chichester District Council	Minor revisions

CAPITA SYMONDS

Capita Symonds House
Wood Street
East Grinstead
West Sussex
RH19 1UU
Tel: 01342 327 161
Fax: 01342 315 927
Project manager: George Baker
Project director: Marc Pinnell
www.capitasymonds.co.uk

Contents

Maps in Volume II (Annex A)

****All maps referred to in this user guide can be found in Annex A of volume ii****

Background maps

Overview
Map O - Overview of Chichester District
Map G2 - Indicative geology map

Management
Map M1 - Areas covered by Catchment Flood Management Plans (CFMPs) and Shoreline Management Plans (SMP)
Map M2 - Existing flood management policies across Chichester District
Map M3 - Location of existing hydraulic model extents across Chichester District

Flood defences and flood warning
Map D1 - System Asset Management Plan areas
Map D2 – Flood Defences across the district (type of defence)
Map D3 – Flood Defences across the district (source of flooding being defended)
Map D4 – Flood Defences across the district (estimated standard of protection)
Map W - Environment Agency flood warning areas

Sequential Test

Flooding from rivers (fluvial)
Map F1-F - Fluvial Flood Zones
Map C2-F - Fluvial Flood Zones with climate change

Flooding from the sea (tidal)
Map F1-T - Sea Flood Zones & coastal risk area
Map C2-T - Sea Flood Zones with climate change & coastal risk area

Flooding from land
Map L - Areas prone to flooding from land

Flooding from groundwater
Map G1 - Land more prone to groundwater flooding

Flooding from sewers
Map S - Historic incidents of sewer flooding

Exception Test

Flooding from rivers (fluvial)
Map A1-F - Actual and residual risk of flooding from rivers (extent)
Map A2-F - Depth of actual flooding from rivers
Map A3-F – Actual flooding from rivers (indicative velocities)

Map C1-F - Extent of flooding from rivers with allowance for climate change

Flooding from the sea (tidal)
Map A1-T - Extent of actual flooding from the sea & coastal risk area
Map A2-T - Depth of actual flooding from the sea & coastal risk area
Map A3-T – Actual flooding from the sea (indicative velocities) & coastal risk area

Map C1-T - Extent of flooding from sea with allowance for climate change & coastal risk area

Map B – Locations where breach assessments may be required

Foreword

Chichester District Council is required to prepare a Strategic Flood Risk Assessment (SFRA) to support the development of their Local Development Framework.

The SFRA creates a strategic framework for the consideration of flood risk when making planning decisions. It has been developed with reference to Planning Policy Statement 25 (PPS25): development and flood risk and additional guidance provided by the Environment Agency.

The fundamental concepts that underpin the SFRA are outlined in PPS25. The guidance provided in this document requires local authorities and those responsible for development decisions to demonstrate that they have applied a risk based, sequential approach in preparing development plans and consideration of flooding through the application of a sequential test. Failure to demonstrate that such a test has been undertaken potentially leaves planning decisions and land allocations open to challenge during the planning process.

The underlying objective of the risk based sequential allocation of land is to reduce the exposure of new development to flooding and reduce the reliance on long-term maintenance of built flood defences. Within areas at risk from flooding, it is expected that development proposals will contribute to a reduction of flood risk.

SFRAs are essential to enable a strategic and proactive approach to be applied to flood risk management. The assessment allows us to understand current flood risk on a wide-spatial scale and how this is likely to change in the future.

The main objective of the Chichester District SFRA is to provide flood information:

- so that an evidence based and risk based sequential approach can be adopted when making planning decisions, in line with PPS25;
- that is strategic, in that it covers a wide spatial area and looks at flood risk today and in the future;
- that supports sustainability appraisals of the local development frameworks; and
- that identifies what further investigations may be required in flood risk assessments for specific development proposals.

The SFRA is presented in a number of documents:

- VOLUME I – user guide
- VOLUME II – technical report and flood maps
- VOLUME III – management guide
- VOLUME IV – assessment of sites of interest

The SFRA is a live document which is intended to be updated as new information and guidance becomes available. The outcomes and conclusions of the SFRA may not be valid in the event of future changes. It is the responsibility of the user to ensure they are using the best available information.

1. Introduction to the SFRA and Study Area

Introduction

Strategic Flood Risk Assessments (SFRAs) provide flood risk information to inform a range of activities, including land use planning, emergency planning, development control and the development of specific flood risk management policy.

The level of detail included in the SFRA depends on the intended use. The Chichester District Council (CDC) SFRA was developed to inform the district wide Local Development Framework, and thus the scale and detail within the assessment reflects this intended use. A Level 1 (initial assessment) has been undertaken over the whole of the District, with a Level 2 (more detailed assessment) undertaken in key locations. Detailed flood risk assessments will be required on a site specific basis if, due to non-flood risk factors, all development cannot be placed outside areas of high flood risk.

The SFRA contains information that demonstrates that flood risk has informed the preparation of the LDF as it provides data that enables a risk based sequential test to be applied. PPS 25 advocates that the risk based Sequential Test is applied at all stages of planning.

At the Site Level it would be necessary for the applicant to refer to the 'Sequential and Exception Tests' performed at the District Level. It is not the responsibility of the applicant to perform the 'testing' but they can be required to submit information to the Local Authorities to enable them to do so.

A Sequential Approach should be applied throughout all stages so that the vulnerability of the intended use is matched to the risk (i.e. higher vulnerability land uses are sited in locations of lower probability of flooding). The Exception Test should only be applied after the application of the Sequential Test.

The underlying objective of the SFRA is to provide a platform for the consistent consideration of flood risk and accommodation of current practice and best available data for the duration of the framework. Inevitably this will require that consideration is given to the lifetime of development for the land uses within the framework so climate change effects described in PPS 25 should be incorporated.

This user guide provides advice on how to interpret the SFRA results to inform land use planning, flood warning and emergency planning and development control. The document also provides guidance for site-specific Flood Risk Assessment (FRA). The document requires the user to refer to technical information and flood maps contained in Volumes II (and Volume IV) of this SFRA.

Volume III – Management Guide - provides information on managing and updating the SFRA, and Volume IV – Assessment of Sites of Search - contains detailed flood risk information specific to settlements within Chichester District. Volume I, III, and IV support the flood risk information presented in Volume II.

The SFRA is a 'live' document and as such, will be updated when new data and/or guidance becomes available. It is the responsibility of the user to ensure that they refer to the latest information that is available.

The SFRA is based on a range of data from different sources and of various degrees of certainty. It is the responsibility of the user to consider the source and certainty of the data when using the results.

This guidance does not supercede that provided in planning policy, by the Environment Agency or CDC.

Catchment Overview

The district of Chichester covers approximately 811km^2. There are three main catchment areas of interest. These are the:

- River Rother and Upper Arun catchments;
- The River Lavant, River Ems and Bosham Stream catchments;
- Sussex Rifes (Including coastal streams draining the Manhood Peninsula).

The underlying geology of the area largely determines the characteristics of the Coastal Plain, the Chalk Downs and the hills of the Weald. Large areas of low-lying land are at risk of flooding, especially on the Coastal Plain. The area is underlain by quick weathering sedimentary rock, dominated by Chalk and Sandstone. The distribution of soil types coincides fairly closely with the geology of the catchment.

The northern area of the District, in which the western tributaries of the River Arun originate (River Rother, River Kird and Loxwood Stream), has relatively impermeable soil with a large band of Weald Clay, and a parent material of Sandstone. This bedrock weathers quickly in geological terms, leaving clay-rich soils, which result in relatively large amounts of runoff and a rapid response to rainfall events. Sandstone is the dominant bedrock in the Low Weald. A higher density of streams on the Weald Clay and a scarcity of alluvial deposits are a result of the poor surface drainage in these areas.

The River Rother is the largest catchment in Chichester District and features a wide functional floodplain. Across the Rother catchment there are no significant flood defences.

The central area of the District in which the Rivers Ems and Lavant, and the Bosham Streams originate has a mixed geology, mainly comprising of a permeable chalk with well-drained soils. The headwaters are fed by springs along the southern edge of the South Downs chalks where the steep foot of the Downs increases flow velocities during times of flood. The watercourses then continue to drain in a south-westerly direction across the relatively impervious coastal plain. High groundwater levels associated with prolonged wet winter periods can result in saturated ground conditions leading to extensive surface water in the upper catchment. This leads to a rapid response to additional rainfall. Water velocities are high during flood events, owing to the steep stream gradients at the foot of the Downs

Soils on the Manhood Peninsula and associated Rifes are seasonally waterlogged and clay-rich. The extensive rife network provides artificial drainage to a low-lying coastal plain area that would otherwise be marshy because of the soil characteristics. Although there is a fast catchment response in the winter period water velocities are on the whole slow because of low gradients.

Much of the area is underlain by Chalk. This weathers to produce chalk or lime dominated soils that are often very shallow and can sustain very little vegetation. Rain can easily infiltrate this geology through large fissures and is released slowly through springs further downstream. Springs sustain baseflow and low flows throughout the district. A good example of this is the River Lavant. Streams respond to seasonal groundwater variations and groundwater flooding occurs in the broad Chalk valleys. The deeper soils in the Chalk valley bottom have a large storage capacity.

The coastline

The coastline of Chichester District was shaped by post glacial sea level rise, when the entire English Channel and Dover Strait were inundated over 8000 years ago. Breaching of the low lying land that once split this water body from the North Sea, initiated a strong eastward transport of sediment. During the early stages of this period, there was an onshore migration of sediment, which led to major episodes of sediment accumulation resulting in the formation of shingle barriers. The shingle barrier now extends from East Head to Brighton Marina, and in a majority of places is a relict feature.

The length of the Chichester District coastline is approximately 21km, from East Head to Pagham Harbour. The shoreline contains two main harbours, Chichester and Pagham Harbour. Chichester Harbour and Pagham Harbour are important coastal habitats designated within the European Natural 2000 network.

The main towns and villages along the Chichester District shoreline are Selsey, East and West Wittering, Chichester, Birdham, Fishbourne, Bosham, Nutbourne and Hermitage.

The extensive coastal defences along Chichester District provide protection against erosion, flooding and tidal inundation. These defences primarily consist of shingle beaches stabilised by rock and timber groynes. Other defences found along this stretch of coastline are linear seawalls at the rear of shingle beaches and shingle beaches retained by groynes. The condition of the defences vary along the coastline, some tend to be in good condition however others may breach or fail easily during an extreme flood event.

2. How is flood risk assessed

The purpose of the SFRA is to enable each of the local authorities to carry out the Sequential Test inline with government flood risk and development policy guidance (PPS25). The SFRA shall be used to assist with the production of the LDF's by identifying flood risk areas and outlining the principles for sustainable development policies, informing strategic land allocations and integrating flood risk management into the spatial planning of administrative areas. The resultant SFRA forms an essential reference tool in the future spatial planning of the study area.

This chapter describes the principles of assessing flood risk and how the SFRA has been undertaken using these principles. It is important to understand where information has come from and how it has been assessed, to ensure that the quality of data is considered in the decision making process.

Source-pathway-receptor model

The latest Government guidance outlined in PPS25 recommends that the source-pathway-receptor model be used when assessing flood risk. This approach is also used when assessing other risks such as land contamination and air pollution. This model requires the identification of:

- **Sources** – where the flood water comes from. PPS25 identifies six sources of flooding (rivers, sea, land, groundwater, sewers and artificial sources).

- **Pathways** – how the receptor and source come into contact. Pathways for flooding include overland pathways, overtopping of flood defences, blockage of culverts, and underground barriers causing groundwater levels to rise.

- **Receptors** – the people, property and/or environment affected by flooding. For land use planning, the receptors of concern are primarily people and property. Table D2 of PPS25 provides guidance on the vulnerability of different land uses to flooding. The classification includes a consideration of the types of people associated with each land use.

The main sources of flooding and their pathways within Chichester are discussed in Volume II Chapters 6 -11. Receptors are the people and property existing or proposed within CDC.

It is important to use a precautionary approach when assessing flood risk to ensure sustainable land use planning, in the light of expected changes over the lifetime of the proposed developments. Climate change is the most obvious change relevant to flood risk. The latest Government predictions on climate change indicate significant increases in river flows and average sea levels. Such changes are likely to have a major impact on existing source-pathway-receptor relationships.

Defining flood risk

The Chichester SFRA has been developed using the strategic risk evaluation procedure (SREP). The basis for the SREP is taken from published guidance, including the Environment Agency's 'Strategy for Flood Risk Management 2003 - 2008' (Environment Agency 2003), which describes flood risk as a combination of two components, the:

- *"**chance (or probability)** of a particular flood event and the*

- ***impact (or consequence)** that the event would cause if it occurred."*

The Government also wants flood risk to be investigated using the "source-pathway-receptor" concept. This means that when investigating flood risk, it is important to consider how flooding occurs and the characteristics of different types of flooding.

Considering both the definition of risk and the "source-pathway-receptor" model, it is beneficial to assess risk in terms of the components shown in Figure 2.1.

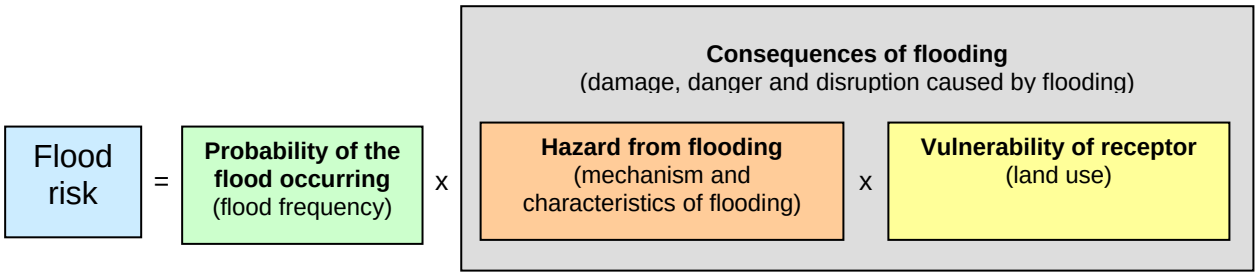

Figure 2.1 Risk equation

The probability of flooding can be defined using existing data and statistical analysis. The hazard from flooding can be evaluated by considering the depth of floodwater, the velocity of flow, the speed of onset of flooding and the rate of rise of floodwater. Hydraulic modelling is used where possible to indicate many of these factors. The vulnerability of flooding can be assessed through analysis of the land use, property or people that would be affected by flooding.

There is inherent uncertainty in estimation of flood probability due to the need to simplify variability in rainfall, storm types, soil types, land cover and antecedent conditions into one design event. By separating flood risk into its three components, it is possible to gauge risk even if the exact probability of an event is uncertain. In this way a precautionary principle can be applied, as flood risk will be higher for floods with significant hazards and consequences, even when the probability of occurrence is uncertain.

The SREP uses this definition of flood risk to define flood zones, actual risk, residual risk and breach and/or failure hazards (further details provided in section 2.4). These are described in PPS25 and the PPS25 Practice Guide. Those using this information should be aware that there is no implied priority given to any of these specific kinds of risk.

When performing the Sequential Test it will be important that all sources of flooding are considered, these are described in section 2.3. By including consideration of climate change (section 2.5) the procedure is precautionary, in accordance with PPS25.

As shown in Figure 2.1, it is possible to reduce risk by reducing the hazard associated with the flooding or the vulnerability of the receptor at risk. It follows that development proposals within Chichester should be developed and assessed using a risk-based search sequence avoiding risk where possible and managing it elsewhere.

The SFRA provides high level information for decisions on land use planning within Chichester. The strategic approach defined in this document will require that information supporting all planning applications in the study area make reference to the SFRA and clearly demonstrate adoption of a risk-based sequential approach.

Sources of flood risk

Flooding can occur from a range of sources. Flooding is heavily dependent on the interaction of rainfall, catchment characteristics and the sea. PPS25 identifies six sources of flooding to be investigated in an SFRA:

- Flooding from rivers

- Flooding from the sea (tidal and coastal)
- Flooding from groundwater
- Flooding from land
- Flooding from sewers
- Flooding from artificial sources (reservoirs, canals, lakes, pumping).

Although flooding in Chichester District is mainly from the sea or rivers a significant proportion of incidents are from other sources. The Autumn 2000 Flood Report produced by the Environment Agency reported that 42 per cent of flooding reported nationally arose from other sources.

Flooding therefore can come from rivers, the sea, directly from rainfall, groundwater, highway and sewer drainage systems, or reservoirs, canals and other artificial sources. The impact of flooding will depend upon its source and the land-use affected. Further information on flooding from other sources in contained within Annex C PPS25 and the PPS25 Practice Guide.

The Flood Zones based on the Environment Agency Flood Map account only for river flooding and flooding from the sea.

In accordance with PPS25 the SFRA has refined the information on the Flood Map to account for other forms of flooding as well. Information on groundwater, surface water, sewers and artificial sources has been collated and is shown on **Maps G1, L, and S**. This information should be used when preparing appropriate policies for flood risk management and land use allocation.

Types of flood risk

The SFRA provides a range of information so that the hazard of flooding, not just the probability of flooding, can be examined. In keeping with PPS25, there are three types of flooding to be considered, Flood Zones, Actual Risk and Residual Risk.

1. Flood Zones (Map F1-F and Map F1-T)

As defined in Table D1 of PPS25, Flood Zones show areas at risk from river and sea flooding, ignoring the presence of flood defences. It is important to recognise this because the Flood Zones ignore the presence of flood defences, they do not describe an actual level of flood risk. For this reason, large areas of development behind flood defences can be shown as at risk.

PPS25 also defines the functional floodplain as the area where water has to flow or be stored at times of flood, and that SFRAs should identify this by the land liable to flood during a flood with a 5 per cent AEP (Annual probability of exceedence). The Practice Companion Guide to PPS25 clarifies that this should be with flood defences in place.

PPS25 requires that all sources of flooding be examined. Flood Zones are a good starting point for this assessment as they show areas at risk of flooding from rivers and the sea, which cause the most damage across England and Wales. However other sources and types of flooding must be examined, even if a proposed development lies within a low probability Flood Zone.

2. Actual risk (Map A1-F and Map A1-T)

Provides information on the actual risk of flooding, where the impact of existing flood defences (assuming that they operate as they are supposed to) is considered. The actual risk of river flooding is usually assessed using the 1 per cent AEP flood event. As the hazards associated with flooding from

sea are greater, actual risk of flooding from sea is usually assessed using the 0.5 per cent AEP flood event.

Actual risk of flooding from other sources (land, groundwater, sewers, and artificial sources) is usually considered through a review of historic flood incidents records and catchment characteristics.

3. Residual risk - overtopping or exceedence (Map A1-F and Map A1-T)

In recognition that engineered flood reduction measures cannot completely eliminate flood-risk, there is a need to be aware of the residual risk generated by an event more severe than that for which the defences have been designed to provide protection. Accordingly, this risk assessment considers the flooding associated with an extreme event (i.e. 0.1 per cent AEP flood event) or flooding that may result from climate change.

4. Residual risk - breach and/or failure (Map B)

This involves the assessment of breach or failure of flood defences or other features, which may act as a defence. Such scenarios may include collapse of a coastal flood defence embankment, blockage of a river culvert or structural failure of a canal or reservoir. Whilst the probability of a breach or failure is generally low, the consequences of such events are often very high. Following the precautionary principle, such high hazards should be considered when making land use planning decisions.

Breach and failure hazards are site specific and need to be assessed in individual flood risk assessments. Probable locations for key breach and failure scenarios can be considered during a SFRA.

Climate change

Projections of future climate change indicate that more frequent short-duration, high intensity rainfall and more frequent periods of long duration rainfall could be expected. Winters are expected to become wetter with summers and autumn becoming much drier than at present. Global sea level rise is also expected to continue. These kinds of changes will have implications for all forms of flooding.

Changes in the extent of inundation as a result of climate change are likely to be negligible in well-defined floodplains but may be dramatic in low-lying and flat areas. It is expected that changes in climate will lead to a reduction in the standard of protection provided by defences constructed in the past. Changes in the depth of flooding may reduce the return period of a given flood and as a result the flood zone classification within which certain areas fall.

The Environment Agency Flood Map and Flood Zones do not take account of climate change. PPS25 requires that the spatial planning process should consider the implication of changes in our climate.

The Chichester SFRA has prepared information on flood probability areas in the future based on 2056 and 2106 time horizons. Future Flood extents taking into consideration current defences are shown in **Maps C1-F** and **C1-T**. Future Flood Zones based on the undefended scenario are shown in **Maps C2-F** and **C2-T**.

In the U.K. the implications of climate change are assessed by the UK Climate Impacts Programme (UKCIP) and latest government guidance on allowing for the impacts of climate change on flooding is provided in PPS25 Annex B and Defra October 2006. Further research and updates are expected in the future, and the SFRA should be updated accordingly.

It is imperative that allowances for climate change are based on the latest predictions and up to date guidance. PPS25 states:

"The most up-to-date guidance on climate change and flooding from the Environment Agency, Defra, Communities and Local Government and the UKCIP should be considered in the preparation of…Strategic Flood Risk Assessments…"

The user must ensure that the most recent climate change guidance is considered over an appropriate time horizon when using the SFRA to inform decision making.

Tiered approach to risk assessment

Flood risk can be assessed in various degrees of detail, which should be proportionate to its nature and complexity. More specifically, the level of assessment will depend on:

- the relative area affected by flooding;
- the severity of the consequences of the flooding;
- the receptors affected by the flooding; and
- the certainty of information.

PPS25 requires that flood risk be considered at all stages of the land use planning process. For this reason it outlines various levels for assessing flood risk, including:

- regional flood risk appraisals (RFRA);
- strategic flood risk assessments (SFRA); and
- site specific flood risk assessments (FRA).

Within those broad categories it is recognised that the degree of assessment required will vary depending on the severity of the flood risk being assessed.

For SFRAs, the quality and quantity of information used in the assessment depends on the extent and severity of flood risk within the administrative boundary, the vulnerability of the development and the certainty of information. A less detailed assessment is recommended where the relative area of flood risk is small, and all development can be allocated in low probability Flood Zones. However a more detailed assessment is required where all development cannot be placed in low probability Flood Zones.

PPS25 recommends a two tiered approach in the assessment of flood risk in SFRAs, allowing flexibility in the level of assessment. The amount of detail required increases at each tier (level), with the risk assessment focussing more closely on higher priority risks identified in the previous tier.

A Level 1 SFRA provides information so that the Sequential Test can be applied. This typically involves providing an initial assessment of the likelihood and magnitude of flooding;

A Level 2 SFRA assessment is only required if

- the Level 1 assessment indicates proposed developments are likely to be allocated in areas of higher probability flooding;
- the Level 1 assessment indicates that there is insufficient certainty in the source-pathway-receptor linkages and the use of conservative assumptions would not be a suitable basis for a decision;

- the receptors of flooding are sufficiently vulnerable to warrant a more detailed assessment.

It is not uncommon for development to be proposed in areas of higher probability flooding due to other overriding pressures or constraints within the administrative boundaries, such as environmental designations or regeneration requirements.

PPS25 states that the Exception Test should be applied (see PPS25 Table D1), where vulnerable land use is planned in areas of higher probability flooding. The SFRA can be used to inform this Test and so must include some indication of:

- Flood probability, depth, velocity and rate of onset, with existing flood defences in place (actual flooding);
- Residual flooding (overtopping and breach failure hazards);
- Options for flood management; and
- Further assessments required in FRAs for allocations across the floodplain.

Approach for Chichester

The SFRA prepared for Chichester will be used to inform the Local Development Framework. In general, proposed allocations include residential and employment development opportunities.

A Level 1 assessment was undertaken as part of phase 1 of the SFRA and found that some of the areas of search were located in areas with a medium and high probability of flooding. The Level 2 assessment further develops understanding of flood risk across the study area, providing information to assist in the application of the Exception test.

The SFRA presented in this and other volumes is therefore a combination of Level 1 and 2 assessments. As SFRAs are documents which should be updated when new information and guidance becomes available, care has been taken to develop the documents in a manner which can be easily updated.

The approach adopted for the Chichester SFRA has two components. The first component is the SFRA, which is a combination of Levels 1 and 2 studies. The second component is the ongoing decision support tools, which reflects the need to continue to support the SFRA once the initial assessment is completed. The support documents include this Volume I - User Guide, Volume III – Management Guide, and Volume IV – Assessment of Sites of Search, which provides an assessment the major settlements within Chichester District. Any additional sites will be assessed at a later date, so that CDC can demonstrate that a risk-based sequential approach has been adopted throughout all stages of the planning process.

Uncertainty

Flood risk can be assessed using a number of techniques and also in various levels of detail. It is important to be confident that the methods used for estimation produce results that are sufficiently certain for land use planning decisions to be based upon.

Uncertainty in flood estimation arises from the:

- complexity of the flooding;
- quality of the input data; and

- the potential impact of climate change

When using SFRAs to inform land use planning the following questions must be answered:

- is the assessment suitable for the type of flooding and the scenarios being considered (fit for purpose)?
- is the study appropriate for the level of detail required for the flood risk assessment?
- are the limitations of the method clearly understood and reported?
- are the studies appropriately verified?
- are the key assumptions identified and stated?
- is the key input data justified and appropriate for the level of flood risk assessment (fit for purpose)?
- has a sensitivity analysis been carried out?
- have all relevant uncertainties (such as climate change) been identified and appropriately addressed?

Where there is high certainty in flood estimation there may be no need for further analyses. Conversely low certainty requires more detailed assessment.

The potential impacts of climate change are an important aspect of uncertainty relevant to flood risk estimation. Government guidance suggests that the impacts of climate change can be managed by either monitoring change in risk and adapting in the future as the need arises (Managed Adaptive Approach) or acting now to manage the eventuality (Precautionary Approach).

Adopting a Managed Adoptive Approach to land use planning is strongly discouraged. Future adaptation to the impacts of climate change may not be technically feasible in the long-term or practical in intervening periods and the requirement to review and take action can be managed more effectively through individual planning applications rather than by the Local Authority within the LDF process.

Climate change information within the SFRA has been based therefore on a precautionary approach to ensure that planning led decisions are “no-regret”.

3. How to use the SFRA in land use planning

Introduction

This chapter describes the application of the sequential risk based approach in the formulation of the Local Development Framework proposals.

Guidance on development and flood risk is given in PPS 25. The policy statement requires that flood risk be considered through the application of a Sequential Test. The process of how to obtain the information needed to perform the test is described in this document. Further guidance is given in Chapter 5 for Development Control and developers regarding windfall sites.

It must be noted that the guidance provided in this document does not supersede guidance provided in PPS25 or other plans or policies. The information and procedures are simply provided as an interpretation of this guidance for the preparation of the LDF.

Objectives

The Local Planning Authority is responsible for carrying out spatial planning and developing the LDF. SFRAs are undertaken to inform the spatial planning process at the local scale.

SFRA must inform the development of the vision, policies and broad search areas during the production of the Core Strategy. A SFRA undertaken to an appropriate level of detail ensures that the Core Strategy is robust and is able to underpin the production of LDD and the LDF in accordance with statutory requirements.

SFRAs enable LPAs to designate areas for development following the Sequential Test as required by PPS25. The policies in PPS25 require that all stages of the development planning process should take account of both the nature and spatial distribution of flood risk and the degree of vulnerability of different types of development. A SFRA should provide the necessary information for planners to be able to take the strategic decisions that identify the amount of development that may be permitted.

The Chichester SFRA has undertaken a Level 1 for the administrative area and a Level 2 assessment for specific locations. CDC can therefore use the SFRA to:

- prepare appropriate policies for the management of flood risk within the District;
- inform the sustainability appraisal so that flood risk is taken account of when considering options and the preparation of strategic land use policies; and
- enable them to determine the acceptability of flood risk in relation to emergency planning..

Decision support guidance

It can be seen from the risk equation in Figure 2.1 that by reducing the hazard or vulnerability of flooding, it is possible to reduce the risk. It follows that, development proposals within Chichester District should be developed and assessed using a risk-based search sequence avoiding risk where possible and managing it where necessary.

PPS25 requires all six forms of flooding (river, sea, land, groundwater, sewer and artificial sources) to be considered when making land planning decisions. As such, the SFRA has provided information on each of these sources of flooding, including flood maps (Volume II, Annex A) which predict areas more likely to be affected by the different sources. Information on all sources of flooding should be used to inform the Sequential Test. By including consideration of climate change the procedure is precautionary, in accordance with PPS25.

PPS25 also requires the vulnerability of different land uses to flooding to be considered when making land-planning decisions. The land uses in the Chichester Local Development Framework will cover a range of vulnerability classifications of land use as per Table D2 of PPS25 (essential infrastructure, highly vulnerable, more vulnerable, less vulnerable and water compatible).

Guidance on applying the Sequential Test, and where necessary the Exception Test is provided below. In addition to this Table 3.1 provides generic decision support in relation to the six sources of flooding and potential land uses for the Chichester Local Development Framework. Table 3.1 refers the user to the relevant mapping in Volume II, Annex A, for assessing flooding risk. It is intended that in future more detailed flood risk assessments will refer to this table as well as SFRA data and planning guidance.

Decision makers should undertake the following generic steps when considering land-use allocation proposals:

- Consult with the Environment Agency.
- Assess the requirement with reference to Figure 3.1, Table 3.1, and Volume II of the SFRA.
- Identify relevant sources of flooding and the uncertainty in the assessment of flood risk.
- Determine where necessary the requirement for more detailed studies based on areas of high risk (where receptors must be located in higher probability flood zones) and where information is too uncertain for an effective land use planning decision to be made.
- Where land use is planned in areas of higher probability flood risk, use the SFRA to test the proposed application against the Exception Test (see PPS25 Table D1).

Further information regarding the management of flood risk from the various sources and planning considerations for each source of flooding are provided in Volume II, Chapter 2.

Sequential Test

It is recognised that flood risk information must be considered alongside other spatial planning issues. Allocations are thus “tested” on the basis of their flood risk attributes and the outcome used to inform decisions that include other spatial planning issues.

The Sequential Test should be applied when allocating land for development. The Test is applied to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding, which would be appropriate to that type of development.

The SFRA provides the flood risk data to enable the application of the risk based Sequential Test in the process of identifying land that is suitable for development in the Local Development Framework. It also provides information to inform Flood Risk Assessments at particular sites. Specifically the SFRA contains information on flood risk that enables CDC to demonstrate that they have tested the reasonably available alternative sites using a risk based search sequence.

To perform the Sequential Test CDC first need to be aware of what sites are reasonably available alternatives. It is necessary to clearly define 'reasonably available' and be able to provide evidence that there are no locations outside of those considered with a lower probability of flooding that could be considered to be 'reasonably available'.

When applying the Sequential Test it will be important for CDC to demonstrate that:

- a transparent process has been formulated and followed;
- this process has sought to steer new development to areas with the lowest probability of flooding (according to table D.1 of PPS 25); and

- full consideration has been given to reasonably available alternatives on land with a lower probability of flooding.

As an example Figure 3.1 provides a flow chart for applying the Sequential Test in determining an appropriate location for an intended land use. This flow chart is provided in the *Practice Companion Guide to PPS25* (DCLG 2007). It is a tool to help the decision-maker locate a proposed development in lower flood risk categories.

The notes provided in the *PPS25 Practice Companion Guide* to accompany the chart combine the Flood Zones with low and medium risk of flooding from other sources when considering the potential location of allocations sites. This may not be beneficial in some instances, as it means that the potential consequence of each source of flooding would be lost. For example, a site with a medium probability of tidal flooding would be placed in the same category as a site with a medium risk of groundwater flooding. The hazard of each source of flooding is significantly different and so it would be beneficial for the Sequential Test to be undertaken with knowledge of the different sources in mind.

It is recommended that CDC revises Figure 3.1 to formulate a bespoke flow chart that:

- adopts the same conceptual logic as the figure (provided in the *PPS25 Practice Companion Guide)*;
- clearly sets out the information used to inform the 'Yes/No' decisions;
- identifies the process used to select 'reasonably available alternatives'; and
- records how information on other material planning issues has been considered in the decision making process.

As such, the guidance notes have been expanded upon in Table 3.1. The identified maps provided in Annex A of Volume II and site maps in Volume IV can be used to inform the Sequential Test. This ensures that all sources of flooding are considered as well as the potential impacts of climate change.

The protocols adopted for the Sequential Test should ideally be agreed with the Environment Agency. It is important that the decision maker engages key stakeholders early in the decision making process. It is also important to consider uncertainty of information when making land use planning decisions.

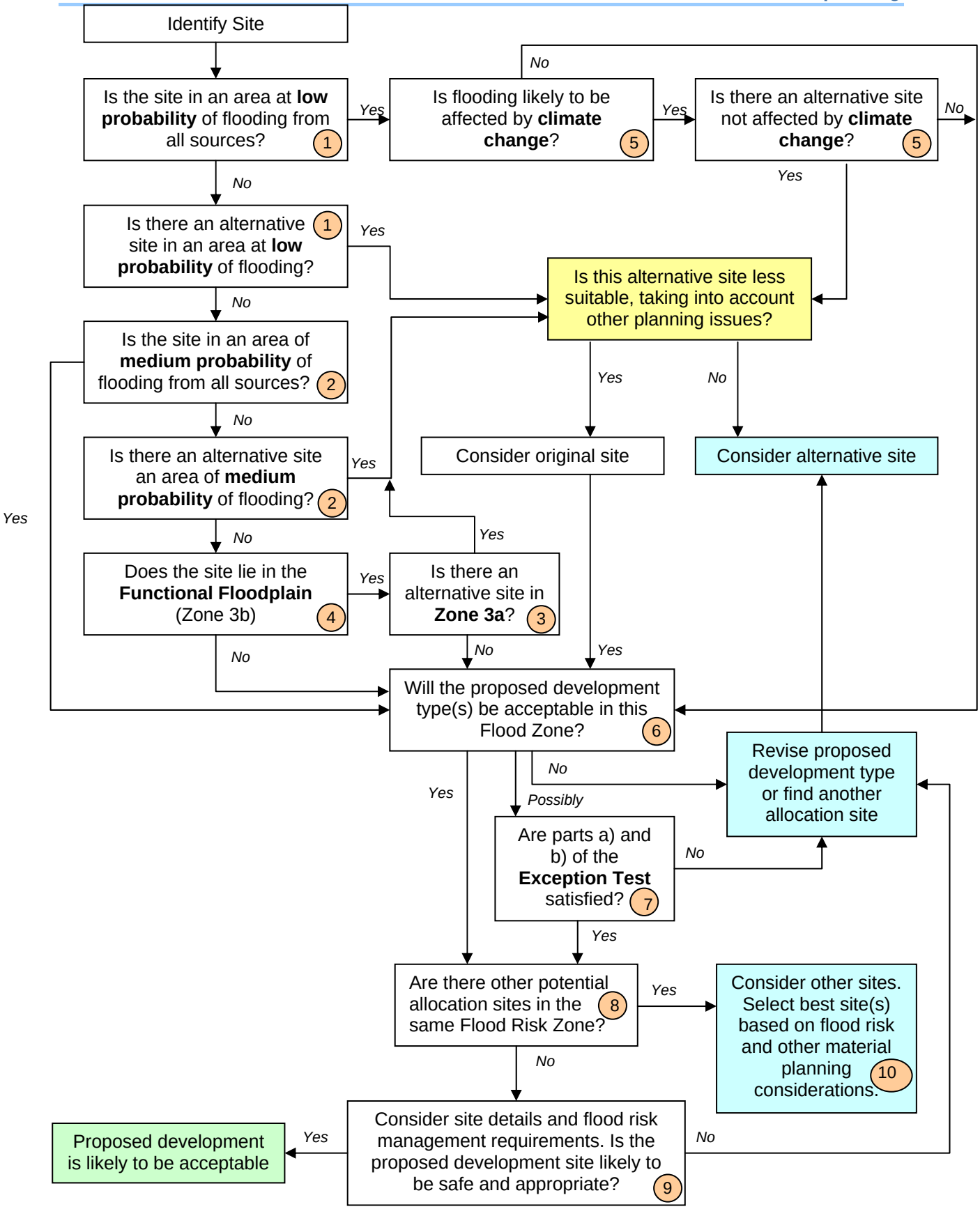

Figure 3.1 Application of the Sequential Test (see overleaf for chart notes)

(based on the flow chart in the PPS25 Practice Companion Guide, February 2007)
(see Table 3.1 for chart notes)

Table 3.1 Notes for use in the Sequential Test Flow Chart (Figure 3.1)

Note	Description	Flood Zone*	Map Ref.	Use
1	An area with a low probability of flooding from all sources, i.e. all of the area outside of Flood Zone 2 and 3.	1	F1-F	Fluvial (river) Flood Zones
			F1-T	Tidal (sea) Flood Zones
			L, G1, S (& H**)	Other sources of flooding
2	An area with a medium probability of flooding from all sources.	2	F1-F	Fluvial (river) Flood Zones
			F1-T	Tidal (sea) Flood Zones
			L, G1, S (& H**)	Other sources of flooding
3	An area with a high probability of flooding from all sources.	3a	F1-F	Fluvial (river) Flood Zones
			F1-T	Tidal (sea) Flood Zones
			L, G1, S (& H**)	Other sources of flooding
4	An area with a high probability of flooding, where water has to flow or be stored in times of flood.	3b	F1-F	Fluvial (river) Flood Zones
			F1-T	Tidal (sea) Flood Zones
			L, G1, S (& H**)	Other sources of flooding
5	An area which is not currently affected by flooding, but may be affected during the lifetime of the development	N/A	C2-F	Climate Change Fluvial (river) Flood Zones
			C2-T	Climate Change Tidal (sea) Flood Zones
6	Compatibility of development	N/A	Table D2 of PPS25	Determine the vulnerability of the proposed development
			Table D3 of PPS25	Determine whether the development is compatible based on its Flood Zone (as described in chart notes 1-4)
7	Exception Test	N/A	See Section 3.3	
8	Identify any other sites within an area with the same probability of flooding.	1, 2 or 3	See Maps in notes 1 to 4	Use maps to identify other sites with the same probability of flooding
9	Is the development safe and not expected to increase flooding elsewhere? Required to pass part c) of the Exception Test, where applicable (see note 6 to determine whether the Exception Test is applicable).	N/A	If the site is affected by fluvial flooding: A1-F, A2-F, A3-F, C1-F	Use Map A1-F to determine whether site is affected by fluvial flooding when flood defences are in place. If the site is still affected, use Map A2-F to see the depth and velocity of the flooding. Use Map C1-F to determine whether the site is likely to be affected in the future, if current flood defences are maintained.
			If the site is affected by tidal flooding: A1-T, A2-T, A3-T, C1-T, B	Use Map A1-T to determine whether site is affected by tidal flooding when flood defences are in place. If the site is still affected, use Map A2-T to see the depth and velocity of the flooding. Use Map C1-T to determine whether the site is likely to be affected in the future, if current flood defences are maintained. Use Map B to identify areas where flood defences may be more susceptible to a breach.
10	Selection of the best site should consider the susceptibility of the site to future climate change and residual flood risk	N/A	See Maps in note 9	Use maps and other planning considerations to select the 'best' site.

* *used for the probability of fluvial and tidal flooding only*

** *historic incidents of other sources of flooding are shown Map H for the sites of search in Volume II of the SFRA*

Exception Test

Following the application of the Sequential Test, if it is not possible for the development to be located in zones of lower risk, and it is consistent with wider sustainability objectives, the Exception Test can be applied in accordance with Table D3 and paragraphs D9 to D14 of PPS 25.

Once the vulnerability of the site is established, Table D3 can be used to determine whether the Exception Test is required. The Exception Test provides a method of managing flood risk while still allowing necessary development to occur. It may not always be appropriate to apply the Exception Test, however if applied, all of the following three elements must be passed:

a) it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. (If the DPD has reached the 'submission' stage – see Figure 4 of PPS12: Local Development Frameworks – the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal);

b) the development should be on developable previously-developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land; and

c) a FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Table 3.2 provides an example decision support matrix giving guidance on applying the Exception Test for Essential Infrastructure, Highly Vulnerable and More Vulnerable land-uses in Flood Zones 2 and 3a. This table may require further updating and adjustment inline with Local Authority polices as they are developed. The suggested depths and velocities in Table 3.2 only provide broad guidelines and are based on Figure 2.1 of the Defra/Environment Agency, Flood and Coastal Defence R&D programme, Flood Risk to People, Phase 2 Guidance Document (FD2321/TR2)

Table 3.2 expands upon Table D3 of PPS25 by providing additional guidance on the likely criteria for development in each combination of land use and flood hazard. A detailed FRA is required to undertake the Exception Test for Essential Infrastructure in Flood Zone 3b.

It is important that CDC retain a record of all their assumptions and decisions with regard to both the Sequential and Exception Tests, in order to demonstrate that they have gone through the process.

Information in the SFRA can be use to assess the safety of particular locations since it gives greater detail on the actual risks, residual risks and the associated magnitude of the flood hazard. Consideration should be given to the safe access and egress arrangements that can be implemented so that during flood events the appropriate level of safety can be maintained.

Flood events, more than many other emergencies, can affect a wide number of homes and the time to recover from a flood emergency can be prolonged. Accordingly it should be remembered that the level of 'safety' will vary depending on the vulnerability of the community affected. More vulnerable land uses will potentially be more severely affected by the consequences of flooding and levels of safety should be commensurate with the risk.

Table 3.2 Example decision support guidance for applying the Exception Test (* Depths and velocities only provide broad guidelines and are based on Figure 2.1 of FD2321/TR2)

Vulnerability classification		**Essential infrastructure**	**Highly vulnerable**	**More vulnerable**
Examples		Essential transport infrastructure and strategic utility infrastructure	Basement Dwellings, Police stations, Fire stations, command centres etc	Hospitals, educational establishments, Buildings used for dwelling house
ACTUAL RISK of flooding from rivers and the sea				
1) Extent of flooding (during 1% AEP river event and/or 0.5% AEP sea event, with flood defences in place) (**Maps A1-F and A1-T**)	Not shown to flood	Go to **4) Residual Risk (breach)**	Highly vulnerable development is not appropriate in Flood Zone 3 (1% AEP river flood or 0.5% AEP sea flood), whether or not the site is defended, therefore Exception Test not appropriate.	Go to **4) Residual Risk (breach)**
	Shown to flood	Go to **2a) Depth of flooding**		Go to **2a) Depth of flooding**
2a) Depth of flooding (during 1% AEP river event and/or 0.5% AEP sea event, with flood defences in place) (**Maps A2-F and A2-T**)	Depth is less than 0.5m*	Go to **2b) Velocity of flooding**		Go to **2b) Velocity of flooding**
	Depth is between 0.5 and 1m*	Go to **2b) Velocity of flooding**		Go to **2b) Velocity of flooding**
	Depth is greater than 1m*	**Generally not appropriate** FRA to demonstrate that the development is safe for its lifetime, including an assessment of hazard, residual risk (overtopping and breach), taking into account the impacts of climate change. Consider strategic options for managing flood risk.		**Generally not appropriate** FRA to demonstrate that the development is safe for its lifetime, including an assessment of hazard, residual risk (overtopping and breach), taking into account the impacts of climate change. Consider strategic options for managing flood risk.
2b) Velocity of flooding (during 1% AEP river event and/or 0.5% AEP sea event, with flood defences in place) (**Maps A3-F and A3-T**)	Velocity is less than 1m/s*	**May be appropriate** FRA to demonstrate that the development is safe for its lifetime, including an assessment of hazard, residual risk (overtopping and breach), taking into account the impacts of climate change. Consider strategic options for managing flood risk.		**May be appropriate** FRA to demonstrate that the development is safe for its lifetime, including an assessment of hazard, residual risk (overtopping and breach), taking into account the impacts of climate change. Consider strategic options for managing flood risk.
	Velocity is between 1 and 2 m/s*	**May be appropriate** FRA to demonstrate that the development is safe for its lifetime, including an assessment of hazard, residual risk (overtopping and breach), taking into account the impacts of climate change. Consider strategic options for managing flood risk.		**May be appropriate** FRA to demonstrate that the development is safe for its lifetime, including an assessment of hazard, residual risk (overtopping and breach), taking into account the impacts of climate change. Consider strategic options for managing flood risk.
	Velocity is greater than 2 m/s*	**Generally not appropriate** FRA to demonstrate that the development is safe for its lifetime, including an assessment of hazard, residual risk (overtopping and breach), taking into account the impacts of climate change. Consider strategic options for managing flood risk.		**Generally not appropriate** FRA to demonstrate that the development is safe for its lifetime, including an assessment of hazard, residual risk (overtopping and breach), taking into account the impacts of climate change. Consider strategic options for managing flood risk.
RESIDUAL RISK of flooding from rivers and the sea				
3) Residual Risk - overtopping (during 0.1% AEP river or sea event, with flood defences in place) (**Maps A1-F and A1-T**)	Not shown to flood	Exception Test not required for sites within Flood Zone 2	Go to **4) Residual Risk (breach)**	Exception Test not required for sites within Flood Zone 2
	Shown to flood		**May be appropriate** FRA to demonstrate that the development is safe for its lifetime, including an assessment of flood velocities, residual risk (breach), taking into account the impacts of climate change. Consider strategic options for managing flood risk.	
4) Residual Risk - breach (areas where existing river or sea defences are expected to be more susceptible to a breach) (**Map B**)	Not close to an area more likely to breach	Go to **5) Climate Change**	Go to **5) Climate Change**	Go to **5) Climate Change**
	Close to an area more likely to breach	**May be appropriate** FRA to demonstrate that the development is safe for its lifetime, including a breach assessment, taking into account the impacts of climate change.	**May be appropriate** FRA to demonstrate that the development is safe for its lifetime, including a breach assessment, taking into account the impacts of climate change. Consider strategic options for managing flood risk.	**May be appropriate** FRA to demonstrate that the development is safe for its lifetime, including a breach assessment, taking into account the impacts of climate change.
CLIMATE CHANGE impacts on flooding from rivers and the sea				
5) Climate Change (during a future 1% AEP river event and/or future 0.5% AEP sea event, with flood defences in place) (**Maps C1-F and C1-T**)	Not shown to flood within design life of development	**Generally appropriate** FRA to demonstrate that flood defences can be maintained and residual risk can be managed, for the lifetime of the development.	**Generally appropriate** FRA to demonstrate that flood defences can be maintained and residual risk can be managed, for the lifetime of the development.	**Generally appropriate** FRA to demonstrate that flood defences can be maintained and residual risk can be managed, for the lifetime of the development.
	Shown to flood within design life of development	**May be appropriate** FRA to demonstrate that the development is safe for its lifetime, including an assessment of flood depths and velocities, taking into account the impacts of climate change. Consider strategic options for managing flood risk.	**May be appropriate** FRA to demonstrate that the development is safe for its lifetime, including an assessment of flood depths and velocities, taking into account the impacts of climate change. Consider strategic options for managing flood risk.	**May be appropriate** FRA to demonstrate that the development is safe for its lifetime, including an assessment of flood depths and velocities, taking into account the impacts of climate change. Consider strategic options for managing flood risk.

4. How to use the SFRA in Flood Warning and Emergency Planning

PPS25 recognises that flooding is a natural process that plays an important role in shaping the natural environment. However, flooding also threatens life and causes substantial damage to property. Although flooding cannot be wholly prevented, its impacts can be avoided and reduced through good planning and management. While physical defences may provide a level of protection, they may be breached or overtopped. A necessary component of flood defence is flood warning, backed up by civil protection measures. In this context, the Environment Agency is the authority responsible for issuing forewarning of possible events to the public, local authorities and emergency services.

Structures and procedures for civil protection drawn up under the Civil Contingencies Act came into force in November 2004. The Act formalises the duties on Category 1 responders to emergencies by requiring risk assessment and contingency planning to deal with emergencies, and the giving of advice and information to the public about actual or likely emergencies.

The Civil Contingencies Act 2004 also places a legal duty on category one responders (which includes Local Authorities) to produce a community risk register. Community Risk registers are a compilation of risk assessments for hazards, including flooding.

The outputs of the SFRA will support CDC in the maintenance of the Community Risk Register and provide data of a higher resolution than shown on Environment Agency mapping so that the magnitude of risks can be evaluated with greater precision. This will help to facilitate joined-up local planning, based on consistent planning assumptions, and provide data that can be used to prepare strategic responses to reduce the consequences of flood emergencies and hence reduce the risks.

The SFRA also provides information on the spatial distribution of flood hazard. This information should be used to feed upwards to strategic land use planning (SEP and RFRA), and down to individual site development control. Inappropriate development in flood risk areas can pose a significant risk to life, especially to the young, elderly and infirm. Flood risk maps are provided in Volume II (Annex A) of this SFRA. It is essential that those new developments which occur within flood risk areas are safe, and that new developments are designed and constructed such that the health, safety and welfare of people is appropriately managed. This is of particular reference to developments which proceed following the application of the Exception Test.

Consideration of health and safety issues should also be a fundamental issue during the design and construction of new developments. The outputs of this SFRA will support CDC in understanding the level of flood risk management requirements at each proposed development. The safety levels considered should be proportionate to the vulnerability of the community affected by the flood risk.

Under the Act, risk assessment and planning is arranged through Local and Regional Resilience Forums. The Forums, which are led by the Regional Resilience Teams in the Government Offices of the Regions, seek to draw in all those bodies, which may be exposed to risk or be required to respond to events, including flooding. This includes production of an emergency flood management plan, which may then be incorporated into a local emergency plan or major incident plan as judged appropriate. The Teams also assist local authorities and emergency services in responding to and recovering from events.

The spatial distribution of flood hazard should inform the production of emergency flood management plans. Emergency flood management plans should minimise risks to life and property, through, for example, ensuring that evacuation procedures are adequate to the kinds of risks that a major flooding event may create. Developers and consultants preparing site specific emergency plans for new developments should consult with the CDC Emergency Planning team during the preparation of such plans. The findings of the SFRA can also be used to inform the production of a Flood Plan, which should include updating the existing guidance on flooding.

The mapping provided in Volume II of the SFRA can be used to support CDC in identifying evacuation and reception centre locations in areas of low flood risk. The SFRA can also help to identify implications for the future resourcing of emergency planning, for example the implications of climate change and flood risk.

The information in the SFRA if made available to those attending flood emergencies would potentially reduce the magnitude of the risks that personnel might be exposed to. Importantly it enables those attending flood emergencies to prepare in advance and reduce the chance of unforeseen exposure to high hazard magnitudes during a flood emergency.

The SFRA identifies that consideration should be given to:

- planning for parts of the study area which respond quickly to rainfall and produce hazardous flows (rapid response catchments);
- planning for rapid inundation of properties due to failure of raised sections of defences and structures;
- the vulnerability of essential infrastructure, such as power stations and public buildings;
- the vulnerability of major transportation linkages; and
- the opportunity to improve flood warning through additional analysis of antecedent conditions and seasonality of flooding.

The SFRA (Volume II, Chapter 5) provides further details of the Environment Agency's Flood Warning Service and Emergency Planning within the study area.

.

5. How to use the SFRA in Development Control

Development Control

At a local level the SFRA sets the context within which any planning application should be considered. The SFRA informs the production of policy relevant to the assessment of flood risk within the LDD.

The SFRA establishes;

- The category of flood risk zone within which the proposed site sits;
- The flood risk constraints in accordance with guidance in PPS25; and
- The basis of the policies of the LPA regarding proposed development in the relevant flood risk zone.

The SFRA should be used to provide high level flood risk information for decisions on land use planning. This can be done on an “as required” basis, matching the needs of phased submission of applications.

Developers should be referred to the SFRA at the start of any pre-application consultation with the LPA. A developer is not required to apply the Sequential Test if a proposed development is located on a site which has been sequentially tested and allocated for that type of development in the LDF and is supported by a SFRA. However, the developer should still apply the sequential approach to any flood risk within the site itself and demonstrate compliance with PPS25 when determining the location of appropriate land uses. The aim of the sequential approach is to minimise the flood risk by considering the probability of flooding in conjunction with the vulnerability of receptors.

Where developers promote development outside of the allocated areas identified in the LDDs and within flood risk areas defined by the SFRA the local authority is responsible for performing the Sequential Test and the developer is responsible for:

- demonstrating compliance with PPS25 notably obtaining confirmation from CDC that the proposed application site satisfies the outcome of the Sequential Test. This might require the developer to collect and submit information to CDC as evidence to be used in performing the Sequential Test and if appropriate the Exception Test;
- providing an assessment of the impact of flooding on the development and of the development on flood risk elsewhere;
- satisfying the LPA that flood risk to the development and the impact of the development on flood risk elsewhere will be appropriately managed.

In areas where flood risk has been identified as an issue, developers should liaise with CDC to agree on who should be consulted. The scope of any site specific FRA should be agreed with CDC, and will be informed by the outputs from this SFRA and consultation with the Environment Agency.

The SFRA provides information which should be considered in the production of site-specific flood risk assessments. In these instances the SFRA allows the LPA to identify the level of detail required for site-specific FRAs in particular locations. The SFRA provides Flood Zone maps and other mapping (Volume II, Annex A) to assist in the initial understanding of flood risk at proposed development sites.

The SFRA should also be used to set planning constraints within development areas designated in the LDDs and where relevant in the case of windfall planning applications.

The Development Control team should refer to the maps in Volume II as appropriate. In cases where the flood risk is predominantly from other sources, the Development Control team should consult the Environment Agency to obtain the latest historic information and if necessary, request site specific investigations.

Developers

Paragraphs 22 and 23 of PPS25 clarify the responsibilities of developers to consider flood risk issues at a site as early as possible. Key points include the responsibility of landowners for safeguarding their land and other property against natural hazards. It is the responsibility of property owners and users to manage the drainage of their land, as far as possible to prevent adverse impacts on neighbouring land.

Developers are advised to make independent checks regarding flood risk before purchasing a site. The scope of any FRA should be agreed with the Local Planning Authority, and if necessary the Environment Agency, and it should be agreed who the developer needs to consult. For example the developer may need to consult Sewerage undertakers, Highways Authorities, and Reservoir Undertakers. The developer is responsible for demonstrating the development is consistent with the policies in PPS25 and those on flood risk in the LDDs.

LDDs may provide specific guidance on, or locational criteria for, allocated development sites. Where sites have been allocated by the LPA in accordance with the Exception Test, the SFRA may provide more detailed background information. A key requirement for Flood Risk Assessments is that they consider all sources of flooding and demonstrate how flood risk will be managed taking into account climate change.

Flood Risk Assessments may be standalone documents submitted by the developer to accompany a planning application, or where an environmental statement is required, the developer should ensure that the FRA is incorporated into the study.

Guidance for site-specific Flood Risk Assessments

The outcomes of the SFRA do not replace the requirement for an appropriate FRA to be undertaken at the planning application stage.

The Environment Agency's Flood Risk Standing Advice for England should be consulted for guidance on whether the Environment Agency needs to be consulted regarding a development proposal and requirements for a FRA. The Environment Agency's Flood Risk Standing Advice for England can be found through www.environment-agency.gov.uk/planning.

The Environment Agency standing advice aims to assist Local Planning Authorities make decisions on low risk planning applications where, whilst flood risk is an issue, there is no need to consult the Environment Agency directly. The standing advice also sets out those higher risk developments on which the Environment Agency are a statutory consultee for development and flood risk. The standing advice also provides guidance for applicants and agents on the requirements for flood risk assessment (FRA) for both low and higher risk developments.

The Environment Agency's Flood Risk Standing Advice sets out the FRA requirements for development based on the size of site and the location within the floodplain. It should be noted that the provision of a FRA will not automatically make a development acceptable in flood risk terms.

Consultation Matrix

PPS25 is relatively clear that a FRA is required for all new development, greater than 1ha in area in Flood Zone 1, and all new developments of any area in Flood Zones 2 and 3. The guidance is not so clear for changing the use of an existing development (to a higher vulnerability classification) and for extensions to existing development.

To help Development Control Officers decide when a flood risk assessment is required, the Environment Agency has developed a consultation matrix (Table 5.1), which identifies when the Environment Agency should be consulted, and what level of information needs to accompany the FRA if one is required.

The different colour boxes provide an indication of the level for consultation and FRA required. No consultation or FRA is required in the grey boxes. Information that should be included in FRAs is expanded upon in the following sections of this chapter.

The Environment Agency Consultation Matrix is part of the Environment Agency's Flood Risk Standard Advice (FRSA), which is provided to LPAs for more straightforward planning applications. The FRSA also allows LPAs to identify those higher risk development situations where consultation with the Environment Agency is essential. This information is available on the Environment Agency website at www.environment-agency.gov.uk/planning and should be checked regularly for updates.

Table 5.1 Environment Agency consultation matrix

A	B	C	D	E	F
Development category	**Development (including boundary walls etc.) within 20 metres of the top of a bank of a Main River**	**Includes culverting or control of flow of any river or stream**	**Within Flood Zone 3**	**Within Flood Zone 2**	**Within Flood Zone 1**
Minor extensions					
Householder development and alterations	Consult EA See column D or E for details of small scale **FRA** if development also lies within Flood Zones 2 or 3	Consult EA with **FRA** showing design details of any culvert or flow control structure proposed.	No consultation. See "standard Agency comment" for details of small scale **FRA**	No consultation. See "standard Agency comment" for details of small scale **FRA**	No consultation – No EA advice
Non-residential extensions with a footprint of less than 250m^2	Consult EA See column D or E for details of small scale **FRA** if development also lies within Flood Zones 2 or 3	Consult EA with **FRA** showing design details of any culvert or flow control structure proposed	No consultation. See "standard Agency comment" for details of small scale **FRA**	No consultation. See "standard Agency comment" for details of small scale **FRA**	No consultation – No EA advice
Material change of land use					
Change of use from 'water compatible' to 'less vulnerable' development	Only consult EA if site also falls with Flood Zone 3. **FRA** required	No consultation – No EA advice	Consult EA with **FRA**	No consultation – No EA advice	No consultation – No EA advice
Change of use resulting in 'highly vulnerable' or 'more vulnerable' development	Only consult EA if site also falls with Flood Zone 3 or 2. **FRA** required	No consultation – No EA advice	Consult EA with **FRA**	Consult EA with **FRA**	No consultation – No EA advice
Development involving building, mining or engineering works.					
Operational development less than 1 hectare	Consult EA See columns D or E for details of **FRA** if development also lies within Flood Zones 2 or 3	Consult EA with **FRA** showing design details of any culvert or flow control structure proposed	Consult EA with **FRA** and Sequential Test Evidence (and where required confirm Exception Test has been applied)	Consult EA with **FRA** and Sequential Test Evidence (and where required confirm Exception Test has been applied)	No consultation: See "standard Agency comment" for advice on whether LPA should request a **FRA**
Operational development of 1 hectare or greater	Consult EA See columns D or E for details of **FRA** if development also lies within Flood Zones 2 or 3	Consult EA with **FRA** showing design details of any culvert or flow control structure proposed	Consult EA with **FRA** and Sequential Test Evidence (and where required confirm Exception Test has been applied)	Consult EA with **FRA** and Sequential Test Evidence (and where required confirm Exception Test has been applied)	Consult EA with **FRA**

Note: This table, and further supporting information, is available at www.pipernetworking.com/floodrisk/matrix.html

Sequential Test

The Environment Agency FRSA sets out the evidence required from Local Planning Authorities as a demonstration that the Sequential Test has been properly applied for individual planning applications.

Table 5.2 contains a summary of the information extracted from the Environment Agency website (www.pipernetworking.com/floodrisk/sequential.html). The website contains a number of useful notes and links and should be checked regularly for updates.

Table 5.2 Evidence required by the Environment Agency in undertaking the Sequential Test

Question	Answer		Sources of information
	Yes	No	
1. Is the proposed development consistent in location, type and scale with an allocated site from a development plan which has already been sequentially tested (i.e. has the flood risk Sequential Test already been carried out for this site at a strategic level?)	Yes - compliance with the Sequential Test has been demonstrated. State which plan, which allocation and the location of the allocation site in the development plan. Apply Exception Test if appropriate – see PPS25 Table D3.	No - go to question 2	Development plan
2. Does the application site fall within an area identified to take 'windfall' development that has been agreed as part of the development plan and in association with a SFRA?	Yes - compliance with the Sequential Test has been demonstrated. State the location in the development plan. Apply Exception Test if appropriate – see PPS25 Table D3.	If the answer is 'No' or there are no such areas identified on the development plan, go to question 3	Development plan
3. Does the development plan or the background documents used to identify potential development plan allocation sites, contain 'reasonably available' alternative sites that are situated in a lower flood risk zone?	Yes - compliance with the Sequential Test has NOT been adequately demonstrated. State which allocation(s) and the location in the development plan.	If the answer is 'No' go to question 4	Development plan Background Documents SFRA
4. Does the development plan or the background documents used to identify potential development plan allocation sites, contain alternative 'reasonably available' sites that are within the same Flood Zone and subject to a lower probability of flooding from all sources as detailed by the SFRA?	Yes - compliance with the Sequential Test has NOT been adequately demonstrated. State which allocation(s) and the location in the development plan.	If the answer is 'No' to questions 3 and 4 compliance with the Sequential Test has been adequately demonstrated. Apply Exception Test if appropriate – see PPS25 Table D3.	Development plan Background Documents Chichester SFRA

Content of Flood Risk Assessments

The FRA will be required to demonstrate that flood risk to the development can be managed now and in the future, that the development will not increase the risk of flooding elsewhere and that the proposals are compliant with the SFRA. Flood Risk Assessments should consider all sources of flooding and where appropriate, mitigation measures. Where risk of flooding from sources other than the sea or rivers has been identified such as groundwater or surface water flooding the FRA needs to consider the risk of flooding at the site.

The principles and key requirements of a FRA are provided in Appendix E of PPS25. The guidance in PPS25 recommends that the level of detail in the FRA should be proportionate to the risk and appropriate to the scale, nature and location of the development. The Environment Agency's FRSA provides guidance on the suggested content of FRAs in various circumstances. This can be accessed through their website at www.environment-agency.gov.uk/planning and should be checked regularly for updates. The advice suggests the following should be included in the FRA:

- **Household and other minor extensions** - evidence that the extension will be flood proof or flood resilient. A more detailed FRA may be required in cases where the cumulative effect of extensions is known to exacerbate flooding (see FRA Guidance Note 2).

- **Development greater than 1ha in Flood Zone 1 (FRA Guidance Note 1)** -location plan with existing surface water infrastructure, an assessment of the proposed development on existing surface water runoff rates (including an allowance for climate change), how any increase in runoff rates will be managed and if any other sources of flooding are likely to affect the site. The FRA is required to consider the proposal relevant to the SFRA.

- **Minor Extensions where the cumulative impact of development needs to be addressed (FRA Guidance Note 2)** - evidence that the extension will be flood proof or flood resilient, an assessment of the actual and residual risk of flooding and an indication of the effect of the proposed development on flood storage, flood flow routes and surface water runoff rates. In some cases this may be a short-written statement based on information contained within the SFRA.

- **Development in Flood Zones 3 and 2 (Excluding Minor Extensions) (FRA Guidance Note 3)** - a detailed FRA is required as described below. It is recommended that applicants seek advice from the LPA before undertaking the FRA to make sure that the site passes the Sequential and is likely to pass the Exception Test.

The following information to be included in a detailed FRA:

- a description of the development and the planning context;
- definition of flood hazard;
- probability of flooding;
- impacts of climate change on flood risk;
- detailed description of development proposals;
- flood risk management measures including Sustainable Drainage Systems (SuDS);
- impacts of the development off site; and
- an assessment of residual risk.

The Companion Guide to PPS25 provides a proforma for developers to complete when undertaking a detailed FRA. The LPA should encourage all FRAs to include this proforma as an appendix.

The SFRA contains a number of maps that may be helpful in preparing a FRA (see Table 5.3). In some cases, the information in the maps will be sufficient for producing the FRA. In other cases, more detailed hydrological and hydraulic modelling studies will be required. It is the responsibility of the user to make sure that the data used in the FRA is proportionate to the risk and appropriate to the scale, nature and location of the development.

Table 5.3 SFRA maps most relevant to FRAs

Source of flooding	Overview Map (Volume II)	Site Map (Volume IV)	Description
Rivers (fluvial)	Map F1-F	Map F1-F	Fluvial Flood Zones 2, 3a and 3b as defined in PPS25 (Note: Flood Zone 2 and 3a ignore the presence of flood defences)
	Map C2-F	Map C2-F	Climate change Fluvial Flood Zones 3a and 3b, for 2056 and 2106 time horizons (Note: Flood Zone 3a ignores the presence of flood defences and Flood Zone 3b assumes that existing flood defences are maintained in accordance with current CFMP, SMP policy)
	Map A1-F	Map A1-F	Extent of flooding during a 1% AEP (actual risk) and 0.1% AEP (residual risk) flood event with defences
	Map A2-F	Map A2-F	Depth of flooding during a 1% AEP flood with defences (actual risk)
	Map A3-F	Map A3-F	Velocity of flooding during a 1% AEP flood with defences (actual risk)
	Map C1-F	Map C1-F	Climate change extent of flooding during a future 1% AEP flood event with defences, for 2056 and 2106 time horizons (Note: Flood Zone 3b assumes that existing flood defences are maintained in accordance with current CFMP, SMP policy)
Sea (tidal/ coastal)	Map F1-T	Map F1-T	Tidal Flood Zones 2, 3a and 3b as defined in PPS25 (Note: Flood Zone 2 and 3a ignore the presence of flood defences)
	Map C2-T	Map C2-T	Climate Change Tidal Flood Zones 3a and 3b, for 2056 and 2106 time horizons (Note: Flood Zone 3a ignores the presence of flood defences and Flood Zone 3b assumes that existing flood defences are maintained in accordance with current CFMP, SMP policy)
	Map A1-T	Map A1-T	Extent of flooding during a 0.5% AEP (actual risk) and 0.1% AEP (residual risk) flood event with defences
	Map A2-T	Map A2-T	Depth of flooding during a 0.5% AEP flood with defences (actual risk)
	Map A3-T	Map A3-T	Velocity of flooding during a 0.5% AEP flood with defences (actual risk)
	Map B	N/A	Locations where breach modelling may be required (based on SMP/CFMP data suggesting that a breach is more likely) and breach flood extents for locations B and C.
	Map C1-T	Map C1-T	Climate change extent of flooding during a future 0.5% AEP flood event with defences, for 2056 and 2106 time horizons (Note: Flood Zone 3b assumes that existing flood defences are maintained in accordance with current CFMP, SMP policy)
Groundwater	Map G1	Map H	Areas more likely to be affected by groundwater flooding (based on a spatial analysis), and historic incidents of groundwater flooding
Land	Map L	Map H	Areas more likely to be affected by surface water flooding (based on a spatial analysis), and historic incidents of surface water flooding
Sewer	Map S	Map H	Historic incidents of sewer flooding

Flood Risk Management Measures

Where there is no viable alternative and developments have to be situated in areas at risk of flooding, or there is residual risk associated with a proposed development, it is the responsibility of those planning the development to propose methods to mitigate and safely manage flood risks. A range of measures are available to manage the risks at development sites.

One method of managing flood risk is to apply a sequential approach, so that more vulnerable land uses are located in parts of the site at less probability and residual risk of flooding. Opportunities should also be taken to lower flood risk by reducing the built footprint of previously developed sites and by using Sustainable Urban Drainage Systems. In some cases the use of flood resilient construction may be considered, to reduce the consequences of flooding and facilitate more rapid recovery from the effects of flooding. Flood resistant construction can prevent or minimise the amount of water entering a building, where there is flooding outside. There remains a risk of buildings being damaged by water pressure or flood debris.

Flood risk from six sources of flooding may need to be managed in different ways. Volume II, Chapter 2, provides further information on the management of flood risk from different sources and Sustainable Urban Drainage Systems.

In some cases it may be necessary to permit development which requires the construction and maintenance of flood defences. It should be noted that Appendix G of PPS25 lists a number of considerations regarding the contributions of developers.

A method of managing residual risk, particularly appropriate to existing developed areas, is the provision of flood warnings and the development of evacuation plans. PPS25 states that the receipt of and response to flood warnings is an essential element in the management of Residual Risks. Flood Warnings are provided for some areas by the Environment Agency. Evacuation Plans should be produced for developments at risk, with particular attention to the mobility of occupants.

It should be noted that PPS25 recommends that there is safe access and escape to/from new developments in flood risk areas.

6. How the SFRA links with other plans and policies

SFRAs enable LPAs to allocate areas for development in accordance with the Sequential Test described in PPS25. Where the Sequential Test cannot be met and allocations are proposed within the Flood Zones (PPS25), Strategic Flood Risk Assessments should be refined to provide information necessary for application of the Exception Test (PPS25).

SFRA can also be used to set planning constraints within designated development areas and where relevant in the case of windfall planning applications (FD2320/TR2). In existing urban areas, SFRAs should be used to inform decision makers of the impacts due to climate change and urbanisation.

SFRA also allow LPAs to identify the level of detail required for site-specific FRAs in particular locations and enable them to determine the acceptability of flood risk in relation to emergency planning. (DCLG, 2007).

The role of the SFRA in the hierarchical planning structure in England, together with its other possible uses is summarised in the following sections, and figure 6.1 describes how the SFRA may fit into the conceptual land use planning framework. Volume II, Chapter 3 also provides further details of the Environment and Planning context for the SFRA.

Regional Spatial Strategy

Regional Planning Bodies (RPBs) are required to prepare Regional Flood Risk Appraisals (RFRAs) and consider flood risk when preparing Regional Spatial Strategies (RSSs).

RFRAs should make reference to and use existing assessments of flood risk including SFRAs where available. In turn the RFRA should inform the requirements of sub-regional scale Strategic Flood Risk Assessments or SFRAs as they are produced or updated.

The current RSS for West Sussex is the Regional Planning Guidance for the South East (RPG9). Policy INF1 provides guidance on flooding.

The overall premise is that development will be planned to avoid the risk of flooding and will not be permitted if it would:

- be subject to an unacceptable risk of flooding or increase the risk elsewhere; and
- prejudice the capacity or integrity of flood plains or flood protection measures.

It encourages Local Development Documents (LDD) to include policies to:

- adopt a risk based approach to guiding categories of development away from flood risk areas; and
- ensure that development proposals are accompanied by flood risk assessments.

The draft South East Plan (SEP) will become the statutory strategy for development and conservation for West Sussex. Adoption of the SEP is expected 2009 and it will replace RPG 9, RPG9a, and RPG9b.

The SEP was submitted by the South East England Regional Assembly to the Secretary of State in March 2006. The timing of the development of the SFRA means that the first version of the SEP will

be unable to draw upon flood data in the assessment. However future iterations of the plan will be able to access the information and extract data at a level relevant to the plan.

Taking account of climate change and the increased risk of flooding, the priority is to;

- Defend existing properties and, where possible, locate new development in places with little or no risk of flooding
- Protect flood plains and land liable to tidal or coastal flooding from development
- Follow a sequential approach to development in flood risk areas
- Use development to reduce the risk of flooding through location, layout and design
- Identify areas of opportunity for managed realignment to reduce the risk of flooding and create new wildlife areas

Local Development Frameworks

The Local Planning Authority is responsible for carrying out spatial planning and developing the Local Development Framework (LDF). SFRAs are undertaken to inform the spatial planning process at the local scale.

Additionally, under the Planning and Compulsory Purchase Act 2004, there is a requirement for Local Development Documents (LDDs) to have regard to national policies and guidance issued by the Secretary of State. The Act also requires those preparing LDDs to consider the needs of sustainable development. The Act therefore requires a Sustainability Appraisal of the strategies and policies in LDDs.

It is anticipated that neighbouring District Councils and West Sussex County Council will produce an SFRA in support of their respective Local Development Frameworks. West Sussex County Council has had an SFRA produced to inform the Waste and Minerals Development Framework. The technical information held within the Chichester SFRA should be used to inform these other frameworks and the accompanying assessments of flood risk therein and be informed by those other assessments where applicable.

When using the Chichester SFRA to inform other LDF documents, consideration must be given to the level of detail and certainty of information provided. The spatial extent and detail of the technical assessments undertaken in this SFRA have been appropriate to inform a District-wide Local Development Framework.

It may be necessary to produce a higher tier of FRA to inform specific land allocations or where a greater degree of certainty in flood hazard is required.

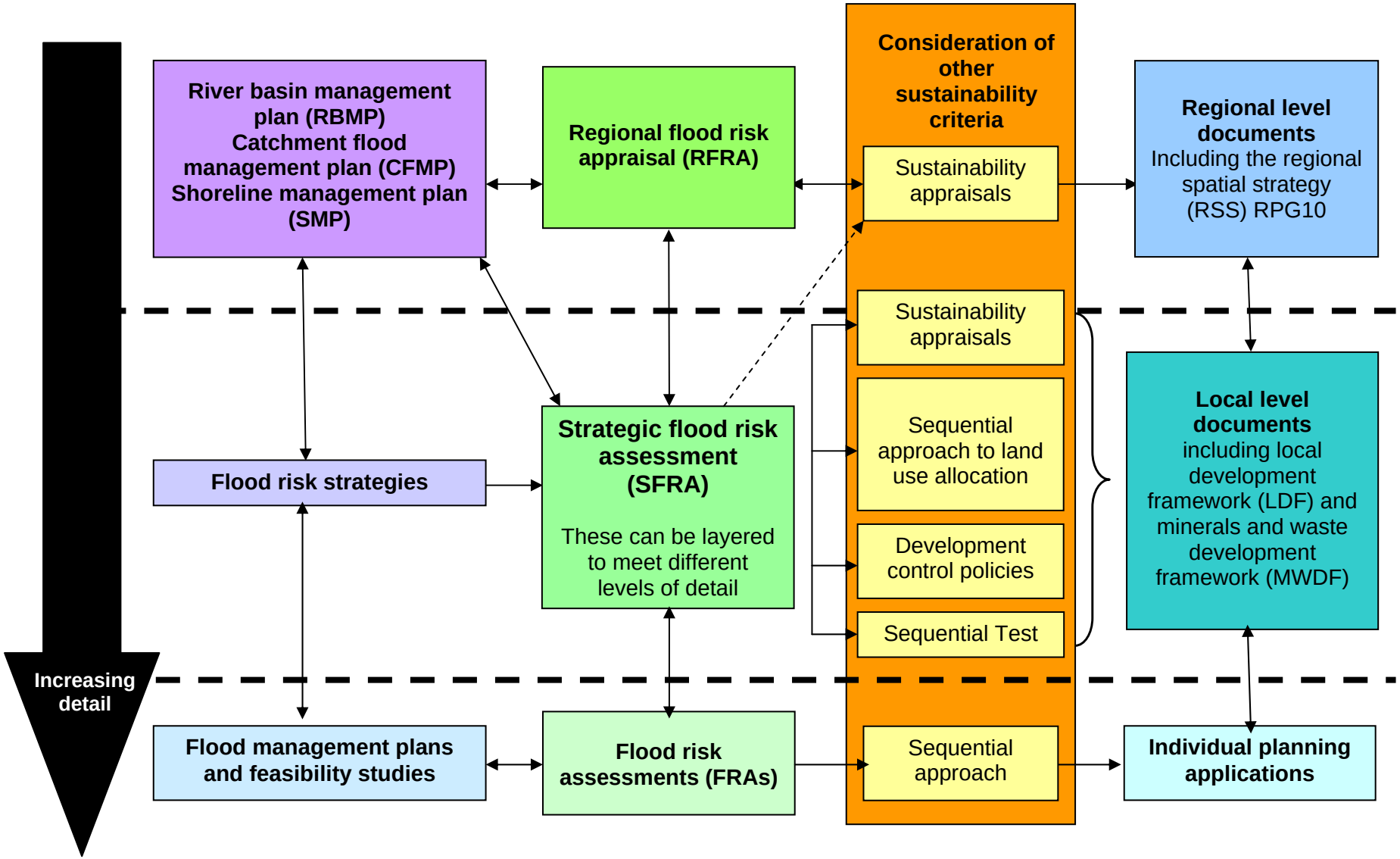

Figure 6.1. How the SFRA may fit into the conceptual land use planning framework

7. Strategic Response

The outcome of the SFRA identifies that there is a requirement for strategic responses to flood risk within the Chichester administrative boundary. The strategic responses require consideration of the following:

- development solutions that complement least risk options;
- commitment to provision, management and maintenance of the standard of protection afforded by existing coastal flood defences;
- where necessary, identification and implementation of strategic solutions that offer a sustainable means of addressing long-term flood risk;
- use of sustainable drainage systems in new developments and redevelopments; and
- preparation of an emergency flood management plan or updating of existing plans for inclusion in local emergency plans and/or major incident plans.

Strategic solutions to development and flood risk issues within the study area should be considered where appropriate. The South East England Development Agency (SEEDA) in partnership with Shoreham Port Authority, the local authorities, Government Office for South East England and other agencies are currently investigating the potential for a comprehensive regeneration of the Shoreham Harbour area. Large schemes such as this have potential to offer strategic solutions to flood risk issues within the district.

8. References

Department of Communities and Local Government (2007) 'A practice guide companion to Planning Policy Statement 25' Living draft, consultation paper

Department of Communities and Local Government (2006) 'Planning Policy Statement 25' (PPS25). Published in December 2006

Defra (October 2006) 'FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities – Climate Change Impacts.'

Capita Symonds (2006) 'Arun and Western Streams Catchment Flood Management Plan' Prepared for the Environment Agency, January 2006.

Environment Agency/Defra (2005) 'Flood Risk Assessment Guidance For New Development' Phase 2 Framework and Guidance for Assessing and Managing Flood Risk for New Developments - Full Documentation and Tools, R&D Technical Report TR2320/TR2, October 2005

CIRIA 624 (2004) 'Development and Flood Risk – Guidance for the Construction Industry'

Environment Agency (2003) 'Strategy for Flood Risk Management 2003 - 2008'

P.B Sayers, J.W. Hall, I.C. Meadowcroft, (May 2002) 'Towards risk-based flood hazard management in the U.K.'

Fleming, G (2001) 'Learning to Live with Rivers – Final Report to the Institution of Civil Engineers.'

9. Glossary and notation

ABD	Area Benefiting from Defences
Actual risk	The risk that has been estimated based on a qualitative assessment of the performance capability of the existing flood defences
AEP	Annual probability of exceedence. The annual chance of experiencing a flood with the corresponding flood magnitude, i.e. a 1% AEP flood is a flood with a flow magnitude that has a 1% chance of occurring in each and every year
Breach or failure hazard	Hazards attributed to flooding caused by a breach or failure of flood defences or other infrastructure which is acting as a flood defence.
CDC	Chichester District Council
CFMP	Catchment flood management plan
DCLG	Department for Communities and Local Government.
EA	Environment Agency
Flood defence	Natural or man-made infrastructure used to prevent flooding
Flood risk	*Flood risk is a combination of two components: the chance (or probability) of a particular flood event and the impact (or consequence) that the event would cause if it occurred* (EA 2003).
FRA	Flood risk assessment
Flood risk management	*Flood risk management can reduce the probability of occurrence through the management of land, river systems and flood defences, and reduce the impact through influencing development in flood risk areas, flood warning and emergency response* (EA 2003).
Flood zones	This refers to the Flood Zones in accordance with Table 1 of PPG25. For the purpose of the SFRA, the definition of flood zones varies slightly from PPG25 in that it shows the extent of flooding ignoring the presence of flooding defences, "except where the 'actual risk' extent is greater"
LDD	Local development documents
LDF	Local development framework
m	metres (measure of distance)
m/s	metres per second (measure of velocity)
NGR	National grid reference

ODPM	Office of the Deputy Prime Minister (ODPM). Former government body responsible for PPG25 and PPS25. DCLG is now the responsible Government body.
OS	Ordnance survey
PPG25	Policy Planning Guidance Note 25: Development and Flood Risk - Guidance explaining how flood risk should be considered at all stages of the planning and development process in order to reduce future damage to property and loss of life.
PPS25	Planning Policy Statement Note 25: Development and Flood Risk. Currently at consultation draft status (October 2005).
Precautionary principle	*''Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation*''. The precautionary principle was stated in the Rio Declaration in 1992. Its application in dealing with the hazard of flooding acknowledges the uncertainty inherent in flood estimation.
RBMP	River basin management plan.
Residual risk	Flood risks resulting from an event more severe than for which particular flood defences have been designed to provide protection.
RFRA	Regional flood risk assessment
RSS	Regional spatial strategy
Sequential risk-based assessment	Priority in allocating or permitting sites for development, in descending order to the flood zones set out in Table 1 of PPG25, including the sub divisions in Zone 3. Those responsible for land development plans or deciding applications for development would be expected to demonstrate that there are no reasonable options available in a lower-risk category (PPG25 paragraph 30).
SFRA	Strategic flood risk assessment
SFRM	Strategic Flood Risk Management. Current Environment Agency framework for commissioning flood mapping products (2003 - 2008).
SMP	Shoreline management plan
SREP	Strategic risk evaluation procedure
S105	National Section 105 Framework Agreement (NATCON 257) (1998 to 2003). Previous Environment Agency framework for commissioning flood mapping products under Section 105 of the Water Resources Act (1991).

TUFLOW	A two-dimensional fully hydrodynamic modelling package developed by WBM Oceanics Australia. The TUFLOW model differs from the ISIS model in that it models the whole floodplain as 2D domains, providing a more complete description of flood behaviour where complex overland flows and backwater filling occur.
1D	1 Dimensional
2D	2 Dimensional
1 in 100 year return period flood event	A flood with an average return period of 100 years. This term is not used in the SFRA as it can be misleading, in that it is possible that this size flood will not occur once in a 100 year period and likewise it is possible that it will occur more than once. The flood is also known as 1 per cent annual probability of exceedence (1% AEP) flood and this term is used throughout the SFRA .