Preston City Council, South Ribble Borough Council and Chorley Borough Council

Central Lancashire

Strategic Flood Risk Assessment

Level 1

Final Report

December 2007

Prepared for:

Prepared for:

Preston City Council

SOUTH RIBBLE BOROUGH COUNCIL

Chorley Council

Revision Schedule

Central Lancashire Strategic Flood Risk Assessment – Level 1 Report – Final

December 2007

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Abbreviations

Acronym	Definition
AOD	Above Ordnance Datum
AONB	Area of Outstanding Natural Beauty
CAMS	Catchment Abstraction Management Strategy
CBC	Chorley Borough Council
CEH	Centre for Ecology and Hydrology
CFMP	Catchment Flood Management Plan
DEFRA	Department for Environment, Food and Rural Affairs
DEM	Digital Elevation Model
DPD	Development Plan Documents
EA	Environment Agency
EP	English Partnerships
FRA	Flood Risk Assessment
GIS	Geographical Information Systems
GWV	Groundwater Vulnerability
ICMP	Integrated Catchment Management Plan
IDB	Internal Drainage Board
LDDs	Local Development Documents
LDF	Local Development Framework
LDS	Local Development Scheme
LiDAR	Light Detection and Ranging
LPA	Local Planning Authority
MDSF	Modelling Decision Support Framework
NFCDD	National Flood and Coastal Defence Database
ODPM	Office of the Deputy Prime Minister
PCC	Preston City Council
PCPA	Planning and Compulsory Purchase Act 2004
PPG25	Planning Policy Guidance Note 25: Development and Flood Risk
PPS25	Planning Policy Statement 25: Development and Flood Risk
RFRA	Regional Flood Risk Assessment
RPG	Regional Planning Guidance
RSS	Regional Spatial Strategy
SAR	Synthetic Aperture Radar
SA	Sustainability Assessment
SFRA	Strategic Flood Risk Assessment
SFRM	Strategic Flood Risk Mapping
SPG	Supplementary Planning Guidance
SRBC	South Ribble Borough Council
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems

Glossary

Term	Definition
Aquifer	A source of groundwater comprising water-bearing rock, sand or gravel capable of yielding significant quantities of water.
Catchment Flood Management Plan	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Climate Change	Both natural and human actions causing long term variations in global temperature and weather patterns.
Culvert	A channel or pipe that carries water below the level of the ground.
DG5	Data collected by Water Companies regarding flooding from sewers. OFWAT use this data as a performance indicator.
Exception Test	Required where the vulnerability of a development type is not entirely compatible with the level of flood risk at a particular site, i.e., following application of the Sequential Test. In order to qualify for development, it must be demonstrated that the development passes all elements of the Exception Test.
Flood defence	Infrastructure used to protect an area against floods such as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Floodplain	Area adjacent to river, coast or estuary that is naturally susceptible to flooding.
Flood storage	A temporary area that stores excess runoff or river flow often ponds or reservoirs.
Flood Outline	The extent of the area that is determined to be at a potential risk of flooding during a flood event of a given magnitude.
Fluvial flooding	Flooding by a river or a watercourse.
Fluvial Reaches	A stretch of river that is not influenced by the tide.
Functional Floodplain	Land where water has to flow or be stored in times of flood. Specifically, this land would flood with an annual probability of 1 in 20 (5 %) or greater in any year and is designed to flood in an extreme (0.1 %) event. The functional floodplain includes water conveyance routes and flood storage areas. Developed areas are not generally considered to comprise functional floodplain.
GIS Layers	Data that is presented in a spatial manner. Normally, each dataset constitutes one GIS layer. A number of GIS layers can be presented on a single map.
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
Indicative floodplain map	A map that delineates the areas that have been predicted to be at risk of being flooded during an event of specified probability.
Internal Drainage Board	Independent bodies with responsibility of ordinary watercourses within a specified District.

Inundation	Flooding.
Isohyet	A line drawn through geographical points recording equal amounts of precipitation during a specific.
LiDAR	An airbourne mapping technique that creates topographic data by useing a laser device to measure the distance between the aircraft and the ground below.
Local Development Framework (LDF)	The core of the updated planning system (introduced by the Planning and Compulsory Purchase Act 2004). The LDF comprises the Local Development Documents, including the Development Plan Documents that expand on policies and provide greater detail. The development plan includes a core strategy, site allocations and a proposals map.
Local Planning Authority	Body that is responsible for controlling planning and development through the planning system.
Mitigation measure	An element of development design that may be used to manage flood risk or avoid an increase in flood risk elsewhere.
Pluvial Flooding	Flooding that results from rainfall generated overland flow, before runoff enters any watercourse or sewer. Also refered to as surface water flooding.
Risk	The probability or likelihood of an event occurring.
SAR	A high-resolution microwave imaging system.
Sequential Test	A risk-based approach to assess flood risk, which gives priority in ascending order of flood risk, i.e. lowest risk first.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
Stakeholder	A person or organisation that has an interest in, or could be affected by the decisions made within a site.
Sustainability Appraisal	A process used to identify whether policies, strategies or plans promote sustainable development and also for improving policies. It is a requirement for Regional Spatial Strategies under the *Planning and Compulsory Purchase Act 2004.*
Sustainable Drainage Systems	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Tidal Outline	The extent of the area that is determined to be at a potential risk of flooding during a tidal flood event of a given magnitude.
Tidal Reach	A stretch of river that is influenced by tidal cycles.
1 in 100 year event	An event that has a probability of occurring once every 100 years. Also expressed as an event, which has a 1% probability of occurring in any one year.
1 in 100 year design standard	Flood defence that is designed for an event, which has an annual probability of 1%. In events more severe than this the defence would be expected to fail or to allow flooding.

Executive Summary

Local Planning Authorities are required to produce Local Development Frameworks (LDFs), which are a portfolio of Local Development Documents (LDDs) that collectively deliver the spatial planning strategy for the authority area. The LDDs undergo a Sustainability Appraisal (SA) which assists Planning Authorities in ensuring their policies fulfil the principles of sustainability. Strategic Flood Risk Assessments (SFRAs) are one of the documents to be used as the evidence base for planning decisions and are a component of the SA process. Therefore, SFRAs should be used in the review or production of LDDs.

Planning Policy Statement 25: Development and Flood Risk (PPS25; Communities and Local Government, December 2006) and its Practice Guide Companion (February 2007) recommends that SFRAs are completed in two consecutive stages. The Level 1 SFRA enables application of the Sequential Test, and the Level 2 SFRA increases the scope of an SFRA for development sites where the Exception Test is required. The Sequential Test is a simple decision-making tool designed to ensure that sites at little or no risk of flooding are developed in preference to areas at higher risk. Where it is not possible, due to wider sustainable development issues, to locate the development in a low flood risk area, the Exception Test must be applied. This Executive Summary and the accompanying Level 1 SFRA report constitute Level 1 of the Central Lancashire SFRA, which has been commissioned by Preston City, South Ribble Borough and Chorley Borough Councils.

Flood related planning policy at national, regional and district levels was collated and tabulated. This serves to highlight the fact that flood risk is taken into account at every hierarchical level within the planning process and also helps to demonstrate how the SFRA will feed into the three Council's LDF process. The Councils have not yet identified specific strategic development locations and the SFRA is designed to inform this decision-making process.

The main source of flood risk policy and strategy within the sub-region are Catchment Flood Management Plans (CFMPs). The three relevant CFMPs shaping flood risk management, guidance and strategy covering the Central Lancashire study area are the River Douglas CFMP, the River Ribble CFMP and the River Wyre CFMP (scoping stage). As well as highlighting the flood risks within a catchment, CFMPs also outline policies for dealing with flood risk management at various locations within a catchment.

PPS25 requires that, as part of any SFRA, all sources of flooding are identified. In order to assess the risk of flooding, the Environment Agency (EA) has provided data and has been closely involved with the Central Lancashire SFRA. In addition, other key stakeholders that have been consulted and that have provided data include United Utilities, Lancashire County Council, British Waterways and the Highways Agency. Parish Councils have also been consulted. From historical flood records, and using other sources of flood risk information, six main sources of flood risk were identified: fluvial flooding, tidal flooding, sewer flooding, surface water flooding, groundwater flooding and flooding from artificial sources.

The catchments of the River Wyre, River Ribble and River Douglas define the main hydrological influences of the study area (from north to south respectively). Parts of these catchments in the west of the study area are tidally influenced.

In order to present the best available flood information, SFRA Flood Zones were derived using a variety of existing sources of data. Where detailed numerical modelling of rivers has been undertaken and the flood outlines mapped, these have been used in preference to broad-scale modelled flood outlines. The result is a single map for each flood zone using a variety of data. Information regarding the relative confidence and source of the data accompanies the electronic versions of this data. All SFRA Flood Zones are based on information provided by the EA and prescribed methodologies in PPS25. All SFRA Flood Zones are based on the best available information provided by the EA. The methodology for deriving each of the SFRA Flood Zones is described below.

Flood Zone 1 refers to all areas that are not considered to be at risk of fluvial or tidal flooding. Flood Zone 1 consists of everything that falls outside of areas shown to be within Flood Zones 2 and 3. Whilst fluvial and tidal flooding is not a concern in these areas, the risk of flooding from other sources, such as surface water, groundwater, sewers and artificial sources may still be an issue.

Flood Zone 2 is the extreme flood event outline. This is the flood outline for the 1 in 1000 year flood event and is entirely based upon coarse modelling provided by the EA as none of the hydraulic models used for this study modelled the 1000 year scenario.

Flood Zone 3a is the combined outline for tidal and fluvial flooding and is the part of Flood Zone 3 that is outside Flood Zone 3b (the functional floodplain). The 1 in 200 year tidal flood event outline and the 1 in 100 year fluvial event outline have been merged to create one outline. For tidally influenced reaches, the 200 year tide levels and topographic data have been used to create an outline and this has substituted the 100 year fluvial flood outline in tidally influenced reaches.

Flood Zone 3b is defined as the functional floodplain (FFP). FFP only applies to undeveloped areas. The 1 in 20 or 1 in 25 year flood outlines have been used to define the FFP where available. For reaches where this is not available, the 100 year flood outline (i.e., Flood Zone 3a) has been used as a proxy until such a time when more detailed information is available (i.e., an EA modelling study or hydraulic modelling undertaken for a site-specific flood risk assessment). This is not to say that the entire area used as a proxy is FFP, moreover that the boundary of the FFP falls somewhere within that area.

Flood Zone 3 plus an allowance for climate change is calculated for fluvial and tidal reaches. For fluvial reaches, this Flood Zone is calculated by adding a net increase of 20 % over and above peak flows to the 100 year flood event. Where modelled information is not available, the Flood Zone 2 outline has been used as a proxy until such a time when more detailed information is available (i.e., an EA modelling study or hydraulic modelling undertaken for a site-specific flood risk assessment). This is not to say that the entire area used as a proxy is Flood Zone 3 plus an allowance for climate change, moreover that the boundary of Flood Zone 3 plus an allowance for climate change falls somewhere within that area. For tidal reaches, the effects of climate change that are prescribed in PPS25 have been added on to the 200 year tide levels and an outline created using topographic data.

In general, the fluvial and tidal flood risk across the study area is low. The SFRA Flood Zones show that there are significant areas in the west of the study area that are potentially at risk of flooding, which is due to the flat, wide floodplains in the west of these areas that are tidally affected. However, these areas are largely rural and the populations potentially at risk are therefore minimal. Locations within the study area that are particularly affected by flooding include Croston, Penwortham, Walton-le-Dale and southwest Preston.

In addition, there are numerous other settlements in the study area that have smaller areas at risk of fluvial and / or tidal flooding.

Sewer flooding was identified using historical records from United Utilities DG5 database (June 2007) detailing the total number of flood events that affected both internal and external property in a six month period. The number of recorded sewer flooding events varies across the region and due to the rural nature of the study area and the format in which data was provided, it is difficult to pin-point specific areas. However, Grimsargh, Walton-le-Dale and Euxton and their surrounding areas were shown to have been particularly affected by sewer flooding.

Little or no records of groundwater flooding were found during the course of the study. However, there are major aquifers with more permeable superficial deposits overlying them within the study area. Following periods of sustained rainfall, there may be a potential for groundwater flooding to affect basements and underground car parking facilities in certain areas, particularly Preston and also in areas immediately south of Preston including parts of Walton-le-Dale, Penwortham and Bamber Bridge.

The industrial heritage of Lancashire means that there are numerous artificial (manmade) waterways and reservoirs within or contributing to the Central Lancashire study area. British Waterways and private owners manage the canal network. Whilst there are few recorded incidents of flooding from the canal network, the risk of flooding still remains. Similarly, there are numerous reservoirs falling under the Reservoirs Act within the study area with additional reservoirs upstream of the region that may pose a risk. Again, there are few recorded incidents of flooding as a result of reservoirs, though the residual risk of breaching and overtopping remains, along with the risk associated with emergency discharges.

Due to the history of flooding in the study area, there are numerous structures and embankments (either purpose built or natural) that contribute to flood risk management. The EA maintain and keep records of many of the defences in the sub-region, though it should be noted that there are a great deal more “private” or “non-maintained” structures and embankments that provide a level of protection to areas. The standard of protection for defences within the study area varies markedly. As the CFMPs have all stated, locating and providing strategic flood storage in upper catchment areas can potentially provide protection to areas much further downstream. At present, there is one formally maintained flood storage area in Central Lancashire, which is located adjacent to Savick Brook in Fulwood, upstream of where Savick Brook passes beneath the A6 (Garstang Road).

A number of studies in addition to the CFMPs have identified an increased level of flood risk to the sub-region over the next 25 to 100 years as a result of climate change. Firstly, as a result of wetter and warmer winters, an increase in large fluvial flood events is likely to affect the larger rivers and watercourses in the sub-region. Secondly, extreme rainfall events are likely to become more frequent leading to a greater storm intensity and duration. This is likely to lead to a great deal more runoff causing surface water flooding and overwhelming of the urban sewer networks in particular.

To attempt to counteract this increase in runoff in local areas, the use of Sustainable Drainage Systems (SuDS) is becoming more important. In addition to the more usual attenuation and infiltration systems, providing more ‘green’ spaces within the urban environment can also help to reduce runoff and also increase wildlife habitat. These areas can be sometimes be most effective when placed alongside development in water corridors (e.g. along canals). Groundwater Vulnerability (GWV) data was collected for this

study. GWV refers to the potential for contamination of groundwater, rather than groundwater flooding, and can be used to identify areas suitable for particular SuDS techniques.

Using information and analysis gathered during the planning policy and flood risk reviews, a strategic overview of the flood risk was carried out to identify potential conflicts between development pressures and flood risk now and in the future.

The draft Regional Spatial Strategy (RSS) outlines the housing provision targets for the Central Lancashire Authorities and involves an increase (between 2003 and 2021) of 9,120 for Preston, 8,600 for South Ribble and 6,500 for Chorley. The draft RSS indicates that at least 80 % of housing is located on previously developed (brownfield) land. Following the Examination in Public of the draft RSS, the panel recommended alterations to these figures. While the maximum target for Preston remains at 9,120, those for Chorley and South Ribble are both altered to 7,500 each. In addition, the brownfield allocation is recommended to be reduced to 70%. The Secretary of State's proposed changes to the draft RSS are still awaited. In addition the three authorities have recently submitted an expression of interest jointly with Blackpool Council for a Growth Point, which will require an increase in housing provision of at least 20% above draft RSS figures.

A focused settlement assessment was undertaken by categorising settlements in the study area according to planning policy. These categories are: Urban Settlements, Potential Major Development Sites and Rural Settlements. A series of maps were produced for each of the Rural and Urban Settlements and Potential Major Development Sites that presented all of the available flood information. The maps, statistics and main issues were presented on summary sheets for each of the settlements.

The Potential Major Development Sites that were investigated at this stage were Riversway (Preston), Buckshaw Village (South Ribble / Chorley) and Goosnargh / Whittingham (Preston). Of these Potential Major Development Sites, Riversway is shown to be at a significant risk of flooding from the tidally influenced reach of the River Ribble. A site specific FRA has been undertaken for the proposed development and this was reviewed.

The purpose of the focused settlement assessment is to identify where future strategic level development sites could potentially be located. In addition, the maps can be used to identify the requirements for, and also inform, site-specific FRAs for future development. Guidance on undertaking site-specific FRAs is provided in the report.

1 Introduction

1.1 Background

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

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

PPG25 was superseded by Planning Policy Statement 25: Development and Flood Risk (PPS25) in December 2006. PPS25 re-emphasises the active role Local Authorities should have in ensuring flood risk is considered in strategic land use planning. PPS25 encourages Local Planning Authorities to undertake SFRAs and to use their findings to inform land use planning. In February 2007, a "Living Draft" of the Practice Guidance for PPS25 was released for consultation. Although this is a consultation document, the approach to SFRAs that is suggested should be considered.

To assist Local Authorities in their strategic land use planning, SFRAs should present sufficient information to enable Local Authorities to apply the Sequential Test to their proposed development sites:

> *"Decision-makers should use the SFRA to inform their knowledge of flooding, refine the information on the flood map and determine the variations in flood risk from all sources of flooding across and from their area. These should form the basis for preparing appropriate policies for flood risk management for these areas."* (PPS25, 2007:31)

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

> *"…the scope of the SFRA will be widened to consider the impact of the flood risk management infrastructure..."* (PPS25, 2007:21)

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

1.2 The Central Lancashire SFRA

The combined administrative areas of Preston City Council (PCC), South Ribble Borough Council (SRBC) and Chorley Borough Council (CBC) form the sub-region of Central Lancashire. The sub-region contains the major conurbation of Preston and the urban areas of Chorley, Leyland and Bamber Bridge.

The sub-region has recently benefited from the development and subsequent economic growth associated with the Central Lancashire New Town. A growth in service-sector employment in Preston and Chorley has offset the decline of the manufacturing industry that has affected much of Lancashire and the northwest. In order to ensure that continued growth is sustainable, the three Local Authorities have jointly embarked upon the Local Development Framework (LDF) process and have undertaken consultations on the issues and options for the Core Strategy. The draft Regional Spatial Strategy (RSS) identifies Preston as one of a number of regional centres where new development will be concentrated in the northwest. Once prepared, the Core Strategy will identify other areas of new development and an SFRA is intended to assist in identifying such development areas.

The spatial planning of any proposed development must be considered with regard to the current and future risk of flooding from a number of sources, including fluvial, tidal, surface water (storm water) and groundwater. It is therefore vitally important that flood risk is considered at a strategic scale to inform land allocations and future developments proposed by the emerging LDFs.

1.3 The SFRA Structure

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

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

The results of the Level 1 SFRA will enable PCC, SRBC and CBC to review the current potential major development sites and to inform the scope of the Sustainability Appraisal. Following consultation with the three Councils, the findings of the Level 1 assessment will enable the scope of the Level 2 SFRA to be defined.

This report comprises the Central Lancashire Level 1 SFRA.

Level 1 SFRA

The Level 1 SFRA should present sufficient information to enable the Local Planning Authority to apply the Sequential Test to potential development sites and to assist in identifying whether the application of the Exception Test will be necessary. In addition, the Level 1 SFRA provides background information and a preliminary review of available data, sufficient to scope the type of assessment necessary should a Level 2 SFRA be required.

The objective of the Level 1 SFRA is to collate and review available information on flood risk for the study area. Information has been sought from a variety of stakeholders including the Environment Agency, Preston City Council, South Ribble Borough Council, Chorley Borough

Council, Lancashire County Council, the Highways Agency and United Utilities. Parish Councils have also been consulted. In addition to the review of data and consultation with local stakeholders, Level 1 also considers any available data needed to meet the requirements of a Level 2 SFRA. Where necessary the report identifies works beyond the critical scope that may benefit the assessment.

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

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

Level 2 SFRA

The Level 2 SFRA will provide sufficient information to facilitate the application of the Exception Test, where required. This will be based on information collected for the Level 1 SFRA and additional works where necessary.

1.4 The SFRA Aims & Purpose

The original Central Lancashire SFRA brief was written prior to the release of PPS25 and the Practice Guide Companion. An agreement was reached with the Councils to continue following the aims outlined in the original brief but to follow the layout recommended by PPS25 and the Practice Guide Companion to ensure that the SFRA is sound and up to date.

The aims and purpose of the Central Lancashire SFRA as set out in the brief dated December 2006 are: -

1. To identify areas that are at risk of flooding for all flood zones now, in 25 years and in 50 years given the known projections on climate change and development proposals,

2. To identify variations in the actual flood risk in a given area, including the effect of any defences, within Flood Zone 3, as identified by the Environment Agency Flood Maps, now, in 25 years and 50 years given the known projections on climate change and development proposals.

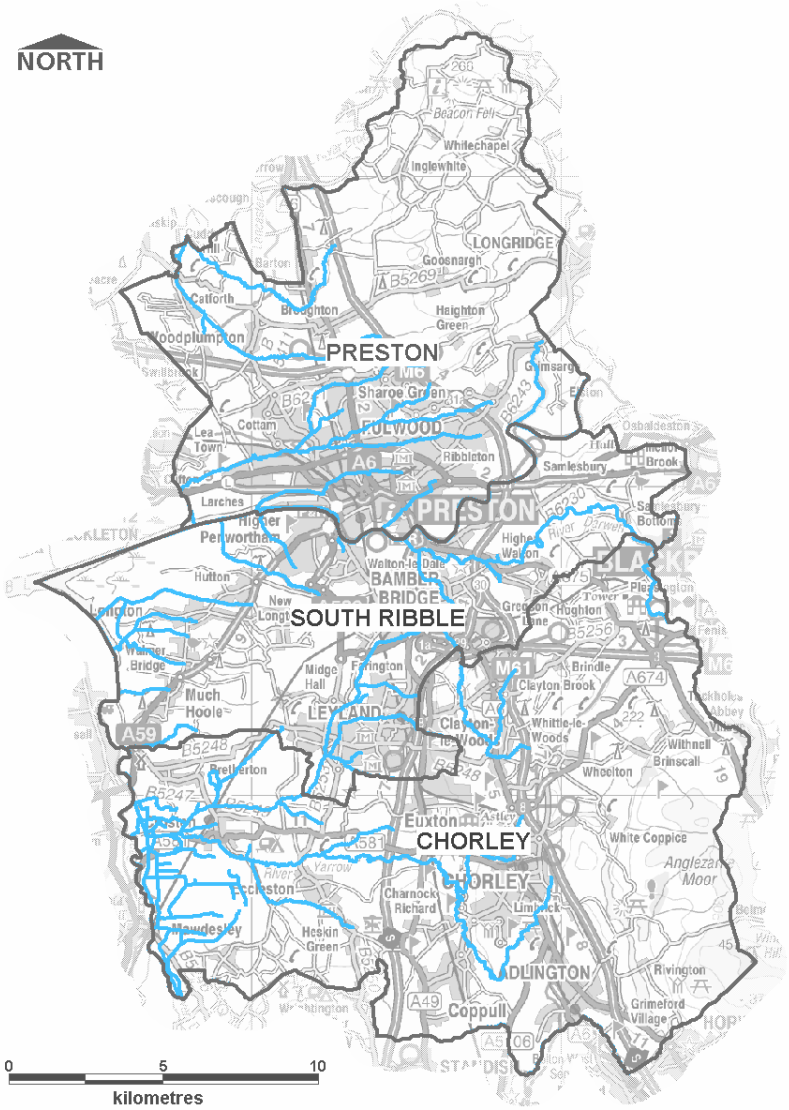
3. To identify the effect of the increase in surface water run off from proposed developments, for all zones identified in PPS25, and any areas where the receiving system is known to be inadequate, now, in 25 years and in 50 years given the known projections on climate change and development proposals.

The Level 1 SFRA Report addresses points 1 and parts of point 2. Once the Level 1 SFRA and other planning policy requirements have been used to identify future development sites that require further investigation, the Level 2 report will be created and will fulfil the remainder of point 2 and point 3.

2 Study Area

The study area is defined by the combined administrative boundaries of Preston City Council, South Ribble Borough Council and Chorley Borough Council (Figure 2-1). This results in a total study area of 459 km². The Central Lancashire administrative area is predominantly rural, with few major urban centres, namely Preston, Chorley, Leyland and Bamber Bridge.

Figure 2-1: Central Lancashire SFRA Hydrological Map



2.1 Hydrology and Flood Sources

The main river catchments within the study area are: -

- The River Douglas;
- The River Ribble;
- The River Wyre.

The River Douglas & Tributaries

The catchment of the River Douglas covers the south of the study area and is covered by the River Douglas Catchment Flood Management Plan (EA, 2007). The entire catchment covers 460 km^2 and within the study area drains the urban centre of Chorley. The main tributary of the River Douglas is the River Yarrow, which has a total catchment area of 150 km^2 in the central and northern parts of the Douglas catchment. The River Douglas rises on Rivington Moor at around 440 mAOD and the upper catchment is characterised by the Rivington Reservoir Complex, a series of four reservoirs that capture the runoff from the moorland areas of the southern Pennines. The Rivington Reservoirs also form the headwaters of the River Yarrow. Downstream of the Rivington Reservoir Complex, the River Douglas flows southwest in a relatively steep narrow valley through Horwich and into Wigan. Downstream of Wigan, the valley opens out into flat, open landscape and flows northwest until it discharges into the Ribble estuary, 8 km downstream of Preston. The lower reaches of the Douglas are tidally influenced and drainage is modified by pumping within a complex network of artificial channels.

From Rivington, the River Yarrow flows west towards the settlements of Chorley and Euxton, before its confluence with the River Lostock and subsequently the confluence with the River Douglas.

The underlying geology of the south and east of the Douglas catchment has rocks of the millstone grit series forming the higher ground and coal measures elsewhere, mainly alternating sandstones and shale/mudstone with coal seams in some areas. The north and west of the catchment is Permo Triassic, made up of Sherwood sandstones and Mercia mudstones.

Development that has taken place within the natural floodplain has resulted in an increased risk of flooding in some areas. In many reaches the rivers in the Douglas catchment have been heavily modified through the introduction of raised defences and culverts.

The River Ribble & Tributaries

The River Ribble forms the administrative boundary between PCC and SRBC and its catchment covers the central part of the study area. The River Ribble CFMP (EA, 2007) notes that the Ribble drains a total area of 1,490 km^2 in North Yorkshire and Lancashire and covers a distance of around 100 km from source to mouth. Its source is located in the Yorkshire Dales near Gayle Woods.

Approximately 12 % of the catchment is urban, with development located in a few key areas (including Blackpool, Preston and Blackburn). Development in the natural floodplain over time has increased the risk of flooding at some locations, including Preston. Elsewhere, land use is largely rural, comprising improved grassland and semi-natural vegetation.

Most of the Ribble catchment upstream of the confluence with the River Calder is Carboniferous Limestone, a minor aquifer, which is important for local supplies and generation of baseflow to rivers. Downstream of the Calder confluence to the M6 motorway is Carboniferous Millstone Grit, which together with the overlying soils tend to generate rapid flow to watercourses. Further west, between the M6 and the Preston estuary, are Permo-Triassic Sandstones, which are classified as major aquifers

Raised river defences have been built across parts of the catchment to prevent flooding and the area now has a legacy of dependency on these defences.

The River Wyre & Tributaries

The catchment of the River Wyre covers the northern part of the study area. According to the River Wyre CFMP Scoping Report (EA, 2007) the River Wyre and its associated tributaries drain a total catchment area of approximately 450 km^2 from the source of the Wyre upland in the Pennines at 560 mAOD. The River Wyre flows in a general east-west direction from the North Lancashire Fells to the Irish Sea at Morecambe Bay. The average annual rainfall for the catchment is 1200 mm. The majority of the catchment is agricultural and there are pockets of urbanisation along the entire reach of the River Wyre, which make up about 10 % of the catchment. Several tributaries join the River Wyre, including the River Calder and the River Brock. The Lancaster Canal crosses the catchment in a general north to south direction. However, the Canal does not have any interaction with the watercourses within the Wyre Catchment.

The geology of the Upper Wyre consists of Namurian Millstone Grit, which is largely impermeable resulting in a rapid runoff response to rainfall. The Carboniferous Limestone that underlies the Upper Brock part of the catchment has potential storage capability, which can delay the runoff response of the Upper Brock catchment. The middle and lower reaches of the Wyre are comprised of Marl, Sherwood Sandstone and Millstone Grit. The Sherwood sandstone is highly permeable and contributes to the base flow of the River Wyre and it's tributaries.

2.2 Historical Flooding

There have been numerous historical flood events in the Central Lancashire study area. These events are summarised by catchment in Appendix F with the causes and effects presented where available. Environment Agency data, including Historical Flood Maps, CFMPs and flood event databases indicate that flooding in the Douglas, Ribble and Wyre catchments has occurred in the past as a result of tidal and fluvial causes. Flooding from lesser sources is also important with stakeholder responses from United Utilities and the Highways Agency indicating sporadic flooding hotspots across the study area.

2.3 Hydrogeology

The geology of the study area is varied. Triassic mudstones and the Permian and Triassic sandstones make up the western part of the study area. The sandstones are classified as major aquifers and are highly permeable. The mudstones are less permeable and result in medium to rapid runoff. Namurian Millstone Grit underlies the south west of the study area. The Millstone Grit series is largely impermeable, resulting in rapid runoff response to rainfall. The Carboniferous Limestone in the northeast of the study area is classed as minor aquifers of low vulnerability and is moderately permeable. The groundwater vulnerability maps and geology maps for each administrative area is presented in Appendix E.

2.4 Tidal Influences

The tidal extents of the Ribble and Douglas catchments are within the study area and watercourses within these catchments in the western part of the study area are tidally influenced. The normal tidal limits are on the outskirts of Preston and at Rufford for the River Ribble and River Douglas respectively. Approximately 7% of the study area is at risk of tidal flooding during the 1 in 200 year tidal flood event, which may increase to approximately 8% with the effects of climate change. The majority of the area at risk of tidal flooding is rural. However, some parts of urban areas are at risk, in particular Preston, Walton-le-Dale and Penwortham

2.5 Sewers

The majority of sewers are built to the guidelines within "Sewers for Adoption" (WRC, 2006). These sewers have a design standard to the 1 in 30 year flood event and therefore it is likely that the majority of sewer systems will surcharge during rainstorm events with a return period greater than 30 years (e.g. 100 years). United Utilities (UU) has provided DG5 data sets for a six month period (October 2006 – April 2007) for the region, which is presented as a thematic map in Appendix D.

2.6 Groundwater

There are no reported occurrences of groundwater flooding from hard rock aquifers or superficial deposits in the Northwest EA region[1]. The underlying geology varies and generally the geology in the northeast and southeast of the study area is classified as minor aquifers with the geology in the central and western parts of the site classified as major aquifers.

2.7 Pluvial

In June 2007, the Lancashire Evening Post reported several incidents of flash flooding in Lostock Hall and Penwortham following a prolonged period of heavy rain. There are no additional records of pluvial, or overland, flooding within the study area. However, such flood events are rarely recorded and there is potential for pluvial flooding in low-lying areas that are behind flood defences.

2.8 Artificial Sources

The EA have provided a list of data relating to a number of reservoirs and inland water bodies that either fall within the study area or where significant failure / breach would have an effect upon watercourses within the study area. The maps in Appendix B show the locations of the reservoirs in relation to the settlements. A list of risk ratings for these reservoirs can be made available to the LPAs from the EA to assist with their undertaking of Sequential Testing of their proposed development sites (upon approval of the EA).

British Waterways have provided a GIS layer showing the canals in the study area. The main canal in the study area is the Leeds and Liverpool canal. These are also shown on the maps in Appendix B.

[1] Defra (2004) Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flood Scoping Study (LDS 23). Volume 1.

2.9 Administrative Areas

Environment Agency

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

Drainage

United Utilities are responsible for storm water and foul water management across the study area. In addition, private individuals may be responsible for drainage systems that operate prior to discharge either into a watercourse or into a public sewer.

2.10 Development Pressures

Development pressures vary somewhat across the Central Lancashire sub-region, with Preston in particular having limited available land that is not open countryside or greenbelt, but the most significant pressure for all three authorities, as it is for many authorities across the country, comes from identifying land for new housing, particularly brownfield land.

The Panel Report for the Examination in Public of the draft RSS for the North West outlines the following housing provision targets for the Central Lancashire Authorities, which involve slight increases from the draft RSS for Chorley and South Ribble:

- Preston – a 9,120 maximum net increase in dwellings for period 2003-2021, which gives a mean annual increase of 507
- South Ribble – a 7,500 maximum net increase in dwellings for period 2003-2021, which gives a mean annual increase of 417
- Chorley – a 7,500 maximum net increase in dwellings for period 2003-2021, which gives a mean annual increase of 417

Outside of housing, development pressures for other uses are not as significant and there are a series of sites remaining that could be brought forward for other uses, particularly in South Ribble and Chorley, if there are no physical or economic factors that might prevent this.

2.11 Future Flood Risk (25, 50 and 100 Year Horizons)

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

The ASCCUE (Adaptation Strategies for Climate Change in the Urban Environment) project is a study undertaken collaboratively by the University of Manchester, the University of Cardiff, the University of Southampton and Oxford Brooks University.

The project aimed to further the understanding of the impacts and risks of climate change on towns and cities through three 'exposure units' of human comfort, urban green space and the built environment. One of the aspects examined was surface water runoff during extreme rainfall events and Manchester was looked at as an example. With an increase in development, there comes an increase in the amount of impermeable areas thus leading to increased runoff during storm events. In one of the worst-case modelled scenarios, an increase in rainfall of 56% by 2080, led to an increase in runoff of 82%. This highlights the increasing conflict and pressures that are emerging between climate change scenarios and future development aspirations.

Fluvial Flood Risk

The EA has provided a number of detailed hydraulic models for watercourses within the study area. There is a potential for increased peak river flow as a result of climate change, as identified in Table 2-1, and an increase in peak flow results in a greater floodplain envelope. The hydraulic models provided by the EA have an outline of Flood Zone 3 plus an allowance for climate change and therefore takes account of the 100 year fluvial flood event plus a 20 % increase in peak river flows.

For watercourses where no detailed hydraulic model was available, the approach was taken to use the Flood Zone 2 outline as a substitute until such a time that modelled data is available. The methodology is explained further in section 3.5.

Tidal Flood Risk (including 25 and 50 year horizons)

PPS25 details the potential sea level rises as a result of climate change. The recommended contingency allowances are included in Table 2-2. These recommendations take account of the proposed net sea level rises for the 25, 50, 75 and 100 year horizons. The sea level rises for tidal reaches within the study area have been calculated and are presented in Appendix C. The methodology for mapping the effects of climate change is explained in section 3.5.

Surface Water and Sewer Flooding

The potential increase in peak rainfall intensity (Table 2-1) will lead to an increase in surface water flooding, surcharging of gullies and drains and sewer flooding. This is very difficult to quantify and should be considered in site-specific Flood Risk Assessments.

Table 2-1 Recommended national precautionary sensitivity ranges for peak rainfall intensities, peak river flows, offshore wind speeds and wave heights. (PPS25 Table B.2)

Parameter	1900 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
Peak river flow	+10%	+20%		
Offshore wind speed	+5%		+10%	
Extreme wave height	+5%		+10%	

Table 2-2 Recommended contingency allowances for net sea level rise (PPS25 Table B.1)

Administrative Region	Net Sea Level Rise (mm/yr) Relative to 1990			
	1900 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
NW England	2.5	7.0	10.1	13.0

3 Level 1 SFRA – Methodology

3.1 Objective

As outlined in Sections 1.3 and 1.4, the objective of the Level 1 SFRA is to collect, collate and review the information available relating to flooding in the study area. This information is then presented in a format to enable the Local Planning Authorities to apply the Sequential Test to their growth areas and to identify potential development sites in Zones 2 and 3, which would require the application of the Exception Test through a Level 2 SFRA. Gaps in the data/information have also been identified in order to ascertain additional requirements needed to meet the objectives of a Level 2 SFRA, where required.

3.2 Tasks

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

- Inception meeting with PCC, SRBC and CBC on 22 March 2007;
- Established the local stakeholders;
- Contacted stakeholders requesting data/information;
- Collated and reviewed data and populated data register;
- Presentation of available relevant information on flood sources and flood risk
- Reviewed received data against the SFRA objectives; and
- Identified gaps in data.

The above tasks were completed between March and July 2007.

3.3 Stakeholders

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

- Lancashire County Council;
- Preston City Council;
- South Ribble Borough Council;
- Chorley Borough Council;
- Parish Councils,
- British Waterways,
- United Utilities,
- Environment Agency; and,
- Highways Agency / Amey Mouchel.

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

3.4 Data / Information Collected

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

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

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

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

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

3.5 Consultations

Parish Councils

Parish Councils within the study area were consulted in order to ensure that the Level 1 SFRA is robust. Each Parish Council was provided with a draft Executive Summary, a map showing flood data within their Parish and a proforma giving the opportunity to comment. A list of the Parish Councils that were consulted is included in Appendix K.

Of the 38 Parish Councils consulted, 11 responses were received. The comments received have been collated and presented in Appendix K. The way in which the comments have been considered is also included in Appendix K.

3.6 GIS Layers

Using the data collected a series of GIS layers were collated to visually assist PCC, SRBC and CBC in their site allocation decisions and Development Control activities. Using GIS, the data was analysed and interrogated to produce flood risk statistics for the entire study area, each district and individual settlements (See Appendix A and Appendix B).

Broadly, the layers can be classified into planning policy, informative and flood risk categories. Table 3-2 summarises the main GIS layers used in the SFRA. Appendix J includes a more detailed table highlighting the GIS layers that have been used and their limitations.

GIS Data Gaps & Assumptions

Some data that is necessary to satisfactorily complete an SFRA is either not available at all, or is not available in GIS format. In order to present complete flood zones with the best available information for the Central Lancashire study area, it has been necessary to make certain assumptions, in agreement with the three Local Authorities and the Environment Agency, so that gaps in data could be filled; these assumptions have been outlined in the proceeding sections and Appendix J.

Table 3-2: GIS Layers used in SFRA

Planning Policy	Informative	Flood Risk
PCC, SRBC & CBC Administrative Boundaries	Main River Network	Flood Zone Maps (Fluvial and Tidal)
Urban Areas	Ordinary Watercourse Network	Historical Flooding Maps
Potential Major Development Sites	Major Water Bodies under the Reservoirs Act (1975)	Flood Storage Areas
	British Waterways Canal Network	Flood Defences
		Flood Warning Areas
		Groundwater Vulnerability maps
		Areas benefiting from defences

Flood Risk GIS Layers

Flood Zones refer to the probability of river and sea flooding ignoring the presence of existing defences. Flood Zones are the starting point for the risk-based sequential approach that should be provided at all stages of planning. The definition of each Flood Zone (FZ) is detailed in Appendix G Table G-1.

Detailed & Coarse Modelled Flood Outlines

In order to present the most up-to-date and relevant flooding information available, the flood zone maps (for both fluvial and tidal) have been created using a variety of existing sources of data. Where detailed hydraulic modelling has been undertaken and flood outlines mapped, these have been used in preference to broad-scale modelled flood outlines. This results in a single map for each flood zone generated using a combination of data. For each fluvial or tidal reach, information on the data has been provided detailing the source of the data used to create the flood zone and the relative confidence in the data.

For example, the flood outlines (both fluvial and tidal for FZ3a, FZ3b and FZ3 + Climate Change) for the River Douglas have been derived from an EA commissioned Strategic Flood Risk Mapping hydraulic modelling study. These outlines have been used in preference to the EA broad-scale modelled outlines. Some watercourses in the study area do not have flood zones associated with them or do not have all flood zones defined. This is not to suggest these watercourses do not flood, moreover that modelled data is not currently available.

Tidal & Fluvial Flooding

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

In tidally affected reaches, a 200 year tidal outline has been created using the 200 year tide levels, which the EA provided for a number of nodes in tidally affected reaches. The levels were derived by Posford Duvivier's Coastal Modelling study (2001), which was undertaken as part of a Strategic Flood Risk Mapping (SFRM) study. The levels were used to create a 200 year tidal outline using LiDAR data and takes account of the gradual increase in flood level travelling upstream. This has substituted the 100 year fluvial flood outline in tidally influenced reaches to create Flood Zone 3a.

Functional Floodplain

In accordance with paragraph 3.17 of the PPS25 Practice Guide, all areas within Flood Zone 3 should be considered as Flood Zone 3b unless proved otherwise. The Practice Guide Companion notes that Flood Zone 3b should be mapped including the presence of defences. PPS25 defines Flood Zone 3b as the flood with an annual probability of 1 in 20 (5% AEP) or greater; or at another probability to be agreed between the LPA and the EA. For the watercourses within the study area, the 5% flood outline has not been delineated or modelled. However, the 1 in 25 year (4% AEP) flood event has been modelled and mapped for some watercourses. The three Council's and the EA agreed that adopting the 1 in 25 year outline was an acceptable and more conservative approach to representing functional floodplain. Where the 1 in 25 year flood outline is not available it was agreed that the whole of Flood Zone 3 should be assumed to be functional until such a time that more detailed information is available, such as the Level 2 SFRA, an EA Strategic Flood Risk Mapping (SFRM) study or a site-specific Flood Risk Assessment (FRA).

The Effects of Climate Change

To ensure sustainable development now and in the future, PPS25 requires that the effects of climate change should be taken into account in an SFRA and that flood outlines delineating climate change should be presented. Where possible, modelled outlines for Flood Zone 3 including the effects of climate change have been presented.

Fluvial

For fluvial reaches, climate change has been added to the 1 in 100 year flood event using a net increase of 20% over and above peak flows. In areas where climate change has not been modelled or mapped, an increase in the depth and extents of the existing flood zones is likely. In order to take this into account, it has been agreed with the three Councils and the EA that Flood Zone 2 should be used as a surrogate for Flood Zone 3 plus climate change until such time that more detailed information is available, such as the Level 2 SFRA, an EA Strategic Flood Risk Mapping (SFRM) study or a site-specific Flood Risk Assessment (FRA).

Tidal

For tidal reaches, the 200 year flood level was provided by the EA for a number of nodes along tidally affected river reaches in the study area. These levels were derived from Posford Duvivier's Coastal Modelling, which was undertaken as part of a Strategic Flood Risk Mapping (SFRM) study. The climate change flood outline includes the projected effects of sea level rise over and above the 1 in 200 year flood event using the net sea levels rises recommended in PPS25 (Table B.1, PPS25). This flood outline has been delineated using the calculated levels and LiDAR data. The calculations for the 200 year plus climate change levels are included in Appendix C. These calculations also consider the impacts of climate change at the 25 and 50 year horizons.

Historical Flood Mapping

A historical flood outline layer was created using data from the EA that delineates approximate areas that have flooded in the past. Much of the information used to create the outlines is estimated following a flood and some inaccuracies may exist. In addition, historical flooding records do not always differentiate between flooding caused by fluvial/tidal sources (which models attempt to replicate) and flooding as a result of other sources such as overwhelmed drainage or waterlogged rural land. However, the layer serves a useful purpose to highlight to PCC, SRBC and CBC that there are areas, some of which may be shown to be outside the Flood Zones, which have experienced flooding in the past.

Storm Water Flooding

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

Flood Defences

Flood defences maintained by the EA have been shown as a separate GIS layer. The information has been derived directly from the National Flood and Coastal Defence Database (NFCDD) and as a result layers also contain metadata detailing the general condition and a description of the defence. This will assist the three Councils in determining sites that potentially lie in defended areas.

Flood Warning Layers

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

Groundwater Vulnerability Mapping

The EA's groundwater vulnerability maps have been presented in a thematic map to highlight areas that overlie aquifers with a high vulnerability. Major Aquifers with a high vulnerability tend to have a more permeable surface geology. Groundwater vulnerability relates to the potential for contamination to groundwater and thus is a useful tool to determine the suitability of sustainable drainage (SuDS) techniques. The Groundwater Vulnerability Maps are shown as a thematic map in Appendix E.

Reservoir Act (1975) Water Bodies

A layer displaying major water bodies falling under the regulation of the Reservoir Act has been provided by the EA (Exeter). This can assist the three Councils in assessing sites immediately downstream of major water bodies. PCC, SRBC and CBC may wish to undertake more detailed analyses of particular water bodies to determine any potential flood risk.

British Geological Survey Geology Mapping

Geology data has been obtained from BGS at a scale of 1:50,000. Superficial and bedrock data is presented in Appendix E. This data can be used to ascertain the suitability of various sustainable drainage (SuDS) techniques for proposed developments.

Planning Policy GIS Layers

Urban Areas & Potential Allocation Sites

The three Councils have provided information on defined urban areas within the study area. SRBC have provided planning related GIS layers including Employment Land Allocations and Housing Land. CBC and PCC have provided information on where potential future development could take place and this has been converted to GIS where appropriate. CBC has provided their Local Plan proposals map.

The three Councils have not yet allocated future development sites and will be using the SFRA to inform this process as outlined in PPS25 and the Practice Guide Companion. However, key development sites in the area are Riversway and Goosnargh/Whittingham in Preston and Buckshaw Village in South Ribble and Chorley.

4 Level 1 SFRA – Flood Risk Review

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

4.1 Broad Scale Assessment

Broad-scale information received from stakeholders that is of use to the Local Planning Authorities in applying the Sequential Test at a District Level is presented in summary and in detail in Appendix A and in an accompanying GIS workspace. The broad-scale assessment has been based on the GIS layers highlighted in Section 3.5. Using GIS, the various layers were queried against one another to determine total areas of intersection for each flood zone.

4.2 Focused Settlement Assessments

As has been agreed with the three Councils, the settlements within the study area have been divided into a settlement hierarchy according to references within various policies held by the three Councils:

- **Urban Areas** represent towns and cities with a good range of services and facilities including public transport. These settlements are capable of sustaining some expansion, infilling and redevelopment.
- **Potential Major Development Sites** represent major new mixed-use developments that include housing, business opportunities, improvements to local infrastructure and open space.
- **Rural Settlements** represent villages with a more limited level of services and should only accommodate small-scale development or minor extensions that address specific local needs.

Tables 4-1 to 4-3 show the various settlements within the study area, broken down into the settlement hierarchy outlined above.

Table 4-1: Central Lancashire Urban Areas

Urban Areas		
Preston City Council	**South Ribble Borough Council**	**Chorley Borough Council**
Preston	Bamber Bridge	Adlington
	Farington	Chorley Town
	Leyland	Clayton Brook / Green
	Lostock Hall	Clayton-le-Woods
	Penwortham	Coppull
	Walton-le-Dale	Euxton
		Whittle-le-Woods

Table 4-2: Central Lancashire Potential Major Development Sites

Potential Major Development Sites		
Preston City Council	**South Ribble Borough Council**	**Chorley Borough Council**
Goosnargh / Whittingham	Buckshaw Village	Buckshaw Village
Riversway		

Table 4-3: Central Lancashire Rural Settlements

Rural Settlements		
Preston City Council	**South Ribble Borough Council**	**Chorley Borough Council**
Barton	Coupe Green	Abbey Village
Broughton	Gregson Lane	Brindle
Grimsargh	Higher Walton	Brinscall/Withnell
Lea Town	Hutton	Bretherton
Woodplumpton	Longton	Charnock Richard
	Mellor Brook	Croston

Rural Settlements continued…		
Preston City Council	**South Ribble Borough Council**	**Chorley Borough Council**
	Much Hoole	Eccleston
	New Longton	Gib Lane
	Walmer Bridge	Higher Wheelton
		Hoghton
		Mawdsley
		Wheelton

Following the Settlement Hierarchy, a more focused, local-level assessment has been carried out for each of the Urban Areas, Potential Major Development Sites and Rural Settlements within the study area and is presented in Appendix B. This consists of the same information used in the District-Level assessment, but at a smaller scale, allowing planners to assess flood risk information at a higher resolution. In addition, these assessments provide a table with information on development aspiration for housing and employment uses, if any, from the Council's policies that influence development. They also provide a summary of reported incidents within the area, highlighting flooding sources and problem areas.

The information presented at the Level 1 SFRA has predominately been provided by the Environment Agency from their high-level hydraulic modelling programmes. PCC, SRBC and CBC, Lancashire County Council, British Waterways and United Utilities have made additional contributions.

4.3 Summary

In line with PPS25, the Sequential Test should be applied at all stages of planning. The aim of this is to direct new development towards areas that have a low probability of flooding. The information provided in Appendix A and B indicates the geographical extent of Flood Zone 2 and Flood Zone 3 for the Central Lancashire study area.

The study area for the combined administrative regions of Preston City Council, South Ribble Borough Council and Chorley Borough Council is 459 km². Using the flood zone maps, it is apparent that 7.40% (33.97 km²) of the total administrative area is located within Flood Zone 3b (Functional Floodplain) whilst 4.42% (20.28 km^2) is located in Flood Zone 3a (High Risk) and 2.66% (12.22 km^2) is located in Flood Zone 2. Of the total area, approximately 16.41% (75.34 km²) is already developed with 6.57% (1.78 km^2) falling under FZ3b, 2.80% (0.63 km^2) falling under FZ3a and 3.14% (2.37 km^2) falling under FZ2.

The broad-scale and settlement-level assessments clearly show that, whilst flood risk exists in areas of the District, it does not pose a widespread and significant issue for the allocation of development sites. Where potential development sites are at risk from flooding, the planning authority must determine their suitability based on the Sequential Test and vulnerability classifications presented in Tables D1 and D2 of PPS25. Wherever possible the LPA's should

seek to direct development to low probability Flood Zones (Flood Zone 1). Where this is not possible, development should preferably be located in Flood Zone 2 and where this is not possible, sites in Flood Zone 3 can be considered. Dependent on the vulnerability of the proposed development (as classified in PPS25 – table D2), some development sites that are either wholly or partly situated in Flood Zone 2 or 3 may require the application of the Exception Test. Those development areas requiring application of the Exception Test will require further assessment in a Level 2 SFRA. Information on the application of the Sequential Test, guidance on strategies for managing flood risk, guidance on the potential use of Sustainable Drainage Systems (SuDS) and guidance on site-specific Flood Risk Assessments (FRAs) are provided in Section 5 and Section 7.

A table of all settlements and potential major development sites and their corresponding flood risk can be found in Appendix B. This table should be used by PCC, SRBC and CBC to identify those areas at risk of flooding in Flood Zones 2 and 3.

5 Sequential Test

5.1 Background

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

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

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

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

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

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

These flood sources are typically less understood than tidal and fluvial sources. Data primarily exists as point source data or through interpretation of local conditions. In addition, there is no guidance on suitable return periods to associate with floods arising from these sources. For example modern storm water drainage systems are constructed to a 1 in 30 year standard. Any storm event in excess of the 30 year return period storm would be expected to cause flooding. If a location is recorded as having experienced repeated flooding from the same source this should be acknowledged within the Sequential Test.

Table G-5 is presented in Appendix G and summarises the appropriateness and FRA requirements for various development types in each Flood Zone thus summarising Tables G-2 and G-3.

5.2 Using the SFRA to Apply the Sequential Test

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

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

The recommended steps required in undertaking the Sequential Test are detailed in Appendix G. The recommendations are based on the Flood Zone and Flood Risk Vulnerability and is summarised in Table G-3. The use of the SFRA maps, data and GIS Layers in the application of the Sequential Test is detailed in Appendix G.

6 Policy Review

National and local policies have been reviewed against the local flood risk issues and objectives identified by the Environment Agency in the CFMPs covering the River Ribble, the River Douglas and the River Wyre. From these policies the following catchment-wide and specific area strategies have been developed under the headings Flood Risk, SuDS and the Water Environment. Integration of these suggested policy considerations into LDF / LDD should ensure that the objectives and aspirations of the EA and national policy are met whilst strengthening the position of the LPA with regard to Flood Risk.

6.1 Planning Policy

The planning policy review collates and summarises all planning policy and guidance, relevant to flood risk in the Central Lancashire Sub-Region. Firstly, PPS25 was reviewed as the key flood risk and development policy at a national level, followed by draft Regional Spatial Strategy (RSS) for the Northwest (January 2006) and the subsequent Panel Report on the draft RSS (May 2007). At a sub-regional level, the Replacement Joint Lancashire Structure Plan 2001-2016 and the Central Lancashire City Sub-Regional Strategy (2006) were reviewed before the relevant local policies for Chorley, South Ribble and Preston were reviewed.

The policy review covered policies pertaining to flood risk and development in flood risk areas and so also expanded to review key strategic development pressures, such as targets for housing provision, as set out by the draft RSS and the Panel Report, as these need to be taken into consideration when assessing flood risk. The planning policy review is presented in tabular form in Appendix I.

6.2 Catchment Flood Management Plans

A CFMP is a high-level strategic plan which is used to identify and agree long-term policies for sustainable flood risk management within individual river catchments. CFMPs undertake an assessment of flood risk to identify the causes, size and location of flood risk throughout the catchment and the various influences that can affect the probability and consequences of flooding. This enables the effect of potential changes in the catchment on flood risk to be identified. Each potential source of change can be influenced by land use planning policy, such as a changing policy approach towards greenbelt protection or the allocation of large greenfield sites for housing development. Potential changes may include, for example:

- Development and land use change, such as new development or significant changes in the developed environment;
- Changes in the rural landscape, including large scale changes in land management;
- Loss of, or potential threat to, wildlife habitats or biodiversity;
- Climate change.

Flood risk management looks at the probability of a flood occurring and the potential resultant impacts. A spatial planning element also exists in flood risk management since it involves decisions on when, where and how to store or convey flood waters to minimise the risks to people, property and the environment.

CFMPs identify broad, long term (50-100 years) policies for sustainable flood risk management in the context of a particular catchment. The planning period is therefore considerably longer than the period typically considered to be "long-term" in land-use planning policy terms, which is usually 10 to 15 years, possibly 20 at the most. This potential conflict in planning timeframes should be taken into consideration, as a change to land-use policy can occur in a much shorter period of time than the CFMP may account for. There is also a potential conflict in that catchment boundaries do not necessarily relate to local planning authority boundaries and land use policy approaches may vary between authorities, increasing the complexity for flood risk management decisions across the catchment.

CFMPs aim, amongst other objectives, to inform and support planning policies, statutory land use plans and implementation of the Water Framework Directive, so that future development in the catchment is sustainable in terms of flood risk. Awareness of the role of CFMPs among land-use planners is in its infancy as these plans, along with SFRAs, are a relatively new requirement.

Preparing CFMP's involves carrying out a strategic assessment of current and future flood risk from all sources (not just fluvial or coastal), understanding both the likelihood and impact of the risk and the effect of current measures to reduce that risk. The scale of risk is broadly measured in economic, social and environmental terms. The Plans identify opportunities and constraints within the catchment to reduce flood risk through strategic changes or responses, such as changes in climate, urban development, land use, land management practices and/or the flood defence infrastructure and waterways.

CFMP policies, which are identiifed for each individual "policy unit" (a policy unit relates to a specific geographical area), establish whether action should be taken to increase, decrease or maintain the current scale of flood risk. The CFMP does not identify specific ways of managing flood risk, which are the subject of subsequent, more detailed studies. A single policy is applied to each policy unit. Six policy options exist and may be applied:

Policy Option	Policy
1	No active intervention (including flood warning and maintenance), continue to monitor and advise.
2	Reduce existing flood risk management actions (accepting that flood risk will increase with time)
3	Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline)
4	Take further action to sustain the current scale of flood risk into the future (responding to the potential increases in flood risk from urban development, land use change, and climate change)
5	Take further action to reduce flood risk (now and/or in the future)
6	Take action to increase the frequency of flooding (where appropriate) to deliver benefits locally or elsewhere, (which may constitute an overall flood risk reduction, e.g. for habitat inundation)

In order to achieve the specified policy approach, a number of actions may be identified for each policy unit. It is expected that CFMPs will be used by regional and local government authorities to inform their spatial planning activities, sustainability appraisal/SEAs and emergency planning.

There are three CFMPs in the study area, which include the River Douglas, River Ribble and River Wyre. The main findings of the CFMPs in the Central Lancashire study area are summarised in tabular form in Appendix I. These are in varying stages of preparation and have been prepared very recently. Consequently, it is unlikely that their implications have been fully taken into account in current development plan documents. The importance of CFMPs for land-use planning and particularly sites allocations planning, is an important message that needs to be conveyed to those responsible for preparing Local Development Frameworks.

At present, CFMPs are "back-door" plans, which hold statutory weight in planning decisions, but which in terms of the preparation and detailed contents of the plans, are not subject to scrutiny through the planning process. Fortunately however, preparation of Local Development Documents in the Central Lancashire area are predominantly in their infancy and therefore the opportunity exists to incorporate the policy directives of the CFMPs, through the SFRA, into strategic land use allocations and policy planning.

6.3 Flood Risk

Regional / National

1. In accordance with PPS25, all sites should be allocated in accordance with the Sequential Test to reduce the flood risk and ensure that the vulnerability classification of the proposed development is appropriate to the flood zone classification;
2. Flood Risk Assessments (FRAs) should be undertaken for all developments within Flood Zones 2 and 3 and sites with identified flooding sources (according to PPS25 Annex E) to assess the risk of flooding to the development and identify options to mitigate the flood risk to the development, site users and surrounding area;
3. Flood Risk Assessments are required for all developments in excess of 1 hectare in Flood Zone 1 (according to PPS25 Annex E).
4. Flood Risk to development should be assessed for all forms of flooding (in accordance with PPS25 Annex E);
5. It is recommended that where floodplain storage is removed, the development should provide compensatory storage on a level for level and volume for volume basis to ensure that there is no loss in flood storage capacity.

Sub-Regional / Local

1. As stated in PPS25, Surface water flooding should be investigated in detail as part of site specific FRAs for developments and early liaison with the Environment Agency and the relevant Local Authority for appropriate management techniques should be undertaken.
2. As stated in PPS25, Groundwater flooding should be investigated in more detail as part of site specific FRAs.

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

- Regional policy for the North West of England of which Policy EM5 (Integrated Water Management) is relevant to the management of flood risk;
- River Douglas, River Ribble and River Wyre Catchment Flood Management Plans;
- Integrated Catchment Management Plan for the Ribble;
- Biodiversity Action Plan for Lancashire;
- River Douglas, River Ribble and River Wyre Catchment Abstraction Management Strategies (CAMS).

Preston Riversway Development: FRA

In December 2006, Halcrow undertook an FRA for the proposed development for the Riversway area of Preston. Existing embankments along the River Ribble and Savick Brook protect the Riversway area. The crest levels of the majority of defences along the Ribble were reported to be in excess of 8 mAOD. However, in several locations the defence level is less and is as low as 7 mAOD in some locations. The crest level of the Savick Brook embankment varies between 7.2 and 7.5 mAOD. Flood levels gained from the EA for the purposes of the FRA were below the crest levels of the existing embankments.

Hydraulic modelling undertaken as part of the FRA showed that Savick Brook overtopped defences during the 1 in 200 year event and consequently part of the proposed development area would be at risk of flooding during this event.

The FRA made a number of recommendations, including increasing the crest level of defences along the River Ribble to 8.27 mAOD and along Savick Brook to 8.17 mAOD. Increasing the Standard of Protection for the defences in these locations would also mitigate against the 200 year tidal flood event plus climate change calculated for the purposes of this SFRA as identified in Appendix C.

6.4 Sustainable Drainage Systems

A guide to Sustainable Drainage Systems (SuDS) is provided in Appendix H. Sustainable Drainage Policies should address the following issues:

Regional / National

1. Sustainable Drainage Systems should be included in new developments unless where it is demonstrably not possible to manage surface water using these techniques;
2. PPS25 requires the use of SuDS as an opportunity of managing flood risk, improving water quality and increasing amenity and biodiversity;
3. Flood Risk Assessments are required for all developments in excess of 1 hectare in Flood Zone 1 (according to PPS25 Annex E).
4. As stated in PPS25, runoff rates from new developments should not be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect;;

5. It is recommended that runoff and/or discharge rates should be restricted to greenfield runoff rates in areas known to have a history of sewer and/or surface water flooding.

Sub-Regional / Local

1. At the site-specific FRA level, the suitability of Sustainable Drainage Systems should be investigated for each development.

A list of each site highlighting the underlying geology and soil, together with site-specific recommendations for SuDS and FRAs is presented in the Broad Scale Assessment of SuDS at the end of Appendix H.

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

- Regional policy for the North West of England of which Policy EM5 (Integrated Water Management) is relevant to the management of flood risk;
- River Douglas, River Ribble and River Wyre Catchment Flood Management Plans;
- Integrated Catchment Management Plan for the Ribble;
- Biodiversity Action Plan for Lancashire;
- River Douglas, River Ribble and River Wyre Catchment Abstraction Management Strategies (CAMS).

6.5 Water Environment

Regional / National

1. Development should not have a detrimental impact on the water environment through changes to water chemistry or resource;
2. Developments should look to incorporate water reuse and minimisation technology;
3. Any development should not be located within 8 metres of the riverbank to ensure access for maintenance but amongst other things should ensure a riparian corridor for improvement of the riverine environment.

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

- The Water Framework Directive (summarised in Appendix I);
- Regional policy for the North West of England of which Policy EM5 (Integrated Water Management) is relevant to the management of flood risk;
- River Douglas, River Ribble and River Wyre Catchment Flood Management Plans;
- Integrated Catchment Management Plan for the Ribble;
- Biodiversity Action Plan for Lancashire;
- River Douglas, River Ribble and River Wyre Catchment Abstraction Management Strategies (CAMS).

Flood Risk Management Policies contained within the Catchment Flood Management Plans have been set out by the Environment Agency and assigned to different zones within the SFRA area. The strategies suggested above interlink with these aspirations and if integrated will aid to strengthen the position of the Local Planning Authority.

7 Site Specific Flood Risk Assessment Guidance

7.1 Introduction

The assessment of flood risk is a fundamental consideration for new development or redevelopment regardless of its scale or end-use. Understanding the flood risk posed to and by a development is key to managing the risk to people and property thereby reducing the risk of injury, property damage or even death. The effects of climate change may exacerbate future flood risk. Current predictions indicate that milder, wetter winters and hotter, drier summers will be experienced in the future and there will be a continued rise in sea levels. These changes will potentially lead to changes to the magnitude, frequency and intensity of flood events. Some areas currently defended from flooding may be at greater risk in the future due to the effects of climate change or as defence condition deteriorates with age.

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

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

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

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

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

When is a Flood Risk Assessment required?

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

In the following situations a Flood Risk Assessment should always be provided with a planning application:

- Development sites located in Flood Zone 2 or 3;

- Development sites in excess of 1 hectare located in Flood Zone 1. Since the risk of fluvial or tidal flooding is minimal such FRAs should focus on the management of surface water;
- Development sites located in an area known to have experienced flooding problems from any flood source;
- Development sites located within 8m (water environment) of any watercourse regardless of Flood Zone classification.

What does a Flood Risk Assessment require?

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

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

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

The staged approach comprises of three stages outlined below.

Level 1 - Screening Study

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

Level 2 - Scoping Study

A Level 2 Scoping Study is predominately a qualitative assessment designed to further understanding of how the flood sources affect the site and the options available for mitigation. The Level 2 FRA should be based on existing available information where this is available and use this information to further a developers understanding of the flood risk and how they affect

the development. This type of assessment should also be used to inform master plans of the site, raising a developer's awareness of the additional elements the proposed development may need to consider.

Level 3 – Detailed Study

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

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

Site-Specific Guidance

Further FRA guidance can be found in the site-specific recommendations table at the end of Appendix H.

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