West Cheshire SFRA
Vale Royal Borough Council Main Report
August 2008

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Abbreviations / Acronyms

AMP	Asset Management Plan
CEH	Centre for Ecology and Hydrology
CCC	Chester City Council
CFMP	Catchment flood management plan
CIRIA	Construction Industry Research Information Association
CLG	(Department of) Communities and Local Government
COW	Critical Ordinary Watercourse
Defra	Department for Environment, Food and Rural Affairs
DPD	Development Plan Documents
DTM	Digital Terrain Model
EA	Environment Agency
EPNBC	Ellesmere Port and Neston Borough Council
FRA	Site Specific Flood Risk Assessment
FZ	Flood Zone
GIS	Geographical Information System
IDB	Internal Drainage Board
LDD	Local development document
LiDAR	Light Detection and Ranging
LDF	Local Development Framework
LPA	Local Planning Authority
MSC	Manchester Ship Canal
NFCDD	National Flood and Coastal Defence Database
ODPM	Office of the Deputy Prime Minister (now CLG)
Ofwat	Water Services Regulation Authority
PPG	Planning Policy Guidance Note
PPS	Planning Policy Statement
RBMP	River Basin Management Plan

RFRA	Regional Flood Risk Appraisal (RFRA)
RPB	Regional Planning Body
RSS	Regional Spatial Strategy
S105	Section 105 Survey
S106 (Agreement)	Section 106 of the Town and Country Planning Act 1990: allows a LPA to enter into a legally-binding agreement or planning obligation, with a land developer over a related issue.
SA	Sustainability Appraisal
SEA	Strategic Environmental Assessment
SFRA	Strategic Flood Risk Assessment
SMP	Shoreline Management Plan
SPD	Supplementary Planning Document
SUDS	Sustainable Urban Drainage Systems
VRBC	Vale Royal Borough Council
SOP	Standard of Protection

.

Introduction

1 Introduction

1.1 Background

Faber Maunsell has been commissioned by Vale Royal Borough Council (VRBC), Chester City Council (CCC) and Ellesmere Port and Neston Borough Council (EPNBC) to produce the West Cheshire Strategic Flood Risk Assessment (SFRA). A joint study offers the benefit of reviewing flood risk and the potential for new development at a much wider scale. This recognises the nature of River catchments which cross administrative boundaries. In this instance, the River Gowy passes through both EPNBC and CCC. Local Planning Authorities (LPAs) are encouraged to work in partnership to develop SFRA's at a sub regional level in national planning guidance.[1]

The SFRA is required to provide a sound and robust evidence base for the preparation of each LPA's Local Development Framework (LDF). The LDF will comprise a portfolio of Local Development Documents which (together with the Regional Spatial Strategy) will provide the planning framework for the Districts. The final SFRA will play a critical role in informing future planning decisions, policies, proposals and potential development sites with respect to all forms of flooding in the Districts. This includes flooding from rivers and the sea, flooding from groundwater, land drainage, sewerage and other artificial forms of flooding.

The SFRA is based on the best available information at the time the study took place (June 2007).

The SFRA has been undertaken and structured to meet the requirements of national planning policy in Planning Policy Statement 25: Development and Flood Risk (December 2006) and the accompanying 'living draft' Practice Guide (February 2007). Further details are provided in the methodology section of this report.

One report has been produced providing an overview of flood risk for the West Cheshire area, including CCC, EPNBC and VRBC. Three separate reports have been produced for each District to provide a more detailed evidence base of flood risk in these areas. This report sets out the detailed evidence on flood risk for VRBC's administrative area.

1.2 The need for a SFRA

Flooding is a natural hazard that puts people's lives at risk, causes immeasurable stress to the people affected and has an economic impact that can cost billions of pounds just from one event. Recent flooding in the UK (summer 2007) has emphasised the possible scale of flooding, in extent and impact, that can occur in the UK.

However it should be remembered that flooding is a natural process which cannot be stopped altogether and therefore tackling flooding is more than just defending against floods. It means understanding the complex causes of flooding and taking co-ordinated action in partnership with others to reduce the impact of floods.

Over the last century and in more recent times, pressures for development have resulted in the widespread development of floodplains. There is now increased pressure to develop in the floodplain but every effort should be made to ensure development only takes place in areas least at risk or constructed safely and not increasing risk either on the proposed site or elsewhere.

Producing a SFRA will allow the LPA to make more informed judgements about potential development sites in the LDF and decisions on planning applications. In relation to flood risk a

[1] In December 2007 CLG announced the Government's intention to restructure Local Government in Cheshire into two Unitary Authorities. Consequently a new Unitary Authority for 'Cheshire West and Chester' will cover the combined areas of CCC, EPNBC and VRBC.

SFRA will also allow the LPA to consider flooding on a catchment scale rather than on a case by case basis. Strategic decisions can therefore be made on where development is most appropriate in relation to flood risk, taking into account climate change.

Guidance has been developed to enable the LPA to consider flood risk and drainage when considering strategic and site specific development. The government guidance in relation to flood risk is Planning Policy Statement 25: Development and Flood Risk (Communities and Local Government, Dec 2006) and Development and Flood Risk: A Practice Guide Companion to PPS25 'Living Draft' (Communities and Local Government, Feb 2006). Section 2.3 provides more information on PPS25.

The PPS25 living draft requires that a SFRA should be carried out by the LPA to inform the preparation of its Local Development Documents (LDDs), having regard to catchment-wide flooding issues which affect the area. A SFRA should provide the information needed to apply the sequential approach (and if necessary, the flood related aspects of the exception test).

The SFRA should also outline flood risk policies for LDDs in accordance with PPS25. These policies should set out requirements for Site Specific Flood Risk Assessments (FRAs) to be carried out by developers and submitted with planning applications in areas of flood risk. In addition the local authorities' sustainability appraisals, potential future development sites and development control policies should all be informed by a SFRA.

1.3 SFRA Objectives

The SFRA should provide sufficient data and information to enable the LPA to apply the Sequential Test to potential future development sites and, where necessary, the Exception Test (see 1.3.1 for explanation of Sequential and Exception Tests). In addition, the SFRA should allow LPAs to:

- meet the requirements of Annex E, PPS25 and the living draft Companion Guide.
- prepare appropriate policies for the management of flood risk within the LDDs
- inform the sustainability appraisal so that flood risk is taken account within the wider context of sustainable development when considering options and in the preparation of strategic land use policies. This includes informing potential development sites through the LDF process.
- identify the level of detail required for FRAs in particular locations, and
- enable them to determine the acceptability of flood risk in relation to emergency planning capability. (PPS25[2])

1.4 Planning and flood risk

Development Plan Documents are one part of an authorities' Local Development Framework. LPAs are required, under the Planning and Compulsory Purchase Act 2004, to prepare a Local Development Framework (LDF). The LDF is made up of a portfolio of Local Development Documents (LDD's), which collectively delivers the spatial planning strategy for the LPA's area. LDD's should reflect Government guidance regarding sustainable development. This includes the guidance within PPS25 Development and Flood Risk. This guidance aims to avoid placing new development, of a type which is incompatible with flooding, in areas at risk of flooding.

LPA's should ensure that flood risk is taken into account at all stages of the planning process to avoid inappropriate development in areas at risk of flooding. Where new development is exceptionally necessary in such areas, the policies aim to make it safe without increasing the risk elsewhere and where possible reducing overall risk.

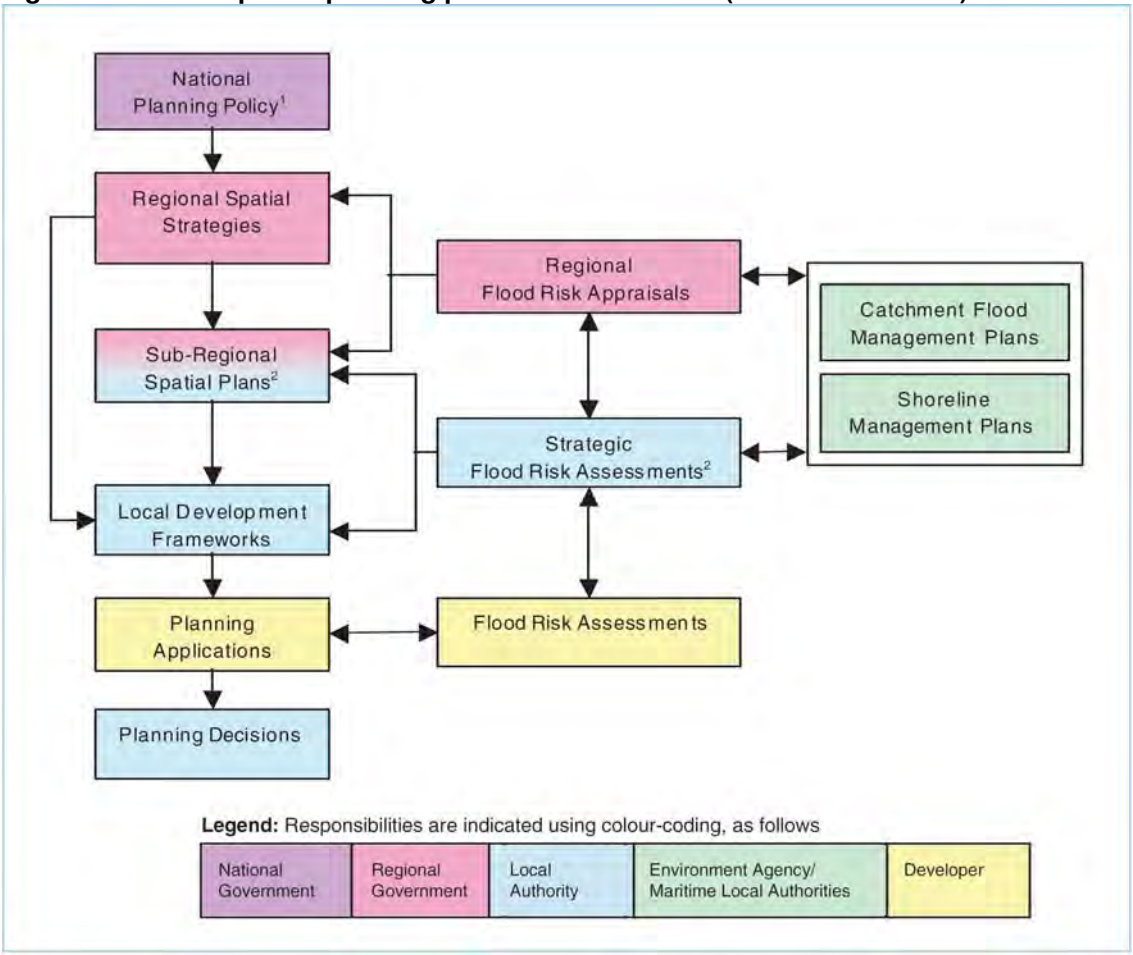
Key development planning tools that are used to implement PPS25 at different scales are summarised in Table 1.1.

Table 1.1 - Key development planning tools in PPS25 (taken from PPS25)

Scale	FRA techniques	Decision-making tools
Regional Spatial Strategy (RSS)	Regional Flood Risk Appraisal (RFRA)	Sequential Approach
Local Development Documents (LDDs)	SFRA and Area FRAs	Sequential Test and Exception Test
Individual Planning Applications	FRA	

Figure 1.1 shows the links between strategy documents (including flood and coastal defence documents) and SFRAs and also indicates who is responsible for them.

Figure 1.1: Development planning process for flood risk (taken from PPS25)



1.4.1 Planning Policy Statement 25

PPS25 requires that a sequential approach to the location of new development is applied. This is done by the application of the Sequential Test (see Annex D of PPS25). The Sequential Test should aim to steer new development to Flood Zone 1(see section 2.3 of this report for Flood Zone definitions). Where there are no reasonably available sites in Flood Zone 1, taking into account the flood risk vulnerability of land uses, sites can be allocated in Flood Zone 2, applying the Exception Test if required. Only where there are no reasonably available sites in Flood Zones 1 or 2 should decision-makers consider suitability of sites in Flood Zone 3, taking into account the flood vulnerability of land uses and applying the Exception Test if required.

The SFRA provides evidence to produce an initial Sequential Test for the potential future development sites provided by the LPAs. The SFRA also provides evidence which will allow the local authorities to assess any future development sites in terms of flood risk and produce their Local Development Documents. The evidence includes levels of flood vulnerability in Flood Zone 3 and the impact of climate change.

1.4.2 Responsibility for LPA

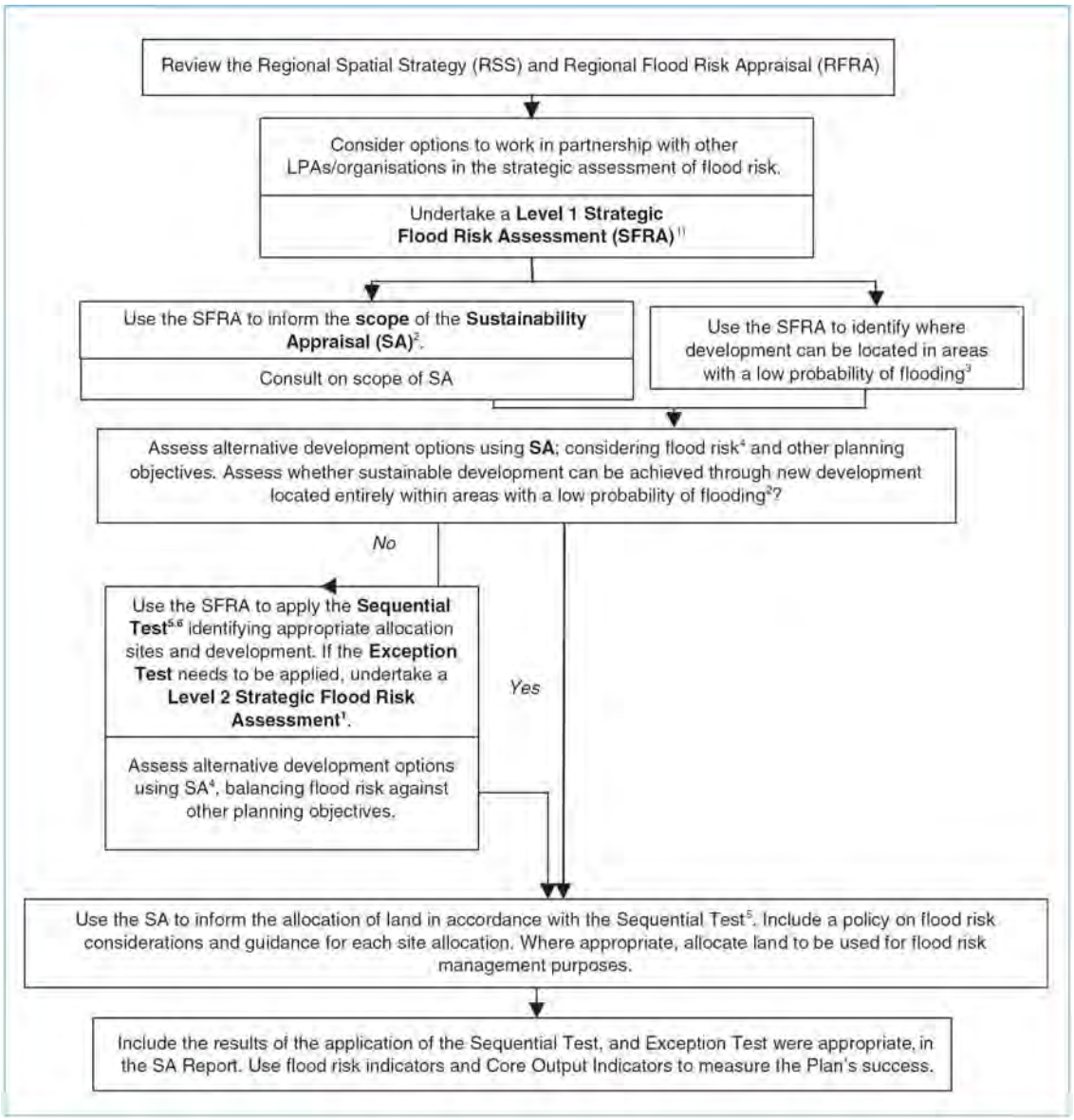
1.4.2.1 A) Policy formulation / LDF

Local Development Documents (LDDs) are mechanisms for ensuring that flood risk is factored into the detailed allocation of land use types across an area in accordance with national and regional policy, but also taking account of specific local issues and concerns. They provide an opportunity to provide clarification to prospective developers in the form of clear policies for the management of flood risk, as well as guidance on how flood risk issues should be addressed at sites allocated within flood risk areas. The Sequential Test and Exception Test should be applied in the site allocation process.

The LDD should contain clear, strategic and robust policies for flood risk management. The SFRA should provide the basis for these policies. The Development Planning Document (DPD) and some Supplementary Planning Documents (SPDs) within the LDD should be informed, through the SFRA, of specific flood risk related issues that should be taken into account for certain potential future development sites.

Figure 1.2 below from PPS25[2] further explains the process and links to the LDF.

Figure 1.2 - Process and links to the LDF from PPS25[2]



Notes

1 Guidance on undertaking a SFRA can be found in Chapter 2 of this Practice Guide.

2 Guidance on developing the scope of SA can be found in ODPM (2005) Sustainability Appraisal of Regional Spatial Strategies and Local Development Documents. Guidance on suitable flood risk indicators can be found in FD2320, D2.1.

3 Flood Zone 1 for fluvial and tidal flooding and with a low risk of flooding from other sources.

4 Including an assessment of the potential effect of proposed development on surface water run-off.

5 Including consideration of the variability of flood risk within a Zone.

This SFRA includes flood risk policies and recommendations for sustainable drainage for sites. The SFRA also provides evidence for an initial Sequential Test for existing potential future development sites and information which should allow the LPA to perform the Sequential Test on any future potential development sites. Locations where the Exception Test is required are also identified. Advice on the necessary scope of a FRA is included in the SFRA as well as other flood risk issues to be considered.

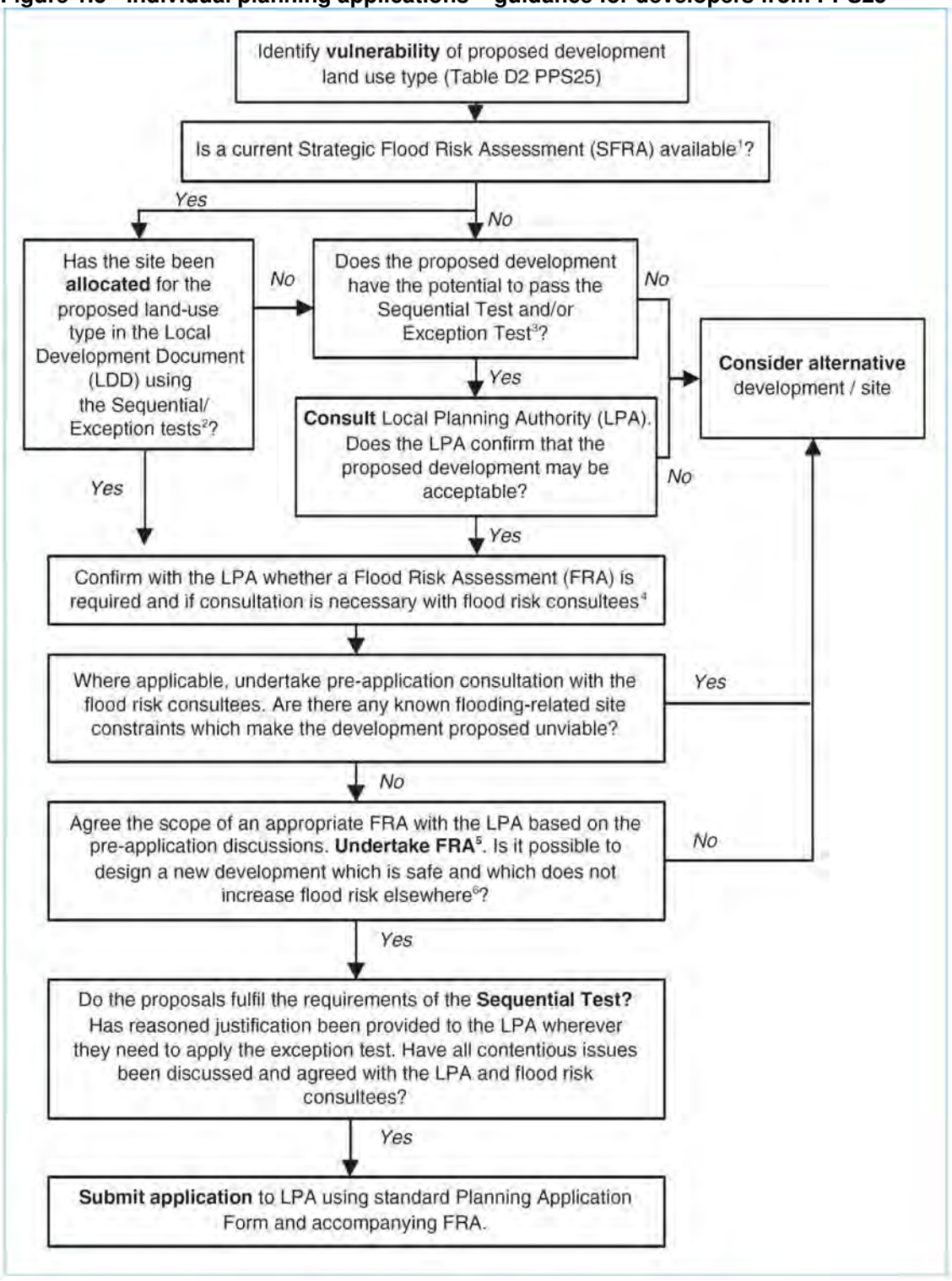
1.4.2.2 B) Development control and planning applications

The LPA is the principal decision-maker regarding applications for new development. LPAs should seek to engage in pre-application discussions with any developer expressing an interest in submitting a planning application for a site that is in an area at risk of flooding or which has potential to increase flood risk elsewhere. Specifically the LPA should:

- refer the developer to the SFRA and any planning policies of relevance to flood risk at the site, including policies or guidance on the application of sustainable drainage measures.
- if the site is allocated for a particular use in the LDF, inform the developer as to whether the Sequential Test and/or Exception Test has already been applied through the site allocation process undertaken during preparation of the DPD. If the allocation does not comply with the Sequential Test and/or Exception test, clarify the specific supporting information required to allow the LPA to apply the Sequential or Exception Test as part of the individual planning application process.
- advise the developer on the need for a FRA and consultation with Environment Agency and/or other flood risk consultees.
- set out and agree the scope for the FRA using the Environment Agency Standing Advice, or in direct consultation with the Environment Agency and any relevant flood risk consultees, as appropriate.
- encourage pre-application discussions with the identified flood risk consultees (such as the Environment Agency) to ensure flood risk issues are resolved prior to submission of the planning application.

This process is summarised in Figure 1.3 below which is taken from PPS25's practice guide.

Figure 1.3 - Individual planning applications – guidance for developers from PPS25[2]



1.5 Methodology

The SFRA is structured into four phases to meet the requirements of Annex E, PPS25 and the 'living draft' Companion Guide.

Phase 1 – Data Collection and identifying areas at risk of flooding (theoretical and actual) from rivers, the sea, groundwater, land drainage, sewerage, and other artificial sources e.g. reservoirs and canals having regard to defences, topography and topographic features. A primary task of the SFRA was to evaluate all existing data, identifying any gaps or inadequacies in the datasets. Faber Maunsell is currently writing the Weaver Gowy Catchment Flood

Management Plan (CFMP). The data collected and analysis completed has been used to inform the SFRA.

Phase 2 – Assess impact of external factors on flood risk including land management practices, climate change on flood risk for future horizons e.g. 25 year and 50 year flood risk zones and increased runoff, flood defence failure. Flood risk locations have been collected and mapped. In addition, any other information such as historic flood outlines and defended areas have been collected and mapped. Climate change flood extents have been produced where information is available. The level of risk within flood extents and the level of hazard to people will be assessed where there is existing modelling data to do so. The SFRA makes use of the latest outputs from the Sealand Basin breach analysis completed for Environment Agency Wales (November 2007). More details on the maps produced can be seen in section 6.1. In addition, further information on the types of flood mapping available is in section 2.4

It is necessary to identify areas of flood risk outside of Flood Zones 2 and 3. PPS25 requires that FRAs looks at all sources of flood risk not just from major tidal and fluvial sources. During the SFRA information on flood risk problem locations has been collected from knowledge holders in the Environment Agency, LPAs, water companies and British Waterways. This information has been put into a database, each entry has a reference. These locations have been mapped in GIS so that it can be seen if a potential development site could be at risk from one of these other sources of flood risk.

Phase 3 – Consultation with the Environment Agency and the LPA to ensure that Policies are drafted with regard to their procedures and policies for responding to Flood Risk Assessments. The SFRA has been completed in close communication with the Environment Agency. The Environment Agency attended progress meetings where technical issues have been discussed. The Environment Agency has also been available throughout the study for guidance to ensure the SFRA is completed in line with their objectives for flood risk management and planning. This also includes the development of flood risk policies for the LPAs.

Phase 4 – Reporting including the preparation of a matrix of flood risk in each area (including recommendations on mitigation needs to bring development forward), identification of areas requiring ongoing or further analysis to build on and reinforce the knowledge base. A flood risk matrix has been developed. This lists current housing, employment and major mixed use development sites and assess them against all the information gathered. This includes flood extents, historic flood maps, flood defences, flood risk locations from other sources and flood hazard. The matrix will form the basis for further analysis by the LPA of future potential development sites being considered for the LPA's LDF.

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Flood Risk

2 Flood Risk

2.1 Introduction

Flood risk predominantly arises from fluvial (rivers and watercourses) and tidal (sea and estuarial) sources. Fluvial flooding occurs as a result of the overflowing or breaching of river or stream banks when the flow in the watercourse exceeds the capacity of the river channel to accommodate that flow. Tidal flooding occurs when an exceptionally high tide, often accompanied by a storm tide surge (increases in water level due to meteorological conditions including atmospheric pressure and wind generated by storms), overtops and/or breaches the tidal defences along a coastline or tidal estuary.

It is also becoming increasingly important to consider flood risk from other sources. These include groundwater, (notably springs from limestone, sandstone and chalk aquifers), land drainage (low lying areas and runoff from steeply sloped areas), sewerage, and other artificial sources e.g. reservoirs and canals.

In West Cheshire there are many different types of flood risk present. In some areas long term commitment to the retention and maintenance of flood defences is required (e.g. Chester and the defences around Sealand Basin), in others changes to land use patterns may be appropriate. Coordination of strategies and plans is crucial, and flood warning, appreciation of vulnerability, and a whole range of mitigation measures are essential if sustainable flood risk management is to be achieved.

As has been illustrated by recent events (e.g. in Summer 2007) flooding can occur virtually anywhere although much flooding was local, rather than strategic in origin and impact. Flooding locations depend very much on the profile and duration of the storms which cause them and on local factors such as blocked drains and culverts, breaches or failure of defences and local topography. Therefore, safety from flooding can never be guaranteed. Flooding may occur in locations which appear to be at relatively low risk compared to others.

> In the West Cheshire area the most serious (and predictable) flooding is still usually from river systems (Main Rivers, Critical Ordinary Watercourses and ordinary watercourses – see glossary for definition).

2.2 Responsibilities

Whilst the Environment Agency is the main authority responsible for developing flood risk management strategies and policies, LPAs, internal drainage boards (IDBs) and Water Companies all have a part to play in achieving the government's aims and objectives. Developers also have a responsibility to protect their land from natural hazards which includes flooding and managing land drainage. Landowners have the primary responsibility for draining their land and managing the flood risk issues associated with their property. The owners of assets such as canals and reservoirs (e.g. British Waterways Board, United Utilities, Welsh Water and private owners) are similarly responsible for managing the flood risk issues associated with them.

2.2.1 Department for Environment, Food and Rural Affairs (Defra)

Defra has overall policy responsibility for flood and coastal erosion risk in England. It funds most of the Environment Agency's activities in this area and provides grant aid to the other flood and coastal defence operating authorities (LPAs and internal drainage boards) to support their investment in improvement works. Improvement projects funded by Defra, including those of the Environment Agency, must meet specified economic, technical and environmental criteria

and achieve an appropriate “priority score” to be eligible for funding. Defra does not build defences, nor does it direct the authorities on what specific projects to undertake.

2.2.2 The Environment Agency

The Environment Agency was established by the Environment Act 1995 and is a Non-Departmental Public Body of Defra. The Environment Agency took over the flood risk management responsibilities of the now defunct National Rivers Authority (NRA) and is the principal flood risk management operating authority in England and Wales.

The Environment Agency is empowered under the Water Resources Act 1991 to manage flood risk arising from designated "main" rivers and Critical Ordinary Watercourses (COWs) and the sea. The Environment Agency is also responsible for flood forecasting and flood warning dissemination, and for exercising a general supervision over matters relating to flood defence. Making space for water is currently considering a strategic overview role for the Environment Agency for all flood and coastal erosion risk management issues.

The Environment Agency has statutory powers to manage flood risk to existing properties and assets. At a strategic level, it provides Regional Planning Bodies (RPBs) and LPAs with advice on the preparation of Regional Flood Risk Assessments (RFRAs) and SFRAs.

> The Environment Agency is a statutory consultee for Regional Spatial Strategies (RSSs), Local Development Documents (LDDs), Sustainability Appraisals (SAs), Strategic Environmental Assessments (SEAs) and for planning applications. The Environment Agency should be consulted on all proposed developments in Flood Zones 2 or 3 and any development over 1 hectare in all flood zones, plus culverting plus known land drainage problems (reference PPS25 and the living guide).

The Environment Agency’s role at the pre-application stage will generally involve provision of relevant flood risk information and advice, as well as comments on the scope of Flood Risk Assessments.

2.2.3 Local Authorities

> Local Authorities are responsible for ordinary watercourses (watercourses which have not been designated as main and which are not within internal drainage board areas or which have not been designated Critical Ordinary Watercourses by the EA) and have powers to undertake flood defence works under the Land Drainage Act 1991.

Sometimes the riparian owners have the responsibility for works which would be identified by the LA. The LA has permissive powers to maintain ordinary watercourses but, as for main rivers, responsibilities to do so rest with the riparian owner. A LA may have responsibilities for coastal erosion and flood risk management if it has been assigned as a Maritime District Council under the Coastal Protection Act 1949. Although there are significant tidal flood risk issues in West Cheshire none of the LAs has responsibilities for tidal/coastal flood risk management.

LPA has a responsibility for considering and minimising flood risk in developing planning policies/proposals and in determining planning applications in line with PPS25.

2.2.4 Water Companies or Sewerage Undertakers

> Water Companies and sewerage undertakers are responsible for surface water drainage from development via adopted sewers (adopted under the requirements of the Water Industry Act 1991) and in some instances Sustainable Drainage Systems (SuDS).

The Water Companies covering Vale Royal Borough is United Utilities. They prepare Asset Management Plans (AMPs) approved by the water regulator, Ofwat, which include investment programmes to manage the flood risk from sewers. Water companies are not responsible for

the maintenance of highway drainage systems. This responsibility lies with Cheshire County Council as the Highway Authority where these are not privately owned.

Water Authorities should ensure that the sewerage undertaker's Urban Drainage Plans reflect the appropriate Regional Spatial Strategies (RSSs) and Local Development Documents (LDDs) in line with their obligations in the current legislation and their Asset Management Plans (AMPs).

LPAs should consult sewerage undertakers in developing their spatial plans, so that their SFRA takes account of any specific capacity problems and of the undertaker's Urban Drainage Plans. Developers should consult their local sewerage undertaker on surface water disposal issues.

2.2.5 Internal Drainage Boards (IDBs)

Internal drainage boards (IDBs) are independent bodies, created under statute to manage land drainage in areas of special drainage need and are empowered under the Land Drainage Act 1991. There are some 170 boards in England, concentrated in the lowland areas of East Anglia, Somerset, Yorkshire and Lincolnshire.

Each board operates within a defined area in which they undertake flood defence works, other than on watercourses that have been designated as "main". Internal drainage board membership includes elected members representing the occupiers of the land in the district and members nominated by LPA s to represent other interests. There are no areas in West Cheshire that are covered by an IDB area.

2.2.6 The Highways Authorities (Cheshire County Council)

Local highways authorities have responsibility for managing road drainage from roads on the local road network, in so far as ensuring that drains which are their responsibility are maintained. The Highways Agency is responsible for managing road drainage from the trunk road network in England, including the slip roads to and from trunk roads.

> Section 41 of the Highways Act 1980 imposes a duty upon the Highway Authority to maintain those roads which are maintainable at public expense. Section 100 of the Highways Act 1980 empowers the Highway Authority to construct, maintain or cleanse drainage systems in the highway or on adjoining/nearby land, for the purpose of drainage or prevention of surface water on the highway.

2.2.7 Reservoir Undertakers

Under the Reservoirs Act 1975, reservoirs impounding over 25,000m3 of water above natural ground level are categorised on a risk basis according to the consequences (in terms of potential for loss of life and/or damage to property) of a structural failure occurring. LPAs should discuss their potential future development sites with reservoir undertakers to:

- avoid an intensification of development within areas at risk from reservoir failure
- ensure that reservoir undertakers can assess the cost implications of any reservoir safety improvements required due to changes in land use downstream of their assets.

Certain reservoir undertakers will be required to produce emergency contingency plans (Flood Plans), following direction by the Secretary of State under the Reservoirs Act 1975, as amended. This requirement will be introduced following consultation by Defra. The presence of reservoirs and implications for flood risk should be recognised in Regional Flood Risk Assessments (RFRAs), SFRAs and Flood Risk Assessments (FRAs).

FRAs should take into account information received from the reservoir undertakers and Flood Plans when they are available and relevant. Where the consequences of dam failure could endanger life, a reservoir has to be designed to cope with floods of greater severity than those where the consequences of failure would have negligible risk to life. It follows that proposed development downstream could have cost implications if it required upgrading works for the reservoir.

There are a number of reservoirs in West Cheshire but none of these are upstream of potential development sites and therefore not thought to put any future properties at flood risk.

2.2.8 British Waterways

British Waterways should be consulted by the LPA and developers in relation to sites adjacent to canals, especially where these are impounded above natural ground level. This is stated in section 1.62 of PPS25 Practical Guide (PPS25[2])

2.2.9 Emergency Services and Multi-agency Emergency Planning

The Civil Contingencies Act 2004 and associated Regulations sets out an emergency preparedness framework, including planning for and response to emergencies. Local Resilience Forums, which include representatives from the Emergency Services, LPAs and the Environment Agency, should ensure that risks from flooding are fully considered, including the resilience of emergency infrastructure that will have to operate during floods.

Emergency Services should be consulted during the preparation of LDDs. In some cases, it may be appropriate for the LPA to consult the emergency services themselves on specific emergency planning issues related to new developments.

2.2.10 The Developer

PPS25 states that it is the responsibility of developers to carefully consider the flood risk issues at a site as early as possible. The Environment Agency internet Flood Maps and the SFRA should provide some indication of whether a site is at risk of flooding. However developers should make independent checks prior to purchasing sites.

A developer is not required to apply the Sequential Test if a proposed development is located on a site which has been allocated for that type of development in a LDD that has been sequentially tested and supported by a SFRA. However, the developer should still apply the sequential approach to any flood risk within the site itself when determining the location of appropriate land uses.

In any areas where flood risk has been identified as an issue, developers should liaise with the LPA to agree on who should be consulted. The scope of any FRA should be agreed with the LPA, if necessary in consultation with the Environment Agency. The SFRA provides guidance on who needs to be consulted for a specific set of circumstances (see Section 8.6 and Appendix C).

2.3 Planning Policy Statement 25

Planning Policy Statement 25 (PPS25) defines four zones of flood risk. These zones are based on the quantified degree of flood risk to which an area of land and buildings are subject at the time at which a land allocation decision is made or a planning application submitted. The PPS25 flood risk zones and their associated fluvial flood risk characterisations are summarised in Table 2.1 below:

Table 2.1 – PPS25 Flood Zones (taken from PPS25[1])

Zone 1 Low Probability This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
Zone 2 Medium Probability This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year.
Zone 3a High Probability This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
Zone 3b The Functional Floodplain This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).

The PPS25 flood risk zones give a broad indication of flood risk. However, most areas which fall within the high risk zone (Zone 3) are on flood plains and many such areas already enjoy some degree of protection from established flood defences. The actual degree of flood risk to which these areas are subject may well be significantly less than that implied by their PPS25 classification, provided of course that those defences are maintained.

PPS25 requires LPAs to adopt a risk-based approach to development in areas at risk of flooding, and to apply a "Sequential Test" to such areas (see Figure 2.1). This means that, other factors being equal, the LPA would favour development in areas with a lower flood risk. It is clear that study areas within the PPS25 "high risk" zone may be at very different risks of flooding. For example, whereas the probability of flooding in one area may be as high as 10% (1in10 years) the probability in a neighbouring area may be as little as 2% (1in 50 years), yet both are within PPS25 Zone 3. The LPA must therefore be able to rank study areas according to actual flood risk (based on a knowledge of Standards of Protection (SoP – see glossary) and condition of the defences).

As shown in Table 2.1, PPS25 Zone 3 is subdivided into two areas, 3a and 3b. Zone 3b is classed as functional floodplain and is defined as being at risk from the 1 in 20 year flood or greater. PPS25 also states that the following types of development should be allowed.

- 3a: Water-compatible and less vulnerable uses of land in Table D.2 of PPS25 are appropriate in this zone. More vulnerable development is allowed subject to the Exception Test. Table 2.2 describes the types of development.
- 3b: Only the water-compatible uses and the essential infrastructure listed in Table 2.2 that has to be there should be permitted in this zone. Essential infrastructure in this zone should pass the Exception Test.

All types of development are acceptable in Flood Zones 1 and 2 apart from highly vulnerable development in Flood Zone 2 for which the Exception Test is required.

Table 2.2 – Flood Risk Vulnerability Classification from PPS25 (taken from PPS25[1])

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

2.3.1 The Sequential and Exception Tests

Annex D of PPS25 provides clear guidance on application of the sequential approach in relation to flood risk. This 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 water-incompatible developments 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. Potential sites for new housing can be considered 'reasonably available' if the 'available' part of the criteria set out in *Housing Land Availability Assessments: Identifying land for residential development* (ODPM; 2005) is, or is reasonably expected to be met within five years of the LDD or planning application submission.

2.3.2 The Sequential Test

The sequential test is applied by the LPA to ensure that any potential development sites are compatible with the level of flood risk in that location and the vulnerability of the proposed development. It aims to ensure that more and highly vulnerable development types (such as residential housing) will not be allocated at areas of high risk of flooding. Through the LDF allocation process, 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 Zones 2 and 3, as identified by the SFRA. It is recognised that some applications for development will still be made on sites that have not been allocated (i.e. windfall sites). Such windfall sites will also be subject to the sequential test and/or exceptions test to steer the proposed development away from areas most at risk of flooding.

Some adopted Vale Royal Borough Local Plan policies/allocations may not have been subject to the sequential test under PPS25, as these policies pre-date the publication of PPS25. In such instances, the sequential test should also be considered in the determination of planning applications. This applies both in the site location and the sequential approach to development within the site itself. In these instances, it is the responsibility of the developer to provide the relevant evidence to be considered by the LPA in the determination of the planning application.

2.3.3 The Exception Test

Following the application of the sequential test, in exceptional circumstances, there may be valid reasons for a development type which is not entirely compatible with the level of flood risk at a particular site to nevertheless be considered as it would deliver wider sustainability benefits. To meet the Exceptions test the developer should demonstrate the wider sustainability benefits that outweigh the flood risk implications of developing the site (see below). It is recommended that the LPA develop a sustainability checklist to assess such sustainability benefits. This should be based on the aims and objectives of their SA Framework used in assessing the LDD.

The Exception Test should only be applied following application of the Sequential Test. There are three stringent conditions, **all of which must be fulfilled** before the Exception Test can be passed. These conditions are as follows:

a) it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the Development Plan Document (DPD) has reached the 'submission' stage (see Figure 4.1 of PPS12: *Local Development Frameworks)* the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal (SA);

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

c) a site-specific Flood Risk Assessment must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Figure 2.1 shows whether the Sequential or Exception Test will be required for a development type in a Flood Zone.

Figure 2.1: Flood Risk Vulnerability and Flood Zone 'Compatibility (taken from PPS25[1])

Flood Risk Vulnerability classification (see Table D2 PPS25 Annex D)		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone (see Table D.1 PPS25 Annex D	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b 'Functional Floodplain'	Exception Test required	✓	×	×	×

✓ Development is appropriate

× Development should not be permitted

Chapter 3 of PPS25's practical guide (PPS25[2]) provides more details of the Sequential and Exception Tests.

2.4 Flood Mapping

Three forms of flood maps are currently available: indicative flood plain maps, flood zone maps and flood maps. The differences between these is highlighted in the following table and described more fully in the following sections.

Map Type	Description	Prospective Use
Indicative Flood Plain ('IF')Maps	"IF maps" are defined as being those areas which would naturally (i.e. without flood defences) be subject to flooding on average at least once every hundred years (i.e. they represent Flood Zone 3)	The latest available version of the IF maps was issued by the Agency in 2002.
Flood Zone ('FZ')Maps	These were prepared using nationally consistent methodologies for the determination of flood risk zones for both tidal and fluvial flooding. The FZ maps show both PPG25 Flood Risk Zones 2 and 3. The FZ maps also exclude the effect of existing flood defences. The FZ maps are not limited to Main River floodplains but include the floodplains of all watercourses with a catchment area of more than 3 sq.km.	Flood Zone maps are not readily accessible to the general public or those wishing to undertake detailed flood risk assessments. Access to the FZ maps for a specific area must be so through the relevant LPA.
Flood Maps	Available on the internet and issued at 1/50,000 scale these maps are intended for use by the general public. and are available on the internet.	They are not intended, at this stage, to supersede the larger scale and more detailed Flood Zone maps issued to LPAs but to be used in conjunction with them. Flood risk on these maps is defined as: "Significant" - annual probability >1.3% (once in less than 75 years) "Moderate" - annual probability between 1.3% and 0.5% (1 in 75 to 200 years) and "Low" - annual probability less than 0.5% (1 in >200 years).

2.4.1 Indicative Floodplain Maps

Under Section 105 of the Water Resources Act 1991 the Environment Agency, having undertaken a nationwide study, produced a series of maps covering the whole of England and Wales ("Circular 30/92 Maps") showing areas of land considered to be at risk of fluvial and tidal flooding and the likely extent of that flooding. These maps were then used as the basis for the Agency's Indicative Floodplain(IF) maps.

"IF maps" are defined by the Environment Agency as being those areas which would naturally (i.e. without flood defences) be subject to flooding on average at least once every hundred years.

The criterion adopted by the Environment Agency to define those areas considered to be at risk of fluvial flooding was an annual risk of flooding of 1% or more (i.e. could expect to be flooded at least once in a hundred years) or where flooding has been known to occur. The 1% annual probability criterion was numerically the same as that subsequently adopted for the Planning Policy Guidance 25 (PPG25 – predecessor to PPS25 see glossary) "High Risk" Zone 3. Where the flooding envelope of the highest recorded historical flood is more extensive than that of the 1% (100-year) flood, the former is shown on the IF maps.

IF maps, based on Ordnance Survey 1/10,000 scale base maps, were first issued in 2000. In 2001 the Environment Agency issued electronic versions of these maps to all LPAs in the form of compact discs (CD). The information was also placed in the public domain on the internet, albeit at a smaller (1/50,000) scale.

On the IF maps, floodplains are shown to extend up river and stream valleys only to the upstream limit of Main River or (in some Regions) where the catchment area above that point

falls below 10 sq.km. This arbitrary limit can sometimes result in the abrupt truncation of a floodplain and give the potentially misleading impression that significant flood risk ceases at the edge of the envelope shown on the map.

The shape and extent of the floodplain shown on the IF maps should not be regarded as definitive. Detailed local studies of the floodplain sometimes reveal anomalies and inaccuracies in the position of the floodplain envelope as shown on the maps. The Environment Agency readily admitted that such anomalies would appear from time to time and indicated their willingness to modify the IF maps in such cases. The latest available version of the IF maps was issued by the Agency in 2002.

2.4.2 Flood Zone Maps

Following a comprehensive tidal and fluvial flood risk mapping exercise carried out across the country, the Environment Agency issued a set of Flood Zone Maps to each LPA in England and Wales during Summer 2004 covering the whole of that authority's area in electronic format. The West Cheshire Flood Zone Maps were made available to Faber Maunsell by the LPAs.

The Flood Zone (FZ) maps were prepared using nationally consistent methodologies for the determination of flood risk zones for both tidal and fluvial flooding. Whereas the IF maps showed only the IF, which corresponded generally to PPG25 Flood Risk Zone 3, the FZ maps show both PPG25 Flood Risk Zones 2 and 3. The FZ maps also exclude the effect of existing flood defences.

The Flood Zone maps, like the earlier IF maps, are based on OS 1/10,000 scale maps but, unlike the IF maps, the FZ maps are not limited to Main River floodplains but include the floodplains of all watercourses with a catchment area of more than 3 sq.km.

Flood Zone maps are not readily accessible to the general public or those wishing to undertake detailed flood risk assessments. Those wishing to consult the FZ map for a specific area must do so through the relevant LPA. FZ maps are not made available by the Environment Agency other than through LPAs if they are asked by a developer for specific information on a site.

2.4.3 Flood Maps

In October 2004 the Environment Agency issued a further set of flood risk maps covering all of England and Wales. These maps, issued only at 1/50,000 scale, were intended for use by the general public and are available on the internet. They are not intended, at this stage, to supersede the larger scale and more detailed Flood Zone maps issued to LPAs but to be used in conjunction with them.

These Flood Maps show two flood risk zones; a dark blue zone in which annual flood risk probabilities are defined as greater than 1% for fluvial flooding (>0.5% for tidal), and a light blue zone in which the annual flood risk probability is greater than 0.1%. Like the IF and FZ maps, the dark and light blue areas show the potential extent of flooding without defences but, unlike the IF maps, no distinction is made on the Flood Maps between fluvial and tidal flood risk areas. Flood defences (and defended areas) are shown where those defences are less than five years old and give a 1% fluvial (0.5% tidal) standard of protection.

Users of the Flood Maps are invited to "click on" to any point on the map for which a specific flood risk assessment is required. The user will then find the flood risk at that point categorised and defined as one of the following:

"Significant"	annual probability >1.3% (once in less than 75 years)
"Moderate"	annual probability between 1.3% and 0.5% (1 in 75 to 200 years)
"Low"	annual probability less than 0.5% (1 in >200 years).

The 1.3% (1 in 75 years) annual probability level corresponds to the level currently adopted by the British Insurance Association and not that used in PPS25.

Users of Flood Maps who "click on" to a point in a dark blue zone on the map may find the flood risk at that point classified as either "significant", "moderate" or even "low". This classification will be determined by the existence and standard of the flood defences at that point. Even where no defences are shown specifically on the map, their presence may sometimes be inferred from the flood risk categorisation given.

The Environment Agency propose to update the Flood Maps on a three-monthly basis in order to ensure that the maps reflect the latest assessments of flood risk and to remove anomalies. At some locations, for example, it is possible to “click on” to a dark blue area on the map where no flood defences exist and where flooding is known to occur and obtain a “Low” flood risk classification.

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Data Collection

3 Data Collection

A primary task of the SFRA is to evaluate all existing data, identifying any gaps or inadequacies in the datasets. Faber Maunsell are currently completing the Weaver Gowy Catchment Flood Management Plan (CFMP). The data collected and analysis completed has been used to inform the SFRA. A summary of the key data sets is presented below.

3.1 Flood Zone maps

The Flood Zone maps are described in Chapter 2. These maps were collected from each LPA in GIS format. The Flood Zone maps were also collected from the Environment Agency because they distinguish between tidal and fluvial flooding.

3.2 Topography

Light Detection and Ranging (LiDAR) data was available for the majority of the West Cheshire area. The Environment Agency map the LiDAR data and have provided it to Faber Maunsell for use in this study. The LiDAR extent available covered all of the main rivers and the main urban areas.

The LiDAR data has a vertical accuracy of +/- 0.25m and has been used for mapping tidal and fluvial flood extents (based on flood data provided by the Agency models). The LiDAR data that covers the study area was flown in the years between February 2001 and February 2006.

3.3 Hydraulic Models

Section 105 modelling was collected from the Environment Agency for this study. The S105 modelling in the study area covers the Rivers Dane, Weaver and Gowy. A broad-scale model used for the Dee Catchment Flood Management Plan (CFMP) exists for the River Dee, some modelling results have been made available for this study. This includes the 1 in 1000 and 1 in 100 year fluvial flood extents.

The model results were used to create flood extents for the named rivers. In some cases these models had to be modified in order to generate the relevant maps. Stage levels were taken from the models and a GIS tool was used to create a flood extent using the LiDAR data as topography. The models were run with a climate change scenario. This involved increasing the river flows by 20% in accordance with PPS25 climate change guidance (i.e. assuming all development will have at least a 60 year development life).

Fluvial flood extents were produced for the following return periods: 25 year, 25 year + climate change, 100 year and 100 year + climate change. The 1 in 25 year return period flood is the closest modelling data to the PPS25 defined functional floodplain (1 in 20 year flood). The 1 in 100 year flood is equivalent to Flood Zone 3. There was no modelling available for the 1 in 1000 year flood (Flood Zone 2). Climate change scenarios were used to estimate how these flood extents could increase in the future.

Extreme tide level data was collected from the Environment Agency. These levels were taken from 'Extreme Sea Levels for Section 105 Surveys, Final Report 1998' prepared by Jeremy Benn Associates (JBA) for Eastham Lock. A review of the expected water levels for the Dee was being undertaken by the Environment Agency, these were made available in May 2007. New flood extents were produced for the river Dee in response to these new tide levels. The new flood extents using the latest tide levels and sea level change estimations have been used for this study. Details on this and other flood extent issues can be seen in section 6.1.2.

Climate change tide levels were produced for 2057, more information on the extents produced can be found in Section 6.1. This was done using the PPS25 criteria as follows:

Table 3.1- Recommended contingency allowances for net sea level rise (taken from PPS25[1]).

Net Sea Level Rise (mm/yr) Relative to 1990	Net Sea Level Rise (mm/yr) Relative to 1990			
	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
NW England, NE England (north of Flamborough Head)	2.5	7.0	10.0	13.0

3.4 Historic flooding

Historic flooding information has been collected from the following sources:

- Interviews with LPA drainage engineers
- Environment Agency Flood Zone maps
- The Dee and Weaver Gowy Catchment Flood Management Plans
- High level DG5 data from United Utilities (see section 3.7.4)

Details of flood history and flood risk problem locations are reviewed in Chapter 5 and Appendix A.

3.5 Defences

The Environment Agency's National Flood and Coastal Defence Database (NFCDD) is considered to be the primary source of flood defence and asset survey information. NFCDD is able to provide details of the type and location of flood defences within the catchment, together with their associated design standards of protection, age, physical condition and the parties responsible for ownership and operation.

As well as raised defences (e.g. earth embankments) the NFCDD information received also holds spatial and descriptive data on culverts, flood defence structures (e.g. weirs), maintained channels and non flood defence structures (e.g. pipe crossings). The natural river banks for the main rivers are also given a return period standard of defence (see glossary) and in some cases a bank height.

The location and extent of raised man-made flood defences across the catchment are illustrated and shown in Figures V1, V2, V3 and V4 and Table 3.2, the main assets and structures are also shown in Figure V5. The majority of the defences are along the River Gowy, River Dee and lower Weaver, and are located at the main flood risk areas such as Stanlow, Northwich, and Chester. The types of defences include raised masonry walls, raised concrete channel sides, concrete, earth or rock embankments and timber lock gates.

3.5.1 Defences on the Rivers Dane and Weaver

The River Weaver from Winsford to Northwich has been canalized into the Weaver Navigation. Downstream of Northwich there is generally an original channel with adjacent canalized sections. Although there are no significant official flood defences in Northwich, the canalised sections of the Weaver through Northwich provide a greater level of protection than a natural river would.

In the Environment Agency's NFCDD the SoP allocated to sections of the River Weaver are given values ranging from 1 in 25, to 1 in 50, to 1 in 80 years. There is one small section of the River Dane in Northwich where there is a masonry flood wall. However the NFCDD states that the majority of the Weaver through Northwich is below the required 1 in 100 year SoP.

In addition, British Waterways operate the sluice gates during flood events which provide some flood risk protections for flood defence purposes. When certain river levels are reached on the River Dane and Weaver, the gates at Winnington, Barnton and Saltersford are automatically raised to their maximum extent. Gates at Vale Royal, Hunt's Lock, Dutton and Sutton operate independently according to water levels monitored local to the structures.

In the Manchester Ship Canal all of the structures are automatically controlled using proportional integral derivative devices (PID) to calculate appropriate gates responses. For the Weaver Sluices the gates are opened and closed in order to maintain as far as possible a constant water level of 4.38AOD.

Table 3.2 summarises the flood defences in West Cheshire. Figures V1 to V4 also show the defences and their SoP (this data may not be comprehensive if the Environment Agency data is incomplete).

Table 3.2- Major flood defences in Vale Royal BC

River Catchment	Watercourse/location	Type	Description	Design SOP	Maintainer
Vale Royal BC					
MSC	Manchester Ship Canal	Fluvial	Raised earth embankment	40	private
Weaver	Cliff Brook	Fluvial	Raised masonry/earth embankment	90	private
Weaver	Weaver Navigation	Fluvial	Raised earth embankment	50	private
Weaver	Weaver Navigation	Fluvial	Timber lock gate	50	-
Weaver	Weaver Navigation	Fluvial	Raised poured concrete wall	80	-
Dane	River Dane	Fluvial	Raised masonry wall	50	EA
Dane	River Dane	Fluvial	Raised earth embankment	70	private

3.6 Flood warning

A flood warning service is available for Northwich. Telemetered river gauging sites are linked to these flood warning services. Information gathered from these gauges informs the flood warnings issued via Automated Voice Messaging (AVM) to emergency services, Parish Councils, businesses and households in flood-prone locations.

A flood watch area, which is communicated through fax for the media and to the public via the media, covers the whole of Vale Royal. This is the Weaver and Gowy catchment flood watch area.

A Flood Warning Management Plan has been produced for the Weaver catchment. In addition to the existing flood warning area in Northwich the study recommended a further 26 areas that could benefit from a flood warning service.

Within the next two years new flood warning areas are to be established in the following areas:

- Winsford for 28 properties
- Acton Bridge for 45 properties

The Flood Incident Response Plan for Northwich has been developed as a scheme to provide a framework for responding to flooding (from the River Weaver and the River Dane) in and around the town centre of Northwich.

The Flood Incident Management team of the South Area office are working on achieving 77% flood warning coverage for the areas at risk of flooding in South area by 2007. The areas at

risk are identified by the Environment Agency's Flood Zone maps, current flood warning areas can be seen in Figure V11.

3.7 Other related plans and strategies

The LPA's policies, proposals and allocations within the DPD should aim to be consistent with a range of other related plans and strategies. Further details will be contained on the LPA's Sustainability Appraisal Scoping Report. In terms of flood risk, the key additional plans that should be considered are:

- Catchment Flood Management Plans (CFMPs)

The Environment Agency is preparing CFMPs for all river catchments within England. These set out the broad level of flood risk posed to development, communities and assets and also apply a broad scale policy for managing this risk in each catchment in the short, medium and long term.

- Shoreline Management Plans (SMPs)

SMPs are prepared by Maritime LPAs and the Environment Agency and perform a similar function to CFMPs but for the coast. In addition to these documents the Environment Agency prepares Flood Risk Management Strategies for groups of assets, subcatchments and estuaries, which are used to plan their investment strategies.

- River Basin Management Plans (RBMPs)

The Environment Agency is also responsible for preparation of RBMPs in accordance with the Water Framework Directive. These documents are a critical source of information for spatial planners considering the flood risk implications of new development.

3.7.1 Catchment Flood Management Plans

Catchment Flood Management Plans (CFMPs) are high-level strategic planning tools through which the Environment Agency works with other key decision-makers within a river catchment to identify and agree policies for sustainable flood risk management. Ultimately all areas within England and Wales will have a long-term flood risk management policy.

> The West Cheshire SFRA is covered by and bordered by the Mersey Estuary CFMP, Weaver Gowy CFMP and the Dee CFMP.

The Weaver Gowy CFMP is currently at the Main Stage and should be completed in 2008. Draft policies have been produced but they have not been consulted on or agreed. Some of the project data will be used in the SFRA. This data may include flood risk problem locations, flood extent maps, broad-scale modelling and the impact of land use, climate change and urban growth of the catchment. The Dee Pilot CFMP has been completed but much of this work is to be redone. The Scoping Stage of the Dee CFMP is due for completion in 2007. No policies have been agreed for the Dee CFMP but some data including the Dee broad-scale model has been used for the SFRA.

A summary of CFMP policies and how these have been applied to key locations in West Cheshire can be seen below.

Environment Agency policy description:

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 over 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 level of flood risk into the future (responding to the potential increases in risk from urban development, land use change and climate change)

5. Take further action to reduce flood risk

6. Take action to increase the frequency of flooding to deliver benefits locally or elsewhere (which may constitute an overall flood risk reduction, e.g. for habitat inundation)

Table 3.3 - Draft CFMP policies for locations in West Cheshire

Key Location	Draft policy	Reason
Vale Royal		
Frodsham (not marshes)	4	Current flood risk is considered to be acceptable but future flood risk is deemed to be too high. The SOP of defences along the lower Weaver will be sustained into the future as flood risk increases.
Northwich	5	Current and future levels of flood risk is considered to be unacceptable. This option would have high initial cost but it would be sustainable in the long term as high annual flood damages would be reduced.
Winsford	2	Current and future flood risk is considered to be acceptable. Reducing existing flood risk management will still produce relatively low flood damages, while ensuring the necessary river structures and channels are maintained.
Rural areas	2 and 6	Current and future flood risk is considered to be acceptable. Would reduce flood harm to people, properties and the economy while restoring natural floodplains. Also includes reducing pumping on Ince and Frodsham marshes which would have economic and environmental benefits.

3.7.2 Shoreline Management Plans

Shoreline Management Plans (SMPs) are high level documents that form an important element of the strategy for flood and coastal erosion risk management. Coastal groups, made up primarily of coastal district authorities and other bodies with coastal defence responsibilities, provide a forum for discussion and co-operation and play an important part in the development of SMPs for their area.

Many operating authorities have adopted the recommendations of their SMP as a basis for production of individual strategic plans, monitoring programmes and studies for all or part of their coastline and, where proven by strategic plans, for investment in appropriate capital improvement projects. The first round of SMPs are now due for review to ensure full account is taken of latest information and future challenges.

Below are the four Defra SMP policies available to shoreline managers and a summary of the existing policies (stage 1) for the West Cheshire SFRA coastline:

Hold the existing defence line by maintaining or changing the standard of protection. This policy should cover those situations where work or operations are carried out in front of the existing defences (such as beach recharge (see the glossary), rebuilding the toe of a structure, building offshore breakwaters and so on) to improve or maintain the standard of protection provided by the existing defence line.

Advance the existing defence line by building new defences on the seaward side of the original defences. Using this policy should be limited to those policy units where significant land reclamation is considered.

Managed realignment by allowing the shoreline to move backwards or forwards, with management to control or limit movement (such as reducing erosion or building new defences on the landward side of the original defences).

No active intervention, where there is no investment in coastal defences or operations.

Policies have not yet extended up the Mersey Estuary. The second stage of the SMPs will consider areas further up estuaries.

3.7.3 River Basin Management Plans

The Water Framework Directive requires the production of River Basin Management Plans across the UK. These plans require assessment under the Strategic Environmental Assessment Directive (2001/42/EC) to identify wider effects on the environment. The scoping report for the Dee RBMP has been produced which set out the information to be included in the Draft RBMP. The Scoping Report consultation began in October 2007.

3.7.4 SFRAs

The Wirral SFRA started in 2007 but there are no outputs for use in this SFRA yet. The Congleton and Macclesfield SFRA, the Halton SFRA Crewe and Nantwich SFRA and Warrington SFRAs have started but no outputs are currently available. Cheshire County Council have produced a consultation draft SFRA as part of their consultation on the Minerals Development Framework (MDF) in September 2007. However, the detailed SFRA's for West and East Cheshire that are currently being undertaken will inform the next stages of the MDF process.

3.7.5 Data collection for other sources of flood risk

Different bodies were contacted for information on other sources of flood risk:

- The Environment Agency were able to supply information on groundwater and aquifers but no specific details on groundwater flooding or areas at risk of groundwater flooding were provided. It is possible to use the information supplied by the Environment Agency to give an overall impression of the potential areas at risk of groundwater flooding.

- British Waterways were contacted for information on flood risk from canals they are responsible for in West Cheshire. Several historic canal breach locations were provided. British Waterways expressed that it is difficult to provide information on vulnerable stretches of their canals because there is little difference in the type of canal structure from place to place. A detailed assessment on the condition on the canals would need to be undertaken for a more detailed picture.

- The LPAs were contacted for information on other sources of flood risk. This information is summarised in Chapter 5.

- United Utilities were contacted for information on sewer flooding. Water authorities maintain a register of locations that have experience sewer flooding. This is called a DG5 register. The water authorities carry out a programme of upgrades based on this register therefore properties on the DG5 register may no longer be at risk of flooding due to works being undertaken.

- United Utilities provided their DG5 register for West Cheshire summarised to ward level. This means the information could not be used to identify areas at risk of sewer flooding just overall numbers of properties that have flooded at ward level.

3.8 Data deficiencies

A register of all the data collected can be found in Appendix D and the Technical Annex. The database provides information of where the data has come from, type of data, date and the owner of the data. Some information is also provided on the quality and relevance of the data.

The SFRA aims to use the best available data to undertake a strategic assessment of levels and extents of flood risk. Some locations in the UK have more detailed and extensive data that has been produced in the past. Below is a summary of future work that could be undertaken to address some data deficiencies.

- Named watercourse network including all drains required. This data could be obtained from the Environment Agency who have named many of the watercourses. The watercourses and drainage network GIS theme belongs to the Centre for Ecology and Hydrology (CEH). A licence for use of this GIS theme would need to be purchased from CEH.
- New climate change tidal outlines. Climate change is not taken into account in the Environment Agency's Flood Zone maps. New climate change guidance has been released

which generally shows an increase in the rate of sea level rise. New tidal and fluvial extents would show this increase and other areas that are potentially at risk in the future.

- Modelling: Crowton Brook. The current Flood Zone for this watercourse is broad-scale and therefore difficult to use for individual properties. River modelling would provide more detailed flood outlines and an estimation of the functional floodplain and climate change extents.
- Assessment of risk for canals breaching and overtopping. PPS25 requires an assessment of flood risk from all sources. Many potential developments will have to assess flood risk for un-modelled artificial sources or from one major source. One detailed study could cover many separate studies saving time and money.
- Detailed reservoir Flood Risk Assessments. These may be a requirement in the near future. These assessments will help assess flood risk to potential developments downstream of reservoirs.
- More specific details on areas prone to sewer flooding. DG5 data is too broad-scale to be of use. A more useable format is required.
- Overall assessment on culvert conditions and the mechanisms of flooding.

Where other agencies have not provided data, they will continue to be consulted as a statutory consultee in the LDF process. These agencies will have the opportunity to bring forward additional data in due course. This information could be used to inform future updates of this SFRA.

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Causes of Flooding

4 Causes of Flooding

4.1 Introduction

High river levels are generally the result of prolonged rainfall. In the summer months the ground may be baked hard by the sun resulting in very high runoff and flash flooding during thunderstorms. In winter the soil conditions are wetter and temperatures lower and a greater proportion of the rainfall will find its way to the river.

> The main source of flooding in the West Cheshire SFRA area is fluvial. The reason for this flood risk to people and property is a combination of insufficient channel capacity and the fact that the affected properties are generally on low lying land in the rivers natural floodplain.

Fluvial flood levels in the lower reaches of the Gowy and Weaver may be increased by high tides in the River Mersey, combining with fluvial flood flows to back up the rivers. The tidal flood limit reaches up to Bridge Trafford on the River Gowy and upstream to Frodsham on the River Weaver. This can create a joint probability flood event under certain conditions. The River Dee is also influenced by high tide levels and high river flows.

Groundwater flooding can be caused by three main contributing factors; prolonged rainfall, higher than average groundwater levels and outcrops of aquifers (in the form of springs).

Flooding can also occur due to failure of infrastructure such as flood defence assets, culverts, sewers, reservoirs and canals.

Flood risk locations for areas outside of the Flood Zone maps have been put into a GIS database. The flood risk locations can be seen in Figures V1and V2 Each location has been given a reference number. The table in Appendix A provides more details on the type of flood risk at this location. The other flood risk locations include flooding from sewers, reservoirs, canals, land drainage and ordinary watercourses.

4.2 Overflowing of watercourses (including Breach)

When the flow in a river or stream exceeds the capacity of the channel to convey that flow, either because of limited cross-sectional area, limited fall, or a restricted outfall, then the water level in that channel will rise until the point is reached where the banks of the channel are overtopped. Water will then spill over the channel banks and onto the adjoining land. With an upland river the adjoining land is its natural flood plain, and fairly well defined which will generally be of limited extent

Floodplains are characterised by flat, riparian land along the valley floor. In pre-industrial England, such land was regarded as liable to flooding and was traditionally reserved for grazing and stock rearing and human settlements were almost always established beyond the edge of the floodplain. In the industrial age and more recent times with different priorities, pressures for development have resulted in the widespread colonisation of floodplains, often with steps taken to mitigate the associated risks of flooding.

When overtopping of an embanked watercourse occurs, the depth of water flowing over the floodwall or embankment will probably be small, a few centimetres at most. The bank will act like a weir and the rate of flow per unit length will be relatively modest and this, combined with the limited duration of the overtopping, will limit the volume of water cascading over the defences to cause flooding. If overtopping does occur and the protected area is of considerable extent, any resulting flooding will often be disruptive rather than be disastrous. The situation becomes far more critical if overtopping of an earth embankment erodes its crest, leading to a breach in the embankment.

4.2.1 Development behind undefended areas

Where development is proposed in undefended areas of floodplain, which lie outside of the functional floodplain, the implications of ground raising operations for flood risk elsewhere needs to be carefully considered and appropriate guidance provided to developers within the SFRA. There are few circumstances where provision of compensatory flood storage or conveyance will not be required for undefended fluvial floodplain areas. This is because, whilst single developments may have a minimal impact, the cumulative impact of many such developments can be significant. More information for individual potential development sites can be found in the flood risk matrix.

In undefended tidal areas, raising the ground is unlikely to impact on maximum tidal levels and provision of compensatory storage should not be necessary.

4.2.2 Development behind defences

When proposing new development behind flood defences, the impact on residual flood risk (see glossary) to other properties should be considered.

New development behind flood defences can increase the residual flood risk, should these defences breach or overtop, by disrupting conveyance routes (flow paths) and/or by displacing flood water. If conveyance routes that allow flood water to pass back into a river or the sea following failure of a flood defence are blocked, this will potentially increase flood risk to existing properties. If there is a finite volume of water able to pass into a defended area following a failure of the defences, then a new development, by displacing some of the flood water, will increase the risk to existing properties. Policy and practice for managing these risks as part of the spatial planning process has been included in the SFRA.

It is recommended that, should any potential development sites be proposed in a defended flood area, the potential cumulative impact of loss of storage at the potential development sites on flood risk elsewhere within the flood cell (area constrained by boundaries that would fill before overtopping into another flood cell) should be considered.

Such assessment should be appropriate to the scale and nature of the proposed development and flood risk. If the potential impact is unacceptable, mitigation should be provided.

4.3 Tidal Flooding

Coastal and tidal flooding can occur during exceptionally high tides or during storm events when low pressure systems result in storm surges that that can funnel water up our estuaries. Wind action causes increased wave heights which also contribute to coastal flooding. This type of flooding is confined to the River Mersey along the Vale Royal Borough boundary.

4.3.1 Breaching of Embankments

An earth embankment may be breached as a direct result of overflowing. Overtopping of a bank, especially when concentrated over a short length of bank, results in a rapid flow of water down the rear slope of the bank. This can cause erosion, which starts at the rear of the bank and works its way forward towards the channel. As the crest of the bank is washed away the flow through the small initial gap increases and a small breach is created. This becomes steadily bigger as water flows through it, eroding the sides and base of the breach, and a rapid and progressive failure of the embankment follows. Complete collapse of the bank may take only minutes. The contents of the embanked channel then pour through the breach and across the surrounding land.

A tarmac road or dwarf floodwall along the crest of a floodbank may inhibit the rate of initial erosion and postpone or even prevent the creation of a breach, depending upon the duration of overtopping. Experience, fortunately limited, shows that when a fluvial floodbank breaches, even if not by overtopping, it does so near the peak of the flood when the flow in the river and hence flood levels are at or near their maxima. Experience also suggests that breaches in river embankments usually extend from 20 to 30 metres in length and rarely grow to more than forty metres. Unlike tidal defence floodbanks, once a breach in a fluvial floodbank has occurred there will be a reduction in flood levels in the river as water flows through the breach. This reduces the stress on neighbouring floodbanks along the same reach of river, thus considerably reducing the risk of further breaches in the same area.

The design of a floodbank (or floodwall) incorporates a certain level of freeboard to allow for uncertainties, bank settlement, wave action, etc. but the height of any floodbank is determined primarily by the peak height of the design flood. Because of freeboard, the return period of the flood which gives rise to overtopping must be greater than that of the design flood. The return period of flooding from a breach caused by overtopping will be essentially the same as for the far less severe flooding resulting from that overtopping alone, but it must be borne in mind that breaches in earth embankments can occur from causes other than overtopping and may thus have return periods significantly less than that for which the embanked channel was designed.

Apart from overtopping, breaches in floodbanks can occur where weak spots in the bank have been created over a long period by gradual leakage through the bank at old, forgotten structures buried in the bank such as culverts or sluices (“slackers”), or where the activities of burrowing animals such as rabbits or coypu have impaired the integrity of a floodbank. These inherent weaknesses may not be readily apparent under normal conditions but when an exceptional level of pressure through the bank arises during flood conditions, a failure may occur, quickly giving rise to a breach. This may well happen in a flood of considerably lesser magnitude and return period than the design flood.

Furthermore, since the inherent weakness tends to increase slowly with age, the fact that a bank did not fail in an earlier flood does not guarantee that it will not fail in a comparable (or even a lesser) flood at some time in the future. If, however, a floodbank is of recent construction it may be assumed that it has been properly engineered and, provided that there is an adequate inspection and maintenance regime, the risk of breaching as a result of the factors outlined above is negligible.

4.4 Mechanical, Structural or Operational Failure

Although less common than overtopping or breaching of defences flooding can also be caused by the mechanical or structural failure of engineering installations such as land drainage pumps (or their power supplies), sluice gates (or the mechanism for raising or lowering them), lock gates, outfall flap valves etc.

Such failures are, by their nature, more random and thus unpredictable than the failures described in the previous sub-sections, and may occur as a result of any number of reasons. These include poor design, faulty manufacture, inadequate maintenance, improper operation, unforeseen accident, vandalism or sabotage.

Structural failure, in this context, is also taken to include the failure of "hard" defences in urban areas such as concrete floodwalls.

"Hard" defences are most unlikely to fail by the overtopping / erosion / breaching sequence experienced by earth embankments. Their failure tends to be associated with the slow deterioration of structural components, such as rusting of steel sheet piling and concrete reinforcement, or the failure of ground anchors. Such deterioration is often difficult to detect and failure, when it occurs, may well be sudden and unforeseen. Structural failure of "hard" defences is most likely to happen at times of maximum stress, when water levels are at their highest during a flood. Failure of hydraulic structures and "hard" defences can, under certain circumstances, be precipitated by the scouring of material from beneath their foundations by local high velocity flows or turbulence, especially under flood conditions.

Flooding can also be caused or exacerbated by the untimely or inappropriate manual operation of sluices, or by the failure of the person or organisation responsible to open or close a sluice at a critical time.

Responsibility for the operation of sluices rests with various public bodies as well as riparian landowners. Operational failures of this nature generally occur during a flood event and their results are to exacerbate rather than to cause flooding, and their impact is normally limited in extent.

Flooding especially that caused by overflowing of watercourses, can be exacerbated by other operational failures. These failures can also include neglected or inadequate maintenance of watercourses resulting in a reduction of their hydraulic capacity. Flooding can also be caused or exacerbated by bridge or culvert blockages, although these are not necessarily due to maintenance failures and may be caused by debris, natural or manmade, swept along by flood flows.

The risks associated with this category of failures are almost impossible to quantify, especially as experience has shown that there is a joint probability relationship between this class of failure and flooding resulting directly from extreme meteorological events. It can of course be argued that if a risk of this type was quantifiable and found to be finite then action should already have been taken to alleviate the risk. Even an assessment of relative risk for failures of this type must depend on a current and detailed knowledge of the age and condition of plant, its state of maintenance, operating regime etc at a significant number of disparate installations.

More information on the potential flood risk from mechanical, structural or operational failure of assets within the study area can be seen in Section 6.5.

4.5 Groundwater Flooding

Groundwater flooding occurs as a result of water rising up from the underlying rocks or from water flowing from springs. Flooding can be both at higher levels (from springs up a scarp slope) or at lower levels e.g. locations of former village ponds etc.

Groundwater flooding tends to occur after much longer periods of sustained high rainfall. Higher rainfall means more water will infiltrate into the ground and cause the water table to rise above normal levels. Groundwater tends to flow from areas where the ground level is high, to areas where the ground level is low. In low-lying areas the water table is usually at shallower depths anyway, but during very wet periods, with all the additional groundwater flowing towards these areas, the water table can rise up to the surface causing groundwater flooding.

Groundwater flooding is most likely to occur in low-lying areas underlain by permeable rocks (aquifers). These may be extensive, regional aquifers, such as Chalk or sandstone, or may be localised sands or river gravels in valley bottoms underlain by less permeable rocks. Groundwater flooding takes longer to dissipate because groundwater moves much more slowly than surface water and will take time to flow away underground. This type of groundwater flooding is unlikely in the Vale Royal area although high groundwater in areas adjacent to rivers (particularly in areas behind defences) could be a problem.

4.6 Land drainage, sewer and ordinary watercourse flooding

Almost all localised flooding of a serious nature occurs as a result of a severe intense summer thunder storms, localised in extent and duration and generally during the summer.

This flooding can, however, be exacerbated by two factors, blockages in the local surface water drainage system or by "floodlocking". Each of these factors is considered separately below. In some instances, in what would otherwise have been a relatively moderate rainstorm, these factors can themselves be the cause of flooding.

Intense storm rainfall, particularly in urban areas, can create runoff conditions which temporarily overwhelm the capacity of the local sewer and drainage system to cope with the sudden deluge. Localised “flash” flooding then occurs.

In upland areas with small, relatively steep, impermeable catchments, this may result in quite severe flooding over a limited area, often with a considerable depth and velocity of flood water. The duration of such flooding is usually relatively short but this does not mitigate its impact for those affected, especially when the flooding may have developed suddenly and unexpectedly.

In addition localised urban flooding can occur where the surface water drainage system is overwhelmed and pumps are not sufficient for an extended period of localised heavy rain (e.g. Hull 2007).

In its natural state, if the channel capacity of a stream is exceeded the channel will overflow along a considerable length and the resultant flooding is distributed over a wide area. If, however, the stream runs through a long culvert and the hydraulic capacity of that culvert is exceeded under flood conditions the culvert becomes surcharged at its upstream end. Water levels will then rise rapidly and localised flooding upstream of the culvert, often quite serious, can occur. The flood water, in attempting to follow the natural line of the culverted watercourse, may also flow through the built-up area above the line of the culvert. This applies equally to many larger surface water sewerage systems in urban areas which are, in effect, culverted watercourses.

4.6.1 Blockages in local surface water drainage

Local flooding is often exacerbated by deficiencies in the local surface water drainage system, but these can usually be remedied by relatively minor works once they have been exposed by a flooding event. Local flooding can also be caused by temporary blockages or obstructions in a drainage system, especially one that has been extensively culverted.

Such flooding can therefore be virtually random in its occurrence, although the prevalence of blockages at a particular location would suggest a systematic problem, justifying action to modify the drainage system at that location in order to resolve it.

In recent years some urban watercourses considered to be particularly at risk from such blockages have been designated "Critical Ordinary Watercourses" (COWs) although this designation does not, as yet, have any statutory status. COWs have been designated in their respective areas by LPAs and Internal Drainage Boards, as well as by the Environment Agency.

The Environment Agency currently proposes to designate all COWs as Main River. Where a COW is at present separated from the Main River system by a length of non-Main River the intervening watercourse will also be enmained (made into a Main River).

4.6.2 Floodlocking

In inland areas, all local surface water drainage systems discharge to a major stream or river. Except where pumps have been installed, this discharge is by gravity. If the receiving stream or river is in flood, especially where that watercourse is contained within raised floodwalls or banks, the flow in the local drainage system can no longer drain to the river and is impounded behind the defence line for the duration of the flood. This is known as "floodlocking". This can result in secondary flooding within the defended area, even though the defences may not have been breached or overtopped. Fortunately, this secondary flooding is almost always much less severe or widespread than primary flooding from the main river would have been.

The occurrence of secondary flooding depends on the coincidence of heavy rain over the local drainage catchment with "floodlocking" of its outfall. In most instances, the rainfall event that caused the flood conditions in the river may also have caused high flows in the local drainage system but because of the much slower hydrological response of the river, the rapid runoff from the local catchment will have discharged to the river before the flood peak in the river arrives at the local drainage outfall.

Because secondary flooding depends upon what are either random events or a complex coincidence of events, its probability of occurrence is difficult to quantify and it falls within the category of "residual risk".

4.6.3 Land drainage and sewer flooding

> The Environment Agency promotes the use of sustainable drainage systems (SuDS) within urban areas.

Drainage systems can be developed in line with the ideals of sustainable development, by balancing the different issues that should be influencing the design. Surface water drainage methods that take account of quantity, quality and amenity issues are collectively referred to as Sustainable Drainage Systems (SuDS). These systems are more sustainable than conventional drainage methods because they:

- Manage runoff flow rates, reducing the impact of urbanisation on flooding.
- Protect or enhance water quality.
- Are sympathetic to the environmental setting and the needs of the local community.
- Encourage natural groundwater recharge (where appropriate).

They do this by:

- Dealing with runoff close to where the rain falls.
- Managing potential pollution at its source now and in the future.
- Protecting water resources from point pollution (such as accidental spills) and diffuse sources.

Surface water drainage in the catchment is covered by a variety of different bodies. United Utilities and Welsh Water have responsibility for adopted surface water sewers. In West Cheshire, drains that exist in association with highways and private surface watercourses are the responsibility of LPAs and private landowners. The adoption of SUDS for maintenance purposes is still under debate and can be a barrier in seeing them implemented for new developments.

More details on the use of SUDS and adoption of SUDS can be found in section 9.3.

Sewers serving a development will either be a combined system or made up of separate foul and surface water sewers. Sewer flooding occurs more commonly in locations that have a combined system. Adopted sewers are designed for a 2 year no surcharge and 30 years no flooding. Areas with separate sewers are less likely to exceed their capacity. However both sewer systems are at a similar risk of flooding as a result of blockages and failed pumping stations.

4.7 Catchment characteristics

The topography of the West Cheshire catchment area is generally low lying. The majority of the catchment is made up of the Cheshire Plain, which is interrupted by a prominent sandstone ridge running north-south across it. Higher relief surrounds the river catchment with the Shropshire hills to the south, the Welsh border hills in the west and the foothills of the Pennines to the east reaching 450m above sea level.

The major rivers that drain the study area are the Rivers Weaver (VRBC), Gowy (CCC and EPNBC), Dane (VRBC) and Dee (CCC). All the watercourses apart from the Dee drain northwards into the Manchester Ship Canal (MSC), which ultimately drains to the Mersey Estuary. The River Weaver has its source east of Peckforton Hills and flows south to north

across the Cheshire Plain until its confluence with the MSC, while the Gowy's source is by Peckforton Castle and reaches the Mersey at Stanlow. The Weaver has two main tributaries, the Rivers Dane and Wheelock. The River Dane has its source high in the Pennines and becomes a meandering stream as the valley widens at Northwich, where it joins the Weaver.

The River Gowy is lower in elevation, with exception of its source at approximately 70m AOD. This illustrates the low lying nature of the catchment, indicating that steep slopes and high gradients are not a major factor contributing to flooding in the study area.

4.7.1 Rivers Weaver and Dane

The River Weaver from Winsford to Northwich has been canalised. However, downstream of Northwich there is generally an original channel with adjacent canalised sections. In the upper reaches, small gravel dominated streams are present. In most cases the streams are low gradient with sand, silt and gravel substrate and laminar flow (see glossary). As the catchment is largely agricultural in land use, the effects on the watercourses can include an increase in organic load, reduced habitat quality and increased erosion of banks and consequent siltation of the channel. Deposition of silt, especially in poorly designed channels and culverts also reduces the watercourse capacity, increasing flood risk. Examples of altered watercourses include the Weaver Navigation. Modifications reduce the physical variety in the channel and lessen biodiversity due to a lack of bank side trees and vegetation.

The River Weaver flows for approximately 110km south to north through the centre of Cheshire. For the lower 30km of this length the river has been made navigable and, is therefore, called the Weaver Navigation. The river was used for its transportation of salt between 1720 and 1829, enabling the salt industry around Northwich, Winsford and Middlewich to flourish. The Anderton boat lift was opened in 1875 to increase traffic between the Trent and Mersey Canal and the river. The lift was listed as an ancient monument in 1994, and has now been restored and re-opened. The canals contained within the Weaver Gowy catchment form the majority of the Cheshire Ring canal route including the Bridgewater Canal, Macclesfield Canal and the Trent and Mersey Canal. The Weaver Navigation is hydraulically linked with part of the River Weaver but the other canals are independent of rivers. The Shropshire Canal runs parallel with the River Gowy in the upper Gowy and the Manchester Ship Canal (MSC) lies in the north of the catchment area.

The River Dane is fast flowing in the upper reaches and becomes more meandering along its floodplain. The meandering river has a variety of flows with clear erosion and deposition leading to the course of the river changing over a cycle of 70 years. Four reaches in the Dane are particularly important for fluvial geomorphology. They exhibit a well-developed modern meander belt and a complex sequence of Holocene terraces.

Changes in topography across the West Cheshire study area significantly influence spatial variation of rainfall in the catchment. The average annual rainfall within the West Cheshire catchment area varies from as low as 500mm in parts of the Gowy sub-catchment and up to 1500mm in the upper reaches of the Dane in the foothills of the Peak District. This compares to an average annual rainfall of 920mm in England and Wales.

Transformation of rainfall into runoff is governed by intensity and duration of rainfall, ground type and intensity of impermeable development and catchment wetness conditions before and during the storm event. The hydrological response of each river catchment is different, owing to variation in size, geology, soils, topography, geomorphology and man made influences.

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Flooding in West Cheshire

5 Flooding in West Cheshire

Locations at risk of flooding have been identified through the Environment Agency's Flood Zone maps, other Environment Agency data holders, information from Local Authorities, British Waterways and United Utilities.

A register of flood risk locations has been created from the data collection stage. Details of each location can be found in Appendix A. A reference number on the register relates to Figures V1, V2, V3 and V4 in Appendix E. These locations have been used to add evidence to the initial Sequential Test undertaken for the existing Local Plan allocations and potential future development sites.

5.1 Historic flooding

A selection of notable flood events in the VRBC area is included in Table 5.1 these have been taken from the British Hydrological Society database of historic flood events.

Table 5.1 - History of flooding (British Hydrological Society)

Year	Location and description	River
353	Flooding in Cheshire 5000 people killed and many cattle	Cheshire catchments
1767	Large quantities of snow melt caused floods in Cheshire. In Northwich the waters were so high, that the inhabitants went about the streets in boats.	Weaver
1768	Flooding in Cheshire 'changed the face of the country'.	Weaver
1775	Great floods in Cheshire	Cheshire catchments
1851	Flooding at Ashbrook near Winsford. Approx. 212m3/s on Weaver at Ashbrook (ga. stn 68001).	Weaver
1852	Flooding of the River Weaver	Weaver
1860	Flooding in Winsford (industrial works).	Weaver
1863	Flooding of the River Weaver	Weaver
1869	Salt works at Winsford and Northwich damaged by flooding. All sluices and ice weirs were opened but this did not prevent flooding..	Weaver
1871	Extensive flooding but no damage caused	Cheshire catchments
1872	Flooding of the River Weaver	River Weaver
1872	The banks of the River Dane had overflowed casuing it to flood some local properties	River Dane
1877	Very heavy rainfall over Northwich 'greater than ever registered'. 2.10 in in 15 hours.	Weaver
1877	Flooding of the River Weaver	Weaver

1877	Due to high floods River Weaver rose between seven and eight foot above its normal level. However the Dutton sluices prevented severe flooding.	Weaver
1879	Heavy and persistant rain at the Dane and Weaver sources caused serious flooding.	Weaver and Dane
1880	Flooding River Weaver	Weaver
1881	Flooding in Cheshire and Lancashire	Cheshire catchments
1886	The following is a list of the principal rivers and their tributaries which were flooded and overflowed their banks: ... DEE, Alyn ..." [ha 067]	Dee
1886	Flooding of the River Weaver	Weaver
1892	Enormous body of floodwater also found its way into the river Weaver, but no damage experienced	Weaver
1924	Rainday mapped totals exceeding 75 mm over a belt including the Wirral	Dee, EPNBC and Weaver
Feb 1946	The highest flood recorded at Ashbrook (Winsford) on 8.2.1946 with an estimated discharge of 212m3/s is reported to be much higher than any other flood since 1851 when a similar flood occurred.	Weaver
Jan 1947	Heavy rain and snowmelt across the catchment: 326 properties flooded. Discharge equals 1851 flood exceeding 1.65m water levels.	Weaver
Feb 1977	River levels above 1.65m with 15 properties flooded.	Weaver
Oct 2000	6 properties flooded in Northwich.	Weaver, Gowy, North Ditch
Jun 2001	7 properties flooded in Northwich.	Weaver

As can be seen from the above table there is an extensive flood history across Vale Royal BC. The flood history is mainly associated with the River Weaver and its impact upon flooding Northwich. However, the River Weaver is also shown to flood parts of Winsford and the River Dane also contributes to the flood history of Northwich.

5.2 Main River flooding

Nearly all of Vale Royal BC falls within the large river catchment of the Weaver and Dane. The majority of the flood risk locations come directly from the Rivers Weaver and Dane. This includes the towns of Winsford, Northwich and the industrial area around Frodsham.

The main river of interest is the Weaver. The River Weaver was made navigable in 1732. Initially, 35km of the river from Winsford to Frodsham was made navigable, later extending to Weston Point docks, with 11 locks. Over the years the river was improved, with river deepening and channel widening for larger craft freight use. British Waterways have authority over the Weaver Navigation, being responsible for its maintenance for navigation but not specifically for flood defence. British Waterways have undertaken a programme of modernisation to automate

the sluices at the various lock structures that may aid flood defence. For example the modernised Hunts Lock Sluice which has recently been automated can be used for flood control. Flood waters can be held back by the gate until channel levels subside reducing flood risk to Northwich town centre.

> The most significant flood risk location in this sub-catchment is in Northwich, where three river catchments converge; these are the Weaver, Dane and Peover Eye. The River Weaver can flood properties to the south of the centre of Northwich before converging with the River Dane in the centre of the town. This is the main flood risk location with potentially over 300 properties at risk.

As the Weaver flows north it converges with Witton Brook (Peover Eye catchment) and brings flood risk to Winnington, an industrial area to the northeast of Northwich (see flood risk ID VR12). This is the area where 'Winnington Urban Village' (which has outline planning permission following consultation with the EA who raised no objections) is proposed., As detailed phases of the Urban Village come forward, flood risk will continue to be a major issue for consideration.

A significant flood event occurred in 1946 flooding 326 properties in Northwich. Flooding from the Weaver and Dane has also occurred recently in 2000 and 2001.

As the Weaver flows northwards, Acton Bridge is thought to be put at risk (ID VR11). On the lower reaches of the Weaver, before it converges with the Manchester Ship Canal, the fluvial floodplain extends to cover a small part of Frodsham and Weaver Park Industrial Estate in Sutton Weaver (ID VR3). Twenty five properties are thought to be at risk in Frodsham from a fluvial and tidal threat from the Weaver Navigation and surrounding tributaries (ID VR4). However it is mainly agricultural land at risk of flooding from the Weaver at its lower reaches.

Overall, flood risk in these lower reaches is believed to come from a combination of pump failures, backing up of tidal waters and fluvial flooding. However, the Weaver sluices are available to control flow levels to a degree.

> Winsford is another town at risk of flooding as the Weaver Navigation runs through and potentially puts 25 residential properties at risk (ID VR15). There is development pressure to the north of Winsford so different levels of flood risk will be considered in the SFRA.

> In summary the major flood risk area is in Northwich although there is a low flood risk to Winsford and the industrial area around Frodsham. The Dane converges with the Weaver in Northwich, contributing considerably to flood risk.

The Northwich flooding issue could be further exacerbated by the development pressure that exists. Flood alleviation and mitigation measures should be considered to reduce the level of risk if development, as part of the Northwich Vision, does take place. In addition more vulnerable development types should be moved away from the highest flood risk locations. Flood risk prevention and mitigation should be at the forefront of the decision making process. Any future planning applications in Northwich town centre should be assessed in relation to flood risk. There is a significant opportunity to reduce the surface water runoff to the Rivers Weaver and Dane during the re-development. The implementation of SUDS for the redevelopment should be a priority and promoted by the LPA.

Vale Royal BC have commissioned an Area Flood Risk Assessments for Winsford and Northwich. These assessments should build on the information gathered during the SFRA. This should insure the proposed large scale developments, in these locations next to the River Weaver, consider the risk of flooding as well as the benefits of being close to a river.

Other main rivers with potential flood risk in Vale Royal include:

Crowton Brook – around Delemere Park, Ruloe, Mill Lane and Crowton

Cuddington Brook – around Cuddington
Peckmill Brook/Hornsmill Brook – Local farms and Helsby
Wincham Brook and Wade Brook - Wincham and Wincham Chemical Works
Ship Street Course and Straight Length – Frodsham and Woodhouses
Cogshall Brook - Comberbach

The Frodsham Marsh is a small pumped drainage catchment. The pumps have failed in the past and may need to be upgraded in order to avoid further flooding from pump failure. A caravan site is also at risk of surface water flooding. Ship Street Course (Main River) is thought to put residential housing at risk around the north end of Frodsham (see ID VR4). A number of poultry farms and other properties lie in the Flood Zone south of Straight Length watercourse which connects to Ship Street Course and a network of tributaries around the Weaver Navigation.

This pumped catchment also extends west to Helsby. There is a works area at risk from Hornsmill Brook and Hoolpool gutter (see ID VR 19). However a Flood Risk Assessment concluded that the flood risk here is low. In the same area Peckmill Brook and Moor's Brook could potentially flood several farms (see ID VR 20).

Other minor problem areas lie adjacent to Crowton Brook including Mill Lane, Kingsley, Ruloe and Delamere Park, where properties (50 in total) lie on the floodplain. This area identified in flood risk problem IDs VR6 to VR10.

Cogshall Brook runs through Comberbach. Some properties at risk of flooding due to being in the floodplain of Cogshall Brook.

A number of villages are at risk of flooding from Crowton Brook. These are Delemere Park, Mill Lane (Ordinary Watercourse) and Crowton, Ruloe (Main River). The mechanism of flooding is simply that the properties are too close to the watercourse or in the Crowton Brook floodplain.

Properties including Wincham Chemical Works are at risk of flooding from Wade Brook, In the past flooding has occurred as a result of a blocked culvert. Wincham Brook also puts properties in the same areas at risk (see ID VR18).

5.3 Flooding from other sources

United Utilities are unable to provide details of locations that have been flooded in the past due to surcharging sewers.

Part of United Utilities DG5 register has been sent at ward level. This gives numbers of properties that have experienced external and internal sewer flooding in the past. However, this only gives an indication of the general risk of sewer flooding in areas rather than in specific locations.

In addition to Main River flooding to Northwich from the Dane and Weaver past events are thought to have combined with sewer and runoff flooding.

An unnamed tributary (Ordinary Watercourse) to Crowton Brook puts a few properties at risk in Kingsley (see ID VR8).

There are no recorded major occurrences of groundwater flooding from hard rock or superficial deposits in the North West Region South Area.

The Base Flow Index derived from the Hydrology Of Soil Types (BFIHOST) classification shows that the rivers are not strongly base flow dominated (Defra/Jacobs Groundwater Flooding Scoping Study, LDS 23).

Following consultation with the Environment Agency's Hydro-geologist during the Weaver Gowy CFMP it was confirmed that groundwater vulnerability zones in the catchment are limited to the western and northern part of the West Cheshire study area. These major aquifers are found because of the Permo-Triassic Sandstones that are predominant. Limited seasonal variations in groundwater levels are seen within these aquifers. Only a few instances of flooding from

groundwater and direct surface runoff within the catchment have been identified in West Cheshire.

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Strategic Assessment of Flood Risk

6 Strategic Assessment of Flood Risk

6.1 Plans produced and mapping

The Environment Agency has produced Flood Zones maps to identify areas that are at risk of flooding:

- Flood Zone 2 shows areas that are at risk from the 1 in 1000 year flood.
- Flood Zone 3 shows the areas at risk from the 1 in 100 year fluvial and 1 in 200 year tidal flood. PPS25 requires that the functional floodplain is identified in order to sub divide Flood Zone 3.
  - Flood Zone 3a comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
  - Flood Zone 3b is classed as functional floodplain and therefore at a higher risk of flooding than Flood Zone 3a. PPS25 defines a functional floodplain as land where water has to flow or be stored in times of flood. PPS25 states that this land would flood with an annual probability of 1 in 20 or is designed to flood in an extreme (1 in 100 year) flood (or at another agreed probability).

The functional floodplain has been mapped where there is existing modelling. This has been limited to areas where there are no flood defences. Extents have been produced for the rivers Weaver and Dane through Winsford, Northwich and Frodsham.

In addition to the above, a climate change flood extent has been mapped. This has been done for the 1 in 100 year fluvial and 1 in 200 year tidal flood event (equivalent to Flood Zone 3). This should allow the LAs to predict what areas will be at risk of flooding in the future or which areas are more sensitive to climate change.

Climate change extents have been produced, not taking into account flood defences, for the rivers Weaver and Dane through Winsford, Northwich and Frodsham .

Climate change extents have been produced for the River Gowy in the Stanlow area, not taking into account flood defences. A functional floodplain extent has not been produced for this area as it is protected by a flood alleviation scheme.

Section 6.3 describes the likely impact of climate change for key locations taking into account the flood extents and professional judgement where there is no mapping.

Figures V6 to V10 show the flood extents produced for different scales for the study areas.

6.1.1 Method

The Environment Agency's ISIS models, produced for the Section 105 modelling projects, were obtained and used to produce mapped flood extents. These models were available for the Rivers Weaver, Dane and Gowy. The CFMP broad scale model was used for the river Dee.

Detailed flood extents are required to be mapped using modelling data of flood levels for the Weaver, Dane and Gowy rivers. These extents included both tidal and fluvial for certain return periods and with account of future climate change.

Model nodes with flooding stage levels were imported into MapInfo (GIS package). A flood surface was created using LiDAR in conjunction with the node levels. The flood surface was created using the Triangulated Irregular Network (TIN) interpolation method from the MapInfo Spatial Analysis extension Vertical Mapper. The result is a gridded continuous smooth surface of the flood level nodes covering the maximum extent of flooding.

6.1.2 Flood extent issues around Frodsham

The Environment Agency Flood Zone maps show tidal and fluvial flooding around Frodsham (mixed).

The production of tidal climate change extents has been attempted. The 1 in 200 year plus climate change tide level was obtained and compared to the LiDAR data for the Frodsham area. This method provided a flood outline that was too detailed (i.e. they did not fit in with Flood Zones 2 and 3) because the elevation data used is more accurate than the elevation used to produce Flood Zones 2 and 3. The extents produced for the SFRA need to conform with the Flood Zone maps. A second attempt at a tidal climate change flood outline was made. The national digital terrain model (DTM) was used, this is less accurate than the LiDAR data. The extent produced was of a similar shape to the Flood Zones but the difference in extents was so small it could not be mapped. This is because the DTM was too broad scale.

The CFMP broad scale model for the SFRA has used the latest climate change guidance on fluvial flows but not tide levels. This model has been used for climate change extents taking into account the latest climate change guidance on fluvial flows but not on sea level rise. This has been decided because the additional work needed to produce a new model (with the new sea levels) would not be of great benefit (because the difference in flood extent around this tidal area is small).

6.2 Flood risk profile

A broad assessment has been made of the flood risk to people in the study area, this has been termed the flood risk profile. This has only been done where there is a risk of tidal flooding to a defended area or a fluvial flood risk area where there is existing modelling. The results of this analysis have been used to judge which potential future development sites, or parts of allocations, are at a greater flood hazard. Certain types of development (i.e. residential) can be directed away from these zones.

6.2.1 Fluvial flood risk method

The method used for this analysis is described below. A more detailed description can be seen in the technical Annex.

The aim of the assessment was to obtain values showing different levels of risk for individual potential future development sites or parts of allocations. The assessment method has been based on the DEFRA/EA Flood & Coastal Defence R&D Programme, R&D Outputs: Flood Risk to People, Phase 2, Guidance Document.

The flood risk profile (flood risk to people) was calculated as a function of flood velocity and flood depth using the following equation:

HR = d x (v + 0.5)

HR = flood hazard rating

d = depth of flooding (m)

v = velocity of floodwaters (m/sec)

0.5 = debris factor

LiDAR data was used to obtain the elevation and therefore potential flood depth of the different potential future development sites. River stage levels were taken from the Environment Agency's ISIS model for the Rivers Dane, Weaver and Gowy for the 1 in 100 year flood event.

Model nodes were plotted on the rivers adjacent to the potential future development sites. Hazard rating values were obtained for the allocations adjacent to these node points.

The degree of hazard (low, moderate, significant and extreme) was then attributed to the hazard rating values. The rating was taken from a table in the EA/Defra guidance and can be seen below.

Table 6.1 - Hazard to People as a Function of Velocity & Depth (DEFRA/EA Flood & Coastal Defence R&D Programme, R&D Outputs: Flood Risk to People, Phase 2, Guidance Document)

d x (v + 0.5)	Degree of Flood Hazard	Description
<0.75	Low	Caution *"Flood zone with shallow flowing water or deep standing water"*
0.75 - 1.25	Moderate	Dangerous for some (i.e. children) *"Danger: Flood zone with deep or fast flowing water"*
1.25 - 2.5	Significant	Dangerous for most people *"Danger: flood zone with deep fast flowing water"*
>2.5	Extreme	Dangerous for all *"Extreme danger: flood zone with deep fast flowing water"*

The flood hazard results can be used as a component of a flood risk matrix (see Appendix C). Sections 8.4 to 8.6 of the report describe how the flood hazard has been used in the assessment of potential future development sites and sections 6.2.3 to 6.2.5 summarise the results.

This will inform the Sequential Test by recommending where certain types of development should be put, depending on the hazard rating attributed. For example, residential development should not be allocated in extreme hazard locations. Ultimately levels of risk within Flood Zone 3 have been identified.

6.2.2 Results

The risk profile of the areas assessed can be summarised. The assessment method used is broad scale and a more detailed approach using a grid theme in GIS would bring greater accuracy.

The results can be seen in Figures V12 and V13 and are summarised below.

As the modelled section of the Weaver enters the built up part of Northwich, adjacent to Cloughs Wood, the hazard rating of flood water is low, up to Sir John Dean's College for the 1 in 100 year flood. After this point there is an extreme hazard section due to the increased depths from the potential for the River Weaver and Weaver Navigation combining. There is another low hazard section until after the railway line. After this point, Northwich town centre is dominated by significant and extreme flood hazard from the 1 in 100 year flood. This is due to the combined effect of the Weaver and Dane flooding bringing greater depths and greater velocities.

Between Northwich and the west part of Winnington, the flood hazard is rated as low. Passing through Winnington adjacent to the Trent and Mersey Canal the flood hazard increases to intermittent extreme and significant. Up until the end of the assessed reach (north of Weaverham) the hazard rating for the 1in 100 year flood is rated as extreme. The high rating around the Winnington area can be accounted for by the combination of the River Weaver and Weaver navigation in flood, bring greater depths.

In Winsford there is a low flood hazard rating from Bottom Flash through the centre of Winsford and past Winsford Bridge. As the urban area thins out, in north Winsford, the flood hazard increases to extreme. This continues until adjacent to Wharton Lodge Mills. From this point until after the sewage works, the hazard rating drops to significant. Where the dismantled railway splits from Bradford Road the hazard rating returns to extreme before returning to significant until the end of the assessed section. The variation in hazard rating is believed to be due to different topographic levels in the floodplain. The lower the land, the greater the potential flood depth and hazard. Generally throughout Winsford, the hazard rating is high.

6.3 Climate change

Current consensus is that climate change will result in changes to flooding in the UK in the 21st century. The main changes will be in rainfall patterns and sea levels. Changes in rainfall patterns could result in increases in the intensity and frequency of storms and the depths and duration of seasonal rainfall. Such changes will affect the way in which a river catchment responds.

The current guidance recommends increasing peak river flow by 10% up to 2025 and 20% thereafter.

Changes in sea level can result in changes to the tide locking of watercourses draining to the sea and in coastal and tidal flooding. Although not an effect of climate change, the rise in sea levels due to large-scale land movement (isostatic uplift due to the melting of icecaps in the north of the UK) is included.

The current estimated rate of sea level rise in the north-west, as recommended in PPS25 can be seen in Table 6.2 below

Table 6.2 - Recommended contingency allowances for net sea level rise, offshore wind speeds and wave heights (taken from PPS25[1])

Factor	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
NW England net sea level rise (mm/year)	5	10	20	30
Offshore wind speed	+5%		+10%	
Extreme wave height	+5%		+10%	

This has the potential to increase the tidal flood risk on the Mersey Estuary to areas at risk from the lower reaches of the Rivers Weaver and Gowy and locations on lower reaches of the River Dee from the Dee estuary.

> Since uncertainty still remains as to the accuracy of current climate change predictions, an upper limit of 20% increase in flows (over the next 50 years) in accordance with Defra and PPS25 guidance has been used in the SFRA.

This has the potential to increase the tidal flood risk on the Mersey Estuary to areas at risk from the lower reaches of the Rivers Weaver and Gowy and locations on lower reaches of the River Dee from the Dee estuary.

Since uncertainty still remains as to the accuracy of current climate change predictions, an upper limit of 20% increase in flows (over the next 50 years) in accordance with Defra and PPS25 guidance will be used in the SFRA.

When designing surface water drainage for a new development, the impact of climate change should also be taken into account. It is predicted that climate change will increase the intensity of storms and the volume of rainwater. The existing guidance for assessing the impact of climate change on peak rainfall is summarised in Table 6.3 below.

Table 6.3– Recommended increases in peak rainfall intensities

	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+ 5%	+ 10%	+ 20%	+ 30%

Current EA guidance (January 2008) in relation to climate change for the design lives for different types of development are as follows:

- 30 years for retail development
- 60 years for commercial development
- 100 years for residential development and critical infrastructure

6.3.1 Vale Royal Climate Change

Future scenarios were tested for the Weaver Gowy CFMP. The scenarios combined the impacts of climate change, landuse management and urban development on flood flows. The CFMP chose to test a medium change in the above drivers up to 2100. The technical annex gives more details on the figures used for the sensitivity testing and scenarios e.g. urban increase figures.

These scenarios from the Weaver Gowy CFMP have been used to inform the SFRA. The results showed that flood risk could increase in the future at Winsford, Northwich and the Frodsham area.

Changes in flood velocity depend on several factors including the geometry of channels, gradient of flow paths and shape of the floodplain. Flood velocity is likely to be low where flow enters flatter areas such as large floodplains in the lower Weaver. Fast flood velocities are more common in upper sub-catchments where flow is restricted or steep gradients are present. This means that as discharge or flood extent increase in the future it does not necessarily mean that flood velocities will also increase as these are dependant on many other factors.

For Winsford the different climate change scenarios did not significantly affect the number of people at risk or the number of properties flooded. However, the risk to people and properties in Northwich is shown to be more sensitive to the future scenarios. The CFMP recommended taking further action to reduce flood risk in Northwich. Area FRAs, which have been commissioned by Vale Royal BC, will look into flood risk in Winsford and Northwich in more detail.

Table 6.4 below shows the potential increase in the number of properties at risk from the 1in 100 year flood from a range of scenarios (increases in climate change, landuse management and urban area). The scenarios projected climate change to 2100 based on a medium projected increase in flood flows from climate change. The different scenarios assessed different flood risk management responses as shown in Table 6.4 below.

Table 6.4 - Properties at risk from future scenarios for the 1% a.p flood

Key communities	**Scenario 1** Retain existing into future	**Scenario 2** Reduce Flood Risk Management actions	**Scenario 3** Continue with existing	**Scenario 4** Further Flood Risk Management actions to reduce flood risk.
Northwich	632	791	711	684
Frodsham	115	150	138	138
Winsford	6	10	7	7
Total	**1021**	**1305**	**1185**	**1148**

The location with highest expected increase in damages for future changes is Northwich. This is due to the increase in flood extent which places a greater number of properties and therefore people at flood risk.

In addition, the Northwich flooding issue could be further exacerbated by the development pressure that exists. Flood alleviation and mitigation measures should be considered to reduce the level of risk if development, as part of the Northwich Vision, does take place. In addition more vulnerable development types should be moved away from the highest flood risk locations.

Frodsham also shows an increase in future flood risk due to a greater flood extent and depth for some of the scenarios.

Although the flood depth in Winsford is expected to increase, the flood risk remains low with no significant increase in people or properties at risk of flooding. The flood extent is not likely to increase significantly either. However if development takes place, adjacent to the River Weaver in north Winsford, many more properties could be put at risk. Extensive flood mitigation and possibly flood alleviation measures would be required to ensure the flood risk in north Winsford does not increase with further development.

Table 6.5 below summarises the expected increase in flood risk for locations within Vale Royal. This data has been extracted from the Weaver Gowy CFMP. The properties at risk have been estimated from the national Property Dataset and broad-scale flood outlines. The annual average damages (AAD) have also been estimated in this way and using a GIS calculation tool. The increase in flood depth is based on broad scale flood depth estimation using a GIS tool. Factors such as the number of people and flood depth reflect the increase in risk to people.

Table 6.5 – Expected increase in flood risk to existing urban areas in Vale Royal BC

Community	Main source of flooding	Now		Change by 2100 (median forecast)			
		Properties at risk (1% flood)	Damages AAD (£k)	Increase in max depth (m)	Increase in risk to people	Additional properties at risk (1% flood)	Additional damages AAD (£k)
Northwich	Weaver	632	6420	0.5	High	159	3550
Frodsham	Weaver	115	700	0.7	Medium	35	1300
Winsford	Weaver	6	17	0.5	Low	4	33

AAD = annual average damages

Due to the flat floodplain area around Winnington, flood risk could increase significantly in the future. This is of particular concern due to the proposed redevelopment of Winnington. It is therefore recommended that flood risk mitigation measures continue to be at the forefront of considerations by the Borough Council, the EA and developers as the phases of the Winnington Urban Village come forward for approval.

The Frodsham Marshes area is currently at risk of fluvial flooding from the pumped drains in this low-lying area. The area currently at risk from the 1 in 100 year flood is an undeveloped area. The 1 in 1000 flood does not increase the flood extent significantly. However, the frequency of flooding is likely to increase in this area as storms and flows become more regular.

As flows increase due to climate change the pumping stations may fail more regularly causing the Frodsham Marshes to flood. The capacity of the pumping stations would need to be increased in order to reduce the flood frequency in the future.

In addition the draft CFMP flood risk policy for this area is to reduce measures and eventually retreat from maintenance completely. This will allow the area to naturally flood on a regular basis.

Cogshall Brook, Crowton Brook and Cuddington Brook all have similar flood extents for the 1in 100 and 1in 1000 fluvial flood events. Climate change is not expected to increase flood risk at these locations.

6.4 Land use changes in Vale Royal

The North West Cheshire Forest Strategy aims to increase woodland in Cheshire from 5% to 30% (Linked to Mersey Forest Plan). Low grade agricultural land has been targeted between Sutton Weaver and Ellesmere Port and also along the proposed Weaver Valley Regional Park. Broadleaved trees make up 6% of the woodland cover and coniferous cover only accounts for 1% of the woodlands. Afforestation is thought to reduce run-off and therefore peak flows during flood events. This could reduce peak flood flows in West Cheshire, but the impact is likely to be small.

An increase in arable farming has lead to a loss of ponds, bogs and mosses, this has improved agricultural drainage. The trend of improving field drainage is likely to continue. Therefore the time between storms and flood peaks may reduce in the future across West Cheshire, increasing flood risk.

Farm size and type (pastoral to fodder crops) has varied significantly in the last ten years. The total number of farms has actually increased in recent years whilst the total area has decreased by around 10,000 hectares in the last decade. The number of small (<5 hectares) and large (100< hectares) farms have increased whilst the number of medium sized farms decreased. In 2002 the most dominant farm type was mixed followed by cattle and sheep and then dairy. One third of Cheshire's agricultural land is classified as Grade 3 (good to moderate), so explains why dairying has historically predominated. Therefore the trend of intensifying agricultural practices (enlarging fields, increasing arable practices, removal of hedgerows) and shift to arable farming is likely to continue leading to greater runoff and higher peak flows. Improved grassland covers much of the study area so a future change for this land cover would have significant influence. Stock density is increasing and leads to higher compaction, erosion and run-off and the loss of herb rich hay meadows and heathlands.

Overall it is thought that changes in land use are likely to decrease the time of storm to peak flood flows. This would overall increase flood levels. Afforestation could reduce peak flows but the impact is thought to be small. Sensitivity tests undertaken in the Weaver Gowy CFMP and other CFMPs in England have shown that landuse changes only have a significant impact on flood flows in larger river catchments. Even in large river catchments the impact over all is not significant. The ability for afforestation to reduce peak flood flows is recognised but the impact is the same and large-scale afforestation would need to take place for any recognisable change.

6.5 Risk from abandonment of assets

The flood risk associated with assets and the perceived risk from the abandonment of assets has been investigated. In assessing these assets, culverts, outfalls, weirs, pumping stations and debris screens have been included. Many of the outfalls in tidal areas will have flap valves attached, sluices and penstock structures. Although these structures can prevent flooding they can further complicate and increase flood risk especially if they are not regularly maintained and checked.

Flooding can commonly be caused by flooding by the mechanical or structural failure of engineering installations such as land drainage pumps (or their power supplies), sluice gates (or the mechanism for raising or lowering them), lock gates, outfall flap valves etc. Such failures can, by their nature be random and unpredictable. Failure can occur for a number of reasons including poor design, faulty manufacture, inadequate maintenance, improper operation, unforeseen accident, vandalism or sabotage.

Flooding can also be caused or exacerbated by the untimely or inappropriate manual operation of sluices, or by the failure of the person or organisation responsible to open or close a sluice at a critical time. Operational failures of this nature generally occur during a flood event and their results are to exacerbate rather than to cause flooding, and their impact is normally limited in extent.

Flooding can also be caused or exacerbated by bridge or culvert blockages, although these are not necessarily due to maintenance failures and may be caused by debris, natural or manmade, swept along by flood flows.

Weirs are constructed to raise the water level upstream or to prevent tidal inundation upstream of the weir. Flood levels will generally be higher upstream of the weir and lower immediately after the weir. If a weir falls into disrepair or is removed, flood levels become more consistent on the stretch of watercourse.

All of the existing assets in the study area can be seen in Figure V5. This includes culverts, outfalls, weirs, pumping stations and debris screens.

6.5.1 Vale Royal

North of Helsby there are a number of culvert outfalls on Helsby Town Ditch. In addition there are several flood defence structures and a weir on Hool Pool Gutter just west of Helsby.

On Hool Pool Gutter there is a Flood Zone outline and known flood history at the works location. This would suggest that the presence of these assets contributes to the flood risk situation.

Helsby Town Ditch flows towards the Frodsham Marshes which is a low lying pumped catchment. Surcharging culverts and blocked outfalls would increase flood risk to the mainly undeveloped Frodsham Marshes area. Therefore the abandonment of these assets would not have a significant impact on any receptors.

The Lower Weaver (downstream of Northwich) shows a sparse distribution of assets. This indicates that these do not complicate flood risk significantly in this area. However there a number of major sluices on the Weaver that have been constructed to make the Weaver navigable.

The sluices on the Weaver are operated by British Waterways. British Waterways operate the sluice gates during flood events which provide some flood risk protections for flood defence purposes. When certain river levels are reached on the River Dane and Weaver, the gates at Winnington, Barnton and Saltersford are automatically raised to their maximum extent. Gates at Vale Royal, Hunt's Lock, Dutton and Sutton operate independently according to water levels monitored local to the structures. On the Weaver Sluices, the gates are opened and closed in order to maintain as far as possible a constant water level of 4.38AOD.

In the Manchester Ship Canal all of the structures are automatically controlled using proportional integral derivative devices (PID) to calculate appropriate gates responses.

These sluices could cause or exacerbate flood risk due to the untimely or inappropriate manual operation of sluices, or by the failure of the person or organisation responsible to open or close a sluice at a critical time.

There are a number of structures including weirs, outfalls and debris screens at Cuddington and Crowton. As there is a perceived flood risk at these locations due to watercourse overtopping, the abandonment and the presence of these assets could complicate or exacerbate flood risk.

There are weirs on the Dane and Weaver as they enter Northwich and on the Weaver as it leaves Northwich, adjacent to Winnington. Weirs raise water levels upstream therefore weirs have the potential to increase flood risk locally and reduce risk downstream. If the weirs were abandoned or removed then more consistent river and flood levels would occur. Other structures are present on the rivers that pass through Northwich but these are not great in number and are therefore unlikely to have a big impact on flood risk.

There are several outfall structures on the Weaver in Winsford. These are unlikely to cause or increase flood risk in Winsford as the flood risk mechanism is overtopping of the Weaver.

6.6 Mitigation for Flood Zones

Flood risk mitigation is the last factor to be considered when considering flood risk management measures (see Table 1.2 of PPS25 practical guide). The first factor to consider is:

- Avoidance/prevention - Allocate developments to areas of least flood risk and apportion development types vulnerable to the impact of flooding to areas of least risk. Then,
- Substitution - Substitute less vulnerable development types for those incompatible with the degree of flood risk. Then,

- Control - Implement measures to reduce flood frequency to existing developments. Appropriate design of new developments. And finally,
- Mitigation - Implement measures to mitigate residual risks.

Mitigation measures include: Flood risk assessments incorporating flood resistance and resilience measures, Emergency Planning Documents and implementation of flood warning and evacuation procedures.

On site flood mitigation measures that FRAs may propose can include improved defences, land raising, nonhabitable ground floors and secondary defences such as flood storage and drainage improvements.

This section aims to advise on the development measures required in each Flood Zone in order to make the development acceptable. This does not override what PPS25 states on appropriate development in Flood Zones. Nor does this override the Sequential and Exception Tests and the other flood risk management options that come above mitigation (see bullet points above).

6.6.1 Flood Zone 3b

No built development is acceptable in this Flood Zone. PPS25 states that only the water-compatible uses and the essential infrastructure is appropriate. Should this type of development go ahead it should be constructed to:

- remain operational and safe for users in times of flood
- result in no net loss of floodplain storage
- not impede water flows and
- not increase flood risk elsewhere.

6.6.2 Flood Zone 3a

PPS25 states that the water-compatible and less vulnerable uses of land in Table D.2 of PPS25 are appropriate in this zone.

Development behind defences should only take place if the defences are constructed to the required standard of protection (SoP) and are in a good condition. The Environment Agency's National Flood Defence and Coastal Database (NFCDD) provides this information and has been used for this report. However, the NFCDD is not exhaustive. The requirement is to provide protection up to the 1 in 100 year fluvial and 1 in 200 year tidal flood event. If possible, developments should be set back from defences, outside of the flood envelope or breach envelope. (Refer to Section 3.5 for more detailed description of River Dee flood projection).

Development within the flood envelope behind defences should have finish floor levels above the 1 in 200 year tidal and 1 in 100 year fluvial flood or breach level. Sufficient freeboard, to take into account climate change and modelling uncertainties, should be added onto this level.

Undefended areas should also have finish floor levels set above the 1 in 200 year tidal and 1 in 100 year fluvial flood or breach level. Sufficient freeboard, to take into account climate change and modelling uncertainties, should also be added onto this level.

For housing proposals significant freeboard allowances should be integrated into the design. For commercial and employment development (less vulnerable) a significant freeboard is not essential. Where flood depths are expected to be over 1.5m, it may not be economically viable to raise floor levels to this degree.

> Unless the development is located in an area which is subject to tidal flooding and which serves no conveyance function (i.e. is behind defences), land raising must be accompanied by compensatory provision or flood storage either on or off site. Even when the development is behind defences flood compensation storage may required for land raising if secondary flooding (e.g. flooding from tide locked rivers) is possible.

Where possible, consideration should be given to making the ground floor uninhabitable by designing ground floor car parking or putting other public areas here.

For defended areas in particular the focus should be on safety to residents from residual risk (e.g. breach of a flood defence). However, all development should consider safe access and eggress in times of flood. Flood risk that threatens public safety and the structural integrity of buildings should not be considered.

6.6.3 Flood Zone 2

PPS25 states that the water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table D.2 of PPS25 are appropriate in this zone. If development does take place in this Flood Zone finish floor levels should be set above the 1 in 100 fluvial and 1 in 200 year tidal flood event. Again, an appropriate freeboard allowance should be added to take into account climate change and modelling uncertainties.

The PPS25 companion guide states that in all flood risk areas, a basic level of flood resistance and resilience should be considered to limit the impact of a flood event. Flood resistant and resilience measures can be described as:

Flood resistance, or 'dry proofing', where flood water is prevented from entering the building. For example using flood barriers across doorways and airbricks, or raising floor levels.

Flood resilience, or 'wet proofing', accepts that flood water will enter the building and allows for this situation through careful internal design for example raising electrical sockets and fitting tiled floors. The finishes and services are such that the building can quickly be returned to use after the flood.

Examples of both flood-resistant and flood resilient design are given in Flood resilient and resistant construction – guidance for new build (CLG/Defra/EA, May 2007: Improving the flood performance of new buildings: Flood Resilient Construction. Available from www.communities.gov.uk).

6.6.4 Surface water mitigation

The surface water disposal for new developments should be managed in a way that does not increase flood risk for downstream properties.

For events with a return-period in excess of 30 to 50 years, surface flooding of open spaces such as landscaped areas or car parks is acceptable for short periods, but the layout and landscaping of the site should aim to route water away from any vulnerable property.

No flooding of property should occur as a result of a 1 in 100 year storm event (including an appropriate allowance for climate change).

The developed rate of run-off into a watercourse, or other receiving water body, should be no greater than the existing rate of run-off for the same event. Run-off from previously-developed sites should be compared with existing rates, not greenfield rates for the site before it was developed. Volumes of run-off should also be reduced where possible using infiltration techniques.

Section 5.18 to 5.51 of PPS25 practical guide provides more details and practical examples of flood risk mitigation measures. In addition, Appendix A3 in CIRIA RP624 *Development and flood risk – guidance for the construction* industry provides further details of mitigation measures for flood risk management.

6.7 Defences not at the required standard

Developed urban areas behind defences should be protected to a certain standard. Proposed development that is below this required standard should not normally be allowed. PPS25 Annex G section G2 states that 'development should not normally be permitted where flood defences, properly maintained and in combination with agreed warning and evacuation arrangements, would not provide an acceptable standard of safety taking into account climate change'.

This acceptable standard is to the 1in 100 year fluvial and the 1 in 200 year tidal flood event in urban areas.

Throughout Northwich there are some small-scale flood defences and the Weaver has been canalised. This has been done to make the channel navigable but this also provides some level

of protection to Northwich. A Flood Alleviation Scheme Pre-Feasibility Study has recently been carried out for the Environment Agency (Arup, July 2006), which reviewed the options for providing flood alleviation to Northwich. A series of possible solutions included flood storage, flood defences within the town centre and alterations to Winnington Weirs and Weaver Flood Course were considered. After reviewing a wide range of options for providing flood alleviation in Northwich, the study identified the most viable option at the pre-feasibility stage is to construct flood defence within the town centre to the 1 in 100 year defence standard, set back from the rivers Dane and Weaver where possible to maximise the use of the existing floodplain.

It is intended that further work on the possible flood alleviation solutions for Northwich will be commissioned in the near future.

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Development in Vale Royal Borough

7 Development in Vale Royal Borough

7.1 Summary of Regional Flood Risk Assessment Figures

The tables below show some figures produced in preparation for the regional flood risk assessment (RFRA) for the Northwest. This was completed by the Environment Agency in February 2006 using proposed housing forecasts according to the Draft Regional Spatial Strategy (RSS). This provides a general assessment of the number of properties at risk and the ranked risk for the local authorities in the northwest. The assessment also attempts to assess potential future flood risk from housing provision and development pressure.

The work undertaken that produced these figures will form the basis of the NWRA's Regional Flood Risk Assessment (RFRA) as required by PPS25. In doing this it will assist the Regional Assembly and Local Planning Authorities in assessing the feasibility and implications for future flood risk of current planned housing allocations in emerging RSS and LDFs.

The housing allocations are extracted from the current draft of the Regional Spatial Strategy. The Data source for housing densities is "Land Use Change in England Residential Development to 2004 - ODPM, May 2005".

Table 7.1 shows the number of properties that are in Flood Zones 1, 2 and 3 (therefore all properties in each council) and then summarises what percentage of these properties are in the highest risk Flood Zone (Flood Zone 3). Vale Royal has been ranked out of all the local authorities in the Northwest according to which has the highest percentage of properties in Flood Zone 3.

Table 7.1

	Property Count					
	Flood Zone 3	Flood Zone 2 & 3	Flood Zone 1	Total	% of props in Flood Zone 3	Overall rank in Northwest region (1-44)
Vale Royal	446	1543	55342	56885	0.8	39

Table 7.2 makes an assessment of how many properties are not protected to the required standard by existing flood defences (i.e. 1 in 100 years fluvial and 1 in 200 years tidal). The local authorities are also ranked according to which has the most properties not protected to the required standard.

Table 7.2

	Properties with *SoP of 1 in 101- 1000 years	Properties with SoP of 1 in 1-100 years	Total properties at Flood Risk	Theoretical Property Risk (Number of properties flooding per year)	Flood Risk Rank	Overall rank in Northwest region (1-44)
Vale Royal	286	809	1,095	14	medium	31

*For SoP definition see Glossary

Table 7.3 summarised the total number of projected housing provisions and their density. This table also provides a Northwest ranking.

Table 7.3

	Total housing provision (2003-2021)	Housing Density (props per hectare)	Overall rank in Northwest region (1-44)
Vale Royal	9000	22	11

Table 7.4 uses all of the above data to give an overall ranked risk in the Northwest.

Table 7.4

	Development Pressure Risk Rank	Region rank	Overall Local Planning Authority Flood Risk Rank (0 low-15 high)
Vale Royal	3	20	6

Table 7.4 combines Tables 7.2 and 7.3 in an effort to rank possible future flood risk, assuming the potential future housing sites are implemented in full. In doing this, it also considers potential available development space outside Flood Zone 3 within each authority boundary and allowance is made too for likely development density (houses per hectare) in each authority, based on recent trends. The Data source for housing densities is "Land Use Change in England Residential Development to 2004 - ODPM, May 2005". Table 7.4 makes no allowance for green belt, designated environmental sites and the numerous other constraints which reduce actual land likely to be available for development.

$$\textit{Development Pressure Ratio (DP)} = \frac{\textit{Area required for housing}}{\text{Area outside floodplain}}$$

The results of calculating this ratio have then been banded and scored as a 'Development Pressure Risk Rank' from 1 (low) to 5 (high).

- A high regional position in Table 7.1 denotes large number of properties in Flood Zone 3 (but no indication as to whether some or all of these are at risk every 10 years, 50 years, or 100 years).
- A high regional position in Table 7.2 denotes high current flood risk (either large numbers, or low standard of protection, or both).

- A high regional position in Table 7.3 denotes significant development pressure – can LPA accommodate this outside Flood Zones 3 & 2?
- A high regional position in Table 7.4 denotes potentially high current and future flood risk. This is due to a combination of the numbers of existing properties in floodplain and the standard of any associated defences, the level of proposed future housing allocations and the space available for residential development outside Flood Zones 3.

This data was produced to enable Local Authorities to consider whether:
- Developments can be accommodated outside Flood Zone 3 (& 2).
- Other options to manage flood risk may be necessary, for example, should the allocation itself be reduced or should higher densities be considered?

7.2 Vale Royal

From the RFRA figures it could be concluded that Vale Royal has a low level of flood risk compared to all the other local authorities in the Northwest. Tables 7.1 and 7.2 show that there is a low number of properties in Flood Zone 3 and that current flood risk is low. However, Table 7.3 tells us that there is high development pressure in Vale Royal and Table 7.4 concludes that development pressure is average to high. Table 7.4 also shows that the number of properties at risk of flooding could increase in the future, pushing Vale Royal up the regional rankings. However, the overall flood risk to Vale Royal is classed as low and should remain low unless future developments around the River Weaver in Winsford and Northwich are developed without sensitivity to flood risk.

Regeneration within Vale Royal

Northwich Vision

Vale Royal Borough is working in partnership with, Cheshire County Council, Northwest Development Agency, English Partnerships, British Waterways, Environment Agency and the Learning and Skills Council to develop a 15-year regeneration strategy for Northwich town centre. The development potential that will be released as a result of the mine stabilisation programme will include:

- The provision of 1000 new homes and 2000 new jobs in the centre of Northwich.
- The utilisation of the Rivers Weaver and the Dane, by creating a mixed-use waterfront activity.
- Two new retail areas covering approximately 400,000 sq.ft.
- A newly designed market square in the centre of the town.
- The Barons Quay site. A mixed-use development, comprising residential, leisure, retail, offices and a new cultural centre.

Winnington Urban Village

Outline planning permission has now been granted for the regeneration of a derelict industrial site of Wallerscote into a new urban village alongside the River Weaver. This will include a mixed use scheme including 1200 new residential units.

Winsford

The Winning Winsford regeneration programme will include major projects to transform the town which will include a new Learning Zone,major regeneration to the waterfront area and preservation work at Winsford Flash, a new Lifestyle Centre and a Business Centre at Woodford Park.

Other projects include:

Two major regeneration projects which are supporting regeneration in the corridor of the River Weaver. The task of REVIVE (Regenerating the Environment Invests in the Economy) across

the Cheshire and Warrington region is to restore and reclaim brownfield sites into environmental assets. Its objective is to reclaim and or bring into effective management 580ha of derelict, underused and neglected, predominantly Brownfield land, in Cheshire and Warrington by 2012.

The Weaver Valley Regional Park covers a 40km stretch of the River Weaver from Runcorn to Crewe. The Regional Park proposes to support urban regeneration, promote tourism and encourages reclamation by using the Weaver and Wheelock Valley as a recreational resource. Development along this major watercourse may influence catchment runoff, water storage and floodplain locations.

Frodsham Waterfront:

It is intended that this project will re-open the Cut to provide a navigable waterway for pleasure craft to access the waterfront at Frodsham.

7.2.1 Potential future development sites - Data Sources for Vale Royal

Appendix B contains the data provided by Vale Royal Borough Council on current and potential future development sites. Data was provided on:

Adopted Vale Royal Local Plan Allocations

- All housing, employment and retail allocations within the Adopted Vale Royal Borough Local Plan First Review Alteration (June 2006).

Employment Land Monitoring Sites (as at 31st March 2007): This includes:

- Sites allocated in the Vale Royal Local Plan First Review Alteration (adopted June 2006) that have not yet been developed and have no planning permission and;
- Sites that have planning permission for employment use, but where development has not yet started.

Housing Land Monitoring Sites (as at 31st March 2007): This includes:

- Sites allocated in the Vale Royal Local Plan First Review Alteration (adopted June 2006) that have not yet been developed and have no planning permission and;
- Sites that have planning permission for housing, but where development has not yet started or where the development is subject to a section 106 agreement.

Strategic Housing Land Availability Assessment

Planning Policy Statement 3: Housing requires that the Council undertake Strategic Housing Land Availability Assessment (SHLAA) to support the delivery of sufficient land to meet the community's need for more homes. The purpose of the assessment is to evaluate the existing supply of housing, identify sites with potential for housing, assess their housing potential and assess the likelihood of those sites coming forward for development. It is a key part of the evidence base for the Council's LDF.
Vale Royal Borough Council are well advanced with the production of the SHLAA for the area. A large number of sites were put forward for inclusion in the SHLAA and Vale Royal Borough Council also invited expressions of interest for potential development sites to be considered. To date, all sites that were put forward to be included in the SHLAA have been surveyed and are currently being assessed in terms of their suitability for housing development. The review of these sites forms part of the ongoing work for the LDF Core Strategy.

As the SLAA is not yet finalized, it would be premature to include these sites within the SFRA at this stage of the process. The SFRA will be used to sequentially assess sites in the Vale Royal Borough Council's Draft SHLAA, following a similar format to the sites already contained in

Appendix C of the SFRA. This information will then be entered into a matrix which will form part of the Appendices to the final SHLAA.

The SFRA provides a consistent methodology for assessing any new potential development sites submitted to the Council. The assessment of these sites will also follow the guidance in the SFRA and the format of Appendix C.

For both the SHLAA and potential development sites, flood risk is an important consideration in determining the allocation of sites for new development. However, the Council will be required to balance this against other environmental, social and economic factors and planning constraints. For any sites that are considered for allocation contrary to the SFRA, appropriate mitigation measures should be provided.

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Assessment of Flood Risk in Study Areas

8 Assessment of Flood Risk in Study Areas

PPS25 requires that LPAs prepare SFRAs to an appropriate level of detail to allow the Sequential Test to be applied in the site allocation process. SFRAs should refine information on the probability of flooding, taking other sources of flooding and the impacts of climate change into account.

This SFRA has gathered flood risk information in order to complete an initial Sequential Test for future development sites being considered by the LPAs, as at June 2007. The SFRA provides enough information to allow the Sequential Test to be completed for any other sites that are to be brought forward for consideration in the future.

The SFRA also identifies areas at risk of flooding from sources other than rivers and the sea and identify any flood risk management measures, including infrastructure and the coverage of flood warning systems. Guidance on the preparation of FRAs for future development sites and guidance on the likely applicability of different sustainable drainage systems (SUDS) techniques for managing surface water run-off at key development sites will also be included.

The majority of this information for the different sites is contained in the matrix which is in Appendix C.

8.1 The Sequential Test

Existing undeveloped Local Plan allocations, sites with planning permission and strategic sites have been provided by the LPAs. The aim of the Sequential Test is to direct development away from areas at risk of flooding.

> 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 Zones 2 and 3, as identified by the Strategic Flood Risk Assessments (SFRA) (see Table D.1 and Table D.2 of PPS25).

The Flood Zone maps show current best estimates of the risk of flooding from rivers and the sea only and does not consider other sources. Therefore this principle of locating development in lower risk areas should be applied to other forms of flooding. Judgement can be used to identify those areas in which flood risk from other sources of flooding is likely to be higher. The sequential approach can then be applied to steer new development away from these higher risk areas.

> Once the Sequential Test has been completed the following should be considered:
>
> - Development in Flood Zone 3 should be seen as a last resort and that certain uses (as identified in PPS25 Table D1) are inappropriate in high risk areas and should not be permitted at all.
> - Development in Flood Zone 2 should not be seen as without risk of flooding.
> - Appropriate measures to manage residual risk must be applied to any developments which are exceptionally constructed in flood risk areas. These measures must take into account effects of climate change

8.1.1 Functional floodplain Flood Zone 3b

PPS25 defines a Functional Floodplain as 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 per cent) or greater in any year, or at another probability to be agreed between the LPA and the Environment Agency (EA), or:
- is designed to flood in an extreme (0.1 per cent) flood, or at another probability to be agreed between the LPA and the EA.

The functional floodplain relates only to river and coastal flooding, it does not include areas at risk of flooding solely from other sources of flooding (e.g. surface water, sewers). The functional floodplain (Zone 3b) is determined considering the effects of defences and other flood risk management infrastructure (i.e. if there is a defence in place there is no functional floodplain).

> Flood Zone 3b (functional floodplain) is the highest risk zone and effort should be made to steer development (apart from water compatible) away from this zone.

In Vale Royal modelling is available for the Rivers Dane and Weaver. Flood Zone 3b can therefore be produced for these modelled reaches. Where there are defences and where the Weaver is canalised it has been deemed inappropriate to class adjacent land as functional floodplain. In other areas Flood Zones 2 and 3 have been used as well as information on other sources of flood risk.

8.2 Application of the Sequential Test

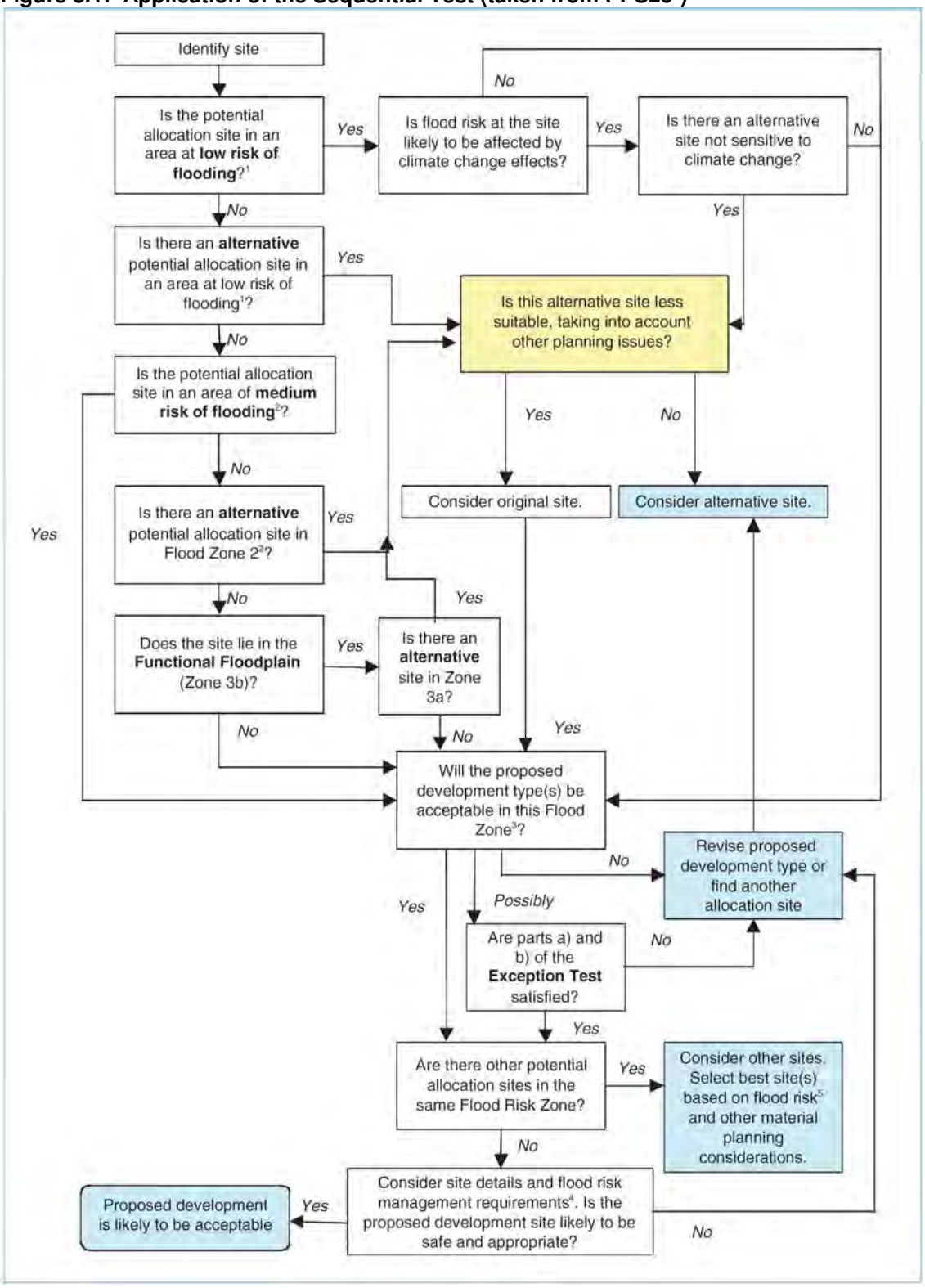
In A Practical Guide Companion to PPS25 (February 2007) a flow chart is provided which shows how to apply the Sequential Test (see Figure 8.1) within the LDF process. This has been used as a basis to the application of the Sequential Test for the SFRA.

The data provided by the LPA (Appendix B) were brought into a GIS mapping system, displaying background OS maps and the Environment Agency's Flood Zones. In addition, information on other sources of flood risk including canals, ordinary watercourses and reservoirs were brought into the mapping as well as climate change flood maps.

This allowed the filtering out of sites (received by June 2007) that are not thought to be directly at risk of flooding now and in the future (due to climate change). For these sites recommendations have been provided based on the size of the allocation. These recommendations include the need to consider surface water disposal and the implementation of SuDS. These sites have remained as point data but are still included in the flood risk matrix and potential future development sites database.

For the remaining potential development sites that were at risk of flooding, a more detailed approach was taken in order to identify the sites most at risk of flooding. This was completed using the GIS mapping and inputting the data into the flood risk matrix.

Figure 8.1: Application of the Sequential Test (taken from PPS25[2])



Notes
1 Flood Zone 1 for fluvial and tidal flooding and with a low risk of flooding from other sources.
2 Flood Zone 2 for fluvial and tidal flooding and with a medium risk of flooding from other sources.
3 As defined by the Sequential Test.
4 Development to be safe and to not increase flood risk elsewhere. Required to pass part c) of the Exception Test, where applicable.
5 Including susceptibility to future climate change and residual flood risk.

8.3 Flood risk matrix explanation

A flood risk matrix has been produced to identify the highest risk potential future development allocations and summarise recommendations. This can be found in Appendix C.

The matrix is made up of a list of sites down the first column and data inputs across the first row. The first few columns of the matrix are concerned with the potential development sites i.e. name, size, type.

The next column identifies which Flood Zone in which the site is located. If the site is affected by different Flood Zones then this is shown. Different recommendations will apply to different parts of the site.

For sites affected by multiple Flood Zones, the LPA should direct less vulnerable types of development towards the less vulnerable parts of the sites (taking into account flood hazard and the different flood extents).

The next column identifies what is the standard of protection of defences adjacent to the development. This can also be applied to the river channel without defences, for example the canalised River Weaver will have a higher standard of protection (SoP) than a natural river because it has been deepened and walled. These sections however are not classed as official raised defences.

By including this column we can identify which potential future development sites are served by flood defences and whether the SoP is met. If defences are not protected from up to the 1 in 100 year fluvial or 1 in 200 year tidal flood then the SoP has not been met. Recommendations can then be made for improving the SoP of defences if there is an overarching need for development to take place here. Alternatively compensatory flood storage can be integrated into the design of new developments.

The flood risk profile column looks at the level of risk within a flood zone. This is based on flood velocity, depth and distance from defences (an explanation can be seen in section 6.2). This column allows us to distinguish higher risk locations within a Flood Zone.

The ‘other influences’ column provides details on other possible sources of flood risk, whether the defence SoP is met, if the site has been flooded in the past or is within a historic flood outline and whether the site is brownfield. These details allow an assessment of whether the site is more at risk from other sources compared to other sites. Also if a site is greenfield, not defended to a high enough standard or has a history of flooding, these sites can put below other sites in terms of acceptability for development.

The ‘site’ column shows what the response to the current development site should be, according to PPS25.

On the recommendations column a brief recommendation is made, for more details on what is required for the allocation Figure 8.2 and Table 8.1 should be used (see Sections 8.6 and 8.7)

The final column summarises SuDS options, recommendations for future works to improve the defence SoP or other measures and mitigation measures for each site.

After each site there is a colour coding. This is based on the level of flood hazard and what flood zone the site is in. It should be possible, using the colour code key, to identify where the highest risk and lower risk potential future development sites are (or parts of sites).

A summary of Appendix C is provided below but specific analysis (directing more vulnerable development away from high flood vulnerable sites) should be undertaken in more detail when producing the DPDs.

8.4 Sequential Test summary

Within the development and flood risk matrix each site has been assessed according to its specific issues. The site has been split in line with which flood zone parts of it fall within. This has then been colour coded. The key to the colour code can be seen on the matrix. The LPA should aim to divert development away from higher flood zones and the higher hazard ratings when planning what type of development should go where. A summary of the findings can be found below.

8.5 General summary

In general flood hazard through Northwich centre is classed as high, the flood extent is also at its greatest through Northwich town centre. In Northwich the lower flood risk areas (in hazard rating and frequency of flooding) are to the north and south of the town centre. The area around the confluence with the Dane and Weaver is at a particularly high risk. This area has a wide, high probability floodplain and a high hazard rating. The potential future development sites with the greatest level of risk associated with them are as follows:

- VLH3 – parts of the Barons Quay allocation near the river Weaver
- VLH5 – The County Council offices site
- VLH7 – Lock Street allocation near to the River Weaver.
- VLH1 and others – Winnington allocation, a large part of this allocation around the Weaver has a high hazard rating and is within the 1 in 25 year flood outline. Winnington Urban Village now has outline planning permission following consultation with the EA. As the detailed phases of the development come forward, flood risk will continue to be a major issue for consideration.

Other areas of high risk include:

- Chester Way
- London Road
- Navigation Road
- Weaverway

The general pattern is that lower risk areas are found further away from the rivers. Locations to the south of Northwich centre and areas between Northwich and Winnington are at a lower risk.

There is a lower level of flood risk associated with Winsford. The number potential future development sites at flood risk in the centre of Winsford is limited due to the confined nature of the floodplain. In addition Flood Zone 3a (functional floodplain) is limited through Winsford due to the higher topography either side of the river. However as the Weaver leaves Winsford any new, extensive, housing allocations will be at risk of flooding. The LPA should consider in more detail the location of different types of development in this area.

The flood mapping in Winsford is broad scale and therefore the exact location of the areas at risk of flooding cannot be ascertained. More detailed modelling is required to find the exact locations that are most at risk.

Vale Royal Borough Council have commissioned Faber Maunsell to undertake a more detailed Area Flood Risk Assessment for Winsford which will provide information on flood risk for Winsford Town Centre.

The remaining potential future development sites are sporadically distributed throughout the Borough or are not within Flood Zones 2 to 3. For potential future development sites outside of the higher flood risk zones, the general guidance should be followed in the SFRA, especially Table 8.1 and Figure 8.2 (see Sections 8.5 to 8.6).

NB: as there are a large number of potential future development sites, not all of them have entries. This is due to many of them being outside of Flood Zones 2 and 3 and because some of them overlap each other. For the potential future development sites outside of Flood Zones 2 and 3 Table 8.1 and Figure 8.2 should be used (also read Sections 8.5 to 8.6 general requirements for planning applications).

8.6 Generic requirements for planning applications

The following table can be used as a guide when considering a site brought forward for development through planning applications. This can be used as a checklist and should ensure all factors relating to flooding, drainage and development near to watercourses are taken into account at an early stage.

Table 8.1- Generic responses for all proposed developments

Development issue	Generic statements/requirements
Proposed developments within Flood Zone 3b	All development proposals in this zone should be accompanied by a FRA, See Annex E of PPS25 for minimum requirements. Only the water-compatible uses and the essential infrastructure listed in Table D.2 of PPS25 that has to be there should be permitted in this zone. Refer to the SFRA (if site included) refer to the site specific guidance. If not included, consider the sequential test requirements/ windfall sites, and general issues described. Use findings from SFRA to consider vulnerability and risk to people and property. The Environment Agency must be consulted.
Proposed developments within Flood Zone 3a	All development proposals in this zone should be accompanied by a FRA, See Annex E of PPS25 for minimum requirements. The water-compatible and less vulnerable uses of land in Table D.2 of PPS25 are appropriate in this zone. Refer to the SFRA (if site included) refer to the site specific guidance. If not included, consider the sequential test requirements/ windfall sites, and general issues described. Use findings from SFRA to consider vulnerability and risk to people and property. The Environment Agency must be consulted.
Proposed developments within Flood Zones 2	All development proposals in this zone should be accompanied by a FRA, See Annex E of PPS25 for minimum requirements. The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table D.2 of PPS25 are appropriate in this zone. Refer to the SFRA (if site included) refer to the site specific guidance. If not included, consider the sequential test requirements/ windfall sites, and general issues described. Use findings from SFRA to consider vulnerability and risk to people and property. The Environment Agency must be consulted.

Development issue	Generic statements/requirements
Major developments[2] within Flood Zone 1	FRAs to be undertaken for all sites major development sites, including those in Flood Zone 1, (EA is a statutory consultee for any development with an area greater than one hectare). Vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a FRA. See Annex E of PPS25 for minimum requirements and the requirements below for drainage requirements.
Minor developments within Flood Zone 1	All types of development are acceptable and a FRA is not required. Refer to the standard Environment Agency comments on managing surface water drainage: (www.pipernetworking.com/floodrisk/operational.html).
Proposed developments adjacent to an Ordinary Watercourse	Land Drainage Act Consent information applicable.
Proposed development within 20m of a Main River	The Environment Agency must be consulted.
Development that requires culverting, operation or the control of the flow of any river or stream.	The Environment Agency must be consulted.
All drainage and sewer design for new developments.	EA should be consulted as per above recommendations and when the surface water is to drain directly to a main river or Critical Ordinary Watercourse. Otherwise UU and LPA consultation only will be required. Sewers should be designed to ensure that no flooding occurs above ground level for events with a return-period in the range of 30 to 50 years. For events with a return-period in excess of 30 to 50 years, surface flooding of open spaces such as landscaped areas or car parks is acceptable for short periods, but the layout and landscaping of the site should aim to route water away from any vulnerable property. No flooding of property should occur as a result of a 1 in 100 year storm event (including climate change). The developed rate of run-off into a watercourse, or other receiving water body, should be no greater than the existing rate of run-off for the same event. Run-off from previously-developed sites should be compared with existing rates, not greenfield rates for the site before it was developed. Determine current runoff for the historic rights, increase rainfall intensity to take into account climate

[2] Major development is defined in The Town and Country Planning (Flooding) (England) Direction 2007 as:
(a) in respect of residential development, a development where the number of dwellings to be provided is 10 or more, or the site area is 0.5 hectares or more; or
(b) in respect of non-residential development, a development where the new floorspace to be provided is 1,000 square metres or more, or the site area is 1 hectare or more;

Development issue	Generic statements/requirements
	change, provide storage/SuDs to maintain current runoff rates for future years.
Regional planning bodies and local authorities should promote the use of SUDS for the management of run-off.	LPAs should promote the use of SUDS for the management of run-off.

In addition, the figure below should be used when deciding what should be done when considering flood risk, drainage and the management of watercourses for certain development types. This table can be applied to all development types and should enable the correct consultation response and should be referred to as a first port of call for planning applications. The table below is a March 2007 version, the table is updated over time and the latest version can be found on the following website address.

http://www.pipernetworking.com/floodrisk/matrix.html

The boxes on the internet version are linked to Environment Agency guidance notes and definitions.

Figure 8.2: Flood Risk Assessment Matrix

Development Type	Relationship to sources of flooding and Flood Zones.				
	Development (including boundary walls etc.) within 20 metres of the top of a bank of a Main River	**Includes culverting or control of flow of any river or stream**	**Within Flood Zone 3**	**Within Flood Zone 2**	**Within Flood Zone 1**
Householder development and alterations (Note 1)	Consult EA	Consult EA with FRA showing design details of any culvert or flow control structure proposed	No consultation - see standard comment (Note 6)	No consultation - see standard comment (Note 6)	No consultation - No EA Advice
Non-residential extensions with a footprint of less than 250m2 (Note 2)	Consult EA	Consult EA with FRA showing design details of any culvert or flow control structure proposed	No consultation - see standard comment (Note 6)	No consultation - see standard comment (Note 6)	No consultation - No EA Advice
Change of use FROM Water Compatible TO 'Less Vulnerable' development (Note 3)	**Only** consult EA if site also falls within Flood Zone 3. FRA Required	No consultation - no EA advice	Consult EA with FRA	No consultation - no EA advice	No consultation - No EA Advice
Change of use RESULTING IN 'Highly Vulnerable' or 'More Vulnerable' development (Note 4)	**Only** consult EA if site also falls within Flood Zone 3 or 2. FRA Required	No consultation - no EA advice	Consult EA with FRA	Consult EA with FRA	No consultation - No EA Advice
Operational development less than 1 hectare (Note 5)	Consult EA	Consult EA with FRA showing design details of any culvert or flow control structure proposed	Consult EA with FRA and Sequential Test Evidence (and where required confirm Exception Test has been applied)	Consult EA with FRA and Sequential Test Evidence (and where required confirm Exception Test has been applied)	No consultation - see standard comment (Note 7)
Operational development of 1 hectare or greater (Note 5)	Consult EA	Consult EA with FRA showing design details of any culvert or flow control structure proposed	Consult EA with FRA and Sequential Test Evidence (and where required confirm Exception Test has been applied)	Consult EA with FRA and Sequential Test Evidence (and where required confirm Exception Test has been applied)	Consult EA with FRA

Colour Key – Red indicates consultations with the EA is necessary, Grey indicates that no consultation is required.

Standard comment - Floor levels within the proposed development will be set no lower than existing levels AND, Flood proofing of the proposed development has been incorporated where appropriate. Or Floor levels within the extension will be set 300mm above the known or modelled 1% (1 in 100 chance each year) river flood level or 0.5% (1 in 200 chance each year) tidal & coastal flood level.

NB – for explanation of notes see following pages. This information was correct at the time of writing but is subject to change. For the most up to date information please see http://www.pipernetworking.com/floodrisk/matrix.html

Notes

Note1 and 2 - ***Minor development***:

(i) development of an existing dwelling-house, or development within the curtilage of a dwelling-house, for any purpose incidental to the enjoyment of the dwelling-house as such;

(ii) the extension of an existing building used for non-domestic purposes where the footprint created by the development does not exceed 250 square metres;

(iii) the alteration of an existing building where the alteration does not increase the size of the building; ".

'Householder' development includes "sheds, garages, games rooms etc. within the curtilage of the existing dwelling in addition to physical extensions to the existing dwelling itself. This EXCLUDES proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats".

Note 3 - ***'Water-compatible'*** development and ***'less vulnerable'*** development (see PPS25 Annex D, Table D.2). Consultation is intended to pick up those proposed developments which may increase flood risk.

The Environment Agency will have NO comment to make on any change of use RESULTING IN water-compatible development and should not be consulted.

Note 4 - ***'Highly vulnerable'*** and ***'more vulnerable' development'*** (see PPS25 Annex D, Table D.2). Consultation is intended to pick up proposed development which may increase flood risk. This will include changes of use WITHIN these categories.

Note 5 - ***'Operational development'*** includes building, mining or engineering works and excludes development involving only a material change of use. The 1 ha threshold is based on the size of the application site as shown on the planning application form or site plan.

Note 6 – EA guidance (see below) is designed to cater for domestic extensions as well as the extension of an existing building used for non-domestic purposes where the footprint created by the development does not exceed 250 square metres.

In such circumstances:

Applicants should complete the table below and include it with the planning application submission. The table, together with the supporting evidence, will form the Flood Risk Assessment (FRA). It will act as an assurance to the Planning Authority that flood risk issues have been addressed as part of the development.

Planning Authorities should check the planning application and ensure that one or other of the mitigation measures proposed in the table have been incorporated into the development.

Applicant to choose one or other of the flood mitigation measures below.	**Applicant to provide the LPA with the supporting Information detailed below as part of their FRA**	**Applicant to tick one of the boxes below**
Either: Floor levels within the proposed development will be set no lower than existing levels AND, Flood proofing of the proposed development has been incorporated where appropriate.	Details of any flood resilience and resistance techniques to be included in accordance with 'Preparing for floods' (ODPM 2003)	
Or: Floor levels within the extension will be set 300mm above the known or modelled 1% (1 in 100 chance each year) river flood level or 0.5% (1 in 200 chance each year) tidal & coastal flood level.	To be demonstrated by a plan that shows finished floor levels relative to the known or modelled flood level. All levels should be stated in relation to Ordnance Datum	

Cumulative Impact of Minor Extensions and the Removal of Permitted Development Rights.

In circumstances where local knowledge (SFRA/ letters from the parish council etc.) indicate that the cumulative impact of minor extensions may have a significant effect on flood risk (PPS25 paragraph D14), FRA guidance note 2 can be applied.

The Environment Agency will comment on minor applications e.g. residential extensions where

(a) Permitted development rights have been removed for flood risk reasons, and

(b) A local consultation protocol has been agreed between the Environment Agency and the Local Planning Authority

Note 7 - For operational developments[3] of less than 1 hectare falling within Flood Zone1, the main flood risk issue to consider will usually be managing surface water run-off (or other forms of flooding).

If a known drainage problem exists and the Local Planning Authority should seek assurance from the developer that flood risk has been addressed, - reference should be made to FRA note 1.

If the proposal part of a larger development site?

Reserved matters applications in Flood Zone 1 might be part of larger sites, which already have outline permission. In such cases, the LPA should ensure that any conditions that were applied to the larger site to manage surface water drainage are taken into account in the reserved matters application, in order to prevent a 'piecemeal' approach to drainage.

Best practice advice-Sustainable Drainage (SUDS) (see Section 9.3)

Surface water run-off should be controlled as near to its source as possible through a sustainable drainage approach to surface water management (SUDS). SUDS offer significant advantages over conventional drainage systems by attenuating the rate and quantity of surface water run-off from a site, promoting groundwater recharge, and improving water quality and amenity.

Support for the SUDS approach to managing surface water run-off is set out in Planning Policy Statement 1 (PPS): Delivering Sustainable Development and in more detail in Annex F of PPS 25.

Part H of the Building Regulations 2000 establishes a hierarchy for surface water disposal, which encourages a SUDS approach. SUDS should be the first option for surface water disposal followed by watercourses and then public sewer systems. It should be demonstrated that that the SUDS options are feasible, can be adopted and properly maintained and would not lead to any other environmental problems e.g. the use soakaways or other infiltration methods on contaminated land carries groundwater pollution risks and may not work in areas with a high water table. An appropriate assessment carried out under BRE Digest 365 should be completed for soakaways.

Flow balancing SUDS methods which involve the retention and controlled release of surface water from a site may be considered to maintain the local greenfield run off rate. Flow balancing should seek to achieve water quality and amenity benefits as well as managing flood risk.

For further information on SUDS see:
- Annex F of PPS 25;
- PPS25 Practice Guide;
- CIRIA C522 - Sustainable Urban Drainage Systems-design manual for England and Wales;
- Interim Code of Practice for Sustainable Drainage Systems;
- Section 9.3 of this report.

The Interim Code of Practice is available electronically on both the Environment Agency's web site at: www.environment-agency.gov.uk and CIRIA's web site at: www.ciria.org.uk

Disposal to public sewer

Where it is intended to dispose of surface water to a public sewer, either United Utilities or Welsh Water should confirm that there is adequate spare capacity in the existing system.

Other flood risk issues to consider for development in Flood Zone 1 - Dry Islands

There are some areas within Flood Zone 1 that are surrounded by areas at a higher risk of flooding i.e. areas falling within Flood Zones 3 and 2 ('dry islands'). In some cases development in these areas can present particular hazards to public safety including risks associated with maintaining safe access and exit for occupants during flood events and access for the emergency services. The local Environment Agency Planning Liaison can advise on such locations within the Vale Royal area.

[3] Operational developments are those which are not limited purely to material changes of use i.e. they involve works such as building, mining or engineering operations which could have an impact on surface water run-off.

8.7 How to use the SFRA to apply the Sequential Test

(a) Local Development Framework

This SFRA has looked at existing development sites, sites with planning permission and strategic sites provided by the LPA. Other sites will be brought forward for consideration by the LPA through the SHLAA and as representations for the LPA's LDF (both by the LPA and by developers and landowners). The SFRA must be used by the LPA to sequentially test these additional sites and use the information provided to strategically assess development in relation to flood risk. This has in part been summarised in Sections 8.4 to 8.5.

The process of applying the Sequential Test should be followed as shown in Figure 8.3 below.

APPLICATION OF THE SEQUENTIAL TEST and EXCEPTION TEST

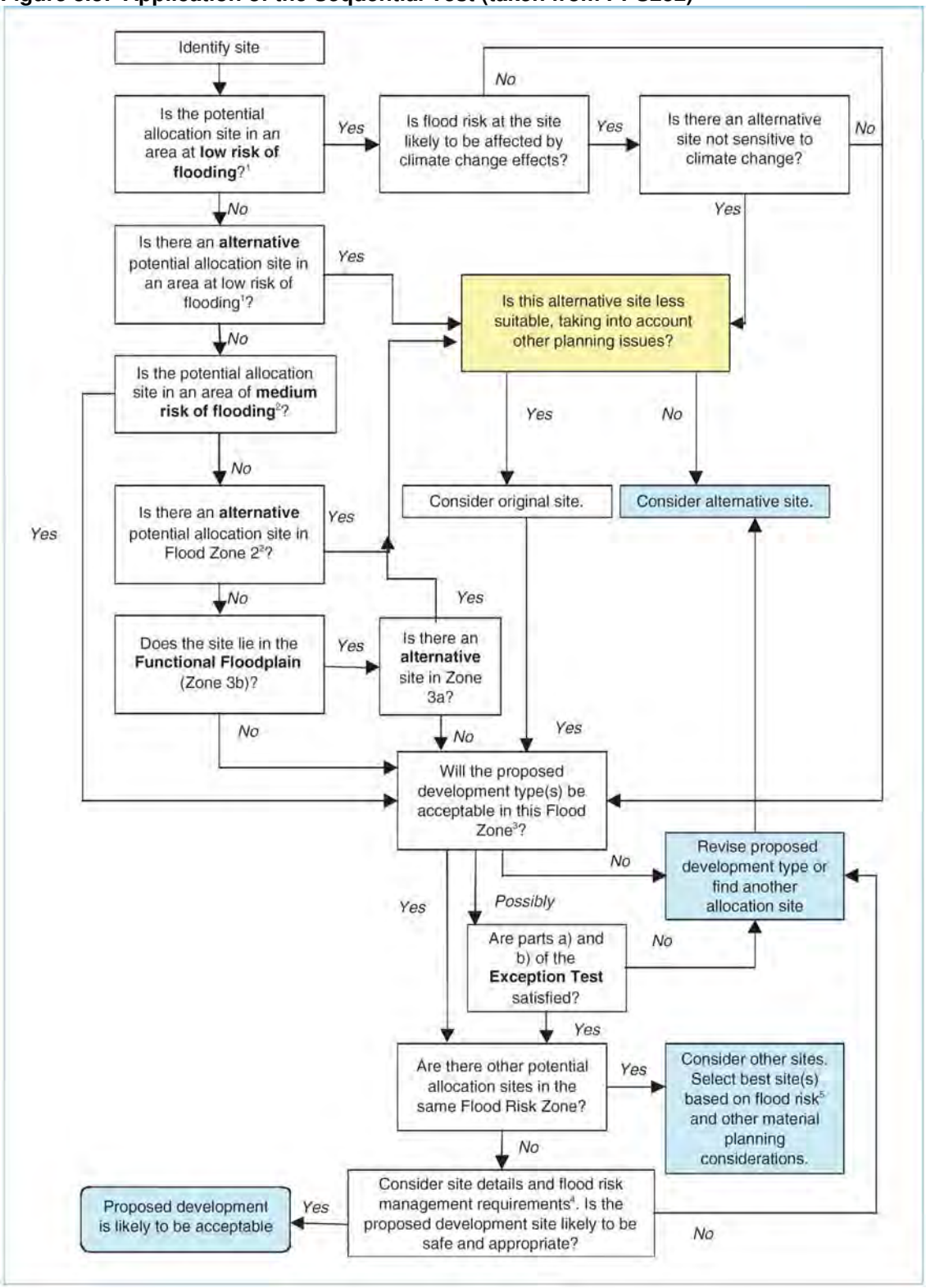
To sequentially test sites, the following information should be used.

1. GIS themes for the site(s), Flood Zone maps and any functional floodplain extent produced should be prepared by the LPA and brought up on background OS mapping. This will allow the identification of the Flood Zone in which the site is located.
2. Any climate change flood extents that have been produced can be made available by the LPA in GIS. These extents can be included to see if the site could be at risk of flooding in the future from climate change.
3. The functional floodplain (Flood Zone 3b) and climate change flood extents will only be available for certain river reaches which has been assessed during the SFRA. Other areas of functional flood plain may exist where there is no river modelling data.
4. The flood risk problems database and GIS theme should be used to identify potential flood risk from other sources. The SFRA has not established whether there is a low or medium risk of flooding from these other sources (see notes 1 and 2 from Figure 8.1).

If a developer is making an application then that developer should be notified if it is believed that the site could be at risk from other sources of flooding. The developer should then be asked to further investigate this during a FRA.

5. If the site is located in either Flood Zone 2 or Flood Zone 3 the Sequential Test should be applied to identify and confirm the location of other reasonably available other sites in lower flood risk zones within the LPA area in an effort to steer new development away from these flood risk areas. This applies to all types of development (except essential infrastructure and flood compatible) irrespective of whether they are suitable for higher flood risk zones or not.
6. If there are no other reasonably available sites then consideration should be given to applying the Exception Test to allow sites to be brought forward safely.
7. Table D2 in PPS25 should be used to ascertain the vulnerability of a development. Table D3 from PPS25 (also shown below as Table 8.2). This assessment can then be used to determine if the proposed development type could be acceptable in a particular Flood Zone (always provided there are not other suitable sites available).
8. Finally the Exception Test will need to be applied if there are other drivers (other than flood risk) requiring the development of certain land uses in Flood Zones 2 or 3.

Figure 8.3: Application of the Sequential Test (taken from PPS252)



Notes

1 Flood Zone 1 for fluvial and tidal flooding and with a low risk of flooding from other sources.
2 Flood Zone 2 for fluvial and tidal flooding and with a medium risk of flooding from other sources.
3 As defined by the Sequential Test.
4 Development to be safe and to not increase flood risk elsewhere. Required to pass part c) of the Exception Test, where applicable.
5 Including susceptibility to future climate change and residual flood risk.

Table 8.2- Flood Risk Vulnerability and Flood Zone 'Compatibility (taken from PPS25[1])

Flood Risk Vulnerability classification (see Table D2 PPS25 Annex D)		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone (see Table D.1 PPS25 Annex D	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b 'Functional Floodplain'	Exception Test required	✓	×	×	×

✓ Development is appropriate

× Development should not be permitted

(b) Development Control

Table 8.3 below sets out the information that the Environment Agency will require as evidence from LPAs as a demonstration that the flood risk Sequential Test has been properly applied. For prospective development allocations this should be done as part of the LDF process. For windfall sites it will be the responsibility of the developer to submit sufficient justification to the LPA to provide to the EA.

Initially on a site specific basis Table 8.1 and Figure 8.2 should be used to find out who should be consulted, what guidance needs to be considered, what development is likely to be acceptable, the scope of an FRA and other factors that should be considered.

A developer for an individual site should identify if the site has already been assessed in Appendix C. This will provide more details on what is required for an FRA and any other factors to consider. For example other flood risk problems, not identified in the Flood Zone maps, could be identified. The developer should be able to find out from Appendix C whether the Sequential or Exception Test is required for the proposed development type. The basic requirements for an FRA should be identified. The developer can then go to PPS25 for further guidance and consult the LPA and Environment Agency to confirm the requirements.

For sites not contained within Appendix C to the SFRA, the developer should establish if the site has been assessed by the LPA through the LDF process. If it has been the subject of assessment, details on what is required for an FRA (as above) will be provided.

Table 8.3– Sequential Test Requirements

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

Note: For prospective development allocations this should be done as part of the LDF process. For windfall sites it will be the responsibility of the developer to submit sufficient justification to the LPA to provide to the EA

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Flood Risk Policies

9 Flood Risk Policies

9.1 Current Planning policy

Based on the outputs from the previous chapters of the SFRA, this section provides a review of current planning policy and makes recommendations for the Council's LDF and for determining planning applications.

Regional

Submitted Draft Regional Spatial Strategy for the North West of England (January 2006) states the following:

Policy EM5 – Integrated Water Management

Plans and strategies should have regard to River Basin Management Plans and assist in achieving integrated water management and delivery of the EU Water Framework Directive (WFD). They should protect the quantity and quality of surface, ground and coastal waters and manage flood risk by:

- Phasing development to reflect existing water supply and waste water treatment capacity, unless new infrastructure can be provided ahead of the development without environmental harm;
- Implementing the "Meeting the Sequential Flood Risk Test – Guidelines for the North West Region"
- Requiring that any development which, exceptionally, must take place in current or future flood risk areas is resilient to flooding; protected to appropriate standards and does not increase the risk of flooding elsewhere;
- Requiring new, and where possible, existing development (including transport infrastructure) to incorporate sustainable drainage systems and water conservation and efficiency measures;
- Raising people's awareness of flood risks and the impact of their behaviours and lifestyles on water consumption.

Policy EM6 – Managing the North West's Coastline

Plans and strategies, proposals and schemes (including Shoreline Management Plans) should take a strategic and integrated approach to the long term management of flood and coastal erosion by:

- Taking account of natural coastal change and the likely impacts of climate change, to ensure that development is sited or re-sited carefully to avoid:
  - ~ the risk of future loss from coastal erosion, land instability and flooding;
  - ~ unsustainable coastal defence costs;
  - ~ damaging existing defences and the capacity of the coast to form natural defences or to adjust to future changes without endangering life or property;
- Making provision for mitigation of and adaptation to natural coastal change and the predicted effects of climate change over the medium to long term (100 years) and supporting a "whole shoreline approach" being taken to coastal risk management;
- Minimizing the loss of coastal habitats and avoiding damage to coastal processes;
- Promoting managed realignment as a tool for managing flood and coastal erosion risk and delivering biodiversity targets and compensatory habitat requirements under the Habitats Directive.

9.2 LDF Draft flood risk policies

Flooding issues have long been recognised as a material consideration in the development planning process, and in view of the apparent increase in frequency and severity of fluvial flooding in recent years, the Government has asked LPAs to give greater consideration to flood risk in the planning process by discouraging inappropriate development. Government advice is that a precautionary and risk-based approach should be taken in respect of decisions made by LPAs on applications for development consent where flood risk is an issue.

Policies should be applied to planning applications based on PPS25's Flood Zones. PPS25 aims to steer development away from areas at risk of flooding. If development does need to take place in a Flood Zone, less vulnerable development types should be considered first and the lower risk Flood Zones should be considered first.

In addition, PPS25 sets guidelines on surface water disposal and developments that interfere with the natural flow of watercourses.

The following Draft Flood Risk Policy Recommendations have been prepared for the West Cheshire SFRA.

DRAFT POLICY RECOMMENDATION 1 - The Need for a Flood Risk Assessment

The Council may require the submission of an appropriate Flood Risk Assessment from the developer in connection with any application for development consent.

If the LPA considers that a proposed development is on land considered to be at risk of flooding or is likely to present a significant flood risk or increased flood risk to other land or property, they may require that the developer submits a Flood Risk Assessment of the development site in connection with the application for planning permission. It should be assumed that a Flood Risk Assessment may be required in most cases, though exceptions will normally be made for minor developments such as alterations to existing buildings. Developers are therefore advised to seek the advice of the LPA before submitting an application as to whether the LPA is likely to require a Flood Risk Assessment. Developers are directed to the "Development and Flood Risk: A Practice Guide Companion to PPS25 'Living Draft' see reference 2 in References. See also guidance on the Sequential Test and the Exception test in Section 8.1 of the SFRA.

The Flood Risk Assessment must examine the flood risk issues and implications for the development over its whole lifetime, taking into account (where relevant) the possible impacts of climate change. The Assessment must be appropriate to the location, size, complexity and sensitivity of the development proposal and should address those matters outlined in Annex E of PPS 25. The Assessment should consider the risks of flooding from open watercourses and, where relevant, from surface water sewers and piped drainage systems, groundwater and any artificial sources of flood risk.

The Flood Risk Assessment should also address the implications of increased surface water runoff from paved and impermeable areas created by the development for flood risk to land and property downstream of the development. If the Assessment finds that additional surface water runoff is likely to be generated by the development at times of heavy rainfall, the development proposals should incorporate suitable measures to attenuate the additional runoff to levels that existed prior to the development taking place. Consideration of the use of Sustainable Urban Drainage Systems ("SUDS") is recommended. SUDS are dealt with in detail in Draft Policy Recommendation 5.

Where a substantial development (e.g. greater than one hectare) is envisaged, the LPA strongly advises developers to consult the Environment Agency before making a formal application for planning consent to discuss the potential flood risks to their development, on the likely impact of their proposals on flood risk elsewhere, and what flood risk mitigation measures might be necessary, effective and acceptable. For substantial developments, a Flood Risk

Assessment carried out by a competent person will be an essential element in the overall evaluation of the proposed development and its approval by the LPA.

Where flood risk alleviation works form a necessary pre-condition of development consent, such works will normally be funded by the developer, probably through a Section 106 Agreement with the LPA. Where the proposed alleviation works are likely to require ongoing future maintenance, appropriate agreements shall be entered into prior to their construction to ensure the long term effectiveness of the works.

DRAFT POLICY RECOMMENDATION 2 - Development in areas deemed to be at Little-or-No Risk of flooding, (Flood Zone 1)
The LPA's SFRA has classified all land within one or other of the four Flood Zones described in the SFRA. This classification has been undertaken at the strategic level and is intended primarily for guidance purposes in the overall planning process. It should not therefore be regarded as definitive and does not remove the need for FRAs.

A Flood Risk Assessment will be required for all applications for major sites[4]. The EA should also be a Statutory Consultee for the following situations:
• development within 20m of the bank top of a Main River
• any culverting operation or development which controls the flow of any river or stream
• development other than minor development in Flood Zones 2 & 3
• development in Flood Zone 1 where there are critical drainage problems
• any development exceeding one hectare in extent.
The Environment Agency is required to respond to consultations on preplanning enquiries within 21 days, unless otherwise formally agreed in writing.

The FRA should consider the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off. Planning approval will only be allowed in these areas on flood risk grounds provided that:

A) The development will not itself be at an inappropriate risk of flooding. (It may itself be at risk from other, secondary sources of flooding such as surface water sewers.)

B) The development will not create an increased risk of flooding for other persons, land and property. (Even though a development outside the floodplain may not itself be at risk of flooding, it may nevertheless increase the risk to others by increasing the rate and volume of surface water runoff from the development site.)

C) All flood risk mitigation measures shall be implemented in accordance with the implementation programme submitted with the approved Flood Risk Assessment before the development is brought into use. Developers should therefore appreciate that a Flood Risk Assessment may still be necessary for developments in Little-or-No Risk or Low-to-Medium Risk areas.

[4] Major development is defined in The Town and Country Planning (Flooding) (England) Direction 2007 as:
(a) in respect of residential development, a development where the number of dwellings to be provided is 10 or more, or the site area is 0.5 hectares or more; or
(b) in respect of non-residential development, a development where the new floorspace to be provided is 1,000 square metres or more, or the site area is 1 hectare or more;

DRAFT POLICY RECOMMENDATION 3 - Development in areas deemed to be at High Risk of flooding (Flood Zones 2 and 3a)
Developments within the natural floodplain of a river or stream are inherently at risk of flooding and can also increase flood risks to others, not only by increasing surface water run-off rates but by obstructing or diverting flood flows and reducing flood storage. Planning permission will only be allowed where the following criteria are met:
A) It is considered either appropriate (in developed areas), or essential (in other high risk areas) for that location within the criteria set out in Tables D1 and D2 of PPS25 (see section Table 2.2).
B) It is protected from flooding to an appropriate standard or is designed to cope with the risk of flooding.
C) Ground floor living accommodation is excluded in residential developments where that development is adjacent to a raised flood defence.
D) The development does not create an unacceptable obstruction to flow across a floodplain under flood conditions, and does not divert the flow of flood water towards or across adjacent land or property.
E) The development does not reduce the volume available for the retention of water on the flood plain in times of flood (i.e. no loss of flood plain storage due to new development, ground raising etc,).
F) The development does not jeopardise the integrity of existing flood defences in any way, or obstructs the operational access thereto.
G) All flood risk mitigation measures shall be implemented in accordance with the implementation programme submitted with the approved Flood Risk Assessment before the development is brought into use.

A development shall not result in a net loss of flood plain storage – i.e. compensation storage can be provided but the compensation storage should be contiguous with the flood plain and connected to the area where flood plain storage is lost. Compensation storage should also be level for level with the flood plain storage lost i.e. if volume is lost from the 1 in 100 year flood plain it cannot be compensated for by additional flood plain storage in the 1 in 25 year flood plain and vice versa. Existing buildings are assumed to take up flood plain storage and need not be compensated for when re-developed.

Table 9.1 summarises which land uses are appropriate in these Flood Zones. This is shown in full in Table 15.

Table 3– Appropriate uses of land in Flood Zones

Flood Zone	Appropriate uses of land
Flood Zone 1	All uses of land are appropriate in this zone
Flood Zone 2	The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table D.2 from PPS25 are appropriate in this zone.
Flood Zone 3a	The water-compatible and less vulnerable uses of land in Table D.2 from PPS25 are appropriate in this zone.
Flood Zone 3b	Only the water-compatible uses and the essential infrastructure listed in Table D.2 from PPS25 that has to be there should be permitted in this zone.

DRAFT POLICY RECOMMENDATION 4 - Development involving building in areas identified as Washland or Functional Floodplain (Flood Zone 3b)

A Washland is an area of land within a floodplain which may be deliberately inundated in times of flood to reduce the risk or severity of flooding elsewhere in the river system. A Functional Floodplain is an area of undefended floodplain which is expected to flood on a frequent basis and which, by being allowed to flood, will reduce the risk or severity of flooding elsewhere

Development involving building in areas identified as Washland or Functional Floodplain in the SFRA will only be permitted in exceptional circumstances. Table 9.1 outlines which land uses are appropriate in this Flood Zone.

This Draft Policy Recommendation is intended to prevent development which might impede the flow of water onto a washland or functional floodplain or reduce the volume available for the temporary storage of flood water in those areas.

9.3 Advice on the use of SuDS and sustainable development

As development increases, so to does the volume of rainwater falling on impermeable surfaces. These surfaces prevent stormwater from draining naturally through the ground to local rivers and streams. In order to compensate for this and to prevent localised flooding, traditional drainage systems aim to convey this water to local watercourses as quickly as possible.

This practice is becoming increasingly undesirable, as it can increase the chance of localised flooding further downstream and leads to increased pollution in the watercourse from pollutants such as oil and litter which are present on the developed surfaces.

In order to relieve the demand on public water supplies and wastewater collection and treatment facilities, it is also becoming desirable to make better use of wastewater and surface water on site, by collection and re-using it where possible.

This section introduces a number of water management methods which may possibly be used to achieve effective drainage and water usage whilst considering the present and future environmental impact. The main aims of these schemes are:

- To keep water on site for longer.
- To prevent pollution.
- To allow the storage and use of the water.

Support for the SUDS approach to managing surface water run-off is set out in paragraph 22 of Planning Policy Statement 1 (PPS): Delivering Sustainable Development and in more detail in Planning Policy Statement 25: Development and Flood Risk, Annex F. Paragraph F8 of the Annex notes that “LPAs should ensure that their policies and decisions on applications support and complement Building Regulations on sustainable rainwater drainage”.

Approved Document Part H of the Building Regulations 2000 establishes a hierarchy for surface water disposal, which encourages a SUDS approach. Under Approved Document Part H the first option for surface water disposal should be the use of SUDS, which encourage infiltration e.g. soakaways or infiltration trenches. Where the intention is to dispose to soakaway, these should be shown to work through an appropriate assessment carried out under BRE Digest 365.

9.3.1 SUDS (Sustainable Drainage Systems)

SUDS is the collective term for a number of drainage methods which can be used in various combinations to provide an effective but sustainable drainage system in place of, or in conjunction with, a traditional drainage system.

SUDS schemes aim to improve on traditional drainage methods by attempting to replicate natural land drainage systems and processes. These schemes reduce the risk of flooding, by more effectively managing the flow rates of surface water to watercourses.

Through natural processes, they also reduce the amount of pollution transmitted to watercourses, stabilising or improving water quality. In addition to this, SUDS schemes can actively enhance the developed environment by improving landscaping, wildlife habitats, and community facilities.

The four general methods included in SUDS are as follows:-

(i) Filter strips and swales
A swale is a shallow channel whereas a filter strip is a gently sloping piece of ground. Both are grass covered areas designed to drain water from surrounding impermeable surfaces.

(ii) Filter drains and permeable surfaces
Both of these use a volume of permeable material below the ground to store surface water for a period of time. Water enters storage via a permeable surface such as grass, gravel, or porous paving. This method is particularly useful to drastically reduce the impermeable area of features such as car parks and paths.

(iii)Infiltration devices
These are features such as trenches, usually filled with stone and usually dry, which are designed to encourage the infiltration of surface water into the ground.

(iv) Basins and ponds
Both of these types of feature are designed to store water during periods of peak rainfall and discharge it during drier periods. Basins include flood plains and detention basins, which are dry under dry weather conditions. Ponds contain water during dry weather, and include features such as balancing ponds, lagoons, retention ponds, and wetlands. These can be enhanced functionally and aesthetically by the introduction of vegetation to the area.

9.3.1.1 Rainwater Reclamation
Rainwater can be collected from roof guttering and permeable paving. It is possible to utilise this water for a range of applications such as toilet flushing, watering of plants, and washing of cars. A certain amount of treatment such as filtration or disinfection may be necessary before re-use, dependant on the proposed use.

9.3.1.2 Grey Water Reclamation
Grey water refers to water which originates from the water supplier but has been used in a wash basin, bath or shower. It does not include water from toilets, clothes washing, and dish washing.

It is possible to collect this water and re-use it in applications such as toilet flushing in order to reduce the unnecessary use of higher quality water and to reduce the volume of water discharged to the sewer network. A certain amount of treatment such as filtration and disinfection is necessary before it can be re-used, dependant on the proposed use and level of contamination.

9.3.1.3 Benefits
The environmental benefits of Sustainable Water Management have already been introduced, these primarily being:

- Limiting the output of wastewater and stormwater from a development to reduce flood risk
- Improving the quality of the stormwater reaching watercourses
- Providing an amenity.

There is also the opportunity of a cost benefit when implementing these schemes, through the possibility of lower construction costs.

Points to Consider
SuDS should be considered as early in the development process as possible preferably at pre-application stage. Not all methods will be suitable or necessary for all developments. Many factors, such as available space or ground conditions, will influence the choice of methods for a particular development.

Adoption issues (responsibility for once implemented – see 9.3.2) can often be a barrier to SUDS schemes and it is essential that consultation with the relevant authorities is undertaken at an early stage.

With all of the methods described above there is a requirement for scheduled maintenance if the schemes are to function correctly. It is important to remember that the incorrect functioning of a scheme could have a severe environmental impact, such as increased levels of pollution in watercourses or localised flooding. Incorrect functioning of rainwater or grey water reclamation schemes could be a danger to public health.

For more information on SuDS and water reclamation schemes, the following websites may be of use:-

- www.environment-agency.gov.uk (Business > Business sectors > Construction > Sustainable Drainage Systems)
- www.ciria.org/suds

9.3.2 Adoption of SUDS

SUDS are usually provided by the developer in compliance with a planning consent condition, imposed by the LPA (usually in consultation with the Environment Agency and/or Welsh Water or United Utilities) where they are considered necessary to attenuate the additional runoff from a development before it is discharged to the receiving watercourse or sewer.

In many cases, especially that of residential development, the developer intends to sell the development to prospective purchasers of the houses, industrial units etc and does not to wish to have any interest or involvement in the development thereafter.

However, for SUDS to provide consistent and effective long-term attenuation of runoff from the development they have to be maintained in an efficient condition for the life of the development. This may involve the control of weed growth in ponds and lagoons, the frequent removal of debris, both natural and man-made, from watercourses and weedscreens, the clearance of blockages, sometimes at short notice, from pipes and culverts, and the repair of malicious damage and vandalism. A routine inspection regime is, of course, essential to ensure that any such problems are identified and dealt with in a timely manner.

This raises the question of the responsibility for the maintenance of SUDS, which may be of particular relevance where the development (e.g. a housing estate) ultimately becomes the property of numerous private individuals. Even where the outflow from a lagoon or retention pond discharges to a public sewer, it is usually found that the water company owning that sewer will be unwilling to accept responsibility for the lagoon. Similarly, even where the receiving watercourse is a Main River, the Environment Agency is unlikely to accept responsibility for any SUDS discharging to that watercourse.

In practice, unless the SUDS in question are to be effectively abandoned at the outset, its maintenance often inevitably devolves onto the LPA in the absence of any other appropriate body. The LPA should, therefore, be prepared for the necessity of accepting de-facto responsibility for many SUDS but should therefore be aware of the need for financial or other provision to be made at planning stage for the long term maintenance of those installations.

DRAFT POLICY RECOMMENDATION 5 - Sustainable Urban Drainage Systems (SUDS)

The Council requires developers to demonstrate that their surface water drainage proposals, particularly for large sites, are appropriate and adequate for the development and will not increase the flood risk to land and property either upstream or downstream of the development site. The Council considers that Sustainable Urban Drainage Systems (SUDS) are a desirable means of achieving this and encourages their use by developers.

New development, especially of "greenfield" sites, alters the existing drainage characteristics of an area with roofs, roads and other impermeable surfaces from which rainfall is more rapidly translated into runoff. The management and control of this increased surface runoff has a major role in sustainable development.

Sustainable drainage is the practice of controlling surface water runoff as close to its origin as possible before discharge to a watercourse or to a soakaway. It has many benefits relating to a variety of environmental issues such as reducing flood risk, minimising pollution of watercourses and groundwater, minimising soil erosion and damage to natural habitats, maintaining or restoring natural flow regimes in receiving watercourses, maintaining groundwater recharge and achieving environmental enhancements. The many and diverse benefits resulting from the use of SUDS justify the requirement for the widespread use of SUDS in development proposals.

DRAFT POLICY RECOMMENDATION 6 - Culverting of Open Watercourses

The Environment Agency and Council are in general opposed to the culverting of open watercourses because of the adverse ecological effect, potentially increased flood risk and other consequences that are likely to arise. Where practical the Council may seek to have existing culverted watercourses restored to open channels as part of the development proposals.

The LPA will therefore only approve plans to culvert an open watercourse if there is no reasonably practical alternative to culverting, or if the detrimental effects of culverting would be so minor that they would not justify a more costly alternative. In all cases where it is appropriate to do so adequate mitigation must be provided for damage caused to natural habitats and to animal, plant and other species by the culverting.

If culverting is approved, the size and material of the pipes used must be adequate to convey flood flows in the watercourse and appropriate to any vehicular or other load likely to be imposed upon the culvert. The developer may be required to demonstrate to the LPA with appropriate hydraulic calculations that the culvert will adequately convey the flood flow in the watercourse without exacerbating flooding upstream or along the line of the culvert. The LPA will not normally approve the installation of a culvert of smaller size than one further upstream on the same watercourse.

Culverts, especially in urban areas, are liable to become obstructed or blocked by debris carried by flood waters or by illegally deposited rubbish. The LPA may therefore require a screen of a suitable design to be erected at the entrance to the culvert. The design of the screen must permit safe and convenient access for the removal of debris and rubbish. Where the culvert is longer than twenty metres, the LPA may require the installation of one or more intermediate access manholes on the line of the culvert for maintenance purposes.

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Conclusions and Recommendations

10 Conclusions and Recommendations

10.1 Conclusions

A Strategic Flood Risk Assessment has been produced for West Cheshire. The study has identified the existing areas of flood risk across the council area from all sources. Where there are proposed development sites in areas at risk of flooding, the assessment has identified which sites are most at risk and from what source of flooding. The culmination is a flood risk matrix and guidance notes that should enable the Local Planning Authority to ensure that development types are sensitively located with consideration to flood risk.

All available data has been colleted for the local authorities. In some areas there is a need for more detailed information which would improve knowledge of flood risk within the council areas. This includes modelled river reaches and more detailed coastal flood outlines. There is also existing data which has not been made available for this study e.g. sewer flooding information, drainage network GIS data and the Manchester Ship Canal hydraulic model.

West Cheshire is at risk of flooding from a number of sources and mechanisms including watercourse overtopping, tidal flooding, flooding from the sea and rivers due to defence failure, surface water sewer and foul sewer flooding, runoff and land drainage and the failure of artificial sources i.e. canals and reservoirs.

Using the available data, flood maps have been produced for different return periods and climate change extents. The potential impact of climate change has been estimated across the council area. Levels of risk within the flood extents have been estimated where there is the necessary available data.

There is historic evidence of flooding in Vale Royal BC predominantly from the Rivers Weaver and Dane in Northwich. Flooding from the Weaver has occurred in other locations along its course but Northwich and the surrounding area is the main flood risk location. There may also be other flood risk sources linked to this e.g. sewer flooding. There are other sources of flooding across Vale Royal BC predominantly from watercourse overtopping in isolated locations.

Using the available data, flood maps have been produced for different return periods and climate change extents. The potential impact of climate change has been estimated across the council area.

As a result of climate change, flood risk is expected to increase in Northwich due to an increase in flood frequency and flood extents. Flood risk in the Frodsham and Winsford areas is not expected to increase as much. However increased development in Winsford could put more properties at risk unless future developments around the River Weaver are planned with regard to flood risk from the outset.

Levels of risk within the flood extents have been estimated where there is available data. Levels of flood risk within Northwich are at their highest in central Northwich, where the Dane and Weaver meet. Flood risk profile results also show the Winnington area at a high risk. Flood risk profile increases in central Winsford and then again as the Weaver passes through north Winsford.

Within Vale Royal BC major development programmes are planned for Northwich centre and Winsford. These could potentially put more properties at risk if flooding.

In general flood hazard through Northwich centre is classed as high, the flood extent is also at its greatest through Northwich town centre. In Northwich the lower flood risk areas (in hazard rating and frequency of flooding) are to the north and south of the town centre. The area around the confluence with the Dane and Weaver is at a particularly high risk. This area has a wide, high probability floodplain and a high hazard rating. The potential future development sites with the greatest level of risk associated with them are as follows:

- VLH3 – parts of the Barons Quay allocation near the river Weaver
- VLH5 – The County Council offices site
- VLH7 – Lock Street allocation near to the River Weaver
- VLH1 and others – Winnington, a large part of this allocation around the Weaver has a high hazard rating and is within the 1 in 25 year flood outline.

Other areas of high risk include:

- Chester Way
- London Road
- Navigation Road
- Weaverway

As the Weaver leaves Winsford the new, extensive, potential future housing allocations along Bradford road are all at risk of flooding. The LPA should consider in more detail the location of different types of development in this area.

The flood mapping in Winsford is broad scale and therefore the exact location of the areas at risk of flooding cannot be ascertained.

Area FRAs have been commissioned by Vale Royal BC for Winsford and Northwich. These assessments should build on the information provided in the SFRA and give more detailed guidance to the proposed major developments around the Rivers Weaver and Dane in these locations.

Policies for flood risk and development have been drafted for the SFRA including policies for SuDS and culverting. SuDS recommendations and advice has also been included.

10.2 Recommendations

During the course of the work a number of specific recommendations for additional work have been identified. These are described below:

- A more detailed assessment of the levels of flood risk within the Flood Zones should be undertaken. This should be used to identify the areas least at risk and in turn inform the major developments that are planned in Winsford, Northwich and Winnington.
- In general, higher probabilities of flooding and flood hazards are found in central Northwich and the Winnington area. Less vulnerable development should be located in these areas with more vulnerable development further back from the rivers Dane and Weaver. However, Winnington Urban Village has now been given outline planning permission. As the detailed phases of the development come forward, flood risk should continue to be a major issue for consideration.
- Development at Barons Quay should take into account the flood extents and flood risk profile.
- Extensive mitigation measures or flood defence improvements along the Weaver and Dane may need to be implemented in order for developments at risk of flooding in Northwich to be brought forward.
- In general, the higher levels of flood risk are found in north Winsford, near the extensive potential future housing allocations. Consideration should be given to putting less vulnerable developments closer to the river and residential further back.
- Mitigation measures or flood defence improvements may be required if the extensive riverside developments are to take place in north Winsford.
- The guidance and matrix in the report should be used *for all developments* in order to find the correct consultation process and requirements for a FRA.

Glossary

AOD	Above ordnance datum
Aquifer	A geological stratum (or rock layer) that bears water.
ArcView	ArcView is a full-featured GIS software for visualizing, managing, creating, and analyzing geographic data, of the ESRI suite of software.
Attenuation	Reduction of peak flow and increased duration of a flow event.
Breach Analysis	Computational analysis of a breach in the defences that assesses flood depths and velocity to inform an assessment of flood risk to people.
Brownfield Development	A new development on land that has been developed previously, and may have become derelict or disused.
Catchment	A surface water catchment is the total area that drains into a river. A groundwater catchment is the total area that contributes to the groundwater component of the river flow.
Catchment Flood Management Plans (CFMP)	A strategic planning tool through which the Environment Agency will seek to work with other key decision-makers within a river catchment to identify and agree policies for sustainable flood risk management.
Critical Ordinary Watercourses (COW's)	Stretches of non-main watercourse that have been defined as critical in terms of flood risk management through consultation between the Environment Agency and Local Planning Authorities (LPA).
Design event	A historic or notional flood event of a given annual flood probability, against which the suitability of a proposed development is assessed and mitigation measures, if any, are designed.
Design flood level	The level of a flood for which a flood defence has been designed.
DG5 Register	Register held by water companies on the location of properties at risk of / have suffered from sewage flooding problems
Digital Elevation Model (DEM)	A digital elevation model is an elevation representing the topography of an area.
Environment Agency	Non-departmental public body responsible for the delivery of government policy relating to the environment and flood risk management in England and Wales.
FEHCALC	Spreadsheet designed by the Centre for Ecology and Hydrology, Wallingford to calculate peak flows, based on the rainfall-runoff methodology detailed in the Flood Estimation Handbook. Procedures are outlined within the MDSF guidelines.
Standard of protection	The design event or standard to which a building, asset or area is protected against flooding, generally expressed as an annual exceedence probability.
Flood Alleviation Scheme (FAS)	A scheme designed to reduce the risk of flooding in a specific location.
Flood cell	Area constrained by boundaries that would fill before overtopping into another flood cell
Flood avoidance (at site level)	Constructing a building and its surrounds in such a way to avoid it being flooded (e.g. by raising it above flood level, re-siting outside flood risk area etc.)
Flood defence	Flood defence infrastructure, such as flood walls and embankments, intended to protect an area against flooding to a specified standard of protection.
Floodlocking	Where a receiving stream or river is in flood, especially where that

	watercourse is contained within raised floodwalls or banks, the flow in the local drainage system can no longer drain to the river and is impounded behind the defence line for the duration of the flood.
Flood Risk	The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage, harm, distress and disruption).
Flood Risk Management	The activity of modifying the frequency or consequences of flooding to an appropriate level (commensurate with land use), and monitoring to ensure that flood risks remain at the proposed level. This should take account of other water level management requirements, and opportunities and constraints. It is not just the application of physical flood defence measures.
Flood risk management strategy	A long-term approach setting out the objectives and options for managing flood risk taking into account a broad range of technical, social, environmental and economic issues.
Flood Envelope	Extent of an area that can be flooded.
Floodplain	Area of land that borders a watercourse, an estuary or the sea, over which water flows in time of flood, or would flow but for the presence of flood defences where they exist.
Flood risk assessment (covers all scales of assessment)	A study to assess the risk to an area or site from flooding, now and in the future, and to assess the impact that any changes or development on the site or area will have on flood risk to the site and elsewhere. It may also identify, particularly at more local levels, how to manage those changes to ensure that flood risk is not increased. PPS25 differentiates between regional, sub-regional/strategic and FRAs.
Flood risk management measure	Any measure which reduces flood risk such as flood defences.
Flood repairable	Constructing the building in such a way that although flood water enters a building, elements that are damaged by flood water can be easily repaired or replaced. This is a form of flood resilience (see below for definition).
Flood risk profile	The level of flood risk used for the SFRA. This is based on flow velocities, depths and distance for flood defences, if present.
Flood Warning Areas	Within Flood Warning Areas, warnings of impending flooding are issued by the Environment Agency to business and the public to enable people to take preventative action to protect themselves and their property. Formal procedures are followed to guide when and how warnings are issued.
Flood Zone	A geographic area within which the flood risk is in a particular range as defined within PPS25.
Flood Map	A map produced by the Environment Agency providing an indication of the likelihood of flooding within all areas of England and Wales, assuming there are no flood defences.
Fluvial	Pertaining to a watercourse (river or stream).
Freeboard	The difference between the flood defence level and the design flood level.
Functional floodplain	PPS25 defines a Functional Floodplain as 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 per cent) or greater in any year, or at another probability to be agreed between the LPA and the Environment Agency (EA), or: • is designed to flood in an extreme (0.1 per cent) flood, or at another probability to be agreed between the LPA and the EA.
Geographical Information System (GIS)	A GIS is a computer-based system for capturing, storing, checking, integrating, manipulating, analysing and displaying data that are spatially referenced.
Geomorphology	The sediment erosion, deposition of transport processes that create the topography and shape of a river and its floodplain.
Greenfield land	Land that has not been previously developed.

Hydraulic Model	A computational model that simulates how water flows through the physical characteristics of a river channel and floodplain. The model can be used to determine peak water levels, peak flows, discharge volumes and flood event durations along a river system for a specific modelled event.
Hydrological Model	Estimates the flow entering a river arising from a given amount of rainfall into the catchment. Such models typically account for factors such as catchment area, topography, soils, geology and land use.
Laminar flow	Sometimes known as streamline flow, occurs when a fluid flows in parallel layers, with no disruption between the layers.
Land Use	Various designations of activities, developments, cropping types, etc for which land is used.
Land Management	Various forms of activities relating to agricultural, forestry, etc practice.
LiDAR	Light Detection and Ranging (LiDAR) is an airborne surveying / mapping technique, which uses a laser to measure the distance between the aircraft and the ground. The results of LiDAR surveys are used to develop digital elevation models.
Local Authority Development Plans	These statutory land development plans generally cover a 10-15-year period from the date of their adoption.
Local development framework	A non-statutory term used to describe a folder of documents which includes all the LPA's Local Development Documents (LDDs). The local development framework will also comprise the Statement of Community Involvement, the local development scheme and the annual monitoring report.
Local Development Documents (LDDs)	All development plan documents which will form part of the statutory development plan, as well as supplementary planning documents which do not form part of the statutory development plan.
Local Plan	A statutory land development plan produced by a District Council. This plan sets out policy for development in the district and allocations of land for housing, employment, and transport and leisure.
Local Resilience Forum	A group required under the Civil Contingencies Act, 2004 who are responsible for the co-ordination of emergency planning within local areas.
Main River	A watercourse designated on a statutory map of Main Rivers, maintained by Defra, on which the Environment Agency has permissive powers to construct and maintain flood defences.
Major development	A major development is a) where the number of dwellings to be provided is ten or more, or the site area is 0.5 ha or more or b). non-residential development, where the floorspace to be provided is 1,000m2 or more, or the site area is 1 ha or more.
Minor development	– Minor non–residential extensions: Industrial/Commercial/Leisure etc. extensions with a footprint less than 250 m2. – Alterations: development that does not increase the size of buildings eg alterations to external appearance. – 'Householder' development: eg sheds, garages, games rooms etc. within the curtilage of the existing dwelling in addition to physical extensions to the existing dwelling itself. This definition EXCLUDES any proposed development that would create a separate dwelling within the curtilage of the existing dwelling eg subdivision of houses into flats.
Flood and Coastal Defence Operating Authorities	The Environment Agency, LPAs and Internal Drainage Boards with legislative powers to undertake flood and coastal defence works.
NFCDD	National Flood and Coastal Defence Database
Ordinary watercourse	All rivers, streams, ditches, drains, cuts, dykes, sluices, sewers (other than public sewer) and passages through which water flows which do not form part of a Main River. LPAs and where relevant, Internal Drainage Boards have similar permissive powers on ordinary

	watercourses, as the Environment Agency has on Main Rivers.
Outfall	An outfall is the discharge point of a waste stream into a body of water; alternatively it may be the outlet of a river, drain or a sewer where it discharges into the sea, a lake or the like.
Planning Policy Statement	A statement of policy issued by central Government to replace Planning Policy Guidance notes. Advice on practical implementation is not included in Planning Policy Statements. Rights to carry out certain limited forms of development without the need to make an application for planning permission, as granted under the terms of the Town and Country Planning (General Permitted Development) Order 1995.
Planning Policy Statement 25: Development and Flood Risk (PPS25)	PPS25 sets out government policy on development and flood risk. This replaces PPG Note 25 (published July 2001). Its aims are to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas of highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe, without increasing flood risk elsewhere, and, where possible, reducing flood risk overall. For further information please refer to the communities and local government website: http://www.communities.gov.uk/index.asp?id=1504640
Previously-developed land (often referred to as brownfield land)	Land which is or was occupied by a permanent structure, including the curtilage of the developed land and any associated fixed surface infrastructure (PPS3 Annex B)
Regional spatial strategy (RSS)	A broad development strategy for a region for a 15 to 20 year period prepared by the Regional Planning Body.
Resilience (Flood Resilience)	Constructing the building in such a way that although flood water may enter the building, its impact is minimised (i.e. no permanent damage is caused, structural integrity is maintained and dry and cleaning are facilitated.
Reservoir (large raised)	A reservoir that holds at least 25,000 cubic metres of water above natural ground level, as defined by the Reservoirs Act, 1975.
Return period	The long-term average period between events of a given magnitude which have the same annual exceedence probability of occurring.
Residual risk	The risk which remains after all risk avoidance, reduction and mitigation measures have been implemented.
Resistance (Flood Resistance)	Constructing a building in such a way to prevent floodwater entering the building and damaging its fabric
River basin management plan	A management plan for all river basins required by the Water Framework Directive. These documents will establish a strategic plan for the long term management of the River Basin District, set out objectives for waterbodies and in broad terms what measures are planned to meet these objectives, and act as the main reporting mechanism to the European Commission
Run-off	The flow of water from an area caused by rainfall.
Section 105	Section of the Water Resources Act (1991) under which Flood Plain Mapping is carried out. Level A was the initial Section 105 modelling, level B modelling has been undertaken to look at key areas in more detail.
Section 106 Agreement	Section 106 of the Town and Country Planning Act 1990 (as amended) allows LPAs to negotiate arrangements whereby the developer makes some undertaking if he/she obtains planning permission. These are known interchangeably as planning agreements, planning obligations or planning gain.
Shoreline Management Plan (SMP)	A plan providing a large-scale assessment of the risk to people and to the developed, historic and natural environment associated with

	coastal processes. It presents a policy framework to manage these risks in a sustainable manner.
Strategic Environmental Assessment (SEA) Directive	European Community Directive (2001/42/EC) on the assessment of the effects of certain plans and programmes on the environment.
Surface Water	Water that drains across the surface of the land and into sewerage systems designed to accept surface water flows.
Sustainable Drainage Systems (SUDS)	A sequence of management practices and control structures, often referred to as SUDS, designed to drain water in a more sustainable manner than some conventional techniques. Typically these are used to attenuate run-off from development sites.
Sustainability Appraisal	An integral part of the plan-making process which seeks to appraise the economic, social and environmental effects of a plan in order to inform decision-making that aligns with sustainable development principles.
Washland	An area of the floodplain that is allowed to flood or is deliberately flooded by a river or stream for flood management purposes.
Water Framework Directive	A European Community Directive (2000/60/EC) of the European Parliament and Council designed to integrate the way we manage water bodies across Europe. It requires all inland and coastal waters to reach “good status” by 2015 through a catchment based system of River Basin Management Plans (RBMP) incorporating a programme of measures to improve the status of all natural water bodies.
Windfall sites	Sites which become available for development unexpectedly and are therefore not included as allocated land in a planning authority’s development plan.

References

1) Planning Policy Statement 25: Development and Flood Risk, December 2006.

2) Development and Flood Risk: A Practice Guide Companion to PPS25, Department for Communities and Local Government: London, 'Living Draft', Department for Communities and Local Government: London, February 2007.

3) Planning Policy Guidance 25: Development and flood risk, ODPM, 17 July 2001

Sources of Information

- Improving the flood performance of new buildings: Flood Resilient Construction, CLG/Defra/EA, May 2007 (Available from www.communities.gov.uk).
- Land Use Change in England Residential Development to 2004 , ODPM, May 2005.
- Regional flood risk assessment (RFRA) for the Northwest (Environment Agency)