Exeter City Council
Strategic Flood Risk Assessment
Final Report

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EXECUTIVE SUMMARY

This Strategic Flood Risk Assessment has been prepared as required by government guidance set out in Planning Policy Statement (PPS) 25, Development and Flood Risk. The report is intended to become a live document that is readily accessible and understandable for local authority staff and wider public use.

1. The Purpose and objective of a Strategic Flood Risk Assessment?

A Strategic Flood Risk Assessment (SFRA) is an overview of flood risk within City Council's current boundaries. It aims to provide general guidance to planning officers, developers and other interested parties about areas where potential flood risk is evidently an issue. This is important because flooding of properties causes disruption, widespread and costly damage, temporary or even permanent displacement of residents, distress, harm leading to or causing loss of life, and the potential blighting of properties.

PPS 25 requires that flood risk is considered in the process of allocating land for development and recommends that sites should be allocated for development in ascending order of flood risk. It is essential at the earliest opportunity for everyone involved in the planning process to be aware of potential flood risk in order that informed decisions about possible or proposed development opportunities can be taken.

The main objectives of the SFRA are:

- To provide maps of the LPA area, Main Rivers, ordinary water courses and flood zones, across the local authority are.
- To assess the implications of climate change for flood risk at development sites within the City.
- To show areas at risk of flooding from sources other than the river and the sea.
- To show the location of any flood management measures, including both infrastructure and the coverage of flood warning systems.
- To state the locations where additional development may significantly increase flood risk elsewhere.
- To provide guidance on the preparation of FRAs for development sites within the City.
- To provide guidance on the applicability of different sustainable drainage systems (SuDS) techniques for managing surface water run-off for all new development.

The study should initially aim to assist with directing development away from areas of elevated flood risk through the sequential test. Secondarily it should inform as to the scale of a site specific FRA needed to accurately determine the significance of flood risk associated with a development.

This SFRA represents the views of the Engineering & Construction Unit of the City Council (the LPA), which have been guided by the Environment Agency who have supplied data and acted as consultant and reviewer.

2. Flood Risk within Exeter City Boundaries

Exeter is located immediately at the head of the tidal influence of a major river catchment, the River Exe, into which many smaller rivers or rivulets and tributaries discharge into upstream from the source on Exmoor in North Devon.

The main river system in Exeter has a natural flood plain which generally extends south westwards into areas of lower Exwick, St Thomas and Marsh Barton which are protected by an existing flood defence system.

Sources of flood risk within Exeter can be summarised as follows;

- The River Exe catchment. This is a major catchment that drains to the estuarial waters via the natural valley from Cowley Bridge to Topsham, draining an area of approximately 1500 km^2 to the English Channel at Exmouth.

- The Exe Estuary. The tidal influence of the Exe Estuary has implications for low lying areas to the south of the City boundary. This area can be assessed separately from the area of Exeter potentially at risk from the River Exe due to the influence of St James Weir. This structure separates the river from the estuary by restricting the influence of the tide as the tidal water below the weir is not expected to rise to the weir level in the foreseeable future. The predicted impact of sea level rise is however anticipated to cause significant increases to extreme high water levels in tidal areas.

- The Alphinbrook. This watercourse drains from west to east across Alphington via a flood alleviation scheme following alongside the Exeter Canal south eastwards.

- The Matford Brook. This watercourse enters the City Council area at Matford Bridge, close to the southern end of Bad Homburg Way. It crosses under the main London Penzance railway line before discharging into the Alphinbrook beside the Canal.

- The Northbrook watercourse incorporating the Mincinglake Stream. This catchment extends from land north of Sylvania Park (Stoke Meadow Road) southwards to its outfall into the Mill Leat at Northbrook Park (off Topsham Road).

- The Pinbrook Watercourse. Issuing from a rural valley north of Beacon Lane, it drains along the eastern boundary of Exhibition Fields, then skirts around southwards below the former village of Pinhoe to Monkerton. Downstream it flows eastwards under the M5 motorway to the River Clyst. This watercourse has been subject to a flood alleviation scheme carried out during the 1980's.

- Taddiforde Brook. The watercourse arises south of Higher Hoopern Lane off Pensylvania Road and passes predominantly through the grounds of Exeter University to New North Road. Crossing under the road, it then passes through the grounds of the former Elmside Nursery before being culverted for a considerable distance, from upstream of Bonhay Road to its outfall into the River Exe, north west of St Davids Station.

- Larkbeare Culvert. This former culverted watercourse arises in the northern end of Belmont Park off Blackboy Road and heads generally southwards to the River Exe at the foot of Colleton Hill at the eastern end of Exeter Quay. Much of this former watercourse now has a public sewer status and is the responsibility of South West Water Ltd, the local water company.

- Longbrook Culvert. This former culverted watercourse arises south of Union Road off Prospect Park and generally runs south westwards to Exe Street where it discharges to the privately owned Higher Leat alongside Bonhay Road. Much of this former watercourse now has a public sewer status and is the responsibility of South West Water Ltd, the local water company.

Most of the study area comprises of a typical urban environment with a mixture of residential, commercial, retail and industrial / employment uses, surrounded by more rural areas on generally higher ground. The former port of Topsham is located along the tidal reaches of the river Exe and is bounded to the north east by the River Clyst immediately upstream with its confluence with the Exe. Hence its lower lying land is at risk of fluvial and tidal flooding or a combination of both.

The flood risk is mostly from river flooding in the lower reaches of the main catchment and from the sea in the tidal influenced areas and from surface water runoff. In localised areas there is a risk of flooding from the relatively steep sided valleys that discharge laterally into the Rivers Exe or Clyst.

The general geology of the Exeter area is predominantly of various forms of clay that are generally impervious and therefore respond to runoff especially in sudden downpours.

As regards land within the rural valley floor and other low lying land, although the natural ground water table may be of concern, it generally remains fairly constant with some seasonal and tidal fluctuations. However, there is potential risk of flooding from ground water.

Ultimately all areas are potentially at risk of flooding, or may have the potential to increase flood risk elsewhere. Some areas are at a higher risk of flooding than others, whereas many other areas are at little or no risk. A combination of factors contributes to making an area at potential risk of flooding. These influences include: (i) Location including proximity to a watercourse or tidal river, (ii) climate, (iii) geology, (iv) topography and (v) natural ground water level. The risk of flooding will increase when there are

extreme local storms or, more particularly, from the River Exe as a consequence of long periods of moderate / heavy rainfall events i.e. rainfall duration of 2 or more days.

This risk will increase further when taking into account the predicted effects of climate change.

Significant areas within Exeter that are at risk of flooding include parts of lower Exwick, lower part St Davids, St Thomas, Marsh Barton, The Quay, Countess Weir, Topsham, Alphington and the Monkerton area of Pinhoe.

Some areas at risk of flooding within Exeter City already have man-made defences (such as raised walls, embankments, flood channels and storage areas) that can act to decrease flood risk in vulnerable areas. These structures are generally located close to the main rivers and watercourses where flood relief or alleviation schemes have been previously carried out to specific design criteria and are the responsibility of the Environment Agency.

Flood risk can be mitigated through the planning process wherever possible, avoiding new development in high risk areas, allowing for natural flooding, and improving existing or creating new flood defences.

It is therefore essential that Local Development Frameworks address flood risk. This SFRA instigates part of this process. It provides guidance on how to identify areas and sites that lie within areas of particular risk and the implications for future land allocation. In addition to this it helps to identify where individual planning applications will need to be accompanied by a site specific FRA.

3. Flood History of Exeter City -Worst Recent Events

Flood risk is a constant threat at any time of the year. There have been significant flooding incidents within the City boundary over the past few decades. For example, in 1960 two serious flood events affected a large area of St Thomas and resulted in the construction of the River Exe flood relief scheme through Exeter. There was serious flooding on the Pinn Brook in 1972, and in the 1980s and 1990s there was localised flooding from thunderstorms.

In 2000 there was widespread flooding of rivers, including the Exe, due to significant rainfall occurring over the region. Whilst a small number of properties still flooded, i.e mainly at Countess Weir and along Exeter Quay, the main river defences protected much of the previously vulnerable areas albeit with very little spare capacity.

The period or duration of the flood was over a number of hours and a secondary problem was caused from leaking outfalls gradually filling up and flooding the highway around Exe Bridges and Frog Street.

It is important to note that flood risk should not be treated complacently, because flood defences are built to protect property from a flood of a certain magnitude (the predicted design standard). The risk remains that the defences will fail or that a flood event will occur that is of greater magnitude than the flood defence scheme is designed for. This is why the Flood Zones

produced by the Environment Agency do not take flood defences into account. They provide a precautionary extent of the flooding by assuming that defences are not in place.

It should also be noted that, old flood defences built to the best available methods of the time may not have the standard of protection which is thought necessary today. This is due to continual improving of estimations of flood events by using sophisticated engineering techniques and by the use of modern technology.

4. Data

The SFRA uses the best current available data collected from the Environment Agency, South West Water Ltd and Exeter City Council. The SFRA is to be considered a 'live' document and hence will only retain its value by continual or periodic updating with latest information provided by various investing bodies.

The quality of the data collected and produced does vary according to its source. Hence, where less reliable information or assumptions are used, a more cautionary approach is to be adopted and will identify the need to obtain more detailed information.

The Environment Agency is the main source of flood related data for the River Exe and has produced flood maps of most for the known affected areas. This information is based upon historical data, gauged flows and aerial photographic evidence of particular events.

Flooding information is provided to the public by the Environment Agency through Floodline on 0845 988 1188, or through their website at www.environment-agency.gov.uk.

Planning Requirements

In general, where any planning application falls outside of Flood Zones 2 and 3, the need for further flood risk assessment information will not be required unless the site area is greater than 1 hectare. However further restrictions regarding drainage or sewerage of the site may still be imposed.

Where applications affect land, which is located fully or partly within either Flood Zones 2 or 3, a site specific FRA should be produced before a decision can be made regarding the suitability of the site and its proposed use. The production and funding of site specific FRAs are the responsibility of the developer. PPS 25 provides guidance for the production of a site specific FRA.

5. Definition of Flooding Terms

The Environment Agency and PPS 25 have used the following terminology to describe flood related aspects. Definitions are set out below and help to provide a better understanding of the terminology used.

All rainfall events are independent, can vary in intensity during an event, and can vary greatly in length of time, known as the duration. This means that when stating the size of a flood, averages must be used. The following terms are particularly useful when describing the size of a flood.

Return Period: A 1 in 100 year flood means that the rainfall-generated peak flood flow will, on average, only be exceeded once in a 100 year period. This is known as the return period of the flood. This does not mean that the flood is due in 100 years time as it could happen at any time and more frequently than once in 100 years. The same principle is applied to tidal events.

Probability: This is the statistical evaluation that a particular event of a certain magnitude will occur in any one year. This can be calculated by dividing 1 by the return period of the flood in question. For example, the probability of a 1 in 100 year flood occurring in 2006 is 0.01 (or 1%), and the probability of a 1 in 200 year flood occurring is 0.005 (or 0.5%).

Environment Agency Flood Zones

The return periods of 1 in 1000 years and 1 in 100 years (or 1 in 200 years tidal) are used by the Environment Agency to estimate the flood extents of flooding from rivers (known as fluvial) or the sea (tidal). These flood extents are represented on the Flood Map as Flood Zones 2 and 3 respectively. The Environment Agency Flood Map does not show areas at risk from ground water or surface water flooding.

Planning Policy Statement 25

PPS25 uses the Flood Zones shown below for categorising flood risk, in order to guide planning decisions:

- **Flood Zone 3b** – The Functional Floodplain
  This zone comprises of land where water has to flow or be stored in times of flood. SFRA's 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).

- **Flood Zone 3a** – High Probability
  This zone comprises of 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 2** – Medium Probability
  This zone comprises of 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.

- **Flood Zone 1** – Low Pobability
  This zone comprises of land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

PPS25 requires that a sequential approach to land use in terms of flood risk is applied. This ultimately means that the planning authority will only allow less vulnerable development in high risk flood areas if lower risk areas are not available or suitable and that appropriate mitigating measures to manage the flood risk are utilised which may involve existing defences being improved or supplemented with proposed new means.

6. SFRA Results – GIS Mapping

The main results of the SFRA are the production of a series of maps covering the whole of Exeter City, a Geographic Information System (GIS) package and this explanatory report. The maps will be made available to the public on a CD to be included with this report. The data on the CD should be used in accordance with the guidance set out in this report.

The maps indicate areas where there is either a known or predicted risk of flooding, and where proposed developments should be restricted because of this very real flood risk. The maps, this report and GIS mapping should collectively enable more informed, consistent and sustainable planning policies and land allocations to be produced and allow development control decisions to be made, taking advice from various statutory consultees with respect to flood risk using the latest information.

Mapping

Maps have been produced so that the public can access the data used in the SFRA. There are three sets of printed maps, which cover:

- Existing flood risk- both Fluvial and Tidal
- Historic flood extents
- Existing flood defences

Historic Flood Extents and Existing Flood Defences Map

The SFRA has identified existing (and some proposed) flood defences that are maintained by the Environment Agency or Exeter City Council. Some historic flooding may have occurred before flood defences were in place, hence it is possible for both historic flooding and flood defences to be shown in the same location.

Flood Risk Map

These maps show current flood risk using the Environment Agency Flood Zones and Potential Flood Risk Areas historically known to Exeter City Council.

A floodplain is an area that would naturally be affected by flooding if a river or watercourse rises above its banks or breaches its defences, or if high tides and rough stormy conditions cause flooding in estuarial areas.

The flood maps show three different kinds of areas.

- Environment Agency **Flood Zone 3a.** This area could be flooded from the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year, or from a river by a flood that has a 1% (1 in 100) or greater chance of happening each year. This is described as a high-risk area.
- Environment Agency **Flood Zone 3b** comprises land where water has to flow or be stored in times of flood. This zone includes 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.
- Environment Agency **Flood Zone 2** shows the additional extent of an extreme flood from rivers or the sea. These area are likely to be affected by a major flood with up to a 0.1% (1 in 1000 year) chance of occurring each year. This is described as a low to medium risk area.
- Land not in Environment Agency Flood Zones 2 or 3 is in **Flood Zone 1** which has little to no risk of flooding.

It must be made clear that these zones show the extent of the natural floodplain if there were no flood defences or other manmade structures and channel improvements.

Flood maps for the areas outside of the River Exe floodplain and tidal zone are based mainly on historic and anecdotal evidence of flooding. The only watercourse that has undergone detailed modelling is the River Exe.

Climate Change

It is necessary to consider the predicted impact of climate change as the SFRA is a long term planning document. However the prediction of the effects of climate change on river flows and sea levels is somewhat uncertain. In the future it is anticipated that in the southwest there could be increases in the amount of winter rainfall and the intensity of storms. It is also widely predicted that sea levels may rise due to global warming. Although the potential impact of climate change is not mapped in this study; guidance is given on how environmental factors are predicted to change and allowances that should be made to take these changes into account.

7. Technical Guidance

As part of this SFRA, technical guidance has been produced for both planning officers, developers and other interested parties. This should be used when considering, at a strategic level, the suitability of a site for development in terms of flood risk. One part of this are flow charts which can be used, along with the maps or GIS package to assess the suitability of a site for development and to determine what level of information is required from a developer in order to support a planning application.

In addition to this, some specific details about flood risk that apply to the District have been documented as a guide for planners and developers.
Details are provided about:

- Tidal and Estuarial Flooding
- Ground water

- Flood Defences
- Flood Warning and Evacuation Procedures

8. Recommendations

The SFRA makes a number of recommendations:

- Every application for development or change of land use must be considered by planning officers in terms of its potential flood risk from whatever source.

- It is the developer's own responsibility to provide a Flood Risk Assessment with any planning application if stated as a requirement by PPS 25.

- All site specific Flood Risk Assessments must be considered by the Environment Agency as part of the planning consultation process and their comments applied / adhered to.

- Potential development land that is found to be unsuitable for one type of development due to the apparent high flood risk may still be suitable for other less vulnerable uses, for example environmental and recreational areas. PPS 25 guidance can be used to suggest suitable alternative land uses.

- The data and information contained within this SFRA constitutes the best current information/ data available and some datasets within the GIS package are periodically updated. It is advised that Exeter City Council update their GIS package accordingly to ensure that decisions are made using the best available data at all times.

- The Strategic Flood Risk Assessment should be used in testing general locations for the strategic expansion of the City and site specific allocations in the Exeter Local Development Framework. This will involve investigating the impact of proposals for new development in the vicinity if it is sensitive to flooding and/or particularly upstream of such areas where there have been past flood events. Within the planning process this will involve applying the sequential test, and where necessary the exception test.

9. SFRA Conclusions

Flooding can be potentially devastating both to life and property with costly consequences. Addressing flooding is therefore a matter of high priority and of such importance that it must not be ignored.

It is predicted that in the relatively near future, climate change will cause flood risks to increase significantly. Hence it is predicted that flooding will occur more frequently and more severely.

This Strategic Flood Risk Assessment, in combination with individual site specific Flood Risk Assessments, will enable Exeter City Council to meet their requirements under PPS 25. This should result in new development being guided to areas that are of lowest probability of flooding. This should allow development to be planned for and allocated in a more sustainable way.

All potential development will require close scrutiny with regard to the risk of flooding. The SFRA will give early identification of likely flood related limitations or restrictions.

CONTENTS

APPENDICES

Associated information

This document should be used in association with the associated CD which contains the mapping data

1 INTRODUCTION

MAIN POINTS

- This Strategic Flood Risk Assessment will form part of the Evidence base for the Exeter Local Development Framework.
- Its main objective is to inform the planning authorities, the general public and developers, and to meet the Council's responsibilities under PPS25, by providing a clear basis for requesting site specific Flood Risk Assessments and giving planners the tools to undertake the sequential test.
- The main output of this SFRA is a series of maps and a Geographic Information System (GIS) package, plus an explanatory report, produced to determine whether land is suitable for development in terms of flood risk.
- The maps, GIS and report are live documents to be updated as new information becomes available

The content of the SFRA has been guided by the Council planners and engineers, in consultation the Environment Agency who have greatly assisted in the supply of data and attended guidance meetings.

1.1 Purpose and main objectives of a SFRA

Flooding is a potentially life threatening hazard and is a major factor that could affect the sustainability of communities within the City Council's boundaries. Flooding and flood risk can involve a wide and complex range of issues because of all the variable factors that can influence it. The purpose of this SFRA is to produce a live document that can readily identify areas of potential flood risk and direct potential and existing vulnerable development to areas of lower risk. The general level of flood risk in Exeter is the frequency or likelihood of flood events and their consequences. Flooding of properties causes significant disruption, widespread extensive damage, considerable distress, physical harm and can ultimately result in loss of life. It is prudent to try and prevent any inappropriate new development; taking place in areas that are at a high risk of flooding, or which if allowed, could increase the risk of flooding elsewhere.

By endeavouring to direct vulnerable development in Exeter away from areas of flood risk and reduce flood risk to existing development a contribution towards achieving a better quality of life and the objectives of sustainable development and more sustainable communities result.

The SFRA will help the planning authority and statutory consultees to consider issues relating to flooding on the wider scale of the main river catchment and the downstream estuarial area. The procedure can then take account of the natural process of flooding in planning future development. This also

means giving serious consideration to how a changing climate is currently predicted to affect the risk of flooding over the lifetime of any new or existing developments. This can vary depending on the type of development permitted.

Exeter City Council is in the process of preparing its Local Development Framework. This is an ongoing process, but the policies and strategy in the Development Plan Documents will cover the period 2006 to 2026. As part of this process ECC has to undertake a SFRA for its area in order to meet the requirements of PPS 25.

In particular, PPS 25 advises that sites should be allocated for development in ascending order of flood risk. This forms part of the sequential test, described in detail in Section 3 of the report. The aim of the sequential test is to ensure that land is allocated in the most sustainable way in terms of flood risk. The Government aims to reduce risk to people and the environment from flooding, by discouraging further built development within floodplain areas and promoting best practice for the control of surface water runoff.

The information in this SFRA is therefore designed to help guide the Local Planning Authority in making informed decisions on allocating land through the planning process and in making development control decisions.

The SFRA study, although targeting the area within the Council's jurisdiction, also takes a broader, more countywide, cross-boundary approach. This is essential as Exeter is located at the lower estuarial reaches of the River Exe and its tributaries, which rise from as far as Exmoor, close to the North Devon coast. This reflects a more regional approach involving large river catchments and estuarial / tidal concerns. It can contribute to the wider and co-ordinated activities of local authorities working across boundaries and with other agencies such as the Environment Agency in the coastal and flood-prone areas.

1.2 Main objectives

The main objectives of the SFRA are:

- To include maps of the LPA area, Main Rivers, ordinary water courses and flood zones across the local authority area, as well as allocated development sites.
- To assess the implications of climate change for flood risk at development sites within the City.
- To show areas at risk of flooding from sources other than the river and the sea.
- To show the location of any flood management measures, including both infrastructure and the coverage of flood warning systems.

- To state the locations where additional development may significantly increase flood risk elsewhere.
- To provide guidance on the preparation of FRAs for development sites within the City.
- To provide guidance on the applicability of different sustainable drainage systems (SuDS) techniques for managing surface water run-off at key development sites.

1.3 Application of the study results

The study has resulted in the generation of a series of maps that have been incorporated onto the Council's Geographic Information System (GIS) package, together with this report.

There are a number of printable maps that cover existing flood risk, historic flood extents and flood defences. The GIS is a corporate tool to search for and enable swift identification of flood risk, flood defences and history of flooding within Exeter. A key illustrative output is the definition of functional floodplain, Flood Zone 3b, described in detail in Section 3 of this report.

The maps and GIS indicate areas where there is a risk of flooding and where proposed developments could be restricted because of the identified flood risk.

The study should initially aim to assist with directing development away from areas of elevated flood risk through the sequential test. Secondarily it should inform as to the scale of a site specific FRA needed to accurately determine the significance of flood risk associated with a development.

The report provides information on how this SFRA was produced in order to meet the above objectives. The maps and the report will enable consistent and sustainable decisions to be made with respect to flood risk.

1.4 Report status, including maps and GIS system

The SFRA is intended to become a recognised reference and policy document that will be part of the basic evidence base for the Local Development Framework.

The report, maps and GIS are ongoing live documents and computer mapping tools. This means that they will be updated whenever new information becomes available. In particular, this means incorporating the updates of Flood Zones currently provided by the Environment Agency on a regular basis. It is proposed to produce the maps and associated information in a user friendly format on a CD to be included with hard copies of the report.

2 BACKGROUND

MAIN POINTS

- The Strategic Flood Risk Assessment covers all land in Exeter City Council's district.
- The impact of topography, geology, watercourses, tides and weather conditions combine to produce circumstances that can lead to the risk of flooding.
- Sources of flood risk include rivers, streams, tidal waters, surface runoff and groundwater.
- There are some areas that are at high risk of flooding from fluvial sources, tidal waters, or both.
- The risk of flooding is real - there have been major flood events in Exeter in the past.
- Everywhere is potentially subject to flood risk. Nowhere is free of risk, but some areas are potentially at much greater risk.

The SFRA study covers the land that lies within the boundaries of the City Council. This boundary line is included on the maps that are associated with this report.

2.1 Topography and location characteristics

The main conurbation of Exeter straddles the River Exe and is located immediately upstream of its normal tidal influence, which is limited by a series of man-made weirs. The City lies on the lower reaches of the River Exe, which drains a large rural upstream area as far north as Exmoor where the average annual rainfall is high. The Exe catchment is a significant catchment area that has a number of smaller tributary river catchments flowing into it.

The downstream River Exe estuarial waters extend southeast to the former port of Topsham, where the river is bounded by the man-made Exeter canal as far as Turf Locks. To the west side of the canal, the River Valley Park and Exminster Marshes are located.

The northern boundary of the City is at Cowley Bridge, where the confluence of two river valleys meet (the River Exe and the River Creedy). Within each

river catchment there are a number of sub catchments with rivulets and many small watercourses.

The valley floor falls gently longitudinally and is fairly flat, thus forming the natural flood plain to the river. This natural flood plain generally widens as the river progresses downstream extending southwards into the lower end of Exwick and then into St Thomas and Marsh Barton beyond.

On both sides away from the river valley, the land rises comparatively steeply and has relatively small lateral valleys that give rise to streams or watercourses that discharge to the main river.

Some of these former valleys have been fully culverted and partially filled, particularly when the Railway infrastructure arrived in Exeter during the mid-19th century. These are now the responsibility of the local water company as they receive flow from combined sewerage overflows, but again eventually discharge into the River Exe.

Immediately to the south east of Topsham, the River Clyst flows into the estuary after skirting to the east of Exeter alongside the M5 motorway. Southwards from Sowton Industrial Estate the natural flood plain to the River Clyst is located immediately alongside the east side of the motorway which is elevated on an earth embankment.

The main river system through Exeter is the River Exe catchment. This is a major catchment in Devon that drains an area of approximately 1500 km^2 from its source at Exmoor to the English Channel at Exmouth in East Devon.

The main watercourses are:

- The Alphin Brook at Alphington
- Unnamed watercourse through the Duryard Valley Park
- The Matford Brook at Matford Business Park
- The Larkbeare culvert
- The Longbrook culvert
- The Northbrook watercourse including the Mincinglake Stream (tributary)
- The Pinbrook watercourse - Beacon Heath to Monkerton area of Pinhoe.
- The Taddiforde Brook via the Hoopern Valley & Exeter University grounds
- The Higher & Lower leats off Bonhay /Commercial Road.

The geological characteristics of Exeter vary considerably across the area, in particular across the natural valley that generally heads southeast towards the sea.

The British Geological Survey map (nr 325) of Exeter indicates that above, or north, of Exe Bridges, the side valleys generally consist of the Crackington Formation of the Carboniferous & Devonian periods, whilst the valley floor is alluvium overlying gravels and breccia.

To the south of Exe Bridges, the ground becomes a mixture of breccias (Heavitree & Alphington) with Dawlish Sandstones of the Permian period on the valley sides whilst the valley floor is again alluvium overlying gravels and breccia.

One exception to this is the Longbrook valley, which is located on the northeast side of the Exe valley, immediately north of the main city centre. This valley consists of Whipton formation from the Permian period.

The Crackington formation gives rise to springs and groundwater rising to the surface at numerous places and can vary locally from year to year.

The lateral streams and watercourses draining the relatively steep sided narrow valleys can rise quickly, for example following rain falling on the surrounding hills, which can potentially pose problems, particularly for short intense rainfall events such as summer thunderstorms.

In the upper part of the River Exe many of the upland watercourses rise on Exmoor where the average annual rainfall is much higher than that of Exeter, which is sheltered to the west by Dartmoor. The rocks in this moor area are mainly granite and the soils are thin. This means that little rain can soak into the ground, and combined with the steeply sloping narrow river valleys typical of this area, makes the receiving rivers react rapidly to rainfall.

Lower down in the river system the river valleys become wider, the underlying rocks become replaced by clay, shales or slate and the overlying soils is deeper which allows more rain water to be absorbed. However when the ground becomes saturated from or during long periods of rainfall, again this will lead to a rapid response in river levels rising. In the lower reaches of the Exe catchment the floodplain is wider and gently sloping.

The river estuary is a distinctive landscape and has been partly designated as a Site of Special Scientific Interest (SSSI) and constitutes particular habitat features for migrating birds. The broad River Exe estuary extends from south eastwards to the mouth of the estuary at a sand spit at Dawlish Warren. This sand spit, together with the sandbars in the river and the salt marshes and estuary margins upstream, provides a level of natural flood protection in the area. The river is currently tidal as far north as the St James weir at Salmon Pool Lane.

The broad River Exe estuary borders part of the north east edge of Teignbridge District Council. This area of natural flood protection from the

sea is provided by the major sand spit at Dawlish Warren and by the salt marshes, reed beds and broad estuary margins.

The banks of the Exeter Canal between Topsham Lock and Turf Lock actually form part of the estuarial defences, the Canal being owned by the City Council.

The river frontage to Topsham is low lying and is in part developed on reclaimed land that was originally part of the estuary waters. Hence there is a history of both fluvial and tidal flooding or the combination of both. There was a proposed flood defence scheme planned by the EA to reinforce the existing defences, but this has been deferred indefinitely owing to schemes of higher priority.

Other watercourses which have been subject to flood alleviation schemes, and as such are maintained by the Environment Agency, are the Alphinbrook at Alphington and more recently the Pinbrook watercourse that skirts to the south of Pinhoe via Monkerton. Historically both had caused flooding problems prior to the implementation of specific flood alleviation schemes.

The Matford Brook flows eastwards into the southern fringe of Exeter at Matford Bridge (adjacent to Bad Homburg Way) from a rural catchment between Shillingford Abbot & Shillingford St George (in Teignbridge) and crosses under the main London to Penzance Railway before flowing into the Alphinbrook.

The other listed main watercourses that drain into the river from west or southwest facing valleys, such as the Duryard Valley, the Taddiforde Brook, the Longbrook, the Larkbeare, are steep sided and give quick responses to rainfall.

Each has a number of road or rail culverts which can restrict the capability of discharging flows further downstream, but this can also sometimes be of benefit to prevent more sensitive areas from flooding.

The Northbrook, encompassing its main tributary, the Mincinglake stream, is the largest natural watercourse system enclosed within the Exeter City boundary and drains a large proportion of the mainly residential eastern areas of the City including Stoke Hill, Polsloe, Whipton, Heavitree, Wonford and St Loyes. Much of this area is also served by surface water sewers which generally discharge into this watercourse. The stream flows southwards and outfalls into the Mill Leat at Northbrook Park off Topsham Road. The maintenance for this watercourse is generally the responsibility of the City Council as riparian owners of the land through which it flows. There is some history of flooding to properties within the Northbrook catchment arising from severe rainfall events.

The Higher & Lower Leats are man-made private watercourses that are fed by the main river off the Head Weir off Bonhay road. These were originally installed to serve the wool mills, which were located on Exe Isle.

The Lower Leat is virtually redundant, whereas the Higher Leat is now being reused to supply water to the newly restored water wheels at Cricklepit Mill, off Commercial Road. The take off from the river is controlled by a sluice gate at Head Weir.

The Longbrook culvert discharges into the Higher Leat at the western end of Exe Street, formerly known as Engine Bridge.

2.2 Climate

The climate on the Devon and Cornwall peninsula is influenced by random weather systems which generally prevail from the south west and transport moist warm air across the Atlantic Ocean. The climate in the British Isles is particularly influenced by the Gulf Stream which flows across the Atlantic Ocean from South America and passes along the western side of Britain.

Dartmoor and Exmoor are the two highest land levels in the South West set at approximately 1,000 metres above sea level and receive more rainfall than other surrounding areas, as the moist warm air is forced to rise, which causes precipitation, i.e rainfall.

Lower lying areas on the peninsula receive far less rainfall, especially to the east of any high ground, which tends to form a rain shadow, thus causing a micro-climate which is not typical of the region. Hence average rainfall can vary significantly between high and low ground in the region. For example, the average rainfall at the headwaters of the Exe on Exmoor is over 2,000 millimetres per year, whereas locally in Exeter area the amount is approximately 850 millimetres per year.

The Atlantic systems are the main source of storms in the area. However the impact of either easterly or south-easterly storms on the Exe Estuary can create flooding problems dependant upon tidal conditions, wind strength and the level of fluvial flow in the river.

Thunderstorms are generally summer events when they tend to be slow moving, of high intensity rainfall, but of fairly short duration. Thus in nature they have the potential to deposit significantly large quantities of rainwater on a very localised area anywhere in Exeter, which may cause very localised flooding due to the very quick surface water runoff generated from the urban catchments.

2.3 City – Employment and resident population

The majority of the study area is an urban conurbation with some large areas being designated as public open spaces or playing fields such as the Valley Parks. There are also recreational parks and gardens that are interspersed throughout the City.

The three main areas of employment are:

1) City Centre
2) Marsh Barton Industrial Estate plus Matford Business Park
3) Sowton Industrial Estate and Exeter Business Park

There are a number of former villages that over the years have been amalgamated inside the City boundaries. These include Heavitree, Whipton and Pinhoe, which are substantially residential areas of mixed densities on the north side of the Exe. Similarly St Thomas, Exwick, and Alphington which are situated on the south west side of the River Exe.

Countess Wear & Topsham are also former village communities that are located close to the river frontage. These have been incorporated within the City boundaries, having been gradually overtaken by the spread of urban sprawl away from the City centre over the last 30 years and are now integrated into the City.

Approximately 117,000 people live in Exeter, including around 13,000 students attending the University over the course of a full academic year. This number is expected to increase to 18,000 over the next 5 years as the University continues to expand.

The study area is tidal in part. Topsham, the largest conurbation along the estuarial waters of the River Exe within Exeter City Council's boundary, is at risk from both fluvial and tidal estuarine flooding.

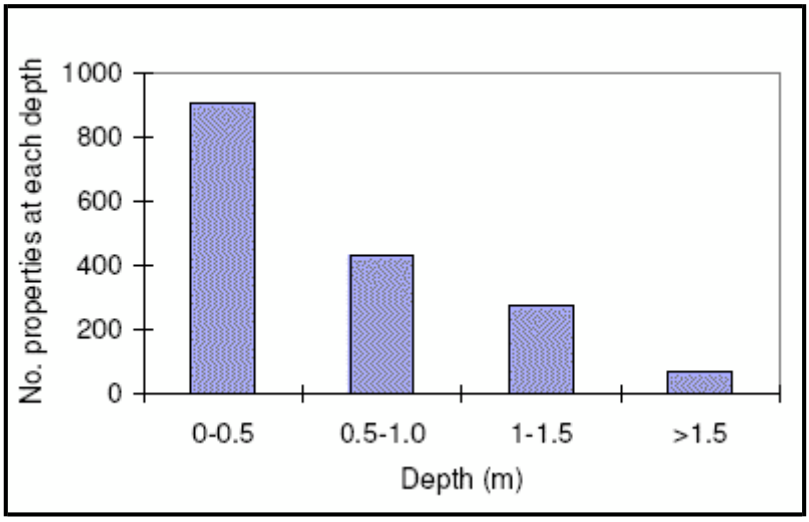


Figure 2.3 Depth of flooding to properties in a fluvial event with 1% probability in Exeter assuming no defences.

In the whole of the Exeter District there are 1,700 properties at high risk from tidal or river flooding. This represents approximately 3.5 % of the 48,600 properties in the Exeter District. Figure 2.3 above breaks down this figure to illustrate the variations of potential depth of flooding in these properties.

Table 2.3 below summarises the number of properties in Exeter at risk of flooding during a 1 in 100 year fluvial/1 in 200 year tidal flooding event and a 1 in 1000 year flooding event.

Table 2.3 Number of properties at risk from flooding in Exeter

Annual probability of 1.0% fluvial and 0.5% coastal flooding	Annual probability of 0.1% fluvial and 0.1% coastal flooding
1,700	2,500

Major infrastructure at risk from flooding with a 0.1% annual probability of flooding from the River Exe includes;

- 2 x Health centres/surgeries
- 2 x Schools/colleges
- Major highway infrastructure at Exe Bridges and the A377 at Marsh Barton
- The main City railway station at St David's

2.4 Flooding history

There is a considerable history of flooding within the main study area based around the River Exe. Much of the data included in this section has been taken from www.exetermemories.co.uk.

The River Exe was until the 13th century tidal up as far as Exeter. It was the building of Countess Weir in 1284 that effectively cut the City off from the sea. The Exe had a wide floodplain that stretched from the City wall across to the rising land of the Haldon Hills. The river through the ages had meandered down this flood plain, moving its course from side to side through the millennia. It was known that the Exe was prone to flooding in medieval times and there are records of floods as early as 1250. In 1286, the new Exe Bridge was partly demolished by flooding and again in 1384. In 1625 a large flood caused devastation from Tiverton down to Exeter. The partly completed Georgian Exe Bridge was swept away in 1775 and work had to recommence on a stronger structure. By the 20th century it was apparent that this bridge helped to hold back the flood waters and create flooding upstream. The new, steel bridge completed in 1905 improved the situation slightly, but its design, along with development along the river banks ensured that serious flooding would occur again. Indeed, there were at least five floods between 1917 and 1952 in Exwick, Cowick Street, St Thomas and other areas to the west of the river.

During October 1960, Exeter had in excess of 380mm of rain, half the annual average. On 26 October 1960, a further 60mm of rain fell over the Exe catchment area causing the river to rise alarmingly. On the 27th October, or 'Black Thursday', 700 cumecs rushed down between the banks of the Exe and overflowed the banks of the river from above Exwick down through St Thomas and towards the low lying parts of Alphington. St David's Station was flooded on the east side of the river, but it was the western bank that took the brunt of the flooding.

In Exwick, Station Road acted as a barrier to the water and caused mud, silt and boulders to be swept through the streets - the water depth was as much as 2 metres (6ft 6 inches). The floodwater flowed on the west side of the railway embankment, over the Exwick playing fields, southwards along Western Road, Okehampton Street and into Cowick Street, the old rugby ground, Haven Banks and Alphington Road.

The rising ground in front of Redhills Hospital and along Exwick Road and Buddle Lane saved these areas from inundation. Another area that was spared was around Flowerpot Fields as it is slightly higher than the surrounding ground.

Western Road around Beach Brothers was flooded to a depth of 1.3 metres (4ft 3 inches) above ground level. The flood was so sudden that more than 150 employees were trapped on the first floor of Beach Bros. premises for nine hours before being rescued by an army DUKW at midnight. It was reported that people were walking along the main railway line towards St David's Station as it was above the flooded surrounds.

Not only was the water deep, but the flow was dangerously turbulent - cars were swept along and people had to take refuge on upper floors. People

were rescued by boat and taken to places of safety. In total, 2,500 houses, factories, churches and pubs were flooded. Carpets, furniture, electric wiring, shop displays, stock and decoration were covered by a layer of thick, muddy red slime. Along the Alphington Road the flood water reached as far as the Crawford Hotel.

Beach Bros lost a total of £21,488 in the October flooding and this was a fraction of the loss in Exeter. Five and a half weeks after the October flood, as people were still recovering from the damage, the waters surged back and on Sunday, 3 December a further 80mm of rain fell to swell the river waters. During this event 1,200 properties were flooded. Shops, factories and houses that were recovering from the October drenching, suddenly found that they were returned to the sodden, muddy condition of a few weeks earlier. Beach Bros sustained another big loss, this time to the value of £20,983. Many buildings were also demolished along the Alphington Road and Cowick Street on the riverside of the railway.

These events prompted planners to investigate possibilities for a flood prevention scheme. At the time it was calculated that a 700 cumecs flood, similar to that which occurred in October 1960, was likely to occur every 50 years. Enlarging the river channel by dredging as well as raising the banks would ensure that a water flow of 350 cumecs could be sustained within the channel without flooding.

It was decided to improve the river channel and build the relief channels that exist at present. It was thought that such a scheme would withstand a 700 cumec flow and could be built in stages to spread the cost over several years. Work started on the scheme in 1965 and the total cost was estimated to be £8 million at 1977 prices.

Three flood relief channels were built - the first started just above Cowley Bridge for approximately 1 km, to return to the river at a point adjacent to Exwick Barton, just below Exwick Weir.

The Exwick spillway is the largest and technically most complex of the channels - a huge radial gate was built just above St Davids Station that is designed to close water from the river and divert into the spillway that runs from the gate down to the new Millers Crossing footbridge, just above the Mill on the Exe pub. The radial gate is totally automatic and responds to changes in water level - a system of chambers fill with water and floats in the chamber rise with the water and lower a huge gate into the flow of the Exe, thus obstructing the flow of water downstream and causing it to spill over into the Exwick Spillway. The spillway is 1,600 metres long and has grass covered concrete banks and a concrete bottom. It is drained of water and cleaned every year and allowed to fill to a depth of 0.7 meters, allowing it to be used for model boating and canoeing. The River Exe and the Exwick Spillway can handle 708 cumecs between them. During the building of the channel in 1974, Station Road and the bridge crossing the Exe were swept

away in another flood. It was a year later that the army lowered into place a new bridge. The Exwick Spillway was formally opened on 23 September 1977.

The third relief channel was installed just above Trews Weir, close to the entrance to the canal. In times of flood, Trew's Weir Relief Channel will allow water to spill over the concrete weir and flow along the grass covered channel to exit adjacent to St James' Weir.

In addition to the flood relief channels, a solution was needed to lessen the obstruction of the Exe Bridge. In 1969 and 1972 the two new concrete bridges were constructed and the old steel bridge dismantled. The two new bridges are utilitarian in design and have streamlined piers and a flat underside to aid the flow of water at the time of flood.

The most recent serious flooding incident from the river occurred in autumn 2000. During the floods of autumn 2000, flows on the River Exe through Exeter topped 500 cumecs – but 40 years ago they reached 700 cumecs.

Some residents said they felt they should have been made more aware of the likelihood of flooding and called for more information to be made available. A small number of properties were flooded relative to the 1960 event. This proved that the City's defences do work, however they were not designed to protect all properties from all possible flooding events.

2.5 Definition of important flooding terms

Floods are not regular, evenly spaced or similar events. They are independent, randomly spaced throughout time and they vary in size. This means that when stating the size of a flood, averages must be used. The following terms are particularly useful when describing the size of a flood:

Return Period: When we speak of a 1 in 100 year flood, we mean the peak flood flow that on **average** will be exceeded only once in a 100 year period. This is known as the return period of the flood. It does not mean it is due in 100 years time, it could happen any time and could happen more than once in a 100 year period.

Probability: The probability that an event of a particular magnitude will occur in any one year is often expressed as a percentage. This can be found by dividing 1 by the return period of the flood in question. For example, the probability of a 1 in 100 year flood occurring in 2006 is 0.01 (or 1%), and the probability of a 1 in 200 year flood occurring is 0.005 (or 0.5%)

3 FLOOD ZONES AND THE SEQUENTIAL AND EXCEPTION TESTS

3.1 Environment Agency Flood Zones

Planning Policy Statement 25 (PPS 25) uses Flood Zones for categorising flood risk, as described below, in order to guide planning decisions.

Zone 1 Low Probability

Definition

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%).

Appropriate uses

All uses of land are appropriate in this zone.

FRA requirements

For development proposals on sites comprising one hectare or above the 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. This need only be brief unless the factors above or other local considerations require particular attention.

Policy aims

In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques

Zone 2 Medium Probability

Definition

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.

Appropriate uses

The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure described in Section 3.2 are appropriate in this zone. Subject to the Sequential Test being applied, the highly vulnerable uses in Section 3.2 are only appropriate in this zone if the Exception Test described in Section 3.4 is passed.

FRA requirements

All development proposals in this zone should be accompanied by a FRA.

Policy aims

In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques

Zone 3a High Probability

Definition

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.

Appropriate uses

The water-compatible and less vulnerable uses of land described in Section 3.2 are appropriate in this zone.

The highly vulnerable uses described in Section 3.2 should not be permitted in this zone. The more vulnerable and essential infrastructure uses described in Section 3.2 should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.

FRA requirements

All development proposals in this zone should be accompanied by a FRA.

Policy aims

In this zone, developers and local authorities should seek opportunities to:

i) Reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage techniques
ii) Relocate existing development to land in zones with a lower probability of flooding
iii) Create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage

Zone 3b The Functional Floodplain

Definition

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).

Appropriate uses

Only the water-compatible uses and the essential infrastructure, listed in Section 3.2 below that has to be there should be permitted in this zone. It should be designed and constructed to:

- Remain operational and safe for users in times of flood
- Result in no net loss of floodplain storage
- Not impede water flows
- Not increase flood risk elsewhere

Essential infrastructure in this zone should pass the Exception Test.

FRA requirements

All development proposals in this zone should be accompanied by a FRA.

Policy aims

In this zone, developers and local authorities should seek opportunities to:

i) Reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage techniques

ii) Relocate existing development to land with a lower probability of flooding

For the purposes of this study the indicative Flood Zone 3, as defined by the EA, has been split into Zones 3a and 3b to further aid the process of land classification for the planning process. Although Zones 3a and 3b are not usually mapped separately by the EA, the maps included in this report have been produced in consultation with the EA. Since the vulnerability classification of appropriate development within these zones differs, as described below, this helps to give a clearer picture of areas available for development and where redevelopment may or may not be appropriate.

3.2 Flood risk vulnerability classification

PPS 25 includes a list of development types classed according to their vulnerability to flooding. These can be cross-referenced with Table 3.3 to assess within which flood zones it is appropriate to locate particular types of development. This list is reproduced below.

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

3.3 The Sequential Test

LPAs allocating land for development should apply the Sequential Test to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed. A sequential approach should be used in areas known to be at risk from other forms of flooding.

In areas at risk of river or sea flooding, preference should be given to locating new development in Flood Zone 1. If there is no reasonably available site in Flood Zone 1, the flood vulnerability of the proposed development can be taken into account in locating development in Flood Zone 2 and then Flood Zone 3. Within each Flood Zone new development should be directed to sites at the lowest probability of flooding from all sources as indicated by the SFRA.

3.3.1 Sequential test in Exeter

Due to the nature of the study area - a historic, prosperous City - a significant proportion of the land is either developed already or unsuitable for development for various reasons.

The City is however undergoing a period of growth and development. This document will therefore inform the pending Local Development Framework to guide specific development types to areas of appropriate flood risk corresponding to the vulnerability of the development proposed.

Table 3.3 – Flood Risk Vulnerability and Flood Zone Compatibility

Flood Risk Vulnerability classification		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test Required	✓	✓
	Zone 3a	Exception Test Required	✓	✗	Exception Test Required	✓
	Zone 3b 'Functional Floodplain'	Exception Test Required	✓	✗	✗	✗

Key;

✓ Development is appropriate

✗ Development should not be permitted

3.4 The Exception Test

If, following application of the Sequential Test, it is not possible, consistent with wider sustainability objectives, for the development to be located in zones of lower probability of flooding, then the Exception Test can be applied. The Test provides a method for managing flood risk whilst still allowing necessary development to occur.

Application of the Sequential Test should ensure that more vulnerable property types, such as housing, would not be allocated to areas at high risk of flooding. However, 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. In these circumstances it will be necessary for the Local Planning Authority or developer to demonstrate that the site qualifies for development in the manner proposed by passing all elements of the Exception Test.

The Exception Test is only appropriate for use when there are large areas in Flood Zones 2 and 3, where the Sequential Test alone cannot deliver acceptable sites, but where some continuing development is necessary for wider sustainable development reasons, taking into account the need to avoid social or economic blight and the need for essential civil infrastructure to remain operational during floods. It may also be appropriate to use it where restrictive national designations such as landscape, heritage and nature conservation designations, e.g. Areas of Outstanding Natural Beauty (AONBs), Sites of Special Scientific Interest (SSSIs) and World Heritage Sites (WHS), prevent the availability of unconstrained sites in lower risk areas.

Where use of the Exception Test is required, decision-makers should apply it at the earliest stage possible to all land allocations for development and all planning applications other than for minor development. All three elements of the test must be passed for development to be allocated or permitted.

For the Exception Test to be passed, PPS25 states:

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 has reached the 'submission' stage – see Figure 4 of PPS12: Local Development Frameworks – the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal
b) The development should be on developable previously-developed land or, if it is not on previously developed land, there are no reasonable alternative sites on developable previously-developed land
c) A FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere and, where possible, will reduce flood risk overall.

Condition a) of the Exception Test requires that it be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk. This assessment would be made with reference to the objectives of the Sustainability Appraisal. The sustainability objectives of Exeter's Core Strategy Sustainability Appraisal are attached at appendix B. It should be noted that these objectives may be subject to change as the Core Strategy progresses through the Examination to adoption and publication.

4 DATA COLLECTION AND DATA QUALITY

MAIN POINTS

- The data collected has been supplied by the Environment Agency and Exeter City Council.
- It is important to be aware of flood risk, to find out if more information is necessary, and what needs to be done to reduce or address the risk - but don't panic.
- The SFRA uses the best data available and the GIS package enables the SFRA to be updated when the data is improved
- Some data will be based on estimations due to the nature of predicting flooding.
- Where only less reliable data is available, a more cautious approach is taken.
- In many cases, before a decision is made about the suitability of a site for development in terms of flood risk, more data and detailed investigations will have to be made by the developer in the form of a site specific Flood Risk Assessment.

4.1 Data collection

Data collected from Environment Agency:

- Environment Agency Flood Zone mapping
- Environment Agency data on flood defences
- Environment Agency Historic Flood Map
- Flooding Incidents recorded by the Environment Agency

Data collected from Exeter City Council:

- Ordnance Survey mapping
- Photographs of significant locations influencing flood characteristics
- Exeter City Council Boundary

As part of the study, the following data and guidance has also been produced:

- Maps illustrating the extent of the functional floodplain, Flood Zone 3b
- Guidance for mitigating flood risk
- Guidance for the production of a site specific Flood Risk Assessment for minor development

4.2 Data quality and risk

In considering the information available, the main point to remember is that everywhere is potentially subject to flood risk. Nowhere is free of risk, but

some areas are potentially at greater risk. The quality of data does not alter actual risk, but could affect the judgement about whether an area is at high risk or not. For that reason the SFRA takes a cautious approach to the use of data.

The quality of the flood-related data collected and produced varies. The data available comes from different sources and was produced at different times. The extent of some flood events have been carefully mapped, others are less precise.

Some data is the best available and is unlikely to be improved upon. Other data have known deficiencies. The analysis in this SFRA makes use of the best data where available, or on data with deficiencies where it will be replaced as soon as improvements become available (this is one reason why the SFRA GIS, maps and reports are 'live' documents, to be updated).

Where data is not available for the SFRA, it has been necessary to make assumptions based on professional experience and recorded literature, applying these to the local area.

For this reason, whilst information is shown on the maps in a relatively precise way, it's not possible to be completely certain from the outputs from this SFRA that any individual property, particularly those near the boundaries of zones of risk, is definitely within that risk zone.

The SFRA is a strategic tool. It is not meant to provide definitive conclusions about flood risk to any individual property or piece of land. But it is sufficient to guide preparation of robust policies and proposals in the Local Development Framework to a standard that will meet the Environment Agency's requirements. This will be combined with supplementary analysis at subsequent plan-making stages when considering specific sites.

It is also provides enough guidance for use in Development Control as a starting point to provide robust grounds for requesting further detailed Flood Risk Assessments.

The quality and accuracy of information is important. This SFRA uses the best information available at this time, respecting the variation in data accuracy. It is also the reason why users of the outputs of this SFRA should treat them as a 'live' document representing the information currently available, and to use the advice given in this document as a guide, which may require further assessments when detailed developments are proposed.

Some information is updated more frequently than others when new data is added or re-modelling is undertaken. The Environment Agency Flood Zone maps are re-issued quarterly, but other data is updated less frequently.

If the SFRA indicates that a property is in a flood risk area, the essential point is that in most cases, before a decision is made about the suitability of a site for development in terms of flood risk, more data and detailed investigations will have to be made by the developer in the form of a site specific FRA. This will highlight if there are areas where data is not accurate and where data can be improved. This information in this SFRA is only as accurate as the data it is based upon.

When considering development, the SFRA will help developers and the local planning authority decide if more information is needed, whether the proposal should be permitted, and if necessary what additional measures are needed to reduce the flood risk and cope in the event of flooding. When used in conjunction with the Local Development Framework the SFRA may also help to highlight to potential developers and planners those sites that are, in relation to flood risk, more suitable for development.

For the individual reader of this report, the SFRA may indicate that property is in a Flood Zone or Potential Flood Risk Area, or could be in a flood risk area at a future date. This is important information and it provides a warning so that if necessary preparations can be made for potential flooding. Flooding could happen at almost any time, but in any individual year the risk of a flood is low. The Environment Agency publishes advice on dealing with flood risk for the general public that can be obtained by contacting Floodline on 0845 988 1188 or through the Environment Agency website at www.environment-agency.gov.uk.

5 MAPPING

MAIN POINTS

- Maps have been produced showing historic flooding extents, locations of flood defences and flood risk areas.
- These maps help to class land into different categories of flood risk or future risk, to which government guidance can then be applied.
- The extracts from the GIS system are included with this report on a CD for general use.
- The maps are part of a strategic analysis and are not precise enough for definitive conclusions to be made about the risk to individual properties.
- The maps are intended to provide guidance as to whether more detailed information is likely to be required before informed decisions can be made regarding flood risk and development.

5.1 Mapping of historic flooding extents and existing defences

These maps indicate where it is thought that flooding has happened in the past. The flooding may have been caused by the sea, from rivers or from surface water runoff or groundwater. This information has been provided by the Environment Agency.

A number of more detailed maps have been produced that illustrate locations of significance to local flood regimes. These are highlighted by links to photographs taken at the locations. The photographs attempt to illustrate the particular attribute and include a brief description of the significance of the location. These maps have been produced by, and photographs taken by, Exeter City Council.

The SFRA has identified existing flood defences that are maintained by the Environment Agency or the City Council. Defences comprise a structure (or system of structures) for the alleviation of flooding from rivers or the sea.

The SFRA does not identify privately maintained defences. Private walls may exist in the area but are not 'flood defences'. Furthermore, not all banks are flood defences.

Defences are designed to protect from flooding to a certain level - a standard of protection. However it cannot be assumed that this level of defence is still at the original design standard because of changes to the way floods are estimated and the effects of climate change.

The map shows the location of existing flood defences. This is useful for a number of reasons. Firstly, this allows planners, developers and the general public to put the potential flood risk into context, especially where historic flooding and flood defences are shown in the same location. The historic flooding may have occurred before flood defences were in place.

Secondly, knowing where flood defences are is useful as it can indicate areas where flood risk may be reduced due to the presence of flood defences. This may require further investigation of the standard of protection that is currently afforded by the defence.

Thirdly, this information on flood defences can be used to identify areas of floodplain that are defended, and can be classed as such, when considering development.

This floodwater can then drain away through watercourses. A general principle of PPS 25 is to maintain a constant amount of functional floodplain. Providing defences will therefore reduce the amount of functional floodplain. Occasionally there are realistic opportunities to provide alternative functional floodplain or to remove floodwater more effectively and efficiently to overcome floodplain loss. However this generally is not likely to be the case within the Exe floodplain.

5.2 Mapping of flood risk

The mapping of flood risk is helpful in the SFRA process as it shows where flooding could occur and therefore where potential new developments should be carefully considered before giving planning permission.

A floodplain is an area that will naturally be affected by flooding if a river rises above its banks, or high tides and stormy seas cause flooding in coastal areas. Over hundreds of years, many natural floodplains have been built on and so today some towns and cities exist on floodplains. Some places have flood defences in place to reduce the risk of flooding. It should be noted however that in these areas there will always be some risk (however low) of flooding.

5.2.1 Environment Agency Flood Zones

This mapping shows the zones where the Environment Agency estimate that there is high risk (Zone 3) or low-to-medium risk (Zone 2) of flooding from rivers and the sea. These zones do not take into account any flood defences that could reduce the impact of flooding if there was a flood event. The Flood Zones cover the watercourses in the study area that have a catchment area of greater than 3km^2. Flood Zones 2 and 3 can be viewed on the Environment Agency website at www.environment-agency.gov.uk.

The Flood Map shows three different kinds of areas:

- Environment Agency Flood Zone 3 is the area that could be affected by flooding, either from rivers and/or the sea, if there were no flood defences. This area could be flooded from the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year, or from a river by a flood that has a 1% (1 in 100) or greater chance of happening each year. This is described as a high risk area. For the purposes of this SFRA, Flood Zone 3 has been split into its respective parts; 3a and 3b. This process has been described in Section 3 of this report, along with a detailed description of what these two sub zones represent.
- Environment Agency Flood Zone 2 shows the additional extent of an extreme flood from rivers and/or the sea. These area are likely to be affected by a major flood with up to a 0.1% (1 in 1000) chance of occurring each year. This is described as a low to medium risk area.
- **All land not in Environment Agency Flood Zones 2 or 3 is in Flood Zone 1, which has little to no risk of flooding.**

For the River Exe through Exeter, the Environment Agency Flood Zones have been defined using hydrological and hydraulic models and mapped using detailed information on the topography of the ground. Flood zones in the catchments described in the flood cells in Section 7 have been derived by the EA using historic and anecdotal evidence, combined with local knowledge and topographic data.

It should be noted that the Flood Map is re-issued by the Environment Agency every quarter. This is to ensure the latest flood maps are being used. The **January 2007 issue of the Flood Maps** has been used to create the mapping of flood risk in the first published printed maps and the first version of the GIS package.

5.3 Mapping of climate change

As the SFRA is a long term planning document is it necessary to consider the potential impacts of climate change in terms of risk of flooding from rivers and the sea. This meets the requirements of PPS25.

Predicting the effects of climate change on river flows and sea levels is uncertain. In the future it is thought that in the southwest there could be increases in the amount of winter rainfall and the intensity of storms. It is also thought that sea levels may rise due to global warming.

It is important to remember that PPS25 requires applications for development, and development for specific uses proposed in the Local Development Framework, to consider long term 'flood-risk' for the lifetime of new buildings.

The following tables give guidance about how climate change is anticipated to impact on flooding related environmental characteristics in the short to medium term. These figures should be taken into account when

allocating land for and designing new development. Interpretation of the predicted net sea level rise table reveals that for a development with a design life of 100 years the extreme water level for which the development should be designed to (i.e. 100 years from now) is approximately 1 m greater than it is at present.

Table 5.3.1 Recommended contingency allowances for net sea level rise

Administrative Region	Net Sea Level Rise (mm/yr) Relative to 1990			
	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
South West	3.5	8	11.5	14.5

Table 5.3.2 Recommended national precautionary sensitivity ranges for peak rainfall intensities, peak river flows, offshore wind speeds and wave heights

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	5%	10%	20%	30%
Peak river flow	10%	20%		
Offshore wind speed	5%		10%	
Extreme wave height	5%		10%	

Flood maps produced by the Environment Agency are indicative and therefore take into account the uncertainties of climate change. Where flood maps indicate that a site specific flood risk assessment may be required this assessment must take into account the potential impact of climate change through the criteria set out above. In such cases it is important that the Environment Agency are consulted during the preparation of the flood risk assessment.

In addition the Environment Agency are currently working on the hydraulic model of the River Exe, which was used to obtain the flood maps through the city, to predict the impact that climate change will have on the future floodplain boundary.

6 GEOGRAPHICAL INFORMATION SYSTEM

A Geographical Information System (GIS) is a computer-based system for using data that is spatially referenced. This means the information can be viewed on electronic maps, where the maps also provide links to the underlying data and details about the information displayed on the maps.

It is anticipated that the maps and associated data will be available for viewing by the public at the council offices. It is also anticipated that the SFRA report and some associated maps and data used as an evidence source for the Local Development Framework will be available for on-line viewing. The Council is exploring how to make the updated GIS information available for viewing under controlled public access for development control purposes.

7 ASSESSMENT OF FLOOD CELLS

For the purposes of this study, areas of the City have been broken down into individual cells, the potential flood risk within each cell being generated from a different catchment.

The maps included below illustrate the scale of the catchments, the significance of the Environment Agency Flood Zones 2 and 3 within the catchments and the proportion of the catchment already developed. The maps included in Sections 7.2 to 7.9 show;

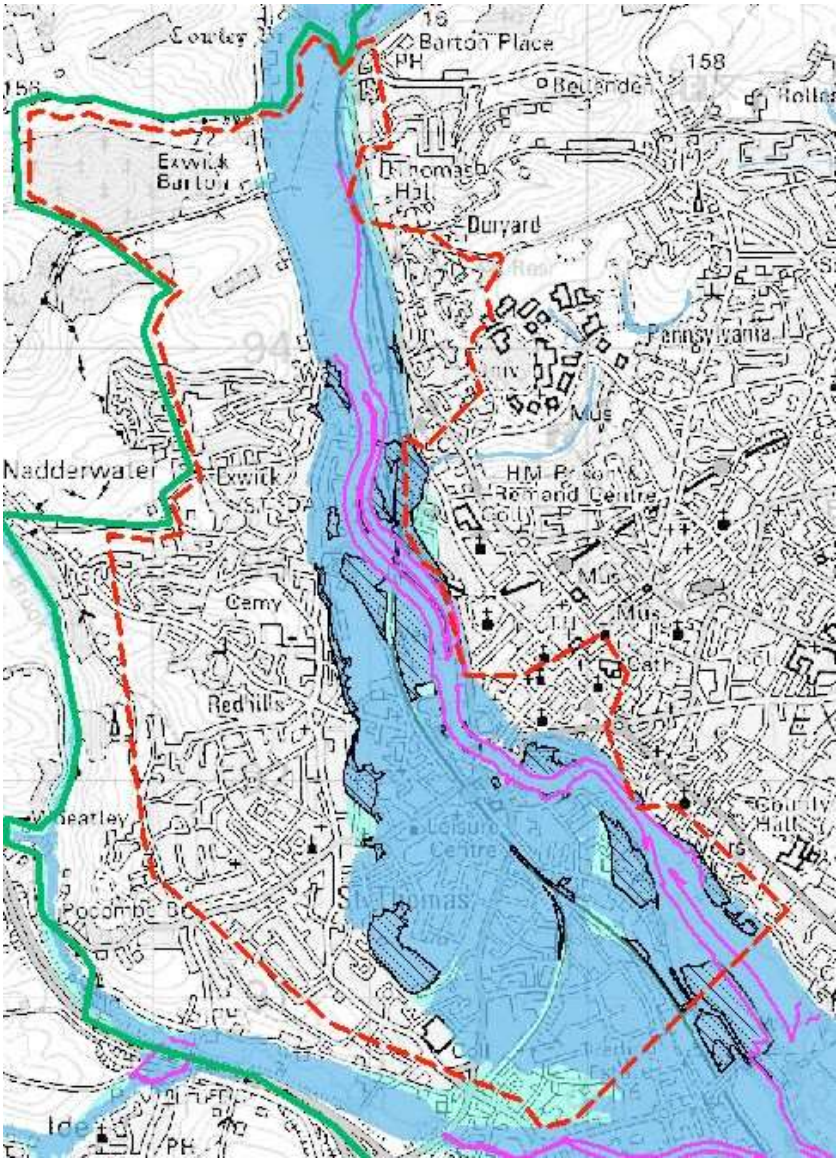
- Flood Zone 3 (Blue): areas at risk of flooding from fluvial sources during events with a return period of 1 in 100 years or less, or tidal flooding during events with a return period of 1 in 200 years or less.
- Flood Zone 2 (Green): areas at risk of flooding during events with a return period of 1 in 1000 years or less.
- Indicative catchment boundary within Exeter City Council boundary (Red).

A number of the flood cells are represented in the graphical GIS section of the report, included on the associated CD. This includes a number of photos covering important structures and landscape features that impact on the flood regime in the City. Each photograph includes a short description of its significance to flooding.

Some areas in Exeter benefit from flood defences. Where sufficient information on these defences is available it has been included in the relevant sections below. Due to the residual risks associated with defences, i.e. that there is a possibility that defences can fail or do not fulfil their designated purpose, development proposals within close proximity to flood defences will be subject to particular scrutiny and control. As part of a flood risk assessment in areas protected by flood defences, particular attention should be paid to the condition and future maintenance regime of the defences.

7.1 River Exe; Cowley Bridge to Trews Weir

This is a major catchment that drains into the estuarial waters via the natural valley from Cowley Bridge to Topsham, draining an area of approximately 1,500 km^2 to the English Channel at Exmouth.



Map source: www.environment-agency.gov.uk and Exeter City Council 2008.

Key:

Flood zone 2 | Flood zone 3

Catchment boundary | Flood defences | Exeter boundary

This section of the Exe receives significant flows from the extensive catchment upstream of the City and also from its tributaries and directly connected surface water drainage systems within the City itself. This secondary source of floodwater, urban in nature, could result in short sharp changes in levels in the Exe should an intense rainfall event occur in the City. However the general source of flooding for the catchment is from longer term rainfall events across the whole catchment.

This implies that flood prediction can be undertaken more accurately and emergency measures can be put in place to mitigate any potential risk. To

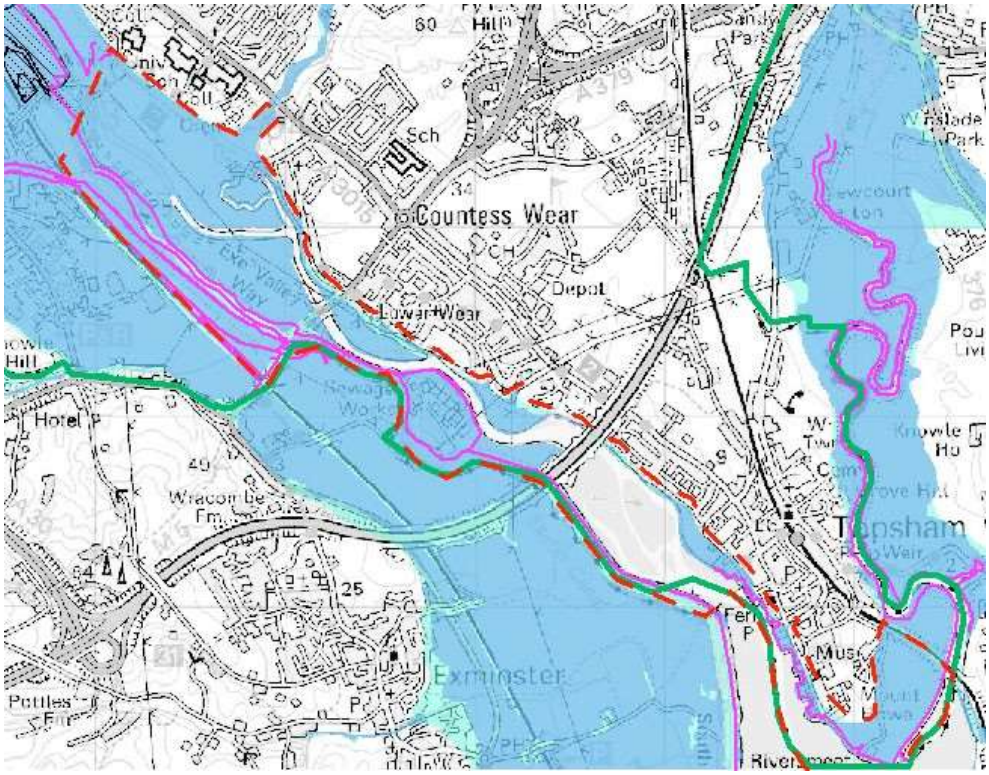
this end the Environment Agency have undertaken detailed hydraulic studies on the river to gain an understanding of how it acts during extreme rainfall events. When preparing a site specific FRA for a site thought to be at risk of flooding from the River Exe, the Environment Agency will provide a top water level for a given return period at the site location. The FRA must then demonstrate that the proposed development will be safe should the river reach the specified level.

7.1.1 Defences

The River Exe through Exeter is served by a complicated and integrated system of flood defences. The main component of the defences is a series of flood alleviation channels that run parallel to the channel above and below the Exe Bridges constriction. The alleviation channels are controlled by a system of weirs and sluice gates. The channels act as a significant storage reservoir as well as increasing the overall conveyance of the channel. These defences are described in more detail in Section 2.

At several locations the defences interact with a number of other structures, which have previously resulted in the obstruction of overland flow routes.

7.2 Exe Estuary Tidal Flood Zone



Map source: www.environment-agency.gov.uk and Exeter City Council 2008.

Key:

Flood zone 2 | Flood zone 3

Catchment boundary | Flood defences | Exeter boundary

A large, low-lying area to the south of Exeter is potentially at risk from a combination of tidal and fluvial sources in the Exe Estuary.

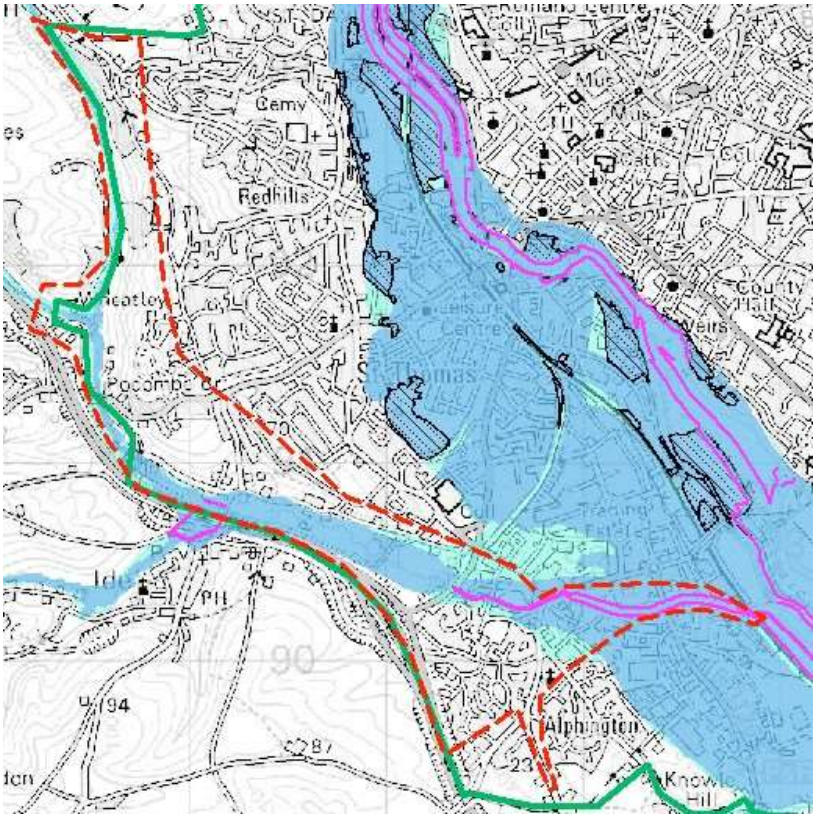
This area can be assessed separately from the area of Exeter that is potentially at risk from the River Exe due to the influence of St James Weir. This structure separates the river from the estuary by restricting the influence of the tide, as the tidal water below the weir is not expected to rise to the weir level in the foreseeable future.

The predicted impact of sea level rise due to potential effects of climate change could however result in significant consequences for the area below St James Weir. This is particularly relevant in Topsham where significant waterside development is anticipated to be subject to more frequent tidal inundation in the short to medium term (50 – 100 years).

A proposed flood alleviation scheme for Topsham which has been repeatedly promoted for a number of years has recently, once again, been postponed due to budget re-allocation.

7.3 Alphin Brook Catchment

The Alphin Brook drains a hilly catchment of approximately 28.5 km^2, situated to the west of Exeter. In its lower reaches it passes through the suburb of Alphington and the Marsh Barton industrial estate before discharging into the River Exe below the canal swingbridge. The Brook also caused severe flooding in 1960, particularly on the industrial estate where staff needed to evacuate buildings and even needed to be rescued from rooftops.



Map source: www.environment-agency.gov.uk and Exeter City Council 2008.

Key:

Flood zone 2 | Flood zone 3

Catchment boundary | Flood defences | Exeter boundary

It was decided to carry out the Alphin Brook Defence Scheme at the same time as the River Exe project. The scheme consists of 550 m of concrete lined channel running through the industrial estate. The flow then enters an earth flood channel via a silting basin. This carries the floodwater under a railway bridge and the Exeter bypass to discharge into Exminster Marshes. Alphin Brook Defence Scheme offers protection in excess of the 1 in 200 year event and has proved successful at protecting surrounding development from flooding since its construction. The defence, designed to keep high flows within the channel, has however caused some ponding to occur due to surface water not being able to drain into the watercourse on the northern

side of the defence just upstream of where the Brook passes under the railway line.

Alphin Brook catchment is generally rural, its tributaries extending to agricultural land beyond the western boundary of Exeter. The only significant urban section of the catchment is that to the south of the watercourse immediately upstream of its confluence with the Exe. The catchment is however relatively steep sided, which, whilst making the area generally unsuitable for significant development, indicates that it will react quickly to rainfall events making flood prediction and warning methods difficult.

7.4 Matford Brook Catchment

The Matford Brook is a minor watercourse that flows into the Exe to the south of the Alphin Brook. Its lower reaches are connected to a series of open drains and ditches that drain the low lying industrial/commercial area.

The Matford Brook is not considered to pose any significant flood risk to most of the lower catchment although a large proportion of the catchment is shown to be within the indicative floodplain. This floodplain has been derived assuming that the defences along the Alphin Brook and the Exe do not exist. As described in Section 7.3 the lower reaches of the Alphin Brook are contained within a flood channel that offers a standard of protection over and above a return period of 1 in 200 years. This is not to say that the catchment is not at risk from flooding. The Flood Zone 3b maps included in the GIS package illustrate that the southeast corner of the catchment remains at significant risk from flooding and should only be considered for limited types of development as described in Section 3.

Map source: www.environment-agency.gov.uk and Exeter City Council 2008.

Key:

Flood zone 2 | Flood zone 3

Catchment boundary | Flood defences | Exeter boundary

A significant proportion of the catchment within the Exeter City Council boundary is occupied by industrial/commercial units. The map included above, showing the section of the catchment within the Exeter City Council boundary outlined in red, shows that the higher area, outside of the indicative floodplain, is occupied by residential dwellings. The developed area within the indicative floodplain is occupied by industrial/commercial buildings. This is in line with guidance set out in Section 3, that steers development that is more vulnerable to flooding away from areas that are at a higher risk from flooding and, where there is a specific need, development that is less vulnerable towards areas with a higher risk of flooding.

The Flood Zone 3b maps indicate small sections of undeveloped land close to the industrial/commercial area that are outside of the Flood Zone. Any proposed development here should carefully consider its impact on the downstream drainage capacity.

7.5 Taddiford Brook Catchment

The Taddiford Brook watercourse rises south of Higher Hoopern Lane off Pennsylvania Road and passes predominantly through the grounds of Exeter University to New North Road. Crossing under the road, it then passes through the grounds of Elmside Nursery before being culverted for a considerable distance, from upstream of Bonhay Road to its outfall into the River Exe northwest of St Davids Station.

The Taddiford Brook catchment is small, steep and therefore responds quickly to rainfall events. This implies that, should flooding in the catchment occur, it will be during or immediately after an extreme rainfall event and will subside soon after the event finishes.

Although it is very close to the City centre a significant proportion of the catchment is undeveloped due to the green landscaped nature of Exeter University campus, which makes up a significant proportion of the catchment.

Map source: www.environment-agency.gov.uk and Exeter City Council 2008.

Key:

Flood zone 2 | Flood zone 3

Catchment boundary | Flood defences | Exeter boundary

7.5.1 Flooding incidents

Regular flooding is reported at the bottom of the catchment as the watercourse is channelled through a culvert underneath Greenslades Garage. This culvert extends underneath the railway and discharges into the Exe approximately 300 m downstream of the culvert inlet.

There are also reports of the highway flooding on the B3183, New North Road at the location where the stream passes underneath the highway.

7.5.2 Potential Development

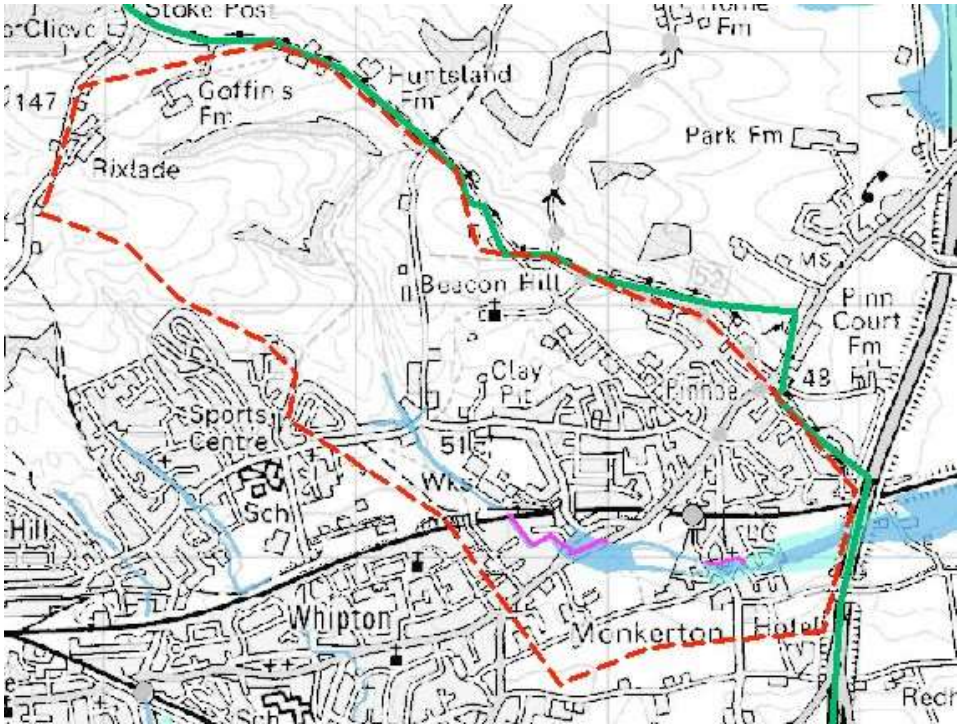
Since the catchment includes the main Exeter University campus, development at the University has the potential to significantly alter runoff characteristics.

The area in the Environment Agency Flood Zones 2 and 3, at the bottom of the catchment in the vicinity of St Davids Station, are generally densely developed at present. Any potential redevelopment in this area should take into account the combined effects of the Exe and the Taddiford Brook.

A site specific FRA for any proposed development in this catchment should carefully consider the downstream constrictions in order that flooding is not exacerbated at these locations.

7.6 Pin Brook Catchment

The Pinbrook Watercourse issues from a rural valley north of Beacon Lane. It drains along the eastern boundary of Exhibition Fields, then skirts around southwards below the former village of Pinhoe to Monkerton. Downstream it flows eastwards under the M5 motorway to the River Clyst. This watercourse has been subject to a flood alleviation scheme carried out during the 1980's.



Map source: www.environment-agency.gov.uk and Exeter City Council 2008.

Key:

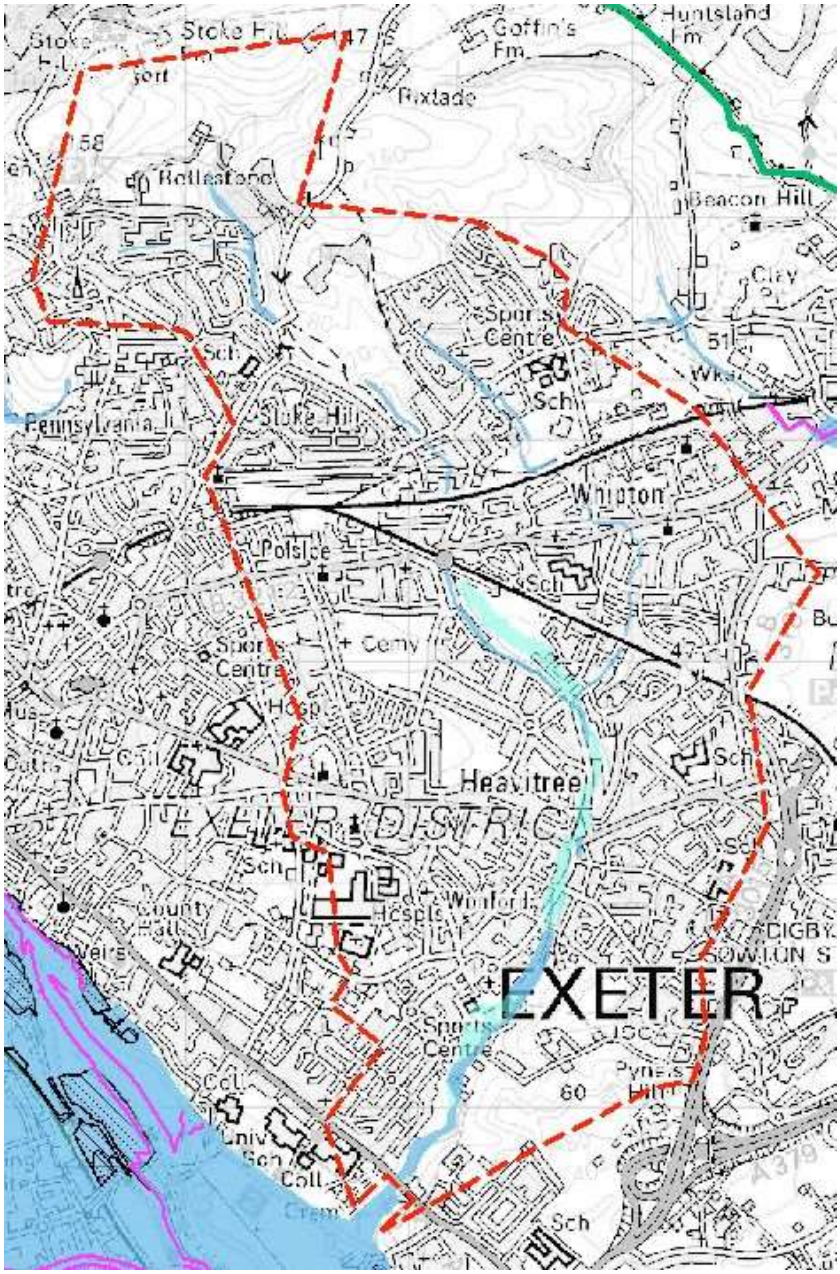
Flood zone 2 | Flood zone 3

Catchment boundary | Flood defences | Exeter boundary

The upstream area that feeds the Brook's upper tributaries is currently designated as an area of Landscape Setting and in some places a Site of Nature Conservation Importance in the Local Plan.

7.7 Northbrook Catchment

The Northbrook watercourse incorporates the Mincinglake Stream. This catchment extends from land north of Sylvania Park (Stoke Meadow Road) southwards to its outfall into the Mill Leat at Northbrook Park (off Topsham Road).



Map source: www.environment-agency.gov.uk and Exeter City Council 2008.

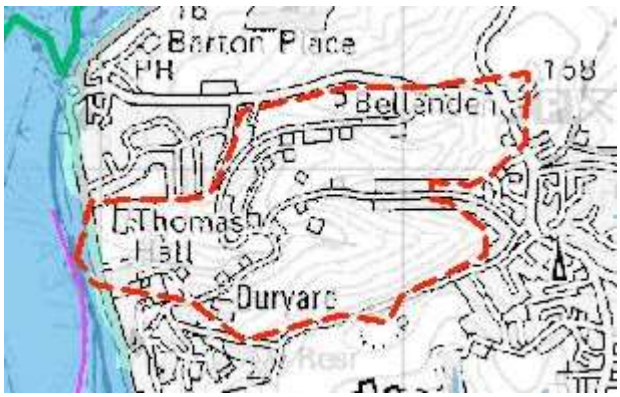
Key:

Flood zone 2 | Flood zone 3

Catchment boundary | Flood defences | Exeter boundary

The Northbrook encompassing its main tributary, the Mincinglake stream, is the largest natural watercourse system within Exeter and drains a large proportion of the mainly residential eastern areas of the City including Stoke Hill, Polsloe, Whipton, Heavitree, Wonford and St Loyes. Much of this area is also served by surface water sewers which generally discharge into this watercourse. The stream flows southwards to outfall into the Mill Leat at Northbrook Park off Topsham Road. The maintenance for this watercourse is generally the responsibility of the City Council as riparian owners of the land through which it flows. There is some history of flooding to properties within the Northbrook catchment arising from severe rainfall events.

7.8 University Brook Catchment



Map source: www.environment-agency.gov.uk and Exeter City Council 2008.

Key:

Flood zone 2 | Flood zone 3 | Catchment boundary | Flood defences | Exeter boundary

The majority of the catchment is classified as Valley Park and a site of Nature Conservation Importance according to the Local Plan. Should development take place, any drainage proposal should consider the potential consequences at downstream constrictions such as causing flooding at the entrance to culverts.

7.9 Longbrook & Larkbeare Catchments

The Longbrook Culvert arises south of Union Road off Prospect Park and flows south westwards to Exe Street where it discharges to the privately owned Higher Leat alongside Bonhay Road at the western end of Exe Street, formerly known as Engine Bridge. Much of this former watercourse now has a public sewer status and is the responsibility of South West Water Ltd, the local water company.

The Larkbeare Culvert arises in the northern end of Belmont Park off Blackboy Road, and heads generally southwards to the River Exe at the foot of Colleton Hill at the eastern end of the Quay. Similarly to the Longbrook Catchment, much of this former watercourse now has public sewer status and is also the responsibility of South West Water Ltd, the local water company.

Map source: www.environment-agency.gov.uk and Exeter City Council 2008.

Key:

Flood zone 2 | Flood zone 3

Catchment boundary | Flood defences | Exeter boundary

Since the catchments are almost entirely outside of the natural floodplain any flooding that does occur will be due to overloading of the urban drainage systems. Most development within the catchment is likely to be on previously developed land and therefore cause minimal changes to the overall runoff characteristics of the catchment. However, during the redevelopment process opportunities should be sought to improve runoff characteristics by attenuating flows to greenfield rates where appropriate. This would help to mitigate the anticipated increases in rainfall intensity due to climate change.

Development sites of less than 1 hectare in Flood Zone 1 would require no formal FRA. However discharge of surface water would have to be agreed with South West Water.

8 FLOODING FROM THE SEWERAGE SYSTEMS

The risk of flooding from sewerage systems within the catchment areas is generally the responsibility of the sewerage undertaker. In Exeter this is South West Water. Information on sewer flooding is therefore recorded and held

by them. The information is generally relatively sensitive as it often concerns private property.

South West Water has been consulted as part of the preparation of this report and their response is summarised below.

8.1 Flooding from sewers

South West Water has a register of DG5 properties that are known to be at risk of flooding from a storm event of less than 1 in 10 year return period. These properties are removed from the register by undertaking Capital work to remove the risk of flooding. This may include upsizing of pipes or providing storage at strategic locations in the system.

Water companies do not put DG5 property registers in the public domain as properties will have been bought and sold without new owners being aware that the property is at risk of flooding.

At present South West Water knows of only two properties in the Exeter catchment at risk of internal flooding due to hydraulic overload. They have also stated that there are planned works that should result in flooding issues being resolved at these properties by the end of 2007.

In relation to flooding due to other causes such as blockages, collapses and equipment failure, most sewered locations are at risk as these cannot be predicted with sufficient accuracy. South West Water has however identified hotspots where frequent problems occur. These are managed by proactive cleaning.

South West Water also have a number of key sites, such as Countess Wear treatment works and a number of pumping stations, where their fixed assets are known to be at risk of flooding should levels rise.

8.2 Groundwater

Ground water flooding occurs when water stored below ground reaches the surface. It does not have to occur near a river, or even when it is raining, and is often associated with porous ground such as sands, gravels, limestone and chalk. Groundwater flooding can take much longer to dissipate than other forms of flooding, as groundwater flow is much slower than surface flow, thus water levels take longer to fall.

Overall, ground water flooding within much of Exeter is not a major problem. However, it is a PPS 25 requirement that the potential effect of ground water flooding must be assessed in any FRA.

8.3 New development

For new development it is a requirement that, for sewers and drains being offered for adoption (they will become the responsibility of the sewerage undertaker), the system should be designed not to flood any part of the site in a 1 in 30 year return period design storm.

In designing the site sewerage and layout developers should also demonstrate flow paths and the potential effects of flooding resulting from storm events exceeding the design criteria.

The Environment Agency generally stipulate that flows should be dealt with within the site for events with a return period of up to 1 in 100 years, in a way that does not result in significant risk to users of the site or result in flooding of any buildings. This constraint is however only applicable if the proposal requires a FRA although in general it is expected that development sites that are significant enough to warrant the adoption of their drainage systems by the sewerage undertaker, are likely to be larger than 1 hectare and therefore require an FRA.

The requirement for developers to design sewerage systems that will contain 1 in 30 year rainfall events, and to provide flood routes for flows in excess, implies that significant overland flow will result should an event exceeding 1 in 30 years occur in sewered/urban areas. However, the required inclusion of proof of consideration of the destination of overland/exceedence flow with an application for adoption of a sewerage system suggests that the water company will ensure that the overland flow is not diverted towards areas particularly vulnerable to flood risk.

9 STRATEGIC FLOOD RISK ASSESSMENT TECHNICAL GUIDANCE FOR PLANNING OFFICERS AND DEVELOPERS

MAIN POINTS

- Government guidance exists to assist planning officers making decisions about land allocation in terms of flood risk.
- This has been used to provide guidance about the flood risk in Exeter City Boundary in particular.
- Guidance for developers undertaking site specific flood risk assessments is included in Appendix A.

9.1 General guidance

Included in Table 9.1 are a number of methods used to mitigate against flood risk together with a list of objectives that each measure aims to achieve. The following section also gives a brief description of each measure highlighting positive and negative attributes and how each can be used.

Table 9.1 – Applicability of mitigation measures to meet key sustainability objectives for new developments (Development and Flood Risk – Guidance for the Construction Industry, CIRIA, 2004)

Objective	Site selection	Development zoning	Raising floor levels	Land raising	Flood warning	Flood proofing	Design of channel and hydraulic structures	Flood defences	Developer contributions	Compensatory flood storage	Management of development runoff	Pumping
Reduce flood risk to development	■	■	●	■	●	●[2]	●	●	●	×	■	●
Manage surface water runoff	●	■[1]	×	×	×	×	×	×	●	×	■	●
Avoid increase in upstream flood risk	■	■	×	×	×	×	●	×	●	×[3]	×	●
Avoid increase in downstream flood risk	■	■	●	×	×	×	×	×	●	■	●	×

■ Often Acceptable ● Sometimes Acceptable × Not Applicable

1 Zoning can be used to provide flow paths for extreme events that exceed the capacity of the formal on-site drainage system.

2 Flood proofing is usually only acceptable as a secondary measure e.g. if used in association with raised floor levels, or to provide protection against an extreme flood event.

3 Land regarding as part of compensatory flood storage works may also in some situations improve conveyance within the system.

The Government aims to reduce the risks to people and the developed and natural environment from flooding by discouraging further built development within the floodplain. Government guidance has been produced for local planning authorities to help them when allocating land for development in order to meet this aim. This guidance is contained in PPS25; Development and Flood Risk.

Table 3.3 and associated guidance in Section 3 clearly indicates those types of development that are appropriate in areas of differing susceptibility to flooding. Section 3 also provides guidance as to whether a specific and detailed Flood Risk Assessment is required with a planning application, in order to be able to assess the suitability of the site for development.

9.2 Defences

Proposed development in or near areas where there is an existing flood defence must be closely examined in order to ensure that future development does not reduce the standard of protection provided by those defences for existing developments. It must be remembered that developments currently protected by defences would be at risk if those defences were to fail. Developments built behind existing defences should take into account the residual risk of being overtopped or breached, resulting in fast flowing and deep water flooding. Planning authorities must remember when drafting Local Development Documents (LDDs), and considering planning applications, that the Environment Agency is not obliged to maintain defences.

It should also not be assumed that the standard of protection provided by the defence is still as quoted when it was designed. Changes in flood estimation procedures and allowances for climate change can mean that the standard of protection may have decreased. It is very important that this is investigated during a flood risk assessment to ensure that existing and new development has the appropriate level of protection; for the 1% probability flood (1 in 100 year standard) for protection from river flooding and the 0.5% probability flood (1 in 200 year standard) for protection from flooding from the sea.

9.3 Surface water runoff and Sustainable Drainage Systems (SuDS)

Surface water flooding happens usually as a result of very heavy rain, when the water cannot soak into the ground or find its way into drains. This type of flooding can happen away from rivers, such as water flowing off fields or along roads. It can be a particular problem in urban areas where there is little grass and lots of roads, pavements and driveways.

Flood risk from surface water flooding is of concern within the study area. A number of flood incidents have occurred within the area caused by surface water alone, or in combination with river flooding. The Environment Agency Flood Maps do not show flood risk due to surface water flooding.

Any change in land use will result in a change to the runoff which is generated from that site. In order to meet PPS 25 considerations, the effect of this change in runoff must be quantified and investigated in order to gauge any potential affect on flood risk from surface water within the development site itself and in the off-site vicinity. Where surface water runoff could be increased, this must be dealt with using Sustainable Drainage Systems (SUDS). The general principle of PPS 25 is that the amount and rate of water flowing off the site must not change from the situation before it is developed. However an allowance for climate change should be considered when calculating peak surface water runoff.

In order to promote sustainability, surface water should be discharged in a way that most closely replicates that which would occur naturally. This approach is summarised in The Building Regulations H – Section 3.2:

- Surface water drainage should discharge to a soakaway or other infiltration where practicable.
- Discharge to a watercourse may require a consent from the Environment Agency, who may limit the rate of discharge. Maximum flow rates can be limited by provision of detention basins.
- Where other forms of outlet are not practicable, discharge should be made to a sewer.

SUDS are techniques designed to control surface water runoff before it enters the watercourse and to mimic natural drainage processes. In addition they can treat the water to reduce the amount of pollutants entering the watercourse. These techniques can be implemented at all scales and in most urban settings.

PPS25 recommends that partnerships are set up between significant stakeholders such as the Environment Agency, the Local Authority and South West Water to assist in the implementation of the strategy to deal with surface water runoff at source. For example, since South West Water are not obliged to adopt SuDS they could enforce restrictions on the discharge of surface water to their sewers in order to force developers to implement and take responsibility for SuDS.

9.4 Flood warning and evacuation procedures

Within the study area, as for the rest of England and Wales, the responsibility for flood warning rests with the Environment Agency. The Environment Agency provides flood warnings for designated flood warning areas. Within the study area the designated flood warning areas are as follows:

Table 9.4 Flood Warning Areas

Watercourse / coastline	Flood Warning Area	Quickdial Number
River Clyst	River Clyst	162079
Exe Estuary (Tidal)	South Devon Coast from Dawlish Warren to Lyme Regis, including the Exe Estuary	162115
River Exe	River Exe (Lower) at Exeter	162069

The Environment Agency provides an indirect and direct flood warning system. The indirect system is based around the Floodline dial-up-and-listen service and the internet, where members of the public and other parties can obtain current flood warning information for their area. The Floodline number is 0845 988 1188 and the website address is www.environment-agency.gov.uk/subjects/flood/floodwarning/. Flood warnings are also broadcast by television and radio services.

The direct warning service requires people in at risk properties to register their telephone number with the Environment Agency. They can then receive automatic warning messages if a flood is likely.

Flood evacuation planning and major flood response arrangements are included in the Exeter Major Incident Plan maintained by the City Council.

Applicants for any development which takes place in Environment Agency Flood Zone 3, which is in an existing designated flood warning area, should acknowledge and take into account the possibility that new property owners may wish to receive direct flood warnings. Discussions should be held as part of the FRA process with the Environment Agency about how to communicate the availability of this service.

Applicants for any proposed development which takes place in Environment Agency Flood Zone 3, which is not in an existing designated flood warning area, should assess the potential for such a service in conjunction with the Environment Agency and make provisions for such within any FRA, in order to meet PPS 25 requirements.

Safety and evacuation procedures should also be addressed for developments within Environment Agency Flood Zone 3 and for civil infrastructure within Flood Zone 2 such as schools and hospitals. Provisions such as refuges, and dry access routes (above predicted extreme floodwater levels) from sites should be incorporated into the design of such sites. Access for emergency vehicles may also need to be considered depending on the proposed use.

Any major development within the urban areas with an existing Major Incident Plan in Exeter should consider the impact of new development on the existing plan. It should be ensured that the procedures can be applied to the new development or modified if necessary, in conjunction with Exeter City Council and the Environment Agency.

9.5 Responsibilities

There is no general statutory duty on the Government to protect land or property against flooding. But the Government recognises the need for action to be taken to safeguard the wider social and economic wellbeing of the country, including adapting to the impacts of climate change. Operating authorities (see Annex H) have permissive powers but not a statutory duty to carry out or maintain flood defence works in the public interest.

9.5.1 The Owner/Developer

Landowners have the primary responsibility for safeguarding their land and other property against natural hazards such as flooding. Individual property owners and users are also responsible for managing the drainage of their land in such a way as to prevent, as far as is reasonably practicable, adverse impacts on neighbouring land. Those proposing development are responsible for;

- Demonstrating that it is consistent with the policies in PPS 25 and those on flood risk in the Local Plan/Local Development Framework.
- Providing a FRA demonstrating:
  - Whether any proposed development is likely to be affected by current or future flooding from any source
  - Satisfying the LPA that the development is safe and where possible reduces flood risk overall
  - Whether it will increase flood risk elsewhere
  - The measures proposed to deal with these effects and risks. Any necessary flood risk management measures should be sufficiently funded to ensure that the site can be developed and occupied safely throughout its proposed lifetime
- Designs which reduce flood risk to the development and elsewhere, by incorporating sustainable drainage systems and, where necessary, flood resilience measures
- Identifying opportunities to reduce flood risk, enhance biodiversity and amenity, protect the historic environment and seek collective solutions to managing flood risk

These matters can affect the value of land, the cost of developing it and the cost of its future management and use. They should be considered as early as possible in preparing development proposals.

9.5.2 The Regional Planning Body (RPB)

The RPB should take flood risk into account in determining strategic planning considerations for its region, including the criteria to be used for selecting and determining broad strategic locations for housing provision and transport infrastructure.

9.5.3 The Local Planning Authority (LPA)

LPAs should consult the Environment Agency and other relevant bodies (including adjacent LPAs) when preparing policies on flood risk management and in relation to areas potentially identified as at risk of flooding. Their sustainability appraisals, land allocations and development control policies should all be informed by a SFRA carried out in liaison with the Environment Agency.

Following the coming into force, on 1 October 2006, of the amendment to Article 10 of The Town and Country Planning (General Development Procedure) Order 1995, LPAs are required to consult the Environment Agency on all applications for development in flood risk areas (except minor development), including those in areas with critical drainage problems and for any development on land exceeding 1 hectare outside flood risk areas. Where the Environment Agency (or other organisations) object to an application on flood risk grounds, but the LPA considers that it should be approved, the LPA should contact the Environment Agency (or the other consultees if appropriate) to allow discussion of the case and the opportunity for further representations or comments to be made. LPAs, advised by the Environment Agency and other relevant organisations, should determine applications for planning permission taking account of all material considerations, including the issue of flood risk, the FRA prepared by the developer (when required) and proposals for reducing or managing that risk.

If the Environment Agency objects to an application for major development on flood risk grounds, all parties (the LPA, the Environment Agency and the applicant) should discuss and agree the course of action that would need to be taken to enable the Environment Agency to withdraw its objection. There should be effective on-going liaison so that each party is aware at all stages in the process of the position of the others with regard to the application.

If, after discussions, it becomes clear that the Environment Agency is unable to withdraw its objection, but the LPA remains minded to approve an application for major development, the Town and Country Planning (Flooding) (England) Direction 2007 requires the LPA to notify the Secretary of State of the proposal. This provides the Secretary of State with an opportunity to check the application's general compliance with the policies in this PPS and to consider whether it would be appropriate to call it in for determination. The Secretary of State would wish to be assured in

considering such cases that all reasonable steps have been taken by the LPA, the Environment Agency and the applicant through discussions to consider ways in which the application might have been amended, or additional information provided, which would have allowed the Environment Agency's objection to be withdrawn.

LPAs should notify the Environment Agency of the outcome of all planning applications for development in flood risk areas, including those for major development. Other organisations that have been consulted, such as Internal Drainage Boards (IDBs), should be notified where conditions attached to planning permissions may affect their area of concern, such as local drainage.

9.5.4 The Environment Agency

The Environment Agency has statutory responsibility for flood management and defence in England and will support the planning system by providing timely information and advice on flooding issues that is fit for purpose. At a strategic level, it provides advice on the preparation of RFRAs and SFRAs. It is a statutory consultation body for strategic environmental assessment and sustainability appraisal, for planning applications and for environmental impact assessment. It also provides advice to those proposing developments and undertaking FRAs.

The Environment Agency will be consulted by local planning authorities on all applications for development in flood risk areas and should contribute to their consideration by providing advice.

9.5.5 Working in Constructive Partnership

There should be early consideration of flood risk in the formulation of Regional Spatial Strategies, Local Development Documents and proposals for development by regional planning bodies, local planning authorities, the Environment Agency, other stakeholders and developers. This should identify opportunities for development of infrastructure that offers wider sustainability benefits. These include dual use i.e. flood storage and recreation and realising cost effective solutions for the reduction and management of flood risk. Consultation should also identify flood risk problems that will need to be addressed.

Proposers of development which may be affected by, or may add to, flood risk should arrange pre-application discussions with the LPA and the Environment Agency and, where relevant, other bodies such as Internal Drainage Boards, sewerage undertakers, highways authorities and reservoir owners and operators. Such discussions should identify the likelihood and possible extent and nature of the flood risk, to assist in scoping the FRA and identify the information that will be required by the LPA to reach a decision on the application when it is submitted. LPAs should advise intending

developers to undertake these steps where they appear necessary, but have not yet been addressed.

10 RECOMMENDATIONS AND CONCLUSIONS

MAIN POINTS

- Every application for development must be considered by planning officers in terms of its potential flood risk.
- It is the developer's responsibility to provide a site specific Flood Risk Assessment in accordance with the requirements of PPS 25.
- All site specific Flood Risk Assessments must be considered by the Environment Agency as part of the planning consultation process.
- By using this Strategic Flood Risk Assessment, in combination with site specific Flood Risk Assessments if necessary, it is possible to restrict new development in places that are at high risk of flooding; and to direct proposed development, including that in the Local Development Frameworks, towards areas of lower risk.

10.1 Recommendations

1) Every application for development, or change of land use, must be considered by planning officers in terms of its potential flood risk. This is because:

   a) There are many potential sources of flood risk within Exeter surface water runoff, ground water, rivers and the sea.
   b) All areas within Exeter have the potential to be at risk of flooding from at least one of these sources, or have the potential to increase flood risk elsewhere.
   c) Although a site may already be developed, a proposed change in land use may not be suitable for that site, or may increase flood risk elsewhere.
   d) Climate change is anticipated to cause an increase in overall flood risk. Land should be allocated today in a way, which will be sustainable in the future.
   e) Where development is proposed behind existing flood defences it should not be assumed that the standard of protection originally designed for is the same as what would be used today. This is due to updated flood estimation techniques, as well as allowances for the predicted impacts of climate change.

2) Planning officers can consider potential flood risk by using the GIS package.

3) If the site has potential flood risk, the relevant guidance described in Section 3 of this report should then be used to test whether the land is suitable for the development proposed, and if so, whether a site specific

Flood Risk Assessment, to be completed by the developer, is required to accompany a planning application.

4) If it is found that a site specific Flood Risk Assessment is required, this must be submitted with the planning application. Planning officers, developers and the general public should now consult the FRA guidance. The SFRA technical guidance should also be specifically considered in assessing Flood Risk Assessments in Exeter.

5) All site specific Flood Risk Assessments must be considered as part of the planning consultation process. It is recommended that Environment Agency advice be applied wherever possible.

6) Land that is found to be unsuitable for one type of development due to flood risk may still be suitable for other types of uses, for example environmental and recreational areas. Guidance contained in PPS25 can be used to suggest suitable alternative land uses.

7) The data and information contained within this SRFA constitutes the best available data at the time of writing. Some datasets within the GIS package are periodically updated. It is advised that Exeter City Council update their GIS package accordingly, to ensure that decisions are made using the best available data at all times.

8) The Strategic Flood Risk Assessment should be used in testing general locations for strategic growth and site specific allocations in the Local Development Frameworks being produced by the Local Planning Authorities. This includes investigating the impact of proposals for new development in the vicinity of, and particularly upstream of, areas sensitive to flooding and where there have been past flood events.

9) The Local Development Framework, through its policies, justification and proposals, should make clear the implications for development and regeneration particularly regarding town centres in areas of high flood risk, including where there is risk of rapid inundation. This will need to reflect any programmes and proposals, or otherwise, for providing or improving flood defences.

10) The Local Development Framework policies controlling development in flood risk areas should reflect the guidance in this SFRA. They may in future require amendments if the SFRA is updated, reflecting those updates.

10.2 Conclusion

Leaving space for natural flooding without causing losses to people or property is very important. In the future, it is likely that flooding could occur more frequently and more severely due to climate change.

Flooding is an important issue that must not be ignored. By using this SFRA, in combination with site specific Flood Risk Assessments submitted with planning applications for development or change of use, it is possible to allocate land for development in a sustainable way. This could mean for example, restricting new housing developments in areas at an unacceptable risk of flooding and guiding them towards areas of lower risk. It also means that areas at high risk of flooding can be developed in a way which means that rivers can behave in a natural way, for example by maintaining or improving functional floodplain.

This Strategic Flood Risk Assessment will assist Exeter City Council in meeting the government guidelines contained within PPS25 and will contribute towards allocating land for development in a sustainable manner.

GLOSSARY OF TERMS

Catchment	The area contributing surface water flow to a point on a drainage or river system (the area drained by that river, including areas away from the watercourse network). Can be divided into sub-catchments.
Coastal Cell	A subdivision of the coast based on the movement of coarse sediments from source through areas of transport to areas of deposition
DG5-properties	Properties that are at risk of internal flooding due to overloading of sewerage systems.
EA Flood Zone 1	Little or no risk
EA Flood Zone 2	Low to medium risk. Probability of fluvial flooding is 0.1 – 1% and probability of tidal flooding is 0.1 – 0.5%
EA Flood Zone 3	High risk of flooding. Probability of fluvial flooding is 1% or greater and probability of tidal flooding is 0.5% or greater.
EA Flood Zone 3a	Developed areas of Flood Zone 3.
EA Flood Zone 3b	Functional Floodplain
Environment Agency (EA)	Non-departmental public body responsible for the delivery of government policy relating to the environment and flood risk management in England and Wales.
Flood Defence	A structure (or system of structures) for the alleviation of flooding from rivers or the sea.
Flood Estimation Handbook	The Environment Agency approved method of estimating flood flows in the UK.
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 Assessment	Considerations of the flood risks inherent in a project, leading to the development of actions to control, mitigate or accept them.
Floodplain	Any area of land over which water flows or is stored during a flood event, or would flow but for the presence of flood defences.
Fluvial	Pertaining to a watercourse (river or stream).
Functional Floodplain	This Zone (Flood Zone 3b) comprises land where water has to flow or be stored in times of flood, with an annual probability of 1 in 20 years (5%) or greater.
GIS	Geographical Information System. A computer-based system for capturing, storing, checking, integrating, manipulating, analysing and displaying data that is spatially referenced.

Groundwater	Water occurring below ground in natural formations (typically rocks, gravels and sand).
HEC RAS	Hydraulic modelling software.
Hydraulic model	A computerised model of a watercourse and floodplain to simulate water flows in rivers to estimate water levels and flood extents.
Lagoon	A pond designed for the settlement of suspended solids or storage of excess river flow.
Main River	Watercourses defined on a 'Main River Map' designated by DEFRA. The Environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only.
Potential Flood Risk Area	The possible extent of flooding along watercourses that have not been covered by the Environment Agency Flood Zones.
PPS 25	Planning Policy Statement 25 for Development and Flood Risk.
Probability	The likelihood of an event occurring.
Return Period	The average time period between rainfall or flood events with the same intensity and effect.
Standard of protection	The level of flood that a defence is designed to protect against before it is outflanked or overwhelmed.
Surface Water Runoff	Water flowing over the ground surface to the drainage system. This occurs if the ground is impermeable, is saturated or if rainfall is particularly intense.
Sustainable Drainage Systems (SUDS)	A sequence of management practices and control structures designed to drain surface water in a more sustainable fashion than some conventional techniques.
Topography	The shape and form of the land, in terms of hills, steepness of slopes, or flat land

11 REFERENCES

- *Guidance Flood Risk Management, Strategic Flood Risk Assessments*, (2005), Environment Agency

- *Planning Policy Statement 25, Development and Flood Risk, (December 2006),* DC&LG

- Development and Flood Risk: A Practice Guide Companion to PPS 25 'Living Draft' (Feb 2007), DC&LG
- Lobley, R, *Strategic Flood Risk Assessments,* Environment Agency

- www.ciria.org/flooding/reducing_the_impact.htm

- www.ciria.org/suds

- www.environment-agency.gov.uk

- Environment Agency Catchment Flood Management Plans - Exe Scoping Report
- The source for all mapping in this document is Environment Agency Flood Mapping CD-Rom July 2007 edition and the Environment Agency website as noted underneath every map. Flood zone 2 and Flood zone 3 were updated in March 2008 from the latest edition of the EA Flood Mapping CD-Rom. The catchment boundaries were created for this SFRA by Pell Frischmann on behalf of Exeter City Council.
- The mapping for Flood zone 3b and Flood defences were provided by Environment Agency in May 2007.
- The sources for all mapping on the enclosed CD-Rom are Ordnance Survey, Environment Agency, Exeter City Council.
- www.exetermemories.co.uk

APPENDIX A - FRA General Requirements

The detail of any specific flood risk report will vary to reflect the relative scale and importance of the study. However, it should, as a guide, address the following requirements:

- A location plan at an appropriate scale that includes geographical features, street names and identifies all watercourses or other bodies of water in the vicinity. This should include drainage outfalls and, if necessary, cross-refer to their operational arrangements in the body of the report.

- An analysis of the Flood Zone within which the proposed development site lies; this will indicate whether a Sequential and Exception Test will need to be prepared to accompany the flood risk assessment.

- A plan of the site showing levels related to Ordnance Datum, both current and following development.

- A more detailed indication, if appropriate, of flood alleviation measures already in place, of their state of maintenance and their performance.

- An assessment of the source of potential flooding - rivers, tidal, coastal, groundwater, surface flow or any combination of these.

- A plan of the site showing any existing information on extent and depth of flood events or on flood predictions. Information may be anecdotal, photographic, survey results or model estimates. The events should be identified with date/time, source of the data and supporting information provided on rainfall and/or return period, or probability of occurrence of the flood or storm surge event, or combination. Recorded data are particularly valuable and, if available, should be highlighted along with evidence of any observed trends in flood occurrence. Any changes that have taken place since the last event should be identified.

- A plan and description of any structures which may influence local hydraulics. This will include bridges, pipes/ducts crossing the watercourse, culverts, screens, embankments or walls, overgrown or collapsing channels and their likelihood to choke with debris.

- An assessment of the probabilities and any observed trends and the extent and depth of floods for the location and in the catchment context and, if appropriate, routes and speed of water flow. At this stage best estimates, based on the most up-to-date findings, should also be made of climate change impacts on probabilities. The assessment should ensure that the development meets an

acceptable standard of flood defence for the design life of the development.

- A cross-section of the site showing finished floor levels or road levels, or other relevant levels relative to the source of flooding, and to anticipated water levels and associated probabilities

- An assessment of the likely rate or speed with which flooding might occur, the order in which various parts of the location or site might flood, the likely duration of flood events and the economic, social and environmental consequences/impacts of flooding.

- An assessment of the hydraulics of any drains or sewers, existing or proposed, on the site during flood events. The methodology for assessment must be clearly stated.

- An estimate of the volume of water which would be displaced from the site for various flood levels following development of the site and of the run-off likely to be generated from the development proposed.

- An assessment of the likely impact of any displaced water on neighbouring or other locations which might be affected subsequent to development. This should address the potential for change of the flooding regime both upstream and downstream of the site due to ground raising or flood embankments.

- An assessment of the potential impact of any development on fluvial or coastal morphology and the likely longer-term stability and sustainability.

- Because of the uncertainties in flood estimation and expected climate change impacts, hydrological analysis of flood flows and definition of defence standards should include the allowances for increased flows and sea-level rise as set out in PPS 25 and Section 5.3 of this report.

- An assessment of the residual risks after the construction of any necessary defences. Where new or modified flood defence arrangements are provided, consideration should always be given to their behaviour in extreme events greater than those for which they are designed and information should be provided on the consideration given to minimising risks to life in such circumstances.

APPENDIX B – Sustainability Drivers

Annex D of PPS25 includes three requirements of a development in order for the Exception Test to be passed. The first of which states, 'It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by an SFRA where one has been prepared'.

In response to this, the following list of sustainability drivers has been compiled that will enable the FRA to demonstrate, in accordance with the above, the wider sustainability requirements as required:

1. To ensure everyone has the opportunity of a decent home.

2. To ensure that all groups of the population have access to the services that are required, in terms of the number of facilities and being able to reach them.

3. To provide for education, skills and lifelong learning to:
    a. meet the needs of the local population; and
    b. meet local employment needs.

4. To improve the population's health.

5. To reduce crime and fear of crime.

6. To reduce noise levels.

7. To maintain and improve cultural, social and leisure provision.

8. To maintain and enhance built and historic assets.

9. To promote the conservation and wise use of land and protect and enhance the landscape character of the City.

10. To maintain the local amenity, quality and character of the local environment.

11. To conserve and enhance the biodiversity of the City.

12. To reduce the level in growth of car usage.

13. To maintain a high quality environment in terms of air, soil and water quality.

14. To contribute towards a reduction in local emissions of greenhouse gases.

15. To ensure that there is no increase in the risk of flooding.

16. To ensure energy consumption is as efficient as possible.

17. To promote wise use of waste resources whilst reducing waste production and disposal.

18. To maintain sustainable growth of employment for the City, to match levels of jobs with the economically active workforce.

19. To maintain and enhance the vitality and viability of the City Centre.

20. To encourage and accommodate both indigenous and inward investment.