Ryedale DC,
Scarborough BC and
North York Moors NPA

North East Yorkshire SFRA

SFRA (PPS25 Update)

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Introduction

Arup was appointed by Ryedale District Council (RDC), Scarborough Borough Council (SBC), and North York Moors National Park Authority (NYMPA) to prepare a Strategic Flood Risk Assessment (SFRA) for their administrative areas (collectively known as Northeast Yorkshire). This report has been prepared to comply with Planning Policy Statement 25 (PPS25) under the guidance of a Steering Committee, comprising representatives of the above bodies and the Environment Agency. The SFRA is an update to the previous Northeast Yorkshire SFRA which was compliant with PPG25. The report constitutes a Level 1 SFRA as defined by PPS25.

The SFRA assesses the different levels of flood risk in Northeast Yorkshire and maps these to assist with statutory land use planning. It provides concise information on flood risk issues throughout Northeast Yorkshire which will assist planners in the preparation of their Local Development Documents and in the assessment of future planning applications. It is also intended that this document may be used by the general public and those wishing to propose developments, as a guide to the approach that Local Planning Authorities will follow in order to take flood risk issues into account in a sustainable manner.

Planning Policy Statement 25: Development and Flood Risk (PPS25) was published by the Department of Communities and Local Government (DCLG) in 2006. PPS25 requires flood risk to be taken into account at all stages of the planning process to avoid inappropriate developments. In accordance with the precautionary principle a sequential approach is recommended, which should lead to new development being located in the areas at lowest risk of flooding wherever possible. PPS25 requires that local planning authorities apply the sequential approach, review their planned land allocations against the flood-risk guidance and develop appropriate policies in relation to flood risk. The SFRA has been produced to assist Northeast Yorkshire meet the requirements of PPS25.

The study reports the result of:

- A review of existing planning policy guidance on development and flood risk;
- Use of the Environment Agency Flood Map to identify fluvial and coastal flood risk, supplemented by a review of existing detailed flood appraisal reports;
- Consultation and review of existing reports to identify areas at risk of surface water, groundwater and/or sewer flooding, and mapping of the general areas where such flooding is most likely to occur;
- Identification of locations which are sensitive to a change in runoff rates and volumes, and identification of Critical Drainage Areas;
- Delineation of Flood Zone 3 as defined in PPS25;
- Identification of the location and standard of flood defences, and the areas protected by these flood defences;
- Description of flood risk issues and provision of relevant planning guidance within settlements expected to come under future development pressure (key settlements);
- Assessment of rapid inundation zones in selected key settlements protected by flood defences;
- Mapping of expected flood depths in selected key settlements;
- Development of policy recommendations to enable the local planning authorities to apply the Sequential Test within Northeast Yorkshire;
- Development of guidance to assist development control within Northeast Yorkshire;
- Provision of guidance on Sustainable Drainage and Land Use Management within Northeast Yorkshire.

Overview of flood risk issues within Northeast Yorkshire

The majority of Northeast Yorkshire lies within the catchment areas of two main rivers, the River Derwent and the River Esk. Widespread flooding has previously occurred on numerous occasions along the River Derwent and its tributaries, and the Sleights to Whitby River Esk corridor. Tidal flooding has been reported to occur on a relatively regular basis in the South Bay area of

Scarborough, Sandsend, and Whitby. Surface runoff flooding has been identified as a significant potential source of flood risk. Local flooding (from groundwater and/or overland flow) has also been reported and groundwater flooding incidents have been reported around Malton and Norton. Sewer flooding incidents have been reported in a significant number of settlements.

A qualitative approach has been applied to the assessment of the potential implications of climate change to settlement areas. An appraisal has been made, based on topographical data and the existing Flood Zones, as to the relative sensitivity of key settlements to increased water levels arising from climate change.

Mapping hazards within Northeast Yorkshire

One of the key objectives of the SFRA was to map flood hazards throughout Northeast Yorkshire to assist in the spatial planning process. PPS25 divides all land into four principal flood zones for fluvial and coastal flooding (see table below).

PPS25 Flood Zones and degree of flood risk.

Flood Zone	Annual probability of flooding[1]	
1	Low Probability (Less than 0.1%)	
2	Medium Probability	River: 0.1-1%
		Tidal & Coastal: 0.1-0.5%
3a	High Probability	River: 1% or greater
		Tidal & Coastal: 0.5% or greater
3b	Functional Floodplain	Land to provide flood storage or conveyance

These zones form the basis for the application of the Sequential Test as recommended by PPS25 and as such their appropriate delineation is an important part of the SFRA process. The distribution of these flood zones throughout Northeast Yorkshire has been mapped using the Environment Agency Flood Map and Ordnance Survey data.

In addition to mapping the extent of flooding, flood depth mapping has also been undertaken in four settlements within Northeast Yorkshire: Malton, Norton, Pickering, and Whitby. Flood depths have been generated using the results of existing modelling studies and Environment Agency Lidar (aerial survey) data. The estimated flood depths in Malton and Norton are those that would occur should the flood defences fail. As part of this study the impact of potential flood defence failure has been assessed by mapping Rapid Inundation Zones for Malton, Norton and Old Malton. Hazard zones have been used to indicate the degree of risk posed to people by the flood velocities and depths which could occur should the flood defences protecting these settlements fail[2].

Within Northeast Yorkshire four zones have been identified where incidents of surface runoff flooding or surface runoff and/or groundwater flooding appear to be particularly prevalent. This information has been supplemented by 'Areas Susceptible to Surface Water Flooding' indicative flood extents. In certain locations throughout Northeast Yorkshire an increase in the volume or rate of runoff from a site may significantly increase the degree of flood risk in locations which are particularly sensitive to such changes. These Critical Drainage Areas have been identified and mapped within the SFRA.

[1] Flood probability is defined by the annual probability of exceedance of a flood event. A 0.1% annual probability event will be equalled or exceeded once every thousand years on average (a return period of 1 in 1000 years). A 0.5% annual probability event has an average return period of 1 in 200 years. A 1% annual probability event has an average return period of 1 in 100 years.

[2] Extreme, Significant and Moderate Hazards relate to the potential for a flood defence breach to cause danger to all people, most people and some people, respectively. See Section 6.3.2 for further details

The Forward Planning departments at RDC and SBC have outlined those broad locations where future development is likely to be focused. Flood risk issues within these key settlements have been described in more detail within the SFRA. Following identification and mapping of flood risk issues within Northeast Yorkshire, guidance has been developed to assist planners with the implementation of PPS25 in Northeast Yorkshire.

Policy Recommendations for Forward Planning in Northeast Yorkshire

PPS25 Flood Zone 3a is defined as those areas with a high probability of flooding of greater than 1% for fluvial flooding or 0.5% for tidal flooding[3] and which are **not** Functional Floodplain. For the purposes of this SFRA three different policies have been developed for Zone 3a, depending on the standard of protection provided by existing flood defences, if any (see Table below).

As part of the preparation of the Local Development Framework, site allocations must be made to identify areas where major developments are expected. In order to assist planners within Northeast Yorkshire a series of policy recommendations have been developed to provide advice on the practical implementation of PPS25 policy. Similar guidance has also been developed for those areas at risk of groundwater and/or surface water flooding. This guidance, together with the Flood Zone maps and descriptions of key settlements, can be used to assist in the site allocation process.

Flood Zone 3 Sub-Zone Descriptions.

SFRA Sub-Zone	Sub-Zone Description
3a(i)	Applicable for those developed areas at high risk of flooding which are not currently defended to an appropriate minimum standard as defined by Defra.
3a(ii)	Applicable for those developed areas at high risk of flooding which are currently defended to the appropriate minimum standard as defined by PPS25 (annual probability of 1% for fluvial flooding and 0.5% for flooding from the sea).
3a(iii)	Applicable for those developed areas at high risk of flooding which are currently defended to the appropriate minimum standard for existing development as defined by Defra (annual probability of 2% for fluvial flooding and 1 % for flooding from the sea) but are not defended to the appropriate minimum standard for new development as defined by PPS25 (annual probability of 1% for fluvial flooding and 0.5% for flooding from the sea).

Guidance for Development Control in Northeast Yorkshire

In order to assist both planners and developers within Northeast Yorkshire, guidance has been developed as part of the SFRA to provide advice on the practical implementation of PPS25 when considering a particular development site. This guidance, together with the Flood Zone maps and descriptions of the issues in key settlements, can be used in conjunction with the Flood Risk Assessment prepared by a developer to assess whether new development is likely to be acceptable on flood risk grounds.

Rural Land Management

Guidance has been provided on good land management practices which may be employed to manage flood risk within Northeast Yorkshire. These practices range from changing the way in which land is managed (e.g. avoiding cultivation of wet soil can reduce soil compaction, increasing infiltration of rainfall into the soil and reducing surface runoff) to changing the use of the land itself (e.g. reversion of arable land to grassland, wetland creation).

[3] For simplicity the standard of protection for fluvial flooding has been quoted. For sites at risk of flooding from the sea "1%" should be replaced by "0.5%".

1 Introduction

1.1 Background

Arup was appointed by Ryedale District Council, Scarborough Borough Council and North York Moors National Park Authority (henceforth referred to as Northeast Yorkshire) to prepare a Strategic Flood Risk Assessment (SFRA) for Northeast Yorkshire.

1.2 Report context

In March 2006 the 'Northeast Yorkshire Strategic Flood Risk Assessment'[4], which addressed the requirements of Planning Policy Guidance 25 (PPG25), the planning policy which addressed flood risk at the time, was issued. In December 2006 Planning Policy Statement 25 *Development and Flood Risk* (PPS25) was released which replaced PPG25.

Subsequently, Northeast Yorkshire commissioned Arup to update the Northeast Yorkshire SFRA from PPG25 to PPS25 compliance. Whilst this report takes into account any recent flood-related information, as well as addressing the particular requirements of PPS25, it remains an update of the previous report. For this reason much of the structure and content of the PPG25 SFRA has been retained. The title of the updated document shall be 'Northeast Yorkshire SFRA (PPS25 Update)'.

1.3 Strategic Flood Risk Assessment and target audience

The SFRA assesses the different levels of flood risk in Northeast Yorkshire and maps these to assist with statutory land use planning. It provides concise information on flood risk issues throughout Northeast Yorkshire which will assist planners in the preparation of their Local Development Framework, by enabling informed decisions to be made on site allocation using the Sequential and, if required, Exception tests as set out by PPS25. It also assists in the assessment of future planning applications. The scope and key outputs of this study include:

- an overview of flood risk issues within Northeast Yorkshire;
- an overview of the Sequential and Exception Tests;
- maps of PPS25 flood zones and other areas at risk of flooding within Northeast Yorkshire, including variations in actual flood risk within an area;
- an assessment of the potential increase due to climate change and the impact on key settlements;
- an overview of flood risk issues, including the impact of historic events, within and around key settlements within Northeast Yorkshire;
- recommended policies for forward planning;
- recommended guidance for development control, including the measures that will need to take place to make development acceptable;
- recommended policies for the implementation of sustainable drainage systems;
- guidance on the requirements for appropriate Flood Risk Assessment;
- guidance on appropriate flood risk control and mitigation measures;
- assessment of the standard of existing defences, the potential effect of the failure of these defences, and the extent and cost of works to raise the defence standard;
- recommendations for land use management within Northeast Yorkshire.

[4] Northeast Yorkshire Strategic Flood Risk Assessment, Arup (2006).

This document is intended to be used primarily by Local Planning Authority staff, particularly those involved in Forward Planning. It is intended that this document provides guidance which is consistent with current Local Planning Authority and Environment Agency policies and procedures. It is also intended that this document may be used by the general public and those wishing to propose developments, as a guide to the approach that Local Planning Authorities will follow in order to take flood risk issues into account in a sustainable manner.

2 Study area description

2.1 Introduction

Northeast Yorkshire lies within the County of North Yorkshire and comprises the administrative areas of Ryedale District Council (RDC) and Scarborough Borough Council (SBC). RDC and SBC are the local planning authority within these areas, except for those areas which lie within the North York Moors National Park, where the North York Moors National Park Authority (NYMPA) is the local planning authority. The regional planning authority for Northeast Yorkshire is the Yorkshire and Humber Assembly.

Northeast Yorkshire is a predominantly rural area, comprising large areas of both agricultural land and moorland, and numerous small settlements. The principal settlements in the area are Malton, Norton, Pickering and Kirkbymoorside (RDC), Scarborough, Whitby and Filey (SBC) and Helmsley (partly NYMNPA, partly RDC).

The entire study area, as shown in Figure 2.1, covers an area of approximately 2,700 km². The area is bounded by the North Sea to the east and the northern boundary of the North York Moors National Park to the north. The southern boundary follows an irregular line along the course of the A166, running from just outside York to Driffield, before turning in a north-easterly direction towards the coast at Filey. The western area boundary runs through the Howardian Hills up to the Cleveland Hills in the north-west.

The study area can broadly be divided into four areas, namely the North York Moors, the Yorkshire Wolds, the Howardian Hills, and the Vale of Pickering. This subdivision is primarily based on topography but also other physical and climatological factors. The description of each area relates how these various factors may impact upon the hydrological response of the zone.

2.2 North York Moors

The North York Moors are characterised by high level moorland dissected by steep-sided river valleys, such as a large portion of the River Esk. The coastline is generally characterised by cliffs and bays, with the land levels generally rising rapidly behind the beaches. Peak elevations are in the order of 450 m AOD on the top of the Moors, where average annual rainfall can be in excess of 1000 mm.

The dominant geology of the North York Moors is the relatively hard Jurassic mudstone. The area is generally dominated by slowly permeable, seasonally waterlogged, clayey and loamy upland soils. The surface layers of these soils are usually peaty and acidic.

Due to these physical and climatological factors, the hydrological response of the North York Moors to rainfall events can be very quick and ‘flashy’. The steep slopes, of hard mudstone overlain by clayey soils, can generate large amounts of runoff very quickly, leading to a very ‘flashy’ hydrological response. Groundwater flows are important in the area of limestone towards the southern edge of the North York Moors.

2.3 Yorkshire Wolds

A portion of the northern sector of the Yorkshire Wolds lies within the study area. The Wolds are a range of low, rolling hills which attain a maximum elevation of around 200 m AOD. Although valley sides can be steep, gradients are not generally as great as those encountered in the North York Moors. Average annual rainfall in this area can be in excess of 750 mm.

The Yorkshire Wolds are dominated by typically shallow, well drained calcareous, silty soils over chalk bedrock.

The response of this area to rainfall events is generally much slower, and with a smaller proportion of rainfall running off, than from the North York Moors, although the steeper

slopes may still generate large amounts of runoff during intense precipitation events. Groundwater flows are important in this area.

2.4 Howardian Hills

A large proportion of the Howardian Hills Area of Outstanding Natural Beauty (AONB) lies within Ryedale District. This area comprises low, rolling hills, with elevations ranging from 20 to 160 m AOD. Average annual rainfall ranges from 600 to 800 mm.

The underlying geology of the Howardian Hills is predominantly limestone, overlain by well drained, coarse loamy soils in the northern part of the area, and slowly permeable, seasonally waterlogged soils in the southern section.

2.5 Vale of Pickering

The topography within the Vale of Pickering is generally low lying flat or gently undulating, with land rising gently in the north to the foothills of the North York Moors, and the steep scarp of the Yorkshire Wolds and the Howardian Hills to the south. This area includes the pastoral floodplains of the Rivers Hertford, Derwent and Rye. Elevations can be as low as 15 m AOD, and average annual rainfall is in the order of 600 - 700 mm.

The Vale of Pickering is underlain by drift geology of generally glacial origin, including glaciofluvial sand and gravel deposits, and glaciolacustrine clays. This lies above a sandstone aquifer. The soils are normally well drained, sandy and coarse loamy soils which, in the absence of drainage, are often affected by high groundwater levels.

3 Flood risk policy and guidance

3.1 The planning system

The planning system in England is the means by which development and land use is regulated. Planning Policy Statement 1 (PPS1) sets out the aim of the planning system which is to encourage sustainable development. National planning policy is defined by a series of planning policy statements[5]. The publication of PPS25 in 2006 has reinforced the position of flood risk as a "material consideration" in the planning system and further increased the profile of flooding issues within the planning system.

The planning system is primarily administered by Local Planning Authorities. They perform a variety of functions, including Forward Planning (preparation of Local Development Frameworks[6]) and Development Control (determination of planning applications). Local Planning Authorities in Northeast Yorkshire are Ryedale District Council, Scarborough Borough Council, North York Moors National Park Authority and North Yorkshire County Council.

The regional planning authority for Northeast Yorkshire is Local Government Yorkshire and Humber (LGYH). LGYH is responsible for establishing regional land use planning and transport policies. This includes preparing the Regional Spatial Strategy (RSS) for Yorkshire and Humber and monitoring and reviewing the delivery of the RSS. The RSS is a broad and long-term planning strategy for a region, is a statutory document and has development plan status.

Further details on the planning system and roles and responsibilities of those involved in the planning system can be found at http://www.planningportal.gov.uk/ and http://www.communities.gov.uk/corporate/ .

When considering development proposals which may affect flood risk local planning authorities often consult the Environment Agency. The Environment Agency is a statutory consultee who must be consulted during the preparation of Local Development Frameworks. Where a proposed development site lies within an Internal Drainage District, or a contributing upland area, the planning authority may consult with the Internal Drainage Board (IDB).

3.2 Local Development Framework

The Local Development Framework (LDF) outlines the spatial planning strategy for an area, as defined by a District or Borough Council area, or a National Park. The LDF consists of a portfolio of Local Development Documents which set out planning issues within the local authority area. A LDF must contain a number of key documents, including Development Plan Documents (DPDs) which outline the planning policy for an area[7]. The Core Strategy is the main DPD which states the key strategic policies and objectives for the LDF. A Strategic Flood Risk Assessment should form a fundamental part of a robust LDF evidence base, which should then inform the production of the Core Strategy which, in turn, should include a strategic policy on how flood risk issues are to be taken into account within the planning strategy for the area (see Appendices C, D and E for the policy statements used previously in the Local Plans covering Northeast Yorkshire).

[5] In 2004 the planning system was reformed through the introduction of the Planning and Compulsory Purchase Act 2004. National planning guidance was formerly issued as Planning Policy Guidance. These documents are in the process of being updated as Planning Policy Statements.
[6] Prior to the reformation of the planning system, local planning authorities produced Local Plans, Structure Plans or Unitary Development Plans as part of their Forward Planning function. These will now be replaced by Local Development Frameworks.
[7] These, together with the Regional Spatial Strategy for Yorkshire and the Humber, will comprise the Statutory Development Plan.

Another of the DPDs which must also be included within a LDF is the Adopted Proposals Map, which identifies the location of any site-specific policies within the area. The flood hazard maps produced as part of this SFRA (Section 10 and 11) can be used to identify the spatial extent of the recommended flood risk policies set out within this SFRA (Sections 7, 8, 9 and 13).

Elements of this SFRA could be adopted as a Supplementary Planning Document (SPD). A SPD can expand upon policy or provide further detail to policies in DPDs, but does not have development plan status.

3.3 National planning guidance

3.3.1 Planning Policy Statement 25

Planning Policy Statement 25: Development and Flood Risk (PPS25) was published by Communities and Local Government (CLG) in 2006. PPS25 explains how flooding should be taken into account when planning for development in England. It recommends that local planning authorities should address the problems which flooding can cause by:

- recognising that the susceptibility of land to flooding is a material planning consideration;
- assessing and taking into account all flood-risk and how it might be affected by climate change in preparing Local Development Frameworks and considering individual proposals for development;
- consulting the Environment Agency, which is a statutory consultee on flood issues at a strategic level and in relation to most planning applications, and other relevant organisations;
- applying the precautionary principle to decision-making so that risk is avoided where possible and managed elsewhere;
- improving the information available to the public about the risks of locating human activities in areas susceptible to flooding;
- taking into account the responsibility of owners for safeguarding their own property as far as is reasonably practicable;
- recognising that floodplains and washlands have a natural role as a form of flood defence as well as providing important wildlife habitats and adding to landscape value; and
- recognising that engineered flood reduction measures may not always be the appropriate solution, since they can have economic and environmental costs and impacts on the natural and built environment, need maintenance and replacement and cannot eliminate all risk of flooding.

PPS25 recommends that local planning authorities should recognise the uncertainty associated with flood risk estimation by adopting the “precautionary principle” when developing plans and assessing planning applications. The practical implementation of this principle is achieved through the use of the “Sequential Approach” to land use planning. This is achieved by zoning the planning area by the level of flood risk, with the nature of permissible development varying between each zone. PPS25 defines four principal flood Zones for fluvial and coastal flooding (Table 3.1).

Table 3.1. PPS25 Flood Zones and degree of flood risk.

Flood Zone	Annual probability of flooding (%)[8]	
1	Low Probability (Less than 0.1%)	
2	Medium Probability	River: 0.1-1%
		Tidal & Coastal: 0.1-0.5%
3a	High Probability	River: 1% or greater
		Tidal & Coastal: 0.5% or greater
3b	Functional Floodplain	Land to provide flood storage or conveyance

The specification and delineation of Zone 3b is not rigidly prescribed and is dependent on the level of flood risk and flood management measures within an area. Section 6.1 discusses the definition of these Zones in more detail.

The application of the Sequential Test should lead to the preferred sites for development being located in the areas of lowest risk wherever possible. Table D.1 of PPS25 (reproduced in Appendix A) summarises the appropriate planning response for each Flood Zone.

PPS25 requires that flood risk should be factored into Local Development Documents (LDDs) and that local planning authorities should prepare a Strategic Flood Risk Assessment to "*an appropriate level of detail to allow the Sequential Test to be applied in the site allocation process*". An SFRA will clarify the baseline to inform the scope of the Sustainability Appraisal of the LDD.

3.3.1.1 PPS25 Practice Guide

The PPS25 Practice Guide was updated in December 2009 and offers more detailed guidance on how to implement the policies of PPS25 in practice. It provides a more detailed discussion relating to the definition of the functional floodplain within the SFRA process. The following sections from the Practice Guide are particularly significant with regard to Northeast Yorkshire:

- "*The definition in PPS25 allows flexibility to make allowance for local circumstances and should not be defined on rigid probability parameters. Areas which would naturally flood with an annual exceedance probability of 1 in 20 (5%) or greater, but which are prevented from doing so by existing infrastructure or solid buildings, will <u>not</u> normally be defined as functional floodplain."*
- *"Developed areas are not generally part of the functional floodplain."*
- *"However, PPS25 does not differentiate between developed and undeveloped areas. This is because some developed areas may still provide an important flood storage and conveyance function…"*
- *"The area defined as functional floodplain should take into account the effects of defences and other flood risk management infrastructure."*

[8] Flood probability is defined by the annual probability of exceedance of a flood event. A 0.1% annual probability event will be equalled or exceeded once every thousand years on average (a return period of 1 in 1000 years). A 0.5% annual probability event has an average return period of 1 in 200 years. A 1% annual probability event has an average return period of 1 in 100 years.

- *"There may be opportunities to reinstate areas which can operate as functional floodplain. Previously developed land adjacent to watercourses may provide opportunities to incorporate space for flood water to reduce flood risk to new and existing development."*

3.3.1.2 Consultation on PPS25

In August 2009 Communities and Local Government (CLG) released 'Consultation on proposed amendments to Planning Policy Statement 25: Development and Flood Risk'. This consultation seeks to make some limited amendments to PPS25 to clarify certain aspects of the policy in the light of experience of its implementation. One of these clarifications relates to the 'identification' of functional floodplain.

The consultation states that "*the definition in PPS25 provides flexibility to make allowance for local circumstances. However, the Government believes this needs to be made clearer to avoid too much weight being placed on the '1 in 20' probability parameter in identifying and defining the boundaries of functional floodplains.*"

The document proposes the following definition of the Functional Floodplain: "*This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their SFRAs areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But 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, should provide a starting point for consideration and discussions to identify the functional floodplain.*"

This consultation is now closed and the aim is to publish amendments to PPS25 policy in Spring 2010.

3.3.2 Planning Policy Guidance note 20

PPG20 (published in 1992) provides planning policy guidance for the coastal zone. PPG20 recommends that those areas likely to be at risk of flooding from the sea are identified and policies to minimise development in areas at risk of flooding from the sea are implemented. The practical implementation of these principles for coastal zones is described in more detail in PPS25, which addresses flood risk from all sources.

3.3.3 Draft planning policy on development and coastal change

Communities and Local Government issued a draft planning policy on Development and coastal change for Consultation in July 2009. Where PPG20 adopts a strong precautionary principle towards any form of coastal development this draft planning policy focuses on managing the impacts of physical changes to the coast on development.

This draft policy acknowledges that planning policy in relation to coastal flooding is already in place (PPS25), and therefore focuses on any physical changes to the shoreline. Upon finalisation it is intended that this policy will be issued as a supplement to PPS25 and will replace the policies within PPG20, which will then be cancelled.

Until the finalised planning policy on Development and coastal change and its accompanying practice guide are issued PPG20 remains the planning policy guidance with respect to the coastal zone. This SFRA addresses coastal flooding aspects and so PPS25 remains the relevant national planning policy.

3.4 Yorkshire and Humber regional guidance

3.4.1 Regional Spatial Strategy

The Yorkshire and Humber Plan is the current Regional Spatial Strategy (RSS) for the Yorkshire and Humber region. It was issued in May 2008 and provides regional planning guidance.

Policy ENV1 (Development and Flood Risk) of the RSS states that:

"*The Region will manage flood risk pro-actively by reducing the causes of flooding to existing and future development, especially in tidal areas, and avoid development in high flood risk areas where possible…Allocation of areas for development will follow a sequential approach and will be in the lowest risk sites appropriate for the development (identified by Strategic Flood Risk Assessments)*."

Policy ENV1 continues with the confirmation that: "*PPS25 sets out national policy on development and flood risk and should be applied in the region*".

Other policies[9] in the RSS which are relevant to this SFRA include:

- **Policy ENV7** (Agricultural Land) which states that "*Development or use of agricultural land in appropriate locations will be encouraged for….Positive land management for flood alleviation, and increased water storage on farms, especially in remoter rural areas*".
- **Policy C1** (Coast sub area policy), which includes a reference to "*Avoid the risk from flooding, erosion and landslip along the coast, through roll-back approaches to relocate existing uses*".
- **Policy YH2** (Climate change and resource use), which states that plans, strategies, investment decisions and programmes should "*Plan for the successful adaptation to the predicted impacts of climate change by…minimising threats from and impact of coastal erosion, increased flood risk, increased storminess, habitat disturbance, increased pressure on water resources, supply and drainage systems*".

It is planned to undertake reviews of the RSS on a continual basis. Regular review of the RSS updates should be undertaken to identify any amendments to flood risk policy.

3.4.2 Regional flood risk appraisal

The primary objective of a Regional Flood Risk Appraisal (RFRA) is to provide an appraisal of strategically significant flood risk issues in a region in order to guide strategic planning decisions. PPS25 identifies the requirement for regional planning bodies to prepare RFRAs.

As per the recommendation within the Practice Guide the Yorkshire and Humber Assembly have completed a RFRA Scoping Study (JBA, 2008). The scoping document has principally been undertaken to:

- Identify issues for the RSS in relation to flood risk;
- Define the objectives of the RFRA in relation to flood risk;
- Identify boundaries to the RFRA;
- Identify key stakeholders;
- Identify potential flood risk components;
- Identify initial flood risk indicators and likely acceptance criteria;
- Determine baseline conditions for assessments.

The scoping report summarises the various components above and outlines the proposed content of the RFRA as well as the main work stages required to produce the final document. No timeframe is provided for the provision of a final RFRA. The output of the SFRA will therefore be the primary tool guiding spatial planning at both LPA and RPB level.

[9] Policies with regard to plans, strategies, investment decisions and programmes

3.5 Local guidance

Northeast Yorkshire is currently covered by adopted Local Plans and, in the case of the North York Moors National Park Authority, Core Strategy and Development Policies (see Table 3.3).

Table 3.3: Adopted Local Plans and Core Strategy and Development Policies in Northeast Yorkshire.

Local Plan/Core Strategy and Development Policies	Date Adopted	Local Policy (relating to Flood Risk)
Ryedale District	March 2002	ENV25
Scarborough Borough	April 1999	E19
North York Moors	November 2008	Development Policy 2: Flood Risk

The Local Plans and Core Strategy and Development Policies set out the general principles of taking flood risk into account when considering development proposals (see Appendices C, D and E). Note that the Ryedale District and Scarborough Borough Local Plans were adopted before the publication of PPS25.

The policies in the Ryedale and Scarborough Local Plans will be replaced by the Local Development Framework, and this SFRA is a key part of this process. The North York Moors National Park Local Plan has already been replaced by the Core Strategy and Development Policies which make up part of the Local Development Framework.

3.6 Strategic Flood Risk Assessment

The preparation of a Strategic Flood Risk Assessment is required by PPS25. The key requirements of a SFRA are summarised in Annexes D and E of PPS25, with more detailed objectives provided in the Practice Guide. The key objective is:

- Provision of sufficient data and information on all types of flood risk to enable application of the Sequential and, where necessary, Exception Tests by the LPA;

In addition, these objectives will allow the LPA to:

- Fully understand flood risk from all sources within the study area, and also the risks to and from surrounding areas in the same catchment;
- Inform the Sustainability Appraisal so that flood risk is fully taken account of when considering options and in the preparation of LPA land use policies;
- Prepare appropriate policies for the management of flood risk within LDDs;
- Identify the level of detail required for site-specific FRAs in particular locations;
- Determine the acceptability of flood risk in relation to emergency planning capability.

A staged approach to the production of SFRAs is recommended in PPS25, designed to enable flexibility in the level of assessment. In this way areas with low development pressures and less significant flood risk need not undertake as detailed analysis as areas with high development pressures and significant flood risk. Further detail regarding the general scope of the staged approach is provided in the Practice Guide:

- Level 1 SFRA: principally a desk-based study making use of existing information.
- Level 2 SFRA: more detailed study considering the detailed nature of the flood hazard, and taking account of any flood risk management measures.

3.7 Climate change guidance

3.7.1 General

The potential impacts of any climate change are far from certain but it can be expected that the degree of flood risk for a particular area will be influenced by any future change in climate. Generally, it is considered that climate change will lead to wetter winters and drier summers, although the summers may be punctuated by intense rainfall events. Climate change is expected to increase the risk of flooding within Northeast Yorkshire. This may lead to an increase in flood levels, and therefore an increase in the extent of the floodplain. It will also affect those areas which are currently at risk of flooding, by increasing the frequency with which flood events are experienced. The following publications and guidance documents provide estimates of how the climate will change over the next 50 years and the potential impacts this will have on sea and river levels.

The approach adopted within this SFRA to provide an assessment of climate change impacts is detailed in Section 6.2.3.

3.7.2 PPS25

PPS25 requires that the spatial planning process should take account of potential climate change impacts. It provides details on the recommended allowances to be made for climate change effects (see Table 3.4 and Table 3.5), which are derived from Defra guidance (see Section 3.7.3 below).

Table 3.4 Recommended contingency allowances for net sea level rise (adapted from PPS25 Table B.1)

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

Table 3.5 Recommended national precautionary sensitivity ranges for peak rainfall intensities, peak river flows, offshore wind speeds and wave heights (from PPS25 Table B.2)

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%	

3.7.3 Defra project appraisal guidance

To assist in the appraisal of publicly-funded flood management projects Defra issued the guidance document 'FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities – Climate Change Impacts' in October 2006. This note utilised the climate predictions within UK Climate Impacts Programme 2002 (UKCIP02) to produce recommended climate change allowances for use in the design and assessment of flood infrastructure. These recommended allowances have subsequently been summarised in PPS25 and are shown in Table 3.4 and Table 3.5 above.

3.7.4 Regional guidance

In 2009 a Regional Adaptation Study for the former Yorkshire and Humber Regional Assembly (now the LGYH) was issued. This study assessed climate change to the Yorkshire and Humber region to 2050. It identified a number of potential climate impacts, the following of which have particular significance for flood risk:

- Greater seasonality of rainfall, with increases in winter combined with significant reductions in summer;
- In northern and upland areas an increase in the number of extreme rainfall events;
- Marginal increases in winter average wind speeds, although summer and autumn speeds reduce slightly;
- Sea levels will rise by around 0.35 metres.

3.7.5 UKCP09

In June 2009 the UK Climate Projections 09 (UKCP09) were released. This is the fifth generation of climate information produced by the UKCP initiative and replaces the UKCIP02 projections. The UKCP09 provides regional climate projections for varying future emissions scenarios over the next three 30-year time periods. There are therefore a number of prediction scenarios for the Yorkshire and Humber region. Some key findings for the 'medium emissions' scenario in the 2080s are:

- the central estimate of change in winter mean precipitation is 15%; it is very unlikely to be less than 2% and is very unlikely to be more than 33%.
- the central estimate of change in summer mean precipitation is –23%; it is very unlikely to be less than -44% and is very unlikely to be more than 0%.
- sea level increase will range from 36.3 cm in London to 24.4 cm in Edinburgh.

The output from UKCP09 has not yet been distilled into readily-useable guidance such as those included in PPS25 and shown in Table 3.4 and Table 3.5. Until such time as such information is available it is recommended that the PPS25 recommended allowances are used to assess the impacts of climate change.

4 Data collection

4.1 General

A key component of the SFRA process is the collation and review of existing data. As part of the original SFRA (Arup, 2006) consultation took place with a number of key stakeholders, including the Northeast Yorkshire partners and the Environment Agency. This consultation process was repeated during the current SFRA update in 2009 in order to draw on any new or updated information. Data from both consultation periods are presented within the updated SFRA. A summary of the consultations, and the key data sources yielded, is provided below.

More detailed information regarding the actual flood risk within Northeast Yorkshire is provided in Section 5.

4.2 Northeast Yorkshire partners

Consultation took place with Council and National Park Authority Officers with regard to historical flood incidents, drainage issues and any existing or potential land management schemes that may have an impact upon flood risk. Both RDC and SBC provided recent mapped data relating to surface water flooding (see Section 6.4) and SBC also provided some more location-specific flood related documents.

4.3 Environment Agency

4.3.1 Data collation

Extensive consultation and data collation has taken place with the Environment Agency. Differing methods of data collation have been employed:

- Discussions with relevant Environment Agency officers. This took place in 2005 and again in May 2009;
- Review of existing flood related documents covering areas within Northeast Yorkshire (e.g. Section 105 Investigations, Flood Risk Mapping Studies, Flood Alleviation Scheme Design Reports). Updated reports were provided during spring 2009. A full list of these documents can be viewed within the References section;
- Direct provision by the Environment Agency of certain key datasets, including Flood Zone maps, plans of Main River networks, flood defence asset information, predicted flood levels and extents from various flood studies, and digital elevation data for selected areas. Updated data sets were provided, where available, in 2009;
- Consultation with the Development and Planning personnel to discuss the requirements for updating the SFRA to PPS25 compliance.

4.3.2 Catchment Flood Management Plan

The EA are in the process of preparing Catchment Flood Management Plans (CFMP) for the River Derwent catchment and the River Esk and Coastal Streams catchment area. These studies will include extensive mapping of river flooding across both catchment areas and this mapping will include relevant climate change allowances. However, neither the CFMP itself nor the accompanying mapping was available for use within this SFRA.

4.4 Additional consultation

Other key stakeholders were consulted to determine the availability of additional relevant flood information and to discuss land use management practices. The bodies consulted and the subject matter of the consultation are detailed in Table 4.3. During the 2005 consultation period several of the large Estates within Northeast Yorkshire were also consulted about land use management practices.

Table 4.3. Additional Consultees and Subject Matter

Regulatory Body	Consultation Subject Matter
Internal Drainage Boards (IDBs): Foss, Muston & Yedingham, Rye, Thornton consulted in 2005 and 2009.	- Flood data availability - Land use management - Development Control
Forestry Commission, consulted in 2005.	- Land use management
North Yorkshire County Council (NYCC) Highways Division, consulted in 2005 and 2009.	- Flood data availability
Yorkshire Water, consulted in 2005 and 2009	- Sewer flood data availability - SuDS Policy
Parish Councils, consulted in 2005.	- Flood data availability
Kirkbymoorside Town Council, consulted in 2009	- Flood data availability

5 Overview of flood risk issues within Northeast Yorkshire

5.1 Principal catchment areas

The majority of the area is drained by two major river systems (Figure 2.1):

- The River Derwent rises in the North York Moors, to the north-west of Scarborough. It then flows in a south-westerly direction, draining the Vale of Pickering, through Malton and Norton before exiting the study area in the south-west corner. The River Hertford drains the area to the east of Seamer, joining the Derwent to the north-east of Sherburn. The River Rye and its tributaries drain the southern section of the North York Moors, and flows into the Derwent approximately 4 miles to the north-east of Malton.
- The River Esk flows in a west to east direction, draining the northern section of the study area, including a large tract of the North York Moors. It flows into the sea through the centre of Whitby.

A small watercourse, known as the Gypsey Race, drains a portion of the northern part of the Yorkshire Wolds. It flows in an easterly direction and enters the sea at Bridlington, to the south-east of the study area.

5.1.1 Watercourse adoption/responsibility

The Environment Agency has a duty to exercise a general supervision over all matters relating to flood risk management. The Environment Agency has permissive powers to maintain and improve rivers designated as a Main River, to construct and maintain defences against flooding, to issue flood warnings, and to manage water levels. Under the Water Resources Act 1991 and associated byelaws, works in, over, under or adjacent to Main Rivers require a Land Drainage Consent from the Environment Agency before such works are undertaken.

Local authorities are the operating authority for most Ordinary Watercourses and have permissive powers to manage these watercourses. Under the Land Drainage Act 1991, consent is required from the Environment Agency before any culvert or flow control structure (such as a weir) is constructed on any Ordinary Watercourse. Local Authorities may give consent to implement a culvert under the Public Health Act 1936.

The Internal Drainage Boards (IDB), of which there are several within the study area (Foss, Muston & Yedingham, Rye, and Thornton), are responsible for the watercourses within their Internal Drainage District. These IDBs exercise similar operational and regulatory powers to the Environment Agency within these areas.

The highways authority (North Yorkshire County Council) is responsible for the drainage of highways while the sewerage undertaker (Yorkshire Water) is responsible for the sewer system. No body has specific responsibility for the management of groundwater or surface runoff flooding.

5.1.2 Flood risk management measures

Flood flows from the headwaters of the River Derwent are controlled by a major flood diversion channel, the Sea Cut, which diverts flood flows from just upstream of Forge Valley (North of West Ayton) to the sea at Scalby.

There are numerous floodbanks alongside the Rivers Rye, Hertford and Derwent, which protect agricultural land from frequent inundation by floodwaters but which are overtopped during significant flood events. A number of land drainage pumping stations operate within Northeast Yorkshire, to control local water levels.

Following the major flood event of 2000 a new Flood Alleviation Scheme was constructed for Malton, Norton and Old Malton. Flood defences were also constructed at Hovingham

following this event. No other key settlements are protected by significant flood defences within Northeast Yorkshire.

5.2 Flood risk overview

The data collection and consultation stage has highlighted a number of flood risk issues within the study area. The location of these reported flood risk issues is displayed in Figure 5.1 on a study area scale, and in the Figures in Sections 10 and 11 for individual settlements. An overview of these issues is provided below.

5.2.1 River flooding

The areas at risk of flooding from main rivers have been identified on the Environment Agency's Flood Zone Maps (www.environment-agency.gov.uk/flood), and are shown in Figure 5.1.

5.2.1.1 Derwent catchment

Widespread flooding has previously occurred on numerous occasions along the River Derwent and many of its tributaries. The March 1999 and Autumn 2000 flood events along the River Derwent caused extensive inundation of the floodplain, and caused significant damage and disruption around Malton and Norton. A Flood Alleviation Scheme (FAS) has since been constructed reducing the flood risk to Malton, Norton and Old Malton.

Due to the very steep nature of much of its upper catchment, the Derwent is susceptible to 'flash' floods, as occurred in June 2005 on the River Rye. On this occasion an intense rainfall event produced very high flows in the River Rye. Widespread flooding, and extensive damage to property, was reported in many places along the upper reaches of the River Rye, including Helmsley and Hawnby.

Other Main River flooding events have been reported along Pickering Beck in Pickering (in 2007), the River Dove at Kirkbymoorside, the River Seven at Sinnington, Thornton Beck at Thornton-le-Dale, and the River Rye at Nunnington. In addition to these flooding incidents, extensive flooding of rural and sparsely developed areas has taken place throughout the River Derwent catchment.

5.2.1.2 Esk catchment

There is a lack of detailed flood information for the River Esk catchment, although flooding has been reported along the Sleights to Whitby part of the River Esk corridor, along with isolated incidents in more rural locations further up the River Esk catchment.

5.2.2 Ordinary watercourse flooding

Ordinary watercourses are those rivers and streams not designated as Main River. For further details regarding adoption/responsibility of these watercourses refer to Section 5.1.1.

Localised flooding incidents arising from ordinary watercourse conveyance issues have been reported throughout Northeast Yorkshire. Flooding attributed to under-capacity or blocked culvert systems has been reported in Cayton, Eastfield, Filey, and Whitby. Flooding from ordinary watercourses has also been reported in Norton, Scarborough, and Sandsend.

Ordinary watercourse flooding incidents are not confined to developed areas and have been reported in rural locations throughout Northeast Yorkshire, particularly in the flood event of June 2005.

5.2.3 Coastal flooding

Large-scale coastal flooding is generally not common along the Scarborough coastline (Figure 5.1). Relatively small-scale tidal flooding has been reported to occur on a relatively regular basis in the South Bay area of Scarborough, Sandsend, and Whitby.

5.2.4 Groundwater and surface water flooding

5.2.4.1 General

Flooding can be caused due to the emergence of groundwater through springs or seeps during periods of high groundwater levels. Flooding can also be caused by local runoff from hillslopes and impermeable areas, especially after periods of very wet weather or intense rainfall. Within the study area distinct episodes of groundwater flooding have been reported. Similarly, flooding due to excess surface water forming overland flow has been reported throughout the study area. There are also several instances of recorded flooding whose source is not well defined. These may be due to groundwater or surface water overland flow, or a combination of the two processes.

The location of previous groundwater and surface runoff flooding incidents are indicated on Figure 5.1. It should be noted that the locations of these reported incidents are approximate, and indicative only. These locations are predominantly based on reports of highway flooding, although some relate to property flooding, and are unlikely to be a comprehensive record of past groundwater and surface runoff flooding events.

Groundwater and surface runoff flooding issues in Northeast Yorkshire are described below and discussed further in Section 6.4.

5.2.4.2 Groundwater flooding

Flooding from groundwater has been reported in both Malton and Norton. Excessive spring water was noted in differing locations in Malton during the Autumn 2000 flood event, while considerable damage to the highway network has been attributed to excess groundwater in Norton. Both springs and rising groundwater were apparent in Malton and Norton during the 2004 flood event, which occurred after the flood defences had been installed.

5.2.4.3 Surface water flooding

Surface water overland flow flooding has been identified as a significant potential source of flood risk within Northeast Yorkshire.

Within Scarborough Borough particular surface runoff problems have been reported in Filey, with other incidents identified along much of the coastal belt including Burniston, Cloughton, Eastfield, Gristhorpe and Lebberston.

Surface runoff flooding is also an issue within Ryedale District Council. Surface runoff caused property flooding in Helmsley during the floods of June 2005. Surface runoff flooding problems have also been reported in the Kirkbymoorside and Leavening areas.

5.2.4.4 Groundwater and/or surface water flooding

Flooding problems have been reported along the base of the northern escarpment slope of the Yorkshire Wolds as it meets the Vale of Pickering, broadly along the A64(T) corridor. Springs and streams are reported to appear rapidly during storm events. The exact flooding mechanism is potentially a combination of a rapidly rising groundwater table coupled with sheet runoff originating from the higher parts of the Wolds.

A similar situation occurs along the A170 corridor, to the immediate south of the North York Moors. It is unclear whether groundwater provides such an important input within these particular flooding events or if the majority of the floodwater originates from sheet runoff from the North York Moors.

5.2.5 Sewer flooding

Flooding due to sewerage issues has been reported in Northeast Yorkshire, primarily within the developed areas of Ryedale District Council (RDC) and Scarborough Borough Council (SBC).

The following locations (Tables 5.5 and 5.6) have been reported as being affected by sewer flooding as a result of inadequate hydraulic capacity. The numbers below indicate the number of properties and external flooding locations included on Yorkshire Water's DG5

Register as reported in April 2005. Also noted in Tables 5.5 and 5.6 are the numbers of properties and locations that have been affected by exceptional rainfall events; events occurring less frequently than once in 20 years. No new information was provided for the SFRA update.

Table 5.5. Reported Sewer Flooding Locations within Ryedale District.

Settlement	Included on Register		Exceptional rainfall	
	Properties	External locations	Properties	External locations
Malton & Norton	3	2		
Pickering	1			
Kirkbymoorside	2	4	2	
Helmsley	3	1		
Claxton			1	
Rosedale Abbey			1	
Little Barugh		1		
Aislaby		1		

Table 5.6. Reported Sewer Flooding Locations within Scarborough Borough.

Settlement	Included on Register		Exceptional rainfall	
	Properties	External locations	Properties	External locations
Cayton		2		
Irton		3		
Filey	4	1	4	
Hunmanby		4		
Whitby	4	8		
Saltburn by the Sea	1	1		
Osgodby		1		
Crossgates		1		
Scarborough	9	2	61	
Gristhorpe		3	5	

5.2.6 Drainage issues

In addition to the flood mechanisms identified above, other flood incidents have been reported throughout the study area. In some instances these have been identified as problems relating to the existing local drainage system, although it is not clear whether this relates to a sewer or watercourse drainage systems. Others have merely been reported as flood incidents with the exact cause unspecified. These incidents have been given the general classification of “drainage issues”.

Drainage issues are widespread throughout Northeast Yorkshire and have been reported in Helmsley, Kirkbymoorside, and many of the satellite settlements to the south of Scarborough.

5.2.7 Reservoirs

There are a small number of reservoirs within the study area, predominantly located at upland, and relatively remote, sites within the National Park. The EA are presently undertaking a study which will assess the degree of flood hazard from reservoirs, however the results are not available for use within this SFRA.

6 Approach and methodology

6.1 Adopted approach

The approach taken in the preparation of this SFRA takes into account the requirements of PPS25 and the guidance within the Practice Guide. It essentially constitutes a Level 1 SFRA but does provide information in certain key locations (e.g. Malton and Norton) which would be considered part of the scope of a more detailed Level 2 SFRA. The approach included:

- review of existing planning policy guidance on development and flood risk;
- use of the Environment Agency Flood Map to identify fluvial and coastal flood risk, supplemented by consultation and review of existing detailed flood appraisal reports;
- a qualitative assessment of the implications of climate change in key settlements;
- consultation and review of existing reports and mapping products to identify areas at risk of surface water flooding;
- identification of areas at risk of groundwater flooding;
- identification of locations which are sensitive to a change in runoff rates and volumes, and identification of Critical Drainage Areas;
- delineation of the Flood Map to identify PPS25 Flood Zones within Flood Zone 3, on the basis of the extent of existing development;
- identification of the location and standard of flood defences, and the areas protected by these flood defences;
- description of flood risk issues, including the implications of climate change, and relevant planning guidance within settlements expected to come under future development pressure (key settlements);
- assessment of rapid inundation zones in selected key settlements protected by flood defences;
- mapping of expected flood depths in selected key settlements;
- develop policy recommendations to enable the local planning authorities to apply the Sequential and, where necessary, Exception Tests within Northeast Yorkshire;
- develop policy guidance to assist development control within Northeast Yorkshire;
- provide guidance on Sustainable Drainage and Land Use Management within Northeast Yorkshire.

This SFRA takes into account the existing and emerging Development Plans developed by the local planning authorities, which highlight the broad locations where future development will be focused. More detailed assessment of flood risk issues has been undertaken for the settlements that have been identified as being likely to come under development pressure in the future.

This SFRA does not remove the need for developers to undertake site-specific Flood Risk Assessments when proposing developments. However, this SFRA does provide additional information and guidance for those undertaking a site-specific Flood Risk Assessment.

6.2 Mapping PPS25 flood zones

PPS25 divides all land within England into 3 zones, based on the degree of flood risk (see Section 3.1). These zones form the basis for the application of the Sequential and Exception tests as required by PPS25 and as such their appropriate delineation is an important part of the SFRA process.

The Flood Zone Maps provided by the Environment Agency delineate those areas estimated to be within Flood Zones 1, 2 and 3, and Figure 5.1 shows the distribution of these PPS25 Zones throughout Northeast Yorkshire. The Environment Agency Flood Zone maps do not identify Flood Zones 3a and 3b. The distribution of these areas throughout Northeast Yorkshire has been identified as part of this SFRA, as described below.

6.2.1 Zone 3a

Zone 3a covers those areas which are at high probability of flooding but are not Functional Floodplain (see Section 6.2.2). Unless explicitly defined in the relevant key settlement description (Sections 10 and 11), all currently developed sites within Flood Zone 3, are defined as Zone 3a.

PPS25 indicates that when considering potential allocation sites within any Flood Zone preference should be given to those sites at the lowest probability of flooding. For the purposes of the Northeast Yorkshire SFRA Update three sub-zones of Zone 3a have been identified:

- Zone 3a(i) is defined as those developed sites at high risk of flooding which are not currently defended to the appropriate minimum standard as defined by Defra (annual probability of 2% for fluvial flooding and 1% for flooding from the sea).
- Zone 3a(ii) is defined as those developed sites at high risk of flooding which are currently defended to the appropriate minimum standard for new development as defined by PPS25 (annual probability of 1% for fluvial flooding and 0.5% for flooding from the sea).
- Zone 3a(iii) is defined as those developed sites at high risk of flooding which are currently defended to the appropriate minimum standard for existing development as defined by Defra (annual probability of 2% for fluvial flooding and 1% for flooding from the sea) but are not defended to the appropriate minimum standard for new development as defined by PPS25 (annual probability of 1% for fluvial flooding and 0.5% for flooding from the sea).

Due to the limited number of areas protected by flood defences within the study area the different sub-zones 3a(i), (ii) and (iii) have not been mapped explicitly across Northeast Yorkshire. Currently developed sites should be defined as Zone 3a(i) unless they are explicitly identified as Zone 3a(ii) or 3a(iii) in the relevant key settlement description (Sections 10 and 11).

6.2.2 Zone 3b 'Functional Floodplain'

PPS25 defines the Functional Floodplain as *"..land where water has to flow or be stored in times of flood".* It goes on to provide further definition as "*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."*

PPS25 suggests that the Functional Floodplain be identified as land which would flood with an annual probability of 1 in 20 (5%). The PPS25 Practice Guide states that the definition should not be based on rigid probability parameters and the proposed re-definition within the consultation document suggests that the 1 in 20 annual probability (5%) be used as a starting point.

Data displaying the predicted extent of the 1 in 20 annual probability flood event is not widely available for the study area. Therefore taking the available guidance into account, in conjunction with applying the precautionary principle, **all areas within Flood Zone 3 which are located outside of currently developed sites and are not defended to a proven standard of protection of at least 5% have been defined as Flood Zone 3b Functional Floodplain. This includes all floodplain areas behind agricultural flood banks.**

Although PPS25 does not differentiate between developed and undeveloped areas the Practice Guide suggests that developed areas are **not** normally part of the Functional Floodplain and that the effects of defences should be taken into account. In conjunction with the lack of explicit data referred to above, **all currently developed sites or those defended to a proven standard of protection of at least 5% are not defined as Zone 3b Functional Floodplain; these sites shall be classified as Zone 3a.**

There are no known areas within the study area which are designed to flood in an extreme (0.1%) flood event.

All Zone 3 floodplain areas not accorded 3a status have been placed within Zone 3b Functional Floodplain, and for this reason have not been specifically displayed in graphical form. This includes undeveloped and previously developed floodplain areas, within a settlement, that are not protected by flood defences.

The Catchment Flood Management Plans (CFMP) for the River Derwent and the River Esk and coastal streams are due to be published in summer 2010. These documents will contain mapping which identifies the predicted extent of the flood event with an annual probability of 1 in 20 (5%). When available, this information should be used as the default starting point for delineation of the functional floodplain, in conjunction with consultation with the Environment Agency.

This method of functional floodplain delineation is considered relatively conservative, due to the absence of more quantifiable information. Until such time as further information is available (e.g. CFMP) it places the onus on the promoting authority/developer to demonstrate that the site should **not** be considered as Zone 3b. This requirement should be borne in mind during application of the Sequential Test.

6.2.3 Climate change

PPS25 requires that the spatial planning process take account of potential climate change impacts. This SFRA update has largely followed the scope of a Level 1 SFRA and, as such, has made use of existing data. As detailed in Section 4.3.2 the flood-mapping being produced for the Northeast Yorkshire area, as apart of the CFMP process, is not available for use in this study. No existing data with an implicit climate change allowance is therefore available.

A qualitative approach has been applied to the assessment of the potential implications of climate change to settlement areas. An assessment has been made, based on topographical data and the existing Flood Zones, as to the relative sensitivity of settlements to increased water levels arising from climate change. Refer to Sections 10 and 11 for this information for each key settlement.

6.3 Flood depth mapping and Rapid Inundation Zones (RIZ)

Additional analysis of the available flood data has been undertaken in certain locations where development pressures are likely to be such that a more detailed understanding of the degree of flood risk is required. This analysis has taken the form of flood depth mapping and the calculation of rapid inundation zone extents.

6.3.1 Flood depth mapping

The Flood Zone maps (Figure 5.1) provide an estimate of the extent of flooding from a 1 in 1000 annual probability (0.1%) and a 1 in 100 annual probability (1%) flood, respectively. Within developed areas where there is likely to be pressure for further development to take place, an idea of the depth of flooding likely from the predicted water level may be beneficial. This can provide an indication of the variation in relative flood risk within this Zone to inform the land allocation process.

To this end, flood depth mapping has been undertaken in four settlements within the study area: Malton and Norton, Pickering, and Whitby. Flood depth mapping was undertaken in

these areas due to the flood risk and expected future development pressures, and because detailed flood level and topographic data was available for these areas.

6.3.1.1 Flood depth mapping process

Hydraulic model results are available for Malton and Norton[10] and Pickering[11]. The modelled maximum 1% flood levels within each watercourse have been extrapolated across the floodplain and have been combined with a Digital Elevation Model (DEM), derived from LiDAR remote sensing, to produce an estimate of 1% flood depths in these settlements. Flood depths have been displayed to a resolution of 0.5 m.

Flood depth maps produced within this study are indicative only, and are designed to give a general distribution of the degree of flood risk at a particular site. They should not be used for design purposes. Hydraulic modelling within a site-specific Flood Risk Assessment will be required should flood levels be needed for design purposes.

6.3.1.2 Malton and Norton

Predicted 1% flood levels through Malton and Norton have been obtained from the Malton Data Improvements Report (2009)[12]. The predicted flood depths through Malton and Norton, displayed in Figure 10.5, have been calculated assuming breaching of the flood defences (Section 10.1) on both sides of the river. With a few localised exceptions, the greatest predicted flood depth is in the order of 2.5 to 3m.

The maximum predicted 1 in 100 year flood level along the section of Priorpot Beck through Norton is lower than the maximum predicted 1 in 100 year flood level in the River Derwent immediately upstream of the Priorpot Beck confluence. Flood depths have been calculated along Priorpot Beck using the River Derwent flood level, to assess the depth of flooding which could occur if the River Derwent flood defences breached.

In several locations the predicted extent of flooding from the flood depth mapping process does not reflect the extent of flooding from Flood Zone 3. In Norton 'islands', where the flood depth map predicts no flooding in the middle of areas of extensive inundation, are apparent. Closer inspection reveals the shapes of large buildings within many of these islands, and it would appear that the DEM is based on roof levels in these areas, rather than ground levels. **In all such locations, the extent of Flood Zone 3 as defined by the Environment Agency Flood Zone maps should be used for planning purposes.**

6.3.1.3 Pickering

Predicted 1% flood levels through Pickering have been obtained from the 'Data Improvements' study[11]. There are no formal, maintained flood defences providing a recognised standard of protection within Pickering (Section 10.2). Flood depth mapping (Figure 10.8) has therefore taken place assuming unobstructed inundation of the 1% flood event. With a few localised exceptions, the greatest flood depth observed is in the order of 1 to 1.5m.

As in Section 6.3.1.2 above, anomalies are apparent between the predicted extents of flooding from the flood depth mapping process and Flood Zone 3. **In all such locations, the extent of Flood Zone 3 as defined by the Environment Agency Flood Zone maps should be used for planning purposes.**

6.3.1.4 Whitby

Flood depth data for Whitby has been supplied directly by the Environment Agency. The values have been produced as a by-product of the method used to produce the Flood Zone extents (Figure 11.15).

Due to the method of production, flood depths for Whitby generally reflect the flood extent predicted by the Flood Zones, apart from the area close to the confluence with Stakesby

[10] Malton Data Improvements, Sumary Report, Halcrow (2009)
[11] Pickering Data Improvements, Halcrow, 2010.
[12] Malton Data Improvements Report, Summary Report Final, Halcrow (2009)

Vale. **In all such locations, the extent of Flood Zone 3 as defined by the Environment Agency Flood Zone maps should be used for planning purposes.**

6.3.2 Rapid Inundation Zones (RIZ)

The PPS25 Practice Guide defines a Rapid Inundation Zone as 'an area which is at risk of rapid flooding should a flood defence structure be breached or overtopped'.

Flood risk is not eliminated completely by the provision of flood defences, although the risk of flooding is reduced. The degree of flood risk reduction provided depends on the standard of protection provided by the flood defence, in conjunction with the condition and reliability of the defence. Flooding may still therefore occur in an area protected by flood defences as the flood defence may be overtopped or breached. Similarly, non-fluvial mechanisms such as groundwater flooding or impeded drainage may cause water to pond behind a flood defence. Any new development within a defended area must give full consideration to all possible flood mechanisms.

Overtopping or breaching of a flood defence is likely to cause a rapid inundation of the defended area, potentially impacting all land up to the level of the water on the unprotected side of the defence. This Rapid Inundation Zone, immediately behind the breach or area of overtopping, is likely to experience high velocities and/or significant flood depths. These velocities are likely to decrease moving away from the defence but the degree to which they, along with the water depths, decrease will be determined by various factors.

The HR Wallingford Report 'Flood Risk Assessment for New Development: Phase 2 FD2320/TR2' provides a tiered approach to the analysis of the potential impacts of rapid inundation. This approach provides an assessment of the hazard posed by potential flood defence failure as a function of the potential depth of flooding (related to the potential height of water retained by the flood defence) and the velocity of flood water should the defence overtop or breach.

The impact of flood depth and velocity, and the debris within the floodwater, is assessed by the consequences that such flooding could have on the **danger to people**, as the most serious risk associated with development behind defences is the risk to people. Flood impact on property is not directly addressed, but it can be inferred that any property in an area affected by flooding will be impacted by that flooding. Table 6.1 summarises the hazard categories used in the HR Wallingford study.

Table 6.1 Hazard rating for Rapid Inundation Zones

Hazard Rating	Definition
Low: *'Caution'*	Flood zone with shallow flowing water or deep standing water, where[a]: d*(v + 0.5) + DF < 0.75
Moderate: *'Danger for some people' (i.e. children and the elderly/infirm)*	Danger: flood zone with deep or fast flowing water, where[a]: 0.75 < d*(v + 0.5) + DF < 1.25
Significant: *'Danger for most people'*	Danger: flood zone with deep fast flowing water, where[a]: 1.25 < d*(v + 0.5) + DF <2.0
Extreme: *'Danger for all people'*	Extreme danger: flood zone with deep fast flowing water, where[a]: d*(v + 0.5) + DF > 2.0

[a] d = maximum depth of water
v = maximum velocity of water
DF = debris factor (0.5 when d < 0.25 m; 1 when d > 0.25 m)

Within this study, the basic approach described in Report FD2320/TR2 has been adopted as the means to provide an initial potential impact analysis. This can be used for the following cases:

- Overtopping scenario (where the hazard is related to the water level above the crest of the defence).
- Breach scenario (where the hazard is related to the water level above the floodplain).

This approach classifies the Hazard (Table 6.1) on the basis of the distance away from a flood defence (Table 6.2).

Table 6.2: Relationship between Flood Hazard and distance away from a flood defence assuming a defence breach (After HR Wallingford, 2005)

Distance from breach (m)	Height of flood water above floodplain (m)				
	0.5	1	2	3	4
100					
250					
500					
1000					
1500					
2000					
2500					
3000					
3500					

Key:

	Danger for some people
	Danger for most people
	Danger for all people

The only settlements within the study area protected by formal, maintained flood defences to a recognised standard of protection are Old Malton, and Malton and Norton (Section 10.1 and 10.9). These settlements are protected by defences constructed within the Malton and Norton FAS. Therefore, the potential impacts of rapid inundation have only been assessed in these settlements, as described below. A preliminary indication of the potential impacts for forward planning purposes only is provided here, it is not intended to be used for design purposes. More detailed assessment of the potential consequences of flood defence failure is recommended for individual sites (Section 8).

6.3.2.1 Old Malton

The flood defences around Old Malton provide a 0.5% standard of protection to the settlement. The 1% event flood level has been used for potential rapid inundation analysis, assuming that a defence breach occurs.

The predicted 1% flood level in the River Derwent through Old Malton is approximately 2.3m above the floodplain level, suggesting that this would lead to 'Danger for all' for floodplain locations within 500m of the flood defence. **The EA Flood Zone 3 predicts a large area of inundation through the settlement, all of which falls within 500m of the flood defences. Therefore, all areas of the settlement within Flood Zone 3 can also be attributed a 'Danger for all' (Extreme) rating in the event of a breach. This is displayed in Figure 10.16.**

6.3.2.2 Malton and Norton

The flood defences through Malton and Norton provide a 2% standard of protection to the settlement, although the crest level of the defences through Malton and Norton are actually higher than the predicted 1% flood level (see Section 10.1 for further information). For this reason, only the impact from a defence breach has been evaluated within Malton and Norton.

Two stretches of flood defences have been identified within Malton (Figure 10.6); the first beginning at the disused railway embankment and stretching down to the County Bridge, the second beginning at the County Bridge and stretching along to the Railway Bridge. A significant proportion of Norton is protected by flood defences, many of which were installed as part of the Malton and Norton FAS. The defences begin in the vicinity of the A64, to the north east of the settlement, and stretch downstream, almost without interruption, to opposite the York Road Industrial Estate.

From the flood depth map for Malton and Norton (Figure 10.5), it can be seen that, apart from a few localised exceptions, the general depth of water on the floodplain is approximately 1.5 m within both settlements, suggesting a 'Danger for all' (Extreme) rating within approximately 100m of the flood defence, a 'Danger for most' (Significant) rating between 100 m and 250 m from the flood defence, and a 'Danger for some' (Moderate) rating between 250 m and 500 m from the flood defence.

The 100 m 'Danger for all' (Extreme) zone extends to beyond the limit of the predicted 1% floodplain throughout the protected area of Malton (Figure 10.6). Figure 10.6 displays the extent of the 'Danger for all' (Extreme) and 'Danger for most' (Significant) zones in Norton. All other areas of Flood Zone 3 in Norton, not covered by these two zones, have a 'Danger for some' (Moderate) rating.

6.4 Mapping groundwater and surface water flood risk

6.4.1 General

As described briefly in Section 5.2.4 above, numerous incidents of surface runoff flooding and/or groundwater flooding have been reported throughout the Northeast Yorkshire study area (Figure 5.1). In July 2009 the EA released 'Areas Susceptible to Surface Water Flooding' maps. Standard flood hazard/risk maps for groundwater flood risk are not available and no single body is responsible for the management of either of these types of flood risk.

The approach adopted within this updated SFRA to mapping groundwater and surface water flood risk has been to make use of both reported/observed and modelled data.

As noted in Section 5.2.4, reported flooding locations have been obtained through consultation, and the indicative location of reported events shown in Figure 5.1. Within Northeast Yorkshire four zones have been identified where incidents of surface runoff flooding and/or groundwater flooding appear to be particularly prevalent (Figure 6.3). The definition of these zones is described below. These zones are indicative only and do not preclude the occurrence of surface runoff and/or groundwater flooding outside these limits. For example, as noted in Section 5.2.4.2, incidents of groundwater flooding have been reported in Malton and Norton.

The EA 'Areas Susceptible to Surface Water Flooding' information has also been used to map areas where surface water flooding may be an issue. The application of this data is further described in Section 6.4.6 below.

6.4.2 The A64(T) – Rillington to Hunmanby corridor (Zone A)

Surface runoff and/or groundwater flooding events have occurred along the base of the northern slope of the Yorkshire Wolds, broadly along the corridor of the A64(T) and A1039 between Rillington and Hunmanby. Many of these events have occurred at the boundary of two soils types, as taken from the Soil Survey of England and Wales. The extent of these soil types have been used as the basis for this surface runoff and groundwater flooding zone as they broadly encompass the break of slope between the northern slope of the Yorkshire Wolds and the Vale of Pickering, and encapsulate the majority of the reported flood incidents in this area.

6.4.3 Coastal belt – Burniston to Filey (Zone B)

A number of surface runoff flooding incidents have been reported along the coastal zone of Northeast Yorkshire. A soil zone, stretching from around Burniston down to the southern extent of the study area, as defined by the Winter Rain Acceptance Potential Map[13] has been used to encapsulate the extent of these flood incidents. Soils within this zone are generally clayey, and prone to slight waterlogging.

6.4.4 The A170 – Helmsley to Seamer corridor (Zone C)

A number of surface runoff flooding incidents have been reported broadly along the break of slope between the southern slopes of the North York Moors and the Vale of Pickering. Another soil zone from the Winter Rain Acceptance Potential Map has been used to broadly define the extent of these flood incidents.

6.4.5 The North York Moors National Park (Zone D)

A large number of surface runoff flooding incidents have been identified within the North York Moors National Park. These flood events may primarily be due to the combination of intense rainfall events with steep, narrow valleys, overlain by impermeable or stony soils. For this reason the National Park boundary area has been used to define the extent of Zone D.

6.4.6 Areas susceptible to surface water flooding

6.4.6.1 Derivation

The Making Space for Water report (2006)[14] defines a surface water flooding event as being derived from "*rainfall generated overland flow before the runoff enters any watercourse or sewer. Usually associated with high intensity rainfall (typically >30mm/hr) resulting in overland flow and ponding in depressions in the topography, but can also occur with lower intensity rainfall or melting snow where the ground is saturated, frozen, developed or otherwise has low permeability. Urban underground sewerage/drainage systems and surface watercourses may be completely overwhelmed, preventing drainage. Surface water flooding does not include sewer surcharge in isolation.*"

The EA have recently released national mapping data which shows areas susceptible to surface water flooding[15]. This information has been produced using a relatively simplified method which routes rainfall over the ground (as represented by a digital terrain model) to identify flowpaths and areas where water may pond. The method excludes buildings and underground and smaller over-ground drainage systems.

The mapping shows three bandings, indicating 'less', 'intermediate' and 'more' vulnerability to surface water flooding. The 'more' band can help identify those areas which have a natural vulnerability to:

- flood first;
- flood deepest;
- and/or flood for relatively frequent, less extreme events (when compared to the other bands)

It is important to note that even if a particular location or settlement contains no areas which are 'more' susceptible to flooding, there will still be some areas which are more vulnerable to surface water flooding than others when assessed at a local level. The maps give a broad indication of the risk of surface water flooding for an area. It is noted that surface water flooding is possible in any location, even those shown outside the zones shown as being susceptible.

[13] Institute of Hydrology (1976) Winter Rain Acceptance Map. Flood Studies Report. NERC.
[14] *Making Space for Water - Flooding from other sources* (HA4a), 2006, JBA Consulting)
[15] *Areas Susceptible to Surface Water Flooding*, Environment Agency, 2009.

6.4.7 Use of 'areas susceptible to surface water flooding' maps

The maps have been produced to be used within spatial planning to highlight areas particularly susceptible to surface water flooding and those where a more detailed study of surface water may be required. Within the SFRA the maps can be used to inform development allocations within the LDD and highlight sites which require a further site-specific flood risk assessment to be carried out.

It is important to note that the maps should not be used as the sole evidence for any specific planning decision at any scale. Instead the maps should be used in conjunction with other existing information (e.g. historical information, other models) to gain a better understanding of potential surface water flood risk at the site. Improvements to the maps are currently being undertaken and should be available in Summer 2010. Users should refer to the updated maps when they become available.

A further proviso to the use of the mapping information is that it should not be plotted against OS background maps with a scale greater than 1:50,000. This is to prevent a portrayal that the accuracy of the data is suitable for such detailed mapping. For this reason standalone maps showing 'Areas Susceptible to Surface Water Flooding' have been produced for Northeast Yorkshire. These maps (Figures 6.3.2 to 6.3.9) are set at a fixed scale of 1:50,000 and so generally encompass more than one key settlement. Figure 6.3.1 shows the distribution of susceptible areas across the study area.

These maps should be used in conjunction with the Surface Water Sensitive Zones (Figure 6.4) to help locate development away from areas where surface water may pose a particular flood risk, and also identify those areas where additional consideration should be given to the management of surface water.

6.5 Mapping 'Critical Drainage Areas'

The Town and Country Planning Order[16] introduces the concept of Critical Drainage areas as "*an area within Flood Zone 1 which has critical drainage problems and which has been notified… [to]…the local planning authority by the Environment Agency*".

In certain locations throughout Northeast Yorkshire an increase in the volume or rate of runoff from a site may increase the degree of flood risk elsewhere in the catchment. Such areas will be sensitive to the drainage system implemented within a particular development site, as the drainage system design will determine site runoff rates and volumes.

These areas have been termed Critical Drainage Areas but have not been limited to locations solely within Flood Zone 1 as it is considered that drainage is a key consideration within any Flood Zone. The following locations are included in these areas:

- Areas that drain behind flood defences. Such areas may become 'flood-locked' during periods of high levels in the receiving watercourse. During such instances the 'flood-locked' watercourse may require pumping to prevent ponding of surface water behind the defence. Any increase in the rate or volume of water draining behind the defence will increase the degree of flood risk as increased pumping would be required to manage water levels. This also includes water originating from springs behind the defences.
- Catchment areas of former 'Critical Ordinary Watercourses'. The initial Northeast Yorkshire SFRA (to PPG25 compliance) identified that specific drainage criteria should be applied within catchments draining to 'Critical Ordinary Watercourses'. These are watercourses which have known flooding problems and therefore any increase in the rate or volume of water entering the watercourse may exacerbate that flood risk. This terminology is no longer in use (these watercourses are now simply 'Main Rivers') but the flood risk problems remain. It is therefore considered that particular regard should

[16] Town and Country Planning (General Development Procedure) (Amendment) (No. 2) (England) Order 2006

be paid to drainage within these catchments and so they should also be considered as Critical Drainage Areas.

Such locations have been identified within Northeast Yorkshire and are displayed in Figure 6.4, and also within the 'Key' settlement descriptions in Sections 10 and 11.

It is acknowledged in the guidance documentation that the 'Areas Susceptible to Surface Water Flooding' maps (see Section 6.4.6 above) can be used to help identify areas having critical drainage problems. Whilst the maps themselves do not show areas with critical drainage problems, they must be used in conjunction with local data to help identify and corroborate these areas and must not be used as the sole evidence to approve or reject a site of flooding grounds. The 'Key' settlement descriptions in Sections 10 and 11 provide further discussion regarding the identification of Critical Drainage Areas.

7 Policy recommendations for forward planning

In order to assist planners within Northeast Yorkshire a series of policy recommendations have been developed as part of the SFRA to provide advice on the practical implementation of the policies contained within PPS25. This Section outlines recommended policies for Forward Planning. Section 8 contains recommended guidance for development control staff.

As part of the preparation of the LDF, site allocations must be made to identify areas where major developments are expected. When making site allocations planners are required to consider a variety of material planning considerations, including the need for housing and the re-development of previously developed land (PPS3), sustainable development in rural areas (PPS7) and biodiversity and geological conservation (PPS9). Flood risk is one of these material planning considerations and PPS25 seeks to help deliver sustainable development by avoiding, reducing and managing that risk.

The need to take flood risk into account when considering the allocation of sites is clearly explained in PPS25 (Point 7.0), the RSS (Policy ENV1) and existing Local Plans (Appendices C, D and E). Certain types of development are more vulnerable than others to the potential impacts of flooding, and as such the type of acceptable development varies with the degree of flood risk. Table 7.1 summarises the types of development by flood risk vulnerability which are acceptable within each Flood Zone, as defined by PPS25. Table 7.2 provides a summary of PPS25 Table D2 which classifies development type by flood risk vulnerability[17].

The existing Planning Policy Statement provides policy on development and flood risk while the accompanying Practice Guide contains general guidance on its application. The following sections provide guidance on how this SFRA can be used to apply this policy in practice within Northeast Yorkshire.

A flowchart outlining a recommended approach to the application of the PPS25 Sequential and Exception Tests has been prepared to assist Forward Planning staff in site allocation for the Local Development Framework (Appendix F). Use of this flowchart refers Forward Planning staff to the appropriate Planning Policy Recommendation to be reviewed for a given site, and can be used as a check that site allocation is consistent with the rationale of PPS25.

[17] The consultation on proposed amendments to PPS25 (see Section 6.2 for further details) proposes four amendments to the classifications shown in Table D2 of PPS25. Until such time as the proposed amendments are adopted into the policy the existing classifications should be used.

Table 7.1. PPS25 Flood Risk Vulnerability and Flood Zone Compatibility (PPS25 Table D3)

Flood Risk Vulnerability:	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone 1	✓	✓	✓	✓	✓
Flood Zone 2	✓	✓	Exception Test required	✓	✓
Flood Zone 3a	Exception Test required	✓	×	Exception Test required	✓
Flood Zone 3b Functional Floodplain	Exception Test required	✓	×	×	×

✓ = Development is appropriate
× = Development should not be permitted

Table 7.2. Flood Risk Vulnerability Classification (PPS25 Table D2)[18]

Flood Risk Vulnerability	Development Type
Essential Infrastructure	Essential transport infrastructure and strategic utility infrastructure
Highly Vulnerable	Police, ambulance and fire stations
	Basement dwellings
	Permanent residence caravans and mobile homes
More Vulnerable	Hospitals
	Residential institutions
	Dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels
	Non-residential uses for health services, nurseries and education
	Landfill and hazardous waste management sites
	Holiday or short-let caravans and camping
Less Vulnerable	Shops, offices and general industry
	Water and sewage treatment plants
Water Compatible	Flood control, water and sewage transmission infrastructure
	Docks, marinas, wharves and navigation facilities
	Water-based recreation (excl. sleeping accommodation) and amenity open space
	Lifeguard and coastguard stations

[18] This table is a summary only, refer to PPS25 Table D2 for a fuller list of property vulnerability classifications.

Forward Planning (FP) Policy Recommendations have been prepared for the following flood risk issues:

- FP Policy Recommendation 1: Development in Flood Zone 1
- FP Policy Recommendation 2: Development in Flood Zone 2
- FP Policy Recommendation 3a: Development in Flood Zone 3a (including separate FP Policy Recommendations for Zones 3a(i), 3a(ii) and 3a(iii) as defined in the SFRA).
- FP Policy Recommendation 3b: Development in Flood Zone 3b
- FP Policy Recommendation A: Development in areas at risk of surface runoff/groundwater flooding
- Drainage Policy Guidance: Sustainable drainage (see Section 9).

PPS25 Flood Zone 3a is defined as land with an annual probability of flooding of greater than 1% for fluvial flooding or 0.5% for tidal flooding, but which is NOT classified as Functional Floodplain. For the purposes of this SFRA three different policies for new development have been developed for Zone 3a (see Table 7.3), depending on the standard of protection provided by existing flood defences (if any).

The policy recommendations below could be included in a Development Plan Document. Local Planning Authorities may also wish to consider including the development control guidance (Section 8) in the same DPD. Alternatively, they may wish to include the development control guidance in a separate Supplementary Planning Document.

Table 7.3. Forward Planning Policy Recommendations within Flood Zone 3a.

SFRA Policy Recommendation	Sub-Zone Description
3a(i)	Applicable for those developed areas at high risk of flooding which are not currently defended to an appropriate minimum standard as defined by Defra.
3a(ii)	Applicable for those developed areas at high risk of flooding which are currently defended to the appropriate minimum standard as defined by PPS25 (annual probability of 1% for fluvial flooding and 0.5% for flooding from the sea).
3a(iii)	Applicable for those developed areas at high risk of flooding which are currently defended to the appropriate minimum standard for existing development as defined by Defra (annual probability of 2% for fluvial flooding and 1 % for flooding from the sea) but are not defended to the appropriate minimum standard for new development as defined by PPS25 (annual probability of 1% for fluvial flooding and 0.5% for flooding from the sea).

7.1 FP Policy Recommendation 1: Areas at little or no risk of flooding

This policy recommendation should be read in conjunction with the flowchart in Appendix F.

Flood Zone 1 is defined as having an annual probability of flooding of less than 0.1%.

PPS25 recommends that in this zone there are no constraints on the allocation of sites due to river, tidal or coastal flooding.

If a potential site lies within or close to one of the key settlements identified in the SFRA it is recommended that the section of the SFRA relating to this key settlement is reviewed (see Sections 10 and 11) before a site allocation is made. Other potential sources of flood risk (e.g. surface runoff flow, groundwater, sewer flooding) and the impact that the allocated development could have on surface water runoff should be considered before making a decision on site allocation.

Runoff rates for developments in this zone should be restricted to an appropriate runoff rate and the implementation of sustainable drainage systems should be the default drainage measures (see Section 9.2). Site allocations should include a suitable allowance for green spaces in which SuDS may be located, if practicable. Refer to Section 9 for further details on Drainage Policy.

The Practice Guide acknowledges that the Environment Agency Flood Zones do not take potential climate change impacts into account but highlights that PPS25 requires that the spatial planning process should. It should be appreciated when making land allocation decisions that some sites may be sensitive to the potential change in flood risk due to climate change. A qualitative assessment of the sensitivity of a site to the potential impact of climate change on flood levels should be made before a site is allocated. Further details on the relevant sensitivity of sites to climate change may be found in the 'key' settlement descriptions (Sections 10 and 11). If two sites within Flood Zone 1 are equal in all other respects, the site which is less sensitive to climate change effects should be preferred for allocation.

Within this Zone mitigation measures relating to flooding from river, tidal or coastal flooding will only be required if the site is at potential risk due to climate change (Section 12).

The Environment Agency may need to be consulted regarding certain types of development within Flood Zone 1. Refer to Appendix G for further details.

7.2 FP Policy Recommendation 2: Areas at a low to medium risk of flooding

This policy recommendation should be read in conjunction with the flowchart in Appendix F.

Flood Zone 2 is defined as having an annual probability of flooding of between 1% and 0.1% for fluvial flooding and 0.5% and 0.1% for tidal flooding[19].

PPS25 states that this Zone is suitable for the majority of developments with the exception of those classified as 'Highly Vulnerable' (see Table 7.1). These development types are only acceptable within this Zone if they pass the requirements of the Exception Test. If other material planning considerations make it necessary for a site to be allocated for 'Essential Infrastructure' within this Zone it must be ensured that this infrastructure would remain safe and operational during an extreme (0.1%) flood event.

If a potential site lies within or close to one of the key settlements identified in the SFRA it is recommended that the section of the SFRA relating to this key settlement is reviewed (see Sections 10 and 11) before a site allocation is made. Other potential sources of flood risk (e.g. surface runoff, groundwater, sewer flooding) and the impact that the allocated development could have on surface water runoff should be considered before making a decision on site allocation.

It should be appreciated that the extents of Flood Zones as mapped in the Environment Agency Flood Zone map are indicative only, and that in many cases the difference in level between the 1% and 0.1% flood event may be smaller than is suggested by the difference in the extent of Flood Zones 2 and 3. It is therefore possible that site-specific FRAs may find that part or all of an area which is mapped as Flood Zone 2 is actually below the 1% flood level (i.e. actually lies within Flood Zone 3). A suitably cautious approach should therefore be taken when considering the allocation of sites within Flood Zone 2.

The Practice Guide acknowledges that the Environment Agency Flood Zones do not take potential climate change impacts into account but highlights that PPS25 requires that the spatial planning process should. It should be appreciated when making land allocation decisions that some sites may be sensitive to the potential change in flood risk due to climate change. A qualitative assessment of the sensitivity of a site to the potential impact of climate change on flood levels should be made before a site is allocated. Further details on the relevant sensitivity of sites to climate change may be found in the 'key' settlement descriptions (Sections 10 and 11). If two sites within Flood Zone 2 are equal in all other respects, the site which is less sensitive to climate change effects should be preferred for allocation.

Runoff rates for developments in this zone should be restricted to an appropriate runoff rate and the implementation of sustainable drainage systems should be the default drainage measures (see Section 9.2). Site allocations should include a suitable allowance for green spaces in which SuDS may be located, if practicable. Refer to Section 9 for further details on Drainage Policy.

Before allocating a site for development in Flood Zone 2, an assessment of the feasibility of providing the flood risk management measures which are likely to be required at the development site should be made. Section 8.3 details the flood risk management measures required for developments in this zone, Section 12 describes potential flood risk management measures, and their implications for development design. This assessment should include consideration of whether the site will be insurable.

The Environment Agency may need to be consulted regarding certain types of development within Flood Zone 2. Refer to Appendix G for further details.

[19] For simplicity the standard of protection for fluvial flooding has been quoted in this Policy Recommendation. For sites at risk of flooding from the sea "1%" should be replaced by "0.5%".

7.3 FP Policy Recommendation 3a(i): Developed areas at high risk of flooding without an appropriate standard of flood defence

This policy recommendation should be read in conjunction with the flowchart in Appendix F.

Zone 3a(i) is defined by PPS25 as those developed sites at high risk of flooding which are not currently defended to an appropriate minimum standard.

PPS25 states that this Zone is appropriate for 'Water Compatible' and 'Less Vulnerable' development types (see Table 7.1). 'More Vulnerable' and 'Essential Infrastructure' development types are only considered appropriate if the requirements of the Exception Test are passed. 'Highly Vulnerable' development types are **not** appropriate within this Zone.

Whilst formal defences are not present within this zone, it is possible that there are features on the floodplain that form some kind of raised defence against flooding, for example railway or road embankments. If such features exist, Rapid Inundation Zones may need to be delineated and appropriate planning procedure followed (as in Section 7.4). These features should only be relied upon to protect a new development on investigation through FRA. This should assess stability, materials, ownership and other items as described in Section 7 of the PPS25 Practice Guide.

If other material planning considerations make it necessary for a site to be allocated within this Zone it must be ensured that all new developments meet with the policy objectives of PPS25 (paragraph 5) that it must be safe without increasing flood risk elsewhere and, where possible, reduce flood risk overall. The Sequential Test should be applied at a site level and new developments be protected from flooding with an annual probability up to and including the 1% flood event, including an allowance for climate change (see Section 12). With regards to 'Essential Infrastructure' within this Zone it must be ensured that this infrastructure would remain safe and operational during an extreme (0.1%) flood event.

PPS25 requires that new developments within developed sites which are not currently defended to an appropriate standard be designed to ensure that flood risk up and downstream of the development site is not increased. Developments in this Zone should therefore not impede flood flows and should not result in a loss of flood-plain storage. Where possible measures should be incorporated to help reduce overall flood risk.

Before allocating a site for development in this Flood Zone, an assessment of the feasibility of providing the flood risk management measures which are likely to be required at the development site should be made. Section 8.4.1 details the flood risk management measures required for developments in this zone, Section 12 describes potential flood risk management measures, and their implications for development design. This assessment should include consideration of whether the site will be insurable. Provision of these measures within this Flood Zone is not a simple task and careful consideration should be given to the likelihood of such measures being achievable. In particular, it should be appreciated that:

- The allocation site should extend into Flood Zone 1 or 2 so that safe access to/from the existing road system in Flood Zone 1 is possible during a 1% flood event. Allocation of sites which would be completely surrounded by Flood Zone 3 should be avoided if possible.
- New developments within undefended areas should not lead to an increase in upstream or downstream flood risk. In order to avoid an increase in downstream flood risk measures to avoid a loss in flood plain storage (Section 12.2) are likely to be required at

allocated sites within this Zone, and the extent of allocated land should take this into account[20] .

It should be noted that the required flood risk management measures may have a significant impact on the design of a development (e.g. may lead to a requirement for finished floor levels to be significantly higher than the surrounding ground level, the types of building material may be restricted).

A sequential approach should be followed when allocating sites within this Zone, with preference being given to those sites with the lower flood risk (e.g. lower depth of flooding (Section 6.3), lower velocity of flood water, greater distance from the river channel).

If a potential site lies within or close to one of the key settlements identified in the SFRA it is recommended that the section of the SFRA relating to this key settlement is reviewed (see Sections 10 and 11) before a site allocation is made.

Other potential sources of flood risk (e.g. surface runoff flow, groundwater, sewer flooding) and the impact that the allocated development could have on surface water runoff should be considered before making a decision on site allocation. Runoff rates for developments in this zone should be restricted to an appropriate runoff rate and the implementation of sustainable drainage systems should be the default drainage measures (see Section 9). Site allocations should include a suitable allowance for green spaces in which SuDS may be located, if practicable. Refer to Section 9 for further details on Drainage Policy.

Flood risk within this zone is already high, and the potential impacts of climate change may increase the frequency and/or magnitude of flood events. It should be ensured that climate change is taken into account when planning all new developments.

The Environment Agency should be consulted regarding all development within Flood Zone 3.

[20] Compensatory flood plain storage is not required for sites which are only at risk of flooding from the sea and which serve no conveyance function.

7.4 FP Policy Recommendation 3a(ii): Developed areas at high risk of flooding with an appropriate standard of flood defence as defined by PPS25

This policy recommendation should be read in conjunction with the flowchart in Appendix F.

Zone 3a(ii) is defined as those developed sites at high risk of flooding which are currently protected to the appropriate minimum standard for new development as defined by PPS25 (annual probability of 1% including a climate change allowance) by flood defences which are in good condition and will be maintained for the lifetime of the proposed development.

PPS25 states that this Zone is appropriate for 'Water Compatible' and 'Less Vulnerable' development types (see Table 7.1). 'More Vulnerable' and 'Essential Infrastructure' development types are only considered appropriate if the requirements of the Exception Test are passed. 'Highly Vulnerable' development types are **not** appropriate within this Zone.

If other material planning considerations make it necessary for a site to be allocated within this Zone it must be ensured that all new developments meet with the policy objectives of PPS25 (paragraph 5) that it must be safe without increasing flood risk elsewhere and, where possible, reduce flood risk overall.

Rapid inundation of an area following the breach or overtopping of a flood defence has the potential to lead to structural damage, injury and/or death. A sequential approach to the allocation of sites within areas behind flood defences should therefore be followed, with preference being given to those sites where the lowest consequences of flood defence failure are anticipated.

The allocation of sites within Rapid Inundation Zones where the consequences of the defences being overwhelmed would be "risk to all people" (see Section 6.3) should be avoided, and only allocated in exceptional circumstances where other material planning considerations make such allocation necessary. This allocation should be informed by consultation with the emergency planners and emergency services and adequate mitigation measures should be identified, based on the results of two-dimensional hydraulic modelling to inform flood depths and velocities. Further detail on the degree of hazard within each rapid inundation zone can be found in Section 6.3.2.

With regards to 'Essential Infrastructure' within this Zone it must be ensured that this infrastructure would remain safe and operational during an extreme (0.1%) flood event.

Before allocating a site for development in this Flood Zone, an assessment of the feasibility of providing the flood risk management measures which are likely to be required at the development site should be made. Section 8.4.2 details the flood risk management measures required for developments in this zone. Section 12 describes potential flood risk management measures, and their implications for development design. This assessment should include consideration of whether the site will be insurable. It should be noted that the required flood risk management measures may have a significant impact on the design of a development (e.g. may lead to a requirement for finished floor levels to be significantly higher than the surrounding ground level, the types of building material may be restricted).

If a potential site lies within or close to one of the key settlements identified in the SFRA it is recommended that the section of the SFRA relating to this key settlement is reviewed (see Sections 10 and 11) before a site allocation is made.

Other potential sources of flood risk (e.g. surface runoff flow, groundwater, sewer flooding) and the impact that the allocated development could have on surface water runoff should be considered before making a decision on site allocation. Runoff rates for developments in this zone should be restricted to an appropriate runoff rate and the implementation of sustainable drainage systems should be the default drainage measures (see Section 9.2).

Site allocations should include a suitable allowance for green spaces in which SuDS may be located, if practicable. Refer to Section 9 for further details on Drainage Policy.

Flood risk within this zone is already high, and the potential impacts of climate change may increase the frequency and/or magnitude of flood events. It should be ensured that climate change is taken into account when planning all new developments.

The Environment Agency should be consulted regarding all development within Flood Zone 3.

7.5 FP Policy Recommendation 3a(iii): Developed areas at high risk of flooding with an appropriate standard of flood defence as defined by Defra but not as defined by PPS25

This policy recommendation should be read in conjunction with the flowchart in Appendix F.

Zone 3a(iii) is defined as those developed sites at high risk of flooding which are currently defended to the appropriate minimum standard for existing development as defined by Defra (annual probability of 2%) but are not defended to the appropriate minimum standard for new development as defined by PPS25 (annual probability of 1%), by flood defences which are in good condition and will be maintained for the lifetime of the proposed development.

Rapid inundation of an area following the breach or overtopping of a flood defence has the potential to lead to structural damage, injury and/or death. This Zone should be treated as if it were a developed site at high risk of flooding without an appropriate standard of flood defence (FP Policy Recommendation 3a(i), see Section 7.3), but a sequential approach to the allocation of sites within areas behind flood defences should also be followed, with preference being given to those sites where the lowest consequences of flood defence failure are anticipated.

The allocation of sites within Rapid Inundation Zones where the consequences of the defences being overwhelmed would be “risk to all people” (see Section 6.3) should be avoided, and only allocated in exceptional circumstances where other material planning considerations make such allocation necessary. This allocation should be informed by consultation with the emergency planners and emergency services and adequate mitigation measures should be identified, based on the results of two-dimensional hydraulic modelling to inform flood depths and velocities. Further detail on the degree of hazard within each rapid inundation zone can be found in Section 6.3.2.

7.6 FP Policy Recommendation 3b: 'Functional Floodplain'

This policy recommendation should be read in conjunction with the flowchart in Appendix F.

PPS25 defines Zone 3b as 'Functional Floodplain' "*land where water has to flow or be stored in times of flood*". The functional floodplain includes water conveyance routes and flood storage areas (sometimes referred to as washlands). This Zone should be identified as:

- all areas within Flood Zone 3 which are located outside of currently developed sites and are not defended to a proven standard of protection of at least 5%. This includes all floodplain areas behind agricultural flood banks (Section 6.2.2).

The functional floodplain extent has been delineated based on this definition and in the absence of a CFMP for the study area. When the CFMP becomes available (estimated for summer 2010), the CFMP delineation of functional floodplain should replace delineation of functional floodplain in the current SFRA (see Section 6.2.2), in conjunction with consultation with the Environment Agency.

This method of functional floodplain delineation is considered relatively conservative, due to the absence of more quantifiable information. Until such time as further information is available (e.g. CFMP) it places the onus on the promoting authority/developer to demonstrate that the site should **not** be considered as Zone 3b. This requirement should be borne in mind during application of the Sequential Test.

PPS25 states that Flood Zone 3b is appropriate for 'Water Compatible' development types only (see Table 7.1). 'Essential Infrastructure' development types are only considered appropriate if the requirements of the Exception Test are passed. If other material planning considerations make it necessary for a site to be allocated for 'Essential Infrastructure' within this Zone it must be ensured that this infrastructure would remain safe and operational during an extreme (0.1%) flood event. All other development types are **not** appropriate within this Zone.

Whilst formal defences are not present within this zone, it is possible that there are features on the floodplain that form some kind of raised defence against flooding, for example railway or road embankments. If such features exist, Rapid Inundation Zones may need to be delineated and appropriate planning procedure followed (as in Section 7.4). These features should only be relied upon to protect a new development on investigation through FRA. This should assess stability, materials, ownership and other items as described in Section 7 of the PPS25 Practice Guide.

Any new development within this Zone must not increase flood risk elsewhere (see Section 12.2) or affect the functionality of the floodplain to store[21] or convey water. Similarly the development should be designed to ensure the safety of occupants, with evacuation procedures clearly defined.

If a potential site lies within or close to one of the key settlements identified in the SFRA it is recommended that the section of the SFRA relating to this key settlement is reviewed (see Sections 10 and 11) before a site allocation is made.

Other potential sources of flood risk (e.g. surface runoff, groundwater, sewer flooding) and the impact that the allocated development could have on surface water runoff should be considered before making a decision on site allocation. Runoff rates for developments in this zone should be restricted to an appropriate runoff rate and the implementation of sustainable drainage systems should be the default drainage measures (see Section 9.2). Site allocations should include a suitable allowance for green spaces in which SuDS may be located, if practicable. Refer to Section 9 for further details on Drainage Policy.

[21] Compensatory flood plain storage is not required for sites which are only at risk of flooding from the sea and which serve no conveyance function.

The Environment Agency should be consulted regarding all development within Flood Zone 3.

7.7 FP Policy Recommendation A: Areas at risk of surface water and/or groundwater flooding

This policy recommendation should be read in conjunction with the flowchart in Appendix F.

This Policy Recommendation relates to those areas which have been mapped as being potentially at risk of surface water and/or groundwater flooding, and for those areas which are close to areas where such flooding has occurred previously. These recommendations are also relevant to those areas where sewer flooding is likely to be an issue (Section 5.2.5).

The type of development to be permitted in this area will depend on the PPS25 Flood Zone within which it lies.

Within these areas, sites which may have a high susceptibility to surface water and/or groundwater flooding may include areas which are:

- identified as 'Areas Susceptible to Surface Water Flooding' (figures 6.3.1 to 6.3.9)
- at or close to sites of previous flooding incidents;
- downslope of areas of development without formal drainage systems
- downslope of areas of ploughed agricultural fields or other disturbed land;
- at a break of slope;
- served by an existing land drainage system;
- at the same level as, or near to, known springs;
- at a lower level than the ground or some other feature (e.g. road) downslope of the site, which may cause water to pond behind it.

If a potential site lies within or close to one of the key settlements identified in the SFRA it is recommended that the section of the SFRA relating to this key settlement is reviewed (see Sections 10 and 11) before a site allocation is made.

A Sequential Approach to site allocation should be made in this 'zone'. The susceptibility to surface water/groundwater flooding should be assessed on a site by site basis within this 'zone'. Unless other material planning considerations make such allocations necessary **and** the development can incorporate appropriate mitigation measures then sites with characteristics (see above) which suggest that the risk of surface water/groundwater flow is high should be avoided for site allocation.

Before allocating a site for development in this 'zone', an assessment of the feasibility of providing the flood risk management measures which are likely to be required at the development site (see Section 12) should be made. This should include consideration of whether the site will be insurable.

The impact that the allocated development could have on surface water runoff should be considered before making a decision on site allocation. Runoff rates for developments in this zone should be restricted to an appropriate runoff rate (Section 9.2) and the implementation of Sustainable Drainage Systems (SuDS) should be the default position, with other drainage measures only considered if sustainable drainage is not viable in any form. Site allocations should include a suitable allowance for green spaces in which SuDS may be located, if practicable. Refer to Section 9 for further details on Drainage Policy.

8 Guidance for consideration of planning applications

In order to assist both planners and developers within Northeast Yorkshire policy guidance has been developed as part of the SFRA to provide advice on the practical implementation of the guidance contained within PPS25. Section 7 contains recommended policies for Forward Planning. This Section outlines recommended policies for Development Control.

Flood risk is a material planning consideration which should be taken into account when making a determination for planning permission. PPS25 advises that those proposing development are responsible for:

- demonstrating that it is consistent with the policies in PPS25 and those on flood risk in the LDD;
- demonstrating:
  - whether current or future flooding from any source is likely to be an issue;
  - satisfying the LPA that the development is safe and where possible reduces flood risk overall;
  - demonstrating whether flood risk elsewhere will be increased;
  - the measures proposed to deal with these effects and risks.
- designs which reduce flood risk to the development and elsewhere, by incorporating SuDS 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.

As such, a Flood Risk Assessment should be submitted with any planning application (for full or outline planning permission) where flood risk is a concern. The detail provided within a Flood Risk Assessment should be appropriate to the scale of the development and the significance of flood risk issues[22]. The Environment Agency have produced Standing Advice which outlines the scope of Flood Risk Assessments which may be expected for various development types, dependent on the level of flood risk at the development site. A copy of the current Standing Advice is provided in Appendix G.

A summary of the information required to complete a Flood Risk Assessment within each Flood Zone is provided in Table 8.1. With regard to who can undertake a Flood Risk Assessment, it is recommended that for a minor development where there is not a significant flood risk the developer may be able to undertake the Flood Risk Assessment themselves. For larger developments, and those developments with a significant flood risk, it is recommended that the Flood Risk Assessment is undertaken by a competent individual, with previous experience of Flood Risk Assessments. The Environment Agency may be able to provide contact details of firms who can provide Flood Risk Assessment services.

PPS25 provides general policy on development and flood risk while the PPS25 Practice Guide provides general guidance on how to implement its policies in practice. **The following sections provide guidance on how this SFRA can be used to apply this policy in practice when considering and submitting planning applications within Northeast Yorkshire.** This guidance takes due cognizance of current Environment Agency policies and procedures. Guidance has been prepared for several flood risk issues:

- Guidance 1: Development in Flood Zone 1
- Guidance 2: Development in Flood Zone 2

[22] CIRIA Report C624 provides further information on how to undertake a Flood Risk Assessment. This report also includes a useful checklist of the issues which generally arise when designing developments to manage flood risk. This checklist can be downloaded free of charge from the CIRIA website as part of the "Flood Risk Assessment Toolkit" (http://www.ciria.org/downloads.php?id=C624PartC).

- Guidance 3a: Development in Flood Zone 3a (including separate guidance for Zones 3a(i), 3a(ii) and 3a(iii) as defined in the SFRA).
- Guidance 3b: Development in Flood Zone 3b
- Guidance A: Development in areas at risk of surface runoff/groundwater flooding
- Drainage Guidance: Sustainable drainage (Section 9)

This guidance could be included in the same DPD as the forward planning policy recommendations (Section 7) or in a separate SPD.

It is recommended that a developer takes the following steps before a planning application or pre-application enquiry is lodged. A development control officer should undertake these steps upon receiving a planning application or pre-application enquiry:

- Review the flood hazard map of Northeast Yorkshire to assess the PPS25 Flood Zone within which the proposed development site is located (Figure 5.1)
- Review the Groundwater/Surface Water flood hazard map (Figure 6.3), Areas Susceptible to Surface Water Flooding maps (Figures 6.3.1 to 6.3.9), Critical Drainage Area Map (Figure 6.4), and relevant settlement description (Sections 10 and 11)
- Review relevant guidance within the SFRA.

Table 8.1. Information required to complete a Flood Risk Assessment within each PPS25 Flood Zone.

Information Required	Flood Zone							Relevant Report Section
	1	*2*	*3a(i)*	*3a(ii)*	*3a(iii)*	*3b*	*3c*	
Proof of Flood Zone status	✓	✓						10, 11, Figure 5.1
Other flood mechanisms considered (e.g. Groundwater, surface runoff, local drainage)? If appropriate, management measures proposed	✓	✓	✓	✓	✓	✓	✓	6.3, 12
If in area at risk from groundwater and/or surface water flooding, potential management measures do not increase flood risk elsewhere	✓	✓	✓	✓	✓	✓	✓	6.3, 12
Check if site lies in Critical Drainage Area	✓	✓	✓	✓	✓	✓	✓	6.4, 9
Appropriate surface water management systems proposed	✓	✓	✓	✓	✓	✓	✓	9
Assessment of climate change impact	✓	✓	✓	✓	✓	✓	✓	5.7
Compliance with EA Standing Advice	✓	✓	✓	✓	✓	✓	✓	Appendix G
Referral to relevant information within SFRA	✓	✓	✓	✓	✓	✓	✓	
Development adequately protected against flooding to appropriate standard of protection		✓	✓	✓	✓	✓	✓	12
Adequate access and egress arrangements during flood events		✓	✓	✓	✓	✓	✓	12
Development will not increase flood risk upstream			✓	✓	✓	✓	✓	12
Development will not increase flood risk downstream			✓	✓	✓	✓	✓	12.2
All developments types within RIZ '*Danger to All People*', assessment of defence overtopping/failure consequences, and appropriate management measures incorporated				✓	✓			6.2
'More Vulnerable' developments within RIZ '*Danger to Most People*', assessment of defence overtopping/failure consequences, and appropriate management measures incorporated				✓	✓			6.2
'Less Vulnerable' and 'Water Compatible' developments within RIZ '*Danger to Most People*', appropriate defence overtopping/failure management measures incorporated				✓	✓			6.2
All appropriate Flood Zone 3 development types within RIZ '*Danger to Some People*', appropriate defence overtopping/failure management measures incorporated				✓	✓			6.2

8.1 Role of Emergency Planners and Emergency Services

Emergency planners within the LPA should be familiar with the SFRA and use it to identify areas at risk of flooding, including residual flood risk behind defences. Roles of emergency planners within the LPA include:

- Within Rapid Inundation Zones, identification of safe places for rescue by the emergency services.
- Work with Local Resilience Forums to ensure the risks from flooding are fully considered, including the resilience of emergency infrastructure that will have to operate during floods.
- Provision of advice to developers producing an evacuation plan for a development.

The role of the Emergency Services is outlined in the PPS25 Practice Guide as follows ”Emergency Services should be consulted during the preparation of LDDs and the consideration of planning applications where emergency evacuation requirements are an issue. There is no statutory requirement on the Environment Agency or the emergency services to approve evacuation plans. The LPA is accountable via planning condition or agreement to ensure that plans are suitable. This should be done in consultation with local authority emergency planning staff”.

8.2 Development Control (DC) Guidance 1: Areas at little or no risk of flooding

Zone 1 is defined as having an annual probability of flooding of less than 0.1%.

PPS25 identifies no constraints on development due to river, tidal or coastal flooding in Zone 1.

Flood risk should be assessed in accordance with Environment Agency standing advice (Appendix G). A Flood Risk Assessment (FRA) would not normally be expected in Flood Zone 1 unless the development footprint is greater than 1 hectare, or the site is at risk from flooding from another source (e.g. groundwater/surface water), or the site is within a Critical Drainage Area. In these cases it is recommended that an FRA is requested and reviewed by the LPA for all development categories except Domestic Extensions. The LPA should ensure that the FRA demonstrates that:

- The development is within Zone 1. Refer to Figure 5.1 and the relevant settlement description (Section 10 and 11).
- Potential groundwater/surface water/local drainage flood risk has been considered and, if appropriate, suitable flood risk management measures are proposed. Refer to Sections 6.4 and 12.
- It has been checked whether or not the site lies within a Critical Drainage Area and, if so, suitable drainage management measures are proposed. Refer to Sections 6.5 and 9.
- Suitable surface water management systems are proposed to manage runoff in an appropriate manner (Section 9).
- The potential impacts of climate change on flood risk to the development have been assessed and appropriate mitigation measures are proposed. Refer to Section 3.7.
- The FRA complies with Environment Agency Standing Advice (as appropriate, see below).
- The relevant information within this SFRA has been taken into account and applied to the proposed development site.

If the FRA does not demonstrate the above and/or the residual flood risk to the proposed development is unacceptable the planning application should be refused.

The Environment Agency will not generally need to be involved in consultation or review of the FRA unless:

- the proposed development is an operational development greater than 1 ha:
- the development lies within the bye-law distance (20 m) of the bank top of a Main River;
- the development includes any temporary or permanent works which will restrict or control flows within any river or stream;
- the development includes any proposed culverting works within any river or stream.

The respective Internal Drainage Board (if any) should also be consulted with regard to any proposed development within their jurisdictional area.

The detail and technical complexity of the FRA should reflect the scale and potential significance of the development. Further details on the appropriate response to planning applications for sites within this zone, including the scope of the Flood Risk Assessment, can be found in the Environment Agency Standing Advice (Appendix G).

8.3 DC Guidance 2: Areas at low to medium risk of flooding

Zone 2 is defined as having an annual probability of flooding of between 1% and 0.1% for fluvial flooding and 0.5% and 0.1% for tidal flooding[23].

Applications for Planning Permission for 'Highly Vulnerable' development types within Zone 2 should only be accepted if it can be demonstrated that the development passes the requirements of the Exception Test[24]. All other development types should be suitable, providing an appropriate Flood Risk Assessment has been submitted (see below).

For development proposals within Flood Zone 2 the Sequential Test should be applied to individual application sites if they have not already been tested through the allocation stage.

The sequential test will need to be applied in the following cases:

- if the site is located within an area not allocated in the plan
- if the site location has not yet been allocated in the LDD
- if the proposed use is not in accordance with the land use allocation in the LDD
- windfall sites in areas which have not been sequentially tested within the LDD

For regeneration sites in Flood Zone 2 a sequential approach to site layout should be followed as these sites cannot be located elsewhere. The developer will be responsible for assembling the evidence for the application and the LPA planning officer will be responsible for carrying out the Sequential Test.

It is recommended that flood resistant construction methods are used in developments within Zone 2 to minimise the potential for damage if a flood in excess of the 1% flood event occurs.

It is recommended that a Flood Risk Assessment (FRA) is requested and reviewed by the LPA for all development categories. The LPA should ensure that the FRA demonstrates that:

- The development is within Zone 2 (if any part of the development before flood risk management measures are implemented is located below the 1% flood level the development should be assessed as a Zone 3 development). Refer to Figure 5.1 and the relevant settlement description (Section 10 and 11).
- The development will be adequately defended against flooding to an appropriate standard of protection without increasing the degree of flood risk to any third party. Refer to Section 12.
- If the development is 'Essential Infrastructure', that this will remain safe and operational during an extreme (0.1%) flood event. Refer to Section 12.
- Potential groundwater/surface water/local drainage flood risk has been considered and, if appropriate, suitable flood risk management measures are proposed. Refer to Sections 6.4 and 12.
- It has been checked whether or not the site lies within a Critical Drainage Area and, if so, suitable drainage management measures are proposed. Refer to Sections 6.5 and 9.
- Suitable surface water management systems are proposed to manage runoff in an appropriate manner (Section 9).

[23] For simplicity the standard of protection for fluvial flooding has been quoted in this Guidance Note. For sites at risk of flooding from the sea "1%" should be replaced by "0.5%".
[24] 'Highly Vulnerable' sites within Flood Zone which successfully pass the Exception Test will also need to submit an appropriate Flood Risk Assessment which addresses development within this Zone.

- The potential impacts of climate change on flood risk to the development have been assessed. Refer to Section 3.7.
- The FRA complies with Environment Agency Standing Advice (as appropriate, see below).
- The relevant information within this SFRA has been taken into account and applied to the proposed development site.

If the FRA does not demonstrate the above and/or the residual flood risk to the proposed development is unacceptable the planning application should be refused.

The Environment Agency will not generally need to be involved in consultation or review of the FRA unless:

- **the proposed development site is greater than 1 ha;**
- **the proposed development type is classified as 'Highly Vulnerable' or 'Essential Infrastructure'**
- **the proposed development type is 'More Vulnerable' containing landfill/waste facilities or caravans and camping;**
- **the proposed development type is 'Less Vulnerable' containing land/building used for agriculture or forestry, waste treatment, mineral workings and processing, water treatment plants, or sewage treatment plants;**
- **the development lies within the bye-law distance (20 m) of the bank top of a Main River;**
- **the development includes any temporary or permanent works which will restrict or control flows within any river or stream;**
- **the development includes any proposed culverting works within any river or stream.**

The respective Internal Drainage Board (if any) should also be consulted with regard to any proposed development within their jurisdictional area.

Further details on the appropriate response to planning applications for sites within this zone, including the scope of the Flood Risk Assessment, can be found in the Environment Agency Standing Advice (see Appendix G).

8.4 DC Guidance within Zone 3a: Developed areas at high risk of flooding

PPS25 Zone 3a covers those areas which have an annual probability of flooding of greater than 1% for fluvial flooding or 0.5% for tidal flooding[25] but are not 'Functional Floodplain' (see Section 6.2.2). Unless explicitly defined in the relevant key settlement description (Sections 10 and 11), all currently developed sites within Flood Zone 3, are defined as Zone 3a.

For the purposes of this SFRA different guidance has been developed for Zone 3a, depending on the standard of protection provided by existing flood defences (if any):

- DC Guidance 3a(i): is applicable for those developed areas at high risk of flooding which are not currently defended to the appropriate minimum standard as defined by Defra.
- DC Guidance 3a(ii): is applicable for those developed areas at high risk of flooding which are currently defended to the appropriate minimum standard as defined by PPS25 (annual probability of 1% for fluvial flooding and 0.5% for flooding from the sea).
- DC Guidance 3a(iii): is applicable for those developed areas at high risk of flooding which are currently defended to the appropriate minimum standard for existing development as defined by Defra (annual probability of 2% for fluvial flooding and 1 % for flooding from the sea) but are not defended to the appropriate minimum standard for new development as defined by PPS25 (annual probability of 1% for fluvial flooding and 0.5% for flooding from the sea).

For development proposals within Flood Zone 3 the Sequential Test should be applied to individual application sites if they have not already been tested through the allocation stage.

The sequential test will need to be applied in the following cases:

- if the site is located within an area not allocated in the plan
- if the site location has not yet been allocated in the LDD
- if the proposed use is not in accordance with the land use allocation in the LDD
- windfall sites in areas which have not been sequentially tested within the LDD

For regeneration sites in Flood Zone 3 a sequential approach to site layout should be followed as these sites cannot be located elsewhere. The developer will be responsible for assembling the evidence for the application and the LPA planning officer will be responsible for carrying out the Sequential Test.

[25] For simplicity the standard of protection for fluvial flooding has been quoted in this Guidance Note. For sites at risk of flooding from the sea "1%" should be replaced by "0.5%".

8.4.1 DC Guidance 3a(i): Developed areas at high risk of flooding without an appropriate standard of flood defence

PPS25 Zone 3a(i) is defined as those developed sites at high risk of flooding which are not currently defended to the appropriate minimum standard as defined by Defra.

Applications for Planning Permission for 'Less Vulnerable' and 'Water Compatible' development types should be acceptable in this Zone, provided that an appropriate Flood Risk Assessment is submitted (see below). Applications for Planning Permission for 'More Vulnerable' and 'Essential Infrastructure' development types within Zone 3a(i) should only be permitted if there is evidence to support that the development passes the requirements of the Exception Test[26]. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood. 'Highly Vulnerable' development types are **not** appropriate within this Zone.

Whilst formal defences are not present within this zone, it is possible that there are features on the floodplain that form some kind of raised defence against flooding, for example railway or road embankments. If such features exist, Rapid Inundation Zones may need to be delineated and appropriate planning procedure followed (as in Section 8.4.2). These features should only be relied upon to protect a new development on investigation through FRA. This should assess stability, materials, ownership and other items as described in Section 7 of the PPS25 Practice Guide.

The finished floor levels of new residential developments should normally be located a suitable distance above the 1% flood level, taking into account freeboard requirements and an allowance for climate change. Commercial and industrial developments should normally have similar arrangements, unless it can be demonstrated that it is more practicable for alternative flood risk management measures (e.g. flood-resistant construction, flood warning, flood response plans) to be implemented.

All properties within this Flood Zone should be designed to withstand the effects of flooding, taking into account any high velocity water, adverse water pressures, potential debris impacts and erosion. Flood resilient/resistant measures should be incorporated in the property construction and should be designed to ensure that structural damage would not occur in the event of a flood.

Developments must be designed so that safe access to and from the development (including access by the emergency services) is possible during the 1% flood event. If this is not practicable (e.g. if it is a single house surrounded by existing houses and roads which are below flood level) the Environment Agency should be consulted regarding alternative development design options (e.g. incorporating safe refuge for occupants or users during a flood event).

It is recommended that a Flood Risk Assessment (FRA) is requested and reviewed by the LPA for all development categories. The FRA should demonstrate that:

- The development will be adequately defended against flooding with an annual probability up to and including the 1% flood event. Refer to Section 12.
- Adequate arrangements have been made for access to and from the development (including access by the emergency services) during flood events. Refer to Section 12.
- The development will not increase upstream flood risk by impeding the flow of water. Refer to Section 12.

[26] Sites within Flood Zone 3a(i) which successfully pass the Exception Test will also need to submit an appropriate Flood Risk Assessment which addresses development within this Zone.

- The development will not increase downstream flood risk by leading to a reduction in the available volume of flood plain storage[27]. Refer to Section 12.
- Potential groundwater/surface water/local drainage flood risk has been considered and, if appropriate, suitable flood risk management measures are proposed. Refer to Sections 6.4 and 12.
- It has been checked whether or not the site lies within a Critical Drainage Area and, if so, suitable drainage management measures are proposed. Refer to Sections 6.5 and 9.
- Suitable surface water management systems are proposed to manage runoff in an appropriate manner (Section 9).
- The potential impacts of climate change on flood risk to the development have been assessed. Refer to Section 3.7.
- The FRA complies with Environment Agency Standing Advice (as appropriate, see below).
- The relevant information within this SFRA has been taken into account and applied to the proposed development site.

If the FRA does not demonstrate the above and/or the residual flood risk to the proposed development is unacceptable the planning application should be refused.

The Environment Agency will normally need to be involved in consultation and review of the FRA for all proposed developments in this Zone. The exception being for domestic extensions and industrial/commercial extensions less than 250 m^2, unless:

- **the development lies within the bye-law distance (20 m) of the bank top of a Main River;**
- **the development includes any temporary or permanent works which will restrict or control flows within any river or stream;**
- **the development includes any proposed culverting works within any river or stream.**

The respective Internal Drainage Board (if any) should also be consulted with regard to any proposed development within their jurisdictional area.

Occasionally, major developments within currently undefended developed areas may provide the opportunity to provide flood defences which also benefit properties in the wider community. If the developer funds the provision of new flood defences to protect the new development and the wider flood cell within which it lies, this may lead to the classification of the flood plain such that Policy Guidance 3a(ii) may apply to the new development. **If such an opportunity is identified this should be discussed with the Environment Agency at an early stage in development planning.**

Further details on the appropriate response to planning applications for sites within this zone, including the scope of the Flood Risk Assessment, can be found in the Environment Agency Standing Advice (see Appendix G).

[27] Compensatory flood plain storage is not required for sites which are at risk only from flooding from the sea and which serve no conveyance function.

8.4.2 DC Guidance 3a(ii): Developed areas at high risk of flooding with an appropriate standard of flood defence as defined by PPS25

Zone 3a(ii) is defined as those developed sites at high risk of flooding which are currently protected to the appropriate minimum standard for new development as defined by PPS25 (annual probability of 1%[28]) by high quality flood defences.

Applications for Planning Permission for 'Less Vulnerable' and 'Water Compatible' development types should be acceptable, provided that an appropriate Flood Risk Assessment is submitted (see below). Applications for Planning Permission for 'More Vulnerable' and 'Essential Infrastructure' development types should only be permitted within Zone 3a(ii) if it can be demonstrated that the development passes the requirements of the Exception Test[29]. 'Highly Vulnerable' development types are **not** appropriate within this Zone.

There is a residual risk of flooding from breaching or overtopping of existing flood defences in this zone. A Rapid Inundation Zone (RIZ) is an area which is at risk of rapid flooding should a flood defence structure be breached or overtopped. Risk to life in this zone is categorized into 'Danger to All People', 'Danger to Most People', and 'Danger to Some People'. PPS25 states that "*new development should be sited away from existing flood defences except in exceptional circumstances, where a flood risk assessment shows how the building and its users will be made safe*".

In the case of areas classified as 'Danger to All People' the level of risk is such that all parties, including emergency services, would be at risk. Development in such areas should only be in very exceptional circumstances, the local emergency planners and emergency services should be consulted and detailed two-dimensional hydraulic modelling should be undertaken to inform predicted flood depths and velocities.

For all developments proposals within Flood Zone 3, an accompanying FRA is required to demonstrate how flood risk to the development, and arising from the development, will be managed. For developments located in an area at residual risk of breaching or overtopping of a defence the FRA should provide evidence of how the development has been sited, designed, constructed and maintained so that the consequences of a flood defence failure are managed appropriately. In all cases, this will require the finished floor levels of new residential developments to be located a suitable distance above the 1% flood level. In other situations it may be required that other measures are provided, such as flood-resistant/resilient construction and flood response plans.

The mitigation measures will depend upon the degree of potential flood risk and the vulnerability of the development. As a minimum, all properties within this Flood Zone should be designed to withstand the effects of flooding, taking into account any high velocity water, adverse water pressures, potential debris impacts and erosion. Flood resilient/resistant measures should be incorporated in the property construction and should be designed to ensure that structural damage would not occur in the event of a flood. Detailed information can be found in 'Guidance Note S3.2 Risks to People Behind Defences – Flood Risk in Assessment Guidance for New Development Phase 2 R&D Technical report FD2320' (Defra, 2005) and in Section 7 of the PPS25 Practice Guide.

It is not normally necessary to ensure that dry access would be available to/from the development in the event of a flood defence failure, but evacuation and flood response actions should be considered. No single-storey buildings should be permitted in areas protected by flood defences as all developments should have a safe refuge for occupiers/users in the event of a flood defence failure. Living accommodation should not be

[28] For simplicity the standard of protection for fluvial flooding has been quoted in this Guidance Note. For sites at risk of flooding from the sea "1%" should be replaced by "0.5%".
[29] Sites within Flood Zone 3a(ii) which successfully pass the Exception Test will also need to submit an appropriate Flood Risk Assessment which addresses development within this Zone.

permitted below first floor level. LPA Emergency Planners should provide advice to developers producing evacuation plans.

It is recommended that a Flood Risk Assessment (FRA) is requested and reviewed by the LPA for all development categories. For a proposed development behind existing flood defences with a standard of protection of 1% or higher, the flood risk will typically be associated with the flood hazard posed by the potential impacts of failure of the flood defences. FRA requirements will therefore vary depending upon the assessment of flood hazard within Rapid Inundation Zones (Section 6.3.2). The FRA should demonstrate that:

- For all developments within the "Danger to All People" zone, that a detailed assessment of the potential consequences of flood defence overtopping/failure has been undertaken (including two-dimensional hydraulic modelling to inform flood depths and velocities), and appropriate measures (refer to Section 12.1) have been incorporated in the design to manage these potential consequences.
- For 'More Vulnerable' developments within the "Danger to Most People" zone, that a detailed assessment of the potential consequences of flood defence overtopping/failure has been undertaken, and appropriate measures (refer to Section 12.1) have been incorporated in the design to manage these potential consequences. For 'Less Vulnerable' and 'Water Compatible' developments within the "Danger to Most People" zone, that appropriate measures (refer to Section 12.1) have been incorporated in the design to manage the potential consequences of defence overtopping/failure.
- For all appropriate Flood Zone 3 development types within the "Danger to Some People" zone, that appropriate measures (refer to Section 12.1) have been incorporated in the design to manage these potential consequences.
- Potential groundwater/surface water/local drainage flood risk has been considered and, if appropriate, suitable flood risk management measures are proposed. Refer to Sections 6.4 and 12.
- It has been checked whether or not the site lies within a Critical Drainage Area and, if so, suitable drainage management measures are proposed. Refer to Sections 6.5 and 9.
- Suitable surface water management systems are proposed to manage runoff in an appropriate manner (Section 9).
- The potential impacts of climate change on flood risk to the development have been assessed. Refer to Section 3.7.
- The FRA complies with Environment Agency Standing Advice (as appropriate, see below).
- The relevant information within this SFRA has been taken into account and applied to the proposed development site.

If the FRA does not demonstrate the above and/or the residual flood risk to the proposed development is unacceptable the planning application should be refused.

The Environment Agency will normally need to be involved in consultation and review of the FRA for all proposed developments. The exception being for domestic extensions and industrial/commercial extensions less than 250 m^2, unless:

- **the development lies within the bye-law distance (20 m) of the bank top of a Main River;**
- **the development includes any temporary or permanent works which will restrict or control flows within any river or stream;**

- **the development includes any proposed culverting works within any river or stream.**

The respective Internal Drainage Board (if any) should also be consulted with regard to any proposed development within their jurisdictional area.

Further details on the appropriate response to planning applications for sites within this zone, including the scope of the Flood Risk Assessment, can be found in the Environment Agency Standing Advice (see Appendix G).

8.4.3 DC Guidance 3a(iii): Developed areas at high risk of flooding with an appropriate standard of flood defence as defined by Defra but not as defined by PPS25

PPS25 Zone 3a(iii) is defined as those developed areas at high risk of flooding which are currently defended to the appropriate minimum standard for existing development as defined by Defra (annual probability of 2%) but are not defended to the appropriate minimum standard for new development as defined by PPS25 (annual probability of 1%[30]).

Applications for Planning Permission for 'Less Vulnerable' and 'Water Compatible' development types should be acceptable, provided that an appropriate Flood Risk Assessment is submitted (see below). Applications for Planning Permission for 'More Vulnerable' and 'Essential Infrastructure' development types should only be permitted within Zone 3a(iii) if it can be demonstrated that the development passes the requirements of the Exception Test[31]. 'Highly Vulnerable' development types are **not** appropriate within this Zone.

There is a residual risk of flooding from breaching or overtopping of existing flood defences in this zone. A Rapid Inundation Zone (RIZ) is an area which is at risk of rapid flooding should a flood defence structure be breached or overtopped. Risk to life in this zone is categorized into 'Danger to All People', 'Danger to Most People', and 'Danger to Some People'. PPS25 states that "*new development should be sited away from existing flood defences except in exceptional circumstances, where a flood risk assessment shows how the building and its users will be made safe*".

In the case of areas classified as 'Danger to All People' the level of risk is such that all parties, including emergency services, would be at risk. Development in such areas should only be in very exceptional circumstances, the local emergency planners and emergency services should be consulted and detailed two-dimensional hydraulic modelling should be undertaken to inform predicted flood depths and velocities.

For all developments proposals within Flood Zone 3, an accompanying FRA is required to demonstrate how flood risk to the development, and arising from the development, will be managed. For developments located in an area at residual risk of breaching or overtopping of a defence the FRA should provide evidence of how the development has been sited, designed, constructed and maintained so that the consequences of a flood defence failure are managed appropriately. In all cases, this will require the finished floor levels of new residential developments to be located a suitable distance above the 1% flood level. In other situations it may be required that other measures are provided, such as flood-resistant/resilient construction and flood response plans.

The mitigation measures will depend upon the degree of potential flood risk and the vulnerability of the development. As a minimum, all properties within this Flood Zone should be designed to withstand the effects of flooding, taking into account any high velocity water, adverse water pressures, potential debris impacts and erosion. Flood resilient/resistant measures should be incorporated in the property construction and should be designed to ensure that structural damage would not occur in the event of a flood. Detailed information can be found in 'Guidance Note S3.2 Risks to People Behind Defences – Flood Risk in Assessment Guidance for New Development Phase 2 R&D Technical report FD2320' (Defra, 2005) and in Section 7 of the PPS25 Practice Guide.

Developments must be designed so that safe access to and from the development (including access by the emergency services) is possible during the 1% flood event and

[30] For simplicity the standard of protection for fluvial flooding has been quoted in this Guidance Note. For sites at risk of flooding from the sea "1%" should be replaced by "0.5%".
[31] Sites within Flood Zone 3a(iii) which successfully pass the Exception Test will also need to submit an appropriate Flood Risk Assessment which addresses development within this Zone.

during any event which may breach the flood defences. If this is not practicable (e.g. if it is a single house surrounded by existing houses and roads which are below flood level) the Environment Agency should be consulted to see whether alternative development design options (e.g. incorporating safe refuge for occupants or users during a flood event) are possible. The LPA emergency planners should also be consulted in such circumstances.

It is recommended that a Flood Risk Assessment (FRA) is requested and reviewed by the LPA for all development categories. The FRA should demonstrate that:

- For all developments within the "Danger to All People" zone, that a detailed assessment of the potential consequences of flood defence overtopping/failure has been undertaken (including two-dimensional hydraulic modelling to inform flood depths and velocities), and appropriate measures (refer to Section 12.1) have been incorporated in the design to manage these potential consequences.
- For 'More Vulnerable' developments within the "Danger to Most People" zone, that a detailed assessment of the potential consequences of flood defence overtopping/failure has been undertaken, and appropriate measures (refer to Section 12.1) have been incorporated in the design to manage these potential consequences. For 'Less Vulnerable' and 'Water Compatible' developments within the "Danger to Most People" zone, that appropriate measures (refer to Section 12.1) have been incorporated in the design to manage the potential consequences of defence overtopping/failure.
- For all appropriate Flood Zone 3 development types within the "Danger to Some People" zone, that appropriate measures (refer to Section 12.1) have been incorporated in the design to manage these potential consequences.
- The development will be adequately defended against flooding with an annual probability up to and including the 1% flood event. Refer to Section 12.
- The development will not increase upstream flood risk, by impeding the flow of water, or downstream flood risk by leading to a reduction in the available volume of floodplain storage[32].
- Adequate arrangements have been made for access to and from the development (including access by the emergency services) during flood events. Refer to Section 12.
- Potential groundwater/surface water/local drainage flood risk has been considered and, if appropriate, suitable flood risk management measures are proposed. Refer to Sections 6.4 and 12.
- It has been checked whether or not the site lies within a Critical Drainage Area and, if so, suitable drainage management measures are proposed. Refer to Sections 6.5 and 9.
- Suitable surface water management systems are proposed to manage runoff in an appropriate manner (Section 9).
- The potential impacts of climate change on flood risk to the development have been assessed. Refer to Section 3.7.
- The FRA complies with Environment Agency Standing Advice (as appropriate, see below).
- The relevant information within this SFRA has been taken into account and applied to the proposed development site.

If the FRA does not demonstrate the above and/or the residual flood risk to the proposed development is unacceptable the planning application should be refused.

[32] If required by the Environment Agency. Compensatory flood plain storage is not required for sites which are at risk only from flooding from the sea and which serve no conveyance function.

The Environment Agency will normally need to be involved in consultation and review of the FRA for all proposed developments. The exception being for domestic extensions and industrial/commercial extensions less than 250 m^2, unless:

- **the development lies within the bye-law distance (20 m) of the bank top of a Main River;**
- **the development includes any temporary or permanent works which will restrict or control flows within any river or stream;**
- **the development includes any proposed culverting works within any river or stream.**

The respective Internal Drainage Board (if any) should also be consulted with regard to any proposed development within their jurisdictional area.

Further details on the appropriate response to planning applications for sites within this zone, including the scope of the Flood Risk Assessment, can be found in the Environment Agency Standing Advice (see Appendix G).

8.5 DC Guidance 3b: 'Functional Floodplain'

PPS25 defines Zone 3b as 'Functional Floodplain' "*land where water has to flow or be stored in times of flood*. *The functional floodplain includes water conveyance routes and flood storage areas (sometimes referred to as washlands)*".

This Zone should be identified as:

- all areas within Flood Zone 3 which are located outside of currently developed sites and are not defended to a proven standard of protection of at least 5%. This includes all floodplain areas behind agricultural flood banks (Section 6.2.2).

The functional floodplain extent has been delineated based on this definition and in the absence of a CFMP for the study area. When the CFMP becomes available (estimated for summer 2010), the CFMP delineation of functional floodplain should replace delineation of functional floodplain in the current SFRA (see Section 6.2.2), in conjunction with consultation with the Environment Agency.

Applications for Planning Permission for 'Water Compatible' development types should be acceptable, provided that an appropriate Flood Risk Assessment is submitted (see below). Applications for Planning Permission for 'Essential Infrastructure' development types should only be permitted if it can be demonstrated that the development passes the requirements of the Exception Test[33]. All other development types are **not** appropriate within this Zone.

Whilst formal defences are not present within this zone, it is possible that there are features on the floodplain that form some kind of raised defence against flooding, for example railway or road embankments. If such features exist, Rapid Inundation Zones may need to be delineated and appropriate planning procedure followed (as in Section 8.4.2). These features should only be relied upon to protect a new development on investigation through FRA. This should assess stability, materials, ownership and other items as described in Section 7 of the PPS25 Practice Guide.

The finished floor levels of new developments should normally be located a suitable distance above the 1% flood level, taking into account freeboard requirements and an allowance for climate change, unless it can be demonstrated that it is more practicable for alternative flood risk management measures (e.g. flood-resistant/resilient construction, flood warning, flood response plans) to be implemented.

All properties within this Flood Zone should be designed to withstand the effects of flooding, taking into account any high velocity water, adverse water pressures, potential debris impacts and erosion. Flood resilient/resistant measures should be incorporated in the property construction and should be designed to ensure that structural damage would not occur in the event of a flood.

Any new development within this Zone must not increase flood risk elsewhere (see Section 12.2) or affect the functionality of the floodplain to store[34] or convey water. Similarly, developments should normally be designed so that safe access to and from the development (including access by the emergency services) is possible during the 1% flood event, unless it can be demonstrated that this is not practicable. In these instances it is essential that the development design incorporates a flood response plan (including an evacuation plan) and safe refuge for users during a flood event.

It is recommended that a Flood Risk Assessment (FRA) is requested and reviewed by the LPA for all development categories. The FRA should demonstrate that:

- The development will be adequately defended against flooding with an annual probability up to and including the 1% flood event, or it is more practicable for alternative

[33] Sites within Flood Zone 3b which successfully pass the Exception Test will also need to submit an appropriate Flood Risk Assessment which addresses development within this Zone.
[34] Compensatory flood plain storage is not required for sites which are only at risk of flooding from the sea and which serve no conveyance function.

flood risk management measures (e.g. flood-resistant/resilient construction, flood warning, flood response plans) to be implemented.. Refer to Section 12.

- Adequate arrangements have been made for access to and from the development (including access by the emergency services) during flood events. Refer to Section 12.
- The development will not increase upstream flood risk by impeding the flow of water. Refer to Section 12.
- The development will not increase downstream flood risk by leading to a reduction in the available volume of flood plain storage[35]. Refer to Section 12.
- Potential groundwater/surface water/local drainage flood risk has been considered and, if appropriate, suitable flood risk management measures are proposed. Refer to Sections 6.4 and 12.
- It has been checked whether or not the site lies within a Critical Drainage Area and, if so, suitable drainage management measures are proposed. Refer to Sections 6.5 and 9.
- Suitable surface water management systems are proposed to manage runoff in an appropriate manner (Section 9).
- The potential impacts of climate change on flood risk to the development have been assessed. Refer to Section 3.7.
- The FRA complies with Environment Agency Standing Advice (as appropriate, see below).
- The relevant information within this SFRA has been taken into account and applied to the proposed development site.

If the FRA does not demonstrate the above and/or the residual flood risk to the proposed development is unacceptable the planning application should be refused.

The Environment Agency should be involved in consultation and review of the FRA for all proposed developments in this Zone.

Further details on the appropriate response to planning applications for sites within this zone, including the scope of the Flood Risk Assessment, can be found in the Environment Agency Standing Advice (see Appendix G).

[35] Compensatory flood plain storage is not required for sites which are at risk only from flooding from the sea and which serve no conveyance function.

8.6 DC Guidance A: Areas at risk of surface water and/or groundwater flooding

This Policy Guidance relates to those areas which have been mapped as being potentially at risk of surface water and/or groundwater flooding, and for those areas which are close to areas where such flooding has occurred previously. These recommendations are also relevant to those areas where sewer flooding is an issue.

It is recommended that a Flood Risk Assessment (FRA) is requested and reviewed by the LPA based on the guidance for the relevant Flood Zone. In addition to this the FRA should demonstrate that:

- Potential groundwater/surface runoff/local drainage flood risk has been considered and, if appropriate, suitable flood risk management measures are proposed. Refer to Sections 6.4 and 12.
- The proposed flood risk management measures will not increase flood risk to other existing properties. Refer to Section 12.
- The relevant information within this SFRA has been taken into account and applied to the proposed development site.

Note that the Environment Agency do not provide flood warning services for groundwater and/or surface water flooding and these incidents can occur with very little prior warning. Management measures to deal with this problem should not, therefore, rely on flood warning or flood response plans.

The detail and technical complexity of the FRA should reflect the scale and potential significance of the development. Major developments proposed at sites with characteristics which suggest that the risk of surface water/groundwater flow may be high should normally be required to produce calculations to demonstrate that the proposed development adequately takes into account the risk of surface water/groundwater flooding. Characteristics which often indicate that a site may have a high susceptibility to surface water/groundwater flooding may include areas which are:

- identified as ‘Areas Susceptible to Surface Water Flooding’ (figures 6.3.1 to 6.3.9)
- at or close to sites of previous flooding incidents;
- downslope of areas of development without formal drainage systems
- downslope of areas of ploughed agricultural fields or other disturbed land;
- at the break of slope;
- served by an existing land drainage system;
- at the same level as or near to known springs;
- at a lower level than the ground or some other feature (e.g. road) downslope of the site, which may cause water to pond behind it.

Minor developments in these areas and developments in lower risk areas will not normally need to provide calculations, but should demonstrate that this source of flood risk has been considered and appropriate management measures will be implemented.

If the FRA does not demonstrate the above and/or the residual flood risk to the proposed development is unacceptable the planning application should be refused.

The Environment Agency will not normally need to be consulted on this matter.

9 Drainage guidance

9.1 Introduction

New development can increase flood risk downstream from the development site if such development causes an increase in runoff rates and/or volumes. PPS25 requires that local planning authorities should work closely with the Environment Agency, Internal Drainage Boards, sewerage undertakers and developers to enable surface-water runoff to be managed as near to the source as possible. The requirement should be for new development not to increase run-off from the undeveloped situation and for redevelopment to reduce run-off.

Within Northeast Yorkshire certain areas have been identified as being potentially particularly sensitive to changes in runoff rates and volumes; these areas have been designated as Critical Drainage Areas (Section 6.5) within this SFRA. It is recommended that more stringent controls on surface-water are implemented within Critical Drainage Areas (See DP Guidance 2 below) than within the rest of Northeast Yorkshire (See DP Guidance 1 below).

PPS25 requires that local planning authorities should promote the use of Sustainable Drainage Systems (SuDS) to achieve control of surface-water. Priority should be given to SuDS so that they are the default drainage measure for all new developments, with other drainage measures only considered if all SuDS forms are considered not viable. Section 12.3 discusses the use of SuDS in more detail.

9.2 DP Guidance 1: General development

Sustainable drainage systems (SuDS) should be the default drainage measure for all new developments, with other drainage measures only considered if all SuDS forms are considered not viable.

PPS25 (Annex F) states that both the rates and volumes of run-off from new developments should be 'no greater than the rates prior to the proposed development, unless specific off-site arrangements are made which result in the same net effect'.

As a minimum, developments on greenfield sites should attenuate surface-water runoff to existing greenfield runoff rates for all events up to and including the 1% design event. Runoff volume should also be addressed as per the Interim Code of Practice for Sustainable Drainage Systems (ICOP)[36].

As a minimum, developments on brownfield sites should lead to a reduction in existing runoff rates, so that, at the very least, an allowance for climate change is incorporated. Ideally a greenfield runoff rate should be implemented, but a minimum 30% reduction is recommended unless it is demonstrated that such a reduction is not practicable[37].

A 30% reduction is recommended in the absence of definitive guidelines and is a relatively typical value suggested to allow for the impacts of climate change on brownfield sites. Developers should consult the LPA to discuss the requirements for surface water runoff on a site-specific level.

It should be ensured that the drainage system will not cause surface flooding of the development site during the 1 in 100 year (1%) storm event.

It should also be ensured that appropriate agreements for maintenance of the drainage systems are in place.

[36]Interim Code of Practice for Sustainable Drainage Systems, Section 6.2.8, National SUDS Working Group (2004)
[37] In cases where a 30% reduction is not practicable the reduction in runoff rate should be as close to 30% as is practicable

9.3 DP Guidance 2: Development in Critical Drainage Areas

The PPS25 Practice Guide states that:

"*SFRA outputs should be used to identify areas with critical drainage issues where measures will be required to ensure that these risks are managed safely, either through development or investment from operating authorities, in particular sewerage undertakers".*

In the case of planning applications for areas shown as being within a Critical Drainage Area, the LPA should respond actively to requests for pre-application discussions with any developer. In this discussion the LPA should advise the developer on the need and scope for a site-specific FRA. When a planning application is received within a Critical Drainage Area the LPA must consult the Environment Agency as a statutory consultee (Article 10 of the Town and Country Planning (General Development Procedure Order 1995).

Sustainable drainage systems (SuDS) should be the default drainage measure for all new developments, with other drainage measures only considered if all SuDS forms are considered not viable.

According to PPS25 (Annex F) both the rates and volumes of run-off from new developments should be 'no greater than the rates prior to the proposed development, unless specific off-site arrangements are made which result in the same net effect'.

As a minimum, developments on greenfield sites should attenuate surface-water runoff to existing greenfield runoff rates for all events up to and including the 1% design event. Runoff volume should also be addressed as per the Interim Code of Practice for Sustainable Drainage Systems (ICOP)[38].

As a minimum, developments on brownfield sites should lead to a reduction in existing runoff rates, so that, at the very least, an allowance for climate change is incorporated. Ideally a greenfield runoff rate should be implemented, but a minimum 30% reduction is recommended unless it is demonstrated that such a reduction is not practicable[39].

A 30% reduction is recommended in the absence of definitive guidelines and is a relatively typical value suggested to allow for the impacts of climate change on brownfield sites. Developers should consult the LPA to discuss the requirements for surface water runoff on a site-specific level. Major developments on brownfield sites may provide an opportunity to provide a strategic solution to alleviate drainage problems in the wider area (e.g. through the provision of a pumping station for the drainage system) and such opportunities should be explored during the pre-application stage.

It should be ensured that the drainage system will not cause surface flooding of the development site during the 1 in 100 year (1%) storm event.

If appropriate, major developments may be required to demonstrate that the development will not exacerbate existing problems by modelling the wider drainage system beyond the boundaries of their site.

It should also be ensured that appropriate agreements for maintenance of the drainage systems are in place.

[38]Interim Code of Practice for Sustainable Drainage Systems, Section 6.2.8, National SUDS Working Group (2004)
[39] In cases where a 30% reduction is not practicable the reduction in runoff rate should be as close to 30% as is practicable

10 Flood risk in key settlements within Ryedale District

Through their emerging Local Development Framework Core Strategy RDC have outlined a settlement hierarchy that highlights the broad locations where future development will be focused. In particular, this identifies the settlements where new employment and housing allocations will be sought.

Malton and Norton will be the main focus of development and is likely to come under the heaviest development pressure. Pickering is a local service centre but is still likely to experience significant pressure for new development. The market towns of Helmsley and Kirkbymoorside will provide for a lower level of growth, providing for local housing and employment opportunities. A number of service villages are identified within the RDC area, in which small housing allocations may be made.

Flood risk has been mapped in each of these locations and a description of the existing flood risk situation within each key settlement is provided. Residual flood risks have been identified, as well as generic land use planning and development control advice for each settlement, aimed at both forward planning and development control officers, and also developers. This advice is compliant with the requirements of PPS25. Table 10.1 summarises the flood risk issues identified for each settlement within Ryedale District.

There are also a number of settlements not specifically looked at within the SFRA, as they are not identified as key service villages in the emerging Core Strategy, but may be at risk of flooding. Planning applications within these settlements should refer to the Environment Agency Flood Zone maps at www.environment-agency.gov.uk/flood. Parts of the following settlements have been identified as potentially being at risk of flooding:

- Brawby, Buttercrambe, Cawton, Crambeck, Duggleby, East Lutton, Gilling East, Great Barugh, Great Habton, Harome, Kirby Grindalythe, Kirby Misperton (Flamingoland), Langton, Low Hutton, Marton, Normanby, North Grimston, Nunnington, Salton, Scrayingham, Settrington, Sinnington, Stonegrave, Weaverthorpe, West Lutton, Wintringham, Yedingham.

Table 10.1. Summary of flood risk issues at each key settlement

Settlement	PPS25 Flood Zone				Other watercourse flooding	Surface Water / Groundwater flow flooding	Sensitive to change in surface water runoff
	1	*2*	*3a*	*3b*			
Malton and Norton	✓	✓	✓	✓		✓	✓
Pickering	✓	✓	✓	✓		✓	✓
Helmsley	✓	✓	✓	✓		✓	✓
Kirkbymoorside	✓	✓	✓	✓		✓	✓
Amotherby & Swinton	✓					*P*	
Ampleforth	✓				*P*	*P*	
Beadlam & Nawton	✓	✓	✓	✓		*P*	
Hovingham	✓	✓	✓	✓		*P*	
Old Malton	✓	✓	✓	✓		✓	
Rillington	✓					*P*	
Sherburn	✓				*P*	✓	
Sheriff Hutton	✓						✓
Slingsby	✓	✓	✓	✓		*P*	
Staxton & Willerby	✓					*P*	
Thornton-le-Dale	✓	✓	✓	✓		*P*	✓

✓ Flood risk identified from Flood Zone mapping or reported flood event

√ Potential flood risk identified from qualitative assessment of the characteristics of the settlement and surrounding area

10.1 Malton and Norton

10.1.1 Description of the Settlements

Malton and Norton effectively form a single settlement, being separated only by the River Derwent. Malton is situated on the northern bank of the River Derwent with Norton on the south bank. Together Malton and Norton form the principal service centre for the Ryedale area and RDC's emerging Core Strategy seeks to develop this area and focus development on the existing settlements. There are a number of brownfield sites within Malton and Norton which, in keeping with government policy, RDC are looking to redevelop as part of the renaissance of the area.

The principal risk of flooding in Malton and Norton arises from the River Derwent. In addition to this, two watercourses flow into the River Derwent through Norton; namely Mill Beck which flows in from the south, and Priorpot Beck which flows in along the eastern edge of the town.

The surface catchment area of Mill Beck is approximately 4km^2, with Mill Beck rising as a spring close to the junction of Whitewall and Langton Road. Much of the watercourse is

artificial with online ponds used for a Fish Hatchery. The channel itself is well defined in sections by reinforced concrete and brick retaining walls. This watercourse was the subject of a Critical Ordinary Watercourse Report[40] as part of the Flood Risk Mapping (FRM) Studies in 2001; a Flood Risk Mapping study[41] in 2005; and a revised flood risk mapping study, the Malton Data Improvements Report in 2009.[42]

Priorpot Beck catchment is larger, at approximately 10km². It was the subject of a Flood Risk Mapping Study[43] in 2001 and the Malton Data Improvements Report in (2009).

10.1.2 Previous Flood Events and Their Extent

The Malton, Norton and Old Malton Flood Alleviation Scheme (FAS) Project Appraisal Report[44] details the recorded flood history of the area. Updates are provided in the Malton Data Improvements Report (2009). The greatest recorded flood events on the River Derwent occurred in 1947, 1999 and 2000; with other significant events in 1892, 1931, 1960, 1963 and 1982.

Flooding has also occurred from Mill Beck and Priorpot Beck, as identified within the respective flood risk mapping studies. The areas of Toisland View and Scarborough Road in Norton have reportedly been quite regularly affected by flooding from Priorpot Beck. Details of the areas impacted by these historical flood incidents are provided in the Priorpot Beck FRM Study and the Malton Data Improvements Report (2009).

The most significant flooding of Priorpot Beck occurred in March 1999 and November 2000. For both flood events the estimated peak flow in the beck was estimated to have a return period of approximately 1 in 5 years. The FRM Study identified the main flooding mechanism for this area as the backing up of flows in the beck. Priorpot Beck normally discharges freely into the River Derwent, but high water levels in the Derwent can impede or prevent this discharge, causing the backing up of flows in Priorpot Beck. The outflow of both Mill Beck and Priorpot Beck are controlled by flap valves and/or penstocks. The operation of these structures has been incorporated within the updated flood modelling carried out for the Malton Data improvements Report (2009).

The Priorpot Beck FRM Study also identifies a high risk of the channel becoming blocked at Priorpot Bridge, due to the dense vegetation and other debris in the channel between Maudon Grove and Scarborough Road. The culvert at Maudon Road was also identified as having the potential to cause flooding.

Flooding incidents relating to drainage issues have been identified in the vicinity of Priorpot Beck, although these may be related to the inability of the drains to discharge into Priorpot Beck during periods of high stage.

The Critical Ordinary Watercourse Report undertaken on Mill Beck gives details of properties in the near vicinity of Mill Beck which have been affected by flooding in recent years. However, there is no known history of flooding solely attributed to Mill Beck; flooding only having occurred during periods of high levels in the River Derwent. High water levels in the River Derwent restricts discharge from the Mill Beck culvert, and results in the backing up of flows along Mill Beck.

The 'Areas Susceptible to Surface Water Flooding' data, shown in Figure 6.3.2, also identifies the areas around Priorpot Beck and Mill Beck as vulnerable to the collection of surface water.

Other reported flood risk issues within Malton and Norton are those associated with groundwater flooding. During the 2000 flood event groundwater was witnessed in differing

[40] 'Mill Beck in Norton – *Critical Ordinary Watercourse Report*', JBA (2001)
[41] '*SFRM Phase 2 Mill Beck – Final Report*', JBA (2005)
[42] 'Malton Data Improvements, Summary Report Final, Halcrow (2009)
[43] 'Priorpot Beck – *Flood Risk Mapping Study Phase 2*', JBA (2001)
[44] Malton, Norton, and Old Malton Flood Alleviation Scheme – *Project Appraisal Report*', Halcrow (2002)

locations in Malton, these recorded instances have been plotted in Figure 10.1. Groundwater flooding was also evident during the 2004 flood event.

10.1.3 Flood Zones in and around the Settlement

Figure 10.1 shows that a significant proportion of Malton and Norton is located within Flood Zone 3. Due to the localised topography the inundation extent predicted within Flood Zone 2 is only marginally larger than Zone 3. A large number of properties are potentially at risk from a 1% flood event. The principal source of the flood waters indicated on the map is from the River Derwent; however significant flooding in Norton is also possible from Priorpot Beck and Mill Beck.

10.1.3.1 Floodplain Delineation

Further explanation of the floodplain zones and their delineation is provided in Section 6.2.

In summary, Flood Zones 1, 2 and 3 are all present within Malton and Norton. Zone 3 has been divided into two sub-zones (a and b), each of these are also present. Furthermore, Zone 3a has been sub-divided to reflect the presence of existing flood defences, and whether the defences provide a recognised Standard of Protection. Zones 3a(i) and 3a(iii) have both been identified within Malton and Norton. Figure 10.2 shows the distribution of Flood Zones in Malton and Norton.

10.1.4 Existing Flood Risk Management Measures

The Environment Agency operates a Flood Warning Area, covering the entire area of Malton and Norton within the predicted extent of Flood Zone 3. The predicted source of the majority of the flooding within Malton and Norton is the River Derwent.

The Malton, Norton and Old Malton Flood Alleviation Scheme Project Appraisal Report provides a fuller précis of the flood management measures currently in operation within the area. A brief summary is provided below.

The Malton and Norton Flood Alleviation Scheme (FAS) was commenced in Autumn 2001. This scheme provides protection for 311 local properties, and against the disruption of the roads and railway, and was completed at the end of 2003.

The design level of protection provided is 2% (1 in 50 year return period). The flood defences were designed to a level such that they had a minimum freeboard of at least 0.2 m above the 2% flood level, to make allowance for the uncertainties in the design process. The predicted 1% flood level is lower than the design level of the flood defences, but would have a reduced minimum freeboard of at least 0.1m. The Malton and Norton FAS has been designed to offer protection from the 1 in 50 year (2%) flood event but will also reduce flood risk for the 1 in 100 year (1%) flood event.

The FAS includes hard (e.g. walls) and soft (e.g. floodbanks) defences along the banks of the River Derwent. The soft defences are situated away from the riverbanks to increase stability and sustainability, and aid maintenance and conveyance. A number of penstocks and flap valves have been fitted through the defences to allow the existing watercourses, such as Mill Beck and Priorpot Beck, to reach the river.

10.1.4.1 Mill Beck

Following recommendations within the Mill Beck FRM Study, a pumping station was constructed close to the confluence with the River Derwent to operate in conjunction with the FAS. It is designed to continue functioning during the scenario of high flows in Mill Beck coincident with high water levels in the River Derwent, with the result that it provides protection to surrounding properties up to the 2% water level in the River Derwent when it coincides with up to the 10% flood on Mill Beck. The operation of these structures has been incorporated within the updated flood modelling carried out for the Malton Data improvements Report (2009).

10.1.4.2 Priorpot Beck

A flap valve was fitted at the outfall of Priorpot Beck to prevent the surcharge of high water levels in the River Derwent up the beck channel. Construction of a pumping station for Priorpot Beck was completed in 2007. This performs a similar function to the Mill Beck station, namely the mitigation of 'flood-locked' conditions in Priorpot Beck when water levels in the River Derwent are high. The operation of these structures has been incorporated within the updated flood modelling carried out for the Malton Data improvements Report (2009).

10.1.5 Potential Flood Risk Management Measures

There are no plans to upgrade the standard of protection provided by the Malton and Norton FAS. As the existing FAS has been designed to a 2% flood level, if the standard of protection was to be increased, many of the existing flood defences may have to be replaced and extended. The FAS Project Appraisal Report estimated that the cost of implementing a FAS to provide a 1% standard of protection would be £6.3 million, although it is now understood that the actual cost of providing this would be significantly greater than this.

10.1.6 Sensitivity to Climate Change

As the estimated 1% flood level is currently just below the actual level of the FAS defences, even a small increase in flood risk due to climate change could lead to the future 1% flood level being in excess of the flood defence level. Such an increase will reduce the standard of protection provided by the FAS to below the current 2% flood.

An initial analysis of climate change sensitivity along the River Derwent was performed by examination of the local topography, which suggests that the extent of floodplain will not be very sensitive to potential climate change increases.

Analyses into the potential effects of climate change along Mill Beck were undertaken in the SFRM Phase 2 Mill Beck Report. With the existing 1% flood flow increased by 20%, the maximum predicted increase in water levels was no more than 160 mm.

10.1.7 Critical Drainage Catchments

Mill Beck and Priorpot Beck both drain areas behind flood defences. The outflow of both watercourses is controlled by flap valves and/or penstocks. As explained in Section 10.1.3, high water levels in the River Derwent may result in the 'flood-locking' of one or both of these watercourses. Any increase in the amount of surface runoff may adversely affect the operating capability of the existing pumping stations.

Similarly, within Malton a relatively large area drains behind the flood defences. There are no specific measures currently in place to deal with any water that may pond behind the defences, making this particular area very sensitive to increases in the amount of surface water drainage.

All these critical drainage catchments may be particularly sensitive to the potential impacts of climate change.

The area which drains behind the Norton flood defences, including the Mill Beck and Priorpot Beck catchments, are displayed in Figure 10.3, and the area which drains behind the Malton defences in Figure 10.4. Refer to Section 9.

10.1.8 Existing Recommendations Regarding New Development

It is strongly recommended in the SFRM Phase 2 Mill Beck Report that if there is any potential future development within the Mill Beck catchment, that "*…it is managed effectively so as to minimise flood risk and to ensure that any additional inflows do not compromise the current capability of the pumping station.*" Any development proposals should be in accordance with PPS25.

10.1.9 Guidance on Land Use Planning and Flood Risk

To assist in the site allocation process within the LDF guidance has been formulated with regard to the flood risk situation.

Due to the size and strategic importance of Malton and Norton, and the complex flood risk situation, further analysis of the available flood data has been undertaken with a view to providing more detailed, settlement-specific land use guidance. Flood depth mapping and the identification of rapid inundation zones has been undertaken.

10.1.9.1 Flood Depth Mapping

Details of the flood depth mapping process may be found in Section 6.3.1. The flood depth map for Malton and Norton is shown in Figure 10.5.

Behind the flood defences, the greatest depth observed is 2.5 to 3 metres. This area is Zone 3a(iii) of the floodplain and the appropriate policy for this zone should be applied. Wherever possible, development proposals should be relocated to areas at lower risk of flooding. When this is not feasible developments should be located in the highest portion of the development site, where flood depths are at a minimum. Such areas are likely to require the smallest amount of flood management measures to be implemented.

10.1.9.2 Rapid Inundation Zones (RIZ)

Details of the rapid inundation zone identification and calculation process may be found in Section 6.3.2. All areas within Zone 3a(iii) of the floodplain within Malton have been classified as 'Danger to all'. The extent of the rapid inundation danger zones 'Danger to All People', 'Danger to Most People' and 'Danger to Some People' in and around Malton and Norton are displayed in Figure 10.6.

The potential depth of flooding and risk of rapid inundation may have significant implications for the types of development which are acceptable within this zone (see Section 12).

10.1.9.3 Generic Land Use Planning and Development Control Advice

The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Policies/Guidance should be applied within Malton and Norton: 1, 2, 3a(i), 3a(iii), and 3b.

As the actual Malton and Norton FAS flood defence levels are greater than the predicted 1% flood level an assessment of the impact of a development within Zone 3a(iii) on upstream and downstream flood risk will not normally be required. Compensatory flood plain storage will not normally be required for those developments in Zone 3a(iii).

Note that some areas mapped as Zone 3a(iii) may fall within the undeveloped flood plains of Priorpot Beck and Mill Beck. In these areas compensatory flood plain storage will be required, and it should be ensured that upstream flood risk on these tributary watercourses is not increased.

Other flood mechanisms reported within the town are groundwater flooding and sewer flooding (see FP/DC Policy Recommendation/Guidance A, and much of the town is within a Critical Drainage Area (see Section 9).

10.2 Pickering

10.2.1 Description of Settlement

The town of Pickering lies on the edge of the Vale of Pickering, and the North York Moors National Park. Pickering is a town of cultural and historic interest, and consequently its economy is strongly supported by tourism.

Pickering Beck flows through the town from North to South and is a designated Main River. The headwaters of this catchment are within the North York Moors National Park, and the Beck is a tributary of the River Derwent. The location of this watercourse is highlighted within the 'Areas Susceptible to Surface Water Flooding' data, shown in Figure 6.3.3.

A second watercourse, Oxfolds Beck, is located along the western edge of Pickering. It flows into Costa Beck which, in turn, joins with the River Derwent. Costa Beck is designated a Main River.

10.2.2 Previous Flood Events and Their Extent

Investigations have been undertaken to assess the feasibility of providing a Flood Alleviation Scheme (FAS) for Pickering. The Project Appraisal Report[45] for this FAS notes that Pickering has a long history of flooding, with major events occurring in 1993, 1999, 2000, and 2002. Further details of the extent of flooding and number of properties affected are included in the report, but the total costs of the flood damages from the 1999 event were estimated at approximately £1 million. It is also estimated that there are 52 residential and 13 commercial properties within the predicted extent of the 1% flood event. A review of the 2002 floods[46] also contains further details of areas impacted by flooding.

Flood extents for Pickering were updated in 2009 following an updated modelling study[47].

Pickering was also affected by a major flood event in summer 2007. The town centre and areas to the south of the town where affected. During the event Pickering Beck overtopped at two locations, Haygate Lane and near Barker Stakes Farm. At Haygate Lane a floodbank was overtopped causing a number of commercial properties and some farmland to be flooded. Near Barker Stakes Farm a number of commercial and private properties, as well as areas of open farmland were flooded due to overtopping from the river.

The Section 105 Survey on Costa Beck/Pickering Beck/Oxfolds Beck[48] contains information on the areas and number of properties impacted by the 1993 flood event. This report attributes the general cause of the flooding to be the overtopping of the channel banks in all areas except Bridge Street, where the cause is believed to have been the blockage of the drainage system resulting in the ponding of surface water. No specific flood extent plans have been included within any of these reports.

A pilot project is being undertaken within the Pickering and Sinnington catchments as part of the 'Slowing the Flow project'. The project looks to make changes to the way the land is managed such as changing the type of vegetation growing on the land to reduce run off, or increasing water storage in the river catchment to increase the time it takes from rain falling on the upper catchment to flood waters arriving in the watercourses flowing through Pickering and Sinnington. The project is described further in Section 13.4.

10.2.3 Flood Zones In and Around The Settlement

The existing flood risk situation within Pickering is displayed in Figure 10.7. It shows that a significant number of properties lie within the predicted extent of Flood Zones 2 and 3. The principal source of the predicted flooding is Pickering Beck.

The town lies within a zone of potential groundwater and surface runoff flood risk (Zone C, see Section 6.3).

10.2.3.1 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the town.

All currently developed sites within Zone 3 may be accorded 3a(i) status, while all sites which are not currently developed within Zone 3 should be accorded Zone 3b status.

10.2.4 Existing Flood Risk Management Measures

The Environment Agency operates a Flood Warning Area, covering the entire area of Pickering within the predicted extent of Flood Zone 3. The predicted source of the majority

[45] '*Pickering Flood Alleviation Scheme* – Project Appraisal Report', Babtie, Brown and Root (2003).
[46] '*Review of August 2002 Floods* – Pickering and Sinnington', Babtie, Brown and Root (2002).
[47] 'Pickering Data Improvements', Halcrow (2010).
[48] '*Section 105 – 30/92 Survey* – Costa Beck/Pickering Beck/Oxfolds Beck: Volume 1 – Main Report', Kennedy & Donkin Ltd (1998).

of the flooding within the town is Pickering Beck. Routine channel maintenance is also carried out by the Environment Agency.

10.2.5 Potential Flood Risk Management Measures

No existing formal flood defences are present within Pickering.

The following options for flood mitigation were considered and assessed within the FAS Report:

- 'do nothing'
- 'do minimum'
- improved maintenance and flood warning
- upstream storage
- widening the existing channel
- channel re-grading
- flood walls and embankments
- flood diversion tunnel

The recommended option was for the construction of a series of flood walls and embankments. This preferred scheme would involve the construction of stone and brick fronted floodwalls, which would range in height from 100 mm to 1200 mm above the current ground level. The estimated total cost of the preferred flood management option is in the order of £5.6 to 5.7 million. This FAS has not yet been implemented, and is not currently on the list of Environment Agency schemes. Therefore, it is unlikely that Pickering will be provided with a FAS in the foreseeable future.

A pilot scheme aiming to reduce flood risk in Pickering and Sinnington via upland land management is currently commencing. The 'Pickering Project' aims to reduce flood risk in lower catchment by increasing the response time of the catchment watercourses to rainfall events. This will be done by a combination of tree planting, creating buffer strips along watercourses and blocking moorland drains. Further information is provided in Section 13.4.

10.2.6 Sensitivity to Climate Change

Climate change sensitivity analyses were undertaken as part of the FAS Project Appraisal Report. It was calculated that, with a 20% increase in flow allowance, the present estimated 1% (1 in 100 year) flow event would equate to a 2.2% (1 in 45 year flow) event within 50 years. The report, however, does not quantify the increase in flows into a relative increase in water levels through Pickering.

Examination of the local topography was also undertaken with a view to providing a qualitative assessment of the likely impact of climate change. This suggests that generally there would not be a high degree of sensitivity to potential climate change increases. However, there is a small area in the south of the town where the topography appears flatter, suggesting that this area may be sensitive to potential climate change increases.

10.2.7 Critical Drainage Catchments

No specific Critical Drainage Areas have been identified within the Pickering area. Refer to Section 9.

10.2.8 Guidance on Land Use Planning and Flood Risk

To assist in the site allocation process within the LDF, guidance has been formulated with regard to the flood risk situation.

Figure 10.8 shows the flood depth map for Pickering (see Section 6.3.1 for details). The greatest flood depth generally observed (with a few very small exceptional areas) is 1 to 1.5 m. The majority of areas where this depth range of flooding is predicted fall within Zone 3b

of the floodplain. Flood depths in areas within Zone 3a are generally in the order of 0.5 to 1 m. Wherever possible, development allocations should be located in areas at lower risk of flooding. Where this is not possible, developments should be located in the highest portion of the site, where flood depths are at a minimum. Such areas are likely to require the smallest amount of flood management measures to be implemented.

Due to the location of Pickering flood warning times are short and flood velocities may be high. The potential depth of flooding, risk of rapid inundation and high flood velocities within this town may have significant implications for the design of developments within Flood Zone 3 (see Section 12).

10.2.9 Generic Land Use Planning and Development Control Advice

Flood Zones present in Pickering have been identified in Section 10.2.3, above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i) and 3b.**

The other flood mechanisms reported within the town are sewer flooding and surface runoff flooding. Refer to FP/DC Policy Recommendation/Guidance A.

10.3 Helmsley

10.3.1 Description of Settlement

The boundary of the North York Moors National Park runs through the middle of the historic town of Helmsley. The northern and western sections of the town fall within the jurisdiction of the North York Moors National Park Authority, while the southern part of the town falls within Ryedale District.

The River Rye flows in an easterly direction along the southern edge of the town, and is a designated 'main river'. Borough Beck flows through the town from the north-west and joins the River Rye just upstream of the Helmsley Bridge. Spittle Beck flows along the eastern edge of the town and confluences with the River Rye downstream of the town. Both of these are ordinary watercourses.

10.3.2 Previous Flood Events and Their Extent

The most recent flood event to impact upon Helmsley occurred in June 2005. A localised high intensity rainfall event generated large quantities of surface runoff and high flood flows within the River Rye. A significant number of properties, both in Helmsley (especially Bridge Street and Rye Street) and the surrounding area (especially the Hawnby area), were impacted, to varying degrees, by this event.

High flood levels were also experienced around Bridge Street during the floods of 2000, and flooding problems from the Becks in Helmsley have also been reported.

Other flooding issues within Helmsley include surface runoff flooding and drainage issues. During periods of intense rainfall, it is reported that sheet runoff flows down several of the roads within the town, swamping the existing drainage systems and entering properties. Occurrence of such events has been reported on several occasions, causing some damage.

The 'Areas Susceptible to Surface Water Flooding' data, shown in Figure 6.3.3, also highlights the potential for the occurrence and collection of surface water across large sections of Helmsley.

10.3.3 Flood Zones In and Around the Settlement

The existing flood risk situation within Helmsley is displayed in Figure 10.9. It shows that a significant number of properties lie within Flood Zone 3, and are therefore potentially at risk from a 1% flood event. There appear to be several sources of this predicted flooding, including the River Rye, Borough Beck, Spittle Beck, and an un-identified source which appears to flow into Helmsley from the north. The origin of this latter source of flooding is unclear as there are no known watercourses within the area predicted as at risk.

Predicted flood outlines were revised by the Environment Agency in 2006 as part of the Helmsley Flood Risk Mapping Study[49] using information from the June 2005 event and updated hydraulic modelling. This work was commissioned due to concerns that the existing EA Flood Zones were over-predicting flood risk on Spittle and Borough Becks when compared to historical evidence.

The outputs from this revised modelling indicate slightly reduced flood extents than those shown by the Flood Zones in Figure 10.9. The flood mapping study also identifies a risk of blockage of certain structures on all three watercourses, however as there is little historical evidence to qualify that this is a significant risk, the report concludes that the likelihood of flooding from blockage is quite low.

Helmsley lies within a zone of potential groundwater and surface runoff flood risk (Zone C, see Section 6.4).

10.3.3.1 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the town.

All currently developed sites within Zone 3 may be accorded 3a(i) status, while all other sites within Zone 3 should be accorded Zone 3b status.

10.3.4 Potential Flood Risk Management Measures

The recommendations of the 2006 Flood Mapping Study were for the regular inspection and maintenance of culverts to avoid blockage, and consideration for the provision of a flood warning system on Borough Beck. Flood warning for the River Rye and Spittle Beck was not considered as modelling shows the flood risk from these rivers to be quite low.

10.3.5 Sensitivity to Climate Change

A flood outline for Helmsley, including an allowance for climate change (20%) was derived as part of the Helmsley Flood Risk Mapping Study. The map indicates that Helmsley is not particularly sensitive to climate change. There are small areas to the south west and south east of the town which are at increased risk of flooding under the climate change scenario, however these areas are rural with little risk of damage to property.

10.3.6 Critical Drainage Catchments

No specific Drainage Sensitive Areas have been identified within the Helmsley area. Refer to Section 9.

10.3.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Helmsley have been identified in Section 10.3.3.1, above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i) and 3b.**

A potential over-estimation of the extent of Flood Zones 2 and 3 to the north of Helmsley has been highlighted above, as well as the Flood Mapping study producing predicted flood outlines of reduced extent. However, until such time as the Flood Zones have been updated with the revised modelling output, the precautionary principle should be applied, and the information shown in Figure 10.9 used for land use planning purposes.

At present, Helmsley does not have a flood warning system. The onset of flooding may be quick and flood velocities may be very high. The risk of rapid inundation within this town may have significant implications for the design of developments within Flood Zone 3. The Helmsley Flood Mapping Study made the recommendation that a Flood Warning system be implemented on Borough Beck but this system has not yet been implemented.

Flooding due to drainage system issues and surface runoff has been reported within the town (see Figures 6.3.4 and 10.9). Referral should be made to FP/DC Policy Recommendation/Guidance A with regard to this flood mechanism.

[49] '*Helmsley Flood Risk Mapping Study*', Jeremy Benn Associates (2006)

10.4 Kirkbymoorside

10.4.1 Brief Description of the Settlement

Kirkbymoorside is situated to the south of the North York Moors National Park. The smaller settlements of Kirkby Mills and Keldholme are located less than 1km to the east and have been included within this settlement description. The settlement area is situated with a steep slope on its north-east border.

The River Dove is the designated Main River within the settlement area. It flows through the settlements of Kirkby Mills and Keldholme, but does not flow within the extent of Kirkbymoorside itself. The River Dove is forked just north of Kirkby Mills by a large diversion weir. This diversion, and the construction of the smaller Mill Race channel, was created to serve the Corn Mill. It is understood that the owner of the mill has the right to operate the sluice gate at the weir. The River Dove joins the River Rye 4km downstream of the settlement area.

There is a second unidentified watercourse to the north-east of Kirkbymoorside, with a spring further up Tenter Dale as its apparent source.

10.4.2 Previous Flood Events and Their Extent

The Phase 1 Watercourse Report[50] on the River Dove provides a chronology of flood events that have occurred in the area, and lists the number of properties that were affected by each event. In the flood event on the 1st November 2000, 27 residential and 6 commercial properties were impacted. Of the properties affected, 21 were in Kirkby Mills, with the remainder in Keldholme. Many of these same properties were affected by another flood event on the 2nd August, 2002.

Flood depths and the properties affected by the Autumn 2000 flood event are also included in the Phase 1 Watercourse Report, but there is no flood extent plan provided. The report also suggests various causes, and exacerbatory factors, of the recent flood events.

The 'Areas Susceptible to Surface Water Flooding' data, shown in Figure 6.3.4, identify a potential low spot through the middle of the town, and also the potential for surface water flooding along the A170.

10.4.3 Flood Zones in and Around the Settlement

The existing flood risk situation within the Kirkbymoorside settlement area is displayed in Figure 10.10. It shows that a significant number of properties lie within Flood Zone 3, and are therefore at risk from a 1% annual probability of exceedance flood event. In the east of the town the River Dove is the principal source of this flooding, whereas the source of the predicted flooding through the middle of Kirkbymoorside itself, and along the A170, is much less clear. Further review of the Flood Zones within the Kirkbymoorside area will be required by the Environment Agency.

The town lies within a zone of potential groundwater and surface runoff flood risk (Zone C, see Section 6.4).

10.4.3.1 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the town.

All currently developed sites within Zone 3 may be accorded 3a(i) status, while all other sites within Zone 3 should be accorded Zone 3b status.

10.4.4 Potential Flood Risk Management Measures

A number of potential flood risk management measures have been suggested for the Kirkbymoorside area within the Phase 1 Watercourse Report. It recommends that the Environment Agency conduct a review of the planned maintenance activities along the River Dove, in particular those concerning tree management. Tree canopy level should be

[50] 'Flood Risk Mapping Studies 2002: *Phase 1 Watercourse Report – River Dove, Kirkby Mills*', JBA (2003).

maintained well above flood level, and trees in a precarious state should be removed, along with accumulations of gravel islands in the channel.

Other recommendations within the report include making local residents aware of the moderate to significant flood risk in the area, and making riparian landowners aware of their rights and responsibilities. Improvement in the direct flood warnings to Keldholme and Kirkby Mills may also be required.

10.4.5 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Kirkbymoorside area.

An initial analysis of climate change sensitivity was undertaken through examination of the local topography. In the area around Kirkby Mills the topography appears relatively flat, suggesting that this area may be sensitive to potential climate change increases. In other areas of the town, the topography appears steeper, suggesting that these areas may not be particularly sensitive to potential climate change increases.

10.4.6 Critical Drainage Catchments

No specific Critical Drainage Areas have been identified within the Kirkbymoorside area. Refer to Section 9.

10.4.7 Existing Recommendations Regarding New Development

It is suggested in the Phase 1 Watercourse Report that the Environment Agency should continue to encourage the appropriate use of SuDS through the planning process, in order to prevent an increase in run-off rate through new development within the catchment.

The Phase 1 Watercourse Report also recommends that the policy on Development and Flood Risk in the final adopted version of the Ryedale Local Plan be endorsed.

10.4.8 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Kirkbymoorside have been identified in Section 10.4.3.1, above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the town: 1,2, 3a(i) and 3b.**

A potential over-estimation of the Flood Zones within Kirkbymoorside has been highlighted above. However, until such times as these extents have been reviewed by the Environment Agency, and in keeping with the precautionary principle, all current Flood Zone designations should remain in place.

Sewer flooding and drainage related flooding issues have both been reported within the town, as have several incidents of surface runoff flooding. Refer to FP/DC Policy Recommendation/Guidance A.

10.5 Amotherby & Swinton

10.5.1 Description of Settlements

Amotherby and Swinton combined form an amalgamated service village, located 3 miles to the west of Malton. There are no known natural watercourses running through or within close proximity to the settlement, but there are artificial drainage systems in proximity to the northern boundaries of the settlement.

The settlement is situated at the break of slope where the Howardian Hills meet the Vale of Pickering. The B1257, Malton to Helmsley road, passes through the settlement. The ‘Areas Susceptible to Surface Water Flooding’ data, shown in Figure 6.3.2, reflects this feature with the land to the north of the settlements exhibiting vulnerability to the collection of surface water.

10.5.2 Previous Flood Events and Their Extent

There are no historic or hydraulically modelled flood levels or extents for this settlement.

No other flood incidents or flooding mechanisms have been reported within the settlement during the data gathering and consultation phase.

10.5.3 Flood Zones in and Around the Settlement

The existing flood risk situation within Amotherby and Swinton is displayed in Figure 10.11. The urban environment of the settlement is entirely within Flood Zone 1. Some of the undeveloped land to the north of the settlement falls within Flood Zones 2 and 3.

10.5.4 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Amotherby and Swinton area.

10.5.5 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Amotherby and Swinton area.

An initial analysis of climate change sensitivity was undertaken through examination of the local topography which suggests that this area may not be particularly sensitive to potential climate change increases.

10.5.6 Critical Drainage Catchments

No specific Critical Drainage Areas have been identified within the Amotherby and Swinton area. Refer to Section 9.

10.5.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Amotherby and Swinton have been identified in Section 10.5.3, above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3b.**

10.6 Ampleforth

10.6.1 Description of Settlement

The settlement of Ampleforth is located partly within the southern boundary of the North York Moors National Park, some 21 km to the north-west of Malton.

A small un-named watercourse, beginning in Smith Hill-Howl, flows through the western side of the settlement before joining Holbeck, to the south-west of the settlement, which, in turn, is a tributary of the River Rye. There are also a number of small watercourses, possibly artificial drainage channels, evident to the south-east of Ampleforth.

10.6.2 Previous Flood Events and Their Extent

There are no historic or hydraulically modelled flood levels or extents available for this settlement.

No other flood incidents or flooding mechanisms have been reported within the settlement during the data gathering and consultation phase.

10.6.3 Flood Zones in and Around the Settlement

The existing flood risk situation within Ampleforth is displayed in Figure 10.12. The built up parts of the settlement are located entirely within Flood Zone 1, but some of the undeveloped land to the south-west of the settlement falls within Zones 2 and 3. The source of this predicted flooding is Holbeck.

10.6.4 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Ampleforth area.

10.6.5 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Ampleforth area.

An initial analysis of climate change sensitivity was undertaken through examination of the local topography which suggests that this area may not be particularly sensitive to potential climate change increases.

10.6.6 Critical Drainage Areas

No specific Critical Drainage Areas have been identified within the Ampleforth area. Refer to Section 9.

10.6.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Ampleforth have been identified in Section 10.6.3, above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3b.**

No surface runoff flooding incidents have been reported within Ampleforth. However, Ampleforth is built on steeply sloping ground, running in a north to south direction. It is recommended therefore, that FP/DC Policy Recommendation/Guidance A is considered when planning new development in this area.

10.7 Beadlam & Nawton

10.7.1 Description of the Settlements

The settlements of Beadlam and Nawton have combined to form a single, larger settlement. It is situated along the A170 between Helmsley and Kirkbymoorside.

There are no known natural watercourses running through this settlement. The 'Areas Susceptible to Surface Water Flooding' data, shown in Figure 6.3.4, suggests a low point vulnerable to the collection of surface water through the middle of the settlement.

10.7.2 Previous Flood Events and Their Extent

There are no historic or hydraulically modelled flood levels or extents for this settlement.

There are also no other reported flood incidents or mechanisms within the settlement.

10.7.3 Flood Zones In and Around the Settlement

The existing flood risk situation within Beadlam and Nawton is displayed in Figure 10.13. It shows that a significant number of properties lie within Flood Zone 3, and are therefore potentially at risk from a 1% event. The source of this flooding is unclear as there is no apparent watercourse flowing through the settlement as suggested by the Flood Zone extents. Further review on Zones 2 and 3 within Beadlam and Nawton will be required by the Environment Agency.

The settlement lies within a zone of potential groundwater and surface runoff flood risk (Zone C, see Section 6.4).

10.7.3.1 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the settlement.

All currently developed sites within Zone 3 may be accorded 3a(i) status, while all other sites within Zone 3 should be accorded Zone 3b status.

10.7.4 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Beadlam and Nawton area.

10.7.5 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Beadlam and Nawton area.

An initial analysis of climate change sensitivity was undertaken through examination of the local topography which suggests that this area may not be particularly sensitive to potential climate change increases.

10.7.6 Critical Drainage Catchments

No specific Critical Drainage Catchments have been identified within the Beadlam and Nawton area. Refer to Section 9.

10.7.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Beadlam and Nawton have been identified in Section 10.7.3.1, above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i), 3b.**

A potential over-estimation of the Flood Zones within Beadlam and Nawton has been highlighted above. However, until such times as these extents have been reviewed by the Environment Agency, and in keeping with the Precautionary Principle, all current Flood Zone designations should remain in place.

No other flood mechanisms have been reported within the settlement. However, groundwater/surface runoff flooding may be a risk (see Figures 6.4 and 6.3.4). Refer to FP/DC Policy Recommendation/Guidance A.

10.8 Hovingham

10.8.1 Description of Settlement

The settlement of Hovingham is situated approximately 12km west of Malton.

Hovingham Beck flows in an easterly direction through the northern section of the settlement. The Beck is a tributary of Holbeck which, in turn, is a tributary of the River Rye. There are many man-made structures within the channel as it flows through the settlement, including sluice gates, bridges, short culvert sections, and a ford. Hovingham Beck is a designated Main River.

10.8.2 Previous Flood Events and Their Extent

The Hovingham Beck Phase 1 Watercourse Report[51] summarises the known history of flooding in the Hovingham area. Flood events have been reported in 1947, 1985, June 2000, Autumn 2000 and 2004[52].

The report considers the flood event of Autumn 2000 as the most severe for the area. Approximately 18 properties were inundated. It is known that the flood waters reached a level of approximately 3 feet against the exterior walls of Hovingham Hall.

The 'Areas Susceptible to Surface Water Flooding' data, shown in Figure 6.3.5, highlights the potential for surface water to collect across much of this settlement.

10.8.3 Flood Zones in and Around the Settlement

The existing flood risk situation within Hovingham is displayed in Figure 10.14. A very significant portion of the settlement lies within Flood Zone 3, and is therefore at risk from a 1% flood event. The source of this predicted flooding is Hovingham Beck.

10.8.4 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the settlement.

All currently developed sites within Zone 3 may be accorded 3a(i) status, while all other sites within Zone 3 should be accorded Zone 3b status. The latest flood mapping study (see below) estimates the diversion channel to have a standard of protection of approximately 10%-4% AEP, which is below the indicative standard required by Defra. In addition there remains the residual risk that this diversion channel may not work effectively and as planned during a flood event.

[51] '*Flood Risk Mapping Studies 2002*: *Hovingham Beck, Hovingham* – Phase 1 Watercourse Report', JBA (2003).
[52] Taken from [53] below.

10.8.5 Existing Flood Risk Management Measures

The Phase 1 Watercourse Report provides details on the existing flood risk management measures within the settlement. Following the Autumn 2000 flood event a series of remedial measures were planned and implemented, funded by public donation. They have been constructed to divert exceptional flows, greater than 0.5 m^3/s, via a flood diversion channel to the tributaries of Spring Beck to the north of the settlement, thereby by-passing Hovingham. A flood embankment was also constructed in front of Hovingham Hall to provide protection to this Grade 1 Listed Building. According to the Phase 1 Watercourse Report the flood diversion scheme provides a standard of defence to approximately 2%.

Results of the Hovingham Phase 2 Modelling Study[53] has lead to a reduction (as compared to the Flood Zones) in the area believed to be at risk during the 1% AEP event. The study modelled flood risk before and after the construction of the existing flood diversion channel. Prior to construction the modelling indicated that significant areas of Hovingham were at risk of flooding, including the Brookside area and at the Medical Centre. Flooding from the right bank was seen to affect Hovingham Hall, Main Street and Church Street, and flooding from the left bank affecting Home Farm Yard and Brookside area. Modelling of the post-flood diversion channel shows that only small areas of Brookside remain at risk during extreme events, and that these areas are predominantly open land and roads. The study estimates that the flood diversion channel provides a standard of defence of 10%-4% AEP.

10.8.6 Potential Flood Risk Management Measures

The Phase 2 Modelling Study recommends that the flood diversion channel embankment if formalised and an appropriate level of freeboard provided.

10.8.7 Sensitivity to Climate Change

The Phase 2 Flood Modelling Study undertook a preliminary climate change assessment. It found that flows would increase by approximately 30% in the diversion channel but only by approximately 8% in the Hovingham Beck channel. No information was provided which translates this information into increased flood levels or extents.

A further initial analysis of climate change sensitivity was undertaken through examination of the local topography which suggests that this area may not be particularly sensitive to potential climate change increases.

10.8.8 Critical Drainage Catchments

No specific Critical Drainage Catchments have been identified within the Hovingham area. Refer to Section 9.

10.8.9 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Hovingham have been identified in Section 10.8.3, above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i), and 3b.**

The Phase 2 Flood Modelling study, taking into account the flood diversion channel, has produced predicted flood outlines of reduced extent as compared to Flood Zone data. However, the flood diversion channel cannot be guaranteed to work effectively and as planned during each and every flood event, and therefore the precautionary principle should be applied, and the information shown in Figure 10.9 used for land use planning purposes.

No other flood mechanisms have been reported within the settlement however, due to the potential for surface water problems highlighted by the 'Areas Susceptible to Surface Water Flooding' data (shown in Figure 6.3.5), referral should be made to FP/DC Policy Recommendation/Guidance A.

[53] '*Dales Area Flood Risk Mapping Phase 2 Studies 2004: Hovingham Beck'*, JBA (2004)

10.9 Old Malton

10.9.1 Description of Settlement

Old Malton is situated on the north bank of the River Derwent, just to the east of Malton and much of the settlement is included in a Conservation Area. There are a number of listed buildings in the area.

A small watercourse, known as Riggs Road drain, flows from the Old Malton Road, behind the line of the flood defences, toward the area known as The Doodales, to the east of Old Malton. The location of this watercourse is highlighted within the 'Areas Susceptible to Surface Water Flooding' data, shown in Figure 6.3.2.

10.9.2 Previous Flood Events and Their Extent

The Malton, Norton and Old Malton Flood Alleviation Scheme (FAS) Project Appraisal Report[54] details the recorded flood history of the settlement. The highest level flood events occurred in 1947, 1999 and 2000; with other significant events in 1892, 1931, 1960, 1963, and 1982.

No details have been given for the exact extent of these flood events, but it is estimated in the Project Appraisal Report that, in the absence of flood defences, 54 properties in Old Malton could be affected by 0.5% flood levels.

Some problems with spring flows have been reported in and around Old Malton. Also, it has been reported that the Riggs Road drain is unable to drain when levels in the River Derwent are high, leading to some flooding behind the defences.

10.9.3 Flood Zones in and Around the Settlement

The existing flood risk situation within Old Malton is displayed in Figure 10.15. A very significant number of properties lie within the Flood Zone 3, and are therefore at risk from a 1% annual probability of exceedance flood event. The source of this predicted flooding is the River Derwent.

10.9.3.1 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the settlement.

The flood defences at Old Malton provide a standard of protection to a 0.5% standard, which is above the appropriate minimum standard as defined by PPS25 (annual probability of 1% for fluvial flooding). All areas within Old Malton which benefit from flood defences are designated as Zone 3a(ii), while any areas not protected within the settlement areas are designated as Zone 3b.

10.9.4 Existing Flood Risk Management Measures

The Environment Agency operates a Flood Warning Area, covering the entire area of Old Malton within the predicted extent of Flood Zone 3. The predicted source of the majority of the flooding within the settlement is the River Derwent.

A fuller description of the flood management measures currently in operation within the settlement is provided in the Malton, Norton and Old Malton Flood Alleviation Scheme Project Appraisal Report. In summary, a flood defence embankment was constructed to provide a 0.5% standard of protection to Old Malton. This scheme would contain the maximum flood levels observed during both the 1999 and 2000 flood events.

10.9.5 Sensitivity to Climate Change

Climate change was considered in the Malton, Norton and Old Malton FAS, during the assessment of various mitigation options. However, due to a number of factors, no climate change elements were included in the decision making process.

[54] Malton, Norton, and Old Malton Flood Alleviation Scheme – *Project Appraisal Report*', Halcrow ()

An initial analysis of climate change sensitivity was undertaken through examination of the local topography which suggests that this area may not be particularly sensitive to potential climate change increases.

10.9.6 Critical Drainage Areas

The area which drains behind the flood defences in Old Malton is displayed in Figure 10.4. There are currently no measures in place to deal with any water which may drain to, and ultimately pond behind, the flood defences. This area may be particularly sensitive to changes in the amount of surface water drainage, especially due to climate change, and has been designated as a Critical Drainage Area. See Section 9.

10.9.7 Guidance on Land Use Planning and Flood Risk

To assist in the site allocation process within the LDF, guidance has been formulated with regard to the flood risk situation.

10.9.7.1 Rapid Inundation Zones (RIZ)

Details of the rapid inundation zone identification and calculation process may be found in Section 6.3.2. All areas within Zone 3 of the floodplain within Old Malton have been classified as 'Danger to all' (Figure 10.16).

The potential depth of flooding and risk of rapid inundation within this settlement may have significant implications for the types of development which are acceptable within Flood Zone 3.

10.9.7.2 Generic Land Use Planning and Development Control Advice

Flood Zones present in Old Malton have been identified in Section 10.9.3.1, above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/ Guidance should be applied within the settlement: 1, 2, 3a(ii), 3b.**

Groundwater flooding may be a risk in Old Malton. Refer to FP/DC Policy Recommendation/Guidance A.

10.10 Rillington

10.10.1 Description of Settlement

Rillington is located along the A64, east of Malton and Norton.

Rillington Beck rises in the hills to the south of the settlement and flows in a northerly direction through the middle of Rillington to join with the River Derwent. Rillington Beck is an ordinary watercourse and appears to be culverted as it flows through Rillington. The location of this watercourse is highlighted within the 'Areas Susceptible to Surface Water Flooding' data, shown in Figure 6.3.2.

10.10.2 Previous Flood Events and Their Extent

There are no historic or hydraulically modelled flood levels or extents for this settlement.

There are also no other reported flood incidents or mechanisms within the settlement

10.10.3 Flood Zones in and Around the Settlement

The existing flood risk situation within Rillington is displayed in Figure 10.17. The settlement is entirely within Flood Zone 1.

The settlement lies on the edge of a zone of potential groundwater and surface runoff flood risk (Zone A, see Section 6.4).

10.10.4 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Rillington area.

10.10.5 Sensitivity to Climate Change

An initial analysis of climate change sensitivity has been undertaken through examination of the nearest Flood Zones and local topography. Land between the settlement and the Flood

Zone outline to the east is relatively flat, suggesting that this area may be sensitive to the potential impacts of climate change.

10.10.6 Critical Drainage Areas

No specific Critical Drainage Areas have been identified within the Rillington area. Refer to Section 9.

10.10.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Rillington have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1.**

No other flood mechanisms have been reported within the settlement. However, groundwater/surface water flooding may be a risk (see Figures 6.3 and 6.3.2). Refer to FP/DC Policy Recommendation/Guidance A.

10.11 Sherburn

10.11.1 Description of Settlement

Sherburn is located to the east of Malton and Norton, along both sides of the A64.

Several springs are located to the south of Sherburn, along the base of the northern escarpment slope of the Yorkshire Wolds. The escarpment slope itself is particularly steep in places, with peak elevations in excess of 160m AOD at the top of the Wolds dropping to 30-45m AOD in Sherburn.

There are also several watercourses within the settlement area. East Beck rises in the vicinity of the aforementioned springs and flows through the eastern side of Sherburn, while an unidentified watercourse rises to the south of Springfield Farm and flows along the western side of the settlement. These two watercourse combine to the south of the settlement to form Sherburn Beck, which ultimately flows into the River Derwent.

10.11.2 Previous Flood Events and Their Extent

There are no historic or hydraulically modelled flood levels or extents for these settlements.

Incidents of groundwater and/or surface runoff flooding have been reported within Sherburn. The 'Areas Susceptible to Surface Water Flooding' data, shown in Figure 6.3.6, highlights the potential for surface water to collect or impact across some areas of this settlement.

10.11.3 Flood Zones in and Around the Settlement

The existing flood risk situation within Sherburn is displayed in Figure 10.18. The settlement is entirely within Flood Zone 1.

The settlement lies within a zone of potential groundwater and surface runoff flood risk (Zone A, see Section 6.4).

10.11.4 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Sherburn area.

10.11.5 Sensitivity to Climate Change

An initial analysis of climate change sensitivity has been undertaken through examination of the nearest Flood Zones and local topography. The Flood Zone outline in the Sherburn area does not encroach over the 25m AOD contour line, while the settlement itself is above the 30m AOD contour line. This would suggest that the settlement is not particularly sensitive to any potential climate change impact. Groundwater flooding could increase in the future.

10.11.6 Critical Drainage Areas

No specific Critical Drainage Areas have been identified within the Sherburn area. Refer to Section 9.

10.11.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Sherburn have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1.**

Groundwater flooding has occurred in the area and may be a risk, and surface runoff may also be an issue (see Figures 6.4 and 6.3.6). Refer to FP/DC Policy Recommendation/Guidance A.

10.12 Sheriff Hutton

10.12.1 Description of Settlement

Sheriff Hutton is located approximately 14 km to the south-west of Malton. It is situated on higher ground. There are no known watercourses within the vicinity of this settlement.

10.12.2 Previous Flood Events and Their Extent

There are no historic or hydraulically modelled flood levels or extents available for this settlement.

Flooding has been reported within the settlement due to drainage issues.

10.12.3 Flood Zones in and Around the Settlement

The existing flood risk situation within Sheriff Hutton is displayed in Figure 10.19. The settlement lies entirely within Flood Zone 1.

10.12.4 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Sheriff Hutton area.

10.12.5 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Sheriff Hutton area. Due to its elevated position this settlement is not considered particularly sensitive to potential climate change effects.

10.12.6 Critical Drainage Areas

No specific Critical Drainage Areas have been identified within the Sheriff Hutton area. Refer to Section 9.

10.12.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Sheriff Hutton have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1.**

Drainage issues have been identified within this settlement. Refer to FP/DC Policy Recommendation/Guidance A.

10.13 Slingsby

10.13.1 Description of Settlement

Slingsby is situated approximately 10 km to the north-west of Malton, along the B1257.

The only watercourse within the settlement is Wath Beck which flows from west to east across the northern part of the settlement. Wath Beck is designated as an ordinary watercourse.

10.13.2 Previous Flood Events and Their Extent

There are no historic or hydraulically modelled flood levels available for this settlement.

There have been no other flood incidents or mechanisms reported within the settlement. The 'Areas Susceptible to Surface Water Flooding' data, shown in Figure 6.3.5, highlights the potential for surface water to collect across much of this settlement.

10.13.3 Flood Zones in and Around the Settlement

The existing flood risk situation within the settlement is displayed in Figure 10.20. Few properties, but a significant proportion of land to the immediate north-west of the settlement, lies within Flood Zone 3, and is therefore at risk from a 1% event. The source of this predicted flooding is Wath Beck.

10.13.4 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the settlement.

All currently developed sites within Zone 3 may be accorded 3a(i) status, while all other sites within Zone 3 should be accorded Zone 3b status.

10.13.5 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Slingsby area.

10.13.6 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Slingsby area.

An initial analysis of climate change sensitivity was undertaken through examination of the local topography. In the northern part of Slingsby the land appears relatively flat, suggesting that this area may be sensitive to potential climate change increases. In other areas of the settlement, the topography appears steeper, suggesting that these areas may not be particularly sensitive to potential climate change increases.

10.13.7 Critical Drainage Areas

No specific Critical Drainage Areas have been identified within the Slingsby area. Refer to Section 9.

10.13.8 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Slingsby have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i), 3c.**

No other flood mechanisms have been reported within the settlement however, due to the potential for surface water problems highlighted by the 'Areas Susceptible to Surface Water Flooding' data (shown in Figure 6.3.5), referral should be made to FP/DC Policy Recommendation/Guidance A.

10.14 Staxton & Willerby

10.14.1 Description of Settlement

The amalgamated settlement of Staxton & Willerby is located approximately half-way between Malton and Scarborough alongside the A64(T). The settlement is situated at the base of the northern slope of the Yorkshire Wolds, and there are no known watercourses within the settlement.

10.14.2 Previous Flood Events and Their Extent

There are no historic or hydraulically modelled flood levels or extents available for this settlement.

10.14.3 Flood Zones in and Around the Settlement

The existing flood risk situation within Staxton and Willerby is displayed in Figure 10.21. The settlement lies entirely within Flood Zone 1.

The settlement lies within a zone of potential groundwater and surface runoff flood risk (Zone A, see Section 6.4).

10.14.4 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Staxton and Willerby area.

There have been no other flood incidents or mechanisms reported within the settlement.

10.14.5 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Staxton and Willerby area.

The settlement lies at an elevation over 10 m above the current level of the River Hertford, suggesting that the settlement is not particularly sensitive to potential climate change increases.

10.14.6 Critical Drainage Areas

No specific Critical Drainage Areas have been identified within the Staxton and Willerby area. Refer to Section 9.

10.14.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Staxton and Willerby have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1.**

No other flood mechanisms have been reported within the settlement. However, groundwater flooding may be a risk (see Figure 6.4). Refer to FP/DC Policy Recommendation/Guidance A.

10.15 Thornton-le-Dale

10.15.1 Description of Settlement

Thornton-le-Dale is situated approximately 4 km to the east of Pickering, at the break of slope from the southern boundary of the North York Moors. Much of the settlement falls within the North York Moors National Park.

Thornton Beck flows through the centre of the settlement in two channels, the main beck channel and the Mill Race, and is a designated 'main river'. Other small watercourses are evident to the south-east of the settlement which are most likely artificial drainage channels.

The location of Thornton Beck is highlighted within the 'Areas Susceptible to Surface Water Flooding' data, shown in Figure 6.3.3.

10.15.2 Previous Flood Events and Their Extent

Historic flood levels are available for both Thornton Beck and Thornton Beck Mill Race but no historic flood extents. There are also no hydraulically modelled flood levels or extents.

Flooding has been reported within the settlement due to drainage issues.

10.15.3 Flood Zones In and Around the Settlement

The existing flood risk situation within Thornton-le-Dale is displayed in Figure 10.22. A number of properties lie within Flood Zone 3, and are therefore at risk from a 1% event. The source of this predicted flooding is Thornton Beck.

The settlement lies within a zone of potential groundwater and surface runoff flood risk (Zone C, see Section 6.4).

10.15.3.1 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the settlement.

All currently developed sites within Zone 3 may be accorded 3a(i) status, while all other sites within Zone 3 should be accorded Zone 3b status.

10.15.4 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Thornton-le-Dale area.

10.15.5 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Thornton-le-Dale area.

An initial analysis of climate change sensitivity was undertaken through examination of the local topography which suggests that this area may not be particularly sensitive to potential climate change increases.

10.15.6 Critical Drainage Areas

No specific Critical Drainage Areas have been identified within the Thornton-le-Dale area. Refer to Section 9.

10.15.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Thornton-le-Dale have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i), 3b. The risk of rapid inundation within this settlement may have significant implications for the design of developments within Flood Zone 3.**

Flooding due to drainage issues has been reported within the settlement and groundwater/surface water flooding may be an issue. Refer to FP/DC Policy Recommendation/Guidance A.

11 Flood Risk in Key Settlements within Scarborough Borough

Using the existing, and emerging, Development Plans, a number of settlements have been identified within Scarborough Borough that are likely to come under significant development pressure in the future. Flood risk has been mapped in each of these locations and a description of the existing flood risk situation within each key settlement is provided. Residual flood risks have been identified, as well as generic land use planning and development control advice for each settlement. Table 11.1 summarises the flood risk issues identified for each settlement within Scarborough Borough.

Table 11.1: Summary of flood risk issues at each key settlement

Settlement	PPS25 Flood Risk Zone				Other watercourse flooding	Coastal flooding	Surface runoff / Groundwater flow flooding	Sensitive to change in surface water runoff
	1	*2*	*3a*	*3b*				
Scarborough (including Newby & Scalby)	✓	✓	✓	✓	✓	✓	*P*	✓
Crossgates	✓						*P*	
Eastfield	✓	✓	✓	✓	✓		✓	✓
Osgodby	✓				*P*		*P*	✓
Filey	✓	✓	✓	✓	✓	✓	✓	✓
Hunmanby	✓				*P*		*P*	✓
Whitby	✓	✓	✓	✓	✓	✓	*P*	✓
Burniston	✓	✓	✓	✓			✓	✓
Cayton	✓				✓		*P*	✓
East & West Ayton	✓	✓	✓	✓			*P*	✓
Seamer	✓	✓	✓	✓	*P*		*P*	✓
Sleights	✓	✓	✓	✓			✓	
Brompton	✓	✓	✓	✓			*P*	✓
Cloughton	✓	✓			✓		✓	
Flixton	✓						✓	
Gristhorpe	✓				*P*		✓	✓
Irton	✓	✓	✓	✓			*P*	
Reighton	✓						✓	✓
Ruswarp	✓	✓	✓	✓			*P*	
Sandsend	✓	✓	✓	✓		✓	*P*	
Snainton	✓	✓	✓	✓			✓	✓
Blue Dolphin	✓							

Settlement	PPS25 Flood Risk Zone				Other watercourse flooding	Coastal flooding	Surface runoff / Groundwater flow flooding	Sensitive to change in surface water runoff
	1	*2*	*3a*	*3b*				
Primrose Valley	✓						√	
Reighton Sands	✓						√	

✓ = Flood risk identified from Flood Zone mapping or reported flood event
P = Potential flood risk identified from qualitative assessment of the characteristics of the settlement and surrounds

11.1 Scarborough (including Newby and Scalby)

11.1.1 Description of Settlement

Scarborough is the largest settlement on the Yorkshire coast, with a growing business and tourist industry. However, parts of the settlement have historically been subjected to flooding both from the sea and local watercourses.

The Scarborough seafront is at risk of tidal inundation. The Shoreline Management Plan[55] (SMP2) indicates that coastal erosion of the Scarborough urban area coastline will be managed to prevent further erosion of strategically important sections. The SMP2 identifies some of the key problems and issues, such as:

- erosion and deterioration of the existing defences;
- insufficient height of the existing seawalls to prevent severe wave overtopping;
- the vulnerability of the Foreshore Road area of Scarborough to regular flooding;
- the current problems will be compounded by the effects of climate change.

The SMP2 identifies a policy of 'holding the existing defence line' as the preferred option for the majority of Scarborough coastline with the exception of the South Cliffs area where a policy of 'no active intervention' shall be employed.

Along the northern districts of the settlement, the Sea Cut channel flows into the North Sea, transporting high flows from the headwaters of the River Derwent catchment. This channel has been artificially created to provide flood relief to properties at East and West Ayton, further down the River Derwent. This watercourse has been accorded Main River status.

There are a number of small watercourses that flow through Scarborough and have associated flooding problems. These include Church Beck, which flows into the Sea Cut along the western side of Scalby, Newby Beck which drains much of the area of Newby into the Sea Cut, and Cow Wath Beck[56] which flows in from the north of Scarborough. Woodlands Beck flows through Scarborough from the west and enters the sea in the North Bay area. The other known watercourse within the settlement is Throxenby Beck, which drains into the Scarborough sewer system. Many of the watercourses within Scarborough flow through culverted sections.

11.1.2 Previous Flood Events and Their Extent

A number of studies have been undertaken on the various watercourses flowing through Scarborough. These studies contain details of previous flood events.

[55] 'Shoreline Management Plan 2 – River Tyne to Flamborough Head', North East Coastal Authorities Group, 2007.
[56] Cow Wath Beck is the official name for this watercourse as it enters the Sea Cut but it is more commonly referred to as Burniston Beck.

Previous flood events along Church Beck are listed in the Flood Alleviation Scheme – Phase 2 Report[57]. This report also provides details on the number of properties affected, and identifies the sources of the flooding which are generally related to culvert and/or channel incapacity.

According to the Newby Beck Critical Ordinary Watercourse Assessment[58], flooding occurred in the Newby area on 4 occasions in 2002, and 3 occasions in 2003. Properties affected and the causes of each flood event are also included in the report.

Assessments into a potential Flood Alleviation Scheme for Newby Beck were carried out by Atkins in 2005[59] and 2006[60]. This assessment was updated by Arup in August 2009[61] and is currently under review by the Environment Agency. The outcomes of this review will assess the viability of a Flood Alleviation Scheme on Newby Beck.

As identified in the Woodlands and Throxenby Flood Alleviation Assessment[62], parts of these areas have historically flooded on an annual basis. This report compiles the available historical flood information and identifies the causes of the flooding, generally attributed to blocked or under-capacity culverts.

The flooding of Scalby Road, from both Woodlands Beck and Throxenby Beck, has serious implications as it is the primary access route for vehicles to Scarborough General Hospital. Flooding of the road can vary in depth from 0.25 m to 0.5 m, making the road impassable for cars.

Peasholme Park Lake, which is fed by Woodlands Vale Beck, has historically overtopped in the vicinity of an overflow structure and flooded the Peasholm Gap/Columbus Ravine roundabout, causing traffic problems but no flooding to properties.

Flooding on the Sea Cut was assessed within the 2004 Flood Warning Improvements Report[63] and the Sea Cut and Upper Derwent Pre-Feasibility Study[64]. This identified flooding from the River Derwent and Sea Cut as occurring due to overtopping of the existing defences and bypassing the Weir Head Sluice. Flood risk to properties in Newby, Scalby, Mowthorpe and Ayton flood cells were assessed. Scalby is at risk only from events greater than 0.1% AEP, some properties in Mowthorpe and Ayton are at risk at 1.33% AEP event, and one property is at risk at the 2% AEP event in the Newby flood cell. All flood cells are at risk of flooding from breaching of the defences on Sea Cut. More information is provided in the report.

Incidents of coastal inundation have been reported along the Scarborough urban area coastline. The maximum level of the Mean High Water Spring tide is the same as the level of the sea defences along the Foreshore Road. Any further waves or surges on top of this level will cause inundation of the seafront. Sewer flooding and drainage issues flooding have also been recorded at various locations throughout Scarborough.

11.1.3 Flood Zones In and Around the Settlement

Figures 11.1 and 11.2, which display the existing flood risk situation within Scarborough, show that a number of properties lie within the predicted extent of Flood Zones 2 and 3. The principal sources of this predicted flooding are Church Beck, Cow Wath Beck, Newby Beck and Woodlands Beck.

Historical flood analysis undertaken in the 'Woodlands and Throxenby Flood Alleviation Assessment'. Flood extents for the 1% flood event along each of these watercourses have

[57] 'Church Beck, Scalby – *Flood Alleviation Scheme Phase 2*', Atkins (2004)
[58] 'Newby - *Critical Ordinary Watercourse Assessment*', Atkins (2004)
[59] '*Newby Flood Alleviation Assessment*', Atkins (2005)
[60] '*Newby Beck Flood Alleviation Scheme: Pre-feasibility Study'*, Atkins (2006)
[61] *'NEECA2 Newby Beck Flood Alleviation Scheme: Technical Note on Scheme Viability'*, Arup (2009)
[62] 'Woodlands and Throxenby – *Flood Alleviation Assessment*', Atkins (2004)
[63] '*NATCON 257 Flood Mapping Framework. West Ayton and Sea Cut Flood Warning Improvements'*, JBA (2004)
[64] '*Sea Cut and Upper Derwent Pre-Feasibility Study'*, JBA (2006)

been produced from the historical analysis. These extents have been included in Figures 11.1 and 11.2 as they predict a greater extent of flooding than that predicted by the Environment Agency Flood Zone map.

11.1.3.1 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the Scarborough settlement boundaries.

For the purposes of land use planning and development control, the historical flood extents described above should be accorded the same status as Flood Zone 3.

All currently developed sites within Zone 3 may be accorded 3a(i) status, while all other areas within Zone 3 should be accorded Zone 3b status.

The settlement lies within a zone of potential groundwater and surface runoff flood risk (Zone B, see Section 6.4).

11.1.4 Existing Flood Risk Management Measures

The Environment Agency operates several Flood Warning Areas within Scarborough, covering Marine and Royal Albert Drive, Foreshore Road and Sandside, the Spa Complex, and the Sea Cut at Newby and Scalby. The predicted source of the majority of the flooding within these areas is tidal, with the exception of Newby and Scalby where the Sea Cut is the source.

There are no flood warnings for Cow Wath Beck, Woodlands Beck, Throxenby Beck and Church Beck.

11.1.5 Potential Flood Risk Management Measures

Coastal protection works are being undertaken to protect Scarborough from coastal erosion.

Woodlands Beck and Throxenby Beck drain neighbouring catchments. It has been identified within the 'Woodlands and Throxenby Flood Alleviation Assessment' that, although both channels flood on a frequent basis, there is no record of properties flooding from Throxenby Beck. Due to this reason the report proposes the '*do minimum*' option as the only economically feasible flood management scheme. This option would entail the construction of additional trash screens, upgrading and clearance of the existing trash screens, plus an enhanced maintenance regime along the watercourse. Such measures would not, however provide protection to a 1% standard.

Within the 'Woodlands and Throxenby Flood Alleviation Assessment', four main options have been identified for Woodlands Beck. These include the '*do minimum*' option of enhanced channel maintenance combined with trash screen installation, the enlargement of an approximately 370 m section of channel, the construction of an embankment in the area close to Hovingham Drive to create a flood storage area, and the replacement of a 600 m section of culvert leading to Peasholme Park. The report recommends that these schemes for Woodlands Beck are taken forward to the next more detailed assessment phase.

A number of mitigation measures have been proposed and appraised in the 'Church Beck Flood Alleviation Scheme Phase 2 Report'. The preferred option encompasses three different flood management measures, namely culvert extension, channel widening along Hackness Road, and the provision of flood embankments along Church Beck and Coldgill Beck.

The Newby Beck FAS Study (2009) proposes two principal flood management options. One option would include a flood diversion channel running along the back of properties on Linden Road and linking back into Newby Beck downstream of Hackness Road. The second option would entail a combination of measures including improvements to culverts and their entrance conditions, as well as a small storage area at the location indicated on Figure 11.4. Further consultation is required with local residents and key stakeholders before the optimal solution is identified and taken forward.

The economic analysis carried out as part of the 'Sea Cut and Upper Derwent Pre-feasibility Study' could not provide justification for a capital scheme on this watercourse due to the existing reasonably high standard of defence, and the low number of properties at risk of flooding. If flood management measures were to be considered further, raising of flood defences and provision of a small storage area are the recommended solutions. At present the flood risk management option recommended is Do Minimum. This option comprises continuing with the existing inspection, and maintenance regime and providing an improved flood warning service to Ayton (JBA, 2006).

None of the above fluvial flood alleviation schemes are likely to be implemented in the foreseeable future.

11.1.6 Sensitivity to Climate Change

Based on Defra recommendations (Section 5.7) sea levels can be expected to rise by around 200 mm over the next 50 years. This will not significantly affect the extent of flooding from the sea in this area.

In the 'Church Beck Flood Alleviation Scheme Phase 2 Report', a sensitivity assessment was undertaken to provide some indication of the potential impacts that climate change may have on flood levels in the Church Beck catchment. The assessment assumed a 20% increase in the 1% design flow. The result indicated a maximum increase in peak water levels of 150 mm around Carr Lane.

No detailed climate change sensitivity analysis was carried out within the 'Newby Critical Watercourse Assessment' or the 'Woodlands and Throxenby Flood Alleviation Assessment'.

An initial analysis of climate change sensitivity was undertaken through examination of the local topography which suggests that this area may not be particularly sensitive to potential climate change increases.

An analysis into the sensitivity of the Sea Cut channel to climate change was carried out in the 'Sea Cut and Upper Derwent Pre-Feasibility Study'. The Sea Cut is not sensitive to climate change, with little impact on the 1% AEP flood outline.

11.1.7 Critical Drainage Catchments

Church Beck, Cow Wath Beck, Newby Beck, and Woodlands Beck have all been designated as Main Rivers. These small watercourses would be sensitive to an increase in the amount or rate of water entering them, and this may lead to an increase in flood risk elsewhere in the catchment. Although not a designated Main River, the same scenario is applicable within the Throxenby Beck catchment. These Critical Drainage Catchments may be particularly sensitive to potential climate change impacts.

The catchment areas of these watercourses have been designated as Critical Drainage Areas and are displayed in Figure 11.3. Refer to Section 9.

11.1.8 Guidance on Land Use Planning and Flood Risks

Flood Zones present in Scarborough have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i), 3b.**

Other flood mechanisms reported within the settlement are sewer flooding, and there is a risk of surface runoff flooding. Refer to FP/DC Policy Recommendation/Guidance A.

Development on the potential sites for flood storage areas, as identified in the 'Newby Critical Watercourse Assessment' and 'Woodlands and Throxenby Flood Alleviation Assessment', should be avoided, in order to ensure that potential future flood management works are not compromised. The location of these areas can be seen in Figure 11.4.

11.2 Crossgates

11.2.1 Description of Settlement

Crossgates is a large settlement situated adjacent to the A64, south-west of the settlement of Scarborough.

A culverted watercourse has been reported running in a southerly direction through the eastern part of the settlement.

11.2.2 Previous Flood Events and Extents

There are no hydraulically modelled flood levels or extents available for Crossgates.

Flooding due to drainage issues has been reported within the settlement. The approximate extent of this flooding and flood flow paths are included in Figure 11.5. These flood incidents may be related to the culverted watercourse identified above. It has been reported that this watercourse resulted in periodic flooding of nearby land prior to culverting.

The 'Areas Susceptible to Surface Water Flooding' plans (see Figure 6.3.7) highlight the susceptibility of this watercourse area to experience surface water flood problems.

11.2.3 Flood Zones In and Around the Settlement

The existing flood risk situation within Crossgates is displayed in Figure 11.5. The entire urban area of the settlement, as well as the immediate surrounding area, is within Flood Zone 1. However, as explained above, flooding has occurred within the settlement. A historic flood extent has been included in Figure 11.5. For the purposes of land use planning and development control this flood extent should be accorded the same status as Flood Zone 3. All currently developed sites within this zone may be accorded 3a(i) status, while all other sites within Zone 3 should be accorded Zone 3b status.

The settlement lies within a zone of potential groundwater and surface runoff flood risk (Zone B, see Section 6.4).

11.2.4 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Crossgates area.

11.2.5 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Crossgates area. The historic outline within Figure 11.5 may be sensitive to the potential impacts of climate change.

An initial analysis of climate change sensitivity was undertaken through examination of the nearby Flood Zone extents and local topography which suggests that this area may not be particularly sensitive to potential climate change increases.

11.2.6 Critical Drainage Catchments

The flooding identified in Section 11.2.2 is believed to be due to issues with culvert capacity in close proximity to Cayton Low Road. The entire catchment area draining to this culvert has been designated as a Critical Drainage Catchment (Figure 11.6) as any increase in the amount or rate of water entering the existing system may exacerbate the current flood risk situation. These Critical Drainage Catchments may be particularly sensitive to potential climate change impacts. Refer to Section 9.

11.2.7 Guidance on Land Use Planning and Flood Risk

The Flood Zones present in Crossgates have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 3a(i), 3b.**

No other flood mechanisms have been reported within the settlement. However, groundwater/surface water flooding may be a risk (see Figures 6.3 and 6.3.7). Refer to FP/DC Policy Recommendation/Guidance A.

11.3 Eastfield

11.3.1 Description of Settlement

Eastfield is a large settlement to the south of Scarborough. A small beck, referred to as The Dell, flows into the settlement from the North, and is culverted under Eastfield Industrial Estate and Cayton Low Road.

11.3.2 Previous Flood Events and Extents

A 'Flood Survey Report'[65] has been prepared in response to the frequent flooding within the Eastfield area. The report lists six flood events which have occurred since 2000. The report also contains a flood extent plan and details of the number of properties affected during the December 2004 flood event. This flood extent has been included in Figure 11.7.

No detailed hydrological or hydraulic modelling has taken place to produce estimated flood extents for differing return period flows.

Surface runoff flooding has also been reported in the north of Eastfield where the surrounding land slopes relatively steeply down into the settlement. The susceptibility for some areas of this settlement, particularly in proximity to the watercourses, to experience surface water flooding problems is highlighted on the 'Areas Susceptible to Surface Water Flooding' plans (see Figure 6.3.7).

11.3.3 Flood Zones In and Around the Settlement

Figure 11.7, which displays the existing flood risk situation in Eastfield, shows that there are no properties within the estimated extent of Flood Zones 2 and 3, which are confined to the lakeland area of Burton Riggs in the south-west of the settlement. However, a significant number of properties fall within the flood extent of the December 2004 event.

11.3.4 Floodplain Delineation

Flood zones 1, 2 and 3 are all present within the settlement.

The majority of Eastfield is classified as Flood Zone 1, however as explained above, a significant amount of flooding has occurred within the settlement. A historic flood extent has been included in Figure 11.7. For the purposes of land use planning and development control this flood extent should be accorded the same status as Flood Zone 3. All currently developed sites within this zone may be accorded 3a(i) status, while all other sites within Zone 3 should be accorded Zone 3b status.

The settlement lies within a zone of potential groundwater and surface runoff flood risk (Zone B, see Section 6.4).

11.3.5 Potential Flood Risk Management Measures

At present, there are no known proposed flood risk management measures for the Eastfield area.

11.3.6 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Eastfield area. It is also not possible to perform a climate change sensitivity analysis on the historic flood extent displayed in Figure 11.7.

An initial analysis of climate change sensitivity was undertaken through examination of the nearby Flood Zone extents and local topography which suggests that this area may not be particularly sensitive to potential climate change increases.

11.3.7 Critical Drainage Catchments

The cause(s) of the recent flood events within Eastfield is unclear. An increase in the amount or rate of water entering the existing drainage system, whether natural or artificial, within the settlement may exacerbate the current flood risk situation. The existing drainage

[65] '*Flood Survey Report*', Eastfield Flood Working Group (2005).

system may be particularly sensitive to potential climate change impacts. The entire catchment area draining to and/or through Eastfield has been designated as a Critical Drainage Area, and is displayed in Figure 11.8. Refer to Section 9.

11.3.8 Guidance on Land Use Planning and Flood Risks

Flood Zones present in Eastfield have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i), 3b.**

Other flood mechanisms reported within the settlement are surface runoff flooding and sewer flooding, while the entire settlement, and much of the surrounding area, is within a Critical Drainage Area. Refer to FP/DC Policy Recommendation/Guidance A.

11.4 Osgodby

11.4.1 Description of Settlement

Osgodby is a relatively small settlement south of Scarborough, situated at the northern point of Cayton Bay. A small, un-named watercourse flows through the northern section of the settlement and into the sea at Wheatcroft Cliff.

11.4.2 Previous Flood Events and Extents

There have been no reports of previous flooding problems in Osgodby. No previous flood studies are available for the Osgodby area.

11.4.3 Flood Zones In and Around the Settlement

The existing flood risk situation within Osgodby is displayed in Figure 11.9. The entire urban area of the settlement, as well as the immediate surrounding area, is within Flood Zone 1.

The settlement lies within a zone of potential groundwater and surface runoff flood risk (Zone B, see Section 6.4).

11.4.4 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for Osgodby.

11.4.5 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for Osgodby.

An initial analysis of climate change sensitivity was undertaken through examination of the nearby Flood Zone extents and local topography which suggests that this area may not be particularly sensitive to potential climate change increases.

11.4.6 Critical Drainage Catchments

As will be explained in more detail below (Section 11.9), a definite flood risk issue has been identified within Cayton. As such, Critical Drainage Catchments have been identified for the area draining through Cayton. Many parts of Osgodby lie within the upper reaches of these Drainage Sensitive Catchments, displayed in Figure 11.10. These Critical Drainage Catchments may be particularly sensitive to potential climate change impacts. Refer to Section 9.

11.4.7 Existing Recommendations Regarding New Development

The Cayton Flood Alleviation Assessment Report[66] identifies a potential issue surrounding one of the components of the proposed A165 Scarborough to Lebberston bypass. A balancing area is proposed in an area to the west of Osgodby (see Figure 11.9). It is the recommendation of the report that, unless flood mitigation measures are put in place along the Coulston watercourse, additional flows should not be routed into the already under-capacity watercourse.

[66] '*Cayton Flood Alleviation Assessment*', Atkins (2004).

11.4.8 Guidance on Land Use Planning and Flood Risk

The Flood Zones present in Osgodby have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1.**

Many parts of the settlement are within a Critical Drainage Catchment, and sewer flooding has been reported as a flood mechanism within the settlement. Refer to FP/DC Policy Recommendation/Guidance A.

11.5 Filey

11.5.1 Description of the Settlement

Filey is a coastal settlement situated approximately 10 km to the south-east of Scarborough. Apart from the sea front, most of Filey is located a significant height above sea level.

In total, four significant watercourses are present within the Filey area. Filey Beck and Long Plantation Watercourse flow through Filey. Martin's Ravine flows into the sea to the south of Filey, and Dam's Goit rises in the Dams area, to the west of Filey. This final watercourse has been diverted into the public surface water sewers at Pasture's Crescent, with only a small overflow pipe to allow some flow to continue along the original channel.

11.5.2 Previous Flood Events and their Extents

According to the Filey Town Flood Investigation Report[67], Filey has been subjected to flooding incidents in the summer and autumn months every year since 1999, and also for many years prior to this date. This report also provides the dates of historical flood events since 1985, and the properties affected by each event. Figure 11.11 shows a generalised representation of these flood locations within the settlement[68].

Recent consultation with Scarborough BC has indicated that the flood risk may have increased further since the original SFRA report. Flooding has continued to occur on an annual, or sub-annual, basis and the town was particularly badly flooded during 2007. Areas impacted in 2007 include the areas around the Wharfedale Estate, Cawthorne Crescent, Linton Close and Muston Road.

The Filey Town Flood Investigation Report attributes the flood events in Filey to a number of interacting problems, some relating to the watercourses and drainage systems, and others to the sewer system. The report suggests that the common factor in the majority of the flood problems is that the existing drainage systems are under capacity to deal with the flood events.

The Long Plantation Watercourse Flood Alleviation Scheme Report[69] also provides details of several recent flood events, with particular impact upon the western side of Filey. The number and general location of properties affected are included. This report attributes the flooding to insufficient channel capacity along sections of Long Plantation Watercourse.

Estimated flood extents for differing return period flow events are included in the report. The flood outline for the 1% event along Long Plantation Watercourse has been included in Figure 11.11.

Surface runoff flooding incidents have also been reported in the north and west of the settlement where surface water may impact upon properties from the surrounding, higher land. These reported events have been plotted on Figure 11.11 which also shows areas in which surface water flooding incidents were reported the during the 2007 event[70].

[67] '*Filey Town Flooding Investigation*', Atkins (2004).
[68] For indicative purposes only. Figure adapted from drawing number 5002531/WA/F017 (Revision A) from the '*Filey Town Flooding Investigation*'.
[69] '*Long Plantation Watercourse, Filey* – Flood Alleviation Scheme, Phase 2', Atkins (2004).
[70] 'Filey Flood 18 July 2007 , Scarborough Borough Council (February 2008)

11.5.3 Flood Zones in and around the Settlement

Figure 11.11, which displays the existing flood risk situation within Filey, shows that a number of properties close to the coast fall within the predicted extent of Flood Zones 2 and 3. The figure also shows that other areas of Filey have experienced either surface runoff flooding or sewer flooding in the past but are located within Flood Zone 1 of the Environment Agency maps.

The settlement lies within a zone of potential groundwater and surface runoff flood risk (Zone B, see Section 6.4).

11.5.3.1 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the settlement.

The majority of Filey is classified as Flood Zone 1, however as explained above, a significant amount of flooding has occurred within the settlement. Historic and hydraulically modelled flood extents have been included in Figures 11.11. For the purposes of land use planning and development control these flood extents should be accorded the same status as Flood Zone 3. All currently developed sites within this zone may be accorded 3a(i) status, while all other areas within Zone 3 should be accorded Zone 3b status.

11.5.4 Potential Flood Risk Management Measures

A number of flood alleviation measures were proposed for the settlement of Filey within the Filey Town Flood Investigation Report, which also discusses the relative merits of each of the proposals in financial terms.

The report identifies surface water attenuation measures as the optimum solutions for the problems associated with Filey Beck and the Muston Road area of the settlement. For Filey Beck, the proposed solution is the construction of an embankment to retain flood water in the fields to the north of the settlement. At Muston Road, the preferred solution is the construction of an offline tank sewer. Other mitigation measures within the settlement include sewer capacity upsizing in the Wharfedale Estate, and drain replacement and tree root cutting in the vicinity of Filey Senior School.

Flood management proposals have recently been further developed as part of a collaborative study[71] evaluating flood risk management and environmental benefits. These proposed measures are shown on Figure 11.11.

The mitigation measures proposed for the Long Plantation Watercourse are detailed in the Flood Alleviation Scheme Report. In summary, three possible solutions were proposed, comprising a flood embankment; a flood storage area; or channel widening and re-profiling works. The latter option has been recommended as the most viable solution but has not yet been taken forward.

11.5.5 Sensitivity to Climate Change

Based on Defra recommendations (Section 3.7) sea levels can be expected to rise by around 850 mm over the next 100 years. This will not significantly affect the extent of flooding from the sea in this area, although some properties and sites along the foreshore will become more vulnerable.

A climate change sensitivity analysis was carried out within the Long Plantation Watercourse Flood Alleviation Scheme Report. Assuming a 20% increase in the 1% flow, a maximum increase in water levels of 70 mm upstream of the Dams area could be expected, with an average increase of 20 mm along the remainder of the watercourse.

No detailed climate change sensitivity analysis was carried out within the Filey Town Flooding Investigation.

[71] Study partners include Scarborough Borough Council, Environment Agency, Natural England, North Yorkshire County Council, Yorkshire Water and Filey Town Council. Consultants are Mouchel.

11.5.6 Critical Drainage Catchments

As explained in the sections above, much of the flood risk within Filey is due to issues surrounding the capacity of the existing drainage systems. Any increase in the amount of water entering these drainage systems may increase the degree of flood risk elsewhere in the settlement. These Critical Drainage Catchments may be particularly sensitive to potential climate change impacts.

The entire area which may drain into the existing systems within Filey, including both the rural and urban areas, is displayed in Figure 11.12. Refer to Section 9.

11.5.7 Existing Recommendations Regarding New Development

It is recommended within the Filey Town Flooding Investigation Report that no further new developments take place in the areas identified as being at risk of flooding, or that have been subject to previous flooding, until alleviatory measures have taken place. These areas can be identified by the generalised flood risk areas in Figure 11.11, or the 'Location Incidents'[72] figure in the Flooding Investigation Report.

11.5.8 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Filey have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i), and 3b.**

Other flood mechanisms reported within the settlement are surface water flooding and sewer flooding. Refer to FP/DC Policy Recommendation/Guidance A. It is recommended in this report that, following the suggestion of the Filey Town Flooding Investigation that no further development take place in the areas identified at risk of flooding until alleviatory measures are put in place, consultation should be undertaken with the appropriate drainage engineers at Scarborough BC at an early planning stage regarding the acceptability of proposed developments.

Development on the potential sites for flood storage areas upstream of Filey should be avoided, in order to ensure that potential for future flood alleviation works is not compromised.

11.6 Hunmanby

11.6.1 Description of Settlement

This large settlement is situated in the south of the Scarborough Borough area and has undergone significant expansion in recent times.

There are no known watercourses within the current urban extent of Hunmanby, however, several un-named watercourses are apparent in the immediate area surrounding the settlement.

11.6.2 Previous Flood Events and Extents

There have been no reports of previous flooding problems in Hunmanby due to watercourse flooding, although sewer flooding problems have been reported. No previous flood studies are available for the Hunmanby area.

11.6.3 Flood Zones In and Around the Settlement

The existing flood risk situation within Hunmanby is displayed in Figure 11.13. It shows that the entire urban area of the settlement is within Flood Zone 1, along with the majority of the surrounding area.

Small areas of Flood Zones 2 and 3 are present to the north-east of the settlement. Those areas within Zone 3 should be accorded 3b status.

The settlement lies within a zone of potential groundwater and surface runoff flood risk (Zone B, see Section 6.4).

[72] Drawing number 5002531/WA/F017 (Revision A) from the '*Filey Town Flooding Investigation*'.

11.6.4 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Hunmanby area.

11.6.5 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Hunmanby area.

An initial analysis of climate change sensitivity was undertaken through examination of the nearby Flood Zone extents and local topography which suggests that this area may not be particularly sensitive to potential climate change increases.

11.6.6 Critical Drainage Catchments

There are no Critical Ordinary Watercourses or formal flood defences within the Hunmanby area. No specific Critical Drainage Areas have therefore been identified. Refer to Section 9.

11.6.7 Guidance on Land Use Planning and Flood Risk

The Flood Zones present in Hunmanby have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, and 3b.**

Problems with sewer flooding have been reported and groundwater/surface water flooding may be a risk (see Figure 6.3). Refer to FP/DC Policy Recommendation/Guidance A.

11.7 Whitby

11.7.1 Description of Settlement

Whitby has a working harbour and a prominent tourist industry, but the town is known to have suffered from both tidal and fluvial flooding.

The main river running through Whitby is the River Esk, which flows into the North Sea after draining a large portion of the northern part of the North York Moors. The tidal limit of the River Esk is a weir at Turnerdale Hall, situated approximately 2 km upstream of Whitby.

Other watercourses within the settlement area are Stakesby Vale, Spital Beck, and Upgang Beck.

Stakesby Vale drains much of western Whitby and is culverted from a point some 800 m west of its outfall into the harbour at Endeavour Wharf.

Spital Beck is also a tributary to the River Esk, with a catchment area of approximately 5km^2. It flows into the River Esk from the area to the east of Whitby. The watercourse has steep sides and a steep longitudinal profile, with around the final 80 m of the stream tidally influenced.

Upgang Beck flows into the North Sea along the northern edge of Whitby, but there are currently no properties in close proximity to this watercourse.

11.7.2 Previous Flood Events and Their Extent

The 'Whitby Flood Alleviation Scheme Pre-Feasibility Report'[73] identifies the last serious tidal flooding event to have occurred in 1983. During this event the sea waters overtopped the harbour edge causing the flooding of properties on New Quay Road, Church Street and Pier Road. A total estimated extent of inundation is not provided within the report. The 'Whitby Coastal Strategy'[74] concludes that the area was affected by a 0.5% tidal event.

The Whitby Flood Alleviation Scheme Pre-Feasibility Report suggests that more recent events may also have occurred but these have been less severe and not reported.

Fluvial flooding to the Station Square area of Whitby, originating from the Stakesby Vale watercourse, has also been identified within the Whitby Flood Alleviation Scheme Pre-Feasibility Report. The culvert leading to Endeavour Wharf became blocked, causing flood

[73] '*Whitby Flood Alleviation Scheme* – Project Pre-Feasibility Report', Atkins (2004).
[74] '*The Whitby Coastal Strategy – Sandsend to Abby Cliff*', High Point Rendel (2001).

waters to back up and eventually flow down the streets toward the harbour area. Estimated extents of this flooding have not been provided in the report.

Properties affected by historical flooding within Whitby, along with the type of flooding, are identified in the Section 105 Survey of Spital Beck[75], but no estimated extents are provided. The Section 105 Survey of Spital Beck[76] also noted that during low frequency events, water levels in the Beck may affect land and urban drainage networks. The backing up of discharges could result in surface water flooding from drains and manholes, which in turn could lead to ponding in low lying areas.

Occurrence of previous flood events, and their extents, along Upgang Beck are not known.

11.7.3 Flood Zones In and Around the Settlement

Figure 11.14, which displays the existing flood risk situation within Whitby, shows that a significant number of properties lie within the predicted extent of Flood Zones 2 and 3. The principal source of the predicted flooding is the River Esk in combination with tidal influences, but significant flooding is also predicted from Stakesby Vale and, to a lesser degree, Spital Beck.

11.7.3.1 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the Whitby settlement boundaries.

Regarding further delineation of Flood Zone 3, all currently developed sites are accorded 3a(i) status, while all other sites should be treated as Zone 3b.

11.7.4 Existing Flood Risk Management Measures

The Environment Agency operates a Flood Warning Area within Whitby, covering New Quay Road, Church Street, and from Bridge Street to Eskside Wharfe. The predicted source of the majority of the flooding within these areas is tidal.

The Whitby Flood Alleviation Scheme Pre-Feasibility Report identifies one flood management measure already in operation. This entails the regular cleaning of the trash screen at the entrance to the culvert under Station Square to help prevent the blockages that contribute to localised flooding.

The report does point out that this new regime is yet to be tested but the culvert should have sufficient capacity to convey the 1% flood event.

11.7.5 Potential Flood Risk Management Measures

At present there are no formal raised flood defences in Whitby, but the man-made harbour walls serve as secondary flood defences and provide some protection in the places where the wall is higher than the land behind them. Also, the continuous dredging activity that takes place within the harbour to maintain a navigable channel has a secondary effect of giving some protection against fluvial flooding. However, the flood management benefits afforded by both these measures are coincidental and not the designated intention of either activity/measure, and as such are not considered as formal flood management measures.

According to the Whitby Flood Alleviation Scheme Pre-Feasibility Report, the settlement is at a greater risk from tidal than fluvial flooding. The target Standard of Protection from flooding from the sea is 0.5%. The Pre-Feasibility Report considers three options for the management of this tidal flooding. These include the upgrading of the current flood warning system, the construction of linear flood defences along the banks of the River Esk, and the construction of a tidal barrage.

It was concluded that in terms of economic viability and 'safeness', the construction of linear flood defences was the most feasible option of tidal flood management, although the tidal barrage option may have to be revisited if the linear defences were to prove unworkable. These flood defences will not be constructed in the foreseeable future.

[75] '*Section 105 -30/92 Survey* – Spital Beck: Volume 2 – Technical Information', Kennedy & Donkin Ltd (1999).
[76] '*Section 105 – 30/92 Survey – Spital Beck*: Volume 3 – Planning Information', Kennedy & Donkin Ltd (1999).

11.7.6 Sensitivity to Climate Change

Based on Defra recommendations (Section 5.7) sea levels can be expected to rise by around 200 mm over the next 50 years. The Whitby Flood Alleviation Scheme Pre-Feasibility Report suggests that the difference between the 0.5% and 0.1% peak tide level is 0.21 m in the harbour area of the town.

An initial analysis of climate change sensitivity was undertaken through examination of the local topography which suggests that this area may not be particularly sensitive to potential climate change increases.

11.7.7 Critical Drainage Catchments

No Critical Drainage Areas have been identified within the settlement or in the surrounding area.

11.7.8 Guidance on Land Use Planning and Flood Risk

To assist in the site allocation process within the LDF, guidance has been formulated with regard to the flood risk situation.

11.7.8.1 Flood Depth Mapping

Further details of the flood depth mapping process undertaken are included in Section 6.2.1.4. The flood depth map for Whitby may be viewed in Figure 11.15.

A flood depth of over 3.5 m is predicted for a significant portion of the land to the south of Whitby. Much of this land can be placed within Flood Zone 3b, but there are some areas accorded Zone 3a(i) status.

The potential depth of flooding within this settlement may have significant implications for the design of developments within Flood Zone 3.

11.7.8.2 Generic Land Use Planning and Development Control Advice

The Flood Zones present in Whitby have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i), 3b.**

Other flood mechanisms reported within the settlement are sewer flooding and ordinary watercourse flooding. Refer to FP/DC Policy Recommendation/Guidance A.

11.8 Burniston

11.8.1 Description of Settlement

Burniston is situated approximately 2km north of Scarborough, and approximately 1km from the North Sea coast.

Immediately to the north of the settlement two watercourses, Cloughton Beck and Quarry Beck, merge to form Burniston Beck, which then flows down the eastern side of Burniston and eventually into the Sea Cut, by which time the watercourse has become Cow Wath Beck.

Immediately downstream of the confluence of Cloughton Beck and Quarry Beck, the Burniston Beck channel splits in two with one channel forming the Mill Race at the Old Mill. Another small, un-named watercourse also appears to join the Burniston Beck channel in the south of the settlement.

11.8.2 Previous Flood Events and Their Extent

The Burniston, Cloughton and Quarry Becks Flood Alleviation Scheme – Phase 2 Report[77] details the recent flood history of the settlement. Five recent flooding events in the area were identified: June 2000, November 2000, August 2002, October 2002, and January 2003. The August 2002 event is identified as the most severe and the report details the number and location of properties impacted during this event. The areas around Rocks

[77] '*Burniston, Cloughton & Quarry Becks*: Flood Alleviation Scheme – Phase 2', Atkins (2004).

Lane and Bridge Close in Burniston were particularly impacted by the flooding. The report also contains details of recorded farmland and garden flooding incidents which pre-date the five events highlighted above. No flood extent plans are available for any of these identified events.

Incidents of flooding due to excess surface runoff and drainage issues have also been reported within the settlement.

11.8.3 Flood Zones in and Around the Settlement

The existing flood risk situation within Burniston is displayed in Figure 11.16. A number of properties lie within Flood Zone 3, and are therefore at risk from a 1% annual probability of exceedance flood event. A much greater number of properties lie within Flood Zone 2, and are therefore at risk from a 0.1% annual probability of exceedance flood event. The source of this predicted flooding is Burniston Beck, and it's Mill Race, along the eastern side of the settlement, and Quarry Beck along the northern edge.

The settlement lies within a zone of potential groundwater and surface runoff flood risk (Zone B, see Section 6.4).

11.8.3.1 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the settlement.

Regarding further delineation of Flood Zone 3, all currently developed sites are accorded 3a(i) status, while all other areas should be treated as Zone 3b.

11.8.4 Potential Flood Risk Management Measures

A series of potential flood management measures have been proposed and assessed in the FAS Phase 2 Report. These include an area of flood flow retention storage, the construction of localised defences, improvements to existing structures, channel widening, and the implementation of temporary defences. Detailed flood mitigation options were then developed from all these measures except the potential storage area.

These more detailed flood mitigation options were subjected to a further appraisal process, from which a preferred scheme was proposed. This scheme comprises the construction of localised flood defence structures, channel widening, culvert improvements, and the raising of the caravan floor levels at the caravan site along the Burniston Road. This proposed scheme has not yet been implemented however, in 2009 Burniston was awarded funding for a flood wall in the River Meadows area, road bridge parapet modifications near Bridge Close and an additional storm culvert.

11.8.5 Sensitivity to Climate Change

A climate change sensitivity analysis was undertaken in the FAS Phase 2 Report. A flow allowance of 20% was added to the 1% peak flow, which resulted in a maximum increase in water levels of 360 mm immediately upstream of the Willymath Bridge, and a maximum increase of 100 mm throughout the remainder of the watercourse.

11.8.6 Critical Drainage Catchments

Burniston Beck, Cloughton Beck and Quarry Beck are all relatively small watercourses which have exhibited previous flooding problems. An increase in the amount or rate of water entering these watercourses may lead to an increase in flood risk elsewhere in the catchment. These Critical Drainage Catchments may be particularly sensitive to potential climate change impacts.

The catchment areas of these watercourses have been designated as Critical Drainage Areas and are displayed in Figure 11.17. Refer to Section 9.

11.8.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Burniston have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i), 3b.**

Flooding incidents due to drainage issues and surface runoff have been reported within the settlement. Refer to FP/DC Policy Recommendation/Guidance A.

11.9 Cayton

11.9.1 Description of Settlement

The settlement of Cayton is located approximately 5 km south of Scarborough, and forms part of the commuter conurbation also containing Eastfield, Seamer and Osgodby.

There are two watercourses running through the settlement, namely Coulston Watercourse and Beck Hole Watercourse, both of which are designated as ordinary watercourses. Both flow into Cayton in open channels, but flow through the settlement within a series of culverts of varying diameters.

11.9.2 Previous Flood Events and their Extents

Previous flood events within the settlement are described in the Cayton Flood Alleviation Assessment Report[78]. During August 2002, an intense localised rainfall event produced widespread flooding through Cayton, inundating some 65 residential properties, one industrial unit, and a caravan park. The estimated flood outline for this event is included in Figure 11.18. The Flood Alleviation Assessment Report attributed the cause of this flooding to the inability of the existing culverts to deal with the excess runoff produced during the storm event. Additional factors which may have exacerbated the flooding include recent development areas upstream, and blocked trash screens in the culvert system. The susceptibility for this settlement to experience surface water flooding problems is highlighted on the 'Areas Susceptible to Surface Water Flooding' plans (see Figure 6.3.7).

Flooding is also reported to have occurred in the settlement during Autumn 2000 but the extent has not been quantified.

Incidents of sewer flooding and those related to issues with the existing drainage system have also been reported within Cayton.

11.9.3 Flood Zones In and Around the Settlement

The existing flood risk situation within Cayton is displayed in Figure 11.18. The Flood Zone data shows the settlement to be entirely within Zone 1, and therefore not at risk of flooding up to a 0.1% annual probability of exceedance flood event.

However, as explained above, recent flood events have been reported within the settlement. The estimated outline from the August 2002 flood event has been incorporated with the Flood Zone data to produce the revised flood risk situation within Cayton, as displayed in Figure 11.18. The Cayton Flood Alleviation Assessment Report assumes the 1% flood event outline follows the historical outline of the 2002 event, with some flooding of additional properties within the known flood outline.

For the purposes of land use planning and development control these revised extents should be accorded the same status as Flood Zone 3. All currently developed sites within this zone may be accorded 3a(i) status, while all other areas within Zone 3 should be accorded Zone 3b status.

The settlement lies within a zone of potential groundwater and surface water flood risk (Zone B, see Section 6.4).

11.9.4 Potential Flood Risk Management Measures

Flood management measures are proposed within the Cayton Flood Alleviation Assessment Report. Four options are considered:

- 'Do minimum' – through the installation of trash screens and cleaning of the existing culverts and channels

[78] '*Cayton Flood Alleviation Assessment*', Atkins (2004).

- Upgrading the existing culvert system through Cayton coupled with trash screen installation and channel maintenance
- Construction of 2 flood storage areas upstream of Cayton (see Figure 11.18)
- Construction of a diversion channel to the west of Cayton

A cost-benefit assessment is undertaken within the Flood Alleviation Assessment. It is determined that each proposed option is robust and should be taken forward to a more detailed mathematical modelling assessment. This scheme is not likely to be implemented in the foreseeable future.

11.9.5 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Cayton area.

An initial analysis of climate change sensitivity was undertaken through examination of the local topography. Much of the Cayton area is relatively flat which suggests that this area may be sensitive to potential climate change increases.

11.9.6 Critical Drainage Catchments

An increase in the amount or rate of water entering either the Coulston or Beck Hole watercourses may exacerbate the current flood risk situation. The catchment areas of these two watercourses have been designated as Critical Drainage Catchments, and are identified in Figure 11.19. Refer to Section 9. These Critical Drainage Catchments may be particularly sensitive to potential climate change impacts.

11.9.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Cayton have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 3a(i), 3b.**

Sewer flooding and drainage issues have been identified as flood mechanisms within the settlement. Refer to FP/DC Policy Recommendation/Guidance A.

Development on the potential sites for flood storage areas to the north of Cayton should be avoided, in order to ensure that potential for future flood alleviation works is not compromised.

11.10 East & West Ayton

11.10.1 Description of the Settlement

The settlements of East and West Ayton are situated along the East and West banks of the River Derwent, respectively. For the purposes of this study they will be described as a single entity. The North York Moors National Park Boundary runs through the settlement.

The River Derwent flows through the settlement and is a designated Main River.

11.10.2 Previous Flood Events and their Extents

Details on five historical flood events are provided in the River Derwent, West Ayton Phase 1 Watercourse Report[79]. The earliest of these occurred in 1931, with further events in 1991, two in 1999, and 2000. The only recorded incident of properties flooding occurred in the 1931 event when houses between Castle Gate and Ayton Bridge were reportedly flooded to a depth of 2 feet. This flood event is believed to have been caused by the breaching and overtopping of the south floodbank of the Sea Cut. No flood extent plans are available for any historic events.

The 'Areas Susceptible to Surface Water Flooding' data, shown in Figure 6.3.6, highlights the location of the River Derwent and suggests some susceptibility to surface water flooding in the south of the settlement.

[79] 'Flood Risk Mapping Studies 2000-2001: *River Derwent, West Ayton – Phase 1 Watercourse Report*', JBA (2001).

Incidents of sewer flooding have also been reported within the settlement.

11.10.3 Existing Flood Risk Management Measures

There are no known existing flood risk management measures directly within the East and West Ayton area. Upstream of the settlement, the implementation of The Sea Cut, which diverts a large proportion of the flows from the headwaters of the River Derwent out into the North Sea, has helped manage flood risk in the settlement.

11.10.4 Potential Flood Risk Management Measures

The Phase 1 Watercourse Report suggests dredging of the River Derwent as a means to help alleviate flood risk.

11.10.5 Flood Zones in and Around the Settlement

The existing flood risk situation depicted by the Environment Agency Flood Map for East and West Ayton is displayed in Figure 11.20. A significant number of properties are shown to be within the settlement lie within Flood Zone 3, and are therefore at risk from a 1% annual probability of exceedance flood event. The source of this predicted flooding is primarily the River Derwent but an unidentified source which appears to flow into the settlement from the north-west is also attributed a significant amount of flooding. The origin of this unidentified source is unclear as there are no known watercourses flowing East and West Ayton in the area indicated.

Further modelling and flood outline refinement was carried out for the Ayton area in the 'West Ayton and Sea Cut Flood Warning Improvements Report' (2004) and the 'Sea Cut and Upper Derwent Pre-Feasibility Study' (2006). Predicted 1% AEP flood outlines derived from this study depict a much smaller area at risk of flooding than indicated by the EA Flood Map. The number of properties at risk for the 1% AEP event reduces from 101 to 9 with the updated flood outlines.

At present, the results from the 2004 and 2006 modelling have not been incorporated into the EA Flood Zones. Until such time as these extents have been incorporated into the Flood Zone data the extents shown in Figure 11.20 should be used for forward planning and development control purposes.

The settlement lies within a zone of potential groundwater and surface water flood risk (Zone C, see Section 6.4).

11.10.5.1 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the settlement.

Until such time as the EA Flood Zones are updated using the output from the Sea Cut modelling studies referred to above, the precautionary principle should be applied, and all currently developed sites within Zone 3 may be accorded 3a(i) status, while all other areas within Zone 3 should be accorded Zone 3b status.

11.10.6 Sensitivity to Climate Change

Sensitivity to climate change in East and West Ayton was assessed as part of the 'Sea Cut and Derwent Pre-Feasibility Study'. The modelled outline, with a 20% flow increase allowance, is significantly larger than for the 1% AEP event in Ayton. Approximately 39 additional properties are included within the 1% AEP plus climate change flood outline, the majority of these being in East Ayton on Main Street and Castlegate, the area affected during floods in 1930 and 1931. This information suggests that the settlement of East and West Ayton may be relatively sensitive to potential climate change impacts.

11.10.7 Critical Drainage Catchments

No specific Critical Drainage Areas have been identified within the East and West Ayton area. Refer to Section 9.2.

11.10.8 Guidance on Land Use Planning and Flood Risk

Flood Zones present in East and West Ayton have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i), 3b.**

Sewer flooding incidents have been reported within the settlement and groundwater/surface water may be a problem. Refer to FP/DC Policy Recommendation/Guidance A.

11.11 Seamer

11.11.1 Description of Settlement

The settlement of Seamer is located approximately 6 km to the south-west of Scarborough.

An unidentified tributary of the Seamer Drain flows down the western side of the settlement, and is designated as an ordinary watercourse.

11.11.2 Previous Flood Events and Their Extent

There are no historic or hydraulically modelled flood levels or extents available for Seamer.

Sewer flooding incidents have been reported within the settlement.

The 'Areas Susceptible to Surface Water Flooding' data, shown in Figure 6.3.6, highlights the location of the ordinary watercourse.

11.11.3 Flood Zones In and Around the Settlement

The existing flood risk situation within Seamer is displayed in Figure 11.21. The entire urban environment of Seamer lies within Flood Zone 1. Undeveloped land to the west of the settlement, and the sewage works to the south-west lie within Zones 2 and 3. The source of this predicted flooding is the River Derwent and tributaries.

The settlement lies within a zone of potential groundwater and surface water flood risk (Zone C, see Section 6.4).

11.11.3.1 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the settlement.

All currently developed sites within Zone 3 may be accorded 3a(i) status, while all other areas within Zone 3 should be accorded Zone 3b status.

11.11.4 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Seamer area.

11.11.5 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Seamer area.

An initial analysis of climate change sensitivity was undertaken through examination of the local topography which suggests that this area may not be particularly sensitive to potential climate change increases.

11.11.6 Critical Drainage Catchments

No specific Drainage Sensitive Areas have been identified within the Seamer area. Refer to Section 9.

11.11.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Seamer have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i), 3b.**

Sewer flooding incidents have been reported within the settlement and groundwater/surface water may be a problem. Refer to FP/DC Policy Recommendation/Guidance A.

11.12 Sleights

11.12.1 Description of Settlement

Sleights is situated approximately 4 km to the south-west of Whitby. The settlement of Briggswath, to the north of both Sleights and the River Esk, has been included in this settlement description. The North York Moors National Park Boundary runs through the settlement.

The River Esk flows in an easterly direction through the settlement, and Iburndale Beck flows northwards along the eastern side of Sleights to join the Esk. Iburndale Beck is designated as an ordinary watercourse and the River Esk is a designated Main River.

11.12.2 Previous Flood Events and Their Extent

The Iburndale Beck at Sleights Critical Ordinary Watercourse Report[80] provides details on the known flooding history in the Sleights area. Significant flood events occurred in 1930, Autumn 2000 (with one property possibly inundated during the 2000 event) and in summer 2007.

Flooding within the settlement is thought to be caused by direct flooding from the River Esk, and also the backing up of flows in Iburndale Beck due to high levels in the River Esk.

The Critical Ordinary Watercourse Report also describes how local residents have noted that the coincidence of sewer flooding with flooding from the river.

Flooding incidents due to drainage issues and surface runoff have also been reported within the settlement.

11.12.3 Flood Zones In and Around the Settlement

The existing flood risk situation within Sleights is displayed in Figure 11.22. A significant number of properties lie within the predicted extent of Flood Zone 3, and are therefore at risk from a 1% flood event. The principal source of flooding is the River Esk but flooding is also predicted from Iburndale Beck.

A detailed hydrological and hydraulic modelling study was carried out in 2008 (the 'Esk and Iburndale Beck Flood Risk Mapping Study', 2008[81]). Flood outlines for a range of return periods for fluvial and tidal events on the River Esk and Iburndale Beck were produced.

Areas at risk of flooding include the River Gardens areas of Briggswath from the River Esk; developments along the B1410 between Sleights and Briggswath, and areas of Ruswarp (as described in Section 11.19). Within Sleights, areas affected include the railway, cricket field, and the Lowdale Lane and Beck Holme areas. The onset of flooding in certain areas is the 4% AEP event.

The Beck Holme development is afforded protection to an unconfirmed standard by a private reinforced concrete floodwall erected in 2007/2008 follow completion of redevelopment of the area.

The settlement lies within a zone of potential groundwater and surface water flood risk (Zone D, see Section 6.4).

11.12.3.1 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the settlement.

All currently developed areas within Zone 3 may be accorded 3a(i) status, while all other areas within Zone 3 should be accorded Zone 3c status.

11.12.4 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Sleights area.

[80] 'Flood Risk Mapping Studies 2000 – 2001: *Iburndale Beck at Sleights – Critical Ordinary Watercourse Report*', JBA (2001).
[81] *Esk and Iburndale Flood Risk Mapping Study*, Halcrow (2008)

11.12.5 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Sleights area.

An initial analysis of climate change sensitivity was undertaken through examination of the local topography. North of the River Esk, in the Briggswath area, the land appears relatively flat, suggesting that this area may be sensitive to potential climate change increases. In other areas of the settlement, the topography appears steeper, suggesting that these areas may not be particularly sensitive to potential climate change increases.

11.12.6 Critical Drainage Catchments

No specific Critical Drainage Catchments have been identified within the Sleights area. Refer to Section 9.

11.12.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Sleights have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i), 3c.**

Incidents of flooding relating to sewers and surface runoff have been reported. Refer to FP/DC Policy Recommendation/Guidance A.

11.13 Brompton

11.13.1 Description of Settlement

The settlement of Brompton is situated along the A170, approximately 11 km to the south-west of Scarborough.

There are two ponds within Brompton, Mill Pond and another un-named pond, which appear to feed Brompton Beck, a designated ordinary watercourse which flows toward the River Derwent out of the south of the settlement.

The location of this watercourse is highlighted on the 'Areas Susceptible to Surface Water Flooding' data, shown in Figure 6.3.6, which also highlights the potential for surface water to impact some areas of this settlement.

11.13.2 Previous Flood Events and Their Extent

There are no historic or hydraulically modelled flood levels or extents available for the settlement.

Sewer flooding incidents have been reported within Brompton.

11.13.3 Flood Zones In and Around the Settlement

The existing flood risk situation within Brompton is displayed in Figure 11.23. A significant number of properties lie within the predicted extent of Flood Zone 3, and are therefore at risk from a 1% annual probability of exceedance flood event. The predicted source of this flooding is Brompton Beck to the south of the A170, but to the north of this road the flood source is unclear as there is no apparent watercourse in this area.

The settlement lies within a zone of potential groundwater and surface runoff flood risk (Zone C, see Section 6.4).

11.13.3.1 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the settlement.

All currently developed sites within Zone 3 may be accorded 3a(i) status, while all other areas within Zone 3 should be accorded Zone 3b status.

11.13.4 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Brompton area.

11.13.5 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Brompton area.

An initial analysis of climate change sensitivity was undertaken through examination of the local topography. In the south of the settlement the land appears relatively flat, suggesting that this area may be sensitive to potential climate change increases. In other areas of the settlement, the topography appears to be a little steeper, suggesting that these areas may not be particularly sensitive to potential climate change increases.

11.13.6 Critical Drainage Catchments

No specific Critical Drainage Areas have been identified within the Brompton area. Refer to Section 9.

11.13.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Brompton have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i), 3b.**

Incidents of flooding related to drainage issues have been reported within the settlement and groundwater/surface water flooding may be a risk (see Figures 6.3 and 6.3.6). Refer to FP/DC Policy Recommendation/Guidance A.

11.14 Cloughton

11.14.1 Description of Settlement

Cloughton is situated approximately 1 km north of the settlement of Burniston.

Cloughton Beck is a designated Main River on the western side of the settlement and merges with Quarry Beck beyond the southern limit of Cloughton.

11.14.2 Previous Flood Events and Their Extent

The Burniston, Cloughton, and Quarry Becks FAS – Phase 2 Report includes Cloughton within its assessment remit.

As described in Section 11.8, flood events occurred within the settlement during June 2000, November 2000, August 2002, October 2002, and January 2003. No details on the number or location of properties affected by these flood events have been reported. The exception is the August 2002 event, described as the most severe, during which 6 properties on Beck Lane were flooded internally, and 11 sheltered accommodation bungalows were flooded externally. In the Little Moor Drive and West Lane area 3 properties reported internal flooding, and 5 residential gardens were flooded.

Potential causes of the recent flooding have been identified within the FAS Phase 2 Report as: the insufficient capacity of the culvert under West Lane; blockages in the channel; and the overgrown condition of some of the channels.

Surface runoff flooding incidents have also been reported within the settlement.

11.14.3 Flood Zones In and Around the Settlement

The existing flood risk situation within Cloughton is displayed in Figure 11.24. The 2009 flood outlines have been revised to take account of hydraulic modelling carried out as part of the 'Burniston, Cloughton and Quarry Becks Flood Alleviation Scheme' report. The majority of Cloughton is indicated within Flood Zone 1, however a number of properties situated along the river corridor are within Flood Zones 2 and 3.

The settlement lies within a zone of potential groundwater and surface water flood risk (Zone B, see Section 6.4).

11.14.3.1 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the settlement.

All currently developed sites within Zone 3 may be accorded 3a(i) status, while all other areas within Zone 3 should be accorded Zone 3b status.

11.14.4 Potential Flood Risk Management Measures

The flood mitigation measures proposed in the FAS Phase 2 Report have also been designed to provide flood alleviation to Cloughton. For further information regarding the proposed FAS refer to Section 11.8.4 or the FAS Phase 2 Report.

11.14.5 Sensitivity to Climate Change

The potential climate change impacts described in Section 11.8.5 are also applicable to Cloughton.

11.14.6 Critical Drainage Catchment

Cloughton Beck is a relatively small watercourse with a history of flooding problems. An increase in the amount or rate of water entering this watercourse may lead to an increase in flood risk elsewhere in the catchment. This Critical Drainage Catchment may be particularly sensitive to potential climate change impacts.

The catchment area of this watercourse has been designated as a Critical Drainage Catchment and is displayed in Figure 11.17. Refer to Section 9.

11.14.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Cloughton have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i), 3b.**

Surface runoff flooding incidents have been reported. Refer to FP/DC Policy Recommendation/Guidance A.

11.15 Flixton

11.15.1 Description of Settlement

Flixton is a small settlement located approximately 7 km to the west of Filey, at the base of the northern escarpment slope of the Yorkshire Wolds.

There are no watercourses apparent within Flixton, but the artificial drainage network of the River Hertford begins close to the north of the settlement.

11.15.2 Previous Flood Events and Extents

There are no historic or hydraulically modelled flood levels or extents available for this settlement.

Incidents of groundwater and/or surface runoff flooding have been reported within the settlement.

11.15.3 Flood Zones in and Around the Settlement

The existing flood risk situation within Flixton is displayed in Figure 11.25. The settlement is entirely within Flood Zone 1.

The settlement lies within a zone of potential groundwater and surface water flood risk (Zone A, see Section 6.4).

11.15.4 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Flixton area.

11.15.5 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Flixton area.

The Flixton area is unlikely to be particularly sensitive to potential climate change increases as the current level of the River Hertford, and its arterial drainage system, is approximately 5 to 10 m below the level of the settlement.

11.15.6 Critical Drainage Catchments

No specific Critical Drainage Areas have been identified within the Flixton area. Refer to Section 9.

11.15.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Flixton have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1.**

Groundwater and/or surface water flooding incidents have been reported within the settlement. Refer to FP/DC Policy Recommendation/Guidance A.

11.16 Gristhorpe and Lebberston

11.16.1 Description of Settlement

Gristhorpe and Lebberston are situated approximately 3 km to the north-west of Filey, and 1.5 km from the coast. For the purposes of this study they will described as a single entity.

A small watercourse is apparent that flows down the west of the settlement, and there are a number of artificial drainage channels to the south of the settlement.

11.16.2 Previous Flood Events and Extents

There are no historic or hydraulically modelled flood levels or extents available for this settlement.

Incidents of sewer and surface runoff flooding have been reported within the settlement.

11.16.3 Flood Zones In and Around the Settlement

The existing flood risk situation within Gristhorpe and Lebberston is displayed in Figure 11.26. The settlement is entirely within Flood Zone 1.

The settlement lies within a zone of potential groundwater and surface water flood risk (Zone B, see Section 6.4).

11.16.4 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Gristhorpe and Lebberston area.

11.16.5 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Gristhorpe and Lebberston area.

The settlement is unlikely to be particularly sensitive to potential climate change increases as the current level of the River Hertford, and its arterial drainage system, is approximately 5 m below the level of the settlement.

11.16.6 Critical Drainage Catchments

No specific Critical Drainage Areas have been identified within the Gristhorpe and Lebberston area. Refer to Section 9.2.

11.16.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Gristhorpe and Lebberston have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1.**

Surface runoff and sewer flooding incidents have been reported within the settlement. Refer to FP/DC Policy Recommendation/Guidance A.

11.17 Irton

11.17.1 Description of Settlement

Irton is a small settlement approximately 5 km to the south-west of Scarborough.

An artificial drainage system, flowing into Irton Dike, is situated to the south-west of the settlement. The ‘Areas Susceptible to Surface Water Flooding’ data, shown in Figure 6.3.6,

highlights the location of this drainage system and suggests some susceptibility to surface water flooding to the west of the settlement.

11.17.2 Previous Flood Events and Extents

There are no historic or hydraulically modelled flood levels or extents available for the settlement.

There are no other reported flood incidents within Irton.

11.17.3 Flood Zones In and Around the Settlement

The existing flood risk situation within Irton is displayed in Figure 11.27. A number of properties in the west of the settlement lie within the predicted extent of Flood Zone 2, and are therefore at risk from a 0.1% annual probability of exceedance flood event. The source of this predicted flooding is Irton Dike and its tributaries.

The settlement lies within a zone of potential groundwater and surface water flood risk (Zone C, see Section 6.4).

11.17.4 Floodplain Delineation

Flood Zones 1, 2 and 3 are present in and around the settlement.

All currently undeveloped areas within Zone 3 should be accorded Zone 3b status.

11.17.5 Potential Flood Risk Management Measures

There are no historic or hydraulically modelled flood levels or extents available for the settlement.

11.17.6 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Irton area.

An initial analysis of climate change sensitivity was undertaken through examination of the local topography. In the western part of the settlement the land appears relatively flat, suggesting that this area may be sensitive to potential climate change increases. In other areas of the settlement, the topography appears to be a little steeper, suggesting that these areas may not be particularly sensitive to potential climate change increases.

11.17.7 Critical Drainage Catchments

No specific Critical Drainage Areas have been identified within the Irton area. Refer to Section 9.

11.17.8 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Irton have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3b.**

No other flood incidents have been reported within Irton. However, groundwater/surface water flooding may be a risk (see Figures 6.3 and 6.3.6). Refer to FP/DC Policy Recommendation/Guidance A.

11.18 Reighton

11.18.1 Description of Settlement

Reighton is located approximately 5 km south of Filey, and 1 km inland from the coast.

There is a small, un-named watercourse flowing toward the sea from the eastern side of the settlement which is designated as an ordinary watercourse.

11.18.2 Previous Flood Events and Extents

There are no historic or hydraulically modelled flood levels or extents available for the settlement.

Flooding incidents related to drainage issues and excess surface runoff has been reported in Reighton. Flooding due to either or both these mechanisms has been reported to impact upon the village hall. The approximate location of this flooding and estimated flow paths are included in Figure 11.28.

11.18.3 Flood Zones In and Around the Settlement

The existing flood risk situation within Reighton is displayed in Figure 11.28. The settlement is entirely within Flood Zone 1. However, as explained above, flooding has occurred within the settlement. An approximate historic flood extent has been included in Figure 11.28. For the purposes of land use planning and development control this flood extent should be accorded the same status as Flood Zone 3. All currently developed sites within this zone may be accorded 3a(i) status, while all other areas within Zone 3 should be accorded Zone 3b status.

The settlement lies within a zone of potential groundwater and surface water flood risk (Zone B, see Section 6.4).

11.18.4 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Reighton area.

11.18.5 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Reighton area.

An initial analysis of climate change sensitivity was undertaken through examination of the local topography which suggests that this area may not be particularly sensitive to potential climate change increases.

11.18.6 Critical Drainage Catchments

The flooding identified above is believed to be due to excess surface runoff and/or drainage issues. The entire catchment area draining to this area of the settlement has been designated as a Critical Drainage Catchment (Figure 11.29) as any increase in the amount or rate of water entering the existing system may exacerbate the current flood risk situation. This Critical Drainage Catchment may be particularly sensitive to potential climate change impacts. Refer to Section 9.

11.18.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Reighton have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 3a(i), 3b.**

Surface runoff flooding incidents and flooding due to drainage problems have been reported within the settlement. Refer to FP/DC Policy Recommendation/Guidance A.

11.19 Ruswarp

11.19.1 Description of Settlement

The settlement of Ruswarp is located approximately 1 km to the south-west of Whitby on the banks of the River Esk.

There are also a number of small, un-named tributaries of the River Esk that flow through the settlement from the west. These tributaries are all ordinary watercourses.

11.19.2 Previous Flood Events and Extents

There are no historic or hydraulically modelled flood levels or extents available for the settlement.

There are no other reported flood incidents within Ruswarp.

11.19.3 Flood Zones In and Around the Settlement

The existing flood risk situation in Ruswarp is displayed in Figure 11.30. A significant number of properties lie within the predicted extent of Flood Zone 3, and are therefore at

risk from a 1% annual probability of exceedance flood event. The source of this predicted flooding is the River Esk.

The settlement lies within a zone of potential groundwater and surface runoff flood risk (Zone D, see Section 6.4).

11.19.3.1 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the settlement.

All currently developed sites within Zone 3 may be accorded 3a(i) status, while all other areas within Zone 3 should be accorded Zone 3b status.

11.19.4 Existing Flood Risk Management Measures

The Environment Agency operates a Flood Warning Area within Ruswarp, covering all of the settlement within the predicted extent of Flood Zone 3. The predicted source of the majority of the flooding within the settlement is the River Esk.

11.19.5 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Ruswarp area.

11.19.6 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Ruswarp area.

An initial analysis of climate change sensitivity was undertaken through examination of the local topography. In the eastern part of the settlement the land appears relatively flat, suggesting that this area may be sensitive to potential climate change increases. In other areas of the settlement, the topography appears to be a little steeper, suggesting that these areas may not be particularly sensitive to potential climate change increases.

11.19.7 Critical Drainage Catchments

No specific Critical Drainage Areas have been identified within the Ruswarp area. Refer to Section 9.

11.19.8 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Reighton have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i), 3b.**

No other flood mechanisms have been reported within the settlement. However, groundwater/surface water flooding may be a risk (see Figure 6.3). Refer to FP/DC Policy Recommendation/Guidance A.

11.20 Sandsend

11.20.1 Description of Settlement

The settlement of Sandsend is approximately 4 km to the north-west of Whitby, along the coast.

Sandsend Beck flows through into the sea through the northern part of the settlement, while East Row Beck does likewise through the southern part of Sandsend. These becks drain the Mulgrave Woods and surrounding area, and are both ordinary watercourses.

11.20.2 Previous Flood Events and Their Extent

There are no historic or hydraulically modelled flood levels or extents available for the settlement.

Incidents of coastal inundation and ordinary watercourse flooding have been reported within Sandsend.

11.20.3 Flood Zones In and Around the Settlement

The existing flood risk situation in Sandsend is displayed in Figure 11.31. A significant portion of the settlement lies within Flood Zone 3, and is therefore at risk from a 1% annual

probability of exceedance fluvial flood event or a 0.5% annual probability of exceedance tidal flood event. The predicted sources of this flooding are the sea, and Sandsend Beck and East Row Beck.

The land immediately to the west of the settlement lies within a zone of potential groundwater and surface runoff flood risk (Zone D, see Section 6.4).

11.20.3.1 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the settlement.

All currently developed sites within Zone 3 may be accorded 3a(i) status, while all other areas within Zone 3 should be accorded Zone 3b status.

11.20.4 Existing Flood Risk Management Measures

The Environment Agency operates a Flood Warning Area within Sandsend, covering the sea front road (A174) and properties adjacent to the road. The predicted source of the majority of the flooding within this area is tidal.

11.20.5 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Sandsend area.

11.20.6 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Sandsend area.

Based on Defra recommendations (Section 5.7) sea levels can be expected to rise by around 200 mm over the next 50 years.

An initial analysis of climate change sensitivity was undertaken through examination of the local topography which suggests that this area may not be particularly sensitive to potential climate change increases.

11.20.7 Critical Drainage Catchments

No specific Critical Drainage Areas have been identified within the Sandsend area. Refer to Section 9.

11.20.8 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Sandsend have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i), 3b.**

11.21 Snainton

11.21.1 Description of Settlement

The settlement of Snainton is situated approximately 13 km to the south-west of Scarborough, along the A170.

There are no watercourses within the urban environment of Snainton, but Welldale Beck flows past the settlement to the west, and there is an artificial drainage system to the south of Snainton.

11.21.2 Previous Flood Events and Extents

There are no historic or hydraulically modelled flood levels or extents available for the settlement.

Flood incidents related to drainage issues and excess surface runoff have been identified within the settlement. The 'Areas Susceptible to Surface Water Flooding' data, shown in Figure 6.3.6, highlights the potential for surface water to collect to the south of this settlement.

11.21.3 Flood Zones in and Around the Settlement

The existing flood risk situation in Snainton is displayed in Figure 11.32. The built environment of the settlement is entirely within Flood Zone 1, but there are areas of Zones 2

and 3 apparent to the south-east of Snainton. The source of this predicted flooding is presumably West Carr Dike.

The settlement lies within a zone of potential groundwater and surface water flood risk (Zone C, see Section 6.4).

11.21.3.1 Floodplain Delineation

Flood Zones 1, 2 and 3 are all present within the settlement.

All currently developed sites within Zone 3 may be accorded 3a(i) status, while all other areas within Zone 3 should be accorded Zone 3b status.

11.21.4 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Snainton area.

11.21.5 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Snainton area.

An initial analysis of climate change sensitivity was undertaken through examination of the local topography. In the southern part of the settlement the land appears relatively flat, suggesting that this area may be sensitive to potential climate change increases. In other areas of the settlement, the topography appears to be a little steeper, suggesting that these areas may not be particularly sensitive to potential climate change increases.

11.21.6 Critical Drainage Catchments

No specific Critical Drainage Areas have been identified within the Snainton area. Refer to Section 9.

11.21.7 Guidance on Land Use Planning and Flood Risk

Flood Zones present in Snainton have been identified above. **The following Forward Planning (Section 7) and Development Control (Section 8) Flood Risk Zone Policies/Guidance should be applied within the settlement: 1, 2, 3a(i), 3b.**

Surface runoff flooding incidents and flooding due to drainage problems have been reported within the settlement. Refer to FP/DC Policy Recommendation/Guidance A.

11.22 Caravan Parks

There are three large caravan parks/holiday parks in the vicinity of Filey. These parks can be larger than many settlements and may come under pressure for redevelopment and/or extension.

11.22.1 Blue Dolphin

The Blue Dolphin Holiday Park is situated on the coast between Scarborough and Filey.

11.22.1.1 Previous Flood Events and Extents

There are no historic or hydraulically modelled flood levels or extents available for this caravan park.

No other flood incidents have been reported within the park.

11.22.1.2 Flood Zones In and Around the Settlement

The existing flood risk situation in the Blue Dolphin Holiday Park is displayed in Figure 11.33. The park is entirely within Flood Zone 1.

The site lies within a zone of potential groundwater and surface runoff flood risk (Zone B, see Section 6.4).

11.22.1.3 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Blue Dolphin Holiday Park.

11.22.1.4 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Holiday Park.

Based on an examination of the local topography, the area is not expected to be sensitive to potential climate change increases.

11.22.1.5 Critical Drainage Catchment

No specific Critical Drainage Areas have been identified within the Blue Dolphin Holiday Park area. Refer to Section 9.

11.22.1.6 Guidance on Land Use Planning and Flood Risk

FP/DP Policy Recommendation/Guidance 1 should be applied to the park.

Groundwater/surface water flooding may be a risk (see Figure 6.3). Refer to FP/DC Policy Recommendation/Guidance A.

11.22.2 Primrose Valley

The Primrose Valley Holiday Village is situated on the coast, immediately to the south of Filey.

11.22.2.1 Previous Flood Events and Extents

There are no historic or hydraulically modelled flood levels or extents available for this caravan park.

No other flood incidents have been reported within the park.

11.22.2.2 Flood Zones In and Around the Settlement

The existing flood risk situation in the Primrose Valley Holiday Village is displayed in Figure 11.34. The developed area of the park is entirely within Flood Zone 1.

The site lies within a zone of potential groundwater and surface runoff flood risk (Zone B, see Section 6.4).

11.22.2.3 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Primrose Valley Holiday Village.

11.22.2.4 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Holiday Village.

Based on an examination of the local topography, the area is not expected to be sensitive to potential climate change increases.

11.22.2.5 Critical Drainage Catchment

No specific Critical Drainage Area have been identified within the Primrose Valley Holiday Village area. Refer to Section 9.

11.22.2.6 Guidance on Land Use Planning and Flood Risk

FP/DP Policy Recommendation/Guidance 1 should be applied to the park.

Groundwater/surface water flooding may be a risk (see Figure 6.3). Refer to FP/DC Policy Recommendation/Guidance A.

11.22.3 Reighton Sands

The Reighton Sands Holiday Village is situated between Filey and Flamborough Head.

11.22.3.1 Previous Flood Events and Extents

There are no historic or hydraulically modelled flood levels or extents available for this Holiday Village.

No other flood incidents have been reported within the park.

11.22.3.2 Flood Zones In and Around the Settlement

The existing flood risk situation in the Reighton Sands Holiday Village is displayed in Figure 11.35. The developed area of the park is entirely within Flood Zone 1.

11.22.3.3 Potential Flood Risk Management Measures

There are no known proposed flood risk management measures for the Reighton Sands Holiday Village.

11.22.3.4 Sensitivity to Climate Change

No specific climate change sensitivity analyses are available for the Holiday Village.

Based on an examination of the local topography, the area is not expected to be sensitive to potential climate change increases.

11.22.3.5 Critical Drainage Catchment

No specific Drainage Sensitive Catchments have been identified within the Reighton Sands Holiday Village area. Refer to Section 9.

11.22.3.6 Guidance on Land Use Planning and Flood Risk

FP/DP Policy Recommendation/Guidance 1 should be applied to the park.

Groundwater/surface water flooding may be a risk (see Figure 6.3). Refer to FP/DC Policy Recommendation/Guidance A.

12 Development Design Guidance

This section provides an introduction to the measures which may be incorporated into the design of developments in order to manage flood risk.

Appropriate development will be protected against flooding to the relevant standard of protection as defined by planning policy guidance. However, the potential availability of flood insurance should also be considered when designing a development. The Association of British Insurers (ABI) and the Environment Agency have published a joint guidance document on insurance issues relating to new development and flood risk[82]. This suggests that the minimum level of protection which would allow insurers to offer cover at normal terms for residential and small commercial properties is a 1 in 75 (1.3%) annual chance of flooding.

In addition to ensuring that a new development is protected against flooding to an appropriate design standard, it should also be ensured that the new development will not increase flood risk elsewhere. To this end, the design of development within Flood Zones 3a and 3b may need to include measures to avoid an increase in upstream flood risk and to provide compensatory flood plain storage. Furthermore, it should be ensured that the potential impacts of climate change have been taken into account.

Whenever a flood risk mitigation measure is proposed as part of the development the operation and maintenance of that measure over the lifetime of the development should be considered and the body responsible for the future maintenance of the measure should be identified. It should also be ensured that future users of the development are aware of the flood management measures in place.

Section 8 details the flood risk management measures required for developments in each Flood Risk Zone, The measures which may be employed to manage flood risk are briefly discussed below. Further details can found in CIRIA Report C624[83].

12.1 Guidance on methods for protecting new development

A number of different mitigation measures can be employed to protect new developments against flooding and to minimise the impact should flooding occur. These measures may be used on their own or, often, in conjunction with one another. The appropriateness of each measure will depend on the nature of flood risk at a site, the type of development being protected and other material planning considerations (e.g. access considerations, particularly for emergency services). The mitigation measures described below may be used.

12.1.1 Development zoning

The best way of managing flood risk to a development site is to locate flood-sensitive land uses outside of the flood plain. This is the basis of the sequential test, but zoning can also be implemented on an individual site basis. Public open space can be designated in Flood Zones, providing adequate warning signs of the danger of flooding and evacuation routes are provided. Car parks should not be planned for flood risk areas if flood depths exceed 0.3 m (as cars may be carried off in the flood water), unless the area is defended to an appropriate standard or an appropriate flood warning system is provided. Care should be taken when planning public open space alongside watercourses which have high flood velocities and which respond very rapidly to rainfall.

[82] 'Flooding Information Sheet – Your Questions Answered', Environment Agency and Association of British Insurers, 2009.

[83] This report also includes a useful checklist of the issues which generally arise when designing developments to manage flood risk. This checklist can be downloaded free of charge from the CIRIA website as part of the "Flood Risk Assessment Toolkit" (http://www.ciria.org/downloads.php?id=C624PartC).

12.1.2 Land raising

Most developments within the flood plain are required to have their floor levels above the 1% flood level (including a freeboard allowance). One method of achieving this is to raise the level of the land at the development site to above flood level. Buildings can then be constructed on top of the raised land, which can also provide a route for access to and from the development site if the site is located next to an area outside the flood plain.

This technique is generally suitable for most flood plain locations or flood depths, although problems may arise if the level to which land raising is required is significantly higher than surrounding land levels, if the land raising will interfere with the flow of the flood water, or if the predicted flood depths are very significant. For example, some predicted flood depths within this SFRA are in excess of 2 m, which is likely to preclude the use of land raising as a method for protecting new development due to economic and/or environmental reasons.

Unless located in an area which is already defended to an appropriate standard or is at risk solely from flooding from the sea, any development which involves land raising will require associated compensatory flood plain storage works (Section 12.2).

12.1.3 Raised floor levels

Most developments within the flood plain are required to have their floor levels above the 1% flood level (including a freeboard allowance). In addition to this there should be an additional freeboard added to account for climate change uncertainty. An FRA can consider the implications of climate change for the lifetime of the development using the *precautionary allowances* and *indicative sensitivity ranges* in PPS25 annex B.

Whilst development zoning (Section 12.1.1) or land raising (Section 12.1.2) are generally preferred, it may be possible to design a development with a ground floor which is below the flood level, providing the design of the development takes this into account. If this method is to be used the development below the flood level should be built using flood-resistant construction methods (Section 12.1.4) and should have a use which is not sensitive to flooding (e.g. no living accommodation).

This method may be suitable for currently undefended areas, providing the development does not interfere with flood flows and suitable access arrangements can be provided during floods. In currently undefended areas, measures (possibly including legal agreements) should be taken to ensure that inappropriate use or alteration of the ground floor will not occur in future. Such developments may also be suitable for areas currently defended to an appropriate standard.

Ground floor car parking should not be planned for flood risk areas if flood depths exceed 0.3 m (as cars may be carried off in the flood water), unless the area is defended to an appropriate standard or/and appropriate flood warning system is provided. Developments with raised floor levels and a ground floor designed for use are unlikely to be suitable alongside watercourses which have high flood velocities and which respond very rapidly to rainfall due to the limited flood warning time and potential impact of flooding on any contents on the ground floor. Developments which rely on raised floor levels as the sole method of flood defence are unlikely to be practicable in areas where expected flood depths exceed 2 m.

12.1.4 Flood-resistant construction measures

Flood-resistant construction measures should be used wherever there is a risk of flooding. This involves the careful selection of construction materials and techniques which are more resistant to the impacts of flooding (e.g. avoiding the use of timber frames, cavity walls, plasterboard and chipboard) and careful design of fittings (e.g. locating electrical circuits above flood level). Flood-resistant construction measures are usually a secondary measure, used in conjunction with other flood mitigation measures. However, using flood-resistant construction measures alone may be appropriate for developments in areas which

are already defended to the appropriate standard of protection as defined by PPS25, providing the danger to life posed by a flood defence failure is not unacceptable.

12.1.5 Flood defences

The provision of flood defence structures (flood walls and/or flood banks) is not normally acceptable if such defences will only protect a new development. This is because such defences are associated with a residual risk of breaching/overtopping and ongoing maintenance requirements. Flood defences may be an acceptable solution if they will protect existing development in addition to the new development, and the residual risk of flooding is not excessive. If such measures are to be considered early consultation with the Environment Agency is essential, and an agreement on the future responsibility for the operation and maintenance of the flood defences over the lifetime of the development must be made.

Developers should refer to the Communities and Local Government document 'Improving the Flood Performance of New Buildings – Flood Resilient Construction'[84].

12.1.6 Flood warning

New developments should generally be designed such that flood warning is not required, and therefore flood warning is usually a secondary measure, used in conjunction with other flood mitigation measures.

In such situations where flood warning is required, occupiers are advised to register with Flood Warning Services, if they are in place. Further details on the availability of Flood Warning Services can be provided by the Environment Agency.

12.2 Guidance on methods to avoid an increase in downstream flood risk

In areas which are at risk of fluvial flooding and which are not protected to an appropriate standard of protection it is normally necessary to ensure that the development will not increase downstream flood risk.

In addition to the potential for increasing runoff rates and volumes (Section 12.3), a development may increase downstream flood risk by reducing the volume of flood plain storage available. This increases downstream flood risk as the volume of water which would otherwise be stored on the flood plain passes downstream more quickly, increasing flood risk to third parties. Although the effects of a loss of flood plain storage from a single development can often be shown to be small, the cumulative effects of such changes could lead to a significant increase in downstream flood risk, and therefore there should be no net loss of flood plain storage due to a development.

When providing compensatory flood plain storage it is necessary to ensure that the new storage is provided at the same level as the storage that was lost. The implication of the requirement for 'level of level' compensatory flood plain storage is that for any development which reduces the volume of flood storage available (e.g. through land raising or flood defences), an equivalent area of new floodplain will have to be created at the same level.

12.3 Guidance on Sustainable Drainage

Sustainable Drainage Systems (SuDS) seek to manage water in as natural a way as possible. This can be achieved through the use of source control (e.g. green roofs, permeable paving, rainwater recycling) and the attenuation and treatment of water through the drainage systems (e.g. using filter drains, swales, basins and ponds). SuDS often involve a "management train" of different techniques to manage runoff on a site.

The use of SuDS has several advantages, including managing runoff so that new developments do not increase runoff rates and volumes, reducing the impact of new

[84] 'Improving the Flood Performance of New Buildings – Flood Resilient Construction', DCLG, 2007.

development on water quality, and the provision of amenity features. The use of SuDS is strongly encouraged by PPS25 (Annex F) and Part H of the Building Regulations, and SuDS should be incorporated within the design of new developments wherever practicable.

The most current guidance on the implementation and adoption of SuDS is CIRIA Report C697[85]. Other useful references include the Interim Code of Practice for Sustainable Drainage Systems[86]. This Code of Practice is supported by a wide range of organisations, including Yorkshire Water and includes recommended policy wording for inclusion within LDFs.

One of the key issues which must be resolved before SuDS are implemented is the responsibility for long-term maintenance, as SuDS require ongoing maintenance over their lifetime (e.g. grass cutting, de-silting) if they are to remain effective. It is for this reason that SuDS require adoption, preferably by a Local Authority or sewerage undertaker.

It may be possible to make arrangements for long-term maintenance with Local Authorities or management companies (through a Section 106 agreement), Highways Authorities or sewerage undertakers. However, many types of SuDS cannot be adopted by sewerage undertakers as they do not meet the legal definition of a "sewer": Table 12.3 summarises the types of SuDS measures which could be adopted by various parties.

Table 12.3: Potential for SuDS ownership/maintenance by relevant parties (after National SuDS Working Group, 2004)

SuDS Component		Local Authority(1)	Highway Authority(1)	Sewerage undertaker(1)
Above ground	Pervious surface	✓	✓	X
	Filter strip	✓	✓	X
	Swale	✓	✓	✓
	Bioretention area	✓	✓	X
	Basin, pond, wetland	✓	✓	X
Below ground	Soakaway	✓	✓	✓
	Infiltration trench	✓	✓	✓
	Filter drain	✓	✓	✓
	Pipe	✓	✓	✓

(1) Refer to National SuDS Working Group (2004) for further details

[85] The SuDS Manual, CIRIA Report C697, 2007.
[86] National SuDS Working Group, 2004 Interim Code of Practice for Sustainable Drainage Systems (http://www.ciria.org/suds/icop.htm)

13 Rural Land Management

Land management can have significant impacts upon the degree of flood risk within a catchment area. The way the land is managed can have a fundamental effect on vegetation cover, soil condition and drainage networks. These factors can influence flood risk as they affect the proportion of rainfall which enters river systems as flood flows, and the speed with which water moves through the catchment. Changes to land use management practices can influence flood risk on the local scale, although there is currently no evidence that such changes can affect flood risk at the scale of a large catchment[87].

As discussed in Section 2, the topography of Northeast Yorkshire varies widely, from relatively wild upland moorland areas to lowland farmland. Land use management practices vary widely between these areas, with arable farming common within the Vale of Pickering and grazing and forestry common in the North York Moors.

Changes in upland land management can affect the quantity and quality of runoff from the land. The previous political and economic climate has encouraged the change from grassland to arable production in lowland areas. Arable farming techniques have changed as farm size and technological inputs to farming have grown and farming practices have intensified, new varieties are cultivated and seasonal farming patterns have changed. Patterns and methods of field drainage have also changed.

It is now realised that for farming to be sustainable, more environmentally considerate approaches may have to be followed. More sustainable land management can reduce flood risk downstream.

The North York Moors National Park Management Plan is the key overarching Plan for the future of the National Park and sets out the Policy Framework for management of land in the Park. The plan is currently being reviewed and the guidance contained below should help to inform policies and actions that arise out of the Plan.

13.1 Rural Land Use Management

Rural land use management is not typically regulated within the planning system: most agriculture, field drainage and forestry operations being permitted development. However, good land use management practice is encouraged and flood management is a secondary objective within the Environmental Stewardship Scheme[88]. This is a Government agri-environment scheme which provides funding to farmers and other land managers who deliver effective environmental management on their land. This Scheme has different levels of Entry, from whole farm Entry Level Stewardship to Higher Level Stewardship which targets critical areas. Land use management measures which can qualify for Entry Level Stewardship and which can also manage runoff include:

- Hedgerow and ditch management
- Use of over-wintered stubbles
- Buffer strips
- Use of a range of crop types.

A number of measures which can manage flood risk can be incorporated within a Higher Level Stewardship scheme, including:

- Restoration of wet grassland for breeding waders and wildfowl;
- Restoration of traditional water meadows;
- Restoration of moorland;

[87] O'Connell *et al.*. 2004. Review of the impacts of rural land use and management on flood generation. EA/Defra R&D Report FD2114.
[88] Natural England (2009) Look after your land with Environmental Stewardship

- Within-field grass areas to prevent runoff and erosion;
- Wetlands;
- Restoration of woodland.

The incorporation of these management practices within the agricultural funding mechanism should encourage their use. To gain access to this scheme the application must be accompanied by a Farm Environment Plan that clearly demonstrates the environmental benefits of the Higher Level Scheme application.

13.2 Land Use and Flooding

Whilst the Environment Stewardship Scheme includes flood management as a secondary objective, other Government policy which has flood risk management as the primary objective also addresses land use management issues. Development of the latest government strategy for flood risk management in England has taken into account the importance of rural land use management[89] and the influence of land use management on flood risk is acknowledged in the Catchment Flood Management Plans (CFMPs) produced by the Environment Agency for catchment areas. CFMPs set out the intended policy for flood risk management within catchment areas, and include strategies for the provision and maintenance of flood defences and recommendations for land use management policies within a catchment area.

The River Derwent was one of the pilot catchments for CFMPs. The River Derwent CFMP was due to be completed in December 2008, but has been put on hold and is not available for use in this study (see Section 4.3.2). An initial draft copy of the CFMP was available during preparation of the original SFRA. Review of that document shows that the CFMP aims to manage flood risk sustainably across the catchment and considers the need to restore the natural use of floodplains and to improve land management practices. The CFMP recommends that the use of Environmental Stewardship Schemes is promoted and identifies several opportunities for land use management changes within the Derwent catchment, including:

- Creation of wetland sites;
- Introduction of buffer strips alongside watercourses;
- Restoration of the natural function of floodplains;
- Setting back floodbanks away from the river channel;
- Increasing meanders on the River Derwent;
- Increasing flood storage;
- Increasing forestation in upland areas.

A draft CFMP is being developed for the catchments of the River Esk and nearby coastal streams. At this stage the CFMP has not identified any specific potential land use management techniques which could be applied in the Esk catchment to manage flood risk. However, the Esk CFMP Inception Report does identify forestry, moorland gripping and land drainage operations as land use management activities which could affect flood risk.

Environmental Stewardship Targeting Statements have also been produced for two areas within Northeast Yorkshire: the North York Moors and Cleveland Hills (JCA 025), and the Vale of Pickering (JCA 026).

[89] Defra (2005) Making Space for Water, 'Taking forward a new Government strategy for flood and coastal erosion risk management in England: First Government response to the autumn 2004 *Making Space for Water* consultation exercise'

Key opportunities related to flood risk within the North York Moors and Cleveland Hills JCA which farmers may take up through Higher Level Stewardship (HLS) include:

- Manage wetland and riparian habitats to increase wildlife and improve floodwater storage.

Key opportunities related to flood risk within the Vale of Pickering JCA which farmers may take up through HLS include:

- Manage riparian habitats, wet grasslands and wetlands in the floodplain to provide habitat for wading birds and waterfowl, protect watercourses and increase floodwater storage.

13.3 Modifying Land Use Management Practices to Manage Flood Risk

A number of changes in farming practices can assist in the reduction of runoff from farmed areas, without requiring a fundamental change in the use of the land. The guidance provided by the Environment Agency is summarised in Table 13.1 below.

Table 13.1: Agriculture and flood risk[90]

Flood Risk Issue	Land Management Mitigation Measures
Capping and compaction of soils leading to increased runoff due to reduced infiltration rates	- Check soil structure regularly - Avoid cultivation of wet soil, use reduced tillage - Avoid trafficking on wet soil - Use more/longer grass breaks in the rotation - Use rough finishes to seedbeds and align with contours - Use rough ploughing after late harvested crops
Low crop cover leading to increased runoff and erosion	- Maintain crop cover throughout the rotation - Consider timing of crops carefully - Avoid working wet land - Use rough finishes to seedbeds - Increase organic matter in the topsoil - Use rough ploughing after late harvested crops - Check soil structure - Sow early to provide vegetation cover before winter - Plant hedges, woodland or grassed areas along contours to reduce field lengths - Use filter/buffer strips at least 2 m wide adjacent to watercourses - On steep slopes and damaged land consider alternative land uses (e.g. permanent grassland)
Soil poaching	- Use floating tyres/lightweight vehicles - Use access tracks and 'cow tracks' - Use well-spaced feeders and move them regularly - Site feeders away from watercourses. - Control stock to minimise poaching - Fencing to exclude stock from sensitive areas - Use drier, well-vegetated fields for out-wintering stock - Restore grazed land by re-seeding
Stock grazing and trampling adding to bank erosion	- Provide bridges over watercourses where stock movement across the watercourse is required, or provide a formal crossing point with reinforced banks and bed. - Use fencing to restrict stock access to streams. - Allow appropriate vegetation alongside stream banks.
Runoff from farm tracks	- Use routes which avoid direct runoff to watercourses. - Ensure tracks are well drained. - Divert track runoff into rough buffer areas - Re-site farm gateways to avoid runoff pathways

[90] After Environment Agency. 2003. Best Farming Practices: Profiting from a better environment.

13.4 Changing Land Use to Manage Flood Risk

Whilst changing land management practices may assist in the reduction of runoff, more significant changes may be achieved if the land use itself is changed. The following land use changes can assist in the management of runoff, and may qualify for funding through the Environmental Stewardship Scheme (see above).

13.4.1 Arable Reversion

Reversion of arable land to grassland can reduce runoff as grassland areas typically have higher infiltration rates than cultivated areas. Such a change in land use may also be accompanied by changes to the drainage regime (see below).

13.4.2 Changes to Land Drainage Systems

Changing the way in which land drainage systems operate is a change in land management practice which can have a fundamental impact on the viability of different land use types in an area.

The effect of land drainage on runoff rates and volumes will depend on the characteristics of the area in which it is installed. The net effect of land drainage is generally an increase in runoff response as the increased drainage network density drains water from the land more efficiently. This normally leads to an increase in runoff rates from an area, although in flat permeable soils drainage may reduce the quantity and speed of runoff as it causes lower water table levels, increasing storage and the time of travel within the unsaturated soil horizons. Except for these areas, reducing the efficiency of land drainage systems (through drain blockage or the cessation of pumping) may lead to a reduction in downstream flood risk.

A special case of land drainage is the drainage of moorland areas, which was previously undertaken to encourage grazing habitat and forestry. It is now widely recognised that the restoration of natural drainage patterns through the blockage of moorland 'grips' is essential to the long term survival of moorland habitats. This has the dual benefit of reducing downstream flood risk and raising local water tables, encouraging the restoration of natural moorland habitats.

A new project 'The Yorkshire Peat Partnership', commenced in July 2009, and is currently looking into re-wetting of moorland peat as a method of reducing peak flood flows, enhancing biodiversity and reducing soil erosion. The project is a collaboration between Natural England, NYMNPA, the Yorkshire Dales National Park Authority, the Environment Agency and a number of other project partners. Methods involve stabilising peat areas using meshing, and blocking of grips to re-wet peat and reduce erosion caused by runoff. The effect of grip blocking on the flood hydrograph will then be analysed.

A similar exercise is being carried out upstream of Pickering in the Pickering and Sinnington catchments as part of the Defra funded 'Slowing the Flow project', see below.

Box 13.1 Blocking of moorland grips in Upper Wharfedale

Erosion of grips and peat erosion is perceived to increase surface runoff on the moors thus affecting upland beck and river flows. Blockage of existing grips creates surface storage which has the potential to delay and attenuate floods and encourage water retention on the moorland. Blocking of several gripped channels within Upper Wharfedale took place in August 1999 using straw bales, heather bales and peat dams using peat taken from adjacent land.

Monitoring before and after blocking of the East Camm grip together with catchment monitoring showed that grip blocking reduced the downstream volume in the grip channel by about 24%. This effect diminishes in a downstream direction as the proportion of storage created by blocked grips in relation to the total catchment runoff reduces.

13.4.3 Creation of Wetlands

The creation of wetland sites can lead to increased storage of flood waters, reducing water levels downstream, and can provide additional benefits by enhancing biodiversity and improving recreational potential.

Wetlands help prevent flooding by acting as natural storage areas. Converting low-lying areas into wetlands can help to reduce flood peaks and velocities. The draft River Derwent CFMP suggested that it may be possible to create wetland sites in the areas around Hemingbrough, Sheriff Hutton, Seamer, Hertford, Cayton, and Dunnington.

Box 13.2: Cayton and Flixton Carr Wetland Restoration Scheme

Wetland creation is currently being considered at a site alongside the River Hertford east of the A64 around Cayton and Flixton Carrs. Existing land use in the area is varied: lower lying land is predominantly set-aside for grasslands, with recently drained areas used for arable agriculture. The higher surrounding land is more freely drained and is therefore predominantly arable. The higher water table in the lower lying areas is making conventional farming increasingly difficult.

A partnership of local farmers, the Environment Agency, Natural England, the Royal Society for the Protection of Birds, Scarborough Borough Council, the Rural Development Service and North Yorkshire County Council is considering options for future use, which would essentially restore the land to a more natural state, allowing areas of land to revert back to grazing marsh, fen and wet woodland. The habitat creation and land management will be funded through applications to the new Higher Level Environmental Stewardship Scheme and will be implemented by the farmers within the project area with support from the partnership.

Such land use changes will provide an alternative income to farmers, promote wildlife and tourism in these areas and allow storage of water, reducing the impacts of localised flood incidents.

13.4.4 Forestry Practices

The Forestry Commission has identified the possible benefits that woodland management may have in terms of managing the risk of increasing flood risk due to climate change impacts, through its Regional Forestry Strategy:

- Increasing rainfall interception (reducing the amount of rainfall reaching the ground);
- Enhancing storage capacity in soils;
- If planted in flood plains, slowing the velocity of flood water;
- Reducing sediment loads from areas at risk of erosion.

This has led to the Forestry Commission developing three strategic aims to help the North East Region adapt more successfully to the anticipated impact of changing climatic conditions on flood risk:

- Reducing regional flood risk through increased woodland creation in river catchments;
- Improving the sustainability of urban drainage systems through increased tree and woodland planting in the region's towns;
- Reducing regional flood risk through increased woodland creation in floodplains.

The Forestry Commission also have national guidance on the management of forestry practices[91], which can assist in the management of flood risk.

[91] Forestry Commission. 2003. Forests & Water Guidelines. Fourth Edition.

Wet woodland creation or tree planting within the floodplain has been suggested by the Forestry Commission to help reduce flow velocities and reducing peak flood levels downstream. They suggest that if designed and managed carefully, wet woodland could add to the retention of floodwaters because it is hydraulically 'rougher' than other vegetation types. This means that the tree trunks, buttress roots and deadwood on the woodland floor slow down the movement of water across the flooded ground.

The creation of riparian and floodplain woodland and the creation of large woody debris dams is one of the elements being considered within the 'Slowing the Flow' project in Pickering and Sinnington. This is one of three land management projects funded nationally by Defra.

13.4.4.1 Slowing the Flow

A two year partnership pilot project is being undertaken within the Pickering and Sinnington catchments as part of the 'Slowing the Flow project'. The work is one of three national Defra funded projects to investigate the use of land management techniques to reduce flood risk whilst also bringing other benefits for water quality, wildlife and soil protection. The project is led by Forest Research and key partners include Environment Agency, Forestry Commission, Natural England, Durham University, North York Moors National Park Authority and other supporting partners.

The project looks to make changes to the way the land is managed such as changing the type of vegetation growing on the land to reduce run off, or increasing water storage in the river catchment to increase the time it takes from rain falling on the upper catchment to manifest itself as flood-waters arriving in the watercourses flowing through Pickering and Sinnington. This will involve:

- forestry work – the creation of riparian and floodplain woodland, and targeted woodland creation within the catchment;
- moorland management – blocking gullies;
- farmland management – creation of buffer strips;
- upstream flood storage – investigating the option of creating low level bunds to store water upstream of Pickering.

13.4.4.2 The Pickering Project

A £700, 000 pilot scheme aiming to reduce flood risk in Pickering and Sinnington via upland land management began in April 2009. The 'Pickering Project' aims to reduce flood risk in lower catchment by increasing the response time of the catchment watercourses to rainfall events. This will be done by a combination of tree planting, creating buffer strips along watercourses and blocking moorland drains. It is anticipated that the scheme could lead to a reduction in flood frequency and severity, however it will not remove flood risk altogether.

The pilot project is a partnership between the Environment Agency, Forestry Commission, Durham University, the North York Moors National Park Authority, Natural England, and Ryedale District Council. If the scheme is successful it will help to identify other UK catchments which may benefit from this relatively new 'whole catchment' approach to flood management.

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FIGURES