Environment Agency

managing flood risk

East Cornwall Catchment Flood Management Plan

September 2008

We are the Environment Agency. It's our job to look after your environment and make it **a better place** – for you, and for future generations.

Your environment is the air you breathe, the water you drink and the ground you walk on. Working with business, Government and society as a whole, we are making your environment cleaner and healthier.

The Environment Agency. Out there, making your environment a better place.

Published by:

Environment Agency
Rio House
Waterside Drive, Aztec West
Almondsbury, Bristol BS32 4UD
Tel: 01454 624400 Fax: 01454 624409

Foreword

I am pleased to introduce the East Cornwall Catchment Flood Management Plan. Past flood events remind us of the hardship that flooding can cause, especially in the built environment. They also reveal the challenges we face when confronted by the forces of nature.

This plan will allow us to use a scientific approach to understand and describe how the catchment behaves and what the most sustainable flood risk management policies may be over the next 50 to 100 years. We can then use this direction to plan the most acceptable ways of managing flood risk for the long term.

We will use the Catchment Flood Management Plan to steer our future investment in flood risk management. We hope that our public and private partners will find it useful in their decision making, especially where it can help them plan how to use the land more effectively.

This plan will help us target our efforts and precious resources in the most beneficial way.

Gordon Trapmore
Cornwall Area Flood Risk Manager

Contents

List of Tables

List of Figures

Executive Summary

This Catchment Flood Management Plan (CFMP) gives an overview of flood risk in the East Cornwall catchment, and how this may change over the next 100 years. The CFMP sets out our plan for managing this risk into the future based on these findings.

Catchment overview

The East Cornwall CFMP area lies near the south-westerly tip of the UK mainland. The CFMP area is made up of two relatively large catchments; the River Fowey and the River Camel, and many other small river catchments. There are two major estuaries in the catchment; the Fowey estuary and the Camel estuary.

The topography of the CFMP catchment is varied. The main area of high ground is Bodmin Moor, where the River Camel and the River Fowey both spring. The remainder of the CFMP catchment is made up of a number of discrete catchments, many of which are small and steep.

The CFMP catchment covers an area of approximately 1,400 km2. Most of the catchment is rural, with only 5 per cent urbanised. The principal urban centres are Newquay, Liskeard, Bodmin, Bude and Wadebridge. There are an estimated 146,000 people living in these areas.

The East Cornwall area is environmentally rich with many important environmental locations, including 46 Sites of Special Scientific Interest (SSSI), 2 National Nature Reserves and 8 Special Areas of Conservation (SAC). The area has a rich mining heritage with a number of locations in the area awarded World Heritage Site status. There are also nearly 500 scheduled ancient monuments.

Current flood risks and management

There is a recorded history of flooding within East Cornwall that dates back to the 1900s.

Previous flood incidents include the 1976 flood in Polperro where one man was drowned and 83 properties were flooded by the river; and the October 2004 flood event where over 70 properties were flooded by high tides in Looe and Fowey. In August 2004 Boscastle was hit by serious flooding caused by an extremely rare rainfall event. Sixty properties were flooded and the risk to life was severe. A major emergency response was initiated and no lives were lost. This flood event demonstrates that while the numbers of properties at risk in East Cornwall may be relatively low compared with other areas, the risk to life and community disruption caused by flooding can be just as great.

Today, there are over 2,700 properties across the catchment at risk of flooding from rivers and the tide at a 1 per cent annual probability (rivers) or 0.5 per cent annual probability (tide) event. These figures do not take into account properties that may be protected by flood alleviation schemes.

Flood risk affects people and property across the East Cornwall catchment, but particularly in the areas of Bude, Bodmin, Looe, Lostwithiel, Wadebridge, and Polperro.

There are flood alleviation schemes throughout the catchment that reduce flood risk. Flood alleviation schemes have been constructed in a number of locations in response to flooding incidents. These locations include Bodmin, Bude, Camelford and Wadebridge. It is estimated that existing flood alleviation schemes reduce flood risk to 1153 residential properties and 588 commercial properties across East Cornwall.

As well as the provision and maintenance of flood alleviation schemes, there are a number of ways today through which flood risk is managed and mitigated in the catchment. This includes:

- providing flood warnings
- improving the Flood Map
- implementing Planning Policy Statement 25 in order to avoid building new developments in flood risk areas

The main risks to people, property and the environment across the catchment are from the rivers and the tide. These risks are estimated to result in Annual Average Damages of £17 million. Other sources of flooding: surface runoff, drainage and sewage, are estimated to cause around £4.5 million in Annual Average Damages (AAD).

Future changes

We have considered a range of factors that could influence flood risk over the next 100 years to find out how flood risks could change in the East Cornwall catchment.

The factors we have looked at are: climate change, land management and urban development. We have used government guidance and other calculations to develop scenarios to test the influence of each factor on increasing flood extents. We have found that climate change has the greatest influence on future flood risk, increasing flood risk from both rivers and the tide. Land management also contributes because of the rural nature of the catchment. We think that urban development could affect flood risk significantly in Bodmin and Newquay. New development is likely in these locations.

In the future we expect flood extents to remain the same or increase slightly. Depths of flooding are likely to increase. This means that more people and property will be affected by flooding in the future. We have found that these changes mean that AADs may increase by around 18 per cent, up to £20 million in 100 years time.

We have found that future flood risk could affect slightly more people and property in the same areas as are at risk today. The main areas that will be at risk are Bude, Bodmin, Looe, Lostwithiel, Wadebridge, and Polperro.

Catchment objectives

There are 11 objectives the CFMP aims to achieve. These have been developed with our Steering Group and through consultation. They are split into three categories; economic, social and environmental objectives.

We have identified opportunities within East Cornwall to help achieve our objectives. The opportunities have been identified by studying relevant plans and polices for the area, and again through consultation. The opportunities range from using former china clay workings on Bodmin Moor to store water, through to the implementation of Sustainable Drainage Systems (SuDS) in locations such as Wadebridge, Newquay and Bude.

There are also a number of constraints within the East Cornwall area that may influence how well we can achieve our objectives. The constraints identified include difficulties in agreeing actions with landowners, lack of influence over agricultural activities and conflicts with other policies (local and strategic) already in place across the area.

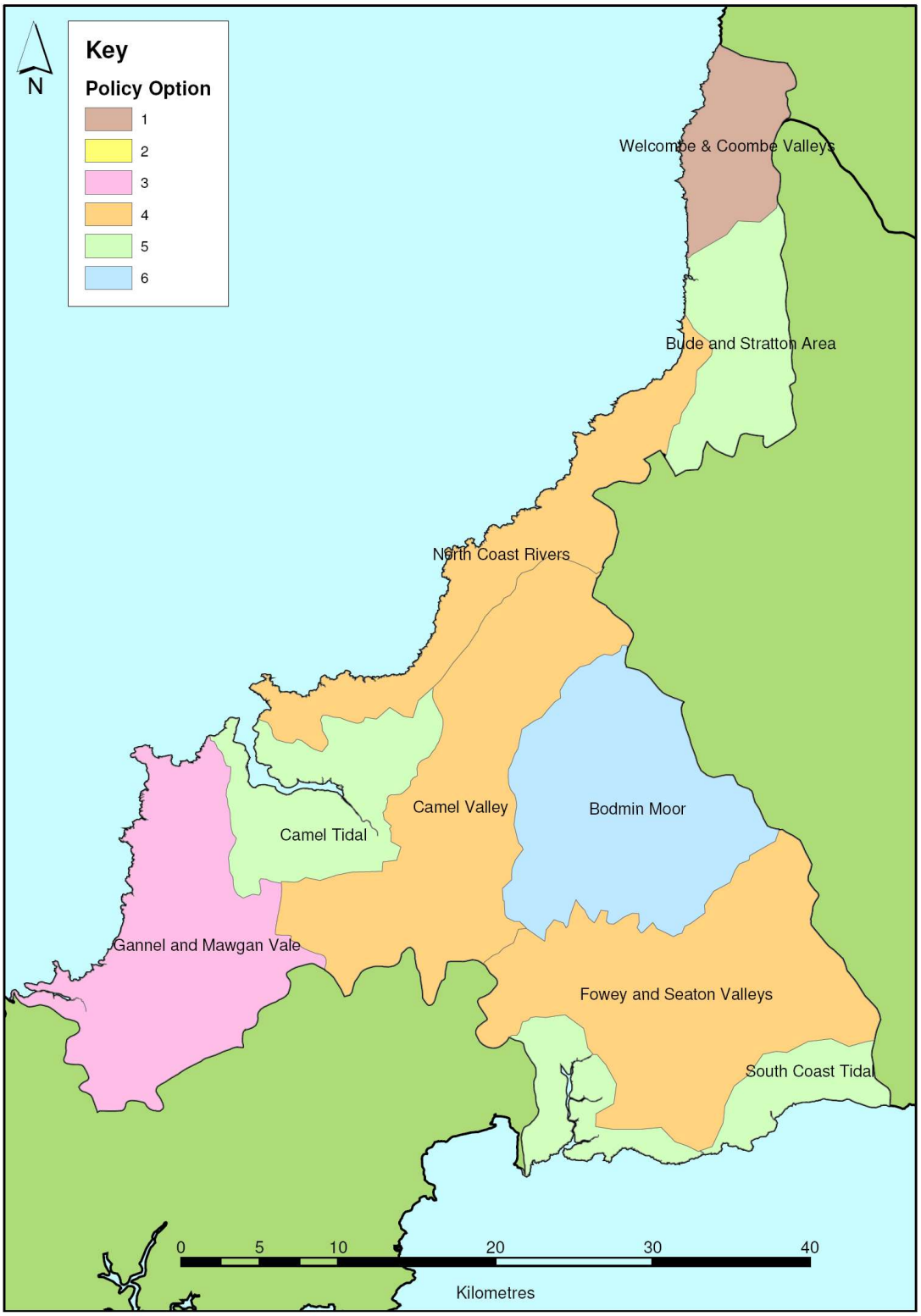
Policy appraisal

We have used the CFMP objectives to evaluate the potential policies for the management of flood risk into the future. Based on this appraisal, we have identified a preferred flood risk management policy for each area within the CFMP catchment. The table below shows the preferred polices and the area (policy unit) within East Cornwall that each relates to.

Policy	Area (see Figure i)
Policy 1. No active intervention (including flood warning and maintenance); continue to monitor and advise.	Welcombe and Coombe Valleys
Policy 3. Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline).	Gannel and Mawgan Vale
Policy 4. Take further action to sustain the current level of flood risk into the future (responding to the potential increases in risk from urban development, land use change and climate change).	Camel Valley North Coast Rivers Fowey and Seaton Valleys
Policy 5. Take further action to reduce flood risk.	Bude and Stratton Area Camel Tidal South Coast Tidal
Policy 6. Take action to increase the frequency of flooding to deliver benefits locally or elsewhere (which may mean an overall reduction in flood risk, e.g. for habitat inundation).	Bodmin Moor

Figure i. illustrates the Policy Options selected for each policy unit within East Cornwall.

Figure i Preferred Policy Option for each policy unit



1 Introduction

This chapter outlines the aims and purpose of the East Cornwall Catchment Flood Management Plan (CFMP). It describes how it relates to flood risk management and what it will achieve. It also discusses how we have involved others through consultation.

The Main Stage reviews information we collected during the previous Scoping Stage, developing our understanding of catchment processes and flood risk. It proposes future scenarios based on the main factors leading to increased flood risk. It then appraises possible responses to future flood risk over broad areas, known as 'policy units', created by grouping areas with the same flood risk characteristics. The appraisal identifies the best Policy Option to manage flood risk into the future and develops a plan of action.

1.1 Background

Flooding is a natural hazard, which can have a major impact on lives, communities, the economy and the environment. Our aim is to reduce the risks flooding causes to people, property and the environment. We do this by taking action to manage and reduce the likelihood and consequences of floods. This is known as 'flood risk management'. Flood risk management involves long term and strategic working with nature to manage flood risk to achieve social, economic and environmental objectives.

Flood risk is made up of two parts: the chance (or probability) of a particular flood event and the impact (or consequence) that the event would have if it occurred. Flood risk management can reduce the chance of flooding by managing the land, river systems and flood defences. It can also reduce the effect of flooding by influencing development in flood risk areas, flood warning and emergency response.

A CFMP is a strategic planning tool, which we use to work with other key decision-makers within the East Cornwall catchment area to identify and agree long-term policies for sustainable flood risk management.

A CFMP looks at flood risk to identify the causes, magnitude and location of flooding throughout the catchment. It also identifies the various influences that can make a difference to the probability and consequences of flooding. We also examine what future changes could affect flood risk, particularly development and land use change, climate change and changes to rural land management.

The Environmental Assessment of Plans and Programmes ('Strategic Environmental Assessment' (SEA)) Regulations 2004 require that certain strategic plans and programmes have their environmental implications assessed if they are likely to have significant environmental effects. Defra guidance states that a statutory SEA is not required as CFMPs do not fall within these SEA regulations. However, it is recommended that an SEA approach should be adopted as CFMPs:

a) aim to set a strategic framework for future planning
b) have significant environmental implications
c) require extensive consultation

Good practice SEA has therefore been undertaken for this CFMP. The SEA process and findings have been fully integrated into the documentation, and an Environmental Report produced to highlight how SEA has been incorporated into the CFMP. This is presented in Appendix B.

Under the Habitats Directive an appropriate assessment needs to be undertaken in respect of any plan or project which:

- either alone or in combination with other plans or projects would be likely to have a significant effect on a European Site (SAC, SPA or Ramsar site)
- is not directly connected with the management of the site for nature conservation

All internationally designated sites within the East Cornwall catchment area have been appraised in Appendix B. An Appropriate Assessment (AA) has been undertaken to make sure that the policies proposed will not have a negative impact on any European Sites within the East Cornwall catchment. The Appropriate Assessment is presented in Appendix E and Appendix F.

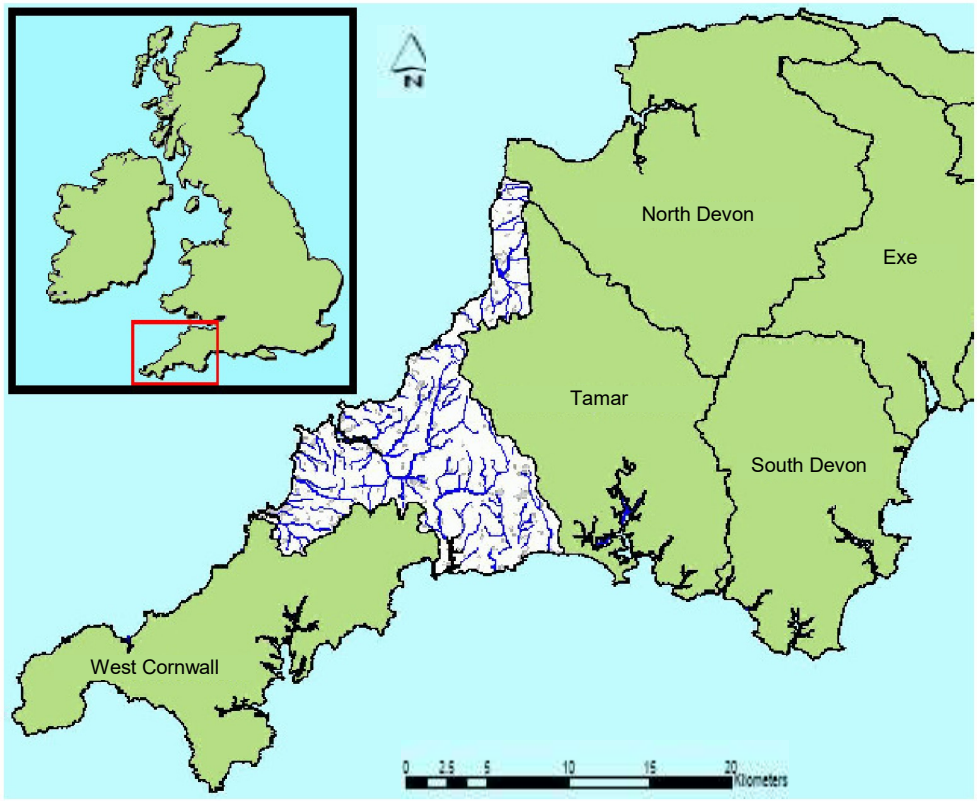
The East Cornwall CFMP will identify broad policies for sustainable flood risk management for the whole catchment area for the long term (50 to 100 years). Sustainable flood risk management meets the needs of the present without compromising the needs of future generations. It does not determine specific ways of managing or reducing flood risk in the catchment, but it aims to give us an indication of the likely way forward to tackling flood risk in the future. Although it is not possible to understand in detail what will happen in 50 to 100 years time, we can predict general trends to test if the CFMP is sustainable. We intend to review the CFMP in the future to reflect changes in the catchment.

1.2 Aims and scope

Through our Strategy for Flood Risk Management (2003/4 - 2007/8), we are committed to developing single, integrated delivery plans for flood risk management. The policies developed from the CFMP will tell us what action we need to take to manage flood risk into the future. The aim of the CFMP is to provide an overview of flood risk on a catchment basis. It does not identify specific measures to manage flood risk for a particular location. This would require more detailed studies such as delivery plans and Strategic Flood Risk Assessments (SFRAs).

The East Cornwall CFMP is bordered by the West Cornwall CFMP and the Tamar CFMP areas (Figure 1.1).

Figure 1.1 Location of the East Cornwall catchment



The aims of Catchment Flood Risk Management planning are:

- to reduce the risk of flooding and harm caused by floods to people, the natural, historic and built environments
- to maximise opportunities to work with nature and to bring about a range of benefits from flood risk management and make an effective contribution to sustainable development
- to support the implementation of EU directives, meet government and other policies and targets, and our corporate Vision
- to promote sustainable flood risk management and seek alternative standard flood risk management responses
- to inform and support planning policies, statutory land use plans and implementation of the Water Framework Directive (WFD)
- to take into account the likely impacts of changes in climate and the effects of land use and land management
- to achieve a range of benefits (for example: biodiversity, habitat, social, agricultural, etc) by developing policies that work together to manage flood risk within the catchment in the long term
- to contribute towards sustainable development where present needs are met without compromising the needs of future generations, by avoiding inflexible, inappropriate or expensive methods or schemes

The completed CFMP will present our recommended objectives for the catchment, its flood risk management policies and actions. This will provide a framework for future decisions.

1.3 Policies

The policies developed from the CFMP will establish whether we should take action to decrease or maintain the current scale of flood risk. In some cases increasing the frequency of flooding may be appropriate. They will aim to set the right approach to manage the overall risk of flooding within the catchment. The CFMP does not set specific measures to manage flood risk for a particular place, but this will happen later as part of more detailed studies to create delivery plans.

The CFMP will show the broad areas where certain policies should be applied. These areas are known as 'policy units'. Policy units are created by grouping areas with the same flood risk characteristics. We will measure each policy unit and its potential future flood risk against the catchment objectives to establish which policy is the most suitable for that area of East Cornwall catchment. The policies are given in Table 1.1.

Table 1.1 Flood risk management policies

Policy Option	Policy
P1	No active intervention (including flood warning and maintenance); continue to monitor and advise.
P2	Reduce existing flood risk management actions (accepting that flood risk will increase over time).
P3	Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline).
P4	Take further action to sustain the current level of flood risk into the future (responding to the potential increases in risk from urban development, land use change and climate change).
P5	Take further action to reduce flood risk.
P6	Take action to increase the frequency of flooding to deliver benefits locally or elsewhere (which may mean an overall reduction in flood risk, e.g. for habitat inundation).

1.4 Links with other Plans

Catchment Flood Management Plans are essential plans to enable a strategic and proactive approach to flood risk management. The development of CFMPs, and Shoreline Management Plans (SMPs) will allow the Environment Agency to plan to deliver flood risk management in a way that reduces flood risk whilst maximising opportunities to deliver multiple benefits. These multiple benefits include the environmental objectives presented in River Basin Management Plans under the Water Framework Directive.

The European Commission has published a directive on the assessment and management of flood risks (the Floods Directive). This is expected to come into force in England in September 2009. The Floods Directive aims to reduce the risk to human health, the environment and economic activity associated with floods. The Directive will require the preparation of Flood Risk Management Plans (FRMPs) that will sit alongside the River Basin Management Plans prepared under the Water Framework Directive. The FRMPs we prepare in the future will build on our Catchment Flood Management Plans and Shoreline Management Plans.

The CFMP aims to achieve an integrated and sustainable approach to flood risk management. Within the strategic flood risk management process, the CFMP is the first stage of this planning process. It provides a basic framework upon which we can develop more detailed flood risk studies. Figure 1.2 shows how the CFMP is built into the statutory and non-statutory planning framework in England and Wales and its links to the Regional Spatial Strategies (RSS) and Local Development Frameworks.

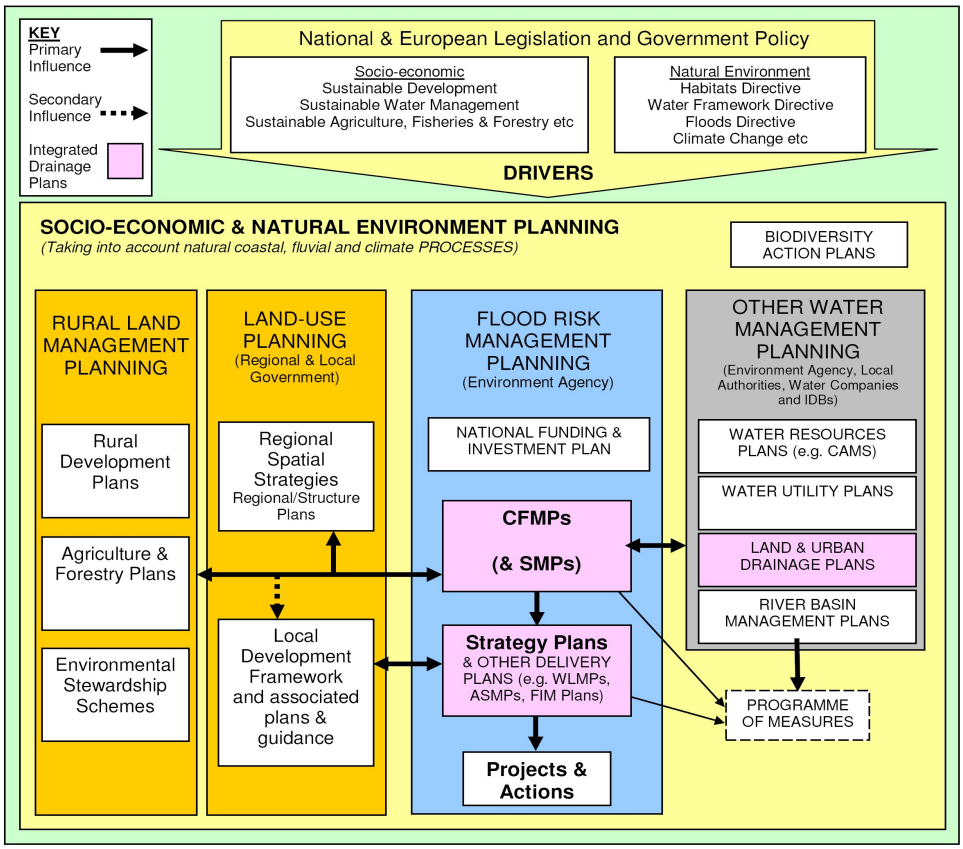
To set the planning context within which the CFMP is being developed, we need to identify and consider all associated policies and local planning legislation. It is essential that we review these policies, plans and strategies to make sure that the CFMP achieves an integrated and sustainable approach to flood risk management.

Local Development Documents (LDDs) will need to make sure that the location of new development is compatible with Catchment Flood Management Plans (CFMPs), Shoreline Management Plans (SMPs) and other existing relevant strategies. In this way, we will establish the CFMP and the SMP as two similar types of planning tool, alongside Strategic Flood Risk Assessments (SFRAs), as the reference base for local planning authorities. This will be an important platform from which we can help to achieve the government's strategy in '*Making Space for Water*'.

Important European legislation to be considered within the CFMP is the Water Framework Directive, the Floods Directive and the Habitats Directive.

The Water Framework Directive was transposed into UK legislation in 2003. It aims to improve the ecological health of waters through planning at a river basin level. It will help us improve and protect inland and coastal waters; direct wiser, sustainable use of water as a natural resource; and create better habitats for wildlife that live in and around water. We need to take account of Water Framework Directive objectives and the Water Framework Directive needs to take account of Flood Risk Management objectives.

Figure 1.2 CFMP within the wider planning framework



The Habitats Directive was introduced in May 1992, to conserve natural habitats and wild fauna and flora. The legislation sets out to establish, conserve and protect a network of internationally important sites. Actions proposed by the CFMP must not adversely affect any sites designated under the Habitats Directive.

There is significant overlap between CFMPs and a number of existing and on-going plans and strategies, including:

Population, property and infrastructure

- Regional Spatial Strategy for the South West 2006–2026 (South West Regional Assembly) for consultation
- Regional Spatial Strategy for the South West of England; Examination in Public Panel Report
- Regional Economic Strategy for the South West of England 2003-2012
- Cornwall Local Transport Plan 2001-2006
- Cornwall Local Transport Plan 2006-2011 (being prepared)
- South West Water Periodic Review (Asset Management Plans)
- PPS 25 Development and Flood Risk

Development planning

- Cornwall County Structure Plan (Adopted September 2004)
- Cornwall Minerals & Waste Development Framework

- Cornwall Minerals Local Plan 1998-2011
- Cornwall Community Strategy
- Cornwall Rural Development Plan
- Carrick District Council Local Plan, 1998
- North Cornwall District Local Plan 1999-2009
- Caradon re-deposit Local Plan, May 2005
- Restormel Borough Council Local Plan 2001-2011

Environment

- Floods Directive
- Water Framework Directive: River Basin Classification studies
- Habitats Directive
- Highways Agency Biodiversity Action Plan (BAP)
- Cornwall Biodiversity Action Plan (BAP)
- Cornish Mining World Heritage Site Management Plan 2005-2010
- Shoreline Management Plans (SMP) [Rame Head to Lizard Point; Lizard to Lands End; Lands End to Hartland Point]
- South West Forest Strategy
- North Cornwall Catchment Abstraction Management Plan
- Seaton, Looe and Fowey Catchment Abstraction Management Plan
- Cycleau Project – Fowey Catchment
- River Camel Salmon Action Plan

We have reviewed the plans and strategies above and identified where policies relate to the CFMP. These are presented in Appendix B, Annex A.

1.5 Involving others

The CFMP aims to encourage interested groups to work together and to help people involved make informed decisions.

Many different organisations and landowners have rights and responsibilities about how land is used, the flow of water and how to control it. The East Cornwall CFMP aims to guide future decision makers in the main issues relating to flood risk management, rather than give extra legal or financial powers or responsibilities to landowners, occupiers, local government, or others.

We believe that this plan will be used by:

- The Environment Agency to guide internal investment in flood risk management activities (for example: strategic planning, asset management and flood incident management) and support other activities within the catchment (for example River Basin management planning under the Water Framework Directive)
- regional and local government authorities to inform land use planning activities, sustainability appraisal/strategic environmental assessment and emergency planning
- water companies to help them plan their work in the wider context of the catchment

- Government and devolved government departments to plan future funding and policy development
- the public to improve their understanding of flood risk and flood risk management

To help guide the direction of the plan, we invited interested individuals from external organisations to form a Steering Group. Liaison with the Steering Group members has provided advice and information, as well as help in formulating the policies. The Steering Group has guided the development of the CFMP, which has taken over 18 months. Members of the Steering Group include representatives of the following:

- Caradon District Council
- Carrick District Council
- North Cornwall District Council
- South West Water
- Cornwall County Council
- Restormel Borough Council
- National Farmers Union
- Regional Flood Defence Committee
- Natural England

The information and comments we have received from the Steering Group are shown in Table B1 Annex B2 in Appendix B. The contributions from the Steering Group include:

- confirmation and development of our knowledge about current flood risk
- contribution and agreement to the development of the objectives of the CFMP
- information on opportunities and constraints for flood risk management
- ideas for policy unit boundaries
- ideas about policy selection

Following approval from the Steering Group, the report was distributed to a wider Consultation Group for their comments. Members of this group include the following:

- Country Landowners Association
- Cornwall Wildlife Trust
- Defence Estates Office (MoD)
- English Heritage
- Farming and Wildlife Advisory Group (FWAG)
- Forestry Commission
- Highways Agency
- Liskeard and District Angling Club
- National Trust
- Railtrack
- Royal Society for the Protection of Birds (RSPB)
- Rural Development Agency
- South West Forest
- South West Regional Development Agency
- Westcountry Rivers Trust

The draft CFMP was also made available to the public during the three-month consultation period, both for their information and to seek comments and suggestions for the final CFMP.

Tables identifying the feedback we received from the wider consultation group and the public and how we addressed these comments in the report, can be found within Appendix D.

Nearly all consultees who responded expressed full support for the CFMP and felt it was a thorough and comprehensive consideration of the flood risks within the East Cornwall catchment. Many organisations expressed their support for the plan whilst raising some important issues to help us make our policy choices. Some key consultation comments/issues recorded during the CFMP consultation process and the action we took to deal with them are detailed in Table 1.2 below.

Table 1.2 Key consultation issues and comments

Owner of comment	Issue/Comment	Action
English Heritage	East Cornwall and Bodmin Moor hold a unique palaeoenvironmental record of vegetation and climate change dating back 12,000 years in some locations.	This important point has been added to the Historic Section of the main report and to the policy appraisal process.
National Farmers Union (NFU)	They felt the plan is robust and understandable and are supportive of working with us to address their points. Many points raised in relation to food security, the increase in agricultural land values and uncertainty surrounding future change in the farming industry.	The Environment Agency held a meeting with the NFU to discuss the points made.
Natural England	Felt the plan provides a comprehensive assessment of the context and issues relating to managing flood risk. A number of points made about specific actions in the action plan and how the actions have been created.	Actions relating to land management have been reworded to focus on land where flood risk benefits can be achieved. Text added to Section 7.1 to direct the reader to Annex B of Appendix B where the actions can be followed through the appraisal process.
Environment Agency's National Environmental Assessment Service (NEAS)	Comments relating to their review of the Environmental Report and the Habitats Regulations Assessment (Appropriate Assessment)	Comments taken on board in consultation with NEAS and amendments made to both documents.
Restormel Borough Council	Felt the plan was a very thorough and excellent document. Raised some minor errors with reported assets at risk from flooding and the existence of a major incident plan for Newquay. Also raised an important point that flooding at key sites may occur from watercourses not specifically considered in detail in the plan	Amendments to the text made to address these errors. Text added to Section 3 and Section 4 to clarify that it is the main source of flood risk at each key site has been considered.

The stages of consultation are outlined in Table 1.3.

Table 1.3 Consultation stages

Timescale	Actions	Achievements
February 2003	East Cornwall CFMP Inception Report completed	Flood risk baseline for East Cornwall established.
February – April 2003	Inception Report circulated for informal consultation.	Comments received from a number of external consultees.
August 2005	Start of Scoping Stage	
October 2005	Combined Steering Group and external interest groups meeting, and individual meetings with local authorities.	Re-engagement of Steering Group members after delaying Scoping Stage.
April – June 2006	Public consultation period. Scoping Report available on our website and distributed to the Consultation Group.	A wide range of comments received from Steering Group and external consultees.
September 2006	Start of Main Stage: Combined meeting with Steering Group and interested groups.	Agreement of catchment objectives, policy appraisal, application of catchment objectives.
June 2007	Steering Group meeting	Support from Steering Group for policies selected.
April 2008 - July 2008	Public consultation period. Draft CFMP made available on our website, local authority offices and advertised in the local press.	Completed July 2008.
August 2008	East Cornwall CFMP reviewed by National Quality Review Panel	CFMP signed off in September 2008 after some minor amendments.
October 2008	East Cornwall CFMP published	

2 Catchment Overview

This chapter provides an overview of the East Cornwall CFMP catchment. It covers the natural and physical characteristics, and land use and land management within the catchment. It provides an understanding of the catchment processes and how the physical and socio-economic systems behave and interact.

2.1 Definition and extent of the East Cornwall catchment

The East Cornwall CFMP catchment is located at the eastern end of Cornwall, near the south-westerly tip of the UK mainland. It covers an area north of Newquay to St Austell, which is defined by the boundaries of the Gannel catchment at Newquay (which is included) and the Par catchment at St Austell (which is not included). It stretches as far as the boundary of the River Tamar to the east and north and to the county boundary to include Bude and the south coast of Cornwall between Rame Head and Gribbin Head. See figure 1.1 for a location plan.

The CFMP comprises a large number of rivers with catchments of varying sizes from only a few kilometres square to the Camel tidal catchment, the largest at 235 km^2. There are 20 Main River reaches within the catchment. Main Rivers are generally the larger arterial watercourses on which the Environment Agency has powers to carry out work. These can be seen in Appendix C. Within East Cornwall the key Main Rivers are the:

- River Camel
- River Allen
- River Fowey
- River Menalhyl
- River Gannel
- River Valency
- River Strat
- River Neet
- River Pol

The CFMP has also considered flooding from the tide within a river catchment where the level of the tide (still water level) creates flood risk either in isolation or in combination with river flows. Tidal flooding is a risk for low-lying locations on estuaries and tidal rivers.

The CFMP does not investigate flood risks arising from coastal flooding. Coastal flooding occurs due to a combination of large waves, strong winds and high tides at exposed coastal locations. Coastal flooding issues are dealt with by Shoreline Management Plans (SMPs). SMPs are in place for the coast of Cornwall, with reviews and updates of these plans due to be completed by 2010.

The boundaries of the CFMP and the SMP depend on the individual characteristics of a given estuary or river. As a rule of thumb, under new guidance produced by Defra, all SMPs will consider an estuary or river to the tidal limit, or to the point where tidal processes no longer affect sediment transport toward the coast. This will particularly be true on larger estuaries. For example, the Cornwall SMP2, which will cover the East Cornwall coastal frontage, should extend upstream on the Camel estuary as far as (or close to) Wadebridge. The CFMP should extend downstream to the point where the true open coast, which is exposed to waves, is reached and where river flows no longer influence flood risk. Therefore we may see a large overlap of the CFMP and SMP on larger rivers like the Camel and the Fowey. For this reason it is very important that the CFMP and SMP are properly linked to avoid duplication of effort and/or conflicting policies being promoted.

The CFMP will therefore consider tidal flooding within the Camel and Fowey estuaries and other low-lying locations, as well as river flooding. Further details regarding the links between the CFMP and SMP are included in Annex A of Appendix B.

Defined with these boundaries, the East Cornwall CFMP catchment covers an area of approximately 1,400km^2, of which only 5 per cent is defined as urban area. The principal urban centres across the catchment are Newquay, Padstow and Wadebridge in the north-west, Bodmin and Fowey in the south-west, Bude in the north, Liskeard in the east and Looe on the south coast of the catchment. These locations can be found in Figure 2.10.

The catchment area is served by Caradon District Council, North Cornwall District Council, Restormel Borough Council and Carrick District Council.

Being predominantly rural, the catchment is environmentally rich, with many important environmental designations and a high quality river system. Due to the mild climate and the natural beauty, tourism is a major industry across most of the catchment.

The CFMP aims to consider flood risk across the East Cornwall catchment area. Within the area we have selected a number of key sites that will be considered in more detail, particularly in relation to current and future flood risk in Chapters 3 and 4. We have selected these key sites based on where flooding has been a frequent problem, as discussed in Section 3.2. They are made up of both the larger towns in the catchment and a number of small towns and villages. We have identified the key sites on the figures throughout the document and are first shown on Figure 2.1.

An overview of the East Cornwall CFMP catchment area and the main features and assets present, including the locations of the key sites, are shown in Figure 2.1 and Table 2.1.

Figure 2.1 Catchment overview

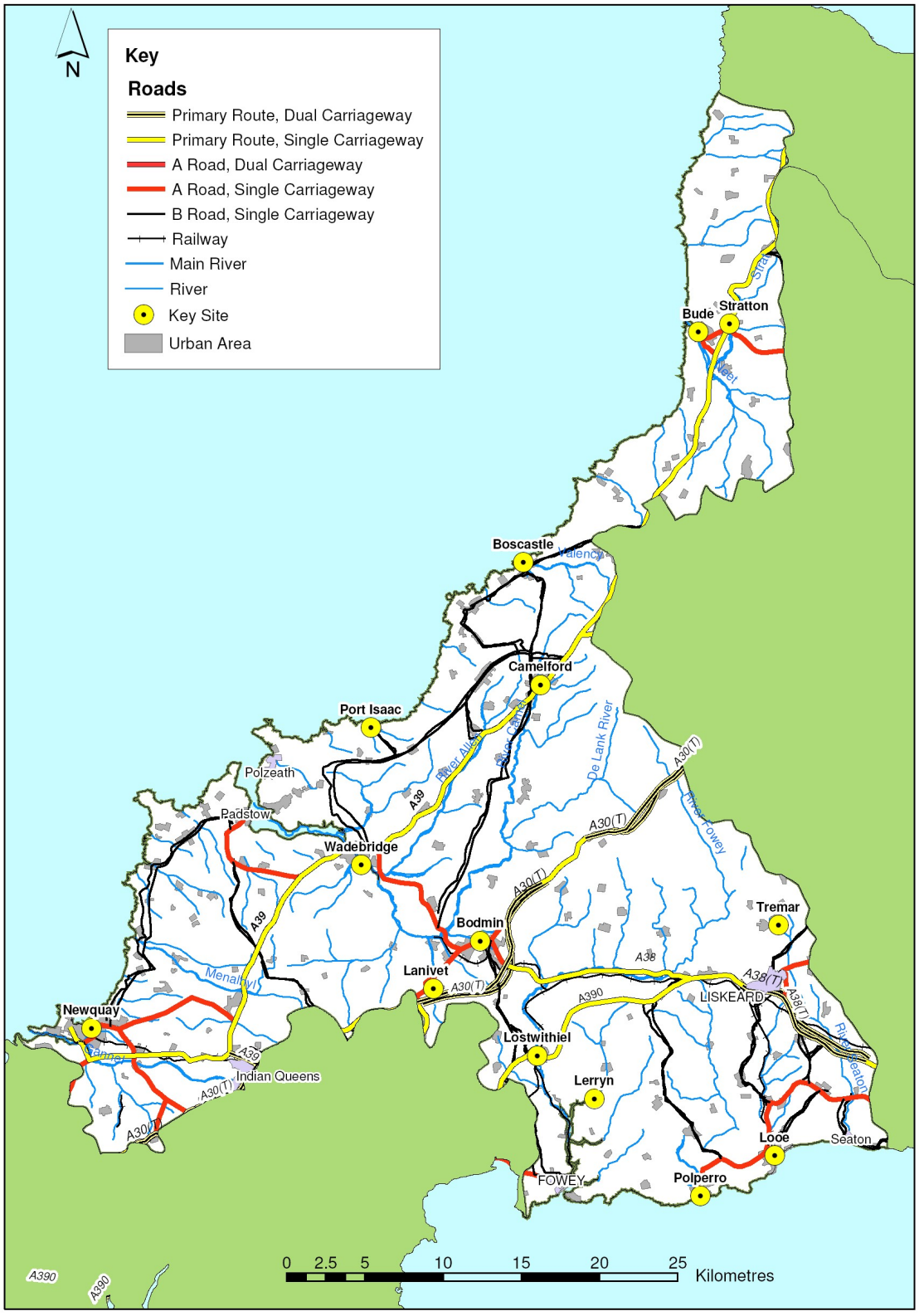


Table 2.1 Key parameters for a number of Main River catchments

Hydrology data						
	Camel	**Gannel**	**Fowey**	**W. Looe**	**E. Looe**	**Seaton**
Total area km²	216	50	175	50	48	55
Length of main river km	35	12	37	15	16	17
Source	Hendraburnick Down	Indian Queens	Brown Willy	East Taphouse	Lower Treworrick	Minions
Tidal limit	Polbrock	Trevemper	Lostwithiel	Milcombe	Tregarland Bridge	Seaton Beach
Mouth / Confluence	Padstow Bay	Crantock Beach	Fowey	Looe	Looe Harbour	Seaton Beach
	Amble	**Allen**	**De Lank**	**Valency**	**Neet**	**Menalhyl**
Total area km²	31	65	35	20	26	28
Length of main river km	8	22	14	8	10	12
Source	Trevinnick	Pengelly	Roughtor Marsh	North Hendraburnick Down	Greena Moor	Tregonetha Downs
Tidal limit	Trewornan	Sladesbridge	-	Boscastle	Bude	Mawgan Porth
Mouth / Confluence	Camel Estuary	Camel Estuary	Keybridge	Boscastle	Bude Haven	Mawgan Porth

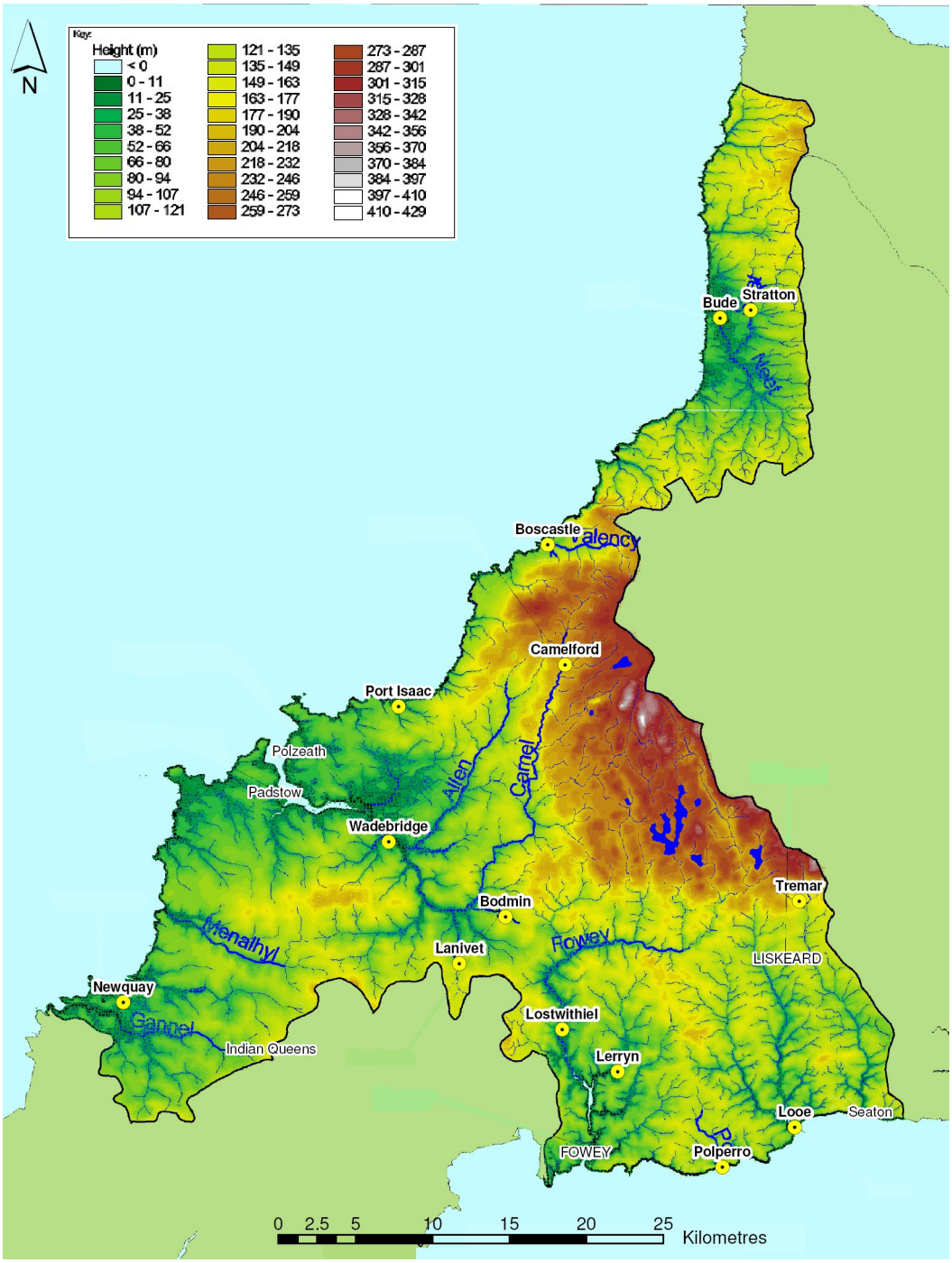
	General
Average annual rainfall	Ranges from 1020mm (coastal and central) to 1500mm (upland areas).
Geology	Mainly Lower, Middle and Upper Devonian and Old Red Sandstone solid geology with large granite (syenite, granophyre and allied types), Upper Carboniferous north of Boscastle covering the remaining north coast. Rhyolite, trachyte, felsite, elvans occur sporadically over East Cornwall, as do divisions of basalt dolerite, and camponite.
Urban area	5.2 per cent of CFMP area; the principal urban centres are Newquay, Bodmin, Camelford, Liskeard, Bude, Wadebridge, Lostwithiel and Looe. The remaining population is distributed in smaller towns and villages spread across the area.

Asset	Total in East Cornwall CFMP catchment	At risk of flooding based on 1% and 0.5% a.p flood extents
Area	1339 km^2	31.1 km^2
Agricultural grade land (Grade 1, 2 and 3)	863.4 km^2	11.7 km^2
Residential properties	59,046	1,612
Commercial properties	9,379	738
A roads	A30, A390, A389, A387, A38, A3082, A3076, A3075, A3073, A3072, A3059 and A3058.	A30, A390, A389, A387, A3082, A3075, A3072, A3059, A3058,
Railway	82.2km	34.4 km (includes embankments as structural integrity could be at risk)
SAC	28.1 km^2	3.51 km^2
SPA	0	0
SSSI	74 km^2	4.25km^2
SMs	600	10
AONB	385 km^2	6.52 km^2
NNR	2.16 km^2	0.17 km^2

2.2 Topography

The East Cornwall catchment includes a range of landscapes, from high elevation moorland, to undulating farmland. Figure 2.2 shows the catchment topography.

Figure 2.2 Topography



The eastern section of the catchment is dominated by the granite of Bodmin Moor. There are also granite outcrops at Hensbarrow on the south-western boundary. The majority of the catchment is rolling grassland, valleys and heaths.

A number of rivers flow from Bodmin Moor, which is the highest area (approx. 390mODN) in the east of the catchment. Further west a number of rivers originate from an area of higher ground at St Breock Downs and in the far north of the catchment a plateau in the Culm gives rise to some short watercourses.

Channel gradients are defined by the topography of the ground. The upper reaches of most rivers in East Cornwall have a steep gradient. This means that water can flow quickly, resulting in flood peaks moving rapidly towards settlements located downstream. As the rivers gets closer to the sea, the gradients often become shallower, resulting in water travelling more slowly, especially towards estuary areas such as the Camel and the Fowey estuaries. Due to the topography of the area some rivers maintain a steep gradient until they reach the sea. This can result in fast flows along the whole watercourse causing particular concerns in vulnerable locations as it takes little time for flows to reach settlements downstream.

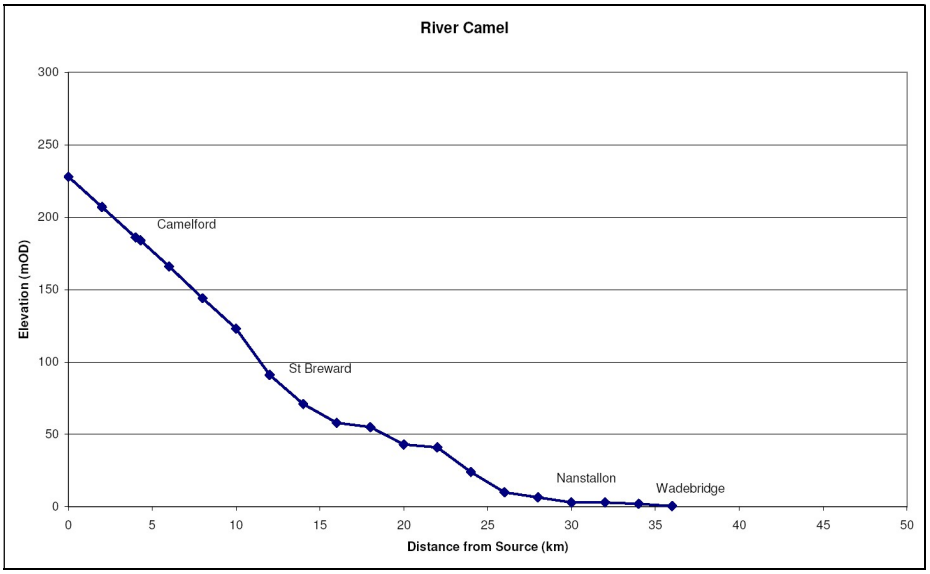
The impact of channel gradient and its influence on flood risk in vulnerable settlements is demonstrated in Figure 2.3. The gradient of three rivers from source to mouth is presented as they pass through or close to main settlements. These rivers have been chosen as they pass through some of the principal urban areas in East Cornwall.

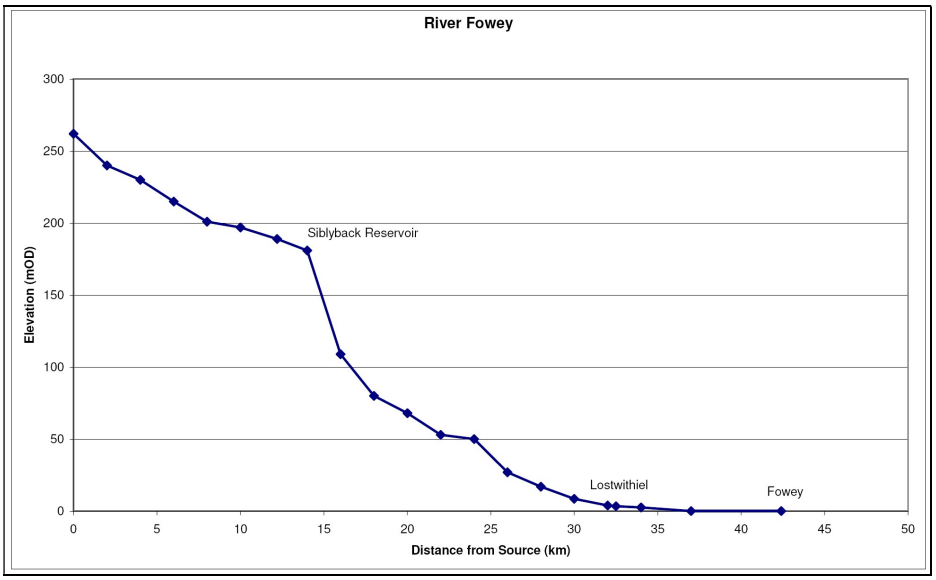
The River Camel, rising on high ground, is one of the longest rivers in the CFMP area with a length of around 35km. The first settlement at risk on the river is Camelford at around 5km downstream from the source. As the channel gradient is steep this means that flows can travel quickly towards Camelford, resulting in little warning of high flows reaching the town. Wadebridge is the last at risk settlement on the river. As it is over 30km away from the source and the gradient of the channel has lessened it would take more time for high river flows to reach this settlement. Wadebridge is shown to be at around sea level and this indicates vulnerability to tidal flood risk.

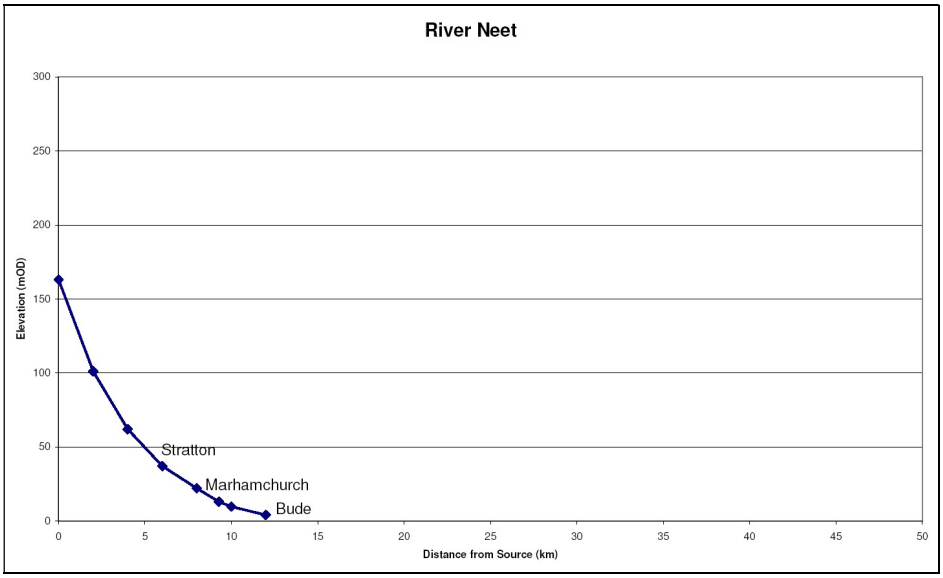
The River Fowey also rises on high ground and is the longest river in the CFMP area. Figure 2.3 shows that the main at risk settlements are located in the downstream area of the river, over 30km from the source. The gradient of the headwaters is relatively shallow; however a short section of steep channel in the mid section of the river means that flows could approach Lostwithiel relatively quickly. Fowey is vulnerable to tidal flood risk as it is near sea level.

The River Neet is one of the shortest watercourses in the CFMP area at only 12km in length from source to mouth. Although rising on lower ground, this watercourse is steeper overall than the River Camel and the River Fowey due to the drop of 150m in only 12km. This height is lost through a consistent high gradient throughout the length of the watercourse, gradually lessening towards the downstream end. Again, flows will travel quickly along this watercourse. Bude is shown to be at around sea level and this indicates vulnerability to tidal flood risk.

Figure 2.3 Channel gradient and settlement elevations on three watercourses







2.3 **Geology** and Hydrogeology

Geology and the ease at which it can be eroded is a key influence on topography (see Section 2.2), drainage patterns, runoff rates and therefore the natural occurrence of flooding within the catchment.

Solid geology in East Cornwall can be split into five main areas, as illustrated in Figure 2.4:

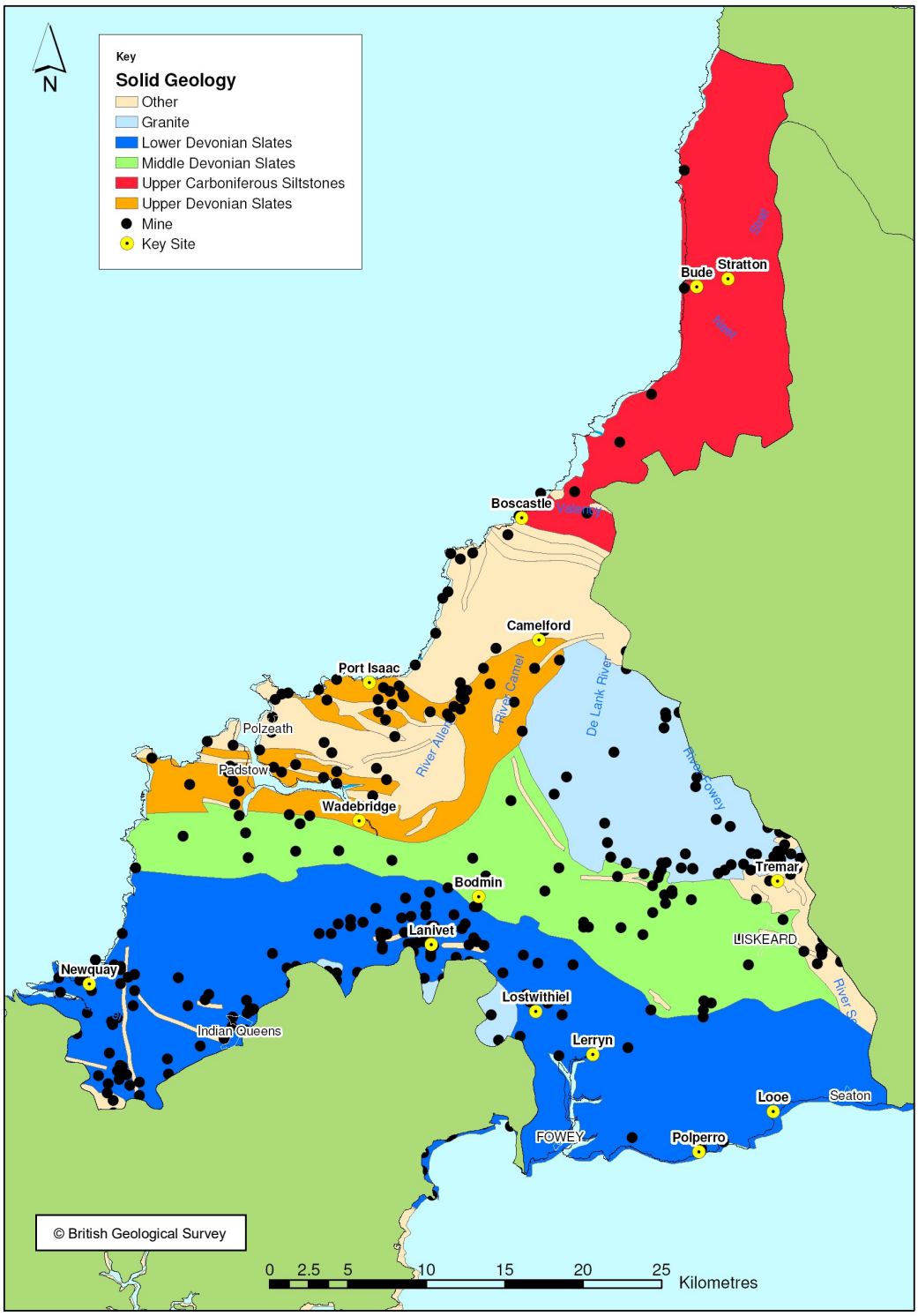
- An east-west band of lower Devonian slates in the south
- A middle band of Devonian slates
- Upper Devonian slates stretching to the River Valency
- Upper Carboniferous siltstones to the north of the catchment
- The Bodmin granite intrusion to the east of the catchment

The Bodmin granite is resistant to erosion and so Bodmin Moor is the highest point of elevation in the catchment (up to 360mODN). Less resistant overlying rocks have been eroded to expose the granite and periglacial action has exposed and shaped the tors that are common on the Moor. The presence of granite at the surface leads to a high percentage of surface runoff in these areas. This, in combination with the steep gradient of tributaries draining off the moor, such as the Warleggan River and St Neot River, leads to a rapid (or “flashy”) response to rainfall in the upper reaches.

The slates are sediments lain down in marine conditions and metamorphosed by heat emanating from the granite instrusion. They are locally known as “killas”, and layers of siltstone and sandstone are often found between the slate. These rocks are more readily eroded than the granite and therefore associated with lower-lying land.

Mining of the minerals associated with the granite has been key to the Cornish economy, notably tin mining on Bodmin Moor. An illustration of the legacy of historic and ongoing mining activities in the East Cornwall catchment is shown in Figure 2.4.

Figure 2.4 Solid geology



Superficial drift geology (which lies over the solid geology but under the soil surface) is limited in extent (Figure 2.5). In most areas no drift geology is present and the soil surface rests directly on exposed bedrock, which is only erodible on geological timescales. The lack of drift geology contributes to high surface runoff in the catchment.

Drift deposits that do exist in the catchment are:

- Alluvium (fine grained river sediments) along the watercourses.

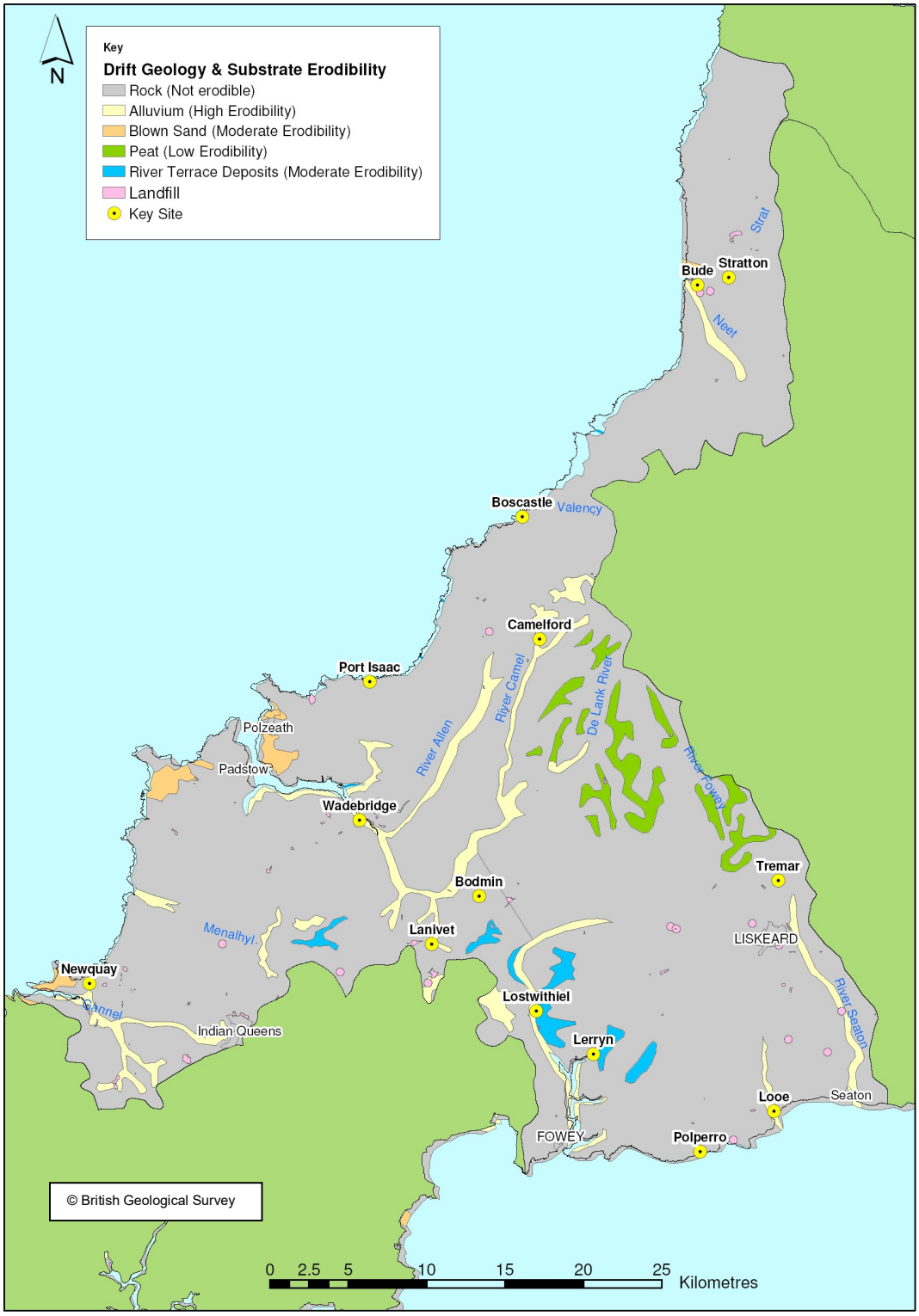
- River terrace deposits along watercourses in the upper catchments of both the Fowey and Camel
- Peat, from the growth of wetland vegetation over poorly drained bedrock, on Bodmin Moor

The distribution of drift geology influences erodibility (see Figure 2.5) and therefore sediment sourcing along the rivers.

Hydrogeology in East Cornwall is influenced by the presence of granite bedrock and historic mining activities. The water table is less than ten metres below ground in areas of granite bedrock. Groundwater flow occurs along open fractures and is shallow and local. It forms the base flow component to rivers, as well as feeding a large number of springs but has little influence on flooding.

The existence of streamed workings and drainage adits associated with mining activities alters local flow pathways, concentrating groundwater flows along underground drainage channels. This can mean that flows are transferred between river catchments, however as mining records are poor, it is difficult to know the effect of such water transfer. In addition, any collapse or blockage within the mine system is likely to disrupt flows, affecting the quality of the water and where the water is released. These effects may need to be considered for hydrological assessments, particularly where significant mine workings are located, for example to the south of Bodmin, and the southern edge of Bodmin Moor from St Cleer to Cardinham.

Figure 2.5 Drift geology and substrate erodibility



2.4 Geomorphology

East Cornwall is dominated by two large river catchments, the Camel and the Fowey, which drain most of Bodmin Moor. The headwaters of these catchments are steep, respond rapidly to rainfall and are highly modified due to mining activities. There are a number of steep river

catchments along the northern coast, which also respond rapidly to rainfall events. These rivers have the potential to source and transport large volumes of sediment and large woody debris during extreme events, which may impact on settlements in the lower reaches of the rivers, as witnessed at Boscastle in the August 2004 event. The potential for conveyance during future extreme events may also increase as the river systems enlarge.

Sediment sourcing from tilled land present on the valley floors and floodplains has the potential to deliver high volumes of fine sediment to the larger lowland river systems. Depending on downstream channel conditions and management practices, fine sediment may be deposited in lower reaches, contributing to degradation of the channel and potentially increasing flood risk.

There is limited functional floodplain in East Cornwall. The incised nature of many of the watercourses reduces the frequency of out-of-bank flows, limiting the extent of wetland habitats. In larger catchments, where there is floodplain, interaction is limited by flood defences in some urban areas.

River continuity is one of the key hydromorphological indicators used within the Water Framework Directive (2000/60/EC) to assess the ecological status of watercourses. River continuity is good in East Cornwall where rivers are unaffected by mining activities. Weirs located in areas where there are also existing flood defences protecting settlements such as Bude, Camelford and Newquay may limit river continuity. Porth Reservoir (shown on Figure 2.14) is likely to disrupt the connection between upper and lower areas of the Porth River catchment. Informal in-channel structures may also be present but not recorded within the national dataset.

The following rivers have been identified as particular watercourses that would benefit from improved river continuity and restoration to their natural state; Neot River, De Lank River, River Camel, River Fowey, River Gannel and Menalhyl River.

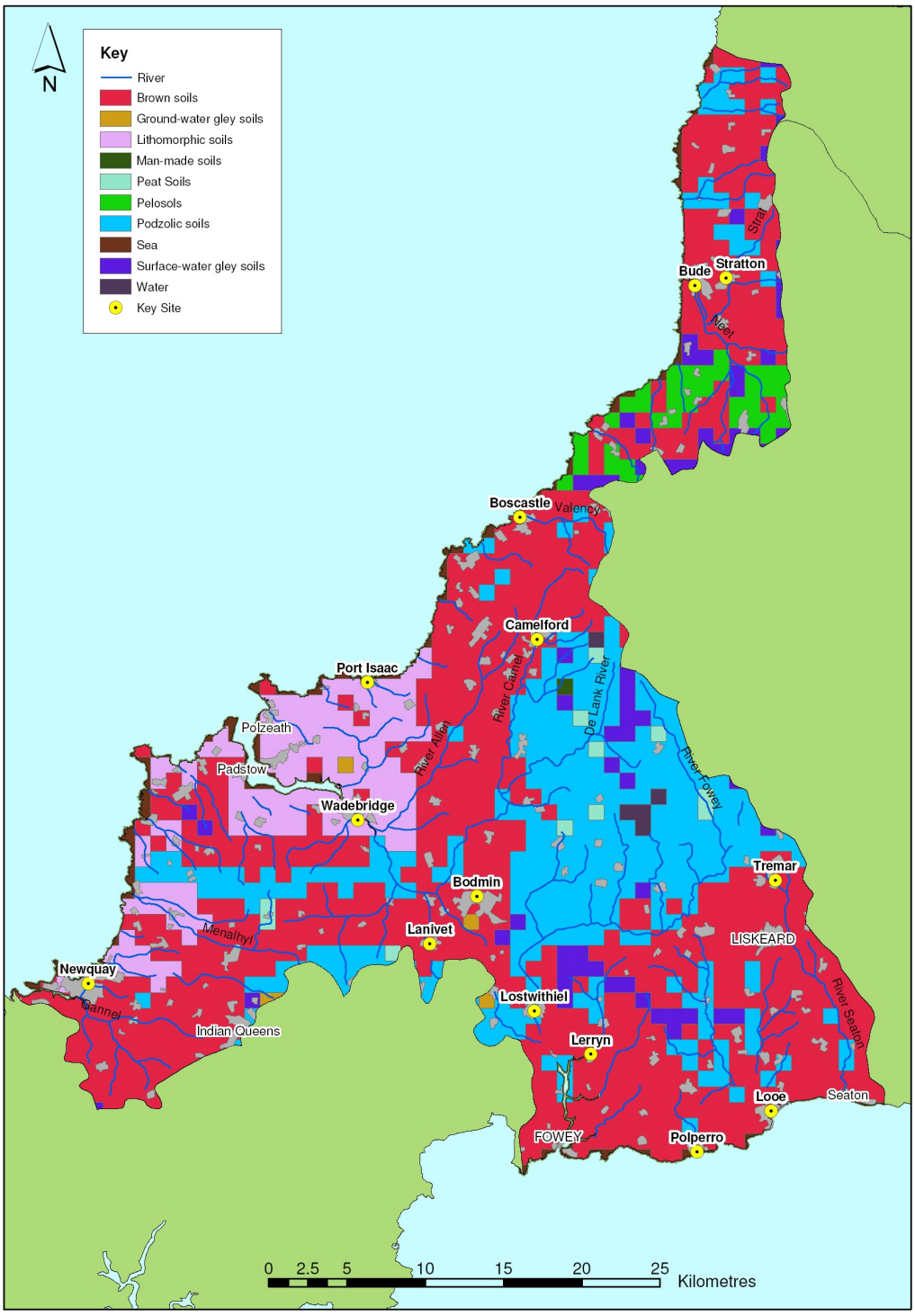
2.5 Soils

The nature of soils in a catchment influences both the volume of surface water runoff and sediment sourced to watercourses. An understanding of the soils that can influence runoff and sedimentation of rivers can help guide flood risk management actions, particularly where ‘flashy’ responses to rainfall are expected.

There are four major soil types within the East Cornwall CFMP area: brown soils, podzols, lithomorphic soils and pelosols (Figure 2.6).

Brown soils cover large areas of low-lying land throughout the CFMP area. These soils contain a high proportion of organic matter, but are only moderately fertile. They are generally well drained and very permeable, with a high Winter Rainfall Acceptance Potential (WRAP) (Figure 2.7). Soils with a low runoff as shown are well drained (1) and soils with a high runoff are impermeable (5).

Figure 2.6 Soils



Podzols are found predominantly overlying the granite of Bodmin Moor (Figure 2.6). These soils are characterised by an organic-rich, leached upper horizon, underlain by a layer highly enriched in iron oxides and organic matter. They are poorly drained, impermeable and have a low WRAP (Figure 2.7). Due to their limited capacity to absorb moisture, podzols generate large volumes of surface runoff during periods of rainfall, which can contribute to flooding. These soils underlie headwater streams feeding the Rivers Fowey, Camel and De Lank, which have a "flashy" flow regime and respond rapidly to rainfall events.

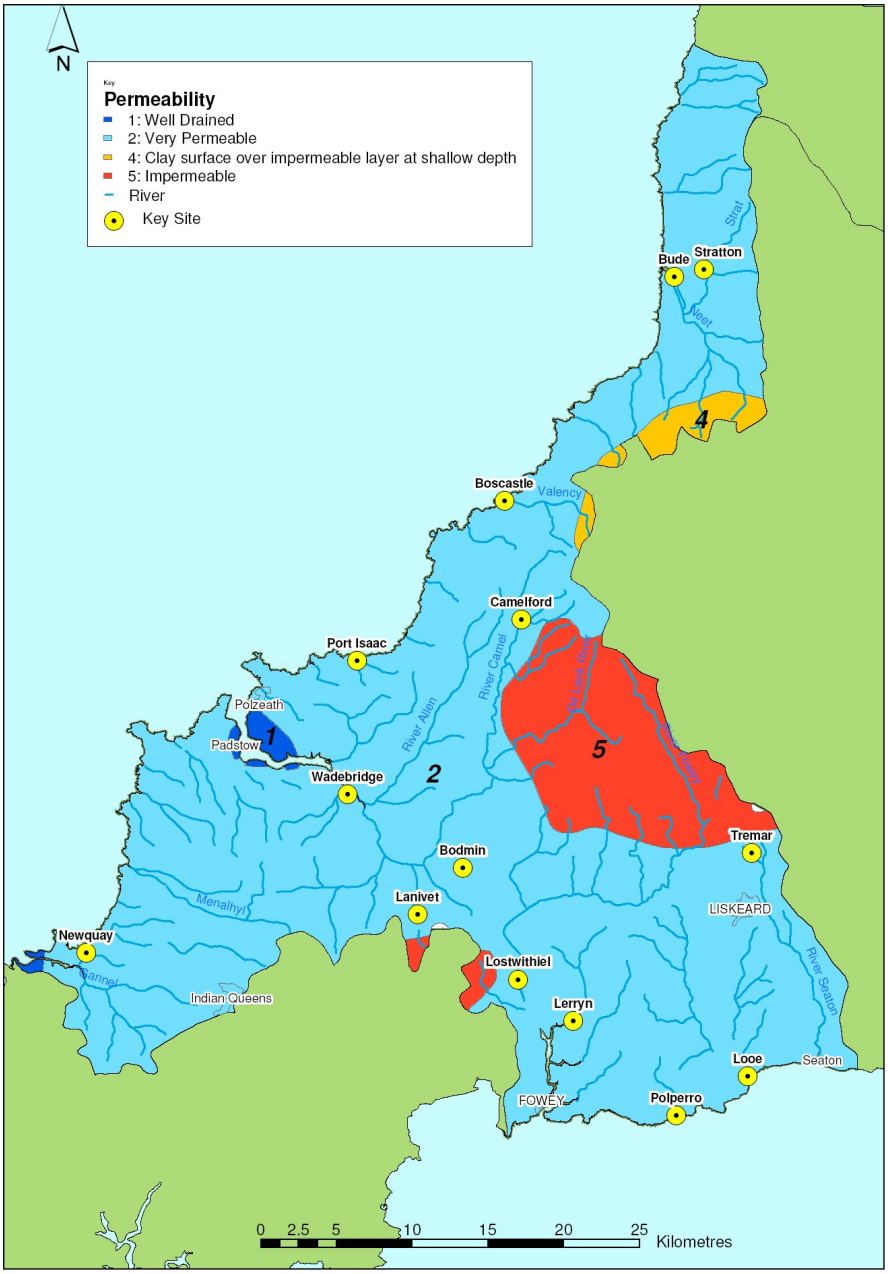
Lithomorphic soils, which strongly resemble the bedrock from which they were derived, are found close to the coast north of Newquay and on either side of the Camel Estuary (Figure

2.6). They are generally well drained, have a high WRAP (Figure 2.7) and have low natural fertility.

Small areas of **pelosols** are also found to the south of Bude. The drainage of these clay-rich, loamy soils is slightly impeded, associated with a medium WRAP (Figure 2.7), but they are highly fertile.

Some soils in the East Cornwall CFMP area have a severely degraded structure. For example, approximately 32 per cent of sites surveyed by the National Soil Resources Institute in the River Camel catchment are severely or highly degraded (Environment Agency, 2006). Such areas are likely to cause enhanced runoff and may contribute to increased flooding and soil erosion.

Figure 2.7 Soil winter acceptance potential to rainfall

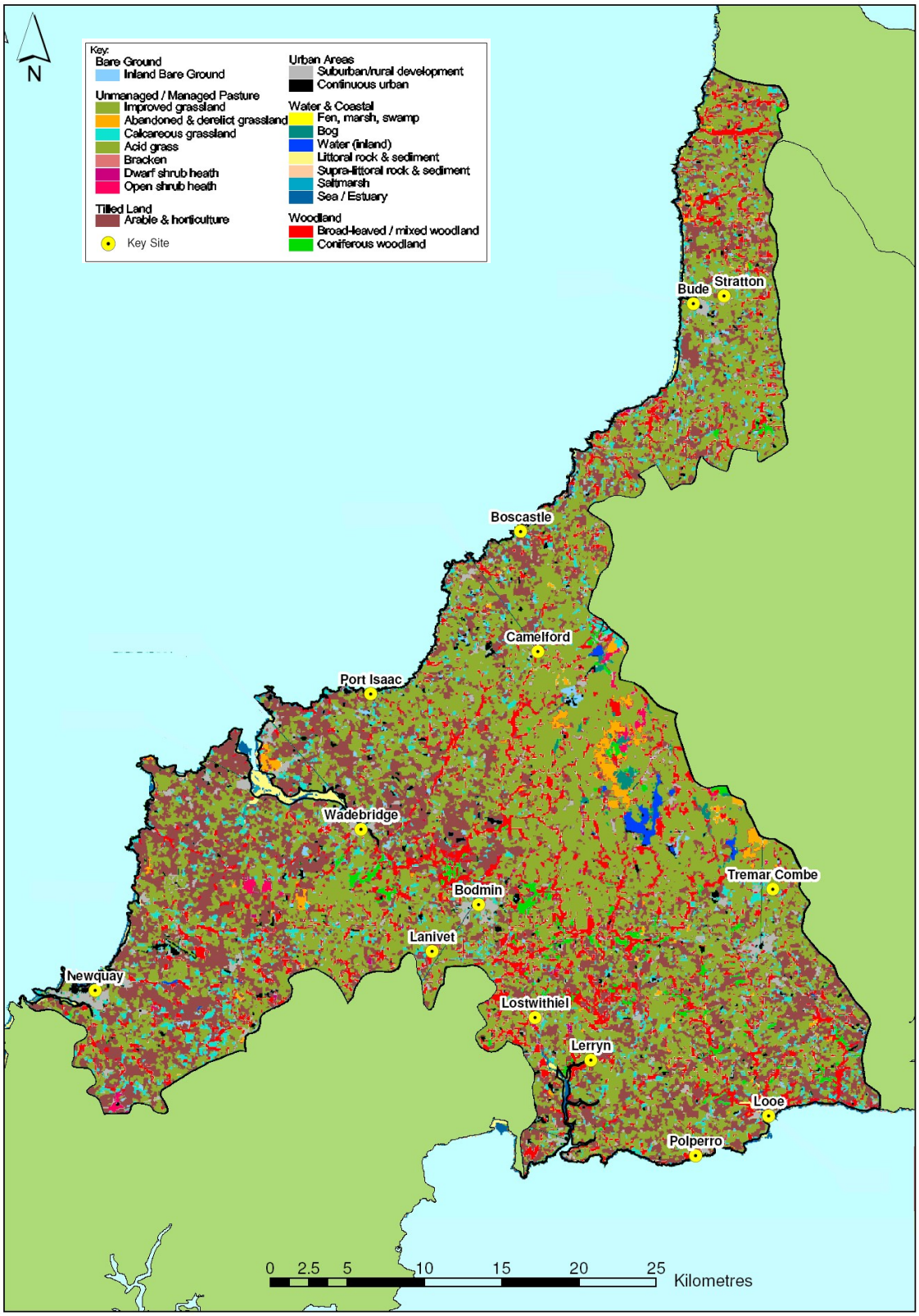


2.6 Land use and land management

2.6.1 Land type and management

The land cover across the catchment is shown in Figure 2.8. Land cover ranges from the heathland of Hensbarrow and Bodmin Moor to the pasture and arable land present throughout the catchment. There are also extensive woodlands in the Camel and Fowey estuaries, with significant wetland and dune habitats in the lower catchments.

Figure 2.8 Land cover



Ninety-three per cent of the land cover within the catchment is grassland, arable, horticultural and woodland, with just five per cent of the land use being urban. The land cover across the catchment and the way it is used can influence how the land responds to rainfall, influencing flood risk in East Cornwall. In addition, some of the land is itself at risk of flooding. Table 2.2 presents each of the main land cover within the catchment and shows how much is at risk of

flooding. In total, around 32km^2 of land in East Cornwall is at risk of flooding from a 1 per cent annual probability (a.p) flood event.

Table 2.2 Land cover within the catchment

Land cover	Catchment		At risk of flooding (1 per cent a.p flood event)	
	Area km^2	per cent	Area km^2	per cent
Arable and horticulture	362	27	5	14
Bare ground	8	0.6	0.3	0.9
Bracken	4	0.3	0.1	0.3
Grassland	719	54	12	38
Heath	6	0.5	0.1	0.3
Inland water	5	0.4	2	6
Littoral rock and sediment	4	0.3	1.4	4
Saltmarsh	1	0.1	0.3	0.9
Urban, gardens	67	5	1.5	5
Woodland	152	11	10	30
Total	**1329**	**100**	**32**	**100**

Figure 2.9 shows the agricultural land classification within the catchment, with a summary of the data presented in Table 2.3. This classification indicates the type of farming that could be carried out on the land.

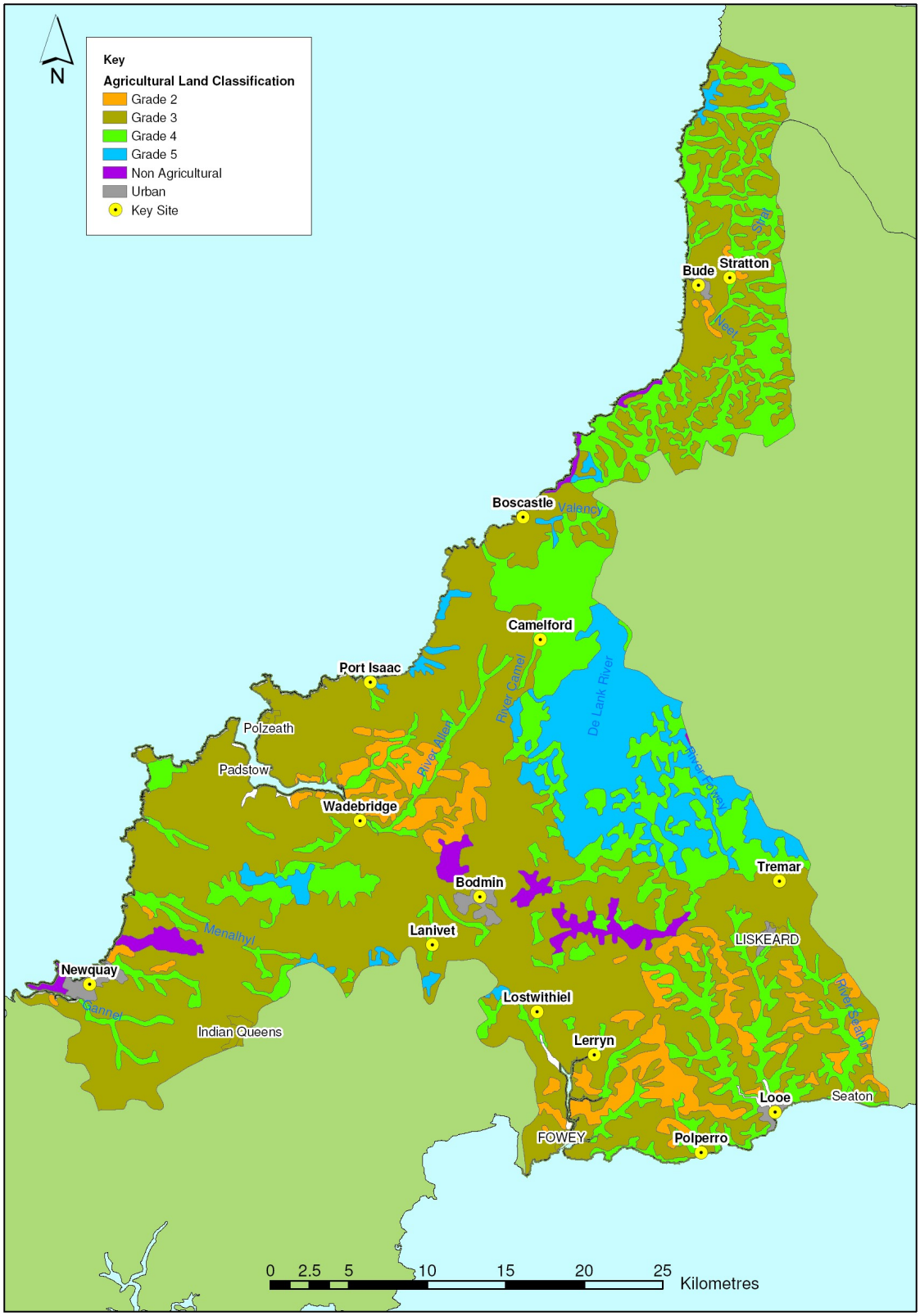
32 per cent of the catchment is Grade 4 and 5 agricultural land (poor quality) and is mainly situated on Bodmin Moor. Approximately 58 per cent of the catchment area is Grade 3 agricultural land, which is good to moderate grade land. Grade 2 agricultural land covers about 6.5 per cent of the catchment and is mainly found in the lower Camel, Allen, Fowey & Seaton Valleys catchments. Grade 1 and 2 land is capable of growing intensive crops such as winter vegetables. There is no Grade 1 agricultural land in the catchment.

Generally, better quality agricultural land will be used for more intensive production, often growing crops. Lower quality land is more often used for grazing. The use of agricultural land can influence flood risk by changing how the land responds to rainfall. Intensive use of land can mean that water is prevented from infiltrating the ground, meaning that water will runoff the land into rivers more quickly.

Table 2.3 Land grade within the catchment and within the 1 per cent a.p flood extent

Land Grade	Catchment		1 per cent a.p flood extent	
	Area km^2	per cent	Area km^2	per cent
Grade 1	0	0	0	0
Grade 2	87	7	0.4	1
Grade 3	777	58	11	35
Grade 4	308	23	15	48
Grade 5	119	9	3	10
Non-agricultural	25	2	0.9	3
Urban	13	1	0.5	2
Exclusion	0.7	0.1	0.5	2
Total	**1,329**	**100**	**32.2**	**100**

Figure 2.9 Agricultural land classifications



Farmland has a much broader role than just the production of food and other renewable resources. Its influence has increasing relevance in the wider economy today, including in relation to flood risk management. Defra operates payment schemes designed to encourage environmentally sensitive farming as well as public enjoyment of the countryside. Under the Single Farm Payment system, farmers receive subsidies from the Rural Payments Agency for

keeping their land in good agricultural and environmental condition and complying with regulations. This system replaces the former production based subsidies. This means that there is now more incentive for farmers and landowners to move away from intensive agriculture, which has been associated with diffuse pollution and runoff from agricultural land, contributing to flood risk. In addition, other voluntary schemes such as the Entry Level Scheme and the Higher Level Scheme can be used to build-in source control on agricultural land to help attenuate surface runoff and prevent diffuse pollution, helping to reduce flood risk. The Catchment Sensitive Farming Scheme is another initiative seeking to achieve this goal. The catchment of the River Camel Valley and tributaries is part of this initiative.

With the majority of the East Cornwall catchment being rural, land management has an important role within flood risk management.

2.6.2 Urban development

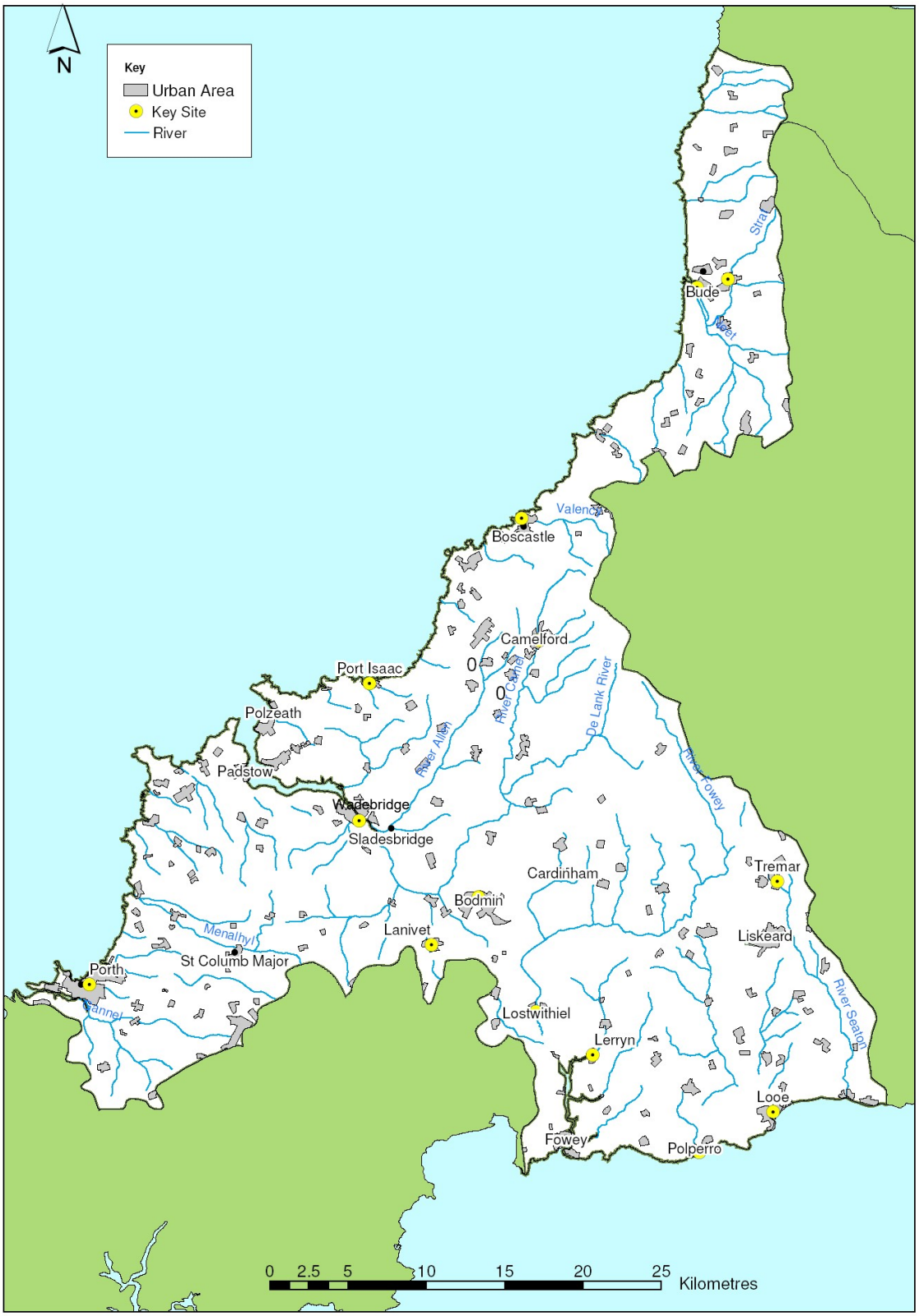
The urban areas within East Cornwall are mainly found in the lower valley areas, with little urban development in the upper reaches. The area has a total population of approximately 146,000 people, most of whom live in the main towns of Bude, Bodmin, Liskeard, Wadebridge and Newquay. The remaining population is distributed in smaller towns and villages across the area.

Many settlements, including the main towns are near rivers and parts of the settlements are at risk from the 1 per cent a.p flood event. The population of the main settlements in the catchment are shown in Table 2.4 and key urban areas are shown on Figure 2.10.

Table 2.4 Population centres and distribution within the catchment

Location	Population	
	2001	per cent of Catchment Total
Newquay	19,562	13
Liskeard	8,478	6
Bodmin	12,778	9
Bude	8,217	6
Wadebridge	6,222	4
Total catchment population (approx.) = 146,000		

Figure 2.10 Urban areas

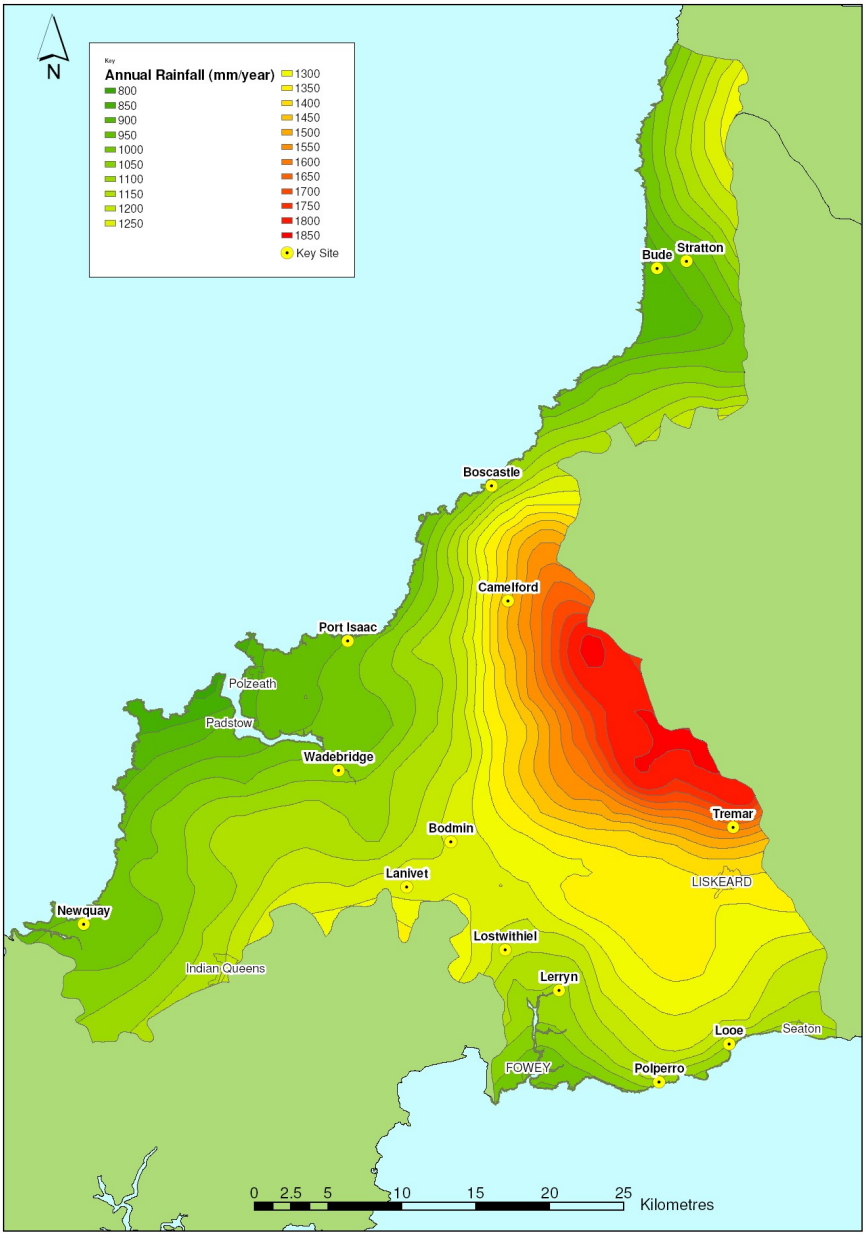


2.7 Hydrology

It is important to understand the processes that lead to flooding if we are to develop effective policies to manage flood risk. A vital part of this is understanding how the catchment responds to rainfall, including how long each watercourse takes to respond.

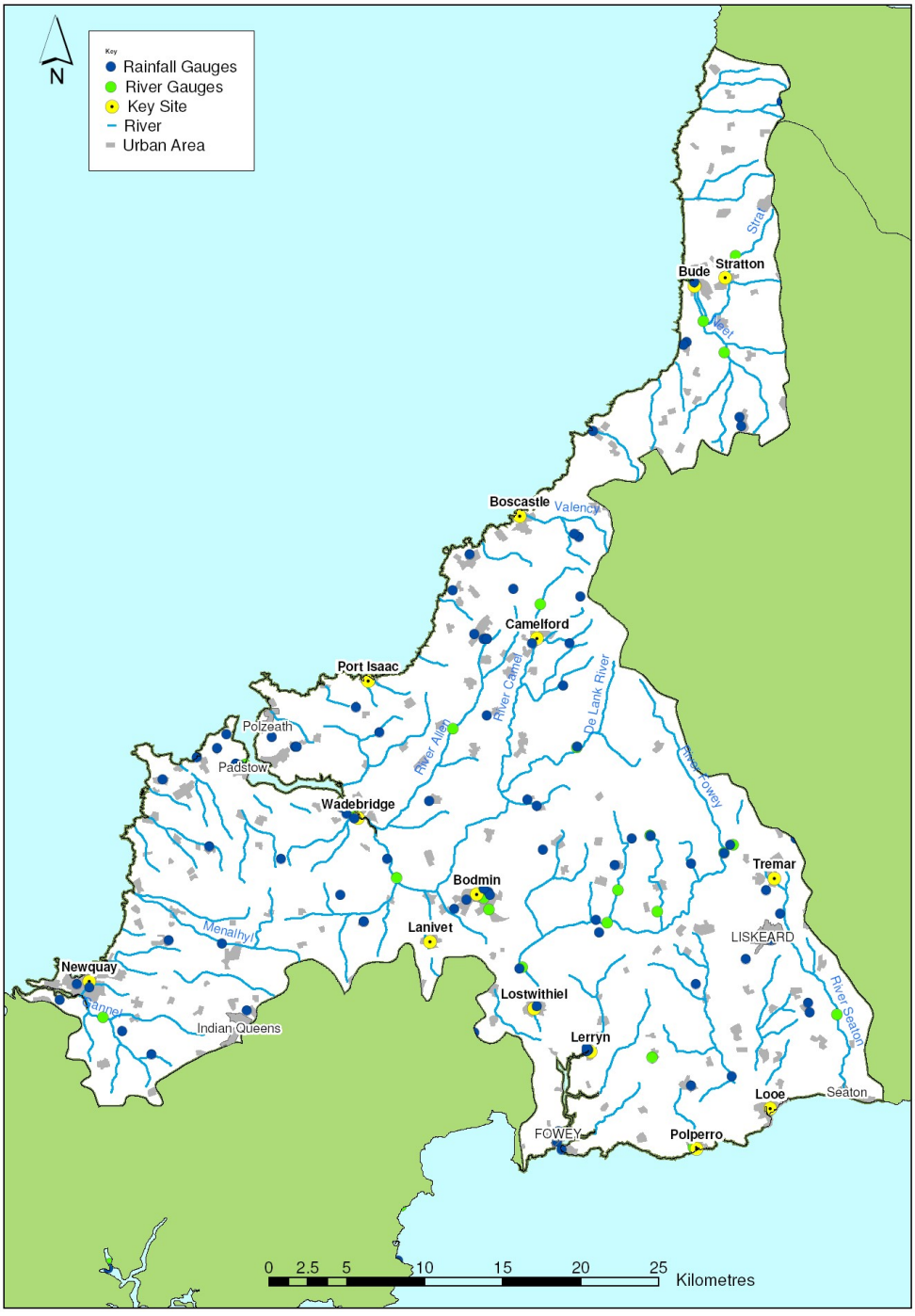
Average annual rainfall varies considerably across the catchment, ranging from around 1000mm in lowland areas to the north, south and west, to more than 1,600mm in upland areas over Bodmin Moor. Much of the catchment receives more than the average annual rainfall for England and Wales of 920mm. The average rainfall distribution across the catchment is shown in Figure 2.11.

Figure 2.11 East Cornwall catchment average annual rainfall (mm/year)



The catchment has a network of gauges for collecting rainfall and river data. These are distributed fairly well across the catchment, with a river level gauge on many of the larger watercourses. The distribution of gauges throughout the catchment is shown in Figure 2.12.

Figure 2.12 Rainfall and river gauges



Data for river level and flow has been collated from 18 of these gauges for a series of historical events including a relatively infrequent flood event that occurred in December 1999.

This data, including that taken from the Flood Warning Levels of Services Studies (FWLOSS, 2003), and the Flood Incident Management flood warning procedures, have been assessed to gain an understanding of the behaviour of gauged watercourses in the catchment. It is hoped

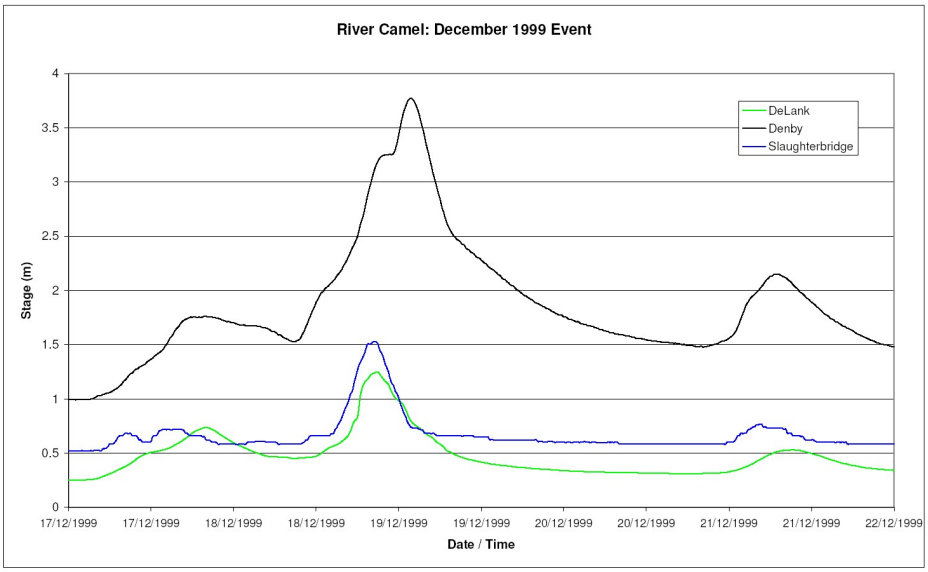
that this assessment can give a wider indication of the nature of rivers in the catchment and how they respond to rainfall events.

The rivers in the catchment are generally steep and impervious giving a rapid response to heavy rainfall. The time it takes for peak flows to be recorded in a watercourse from the start of rainfall can range from as little as 3 hours to 15 hours. Very small, steep catchments, such as those on the North Cornwall coast could respond to rainfall in less than 3 hours; however there is no gauging on these catchments to prove this.

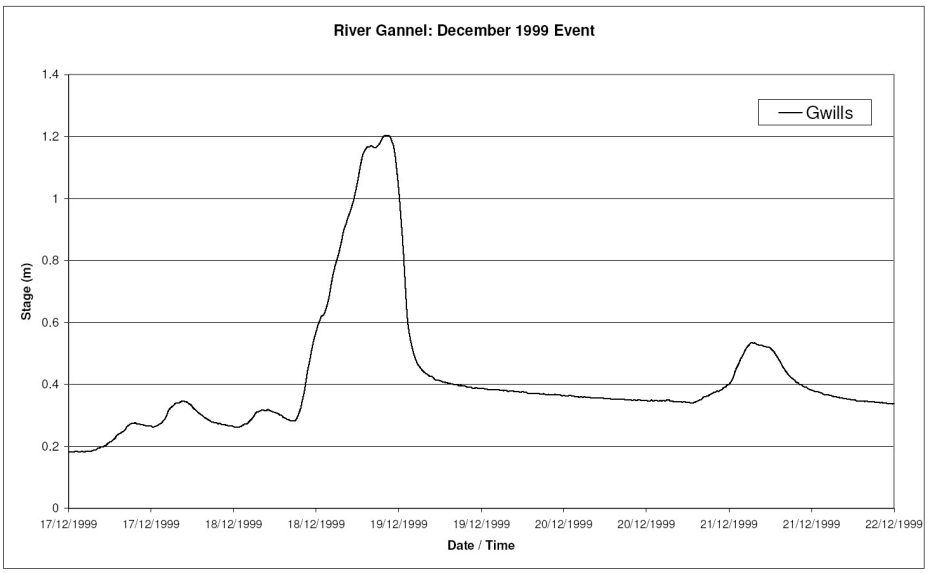
Figure 2.13 presents a comparison of river levels (stage) along a selection of Main Rivers in the catchment for a flow event with around a 7 per cent annual probability in December 1999. This is based on recorded data.

Figure 2.13 Comparison of river levels along Main Rivers for December 1999 event

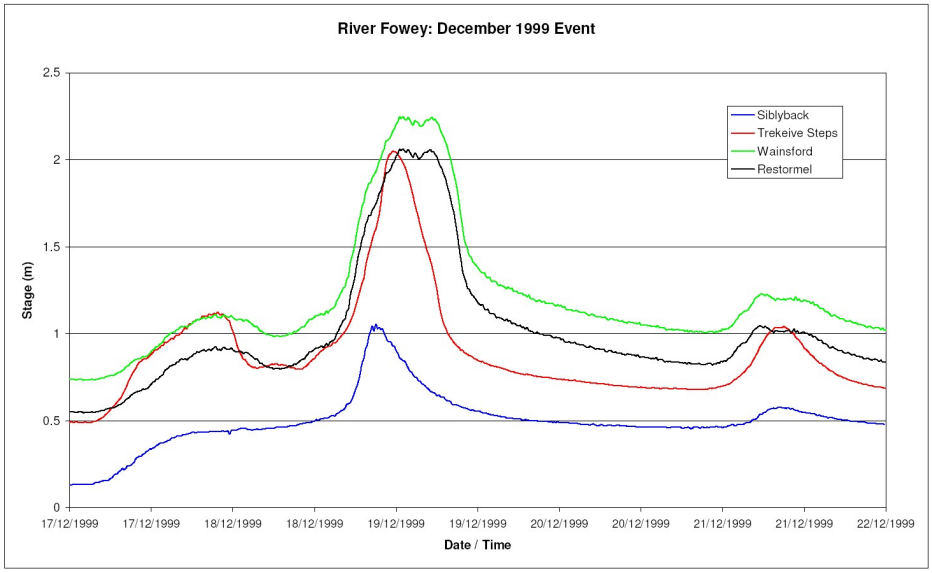
(a) River Camel



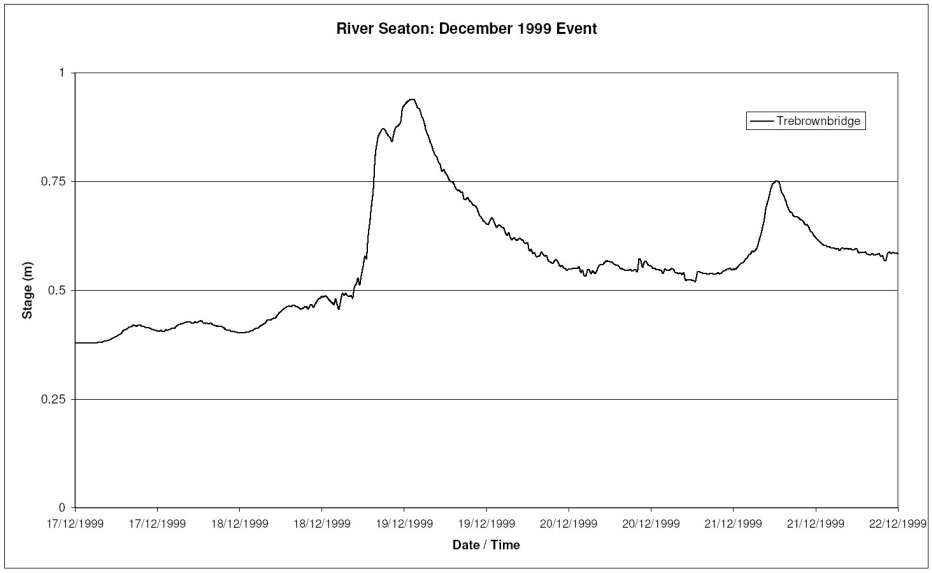
(b) River Gannel



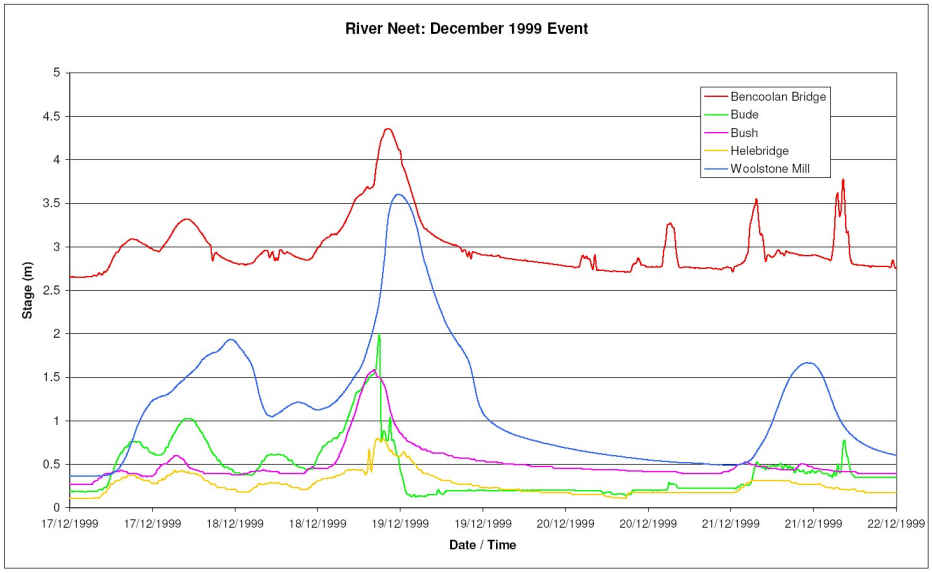
(c) River Fowey



(d) River Seaton



(e) River Neet



2.7.1 Review of catchment behaviour from December 1999 event

By reviewing Figures 2.13(a) to (g) we can draw a picture of how these gauged watercourses behave. The observed behaviour of each watercourse is described in Table 2.5.

Table 2.5 Watercourse response

Watercourse and length	Response
Camel (35km)	➢ Fairly fast reaction ➢ Short peak ➢ Fairly slow to return to base flow
Gannel (12km)	➢ Fairly fast reaction ➢ Peak drops off very quickly
Fowey (37km)	➢ Fairly quick reaction ➢ Relatively long peak ➢ Peak drops off quickly
Seaton (17km)	➢ Very fast reaction ➢ Slow to return to base flow
Neet (12km)	➢ Fairly fast reaction ➢ Peak drops off slowly

We can see from Table 2.5 that for the majority of the rivers in the catchment the response to rainfall is fast and results in a short peak, which quickly returns to the base flow. There are some exceptions, especially with the longer, larger watercourses, such as the Fowey and the Camel. In these watercourses the flow peaks are longer with a slower return to the base flow.

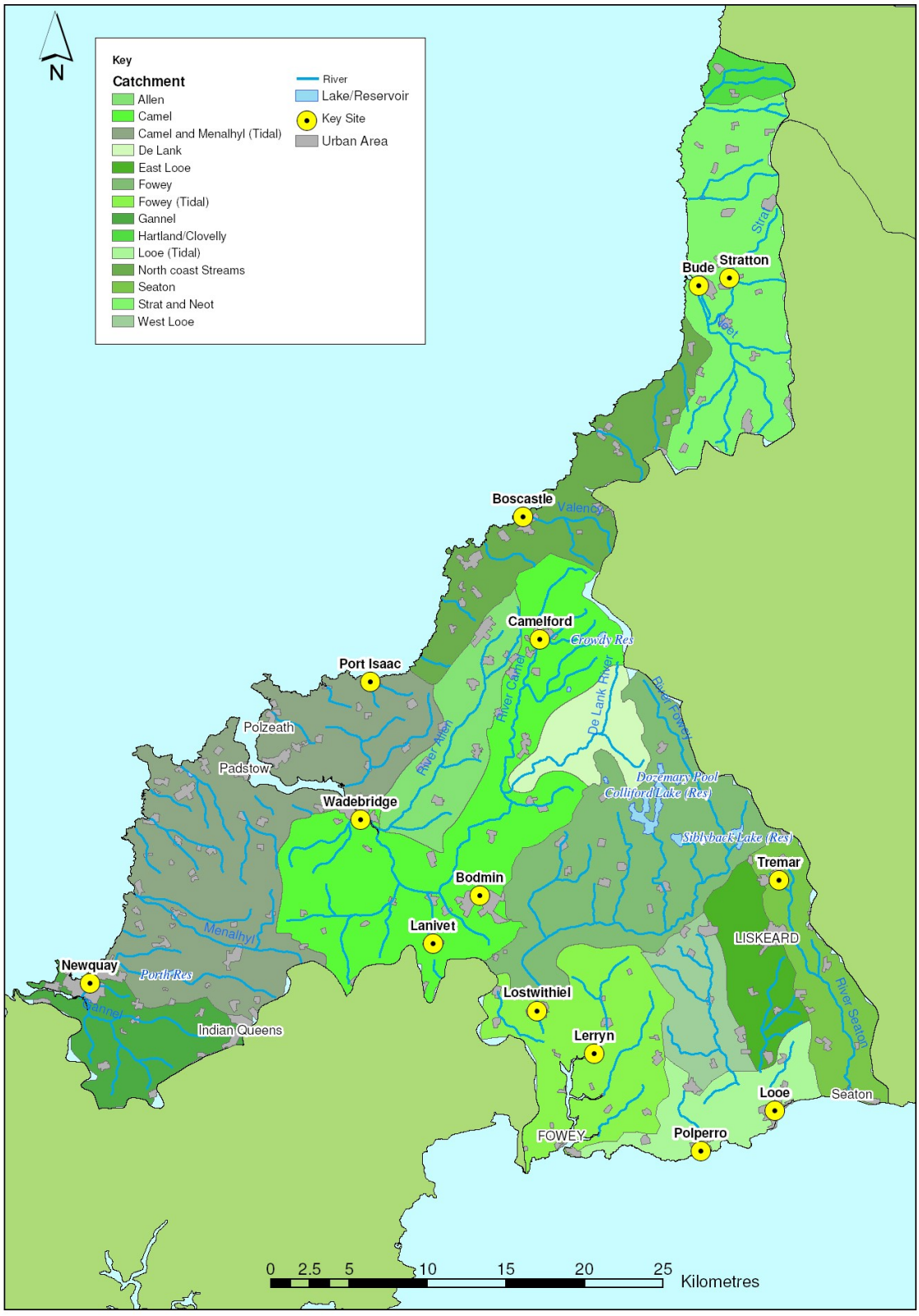
A fast reaction to rainfall events is typical of the majority of watercourses in this catchment. This is due to the nature of the geology and topography of the catchment, as well as the relatively short river lengths. These features of the catchment mean that it is vulnerable to short, intense rainfall events which can lead to events similar to that seen in Boscastle in August 2004, although this is an extreme example, rated as a 0.25 per cent annual probability flood event.

Due to the nature of the rivers in the CFMP area, we usually carry out gauging at individual sites on main watercourses, downstream of tributaries. So, it is not possible to assess how important each tributary is to the peak flow downstream in the principal watercourse. In

practice, because the rivers are short and have a compact catchment area the tributaries will react in the same way as the principal watercourse.

An overview of watercourses, water bodies and catchments in the East Cornwall Area can be seen in Figure 2.14.

Figure 2.14 Watercourse catchments



In addition to the water bodies shown in Figure 2.14 there are a number of disused china clay pits across the catchment. Both these china clay pits and reservoirs store water and attenuate flows through the system. This is discussed further in Section 3.2.6.

2.8 Environment and Heritage

2.8.1 Biodiversity

The catchment area supports a wide range of habitats and species and there are five natural areas (see section 2.8.2), which support them. From freshwater lagoons near the coast to reservoirs in the moors, lowland meadows to moorland bogs, the biodiversity of this catchment is one of its greatest assets.

The remainder of this section details statutory and non-statutory biodiversity interests within the catchment. The State of the Environment for the South West (2005) identifies that the condition of SSSIs and positive signs of otter are improving in the South West. These improvements are directly relevant to watercourses within the catchment:

- The Fourth Otter Survey of England between 2000 and 2002 revealed that sites showing positive signs of otters increased by 83 per cent in Devon and Cornwall
- Almost a fifth of England's Sites of Special Scientific Interest (SSSIs) are in the South West and, in 2005, 53 per cent were in favourable condition compared to 44 per cent in 2002

Designated sites

The catchment supports a variety of nationally and internationally designated nature conservation sites. These are presented in Figure 2.15 and include:

- 8 Special Areas of Conservation (SAC, also known as Natura 2000 sites);
- 46 Sites of Special Scientific Interest (SSSI); and
- 2 National Nature Reserves (NNR).

Of the eight SACs located within the CFMP study area, four currently lie within the one per cent annual probability flood extent.

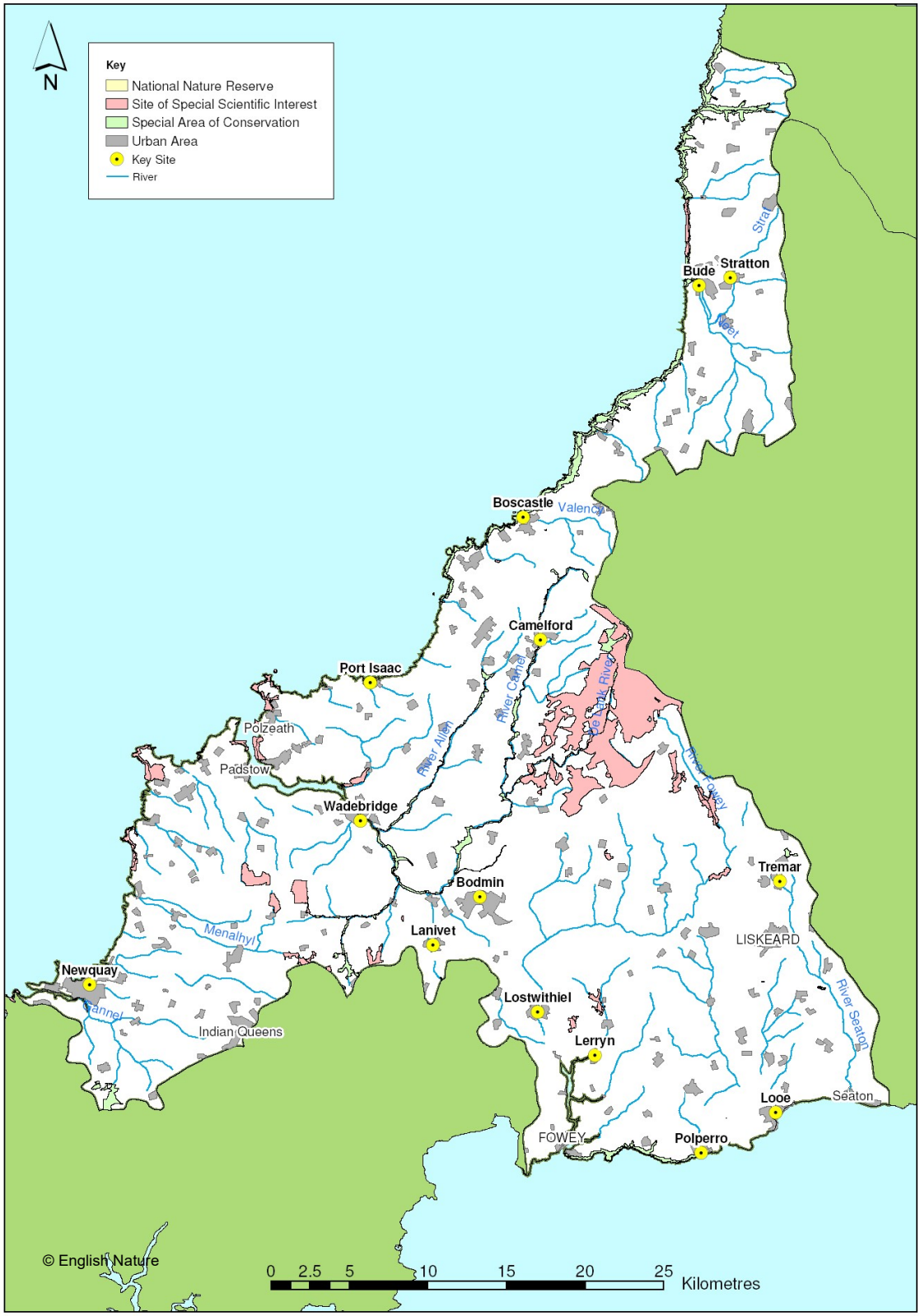
The River Camel SAC is of particular importance within the catchment. It supports areas of wet and dry heath, sessile oak forest, and alluvial forest along the river banks. It also supports populations of otter, salmon and bullhead due to the unspoilt nature of the river valley and its tributaries.

Tintagel-Marsland-Clovelly SAC is a predominantly coastal site designated for its dune and vegetated sea cliff communities. It supports dry heath, sessile oak forest and alluvial forest on the river valleys within the site.

The Phoenix United Mine SAC is designated for its metallophytic bryophytes growing on copper and tin spoil. This site is not considered to be risk of significant impact through current flooding activities; however it could be at risk if changes in drainage and modification of watercourses were to occur.

Polruan-Polperro SAC is a predominantly coastal site designated for its vegetated sea cliff communities. It supports dry heath, dry grassland and improved grassland on the cliff tops. This site is not considered to be risk of significant impact through current flooding activities.

Figure 2.15 Conservation designations



Twenty-five of the SSSIs are located within the one per cent annual probability flood extent and their condition is listed in Table 2.6. Through consultation with Natural England, the designated sites are not currently perceived to be adversely affected by flooding, although with any extreme flood event potential damage could arise from erosion or flood disturbance. The

majority of sites are maintained or benefit from water. Specific impacts and benefits to these sites are discussed in Table 12.6 in Appendix B, Annex B.

Table 2.6 Condition of SSSIs within the 1% a.p flood extent (November 2006)

100% favourable			
Cabilla Manor Wood	Coombe Mill	Crow's Nest	De Lank Quarries
Draynes Wood	Duckpool to Furzey Cove	Harbour Cove	Pentire Peninsula
Rock Dunes	St Nectan's Glen	Trebetherick Point	Trevone Bay
Predominantly favourable			
Boconnoc Park and Woods	Boscastle to Widemouth	Bude Coast	Marsland to Clovelly Coast
Polruan to Polperro	Tintagel Cliffs		
Predominantly unfavourable			
Amble Marshes	Bodmin Moor North	River Camel Valley and Tributaries	Steeple Point to Marsland Mouth
100% unfavourable			
Retire Common	Rosenannon Bog and Downs	Upper Fowey Valley	

2.8.2 BAP habitats and species

The range of habitats and species within the catchment is extensive. The Biodiversity Action Plans (BAPs) produced by a number of authorities examine the habitats and species that require specific protection and enhancement. The following BAPs cover the catchment:

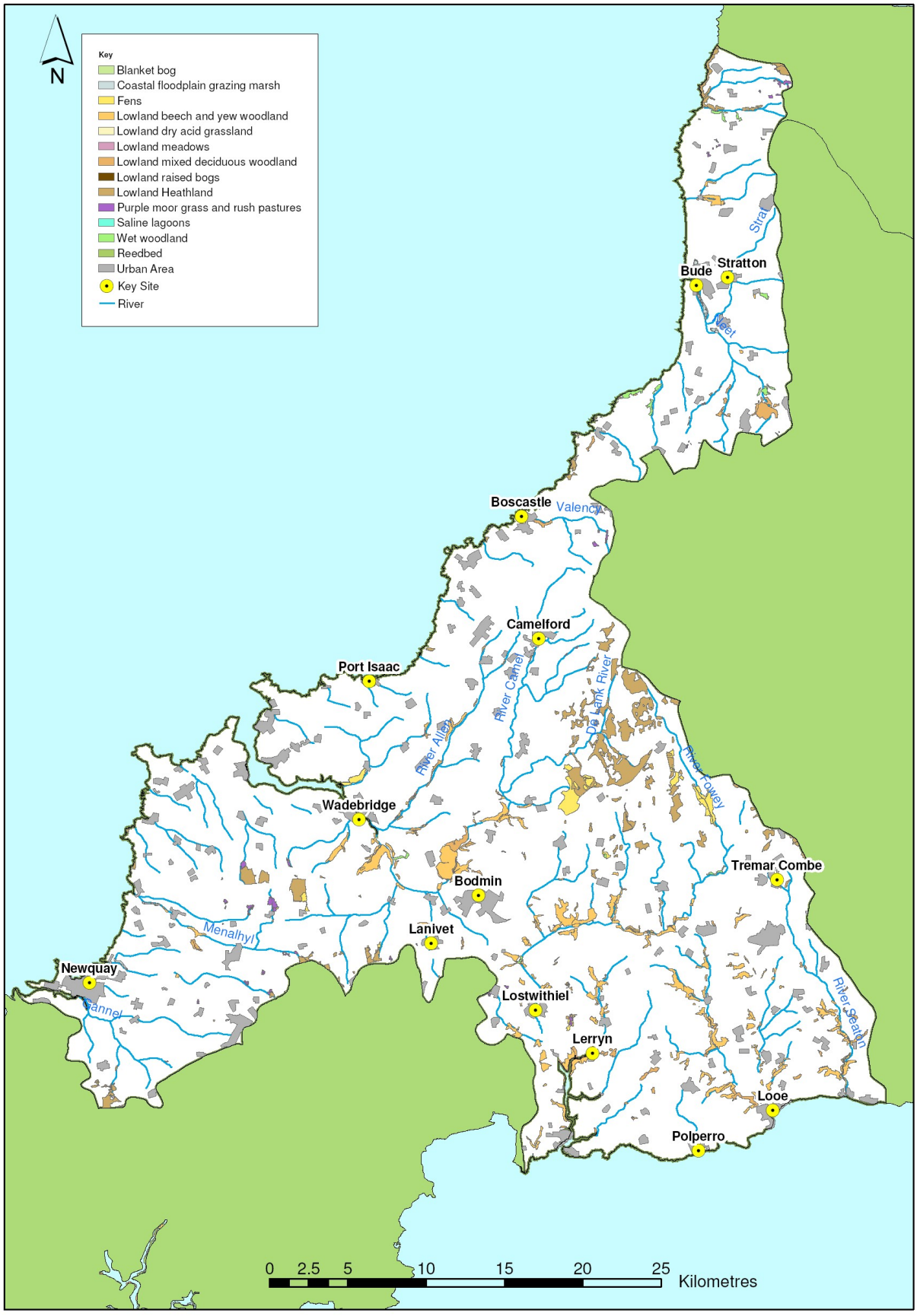
- UK BAP
- Environment Agency BAP (and "Focus on Biodiversity", 2001)
- Cornwall BAP
- Highways Agency BAP

The following BAP habitats are associated with water and are therefore relevant to the CFMP in terms of their presence or association with the floodplain, flood risk areas and watercourses. These can be seen on Figure 2.16:

- Fens (UK BAP & Cornwall)
- Purple moor-grass and rush pasture (UK BAP & Cornwall)
- Ponds and pools (Cornwall)
- Reedbeds (UK BAP & Cornwall)
- Wet woodlands (UK BAP & Cornwall)
- Rivers, streams and floodplains (Cornwall)
- Estuaries including mudflats, saltmarsh, sheltered muddy gravels and seagrass

Habitats and species can be affected by flooding and also as a result of flood risk management. Habitats can be changed due to an increase in flooding, deeper flood waters or even standing water. They can also be affected indirectly, through the deterioration in water quality for example. Flooding may be beneficial to some habitats and could even lead to the development of new ones.

Figure 2.16 BAP habitats



2.8.3 The landscape

The catchment supports four main landscape character areas, as identified by the Countryside Agency, now part of Natural England. Figure 2.17 shows these areas and the other landscape designations. The features of the character areas relevant to East Cornwall are detailed below:

Culm:

- Rolling, and locally steeply-undulating, open pasture separated by many small valleys
- Heavy, poorly-drained soil supporting rushy pastures of low agricultural quality but high nature conservation interest
- Wide views across a remote landscape
- Little tree cover except occasional wind-shaped hedgerow and farmstead trees, conifer blocks and valley woodlands
- Patches of heathland commons
- Scattered hamlets and farms in cob and whitewashed stone, connected by winding sunken lanes
- Occasional hilltop villages
- Contrasting enclosed wooded valleys cutting through the ridges

Cornish Killas:

- Undulating slate plateau with little woodland and few hedgerow trees
- Numerous broad-leaved wooded valleys, varying greatly in size. Northern valleys generally narrow and densely wooded. In the south there are drowned valleys (rias) with wide estuaries
- Rugged coastal scenery. Exposed and windswept cliffs in the north with limited access to the sea, more sheltered and wooded in the south
- Outstanding historic parks, mainly in the sheltered valleys in the south
- Generally a dispersed settlement pattern of hamlets, farmsteads and small fishing villages
- Variable field pattern dominated by stone-built Cornish hedges
- Important archaeological and industrial-archaeological sites

Bodmin Moor:

- Exposed, windswept, granite uplands rising to tors and clitter slope
- Extensive treeless heathland and wet moorland
- Sheltered wooded valleys with fast-flowing streams
- A high concentration of prehistoric monuments of international interest
- Dispersed settlement pattern of hamlets and farmsteads with villages mainly of recent industrial origin on moorland fringes and valleys

Hensbarrow:

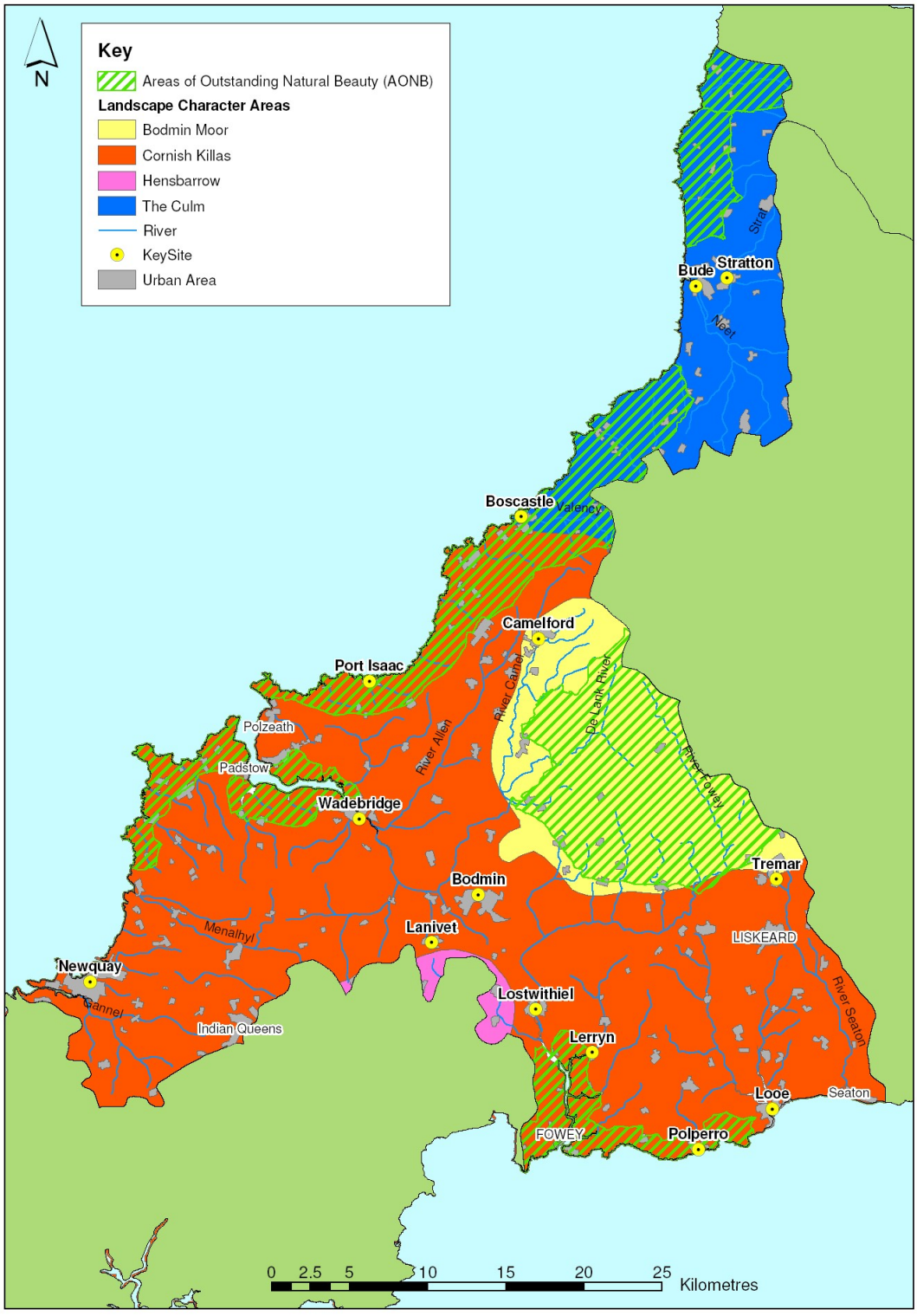
- Remnants of what must once have been more extensive and exposed, windswept, heather moorland
- On the lower and more sheltered areas, there is a pattern of irregular small pastoral fields enclosed by Cornish hedges, scattered farmsteads and hamlets
- Sheltered, wooded valleys with willow scrub and fast-flowing streams
- Dispersed settlement pattern of hamlets and farmsteads with villages of mainly recent, industrial origin. Pylons feature strongly in the landscape
- China clay works originally with white conical spoil heaps - now reshaped mainly to flat-topped, heath covered spoil heaps

The Cornwall Area of Outstanding Natural Beauty (AONB) is located within the catchment. AONBs are landscapes that are considered to be of national importance. The key features of

the Cornwall AONB are the headlands, extensive rolling dunes, the folded cliffs of the north coast, and the softer landscape of multi-coloured cliffs, tiny coves and picturesque fishing villages of the south coast. The AONB also contains the broad expanse of the Camel Estuary and Bodmin Moor, which is the only extensive upland area in Cornwall.

Heritage Coasts are a non-statutory landscape definition. They are special coastlines that are managed so that their natural beauty is conserved and, where appropriate, the accessibility for visitors is improved. On the north coast, the Trevose Head Heritage Coast and the Pentire Head - Widemouth Heritage Coast are located in the study area. These support rugged cliffs and headlands interspersed with lower-lying areas and sandy beaches. On the south coast, the Gribbin Head – Polperro Heritage Coast supports wooded valleys.

Figure 2.17 Landscape



In general, flooding has a temporary effect on the landscape. Flood risk management strategies however could affect the landscape over a longer period, for example where the nature of a watercourse is changed or where wetlands or flood storage areas are created.

2.8.4 Fisheries

Within the catchment area, the Rivers Camel and Fowey contain excellent migratory salmonid populations. The River Camel has been designated as a Special Area of Conservation (SAC), with one of its interest features being Atlantic Salmon. The River Camel has one of the best rod catches for any of the salmon rivers in the South West, closely followed by the River Fowey. These two rivers also support large sea trout fisheries. Other rivers with small Atlantic salmon populations include the Valency and Porth River on the north Coast, and the East and West Looe on the south coast. In addition, the Camel and the Fowey estuaries support licenced salmonid netsmen.

A number of other rivers also support smaller populations of salmon and many more contain sea trout/ migratory trout populations. Virtually all of the rivers and streams in this area support brown trout, bullhead, eels, etc.

Bullheads (listed on *Annex II* of the EU Habitats Directive) have one distinct population within the catchment on the Gannel. There are no records of the larval stages of lampreys (also listed on the *Annex II* list) within the catchment.

As with other species, fish may be adversely affected by flooding and flood strategies. Flooding, especially at sensitive times of the year, can disrupt spawning and migration patterns, and the indirect effects of flooding such as the deterioration of water quality, can also have an impact. Flood risk management strategies can disrupt fish communities, particularly where hydrological changes occur and especially as a result of habitat loss or creation of obstructions within watercourses.

The reaches presented in Table 2.7 are designated as suitable for salmonids under the Freshwater Fisheries Directive (78/659/EEC).

Table 2.7 Designated salmonid rivers/reaches

Water	Stretch
Allen	Knightsmill Bridge to normal tidal limit
Camel	Slaughterbridge to Gam Bridge
Camel	Gam Bridge to normal tidal limit
Coombe Valley Stream	Coombe to normal tidal limit
Crowdy Stream	Crowdy Reservoir
De Lank River	Scribble Downs to confluence with River Camel
Fowey	Lamelgate to Draynes Bridge
Fowey	Draynes Bridge to normal tidal limit
Menalhyl	St. Columb Major bridge to normal tidal limit
Porth Stream	Porth Reservoir outflow to normal tidal limit
Seaton	Hendra Bridge to normal tidal limit
Siblyback	Siblyback Reservoir
St. Lawrence Stream	Bodmin to confluence with River Camel
St. Neot River	Colliford Lake
St. Neot River	Colliford Lake outflow to confluence with River Fowey
Valency	Lesnewth to normal tidal limit
Warleggan	Source to confluence with River Fowey
West Looe River	Churchbridge to normal tidal limit

Fisheries in themselves are unlikely to enhance flood risk. However, it is relevant to consider fisheries carefully when we are assessing how our adopted policies may affect flows and flow velocities in watercourses that support fisheries.

2.8.5 Tourism and recreation

The East Cornwall catchment supports a range of recreational activities. Although water-related sports are concentrated within the main estuary areas and along the coast, a number of activities are associated with the watercourses themselves. Activities include walking (footpaths adjacent to and crossing the watercourses), cycling, horse riding, fishing, canoeing, surfing and in specific locations, sailing. The range of recreational watersports increases significantly in the lower estuary and along the coast, with activities including sailing, rowing, jet-skiing, water-skiing, windsurfing, diving and swimming.

Sailing and canoeing clubs are mostly located in the Newquay, Padstow and Looe areas. Many coastal communities also support an active gig club. Some of the more accessible main rivers are popular with canoeists. The River Fowey has a British Canoe Union (BCU) access agreement in the freshwater part of the system through which access must be obtained and is only allowed during the winter, outside of the fishing season.

A number of key footpaths traverse parts of the catchment, notably the South West Coastal Path as well as a large number of other footpaths and bridleways. Due to the popularity of the area for tourism as well as significant local interest, paths across all areas of the catchment are commonly used, which is known to cause land erosion problems.

Navigation issues are not likely to present a major constraint in relation to flood risk management, although strategies should consider any potential adverse effects for recreational uses, particularly around the estuary areas.

Camping is a popular activity throughout East Cornwall, with sites often close to rivers and the coastline. Where sites are at risk of flooding we work closely with the owners to provide flood warnings were possible and advice on emergency response to flooding.

2.8.6 Surface water quality

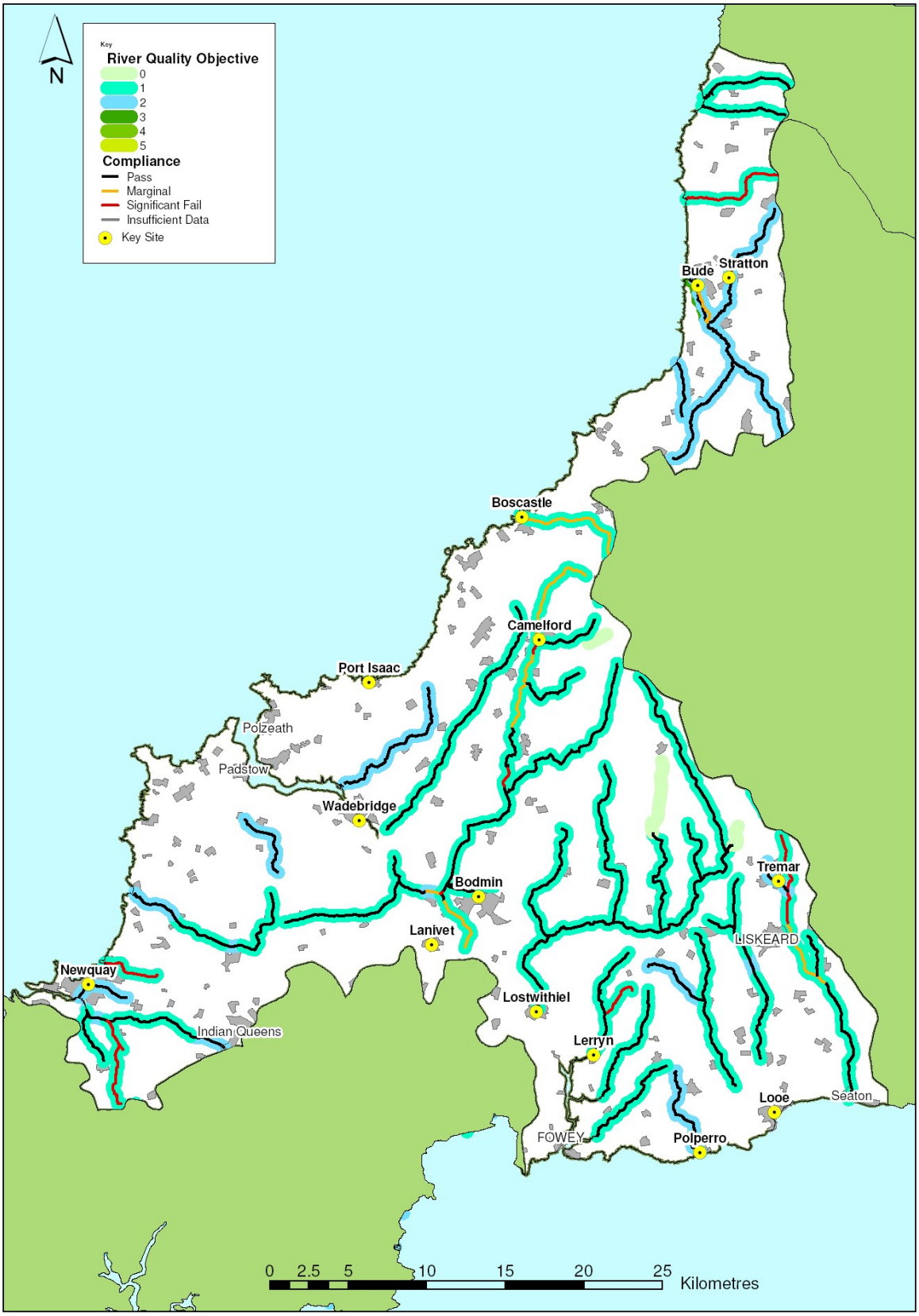
The Water Quality Objectives (WQO) scheme is the key scheme for reporting the surface water quality in rivers. The WQO scheme considers the different ways in which a stretch of river is used, including that of the River Ecosystem (RE). The RE categories look at the chemical quality requirements of different types of aquatic ecosystem. Each stretch of river is assigned a target RE class called a River Quality Objective (RQO). This classification system ranges from 1 to 5, where 1 represents water of very good quality suitable for all species of fish, to 5, which represents water of poor quality, which is likely to limit numbers of coarse fish. RQOs are used to set discharge consents and when carrying out other water quality planning activities. Generally, the water quality target is higher for rural watercourses and lower for those in urban areas. The River Quality Objectives for the East Cornwall catchment are shown on Figure 2.18 and the results presented in Table 2.8.

Table 2.8 River Quality Objectives (2000)

Objective	Length (km)		
	Pass	Marginal	Significant Fail
1	233.2	28.7	29.7
2	75.2	4.3	-
3	3.0	-	-
Total length	**311.4**	**33.0**	**29.7**

Flooding can have effects on surface water quality. It can lead to an increase in suspended sediments, which can alter water quality. Surface flooding can also result in the transfer of pollutants into watercourses, for example sewage effluent, oil and other liquid matter from highways, etc.

Figure 2.18 River Quality Objectives



2.8.7 Groundwater quality

Groundwater quality in this catchment is generally good. Surface water flooding can affect the quality of groundwater by moving pollutants. Flood risk management strategies could also affect groundwater quality and flow paths.

2.8.8 Water resources

Under the Water Framework Directive, Member States have to work towards and achieve at least "good ecological status" in all bodies of surface water. The Directive is mainly concerned with the ecological status (water chemistry, water resources and hydromorphology) of aquatic ecosystems. Its main aims are to improve water quality, whilst reducing any danger a water body poses, for example from flooding. It is also designed to stop wetlands deteriorating and improve aquatic habitats for wildlife. Under the Water Framework Directive every member state should make the same plans to protect and improve rivers, lakes and coastal waters when trying to prevent floods or manage droughts.

The water table is generally less than ten metres below ground in areas of granite bedrock. Most groundwater flow in these areas occurs along open fractures and is shallow and local. It forms the base flow component to rivers, as well as feeding a large number of springs.

In areas of killas bedrock, the water table is generally less than 15 metres below ground. These are permeable and consequently can infiltrate more rainfall. Although the main permeability is low, the well-developed fracture system enables groundwater transport. Water quality is generally good apart from highly mineralised areas, where trace metal concentrations can be high.

The main water supply reservoirs in the catchment are at Colliford Lake, Siblyback Lake and Crowdy Reservoir, as shown in Figure 2.14.

South West Water is responsible for the water supply network and the main sewerage assets across the region. Within the East Cornwall CFMP catchment, they manage 58 Wastewater Treatment Works and 95 Sewage Pumping Stations.

The main surface and ground water abstractions are for agricultural use, and a large number for industry and water supply. Additionally there are a few for environmental purposes and energy production. Other abstractions for clay washing, farms, industrial works, etc., are distributed across the catchment. Due to the low volume of these abstractions, they do not generally present a problem to catchment flows.

The Environment Agency has undertaken Catchment Abstraction Management Strategies (CAMS). These examine the availability of water within catchments and identify policies to manage water abstraction. The ones that cover the East Cornwall catchment area are North Cornwall, and the Seaton, Looe and Fowey CAMS. These show that the River Menalhyl, Porth Stream and De Lank river are over-licensed or over-abstracted, so are not achieving their environmental requirements. On the Upper Fowey, Lower Fowey and St Neot rivers there is a balance between the environment and abstractions. Elsewhere within these catchments water is available for abstraction and this is not likely to adversely affect the environment.

The quantities of water abstracted are very small compared to flood volumes. Therefore the CAMS are unlikely to present any issues, either opportunities or constraints, in relation to flood management. However, operation of the reservoirs may be able to provide some opportunities to minimise downstream flood effects.

2.8.9 The historic environment

This section highlights key historic environment features in the East Cornwall CFMP area. For this CFMP, we have considered the following:

- World Heritage Sites

- Scheduled Monuments (SM)
- listed buildings
- registered parks and gardens, and historic battlefields
- conservation areas
- non-designated sites

Most historic environment sites will be vulnerable to damage from flooding, including occasional flooding. If flooding occurs more often in the future and is more severe it may lead to the loss or damage of these assets. Historic environment features, and their settings may also be vulnerable to damage resulting from flood risk management schemes, in particular those requiring construction of defences.

There are 469 SMs in the East Cornwall CFMP area. These are legally protected under the Ancient Monuments and Archaeological Areas Act 1979. Any works affecting a scheduled monument or its setting requires the consent of the Secretary of State for the Department of Culture, Media and Sport.

Also, there are seven registered historic parks and gardens in the East Cornwall CFMP area. These landscapes are sensitive to flooding, and may deteriorate as a result of flooding.

Not all nationally important historic environment assets are designated. Other features may be known and recorded on the Local Authority Historic Environment Record (HER). Additionally, there may be unknown features of significant interest, particularly buried archaeological and palaeoenvironmental remains. These are particularly likely to occur in deeply alleviated floodplains and are also known to occur on Bodmin Moor. As the CFMP is a high level strategy document, data from the HER have not been considered as they are too detailed for this study. However, these data must be considered, and the views of local authority archaeological officers sought during the development of flood risk management actions.

2.9 Communities and the local economy

2.9.1 Settlements and population

Section 2.6 identifies the key urban centres within the catchment. In addition there are a wide range of rural settlements spread throughout the catchment, the locations of which are shown on Figure 2.10. The great number of small towns and villages throughout East Cornwall reflects an economy that was built around largely self sufficient farming, fishing and mining communities.

The catchment today has an estimated total population of around 146,000. The main population centres are indicated in Table 2.4. Throughout Cornwall, around one third of people live in towns of over 10,000 inhabitants, and a quarter live in small towns and villages. The remaining population reside in villages with less than 2000 inhabitants. There is a low population density, with some areas within the catchment at a density of less than 68 people per square kilometre.

From the 1950's onwards the previous period of population decline within Cornwall was reversed. Between 1971 and 1991 the population increased by 24 per cent and was one of the fastest growing counties in the country. This growth rate has now slowed to be around the national average. Population growth in Cornwall is through migration, as the area is considered a desirable location to live, particularly for families and older people.

Cornwall is generally poorer than other regions of the country. The main economic sectors are the manufacturing industry, the service industry and tourism. Traditional activities such as agriculture, mining and fishing have been in decline for over a hundred years, although still contribute to the economy today. Employment opportunities are limited, especially where traditional industries are in decline.

Average earnings in Cornwall are very low and below the national average. Unemployment is relatively high. One area that provides many employment opportunities is the tourist industry. Many of these jobs however are seasonal and low paid.

The East Cornwall area has a large number of second homes, particularly in coastal areas. This means that in the winter months a significant proportion of dwellings within communities can be empty, particularly in tourist hotspots. There is great pressure on the local housing market, with both second home-owners and people retiring to the area, creating affordability and supply issues.

These factors reflect the fact that Cornwall continues to qualify for European Objective 1 status (Convergence funding 2007 – 2013). Such funding is provided to support the local economy and benefit the community. The Regional Spatial Strategy (draft) recognises the challenges to meet and promotes regeneration and development in Cornwall focused on the key towns, affordable homes, and need to accommodate further changes in agriculture.

2.9.2 Community assets and critical infrastructure

Community assets are spread throughout the catchment. Key assets such as hospitals, schools and residential homes are mainly found in the urban areas of Newquay, Bodmin, Fowey, Liskeard and Bude.

The dispersed nature of settlements means that transport links are vital to everyday life. Overall, car ownership in the county is below the national average, which suggests some people cannot afford to run a car, or spend a high proportion of income on the costs of doing so. There are public bus services throughout the county and community and voluntary transport schemes to help support travel.

Critical infrastructure such as the A30 trunk route, the A38, the mainline railway line and Newquay Airport are vital transport links for the area, reducing isolation from the rest of the country. The A30 and A38 have been upgraded over the last twenty years, with improvements on the A38 at Dobwalls nearing completion.

The rail network operates around a mainline that runs through the county from Plymouth to Penzance. This mainline provides the rail link to the rest of the country, to the East and North. Branch lines within the catchment serve communities such as Newquay and Looe.

Newquay airport has a number of UK and foreign destinations, the most important for linking Cornwall to the rest of the country being the route into London Gatwick.

Emergency response infrastructure such as police, fire and ambulance stations, is located across the catchment, as are waste water treatment works and sewage pumping stations. In addition, four electricity substations are located within the area.

Due to the tourist industry, particularly in the summer months, the numbers of people within the county can swell significantly. This is not only within the main population centres but also throughout the county, especially in coastal areas. This can put pressure on water supplies and waste water treatment, the natural environment, and transport infrastructure.

These elements can combine to create a pressured infrastructure and environment, with a dynamic population that can be more vulnerable to flooding because of a lack of knowledge about flood risk specific to their location, and generally less means with which to recover following flooding.

3 Current Flood Risks and Management

This chapter provides information about the current risk of flooding to people, property and the environment. It also provides a history of flooding in East Cornwall and how we manage those risks now.

Historic data shows that there is a major risk of flooding in the catchment from rivers and the tide. There are also issues with surface water runoff. Significant risks to people, property and infrastructure exist mainly in Wadebridge, Looe, Bodmin and other towns. Annual economic damages in the catchment are estimated at £21.5 million; £17 million related to river and tidal flooding. A further £4.5 million is due to other flooding issues such as highway, urban drainage and sewerage. There are also several community and environmental assets at risk.

3.1 History of flooding

There is a long history of flooding within the East Cornwall catchment, from both rivers and the tide. There have been a number of large and small-scale flooding events in the catchment, with records of flooding held by us dating back as far as 1900. In this period settlements had been established and developed around river and estuary locations, essential for trade and industry. People were connected with the land and flooding was considered as part of life in many communities.

Urban development in the 20th century meant that the frequency of flooding in some places was increased due to increased runoff from the land. In the latter part of the 20th century flood risk became increasingly unacceptable and flood alleviation schemes were developed in response to flooding where significant disruption and even loss of life occurred. Flooding was considered as something that could be controlled, with emphasis placed on modifying watercourses and building defences to control water.

As we have moved into the 21st century, we have come to understand that flooding is not something that can be controlled indefinitely. Instead flooding is something that must be managed, within environmental, social and economic constraints. The emphasis today is on working with nature to manage flood risk to reduce the probability of flooding through the management of land, river systems and flood defences. We also use a range of methods to influence and inform communities at risk of flooding to reduce the risk to life and damage caused by floods.

We hold a register of flooding incidents called the Flood Reconnaissance Information System (FRIS). This has information about every recorded flood event across the catchment. This flood incident register shows the type of flood events that are occurring across the East Cornwall catchment. Information about these flood incidents was gathered during the inception stage of this study and then reviewed and developed during the scoping stage. This gave us an understanding of the flooding problems within the catchment. Table 3.1 below gives a brief description of some of the main historical flood events within the East Cornwall, which have been recorded in the last 50 years. Some areas have experienced repeated flooding whilst other cases have been isolated. We cannot estimate the scale of most of these events as this information has not always recorded in the past.

Table 3.1 Historic flood events

Date	Details	Cause
June 1958	• Boscastle - One life lost. Homes and businesses flooded	River overtopped after intense rainfall
July 1965	• Polmorla - Church flooded to a depth of 4 ft • Wadebridge – numerous properties flooded	Polmorla stream overtopped
September 1976	• Polperro & Langreek Stream - 1 man drowned83 residential and commercial properties flooded	Heavy rain and blocked culverts
October 1982	• Seaton - Seaton Holiday Village and chalets next to River Seaton flooded to a depth of 4ft	Heavy rainfall River overtopped
June 1993	• Sladesbridge to Egloshayle - Widespread flooding around confluence of the Rivers Camel and Allen. Flooding of 20 properties up to 1.5m	Very heavy rain River & culvert over-topped.
December 1993	• Polperro - 99 residential and commercial properties flooded as well as dozens of vehicles	Very heavy rain Blockages to culverts River over-topped
February 2002	• Fowey - Town Quay and Fore Street flooded • Lerryn and Golant – property and roads flooded • Lostwithiel – Coulsons Park flooded	High spring tide
November 2002	• Bodmin, Boscastle, Rumford, Polmorla, St Columb Minor all affected	Heavy rain resulting in out of bank flows
August 2004	• Boscastle - 60 properties flooded • Crackington Haven - Several properties flooded • Helebridge - 5 properties flooded up to 2m • Flexbury - 4 properties flooded	0.25 per cent a.p. event at Boscastle Excessively high rainfall over a short period of time Over topping of banks
October 2004	• Looe - 49 properties flooded • Fowey - 26 properties flooded • Seaton, Lostwithiel, Polperro, Milendreath and Bude – property and roads flooded	High tides and severe storms. SE gale force winds
March 2006	• Looe – 5 to 15 properties flooded • Fowey - Road and car park flooded • Wadebridge, Sladesbridge and Boscastle all affected by small scale tidal flooding	High spring tide
February 2007	• Looe – Flooding in East and West Looe	High spring tide
June 2007	• Boscastle – Limited amount of flooding	Heavy rain
August 2008	• Lostwithiel – 8 properties flooded	Heavy rain and blockage caused Tanhouse Stream to overtop banks

These events give an indication of the severity of flooding from rivers and tides within the East Cornwall catchment. These however are just a selection of the numerous river and tidal flooding events that have happened in the past. There are also a number of reoccurring highway and surface water flooding problems.

Flood alleviation schemes have been built in response to past flood events at locations including Bude, Lostwithiel, Bodmin, Wadebridge, Polperro, Boscastle and most recently Flexbury.

The role of the Flood Incident Management service is becoming increasingly important in managing flood risk. This service provides flood warnings. Flood Warning plays a major role as it aims to provide an early warning of the onset of flooding. The public are recognising that there will always be a risk of flooding even if there are defences. A timely and reliable flood warning system is key in reducing risk to life and the damages caused by flooding.

3.2 Sources and probability of flooding

The East Cornwall catchment is subject to a range of flooding issues from rivers, tidal, sewerage and surface water.

Our flood incident register (FRIS) reveals the nature of these problems. These have been categorised and are shown in Figure 3.1.

The causes of the flooding incidents are summarised in Table 3.2 and Figure 3.2. It is likely that the numbers show a bias towards watercourse related flooding, as these are the most commonly reported. However, the records do give a good indication of the nature of problems in the catchment.

Table 3.2 Sources of flooding

Cause of flooding	No. incidents
River water exceeding channel capacity	335
Bridge capacity exceeded / blockage	40
Culvert capacity exceeded / blockage	72
Surface water/ Highways runoff	85
Urban drainage / sewerage systems overwhelmed	56
Field runoff	28
Groundwater	3
Tidal	136
Total:	**755**

The large majority of flooding incidents, 59 per cent, are caused by rivers. These are due to either the capacity of the river channel becoming exceeded or constrictions at bridges or culverts. They are distributed fairly evenly across the catchment affecting all of the main watercourses in both upper and lower reaches.

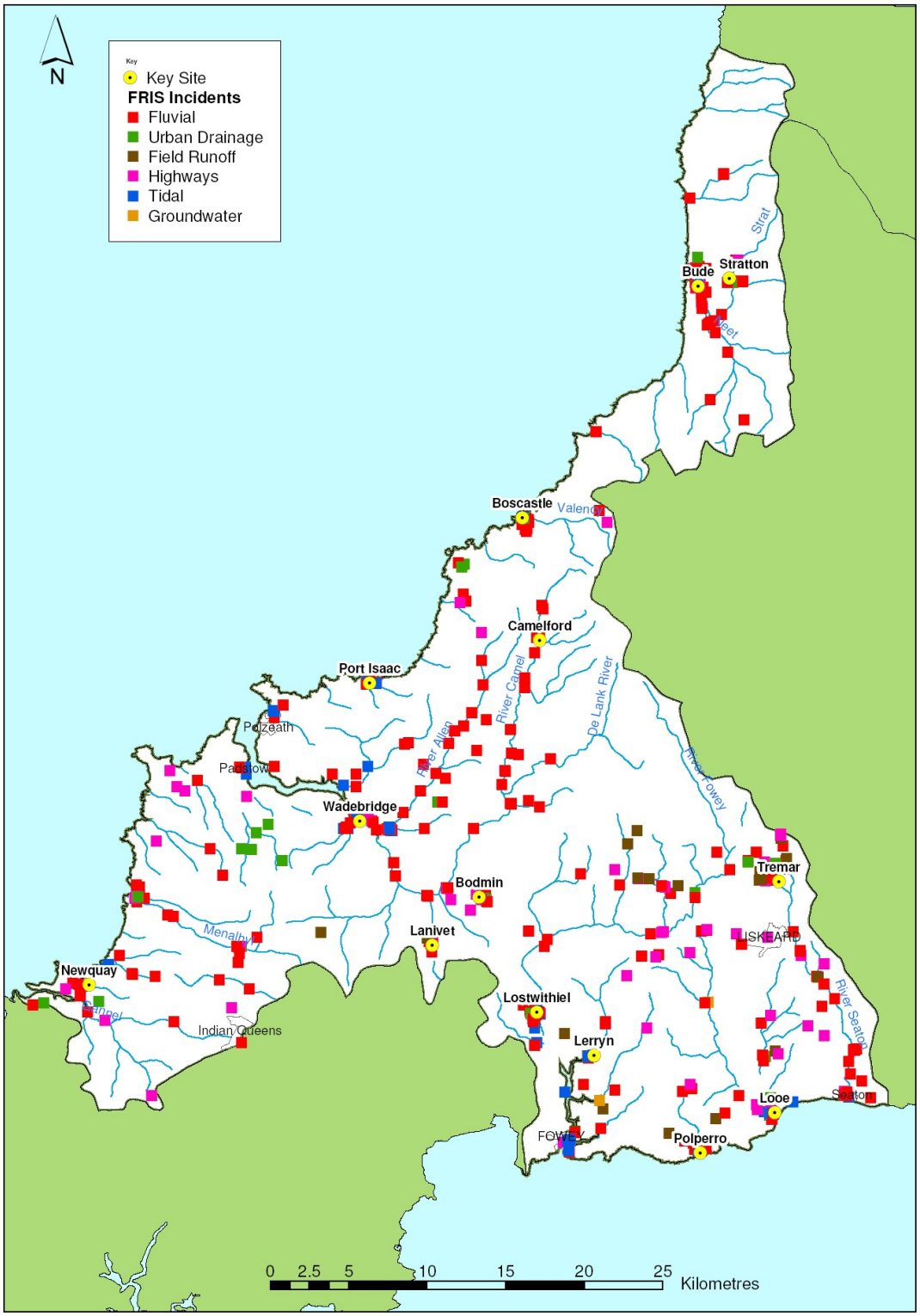
As the catchment contains significant areas of coast, tidal flooding problems are prevalent in a number of locations. Although only 18 per cent of the reported incidents are related to tidal conditions, the resulting flooding can often affect large areas due to the large volumes of water.

Surface water and urban drainage flooding are also significant problems. These are typically more localised, isolated incidents affecting both urban and rural areas. They are particularly

notable in the large urban locations of Bodmin, Newquay and Bude. The sources of these problems are from inadequate sewerage, highway, and urban drainage systems or from field runoff.

Figure 3.2 shows the proportion of recorded flood incidents from sources of flood risk with the East Cornwall catchment.

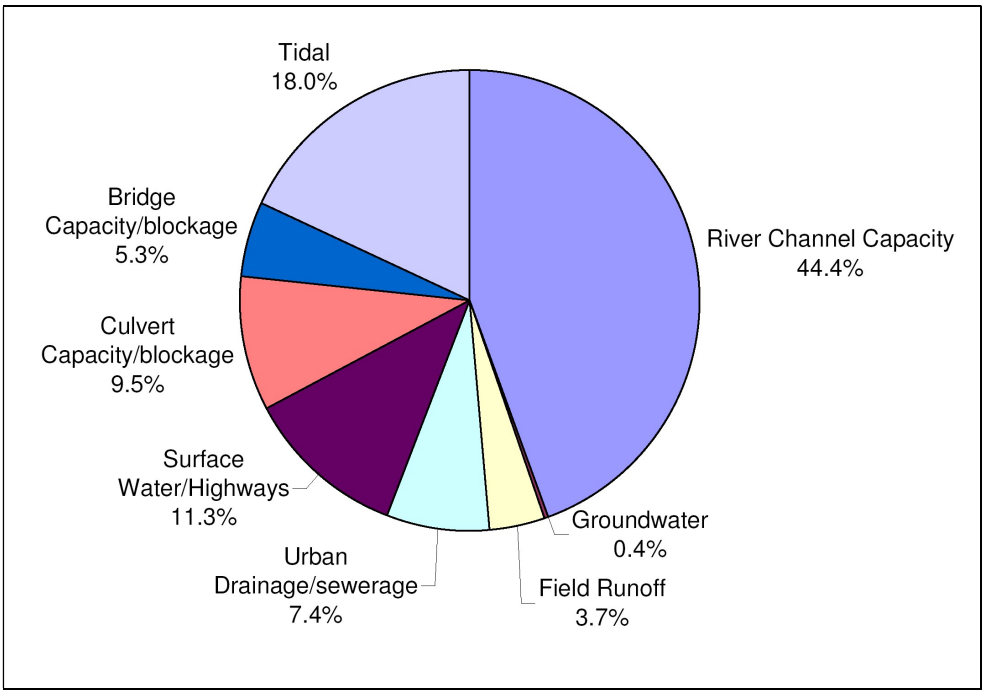
Figure 3.1 Recorded flood incidents and sources of flooding



Locations that have had a number of reoccurring flood incidents have been identified as key sites, and are investigated more closely within the CFMP, particularly in Chapters 3 and 4. The key sites are:

- Bodmin
- Boscastle
- Bude
- Camelford
- Lanivet
- Lerryn
- Looe
- Lostwithiel
- Newquay
- Polperro
- Port Isaac
- Stratton
- Tremar
- Wadebridge

Figure 3.2 Sources of flooding



River and tidal flooding are the major sources of flood risk within East Cornwall. We have considered where flood risk is located and how deep flooding could be at a number of key sites. Flood extent and depth maps for these key sites are shown in Figures 3.3(a) to (d) below.

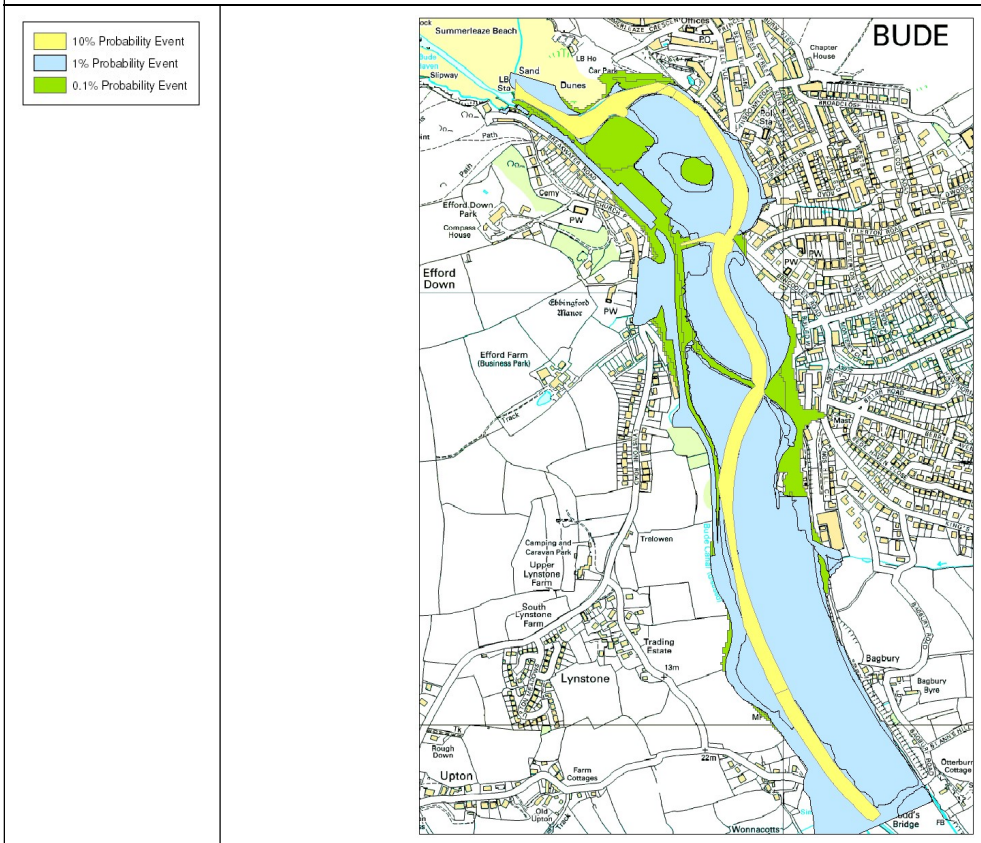
Flood extents and depths are based on our Flood Map, which are available to the public on our website at www.environment-agency.gov.uk/flood. The Flood Map is intended to provide information on flood risk to the postcode level. These maps do not take into account the presence of any flood alleviation schemes and so show the worse-case flood scenario for a 1 per cent and 0.1 per cent a.p. flood event.

For the purposes of the CFMP, we have added a 10 per cent a.p flood extent to the maps to show how our flood defences, if they are present, reduce flooding from frequent events.

On Figure 3.3 there is not depth information for every area covered by the flood extent. At these points the ground rises above the surrounding land, creating a ‘dry-island’. These ‘dry islands’ are still at risk because the area would be surrounded by flood water, and so are included within the Flood Map.

Figure 3.3 Flood extents and depths at selected key sites

Figure 3.3a Bude



1 per cent Probability Event

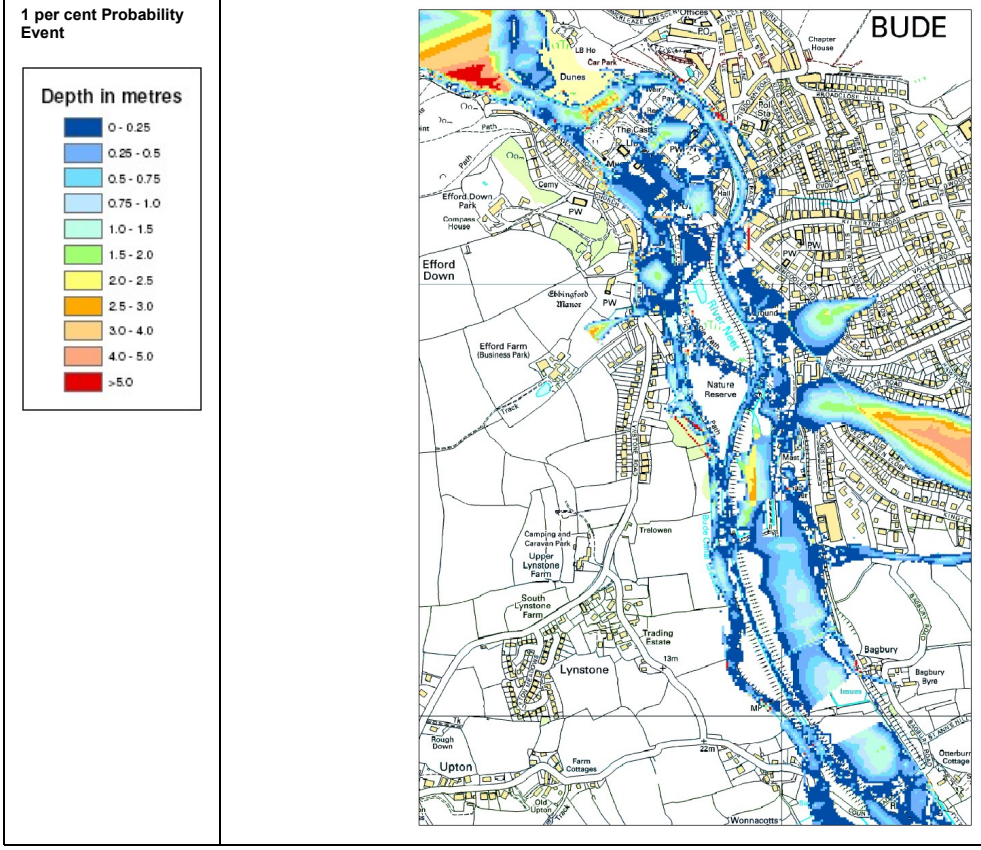
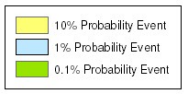
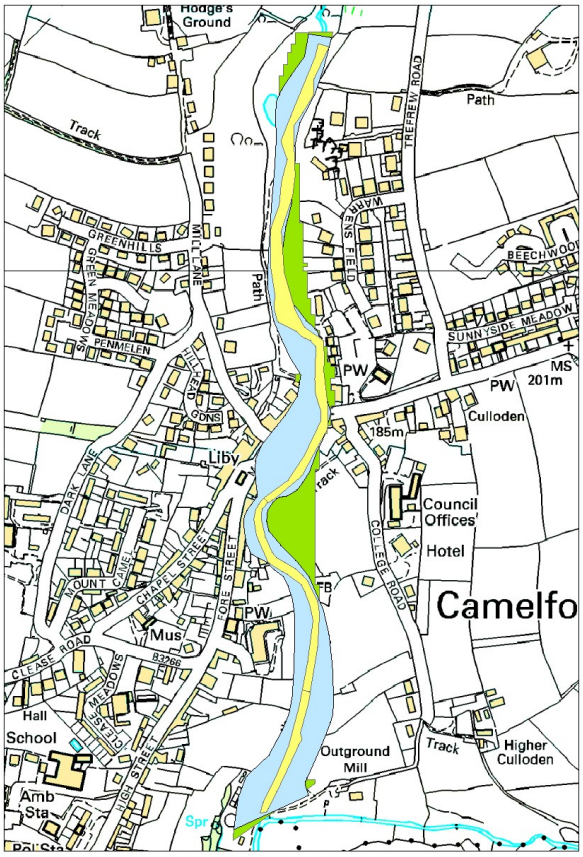
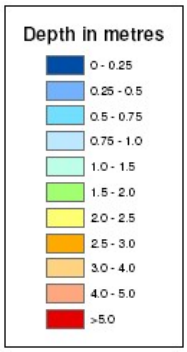


Figure 3.3b Camelford





1 per cent Probability Event



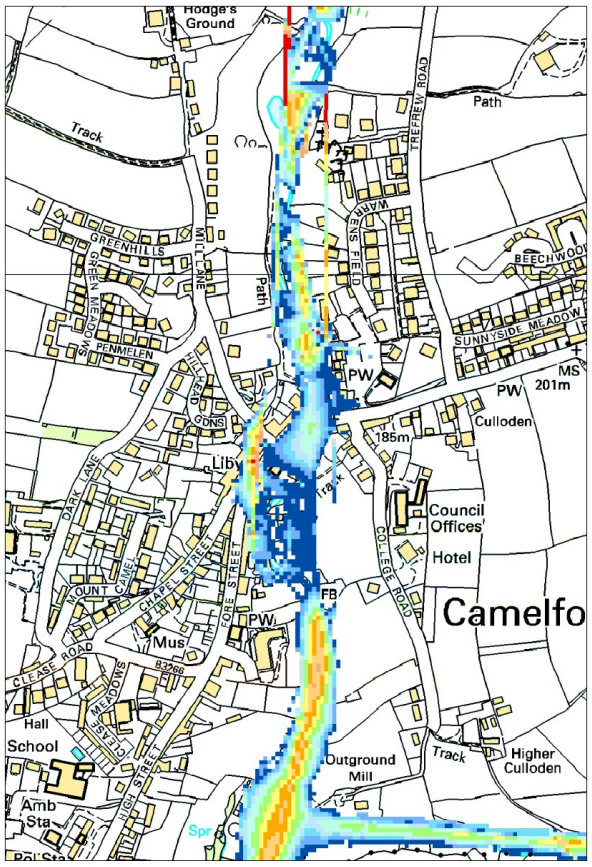
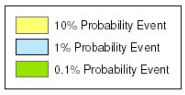
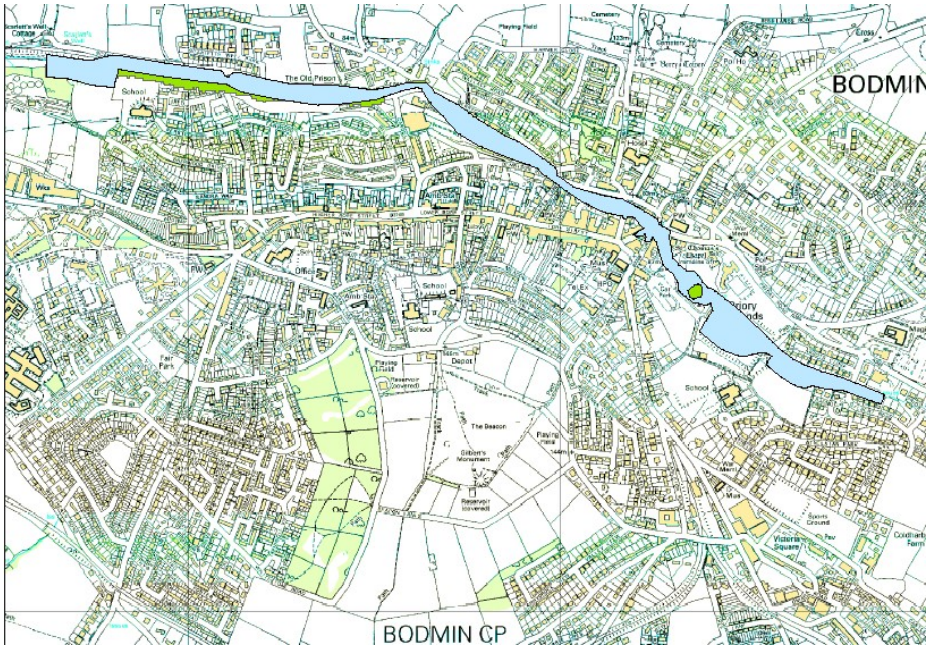


Figure 3.3c **Bodmin**





This watercourse is mainly culverted and so a 10 per cent a.p flood event is designed to be contained within the culvert; hence no outline is shown for this scale of event.

1 per cent Probability Event

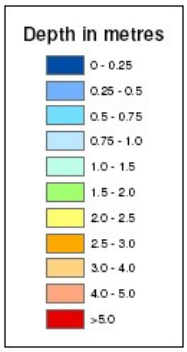
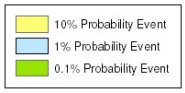
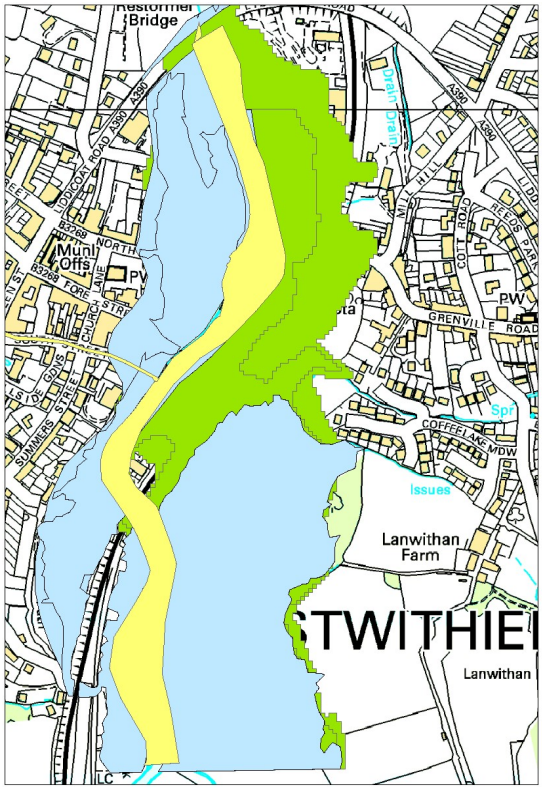
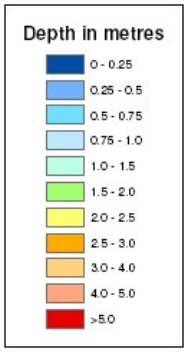


Figure 3.3d Lostwithiel





1 per cent Probability Event



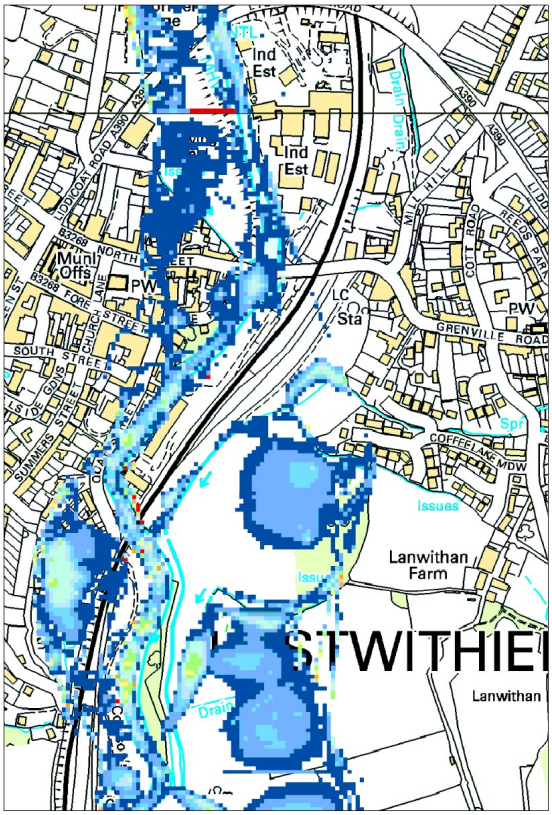
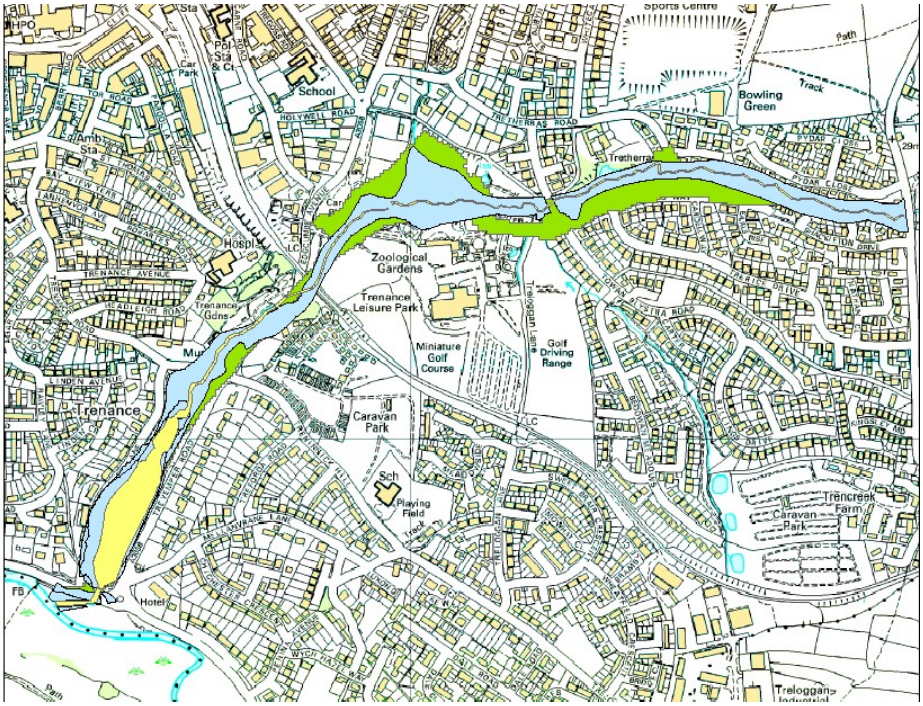


Figure 3.3e Newquay

10% Probability Event
1% Probability Event
0.1% Probability Event



1 per cent Probability Event

Depth in metres
0 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 4.0
4.0 - 5.0
>5.0

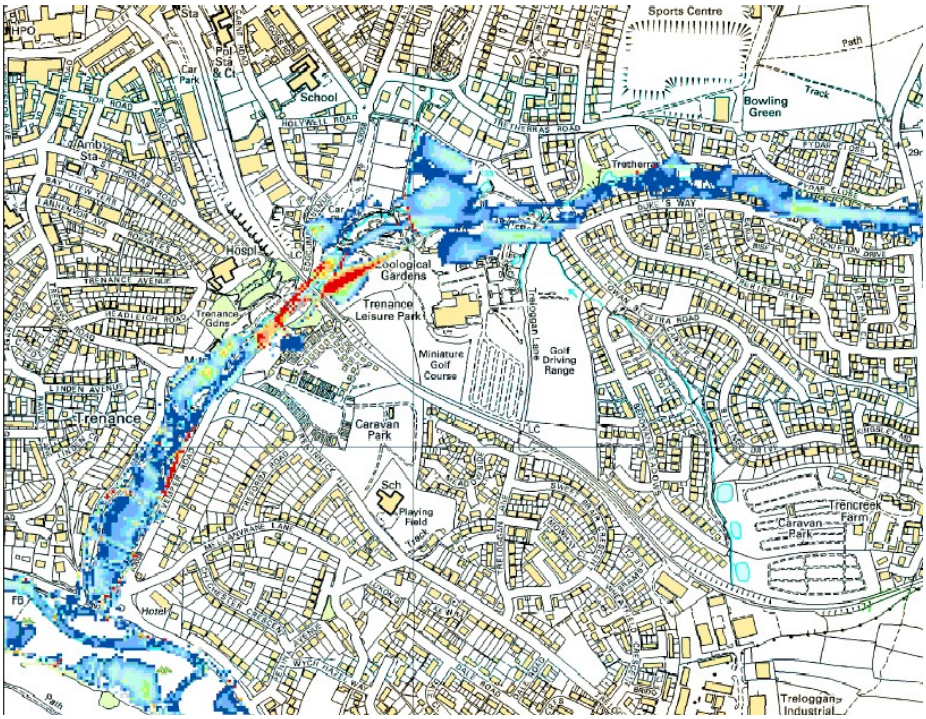
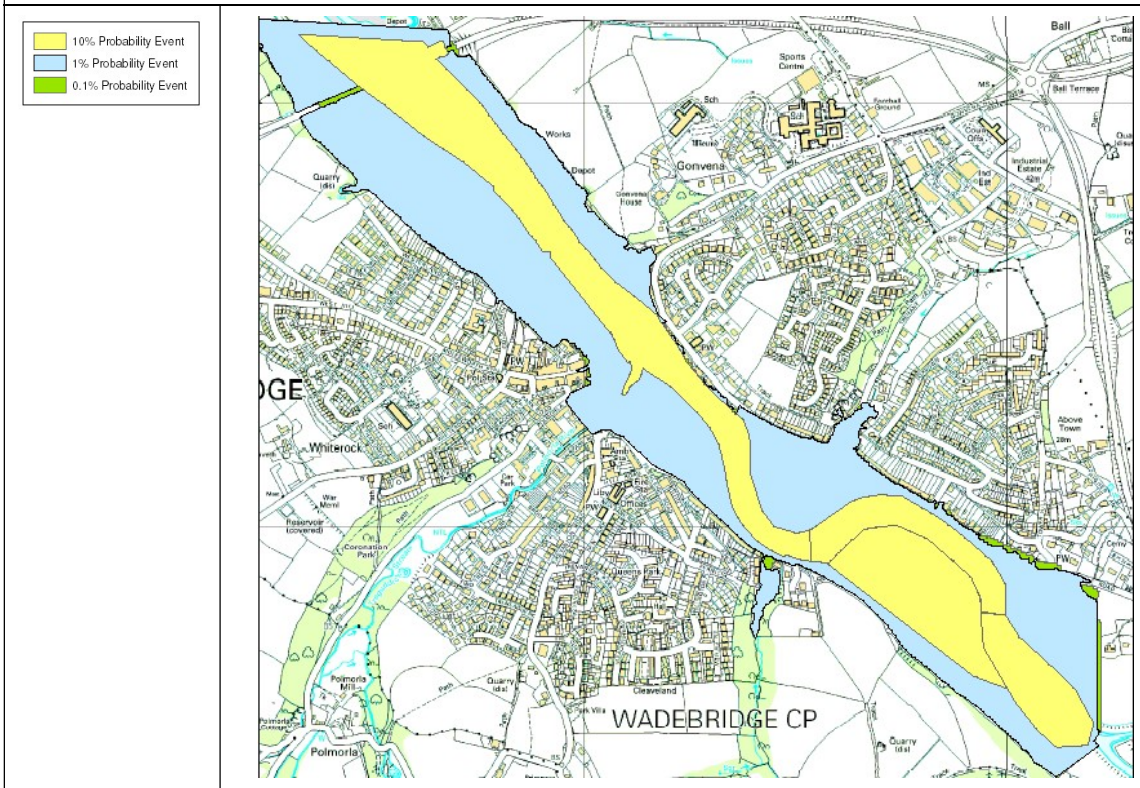
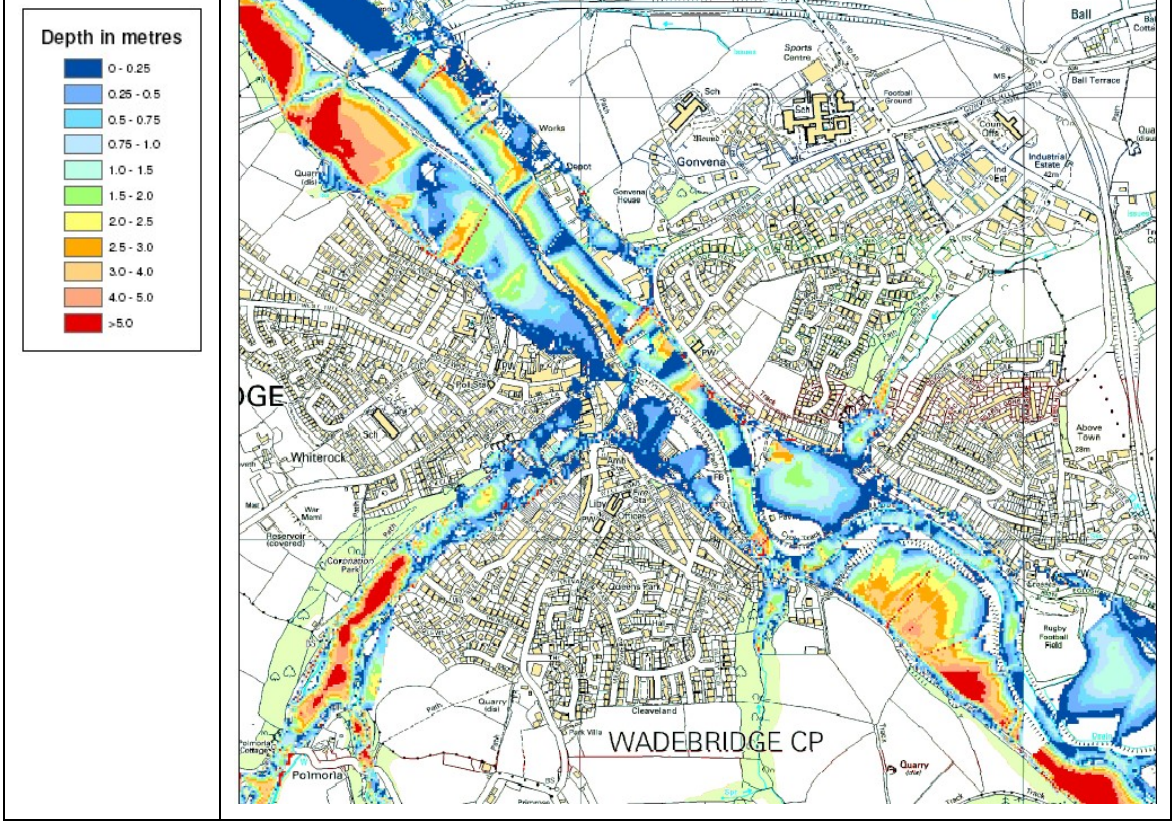


Figure 3.3f Wadebridge



1 per cent Probability Event



3.2.1 River flooding

River flooding is a natural event. Generally, rivers develop a channel that is wide enough and deep enough to carry normal flows. Under storm conditions flows in river channels significantly increase and water spills out of bank and into the floodplain. This allows natural temporary storage of the increased volume of water and is a generally positive effect. If, however, the floodplain has been altered through development or agriculture, the natural floodwaters can have a negative effect and in some cases can become a risk to life.

In many cases, changes have also been made to the natural river channel. For example, bridges and culverts not only restrict high river flows passing, but they can also get blocked, which means that normal flows can then cause flooding. Blockage of bridges by trees and other debris contributed to the flooding at Boscastle in 2004.

Due to the nature of the topography and geology in some areas, the steeper river sections of the catchment react quickly to rainfall. Hensbarrow and Bodmin Moor are particularly vulnerable, as these are steep upland heathland and moorland areas. The hard granite geology in these parts produces impermeable steep catchments where rainfall runs off quickly into watercourses. Combined with the high rainfall levels experienced in these places, significant problems can occur in the upper catchments.

A large number of flood risk problems happen at the mouths of rivers. Storm flows combined with high tides can often result in the flooding of a significant number of properties. High intensity localised coastal storms produce lots of runoff from the impermeable, steep catchments that flow rapidly into the catchment. These flows become constricted, often due to culverts or bridges, and overtop the river banks flooding surrounding property. 'Tide-locking' of the river outlet at times of high tides or surges can then worsen the problem.

Flooding in Boscastle (August 2004)

There are numerous small, steep coastal catchments within East Cornwall, particularly along the north coast, such as Boscastle and Mawgan Porth.

Coastal thunderstorms are typically localised events of short duration, but very high intensity, as with the storm affecting Boscastle in August 2004. Other valley locations are also thought to be susceptible to these flash flood events. We are currently carrying out further work to identify rapid response catchments.

3.2.2 Tidal flooding

The CFMP considers flooding from the tide within a river catchment where the level of the tide (still water level) creates flood risk either in isolation or in combination with river flows. Tidal flooding is a risk for low-lying locations on estuaries and tidal rivers. This is explained in more detail in section 2.1.

There are a number of low-lying locations within East Cornwall that are at risk from tidal flooding, particularly in estuary locations. Overtopping causes most of the tidal problems. Settlements such as Wadebridge, Bude, Looe and Fowey have been affected. Although often not as frequent as river flooding, tidal flooding can involve large volumes of water and affect large areas of the population. Events often happen in combination with stormy conditions and so can combine with high river flows to make conditions worse by affecting the ability of the river to discharge into the sea. This is known to affect places such as Looe, Lostwithiel and Polperro.

Examining the likelihood of tidal and river flows occurring at the same time was not deemed necessary for the CFMP, as it was too detailed for this level of study. However, when undertaking specific investigations into flooding issues at locations where this combined risk can occur, it should be considered within those studies.

Tidal flooding is represented within the Flood Map that we produce. Defra considers that an appropriate standard of protection from tidal flooding is at the 0.5 per cent a.p. event, so where tidal flooding is mapped we represent the flood extent associated with a 0.5 per cent a.p. flood event.

3.2.3 Surface water

Surface water runs directly off the ground. Flooding caused from this source does not come from a watercourse and can be referred to as 'unconnected flooding'. Surface water runoff can cause flooding to both rural and urban areas.

Surface runoff in rural areas

Field runoff from agricultural land has been the source of flooding for around 4 per cent of recorded flood incidents in the catchment. Field runoff is a particular issue for locations on Bodmin Moor, which has impermeable ground and receives high rainfall. Agricultural areas are spread right across East Cornwall so land management is a key issue in controlling field runoff.

Incidents of field runoff causing road and property flooding have been recorded at number of locations across the catchment. These include St Cleer, St Neot and the Looe area. There have also been incidents of water carrying soil across roads and into drainage systems. This not only worsens the risk of surface water flooding from blocked drainage systems, but it also contributes to soil erosion.

Field runoff has become more of an issue in recent years as land is now farmed more intensively. For example, the use of heavy farm machinery on wet soil for winter harvesting or the removal of hedges to make fields bigger has increased the vulnerability of soils to degradation. When soils are degraded their structure is damaged and the topsoil can become easily compacted. Compaction means that rain cannot infiltrate into the soil structure so the soils capacity to accept rainwater is significantly reduced. When it rains the thin layer of soil above the compacted layer becomes saturated very quickly and further rain will then run off the surface. This process can be worsened by cultivating, tilling and tramlining, which encourages the runoff to flow into channels downhill. Hedge removal also means that there are no barriers to slow the flow of runoff. Field runoff has the potential to cause flooding independently of rivers.

The phasing in of the Single Farm Payment System as described in Section 2.6 may decrease the incentive to manage land intensively. This could indirectly reduce farm runoff caused by inappropriate land management. There are also measures identified in the Environmental Stewardship Entry Level and Higher Level Scheme to decrease field runoff, with the aim of reducing soil erosion and improving water quality.

There are many external pressures on farmers that influence land management practices. For example, supermarket specifications, delivery targets and the use of sub-contractors for harvesting, can all constrain how and when farmers can work their land.

Climate change may also affect field runoff. Milder and wetter weather will mean that spring arrives earlier, making crops mature faster. This will increase the pressure on farmers to harvest on wet soils causing increased soil degradation.

Due to the nature of the small river catchments and land use in the East Cornwall catchment, land management and the control of runoff from agriculture are significant issues. It is an important element of flood risk management.

Surface water in urban areas

Surface water runoff contributes to a large number of flooding problems in the catchment, with over 11 per cent of recorded flood incidents attributed to surface water. This can be a particularly risk in urban areas. Urban drainage systems are currently designed to accommodate flows to a 1 in 30 year return period, but older systems are often overwhelmed by rainfall events much more frequently than this. Blockages within the system can make problems worse and drainage grids can become covered by debris and leaves. During large storms, high river flows can prevent drainage systems from working properly, causing them to back up and flood the system.

Surface water flood events tend to be a high frequency, low impact incident. Recorded incidents of property flooding are distributed widely across the catchment, particularly at Bodmin, Wadebridge and Liskeard. Many isolated and localised problems have occurred in villages such as Herodsfoot and Pelynt. This is a source of property flooding but it is difficult to deal with on the catchment scale. It is not as severe, or as much of a risk to life, as river or tidal problems, but it is still significant issue, especially where repeated flooding occurs.

Highway flooding has been recorded in urban areas such as Bodmin, Looe and to the west of Padstow. There is also a spread of incidents in the south-eastern areas of the catchment linked to the Bodmin Moor where runoff is fast. Summer flooding can often be more problematic than larger winter floods for surface water in urban areas. Summer rainfall events are typically shorter but are of higher intensity. Such storms can quickly saturate the ground leading to fast runoff flows that overwhelm local drainage systems. Highway flooding on the A30, and the A38 at Glynn Valley has also occurred and this is particularly serious, causing unsafe driving conditions and disruption to major road links.

Through the CFMP we can try and deal with these issues by proposing opportunities for improvement, such as through Surface Water Management Plans. Although policies can be recommended, it will be up to individual stakeholders to resolve the problems. Working in partnership will help promote solutions especially where several parties will benefit.

3.2.4 Sewer flooding

Urban sewer systems were historically designed to carry flows of both household waste and rainwater. For the last 30 years systems have mainly been constructed to carry these flows separately. But, combined drainage systems, some dating back to Victorian times, are still common.

The vast majority of the sewer network is made up of combined sewer systems. Sewers can become too full or blocked during large rainfall events leading to flooding of properties and roads. Within East Cornwall around 7 per cent of recorded flood incidents have been attributed to urban drainage or sewerage. Limited incidents of sewer flooding have occurred at Perranporth, Marhamchurch and Padstow.

South West Water (SWW) maintains all of the public sewer systems within the catchment. They intend to eliminate all flooding caused by sewer systems where it is economically feasible during the current AMP (Asset Management Plan) period. Because SWW undertakes a rolling programme to address sewer flooding it is not possible to publish a list of locations affected by this source of flooding, as it quickly becomes out of date.

3.2.5 Groundwater

Very few incidents of flooding have been linked to groundwater within the East Cornwall area (less than 0.5 per cent of recorded incidents). They occurred in isolated areas of Camelford, Herodsfoot and near Lanteglos, northeast of Fowey between 1993 and 2000. They do not represent a significant issue in the catchment, particularly when viewed alongside the characteristics of the catchment geology and topography.

Groundwater recharge during winter periods will raise the water table and although unlikely based on historic records, could increase the flood risk from this source.

3.2.6 Reservoirs

There are a number of reservoirs in the CFMP area, shown in Figure 2.14. Flow downstream of reservoirs is controlled and will be regulated to maintain a minimum flow. This means that in periods of heavy rainfall the flow in the river will continue to be regulated to balance the amount of water entering and leaving the reservoir. This can reduce flood risk along rivers downstream of reservoirs, such as the River Fowey.

Reservoirs themselves can pose a flood risk, which is difficult to quantify. Failure in the dam structure or overtopping of the reservoir, while a very remote risk, could cause significant impacts downstream. SWW carries out regular safety inspections and maintenance programmes to minimise this risk. There are no recorded incidents of flooding in East Cornwall due to reservoir failure or release of reservoir water.

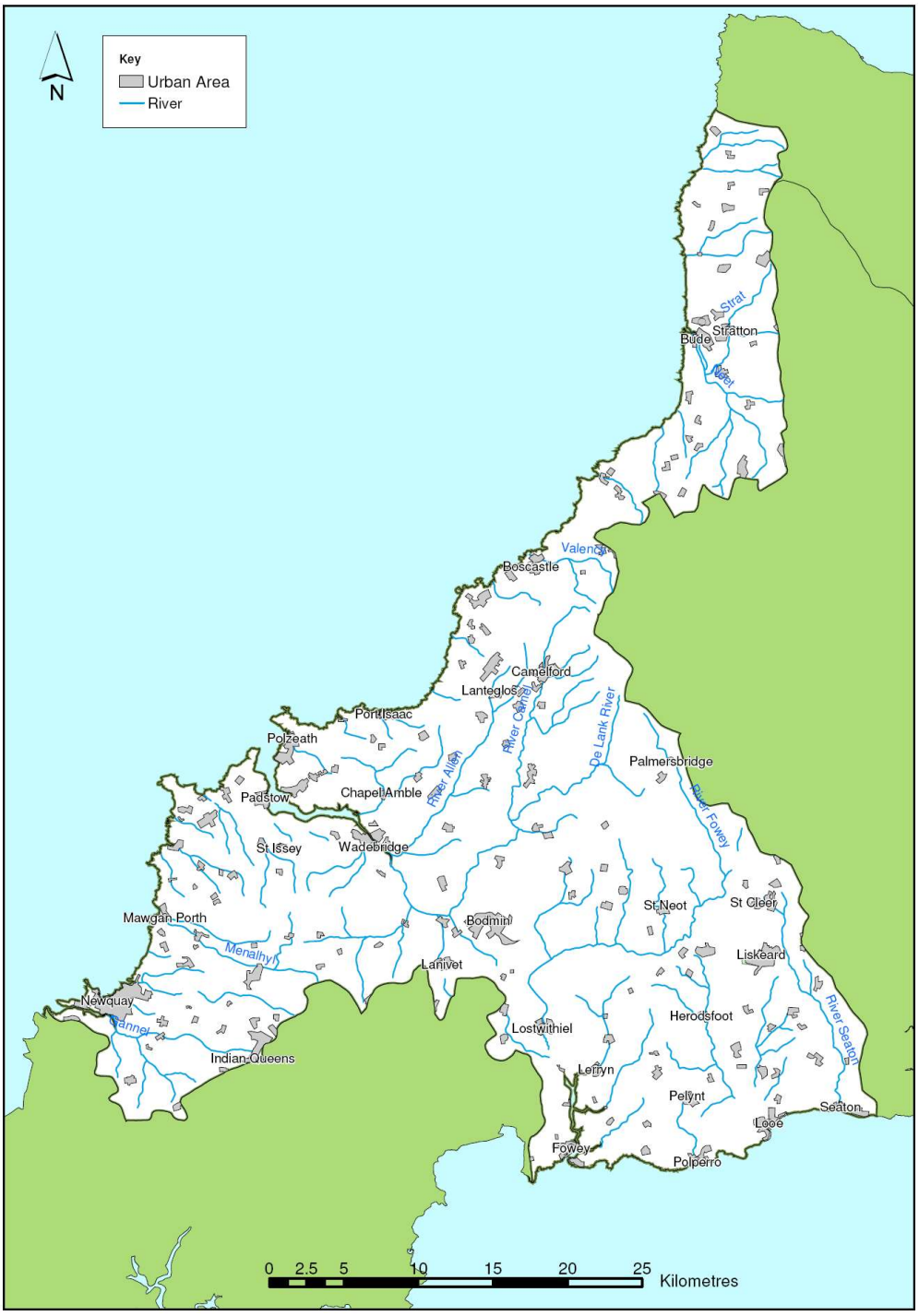
The Environment Agency now enforces the Reservoirs Act 1975, making us responsible as Enforcement Authority of some 2000 reservoirs in England and Wales. As an Enforcement Authority we have the following key roles:

- surveillance - maintaining a register of reservoirs for England and Wales and
- enforcement - achieving compliance
- provisionally from spring 2009 we will ensure flood plans are produced for specified reservoirs. This will include actions to reduce the risk of failure and analysis of the impact of an uncontrolled release of water.

3.2.7 Summary

The East Cornwall Scoping Report identified a number of flooding locations. Flooding is caused by a range of river, surface water and tidal problems. This list has been reviewed and amended based on discussions with the various stakeholders. The flooding problems are spread across the entire catchment, in both urban and rural locations. All flooding incidents are shown in Figure 3.1. Locations and places mentioned above are shown in Figure 3.4.

Figure 3.4 Locations referred to in Section 3.2.1 ~ 3.2.6



They range from isolated river flooding problems such as experienced in Herodsfoot, St Neot and Chapel Amble through to more frequent flooding incidents in places like Flexbury. More complex, tidally-influenced problems occur around Fowey, Looe and Bude.

3.3 Consequences of Flooding

Flood risk and the consequences of flooding have been considered in more detail using the Flood Map at key site locations. We have produced the Flood Map to enable us to assess where flooding from rivers and the sea is likely to happen. The Flood Map does not take into account any flood alleviation schemes.

Flood risk is the combination of probability (the chance of it happening) and impact (the damage that occurs if it does happen). To assess the chance of flooding happening within the catchments, we need to estimate how often it could happen in any given area, how deep the flooding could be and the likely consequences of flooding.

We have considered the effects (positive and negative) on three aspects: flood risk to people, flood risk to property, assets and infrastructure, and flood risk to the environment. Three flood events have been considered in order to assess the impacts from frequent and extreme flooding: 0.1 per cent a.p. flood event, 1 per cent a.p. flood event, and 10 per cent a.p. flood event.

We have taken flood alleviation schemes into account where they exist at the key sites. We have done this under the assumption that the scheme performs in flood conditions as it was designed and to the standard of protection for which it was designed. If we do not know the standard of a scheme then we have not taken the scheme into account. A list of flood alleviation schemes in the catchment is provided in Table 3.17 in Section 3.5.3.

In Section 3.2 we identified Bodmin, Boscastle, Bude, Camelford, Lanivet, Lerryn, Looe, Lostwithiel, Newquay, Polperro, Port Isaac, Stratton, Tremar and Wadebridge as locations with reoccurring flooding problems recorded in FRIS, and these are called key sites. At each key site we have considered flood risk from the main source(s) of flood risk, as identified in Table 3.3. Due to the strategic nature of the CFMP, we were not able to consider all sources of flood risk that may be present at a key site.

Of the key sites, we have identified Polperro, Looe, Wadebridge, Tremar and Bodmin as locations with the highest number of people at risk, deepest flooding or fastest onset. Looe, Boscastle, Bude and Newquay are also very popular tourist destinations.

There are flood alleviation schemes that provide protection from both frequent floods and more extreme floods (up to a 1 per cent a.p. event) at Bodmin, Boscastle, and Polperro. Boscastle is only partly defended (on the Valency only) to the 1 per cent a.p flood event. The risk to these communities is therefore lessened, but cannot be eliminated completely as flood defences may fail or be exceeded. Wadebridge, Bude, Lostwithiel have flood alleviation schemes although the standard of protection provided is unknown. This is discussed in Section 3.5.3. Where we know what standard of protection is offered by the flood alleviation schemes we have taken this into account when assessing flood risk and estimated economic damages at key sites.

As well as the economic impacts of flooding, there are also social effects on the people who live and work within flood risk areas. We have considered social vulnerability levels, as well as the risk to social and community assets, and road and rail infrastructure.

Damages are based on properties at risk from flooding, with these divided into residential and commercial properties to determine damages for each. Total damages are the sum of the commercial and residential damages. We have used the damages incurred by a 1 per cent a.p. flood event to calculate the Annual Average Damages (AAD); the average damages expected in any year. This is explained in Section 3.3.2.

Finally, we have considered the environmental impacts of flooding on designated sites in East Cornwall. While social and economic impacts are generally negative, flooding can be a positive aspect from an environmental perspective, such as for wetland habitats.

3.3.1 Risks to People

We have counted the number of residential properties shown on the flood map and estimated how many people may be at risk of flooding at each key site. We have also considered flood depths, velocities, social vulnerability, social/community assets and the impact of tourism in determining flood risks to people.

The number of people at risk from flooding in each of the key locations for three flood events is shown in Table 3.3.

Table 3.3 People at risk of flooding at key sites in East Cornwall

Key site	Main source of flooding	Number of people at flood risk*		
		0.1 per cent a.p.	1 per cent a.p. (river) 0.5 per cent a.p. (tidal)	10 per cent a.p.
Bodmin	Bodmin Town Leat	214	-	-
Boscastle	Valency	104	101	-
Bude	Neet/Tidal	347	248	-
Camelford	Camel	16	16	-
Lanivet	Lanivet	81	25	-
Lerryn	Unnamed watercourse	25	25	2
Looe	Tidal	232	232	187
Lostwithiel	Fowey/Tidal	239	200	-
Newquay	Trenance	115	63	-
Polperro	Pol	216	-	-
Port Isaac	Port Isaac Leat	34	34	5
Stratton	Strat	115	108	-
Tremar	Unnamed watercourse	117	117	99
Wadebridge	Camel (Tidal)	491	450	-

*The number of people at risk has been estimated based on the number of residential properties at risk of flooding. We have assumed an average of 2.25 people per property.

The key sites with the greatest number of people at risk overall are Tremar, Wadebridge and Looe, with people at Tremar and Looe at risk of both frequent (10 per cent a.p flood event), and extreme events. Four of the key sites are at risk of frequent flooding (10 per cent a.p flood event), with the remaining ten sites protected from this scale of event by flood alleviation schemes.

Bodmin, Polperro and Boscastle (Valency only) are protected up to the 1 per cent a.p flood event. This means that about 400 people in these locations should be protected from river flooding at this scale of event. People at all of the locations are at risk from a 0.1 per cent a.p flood event, with the highest numbers at risk in Wadebridge, Polperro, Bodmin, Tremar, and Lostwithiel.

Locations such as Newquay, Polperro, Bude, and Boscastle are popular tourist destinations and may have more people at risk during the summer than are presented here. Historically, some of the most significant flooding events have occurred in the summer/autumn period, and this puts some camping and caravan sites also at risk. Other locations such as Wadebridge, Lostwithiel, Camelford, Bodmin and Stratton are less affected by tourism and are likely to have a more consistent population year round.

It is important to understand the impact that flooding could have to the population of a community. We have estimated the percentage of each key site's residents affected by flooding at each scale of event.

Onset of flooding is also an important factor in flood management as a rapid onset of flooding increases risk to life. The speed of onset affects how much time people have to react to rising water levels and possible flooding. Speed of onset has been based on the time to peak calculations derived from Flood Estimation Handbook (FEH) catchment characteristics. All the catchments show very short time to peak values, i.e. a rapid onset. These have been grouped into ranges to distinguish which catchments demonstrate a particularly rapid onset. Tidal flooding is considered a moderate onset where it is dominant over river flooding.

The percentage of residents affected and the speed of flooding onset is shown in Table 3.4.

Table 3.4 Percentage of residents affected by flooding and speed of flooding onset

Key site	Estimated number of people in community	Percentage of people affected			Speed of onset[1]
		0.1 per cent a.p.	1 per cent a.p. (river) 0.5 per cent a.p. (tidal)	10 per cent a.p.	
Bodmin	13,160	2	0	0	Fast
Boscastle	1,154	9	7	0	Moderate
Bude	5,370	6	5	0	Slow
Camelford	1,584	1	1	0	Slow
Lanivet	881	9	3	0	Moderate
Lerryn	360	7	7	1	Slow
Looe	4,961	5	5	4	Moderate*
Lostwithiel	1,591	15	13	0	Moderate
Newquay	11,260	1	1	0	Fast
Polperro	604	36	0	0	Moderate
Port Isaac	1,278	3	3	<1	Moderate
Stratton	1,558	7	7	0	Moderate
Tremar	924	13	13	11	Fast
Wadebridge	6,834	7	7	0	Moderate

[1]Onset ranges
Fast = < 1.5 hours time to peak
Moderate = 1.5 - 4 hours time to peak. *Tidal flooding dominant
Slow = > 4 hours time to peak.

The flood alleviation scheme in Bodmin prevents flooding for around 2 per cent of Bodmin residents at the 1 per cent a.p flood event, with the scheme in Polperro avoiding disruption to about a third of the Polperro residents.

Tremar and Looe would experience the greatest percentage of the community affected at a 10 per cent a.p flood event, with all other locations protected by flood alleviation schemes or experiencing a minimal amount of the community affected. Tremar remains the greatest community affected at a 1 per cent a.p flood event, with Lostwithiel showing the same percentage of residents affected, at 13 per cent. At the 0.1 per cent a.p flood event, Polperro could be expected to have over one third of its residents affected by flooding.

It is important to understand the depth of flooding that may be experienced by people within the residential properties. Generally, deeper floodwater could result in greater risks to life and health.

Table 3.5 shows estimated depths of flooding for each key location, with the numbers of people affected by each range of depths. A property is considered to have flooded under each scale of event if water levels around the property exceed 300mm, the average height of a property threshold. This means that there may be people identified in Table 3.4 at risk of flooding but would not experience property flooding.

Table 3.5 Depth of flooding at key sites

Key site	a.p. flood event (per cent)	Numbers of people at risk (Depths in metres)					
		<0.5	0.5 - 1.0	1.0 - 2.0	2.0 - 3.0	>3.0	Total
Bodmin	0.1	92	101	14	2	-	209
	1	-	-	-	-	-	-
Boscastle	0.1	40	16	26	5	13	100
	1	40	16	26	5	12	99
Bude	0.1	152	110	31	12	12	317
	0.5/1	129	116	-	-	-	245
Camelford	0.1	7	7	2	-	-	16
	1	7	7	-	-	-	14
Lanivet	0.1	45	7	14	8	2	76
	1	15	2	5	-	-	22
	10	-	-	-	-	-	-
Lerryn	0.1	3	16	2	-	-	21
	1	7	11	2	-	-	20
	10	2	-	-	-	-	2
Looe	0.1	92	57	29	22	17	217
	0.5/1	106	49	26	21	15	217
	10	126	55	-	-	-	181
Lostwithiel	0.1	167	51	14	2	-	134
	0.5/1	180	12	2	2	-	196
Newquay	0.1	32	58	14	2	-	106
	1	36	21	5	-	-	62
Polperro	0.1	45	28	24	33	83	213
	1	-	-	-	-	-	-
Port Isaac	0.1	19	-	11	2	-	32
	1	17	7	-	-	-	24
Stratton	0.1	47	24	26	12	-	109
	1	52	21	22	-	-	95
Tremar	0.1	26	16	47	21	7	117
	1	24	19	42	22	5	112
	10	44	20	27	7	-	98
Wadebridge	0.1	123	111	139	49	56	481
	0.5/1	101	68	131	51	49	400

This table shows three locations where a high number of people are estimated to flood to a depth greater than 3m: Boscastle, Looe, Polperro and Wadebridge.

Table 3.6 shows the estimated maximum velocity of flood water at the key locations. In general, velocities do not exceed 1m/s. Tremar has fairly low velocities at less than 0.25 m/s, although it does have people at risk at depths greater than 3m.

Table 3.6 Velocity of flooding at key sites

Key site	1 per cent a.p flood event velocity (m/s)	0.1 per cent a.p flood event velocity (m/s)
Bodmin	-	0.25 ~ 1
Boscastle	0.25 ~ 0.5	0.25 ~ 1
Bude	0.25 ~ 0.5	0.25 ~ 1
Camelford	<0.25	0.25 ~ 1
Lanivet	<0.25	0.25 ~ 0.5
Lerryn	0.25 ~ 0.5	0.25 ~ 1
Looe	<0.25	0.25 ~ 0.5
Lostwithiel	0.25 ~ 0.5	0.25~1
Newquay	0.25 ~ 0.5	0.25 ~ 1
Polperro	-	0.25 ~ 0.5
Port Isaac	<0.25	0.25 ~ 0.5
Stratton	0.25 ~ 0.5	0.25 ~ 0.5
Tremar	<0.25	<0.25
Wadebridge	0.25~1	0.25 ~ 1

The combination of depth and velocity can be used to provide a flood hazard rating. The level of the flood hazard can indicate the risk to life caused by a flood event. We have calculated a flood hazard rating for each key site, based on the maximum depth and maximum velocity. This is shown in Table 3.7 and is based on the Environment Agency\DEFRA R&D Technical Report FD2321/TR1 by HR Wallingford (2005); The Flood Risk to People Methodology.

There are three levels of flood hazard:

- Moderate: Danger for some, including children, the elderly and infirm.
- Significant: Danger for most, including the general public
- Extreme: Danger for all, including emergency services

Table 3.7 Maximum flood hazard at key sites for the 1 per cent a.p flood event

Key site	Maximum depth in floodplain (m)	Maximum velocity in floodplain (m/s)	Flood hazard
Bodmin	-	-	n/a*
Boscastle	3.1	0.5	Significant
Bude	1.2	0.5	Moderate
Camelford	1	0.25	Moderate
Lanivet	1.5	0.25	Moderate
Lerryn	1.8	0.5	Significant
Looe	3.1	0.25	Significant
Lostwithiel	3.1	0.5	Significant
Newquay	1.3	0.5	Significant
Polperro	-	-	n/a*
Port Isaac	0.8	0.25	Moderate
Stratton	1.8	0.5	Significant
Tremar	3.7	0.25	Significant
Wadebridge	3.3	1.0	Extreme

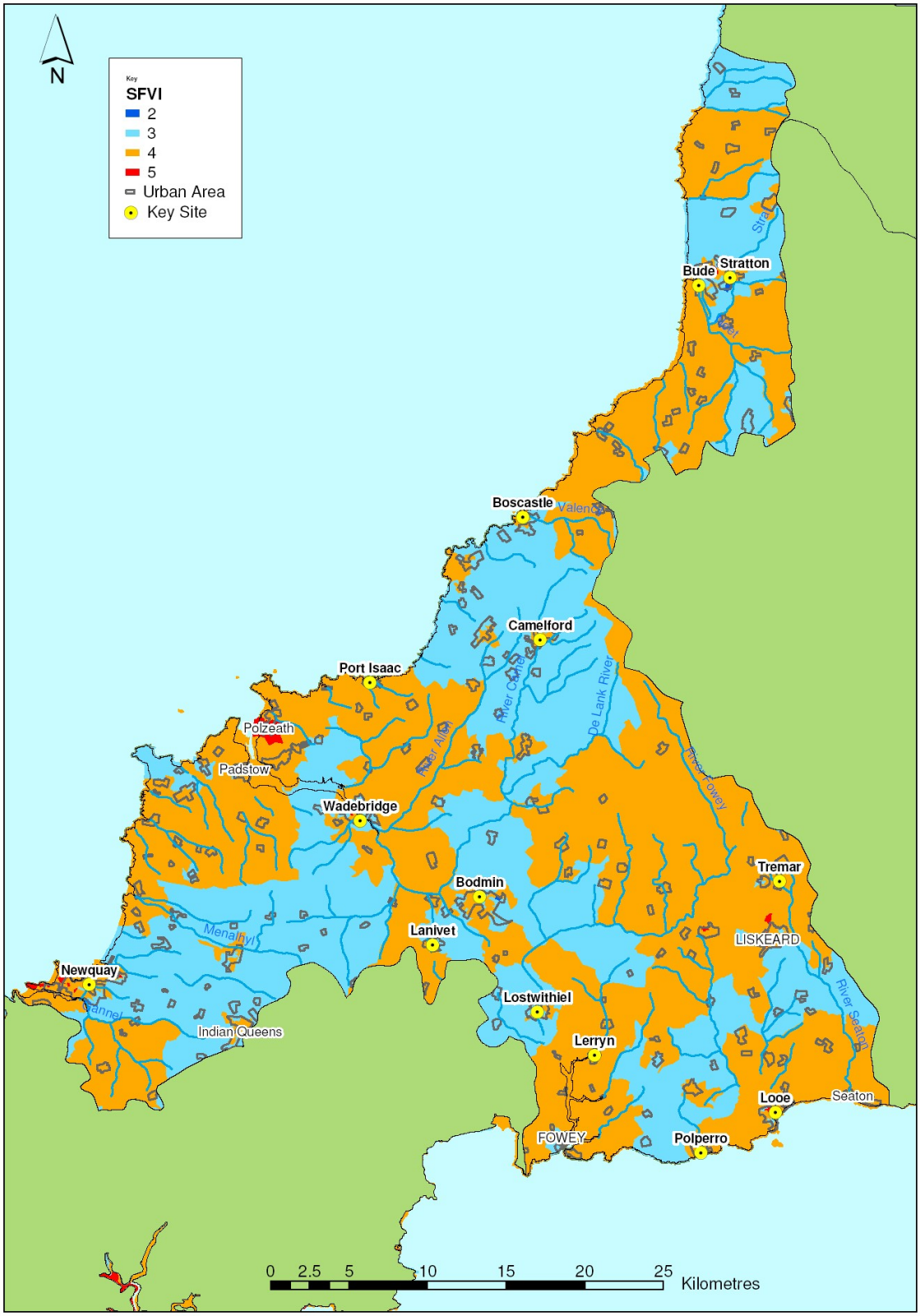
* The flood alleviation schemes in Bodmin and Polperro are designed to protect against a 1 per cent a.p flood event. We estimate that the schemes avoid a Moderate Hazard at Bodmin and a Significant Hazard at Polperro at the 1 per cent a.p flood event.

Social vulnerability

Some social groups experience greater levels of vulnerability to flooding; this is related to age, gender, disability, ethnicity, location and so on. It can also be linked to access to education facilities, health services and information about flooding. Reducing vulnerability to flooding is an important part of responding to flood risk.

Based on properties and people affected by flooding, each group is given a Social Flood Vulnerability Index (SFVI) category (as defined by the 2001 Census). These indices range from 1(low vulnerability) to 5 (high vulnerability). Figure 3.5 shows the SFVI indices within the catchment.

Figure 3.5 Social Flood Vulnerability Index



The categories are based on the percentage of the total number of people living in the area that are likely to be worst affected by flooding should it occur. These include single parents, the elderly and the long-term sick. A summary of social vulnerability at the key sites is shown in Table 3.8.

Table 3.8 Social vulnerability

Key site	Social Vulnerability		No. of Social / community assets[2] at risk 1 per cent a.p. (river) 0.5 per cent a.p. (tidal)
	Average[1]	Max	
Bodmin	3.5	4	n/a*
Boscastle	3.3	4	2
Bude	4	4	6
Camelford	3.5	4	10
Lanivet	3.7	4	0
Lerryn	4	4	0
Looe	3.9	5	14
Lostwithiel	3.5	4	2
Newquay	3.8	4	0
Polperro	3.8	4	n/a*
Port Isaac	4	4	0
Stratton	3.5	4	0
Tremar	4	4	0
Wadebridge	3.6	5	9

1. This is the average rank per key site.

2. Social/ community assets are buildings and services such as doctor's surgeries, libraries, post offices, churches, community centres, banks etc.

* Bodmin and Polperro are defended to a 1 per cent a.p. standard. These defences protect 20 social and community assets at risk from a 1 per cent a.p flood event in Bodmin, and 8 social and community assets at risk from a 1 per cent a.p flood event in Polperro.

Within the East Cornwall CFMP there are a number of areas with a SFVI of 3 or 4, with a few isolated areas with a value of 5. These areas of highest vulnerability are on the outskirts of Bude, Liskeard, Newquay and Wadebridge. There are no areas with a rating of 1 and so all areas of East Cornwall display some vulnerability to flood risk.

SFVI levels are related to the risk of flooding. As flood risk may change in the future, so will levels of flood vulnerability.

Social/Community Assets

Social and community assets have been defined as those that are relied upon by the community, but are not part of the critical infrastructure. From the total social and community assets identified at risk in Table 3.8, we have checked to see which are schools, hospitals, doctors' surgeries and residential homes. The following of these assets were found within the 1 per cent a.p flood extent.

- Downderry Primary School (near Seaton)
- Looe Health Centre (Looe)
- The Surgery (Polperro)
- Care Home (Flexbury)

Looe has the greatest number of social and community assets at risk from flooding from a 1 per cent a.p. event.

3.3.2 Risks to Property, Assets and Infrastructure

To measure the scale of the flood risk in the catchment, we have calculated the number of properties that lie within the one per cent annual probability flood extent. This is shown in Figure 3.6 and shows the number of properties at risk along each section of the main watercourses.

Figure 3.6 Number of properties affected by a 1 per cent a.p flood event

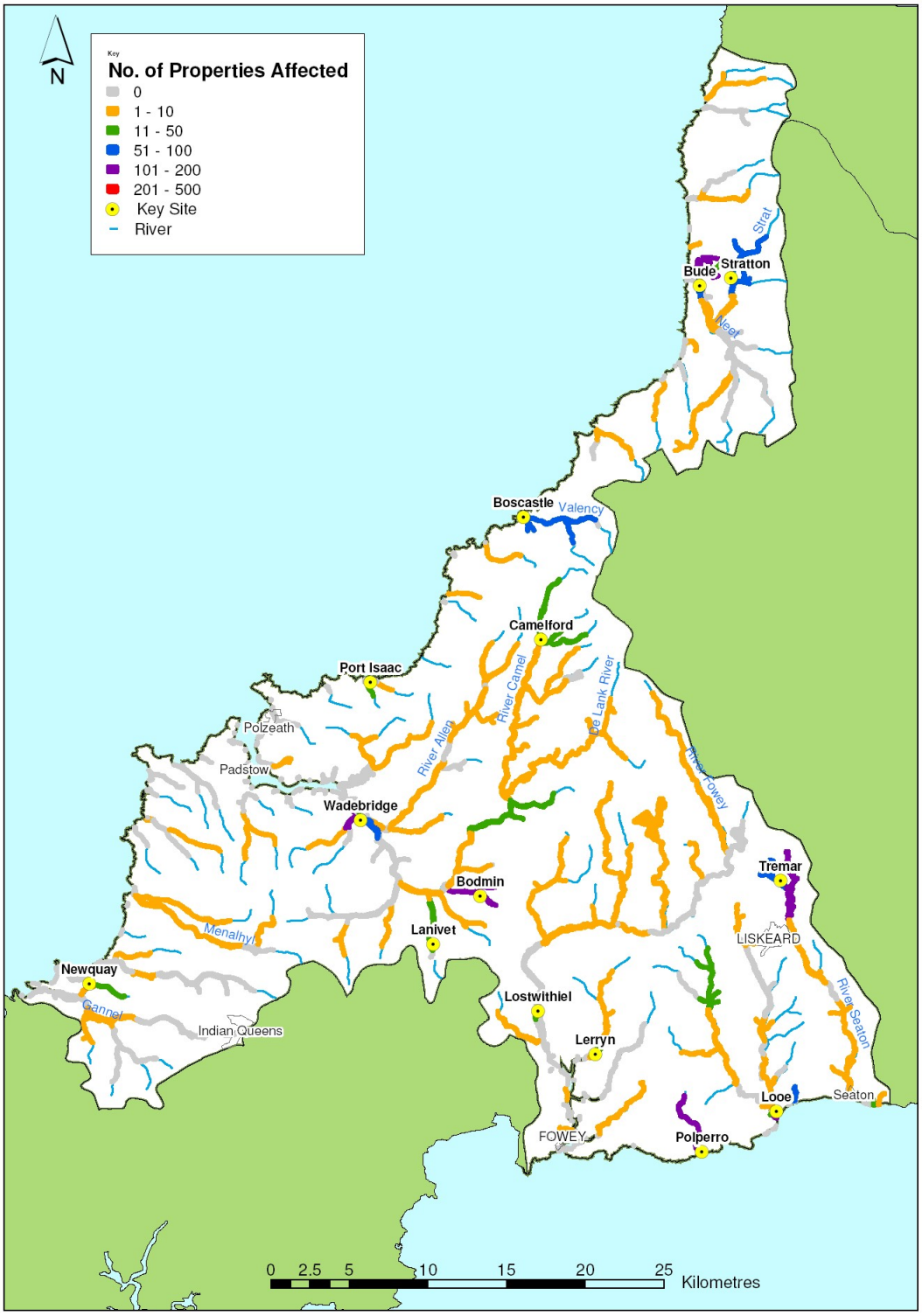


Figure 3.6 does not take into account the presence of flood alleviation schemes. The results show that the higher numbers of properties at risk of flooding occur at the key sites, many of which have flood alleviation schemes. This demonstrates that the provision of flood alleviation schemes is linked to the numbers of properties at risk. Away from the key sites, the numbers of properties affected along the watercourses are generally less than ten, demonstrating the dispersed nature of flood risk across the catchment.

We have estimated the damages caused by river and/or tidal flooding across the catchment. This includes damages to properties and agricultural land. The damage estimates do not include damages caused by other sources of flooding such as surface water or sewage. We have not included the impacts on infrastructure or environmental assets, but we will discuss this in later sections.

Direct damage results from floodwater having physical contact with property and its contents or land. The nature and extent of flooding, including its duration, velocity and quality cause flood damage loss.

We have estimated damages based on the results from using the Modelling and Decision Support Framework (MDSF) tool. This uses the current 1 per cent annual probability flood extents to create depth grids across the area. It then assesses associated damages to property and land, based on this depth information. The accuracy of this method largely depends on the quality of the flood extents and the Digital Terrain Model used. These results are not derived from detailed hydrological or hydraulic modelling, as MDSF does not predict river water levels and flows or wave heights and sea levels. We have used MDSF to estimate damages at the key sites and more widely across the whole catchment.

Damage estimates at key sites

Damages have been estimated for the key sites considering commercial properties, residential properties and community assets.

Table 3.9 shows the estimated Annual Average Damage (AAD) expected in each key site for a 1 per cent a.p flood event. AAD intends to show the average level of damages that might be expected in any given year. AAD is calculated by considering a range of different frequency flood events based on the damages caused by a 1 per cent a.p flood event.

In order to estimate AADs based on one flood event we have used guidance within The Benefits of Flood and Coastal Risk Management: A Manual of Assessment Techniques published by Defra and the Environment Agency and undertaken by the Flood Hazard Research Centre.

The guidance says that for strategy studies, the weighted AAD within a defined benefit area (e.g. 1 in 200 year floodplain) can be found by assuming that the number of properties affected by successively more frequent flood events can be reduced as follows (OST 2004):

1 per cent a.p property numbers 93per cent of 200 year floodplain AAD
2 per cent a.p property numbers 80 per cent of 200 year floodplain AAD
4 per cent a.p property numbers 25 per cent of 200 year floodplain AAD
10 per cent a.p property numbers 10 per cent of 200 year floodplain AAD
20 per cent a.p property numbers 5 per cent of 200 year floodplain AAD

This approach moderates property numbers to account for flood frequency so that weighted AADs are realistic. A damage value has been found for each a.p flood event, which is then used to calculate the AAD.

The AAD is used in economic assessments to work out the present value of flooding over the life of flood management schemes. The methodology for assessing the benefits of flood alleviation comes from the Multi-Coloured Handbook (Flood Hazard Research Centre). It combines an assessment of risk in terms of the probability of future floods, with the vulnerability in terms of the damage that flooding could cause.

Table 3.9 Economic flood damages for key sites – Annual Average Damage

Key site	Annual Average Damage (Commercial) (£)	Annual Average Damage (Residential) (£)	Total damages (£)
Bodmin	11,246	12,251	23,497
Boscastle	72,042	32,266	104,307
Bude	354,867	124,548	479,415
Camelford	93,171	3,552	96,723
Lanivet	3,467	20,867	24,334
Lerryn	0	2,096	2,096
Looe	1,022,138	132,653	1,154,791
Lostwithiel	44,546	95,065	139,610
Newquay	0	30,710	30,710
Polperro	45,827	11,791	57,618
Port Isaac	3,128	11,575	14,703
Stratton	19,299	61,563	80,861
Tremar	0	95,712	95,712
Wadebridge	1,224,355	341,887	1,566,241

Economic damages caused by specific flood events; 10 per cent a.p, 1 per cent a.p and 0.1 per cent a.p are shown in Tables 3.10(a) to Table 3.10(c). Commercial and residential properties are shown individually, with the cumulative costs shown as Total Damages. The damage estimates take into account the presence of flood alleviation schemes that provide protection for the 10 per cent and 1 per cent a.p flood event, with the assumption that the scheme performs as designed and direct flooding from the river or tide is therefore prevented.

Table 3.10a Estimated commercial and residential damages from a 10 per cent a.p. flood event

Key site	No. of commercial properties affected	Damages (Commercial) (£)	No. of residential properties affected	Damages (Residential) (£)	Total damages (£)
Bodmin	0	0	0	0	0
Boscastle	0	0	0	0	0
Bude	0	0	0	0	0
Camelford	0	0	0	0	0
Lanivet	0	0	2	43,165	43,165
Lerryn	0	0	2	24,259	24,259
Looe	45	6,324,588	5	256,850	6,581,438
Lostwithiel	0	0	0	0	0
Newquay	0	0	0	0	0
Polperro	0	0	0	0	0
Port Isaac	1	58,846	1	18,304	77,150
Stratton	0	0	0	0	0
Tremar	0	0	42	1,302,638	1,302,638
Wadebridge	0	0	0	0	0

Table 3.10b Estimated commercial and residential damages from a 1 per cent a.p. (river) 0.5 per cent a.p. (tidal) flood event

Key site	No. of commercial properties affected	Damages (Commercial) (£)	No. of residential properties affected	Damages (Residential) (£)	Total damages (£)
Bodmin	0	0	0	0	0
Boscastle	29	1,367,012	27	612,253	1,979,265
Bude	33	6,733,713	110	2,363,337	9,097,050
Camelford	19	1,767,949	2	67,396	1,835,345
Lanivet	0	0	14	395,953	395,953
Lerryn	0	0	3	39,763	39,763
Looe	138	19,395,402	49	2,517,133	21,912,535
Lostwithiel	9	845,267	89	1,803,881	2,649,148
Newquay	0	0	26	582,737	582,737
Polperro	0	0	0	0	0
Port Isaac	1	59,348	12	219,645	278,993
Stratton	4	366,196	40	1,168,169	1,534,365
Tremar	0	0	49	1,816,346	1,816,346
Wadebridge	126	23,232,538	200	6,487,412	29,719,950

The flood alleviation scheme at Boscastle avoids around £679,666 of damages at 1 per cent a.p flood event to 8 commercial and 10 residential properties.

The scheme in Bodmin avoids approximately £4.5M of damages to 31 commercial and 80 residential properties and the scheme in Polperro avoids about £11M of damages to 76 commercial and 53 residential properties.

Table 3.10c Estimated commercial and residential damages from a 0.1 per cent a.p. flood event

Key site	No. of commercial properties affected	Damages (Commercial) (£)	No. of residential properties affected	Damages (Residential) (£)	Total damages (£)
Bodmin	32	2,549,113	95	2,355,940	4,905,053
Boscastle	29	1,721,106	46	961,875	2,682,981
Bude	42	9,434,980	154	4,027,366	13,462,346
Camelford	19	2,416,750	7	67,905	2,484,655
Lanivet	5	624,014	36	905,894	1,529,907
Lerryn	0	0	11	63,137	63,137
Looe	138	19,395,402	103	2,517,133	21,912,535
Lostwithiel	31	2,491,689	106	2,638,617	5,130,306
Newquay	0	0	51	968,440	968,440
Polperro	80	9,974,022	96	2,393,901	12,367,923
Port Isaac	1	59,348	15	219,645	278,993
Stratton	5	387,751	51	1,173,983	1,561,734
Tremar	0	0	52	1,816,346	1,816,346
Wadebridge	139	29,880,611	218	7,388,696	37,269,307

The damage estimates made for the key sites show that across the three scale of flood events investigated, Looe has the highest damages, reflected in AAD estimate for Looe, which is the highest at over £1 million. Looe stands out as a location which would experience significant damages from both frequent and extreme flood events.

Nine of the 14 key sites have flood alleviation schemes that provide protection at least up to the 10 per cent a.p flood event. These means that frequent floods in these locations should not cause flooding if the schemes operate as designed. This is reflected by no damages estimated for this scale of flood at these key sites.

Bodmin, Boscastle and Polperro are protected (Boscastle only partly protected) from flooding at the 1 per cent a.p flood event. Again, these means that frequent floods in these locations should not cause flooding if the schemes operate as designed. This is reflected by no damages estimated for this scale of flood. The amount of direct damages these schemes avoid is around £16 million at this scale of flood event.

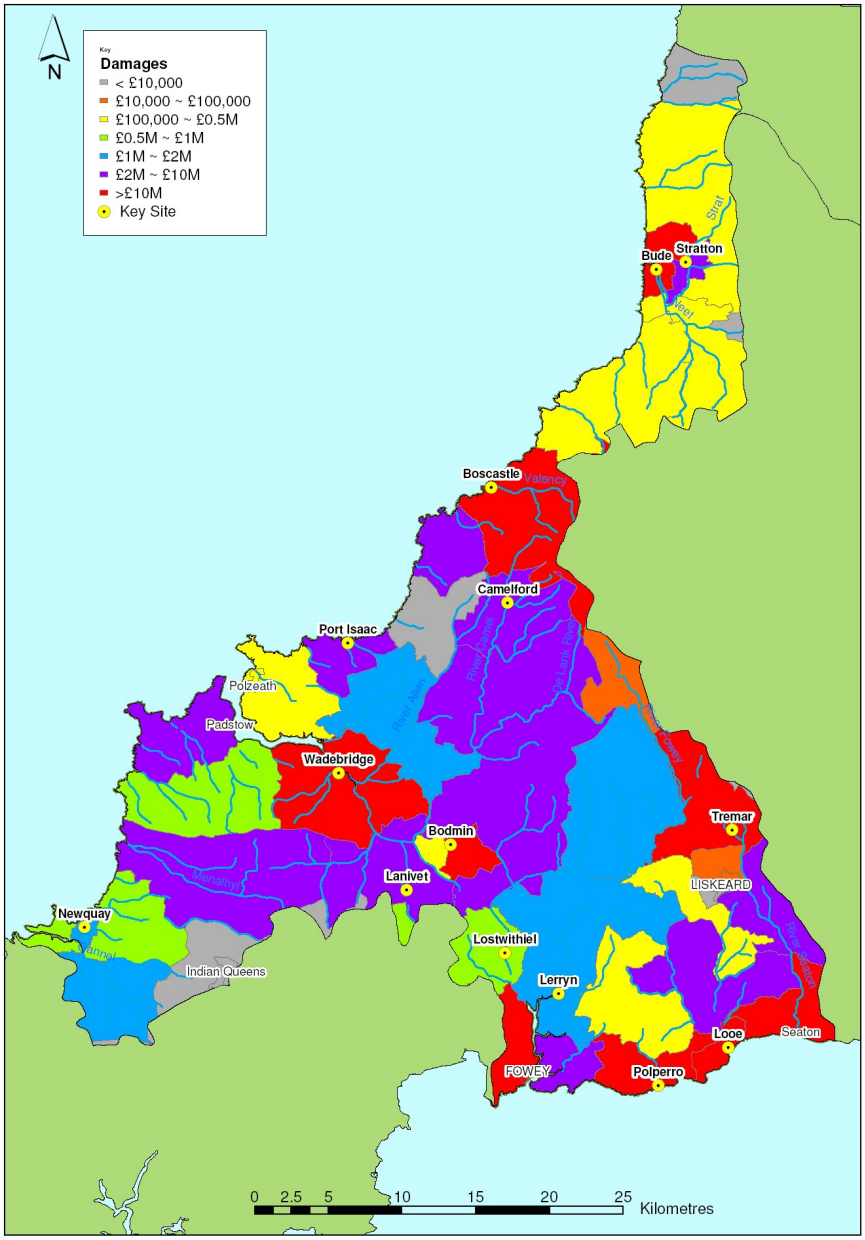
All key locations show damages at the 0.1 per cent flood event. At this scale of extreme event, the flood alleviation schemes at the key sites would be exceeded and flooding would be severe. The highest damages would be experienced at Wadebridge, Looe, Bude and Polperro.

Damage estimates across the catchment

Damage estimates have been calculated across the catchment to find the damages caused by flooding from the river or tide for the 1 per one per cent and 0.5 per cent annual probability flood event.

Figure 3.7 shows the distribution of damages across the catchment in ward areas. This assessment does not take into account the presence of defences. This allows us to understand the impact that the flood alleviation schemes in Bodmin, Boscastle and Polperro have in reducing the damages caused by flooding at the 1 per cent a.p event.

Figure 3.7 Estimated damages from a 1 per cent a.p. (river) 0.5 per cent a.p. (tidal) flood event



There is an annual average damage total of £17 million for the whole catchment based on river and tidal flooding. For the one per cent annual probability flood, the catchment is estimated to incur total damages from river and tidal flooding of around £336 million, not accounting for the damages avoided by flood alleviation schemes.

Table 3.11 shows the damages presented in Figure 3.7 grouped into catchment areas. Similar catchments in the same vicinity have been grouped together and damages for a 1 per cent a.p. flood event and Annual Average Damage are shown for economic and agricultural damages. Damages avoided at the 1 per cent a.p flood event of £16 million have been accounted for within the table.

Table 3.11 Total estimated damages

	1 per cent a.p. (river) 0.5 per cent a.p. (tidal) flood event damages (£)			Annual Average Damage (£)		
Catchment areas	Economic	Agriculture	TOTAL	Economic	Agriculture	TOTAL
Neet, Stratton	£33M	£76K	£33M	£1.7M	£4K	£1.7M
Valency, Polzeath	£25M	£14K	£25M	£1.4M	£0.7K	£1.4M
River Camel (Tidal)	£60M	£51K	£60M	£3.2M	£3K	£3.2M
River Camel, Camelford	£26M	£97K	£26M	£1.4M	£5K	£1.4M
Trenance, Gannel, Menalhyl	£9M	£55K	£9M	£0.5M	£3K	£0.5M
Bodmin Moors area	£3M	£34K	£3M	£0.16M	£1.8K	£0.17M
River Fowey, River Pol	£24M	£92K	£24M	£1.2M	£5K	£1.3M
Fowey, Seaton, Looe, Lostwithiel	£140M	£16K	£140M	£7.3M	£0.8K	£7.3M
Catchment Total:	**£320M**	**£0.4M**	**£320M**	**£17M**	**£23K**	**£17M**

This table shows that on catchment basis least damages occur on Bodmin Moor. Highest damages occur along the south coast, and around the River Camel tidal reach.

The damage results presented in this section are not intended as absolute values. They are useful within the CFMP because they highlight where flooding is likely to cause the highest economic damage. This shows us where the impacts of flood will be greatest and can help us to prioritise flood management within the catchment. However, we also need to consider other impacts of flooding, such as on critical infrastructure, social and environmental implications, when considering damage caused by flooding.

Critical Infrastructure

In East Cornwall, there appear to be no hospitals, food distribution centres or prisons affected by a 1 per cent a.p. (river) 0.5 per cent a.p. (tidal) flood event. However, schools, health centres, surgeries and residential homes are affected, and these are covered in 3.3.1. Transport links are covered below. We have not determined the effects of flooding on other critical infrastructure, such as power lines or telecommunications, within the area.

We have identified the following emergency response facilities at risk:

- ambulance station (Looe)
- police station (Looe)
- fire stations (Wadebridge, Bude).

In addition, there is a fire station within the 1 per cent a.p flood extent in Bodmin; however this should be protected from flooding by the flood alleviation scheme at this scale of event.

These emergency response facilitities are not at risk from the 10 per cent a.p flood event, because they are outside of the 10 per cent flood exent (Looe), or because they are protected from flooding by flood alleviation schemes (Wadebridge and Bude).

During the tourist season, a significant increase in the number of people coupled with a lack of local knowledge about flood risks mean that the consequences of flooding within the area could be severe. The timing of the severe flooding in Boscastle in August 2004 meant that the

emergency services had many more people to evacuate from the area and the traumatic impact of the flooding was felt more widely than within just the local community itself.

Table 3.12 summarises the critical infrastructure affected by flooding in the catchment. This includes embankments which may protect certain sections of railway or major roads from flooding. We have included any embankments as the impact of flooding on their integrity is unknown, and a structurally damaged road or railway does not have to be flooded to be affected. These figures represent the transport network across the catchment

Table 3.12 Critical infrastructure affected by flooding

Catchment(s)	A Road (No.)	B Road (No.)	Water Treatment works	Electricity Substation	Railway (No.)
Trenance, Gannel, Camel, Chapel Stream, Menalhyl, Polmorla, Allen, Lanivet & Amble	5	-	-	-	1
Neet, Strat & Valency	3	2	-	2	-
Fowey, Pol, Seaton & East Looe	1	3	1	1	1
Camel	-	-	-	1	-
North Coast Rivers	-	-	-	1	-
Total	**9**	**5**	**1**	**5**	**2**

The transport links in East Cornwall are essential not only for residents, but also for tourists visiting the area. Flooding and damage to rail and road links can result in massive disruption particularly in summer months.

The railway network in East Cornwall crosses the 1 per cent a.p. flood zone in two places, at Newquay and near Lostwithiel. While the line may not be threatened by floodwater directly, the structural integrity of the railway line may be affected by floodwaters. Closure of the line at Lostwithiel would effectively cut off rail transport to and from the rest of the country.

The A30 trunk road, which forms the main road link through Cornwall, is at risk at Lanivet, Palmersbridge and Temple. Transport links would be severely affected, with long diversion routes along smaller A or B roads.

Other A-roads would be affected around Newquay, Bude, Looe, Bodmin, Lanivet and St. Issey. This would disrupt local traffic, and transport in and out of these towns. This may affect some emergency services responses.

Table 3.12 shows there are five electricity substations at risk from a 1 per cent a.p. (river) 0.5 per cent a.p. (tidal) flood event, threatening power supplies in the Bude area, and along the south and north coasts. There are no gas distribution plants at risk.

Other flooding (surface water, groundwater and drainage)

There is a large amount of flooding that does not come from river or tidal sources, but can be linked to surface water, field runoff or overloaded sewers.

It is difficult to work out the costs about flooding caused by these sources due to the lack of information available. However we can try to determine the scale of the problem.

A review of the major floods in autumn 2000 (Flood Hazard Research Centre 2002) found that in approximately 25 per cent of cases only single properties were affected. This showed that flooding was scattered and away from rivers. Based on the possible numbers of properties affected, we have estimated that the economic effect of other sources of flooding in East Cornwall is approximately one quarter of the effect from rivers and the sea.
This is however simply an estimate, and during extreme rainfall events it is highly likely that the scale of these problems will be much greater. Surface water drainage and sewerage systems are not designed to accommodate the flows that a large flood event could create. Our FRIS data indicates that 41 per cent of the recorded flooding incidents in the CFMP area are related to these non-river problems. However as previously indicated, it is also likely that flooding events linked to surface water run-off and drainage systems are less widely reported than river and tidal incidents. Much better records of the frequency of these events and the associated numbers of properties flooded during non-river and non-tidal events will need to be collected and used in the future to refine this estimation of damage relating to other sources of flooding. Recent instances of flooding elsewhere in the UK during the wet summers of 2007 and 2008 have shown that flooding in urban areas due to surface water runoff and limited capacity of drainage systems can result in very significant damages.

Table 3.13 summarises the recorded number of these types of flooding incidents within each of the local authority areas within the catchment. The annual average cost of potential damages is estimated to be around £4.5 million.

Table 3.13 Economic damages related to other flooding

District / Borough	No. incidents	Field runoff	Highway runoff	Drainage	Groundwater	Annual Average Damage (£)
North Cornwall	69	1	34	33	1	£ 1,788,000
inc. Bodmin	23	-	*7*	*16*	-	*£ 596,000*
Caradon	72	23	38	9	2	£ 1,865,000
Restormel	27	4	10	13	-	£ 700,000
Total	**168**	**28**	**82**	**55**	**3**	**£ 4,350,000**

3.3.3 Risks to the environment

Biodiversity

Table 3.14 identifies the designated sites that lie within the 1 per cent a.p. (river) 0.5 per cent a.p (tidal) flood event extent. Two of the SACs are influenced by hydrology (River Camel and Tintagel-Marsland-Clovelly Coast).

Table 3.14 Designated Sites at risk

Designation	Site Name		
Special Area of Conservation (SAC)	Polruan to Polperro		River Camel
	Tintagel-Marsland-Clovelly Coast		Phoenix United Mine & Crow's Nest
National Nature Reserve (NNR)	Golitha Falls		
Site of Special Scientific Interest (SSSI)	Amble Marshes	Boconnoc Park and Woods	Bodmin Moor North
	Boscastle to Widemouth	Bude Coast	Cabilla Manor Wood
	Coombe Mill	Crow's Nest	De Lank Quarries
	Draynes Wood	Duckpool to Furzey Cove	Harbour Cove
	Marsland to Clovelly Coast	Pentire Peninsula	Polruan to Polperro
	Retire Common	River Camel Valley and Tributaries	Rock Dunes
	Rosenannon Bog and Downs	St Nectan's Glen	Steeple Point to Marsland Mouth
	Tintagel Cliffs	Trebetherick Point	Trevone Bay
	Upper Fowey Valley		

The following SSSIs are influenced by hydrology: Amble Marshes, Boconnoc Park and Woods, Boscastle to Widemouth, Cabilla Manor Wood Coombe Mill, Duckpool to Furzey Cove, Marsland to Clovelly Coast, Pentire Peninsula, River Camel Valley and Tributaries, St Nectan's Glen and Upper Fowey Valley. The status of these sites is presented in Table 2.7. Of these sites flooding would contribute to the improvement of the condition of Amble Marshes, River Camel Valley, and Upper Fowey Valley.

In total 4.6km^2 of SSSI falls within the 1 per cent a.p. (river) 0.5 per cent a.p (tidal) flood event extent. The area of each individual SSSI is presented in Table 12.5 in Appendix B, Annex B (Policy Appraisal Tables). The designated sites are not, through consultation with Natural England, currently perceived to be adversely affected by flooding, although with any extreme flood event potential damage could arise from erosion or flood disturbance. The majority of sites are maintained or benefit from water. Specific impacts and benefits to these sites are discussed in Table 12.6 in Appendix B Annex B (Policy Appraisal Tables).

There are also a number of BAP habitats within the East Cornwall catchment. In total nearly 7km^2 of BAP habitats fall within the 1 per cent a.p. (river) 0.5 per cent a.p (tidal) flood event extent.

BAP habitats that are influenced by hydrology are fen, purple moor-grass and rush pasture, ponds and pools, reedbed, wet woodland, rivers, streams and floodplains and estuaries including mudflats, saltmarsh, sheltered muddy gravels, and seagrass. These are not currently expected to be affected adversely by flooding, although with any extreme flood event potential damage could arise from erosion or flood disturbance. The majority of sites are maintained or benefit from water. Most of these habitats would benefit from an increase in flooding.

BAP habitats within the catchment that are not influenced by flooding include blanket bog, saline lagoons, lowland heath, raised bog, lowland mixed deciduous woodland, lowland meadows, lowland dry acid grassland, lowland beech and yew woodland. Any increase in flooding to these sites would have a detrimental impact to the habitat quality.

Landscape

There are no current issues in relation to existing flooding affecting designated landscape interests.

Fisheries

There are no current issues in relation to existing flooding affecting fishery interests within the catchment.

Tourism and Recreation

Tourism and recreation are affected by flooding inasmuch as access is prevented by roads during flood events. However, no significant impact from flooding on tourism or recreational sites or assets has currently been identified or raised by consultees.

Water Quality

Of the current monitored watercourses, 81 per cent passed the River Quality Objectives (RQOs), 8 per cent were marginal and 11 per cent failed. The direct effect of flooding on water quality is generally small, as flooding does not tend to last long.

There are currently no issues raised to indicate whether the 14 landfill sites within the existing flood zone have been affected by flooding, or that impacts on water quality have arisen. There is a potential that minewaters could impact on water quality, particularly during flooding, though no specific sites have been identified during consultation as at risk.

Historic Environment

Flooding has the potential to cause physical damage to all aspects of the historic environment, whether designated or not. In particular, flooding, and flood risk management activities can cause:

- erosion of archaeological earthworks, buried sites and standing buildings/structures caused by repeated flood events or by changes in water flow.
- erosion of parts of historic battlefields; or registered parks and gardens, resulting damage to planting schemes, trees, designed landscape features and structures.
- damage to the integrity of listed buildings, their construction materials, interior and exterior decoration and significant interior features.
- degradation of preserved organic archaeological and palaeoenvironmental evidence resulting from changes in groundwater flow and chemistry, including pollutants. Where ground water levels are lowered to reduce flood risk, this could cause the deterioration of organic remains through the drying out of deposits and introduction of oxygen leading to bacterial decay.
- impacts on the setting of sites by construction of flood protection measures (banks, barriers).

11 of the 469 scheduled monuments within the CFMP area, and four of the seven registered parks and gardens, lie within the 1 per cent a.p. (river) 0.5 per cent a.p (tidal) flood event extent. It should be noted that none of the SMs within the CFMP area are on the at risk register, therefore there is no method for determining deterioration of these assets.

A proportion of designated historic environment assets may be located within close proximity to rivers and streams as a result of their function, for example, bridges, mills, and other water management structures. The CFMP objective relating to the historic environment seeks to ‘protect and enhance significant historic environment assets and their settings’, but it is possible that the location of some of the features discussed above (historic bridges, mills etc) may restrict flood risk management options.

3.4 Summary of flood risk

Table 3.15 summarises the flood risk in East Cornwall described in Section 3.3 for a 1 per cent a.p. (river) 0.5 per cent a.p (tidal) flood event.

Table 3.15 Summary of flood risk

Key site	Main source of flooding	Estimated number of people		Speed of onset	Hazard	SFVI		AAD (£ 000's)
		At risk	In community			Average	Max	
Bodmin	Bodmin Town Leat	-	13,160	Fast	n/a	3.5	4	238
Boscastle	Valency/Jordan	101	1154	Moderate	Significant	3.3	4	104
Bude	Neet/Tidal	248	5370	Slow	Moderate	4	4	479
Camelford	Camel	16	1,584	Slow	Moderate	3.5	4	96
Lanivet	Lanivet	25	881	Moderate	Moderate	3.7	4	30
Lerryn	Unknown	25	360	Slow	Significant	4	4	3
Looe	Tidal	232	4,961	Moderate	Significant	3.9	5	1154
Lostwithiel	Fowey/Tidal	200	1,591	Moderate	Significant	3.5	4	139
Newquay	Trenance	63	11,260	Fast	Significant	3.8	4	6
Polperro	Pol	-	604	Moderate	n/a	3.8	4	583
Port Isaac	Port Isaac Leat	34	1,278	Moderate	Moderate	4	4	14
Stratton	Strat	108	1,558	Moderate	Significant	3.5	4	80
Tremar	Unknown	117	924	Fast	Significant	4	4	158
Wadebridge	Camel (Tidal)	450	6,834	Moderate	Extreme	3.6	5	1566

There are flood alleviation schemes at Bodmin, Boscastle, and Polperro. The risk to these communities is therefore lessened, but cannot be eliminated completely as flood defences may fail or be exceeded. Wadebridge, Bude and Lostwithiel have flood alleviation schemes although the standard of protection provided is unknown.

Social vulnerability levels show that most of East Cornwall displays a level of social vulnerability of 3 or 4. There are small pockets where there is a level of social flood vulnerability at the highest level. In these areas flooding will put extra pressure on local services and their populations.

There are some social and community assets at risk from a 1 per cent a.p. (river) 0.5 per cent a.p (tidal) flood event. These are Downderry Primary School (near Seaton), a Health Centre in Looe, The Surgery in Polperro and a care home near Bude. This shows that across the CFMP area flood risk has a relatively low impact on these types of services, however at a local scale, the impact of flood risk on such services can be greater, especially at Looe.

We have identified some critical infrastructure at risk from a 1 per cent a.p. (river) 0.5 per cent a.p (tidal) flood event. This includes 5 electricity substations. There are no gas facilities identified at flood risk.

There a number of emergency response bases at risk from the 1 per cent a.p. (river) 0.5 per cent a.p (tidal) flood event. These are the fire station, police station and ambulance station in Looe, and fire stations in Wadebridge, Bude and Bodmin.

The total Annual Average Damage in East Cornwall caused by all sources of flooding are £21.5 Million, and estimated damages for a 1 per cent a.p. (river) 0.5 per cent a.p (tidal) flood event are £320 million. The catchment areas with the greatest damages are along the tidal stretches of the River Camel, and along the south coast of Cornwall. The least amount of damages occurs in the Newquay area.

Table 3.16 summarises the flood risk to the road and rail infrastructure from a 1 per cent a.p. (river) 0.5 per cent a.p (tidal) flood event.

Table 3.16 Summary of infrastructure at flood risk

Asset	Location	Consequence
A30 Trunk Road	Lanivet Palmersbridge Temple.	Main route into Cornwall. Only minor roads available for diversion
A-Roads	Newquay (A3058, A3059, A3075) Bude (A39) Bodmin (A38) Looe (A387) Lanivet (A389) St. Issey (A389)	Localised disruption
Rail	Newquay Lostwithiel	Closure at Lostwithiel affects London to Cornwall route. Closure at Newquay affects stations between Newquay and Par

The main railway line from London to Penzance is at risk from being affected at Lostwithiel.

The catchment contains many designated sites including:

- 8 Special Areas of Conservation, of which 4 lie within the 1 per cent a.p. (river) 0.5 per cent a.p (tidal) flood event extent
- 46 Sites of Special Scientific Interest of which 24 lie within the 1 per cent a.p. (river) 0.5 per cent a.p (tidal) flood event extent however only 17 SSSIs are currently influenced by flooding)
- 1 National Nature Reserve which lies within the 1 per cent a.p. (river) 0.5 per cent a.p (tidal) flood event extent
- 469 Scheduled Ancient Monuments, of which 11 lie within the 1 per cent a.p. (river) 0.5 per cent a.p (tidal) flood event extent (it should be noted, that none of these SMs are on the at risk register, therefore there is no record of deterioration)
- 9.48km^2 of Historic Parks and Gardens, of which 0.45km^2 lies within the 1 per cent a.p. (river) 0.5 per cent a.p (tidal) flood event extent
- 7km^2 of UK Biodiversity Action Plan Habitat, of which 2.3km^2 comprises water related habitat

Consultation with Natural England has identified that none of the designated sites that lie within the flood zone are negatively impacted by flooding. In addition, sites close to residential areas are also valuable to local communities for recreation and their landscape quality and therefore, the negative effects of flooding would be more widely felt.

There are no significant flooding issues identified related to landscape, fisheries, tourism or water quality.

3.5 Existing Flood Risk Management

Historically, flooding in East Cornwall has been approached as a problem to control. Flood defence schemes tended to be constructed as a reaction to flood events, rather than as part of an overall management policy. Recently we have become more aware that with the pressures of climate change, development and land use change, we must work with natural processes to manage flood risk in a more proactive manner. A holistic approach is required to manage flood risk from source to receptor.

Today, we do not control flood risk in East Cornwall by simply building flood defences. We manage flood risk to minimise the negative impacts and maximise the positive impacts of flooding. We do this is a number of ways which include improving flood risk mapping and data management, supporting local planning authorities in making sustainable decisions about allocating land for development, and looking after our existing network of defences. We can also use innovative techniques for future works and we understand how important a timely and accurate flood warning service is.

3.5.1 Flood risk mapping and data management

The Flood Risk Mapping and Data Management Team is responsible for developing and managing the mapping of flood risk areas. They respond to flood risk related enquiries, as well as developing and managing a programme of data collection. They provide the public with information on the chance of flooding occurring using the flood map on our website. These maps show places that would be affected by flooding from rivers or the sea under a severe event, assuming that any flood defences that may exist in that location are not present. A rolling programme of improvements to the Flood Map is in place to ensure that the latest information and techniques are used in building up our picture of flood risk across East Cornwall.

We use the Flood Map to raise awareness of flood risk among the public and allow our partner organisations, such as local authorities, emergency services and drainage authorities to plan for flood emergencies. This currently includes the collection of flood vulnerability data, which will support future strategies and review of the CFMP.

We also manage the National Flood and Coastal Defence database (NFCDD). NFCDD holds all information on flood defence assets, structures and defences. The assets are owned, operated or maintained by either us, local authorities or privately. Data from NFCDD has been used in the CFMP to identify the location of defence schemes and the level of flood protection they provide.

Other work being undertaken in East Cornwall includes the assessment of Areas Benefiting from Defences. This allows us to get a clearer picture of what area are protected by the flood defences already in place. The results of Areas Benefiting from Defences mapping in tidal risk locations such as Lostwithiel and Wadebridge have been used in the CFMP to help us understand how the defences in these locations work. We are also working on flood hazard mapping to locate the areas most at risk.

The Flood Risk Mapping and Data Management Team has provided a large proportion of the data used within this CFMP. We have used this data to provide a baseline of the current flood risk within the East Cornwall catchment and to gain an indication of future trends. This team manages the Flood Reconnaissance Information System (FRIS), and undertakes flood reconnaissance across the catchment to record flood events and keep the system up to date. We have used FRIS to identify patterns of flooding across the CFMP area.

3.5.2 Sustainable development planning

The government aims to reduce flood risk to people, as well as the developed and natural environment by discouraging further development on floodplains. It also promotes best practice for controlling surface water runoff, including producing Surface Water Management Plans (SWMPs).

The government has produced guidance for local planning authorities to help them meet this aim when allocating land for development. This guidance is contained in a document called Planning Policy Statement 25; 'Development and Flood Risk' (PPS25).

PPS25 aims to guide local planning authorities in making decisions about where to allocate land for development, assisted by information within a Strategic Flood Risk Assessment. This means that development should take place on land with the lowest risk of flooding first. PPS25 also helps local authorities prepare policies for flooding.

Local authorities in East Cornwall are currently developing their Local Development Frameworks (LDFs), which will replace their previous Local Plans. It is expected that the LDFs may have relatively high development allocations proposed by the South West Regional Spatial Strategy (although the final figures have not been finalised). This is to tackle housing shortages and provide buildings for employment opportunities.

Our Development Control Team plays a crucial role in supporting the local planning authorities in the LDF process particularly in the development of Strategic Flood Risk Assessments, and in the consideration of individual planning applications and Flood Risk Assessments. Flood Risk Assessments have to be carried out to make sure that the development will not be at risk of flooding and will not add to the risk of flooding elsewhere. The increased surface water runoff that these developments will create should be managed and reduced by using Sustainable Drainage Systems (SuDS) and through the integrated design of urban drainage systems.

North Cornwall District Council, Caradon District Council and Restormel Borough Council are in the process of developing their SFRAs with technical assistance and approval provided by the Development Control Team. We will recommend that developments do not go ahead if they are to be placed in areas at risk of flooding.

Plans for development in the East Cornwall CFMP area are centred on the existing urban areas of Newquay and Bodmin.

3.5.3 Flood defence asset management

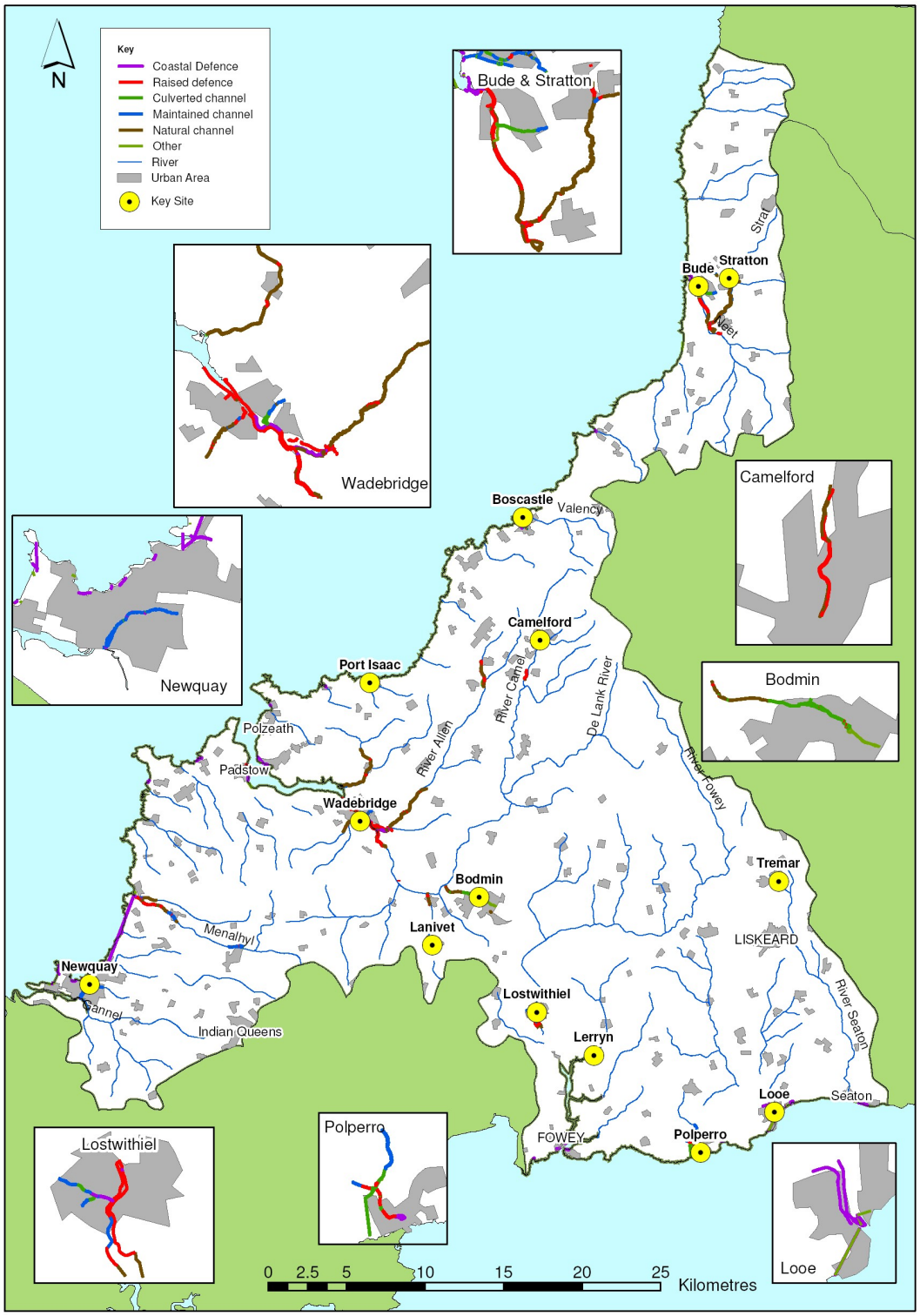
There are a number of flood alleviation and management assets across the catchment. We and/or the appropriate district council maintain most of these structures, with some assets maintained by other landowners. Table 3.17 provides a summary of the river flood alleviation schemes, with the information taken from NFCDD. These are also shown in Figure 3.8. Flood alleviation schemes are built to a certain design standard and that standard can be exceeded or fail. The design standard of each scheme is indicated where we know it.

Table 3.17 Existing river flood alleviation schemes and maintained watercourses

Location	Watercourse	% a.p flood event	Type	Estimated Date of Completion	Residual Life
Lostwithiel	Unknown	4% ~ 2%	Culverted channel, Maintained channel	Data not available	No data
	Fowey	2%	Raised defence, Maintained channel	Data not available	No data
Lanivet	Lanivet	10%	Raised defence, Culverted channel	Data not available	No data
Bodmin	Bodmin Town Leat	1%	Culverted channel, Raised defence	2005	No data
Camelford	Camel	5%	Raised defence,	Data not available	No data
Knightsmill	Allen	4%, 2%, 1%	Raised defence, Culverted channel	Data not available	No data
Kenningstock Mill	Camel	4%, 1.3%	Raised defence	Data not available	No data
St Columb Major	Menalyhl	4%, 10%, 5%	Raised defence, Culverted channel, Maintained channel	Data not available	No data
Mawgan Porth	Menalyhl	20%, 5%, 4%, 2%	Raised defence, Maintained channel	1994	No data
Newquay	Trenance	2%	Maintained channel, Culverted channel	Data not available	No data
Polzeath	Unknown	2%, 1%	Raised defence, Culverted channel, Maintained channel	Data not available	No data
Sladesbridge	Allen Camel	1.3%, 0.5%	Raised defence	2004	No data
Wadebridge	Polmorla Camel	20%, 1%	Raised defence	Data not available	No data
Port Isaac	Port Isaac Leat	Data not available	Maintained channel, Raised defence,	1960, 1970	No data
Polperro	Langreek Stream	20%, 1%	Raised defence, Culverted channel, Maintained channel	1999	No data
	Pol	1%	Raised defence, Culverted channel	1999	No data
Boscastle	Valency	1.3%	Raised defence, Culverted channel, Maintained channel	2008	No data
	Jordan	1%	Raised defence, Culverted channel, Maintained channel	2008	No data
Flexbury		1.3%	Maintained channel, Culverted channel	Scheme under construction	No data
Helebridge	Strat Neet	20%, 4%	Raised defence	Data not available	No data
Bude	Neet	20%	Raised defence, Culverted channel, Maintained channel	Data not available	No data
Stratton	Strat	4%	Raised Defence, Maintained Channel	Data not available	No data

As well as these flood alleviation schemes on rivers, there are a number of places that have significant tidal defences, as shown in Figure 3.8. Wadebridge, Bude and Lostwithiel for example have tidal flood schemes that are designed provide protection up to the 0.5 per cent a.p flood event. Recent Areas Benefiting from Defences mapping using the latest extreme tide level data shows that this standard is not provided by the schemes at Wadebridge, Bude, and Lostwithiel. We have not yet determined what the current standard of these schemes are.

Figure 3.8 Existing flood alleviation schemes (river and tidal)



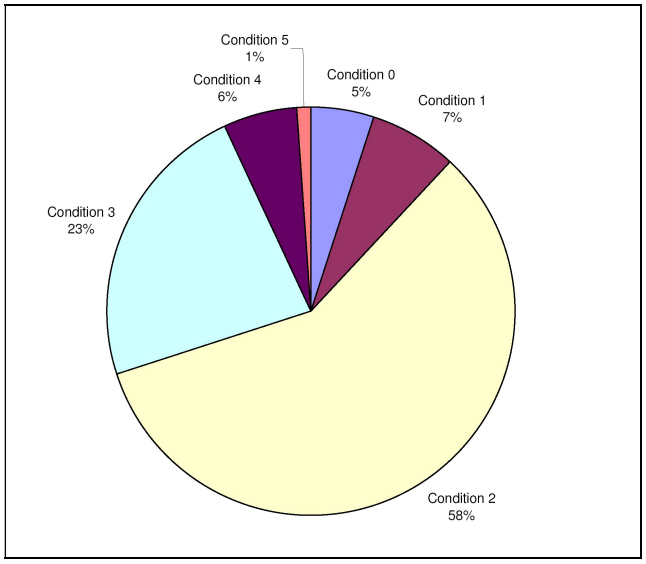
We carry out asset risk assessment work to assess the condition of defences. A score rating of 1 to 5 is assigned with 1 being the highest condition and 5 the lowest. A description of each asset rating is given below.

Condition 1/2: Asset is in good condition and adequate for the standard of service it is supposed to provide. However, the level of flood risk mitigation may not always be appropriate for the specific location.

Condition 3: Asset needs monitoring and or improving through maintenance.
Condition 4: Asset needs significant improvement by improving maintenance, revenue funded improvement or capital schemes.
Condition 5: Asset has failed completely. Major improvements or rebuilds are required.

The cost of completing asset surveys for the year 2007/08 was around £100,000. Figure 3.9 shows the asset conditions for structures and defences across the catchment.

Figure 3.9 Asset Condition (structures and defences)



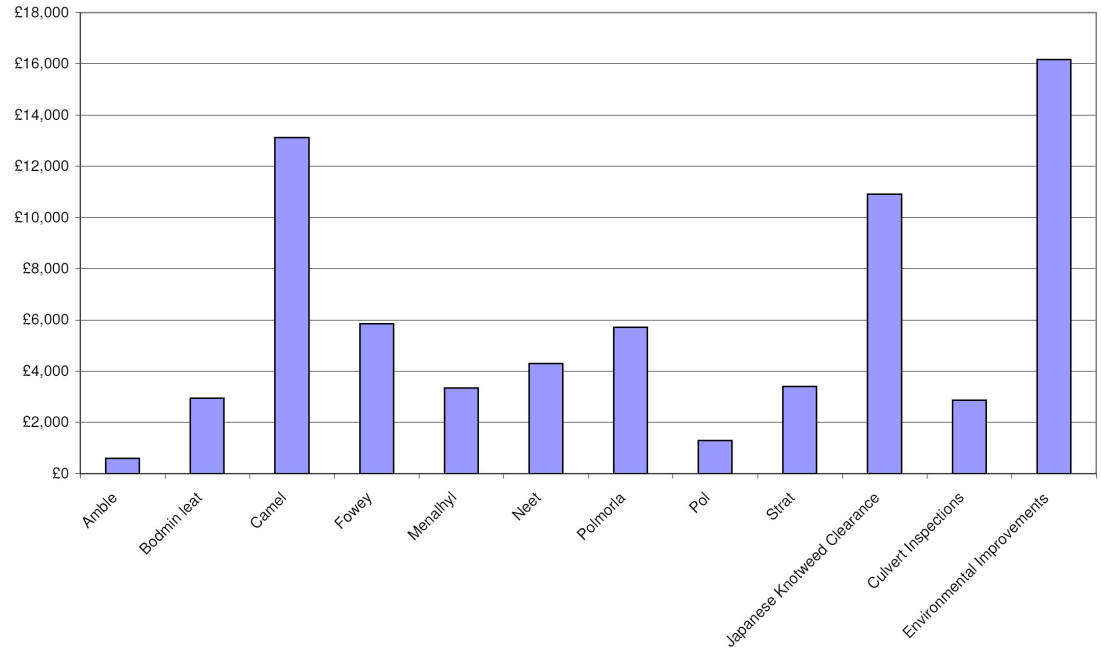
Our Asset Systems Management Team is developing performance specifications for all the Flood Risk Management Systems (flood defences assets) in East Cornwall. These performance specifications, called System Asset Management Plans (SAMPs) will determine the condition (from 1-5) that each scheme should meet in order to provide an appropriate level of protection to the properties they protect.

All flood alleviation schemes need maintaining to reduce the risk of them failing. Last year we spent approximately £127,000 on maintenance work in the East Cornwall area and it is projected that the costs this year will be similar (this does not include emergency callout costs or increased costs due to bad weather conditions). Figure 3.10 gives the maintenance costs expected for the main rivers within East Cornwall for this year, with total catchment costs provided for Japanese Knotweed removal, culvert inspections and environmental improvements.

Most maintenance carried out includes mechanised mowing and strimming of areas of land near to watercourse structures and defences, as well as inspection and safety checks. Following the flooding at Boscastle, additional maintenance work to reduce the risk of bridge blockage was identified in the Valency Valley Tree Management Study.

New schemes and associated new assets are planned for Crackington Haven, and Lostwithiel. A new scheme at Flexbury is currently under construction.

Figure 3.10 Maintenance costs for some Main Rivers



3.5.4 Flood incident management

Where feasible we can provide flood warnings for areas at risk of flooding. The flood warning service is based around a system of rain and river gauge telemetry that is distributed across the catchment.

Where flood forecasting exists, we aim to provide at least two hours warning of imminent flooding to people in designated risk areas. However, this is not always possible as shown in Table 3.18 due to the flashy nature of the East Cornwall rivers. The service involves using a multi-media communication tool called Floodline Warnings Direct (FWD). This provides a system that can target warnings to people via different media methods, including telephone, email and SMS text messaging. We also provide a public access telephone service called Floodline that people can ring to check if there is a flood warning for their area. Flood warnings in force are also listed on our website and updated as the situation changes.

In partnership with Cornwall County Council, we have developed Major Incident Plans (MIPs) for a number of the larger urban areas. We have produced MIPs for areas where a severe event would affect a significant number of people and properties. The areas in East Cornwall with a MIP in place are Wadebridge, Bude, Camelford, Padstow, and Bodmin.

Cornwall County Council and local authorities play their part in incident management by working closely with us when warnings are issued. They are often the first port of call for the public and can sometimes provide sand bags to residents if required.

Work to produce evacuation procedures for small flood prone communities not covered by MIPs is also being undertaken, which is a requirement that has come to light following the Boscastle 2004 event.

Figure 3.11 shows the flood warning telemetry and the flood warning service available in the catchment. It shows the sub-catchments that can receive flood watches. Flood watches cover large areas of the catchment and are issued to warn the public that conditions are expected to create generalised and widespread low impact flooding. This covers all areas at risk from flooding. It also shows the areas where a more specific flood warning service can be provided. These are mainly on larger rivers through settlements.

Figure 3.11 Flood warning service

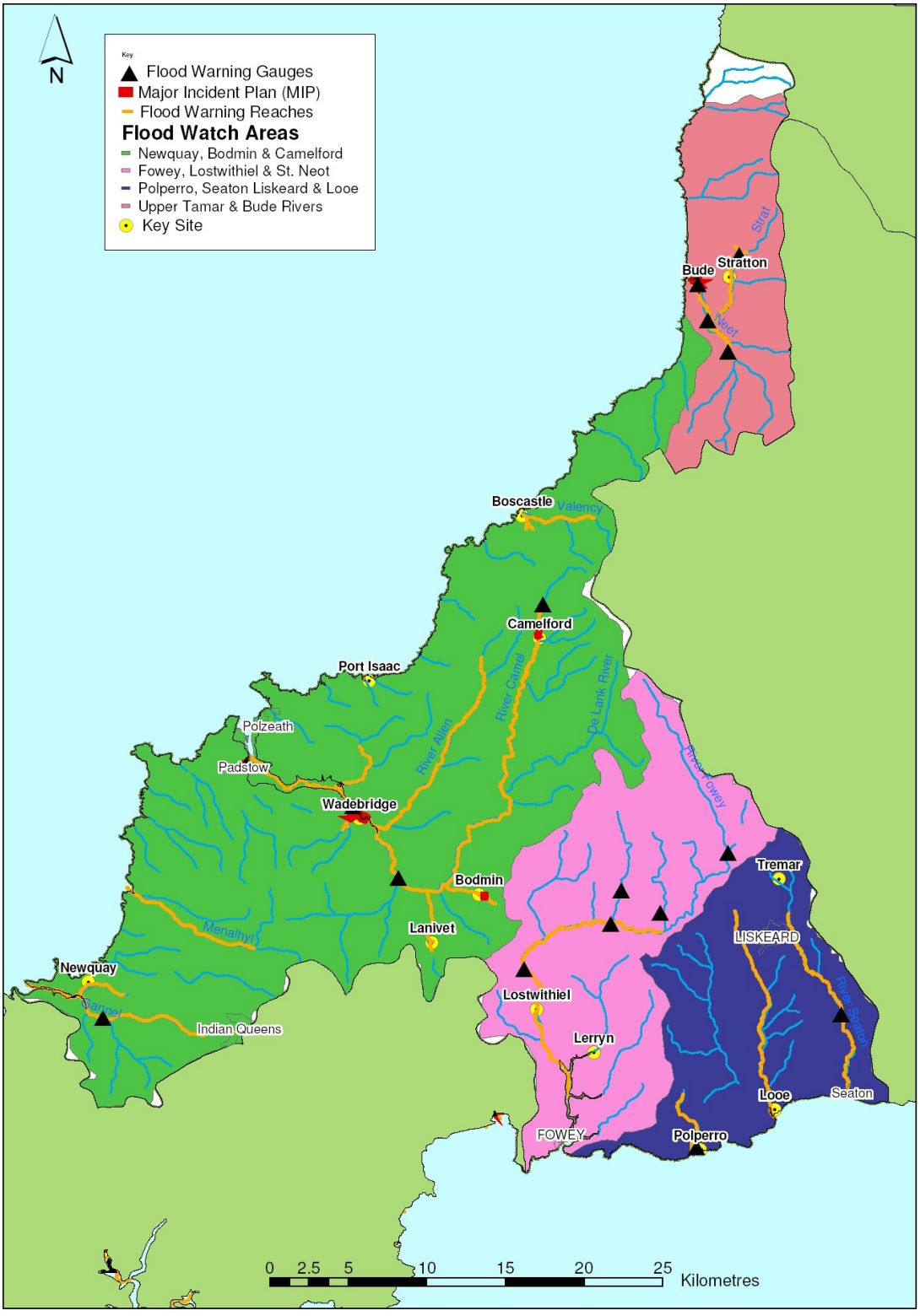


Table 3.18 shows the flood warning service we provide. It shows the number of properties signed up to FWD and the number of properties at risk. There is a facility to sign up to a flood warning area where you have an 'area of interest' (e.g. you may just be outside the area at risk). This is certainly the case with the River Seaton and the River Neet flood warning reaches, where the number of properties signed up to the services are higher than the number properties at risk.

The table clearly shows that encouraging people to sign up to the flood warning service provided on the River Camel and River Fowey could be beneficial in reducing the effects of flood risk along these watercourses.

Other work involves research into identifying rapid response catchments, which was prompted after the Boscastle August 2004 event. A number of trial catchments have been selected for the study, several from the East Cornwall area. This includes the River Valency at Boscastle, the River Pol at Polperro, the River Camel at Padstow / Polmorla, Port Isaac Stream and Crackington Haven.

Any flood warning strategy needs to take into account that many people at risk from flooding in this area will be tourists. They may not be informed of any flood warning measures in place. Following the Boscastle event of August 2004 this is particularly relevant for all areas within rapid response catchments.

Table 3.18 Flood warning service

Flood warning station	FWD Target Area name	FWD number of properties at risk+	Properties signed up to FWD (residential and commercial)	Lead time in hours ++
Slaughterbridge	River Camel from Camelford to Wadebridge	274	50	>2
Slaughterbridge	River Camel At Camelford (MIP)	28	N/A	<6
Denby	River Camel At Wadebridge (MIP)	298	N/A	<6
Penvose	River Allen (Camel) from Penvose to Sladesbridge	41	29	<2
Bodmin RL	Bodmin Town Leat At Bodmin (MIP)	134	N/A	<2
Trekeivesteps	River Fowey from Trekeivesteps to Lostwithiel	117	71	<2
Trebrownbridge	River Seaton from Trebrownbridge to Seaton	4	6	<2
Polperro	River Pol At Polperro	169	0	<2
Woolstone Mill	River Neet from Woolstone Mill to Bude	14	25	<2
Bush	River Neet At Bude	120	55	<6
Bush	River Strat from Bush to Helebridge	45	41	<2

+The numbers of properties at risk are based on July 2008 figures

++Lead times are approximate and will vary according to weather/rainfall patterns, improvements in flood forecasting and antecedent conditions

We have taken the information provided in Section 3 from a wide variety of our own datasets and other sources. We are confident that this data accurately portrays the current flood risk issues within the boundaries of this CFMP. It provides a reliable baseline to compare to future flood risk.

4 Future flood risk

This chapter looks at a range of possible factors that could influence flood risk within East Cornwall over the next 100 years. Future flood risk is likely to increase due to the effects of land use change, urban development pressures and climate change. We have tested how sensitive the catchment is to changes in these factors, as they are likely to alter significantly over time. We can then set appropriate flood risk management strategies to achieve sustainable flood risk management in the future.

4.1 Introduction

There are a number of factors that could affect future flood risk and the location and extent of flooding within East Cornwall over the next 100 years:

- Urban and commercial development: Urban areas are likely to increase across the catchment, resulting in more impermeable surfaces. This can lead to an increase in surface water runoff and a more rapid rise in flows on watercourses that drain these urban areas
- Land use management: More land is required for housing which will reduce the amount of area where rainwater can naturally soak into the ground. Land currently used for agriculture may be poorly managed, degrading the soil structure. These changes to land use and loss of vegetation can lead to an increase in surface water flows and field runoff with a more rapid rise in flows in watercourses that drain these rural areas
- Climate change: Milder, wetter winters and more frequent, heavy rain could increase flows in rivers and increase demands on our urban drainage networks. Rises in sea level could mean that our estuaries experience higher tides and through stormier conditions, greater tide surges. This means the impact of climate change for low-lying estuary and coastal areas could be severe

How these factors might affect flood risk within the catchment is uncertain and so we have undertaken testing to assess how sensitive the catchment is to these types of changes.

Testing each factor at key sites in East Cornwall, we found that all were sensitive to the impacts of climate change and land use management change. Due to the rural nature of the area, only some locations were sensitive to urban development. These were areas where there is already a lot of development, and catchments are small.

Government guidance suggests that we should consider a 0.1 per cent, 1 per cent and 10 per cent annual probability flood when we assess sensitivity to change. We concentrated our sensitivity assessments around the 1 per cent a.p flood event. We did this because we wanted to test relative change at this scale of event to inform our appraisal of possible responses to flood risk. We did not do specific sensitivity testing at the 10 per cent a.p or the 0.1 per cent a.p flood event because the changes we found using the 1 per cent a.p flood event were enough to inform us which catchments are most sensitive.

Climate change
We tested the sensitivity of the catchment to climate change using government guidance available at the time of analysis. We found that all catchments were sensitive to an increase in flows by 20 per cent.

Land use management
The sensitivity of the land to management change was tested using CFMP guidance. We used the Flood Estimation Handbook Rainfall (FEH) Runoff Method to consider the following factors in land use change for key sites in the CFMP area:

- Increased runoff from agricultural land by 15 per cent. This means that 15 per cent more surface water will reach the catchment watercourses through field runoff

- Time to peak reduced by two hours. It will take a watercourse two hours less to reach its highest or peak flow after it starts raining. This was not carried out for some of the catchments because they take less than two hours to peak

Table 4.1 shows that many of the catchments in East Cornwall are sensitive to the way in which the land is managed, particularly because the majority of the catchments are small. At the one per cent a.p flood event, the effect could be to increase flows in watercourses by around 10 per cent on average across East Cornwall.

Table 4.1 Summary of effects of land use change

Catchment to:	Natural per cent runoff from land	Runoff per cent through inappropriate practice (+15 per cent)	Percentage increase in river flow at the 1 a. p. flood
Polperro	32.2	37.0	11
Stratton	39.8	45.8	11
Lerryn	33.1	38.1	9
Port Isaac	39.3	45.2	11
Tremar	25.7	29.6	10
Wadebridge	40	46.0	11
Bude	40.1	46.1	11
Lostwithiel East	31.8	36.6	11
Lostwithiel West	27.7	31.9	11
Bodmin	32	36.8	10
Boscastle	34.5	39.7	11
Newquay	33.9	39.0	10
Camelford	35.5	40.8	11
Lanivet	26.8	30.8	10
East Looe	32	36.8	11
West Looe	32.2	37.0	11

Urban development
We tested sensitivity to urban development by assuming a 10 per cent increase in urban areas at all key sites. This method allowed us to quickly identify that the Bodmin and Newquay areas in the catchment that showed most sensitivity to further development. We found that a 10 per cent increase in urban development around Bodmin could increase flows by 4.5 per cent and in the Newquay area development could increase flows by nearly 6 per cent.

4.2 Future Scenarios

As the long-term changes within the catchment are uncertain and based largely on speculation we cannot accurately predict them. Instead, we have to predict general trends. We can use these trends to work out the amount of change that will affect flood risk in the catchment. We agreed that one future time period would provide us with enough information when assessing future scenarios. We made our assessments for the year 2100, the later of two time periods suggested by the CFMP guidance.

Using the results of our sensitivity testing, we developed scenarios of future change, based on general trends identified for the East Cornwall area.

We have assessed the low, median and high situations for all factors to work out the possible effects. We have mainly considered uniform changes across the catchment, as it is difficult to set specific locations for urban developments on a catchment basis and land use changes for the long-term.

The median level of change shows the most likely result and its effect on flood risk in the catchment. The higher and lower bands set the worst and best-case scenarios for increases to future flood risk. We have considered five scenarios that include different amounts of change for each of these factors and these are given in Table 4.2. We have set these scenarios following feedback from the Scoping Report and the Steering Group.

Table 4.2 Definition of future scenarios

Scenario	Degree of change*		
	Land use	Urban development	Climate change
A	Median	High	High
B	Median	Median	High
C	Median	Median	Median
D	Median	Low	High
E	High	High	High

*Median: current trend
Low: -25 per cent of current trend
High: +25 per cent of current trend

These scenarios identify the range of future baselines. We then worked out the effects they have on the existing flood risk. The low degree of change represents little or no increase, whilst the median situation represents an increase but following the current trends. A high degree of change signifies a large change across East Cornwall. We investigated the low and high trends by decreasing or increasing the median trend by 25 per cent, as suggested by the CFMP guidance.

We have assessed the impact of future scenarios on the 1 per cent, 0.1 per cent and 10 per cent a.p flood in detail at our key sites. Our initial investigations showed that there was a significant increase in flows for the 1 per cent a.p flood and so we have concentrated on looking at this scale of event, applying the findings to the 0.1 per cent a.p flood. We also applied the same findings to the 10 per cent a.p. It was important to assess how this smaller, but more frequent scale of flood event could affect our key sites in the future, particularly those with flood alleviation schemes. This is considered more in Section 4.3.

4.2.1 Urban and commercial development

Development and urbanisation has contributed to flood risk. Development over time in the floodplains of rivers and at low-lying coastal areas has meant that flooding from rivers and the sea in a large number of areas in the catchment has negative effects to people, property, infrastructure and the environment.

In addition, greater areas of paving, less vegetation, extra roofs and drainage have increased the amount of surface water runoff and the speed with which it reaches watercourses, increasing flood risk to these areas.

As more development is planned for East Cornwall, the effects of urbanisation on flood risk could continue. High level plans for development are set out in the Regional Spatial Strategy (RSS), which establishes a regional framework about 'where things go', what the scale of development should be and the links between issues like healthcare, education and crime, as well as basic infrastructure such as transport. The RSS covers future development up to the year 2026, with the aim of protecting what is highly valued about the South West region. At the same time, it aims to provide enough new homes and jobs, retail and leisure facilities to meet the needs of a growing and increasingly affluent population.

The current development proposals extend up to 2026, however they are still in draft. A recent Examination in Public of the RSS has taken place and suggests greater housing allocations than published in the draft RSS. We will not know the final allocations until the RSS is finalised, estimated to be in late 2008.

Local Development Plans for the four local authorities in East Cornwall have been in progress. At the time of writing, the development of the plans is on hold. In 2009 Cornwall will become a unitary authority and at this point a 'One Cornwall' Local Development Plan will be created. However, although development allocations and Local Development Plans have not been finalised, we know that the main areas of development in the catchment will be around Bodmin and Newquay.

In addition to the short term uncertainty regarding housing allocations, we do not know the longer-term proposals for future development (up to the 100 year timescale of the CFMP).

From the sensitivity testing we know that the locations of Bodmin and Newquay are sensitive to further development. As we do not know how many houses will be allocated and where this development will take place, we have assumed a 10 per cent increase in development for both locations by 2100.

The results showed that for a 1 per cent annual flood event occurring in 2100, urbanisation on this scale could increase flows significantly:

- Trenance River in Newquay – 6 per cent increase; could increase flood risk to residential area.
- Bodmin (Bodmin Town Leat) – 4.5 per cent increase. Could increase flood risk to residents and the town centre

We have assumed these results relate to the median growth situation. We investigated the low and high trends by decreasing or increasing the current trends by 25 per cent respectively.

The results obtained, including the low, current and high growth rates are shown in Table 4.3.

Table 4.3 The possible effects of urbanisation

Location	Scenario	Percentage increase in river flows for the 1 per cent annual probability flood
		2100
Bodmin	Low growth rate	4.0
	Current trend	4.5
	High growth rate	5.0
Newquay	Low growth rate	4.5
	Current trend	6
	High growth rate	7.5

Government planning guidance (PPS25) states that new development must not make flood risk worse elsewhere and this should be demonstrated in a Flood Risk Assessment. Using SuDS appropriately is one way that the effects of urbanisation can be reduced by preventing any increase in surface water runoff due to urbanisation. In theory this means that flows should not increase because of new development. However, as a precautionary measure we have selected the median growth situation to reflect the relatively significant development that is likely to occur in these areas of East Cornwall in the future.

4.2.2 Land use management

From our sensitivity testing we found that runoff from the East Cornwall catchment area is sensitive to the way land is managed. As the CFMP area is mainly rural, rural land use and agriculture can play a big role in determining future change. Factors influencing change include soil degradation due to the development of more intensive farming methods, changes to agricultural policy and the expansion of environmental designations and forestry.

In developing our future scenario for land management we have considered the following pressures and influences that could occur in the catchment over future years:

- opening of world markets, making agriculture in the UK less economically viable
- shift to other farming practices, driven by market forces
- shift in consumer needs
- drive to improve environmental habitats and landscape
- drive to reduce CO_2 emissions by using bio fuels and carbon sinks
- increasing fuel prices, making the import of produce uneconomic
- Common Agricultural Policy reform (introduction of Single Farm Payment System (SPS)) and future agricultural policy changes

It is difficult to quantify how most of these pressures and influences will affect land use at a catchment scale. So, we have focused our assessment on the way farming can affect flood risk by increasing runoff and how the introduction of the SPS could reduce this.

We think that the amount of land used for agriculture today will stay broadly the same in the future, as over 80 per cent of the land is already used for arable production or is grassland that can be used for grazing. Areas of the catchment are also protected through environmental designations. There are no current plans to significantly change the current levels of woodland in the area.

Current agricultural activities can potentially affect flood risk by the way in which the land is managed. We can already see this happening, with incidents of field runoff causing road and property flooding recorded at number of locations across the catchment. This is linked to the process of farming land more intensively, which can increase the vulnerability of soils to degradation and as a result, increased runoff. Field runoff has the potential to cause flooding independently of rivers, and this is the current trend in parts of East Cornwall.

The link between land management practices and localised runoff is well documented. The potential impact on broader catchment flooding is less well defined and needs more research.

The results of our sensitivity testing showed that an increase in runoff of 15 per cent, combined with a reduction in the time it takes flows to peak, could lead to an average increase in flows of 10 per cent. CFMP guidance states that this should be considered as the current trend.

The increase in flows for the low and high rate of land use change were calculated and are shown in Table 4.4.

Table 4.4 Impact of land use change on river flows

Location	Scenario	Percentage increase in river flows for the 1 per cent annual probability flood
		2100
East Cornwall catchment	Low growth rate	7.5
	Current trend	10
	High growth rate	12.5

Good land management practice could reduce these flows by returning the soil structure to its natural state and therefore increasing the amount of water that it can hold through infiltration. This means that the amount of runoff from the land in each catchment could return its natural rate.

Changes in the way the land is used in the future will have a significant effect on flood risk within East Cornwall at a catchment scale. Local land use changes should be investigated in detail to make sure we manage the land correctly and that runoff is not increased.

We have taken forward the current trend into the development of our future scenario as we believe this represents a realistic assessment of how current land management practices influence catchment behaviour.

4.2.3 Climate change

The results of our sensitivity testing have shown us that climate change will have an impact on flood risk across the catchment. It is widely accepted that climate change is happening and it is predicted to have a significant effect on flooding in the UK in the 21st century.

The South West Region Climate Change Impacts Scoping Study, initiated by the South West Climate Change Impacts Partnership (SWCCIP), highlights predicted changes in climate in the South West over the next 75 years. It includes the following:

- annual average precipitation could decrease by as much as 15 per cent over the next 75 years, with heavy rainfall in winter becoming more common and spring rainfall more varied
- summers could be 25 to 55 per cent drier by 2100, although there could be more intense, stormier rainfall, for example thunderstorms, which could cause problems for drainage networks and increase surface water runoff
- winters could be wetter by up to 30 per cent, with 70 to 90 per cent less snow falling by 2100

The effects of climate change are highlighted in the region's State of the Environment Report, which is led by the Environment Agency in conjunction with other environmental organisations. A summary of its findings are below:

- a northward shift of natural habitats by 50km - 80km per decade
- wetland habitats drying out
- a sea level rise of 20cm by 2030 would affect freshwater habitats, sea defences and make tidal flooding happen more often
- increases in both the amount of winter rainfall and the intensity of storms could increase the risk of flooding
- a longer growing season

The possible impacts of climate change on flood flows are still being investigated. The latest guidance given by Defra is in FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities – Climate Change Impacts, October 2006. This suggests dealing with climate change by increasing the magnitude of peak river flows by up to 20 per cent to 2115.

Climate change is not only increasing river flows; it is also causing sea levels to rise. This could result in more incidents of tide-locking of watercourses draining to the sea and an increase in the existing risks from tidal flooding. To assess the risk of rising sea levels, an average increase of 5mm a year has been applied as stated in CFMP guidance (June 2006) and shown in Table 4.5.

Table 4.5 Impact of climate change on river flows and sea level (2100)

Impact of Change	Peak River Flow	Sea Level Rise
High	+20 per cent	+500mm

Since the publication of the CFMP guidance, the Defra guidance (October 2006) detailed above has been published. This suggests a greater allowance of sea level rise per year should be made, resulting in a total allowance of 967mm to be made over a 100 year period. We have considered this to see how much it would impact on our future scenario predictions. We do not think that it would directly affect any outcomes of the CFMP including which locations are expected to experience the greatest impact from sea level rise. These locations will continue to be Looe, Fowey, Lostwithiel, Wadebridge and Padstow.

4.2.4 Summary

We have predicted future situations based on what we understand about the catchment now and the latest research available on future trends. We have generally been cautious about the amount of future changes to make sure that we have considered a suitably extreme situation to adequately test how sensitive the catchment is.

We know that climate change is happening and that we have little control over the effect it will have in the future. Therefore, we have looked at the worst-case scenario (high degree of change).

Land use management is important across East Cornwall and we have investigated the current situation along with likely change. As the links between land management and flood risk are still unclear on a broad scale, we do not know how successful improving land management practices will be in reducing runoff from the land. We have therefore selected the median level of change (current trend) within our future scenario as we know that runoff from land in some areas of East Cornwall today is greater than its natural rate.

There are urban development pressures within the area, although they are not widespread. In general terms urban development in East Cornwall is below the national average and not a dominant driver of change across the catchment, however it could have significant effects in the designated growth areas. We have reviewed Local Development Plans where development is planned and catchments are sensitive to urban development. It is clear that Bodmin and Newquay will be the main growth areas; however the final allocations are unclear at present. Across the catchment we have selected the median level of change to reflect the broad proposals for development.

This means for the East Cornwall catchment we are basing our assessment of future flood risk on Scenario B. This is shown in Table 4.6.

Table 4.6 Future scenario selection

Scenario	Degree of Change*		
	Land Use	Urban Development	Climate Change
B	Median	Median	High

4.3 Assessment of Future Flood Risk

We can assess flood risk in East Cornwall in the future by using the scenarios selected above. We finalised this after consulting with the Steering Group. Our investigations have highlighted that climate change, both in terms of increased river flows and sea level rise, and land use change is likely to have the largest effect on future flood risk. Urbanisation will have an effect in a small number of places.

We have investigated the impacts of the future risk at the same key sites using the same sources of flooding that we investigated in Chapter 3. We have assessed increased flood risk from rivers using a combination of the factors influencing change under Scenario B to calculate an estimated percentage increase in river flows in 2100. Using Light Detection and Ranging (LiDAR) Digital Terrain Model (DTM) data, we have then applied the calculated percentage increase in flow to the current flood map

(as the best indicator of current flood risk) in each location to find the lateral increase in flood extent under the future scenario. This has created a one per cent annual probability flood extent at key sites for the year 2100. We have also applied this method to find the lateral increase in flood extent under the future scenario for the 0.1 per cent and 10 per cent a.p flood event.

We have found that increased river flows result in increased flood extents in some sites. In other sites the increase in extent is limited by the incised nature of many of the river valleys in the East Cornwall area. Increases in flood extent were most significant in Bude, Lostwithiel, Lanivet and Wadebridge. The depth of flooding increased at all key sites.

The impact of sea level rise has been estimated using LiDAR with the high scenario sea level rise allowance shown in Table 4.5 above. We found that increased sea level rise increased flood extents though this is limited by the incised nature of the ria estuaries in East Cornwall.

Using this information we have identified that key sites Wadebridge, Lostwithiel and Looe and will be at most risk from rising sea levels. We have also identified Padstow, Polzeath and Fowey as additional locations that may experience a future increase in the frequency of flooding.

We have used the information from the key sites to build up a picture of how the future scenario may affect flood risk across East Cornwall. A summary of the scenarios and their likely impacts can be found in Table 4.7.

Table 4.7 Summary of possible future impacts

Scenario	Impact
Climate change: River flows	River flows could increase by 20 per cent. In general, this could cause flood extents to increase laterally by up to 10 metres, although the specific increase in flood extents will vary between each catchment due to the characteristics of the watercourse and the topography of each catchment. Where narrow valleys limit floodplains it is likely that the increase in flows will result in deeper flooding rather than increased extent. Depths of flooding could increase by up to 1m, depending on the local surroundings.
Climate change: Sea level rise	Much of the East Cornwall catchment is not affected by tidal flooding due to the presence of high cliffs. However, modelling has shown that there will be increases in flood extent in low-lying coastal areas such as Looe, Polperro, Bude, Wadebridge, Polzeath, Fowey and Lostwithiel.
Climate change: Surface water	Incidents of surface water flooding are likely to increase if climate change predictions about the increasing intensity of rainfall are realised. Unless significant improvements are made to the drainage systems in locations already experiencing surface water flooding, the places we expect to be increasing vulnerable to this source of flooding are Bodmin, and Wadebridge.
Urbanisation	Investigations have shown that urbanisation could result in up to a 6 per cent increase in river flows in specific locations. This is not significant across the CFMP area as a whole, however at a local scale this is important, as reflected by the modelling at key locations. The main effects of urbanisation are likely to be felt at a local level due to increased surface water runoff and the impact on local drainage systems.
Land use change	In general flows could increase by around 10 per cent due to changes in land management. This could cause flood extents to increase laterally by around 5m, although the specific increase in flood extents will vary between each catchment due to the characteristics of the watercourse and the topography of each catchment. Depths of flooding could increase by up to 0.5m, depending on the local surroundings. At the catchment scale this is important, as reflected by the modelling at key locations.

We have been able to undertake some limited analysis to find out how sensitive our predictions of future change are to the future scenario we have chosen. Based on numbers of residential properties at risk, we have found that because our flood risk areas are relatively limited in extent due to the topography of the ground, changing our future scenario does not make a significant difference to the future numbers of properties at risk that have been estimated.

It should be noted that Table 4.7 provides an overview of the entire East Cornwall area and the results are based on assumptions made based on findings at the key sites and so they are only approximate. We would need more detailed information such as specific Flood Risk Assessments to be accurate about the effects each factor will have on flood risk at a local level. The Environment Agency and local authorities are responsible for assessing flood risk.

4.3.1 Flood risk to people

An increase in the annual probability flood extent is likely to affect more people across the catchment. Here we consider the increases in people at risk in 2100 compared to the people at risk now for the three flood events considered in Section 3.3.

Table 4.8 shows the increase in the number of people in key sites that could be at risk from flooding in 2100 from a 10 per cent a.p. flood event.

Table 4.8 Comparison of people at risk from 10 per cent a.p flood event now to 2100

Key site	Main source of flood risk	Number of people at risk now	Number of people at risk in 2100	Increase in number of people at risk	Percentage increase of people at risk
Bodmin	Bodmin Town Leat	-	-	0	0
Boscastle	Valency/Jordan	-	-	0	0
Bude	Neet/Tidal	-	220	98	n/a*
Camelford	Camel	-	-	0	0
Lanivet	Lanivet	-	9	9	n/a*
Lerryn	Unnamed watercourse	2	10	8	400
Looe	Tidal	187	200	13	7
Lostwithiel	Fowey/Tidal	-	172	172	n/a*
Newquay	Trenance	-	-	0	0
Polperro	Pol	-	-	0	0
Port Isaac	Port Isaac Leat	5	23	18	360
Stratton	Strat	-	77	77	n/a*
Tremar	Unnamed watercourse	99	101	2	2
Wadebridge	Camel (Tidal)	-	236	236	n/a*

* no residential properties at risk in current 10 per cent a.p flood extent so percentage cannot be calculated

This shows that flood risk to people for this event is likely to increase mainly at Wadebridge, Lostwithiel, Bude and Stratton, with increases also at Lanivet, Lerryn, Port Isaac, and Looe.

Lostwithiel and Stratton currently have defences protecting against a 10 per cent a.p. event, but this is estimated to be insufficient to protect against a future 10 per cent a.p. event. This would expose people to a risk of flooding that does not exist at present. This is explained in detail in Section 4.3.2

Lostwithiel, Bude, Looe and Wadebridge are at risk from tidal flooding. Defences at Wadebridge, Bude and Lostwithiel are of an unknown standard, so we have assumed they will not protect against a future 10 per cent a.p. flood event.

Table 4.9 shows the increase in the number of people in key sites that could be at risk from flooding in 2100 from a 1 per cent a.p. (river) 0.5 per cent a.p. (tidal) event.

Table 4.9 Comparison of people at risk from 1% a.p (river) 0.5% a.p. (tidal) flood event now to 2100

Key site	Main source of flood risk	Number of people at risk now	Number of people at risk in 2100	Increase in number of people at risk	Percentage increase of people at risk
Bodmin	Bodmin Town Leat	-	214	214	n/a*
Boscastle	Valency/Jordan	101	103	2	2
Bude	Neet/Tidal	248	309	61	25
Camelford	Camel	16	16	0	0
Lanivet	Lanivet	25	59	34	136
Lerryn	Unknown	25	25	0	0
Looe	Tidal	232	232	0	0
Lostwithiel	Fowey/Tidal	200	221	21	10
Newquay	Trenance	63	90	27	43
Polperro	Pol	-	205	205	n/a*
Port Isaac	Port Isaac Leat	34	34	0	0
Stratton	Strat	108	112	4	3
Tremar	Unknown	117	117	0	0
Wadebridge	Camel (Tidal)	450	478	28	6

* no residential properties at risk in current 1 per cent a.p flood extent so percentage cannot be calculated

This shows that flood risk to people is likely to increase significantly at Bodmin, Bude, Lanivet, Newquay, and Polperro, with smaller increases at Boscastle, Lostwithiel, Stratton and Wadebridge.

In locations where steep valley sides bound the floodplain we do not expect the numbers of people at flood risk to change significantly, such as at Looe or where there are a few properties, such as at Lerryn.

Table 4.10 shows the increase in the number of people in key sites that could be at risk from flooding in 2100 from a 0.1 per cent a.p. event.

Table 4.10 Comparison of people at risk from 0.1% a.p. flood event now to 2100

Key site	Source of flood risk	Number of people at risk now	Number of people at risk in 2100	Increase in number of people at risk	Percentage increase of people at risk
Bodmin	Bodmin Town Leat	214	214	0	0
Boscastle	Valency/Jordan	104	106	2	2
Bude	Neet/Tidal	347	432	85	25
Camelford	Camel	16	16	0	0
Lanivet	Lanivet	81	90	9	11
Lerryn	Unknown	25	25	0	0
Looe	Tidal	232	232	0	0
Lostwithiel	Fowey/Tidal	239	263	24	10
Newquay	Trenance	115	137	22	19
Polperro	Pol	216	232	16	7
Port Isaac	Port Isaac Leat	34	34	0	0
Stratton	Strat	115	119	4	4
Tremar	Unknown	117	117	0	0
Wadebridge	Camel (Tidal)	491	521	30	6

This shows that Bude and Newquay have the largest increases in people at risk, with smaller increases at Boscastle, Lostwithiel, Polperro, Stratton, Lanivet and Wadebridge.

Overall, Bude and Wadebridge stand out as the key sites with the greatest number of people at risk. Camelford, Tremar and Looe will have no more people at risk from a 0.1 per cent a.p. flood event than from a 1 per cent a.p. flood event (0.5 per cent for Looe), though Looe will have significantly more people at risk.

In future, we can expect the most significant increase in flood risk to people at defended and tidal locations.

Table 4.11 shows the estimated percentage of people in each key site affected by flooding of a 1 per cent a.p. (river) 0.5 per cent a.p. (tidal), and a 0.1 per cent a.p. flood event in 2100 in all the key sites.

This also shows the speed of onset of flooding for the key sites. We estimate that the ranges of speed of onset for each key site are unlikely to change for 2100.

Table 4.11 Percentage of residents affected by flooding and speed of flooding onset in 2100

Key site	Estimated number of people in community	Percentage of people affected		Speed of onset*
		1%^ a.p.	0.1% a.p.	
Bodmin	13,160	2	2	Fast
Boscastle	1,154	9	9	Moderate
Bude	5,370	6	8	Slow
Camelford	1,584	1	1	Slow
Lanivet	881	7	10	Moderate
Lerryn	360	7	7	Slow
Looe^	4,961	5	5	Moderate
Lostwithiel^	1,591	14	17	Moderate
Newquay	11,260	1	1	Fast
Polperro	604	34	38	Moderate
Port Isaac	1,278	3	3	Moderate
Stratton	1,558	7	8	Moderate
Tremar	924	13	13	Fast
Wadebridge^	6,834	7	8	Moderate

*Onset ranges
Fast = < 1.5 hours time to peak
Moderate = 1.5 - 4 hours time to peak
Slow = > 4 hours time to peak.
^ Key sites with tidal flooding dominant are affected by 0.5 per cent a.p. flood event rather than a 1 per cent a.p. flood event.

Where the numbers of people at risk of flooding in 2100 have increased we would expect a greater percentage of the community to be affected by a flood. This is particularly true where a flood alleviation scheme with a 1 per cent a.p flood event today is likely to be exceeded by a 1 per cent a.p flood in 2100. This is the case for Bodmin, Polperro and Boscastle.

Polperro has the greatest future increase in the number of people affected by flooding; estimated to be none at risk from a 1 per cent a.p flood event, but over one third of the community at risk for the same event in 100 years time.

Boscastle would have around 9 per cent of its community experience flooding, with Bodmin having relatively few of its residents affected by flooding at just 2 per cent.

We have also considered the depth of floodwater when we assess risk. Deeper flooding suggests that there could be more injuries and an increased risk to life. Table 4.12 shows the expected increase in maximum depths of flooding at key sites for the future 1 per cent a.p (river) 0.5 per cent a.p. (tidal) flood event in 2100.

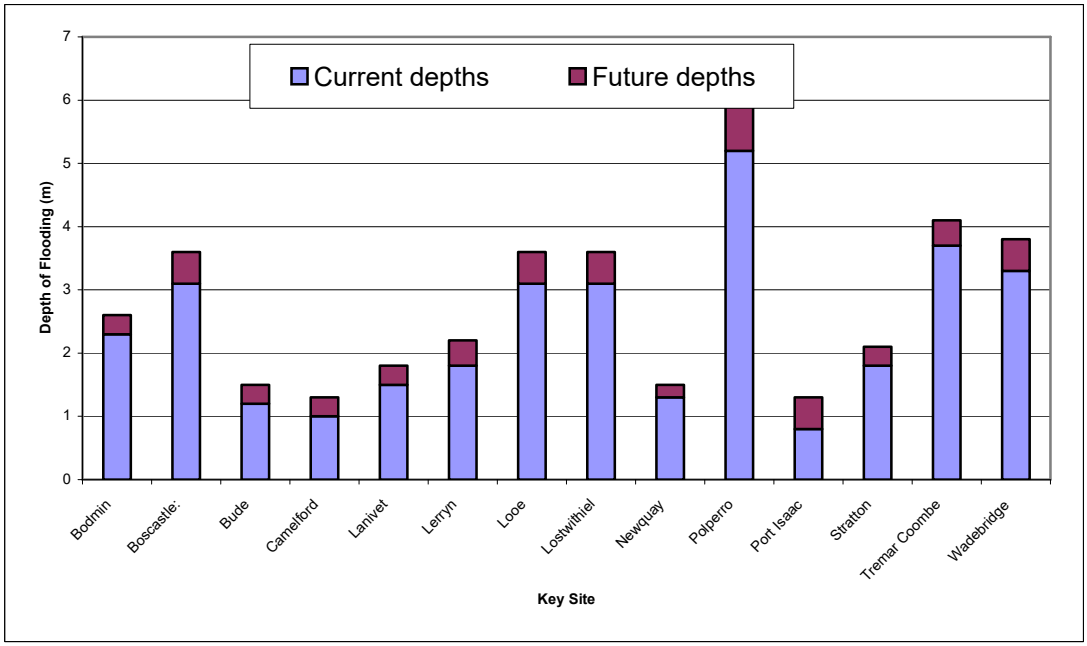
Table 4.12 Estimated increases in flood depth expected by 2100

Key site	Average increase in the depth of maximum flooding (m)
Bodmin	0.3
Boscastle	0.5
Bude	0.3
Camelford	0.3
Lanivet	0.3
Lerryn	0.4
Looe	0.5
Lostwithiel	0.5
Newquay	0.2
Polperro	1.2
Port Isaac	0.5
Stratton	0.3
Tremar	0.4
Wadebridge	0.5

This shows a minimum depth increase of about 0.3m, with significant increases at Polperro.

These average future increases in depths are added to the estimated maximum depths at key sites now, to give an estimated maximum depth in the future. This is shown in Figure 4.1.

Figure 4.1 Comparison of the estimated maximum depths of flooding for key sites



These increased maximum flood depths can now be used to assess flood hazard at our key sites in 2100, using the same method described in Section 3.3. This is shown in Table 4.13.

Table 4.13 Future maximum flood hazard at key sites

Key site	Maximum depth in floodplain (m)	Estimated velocity in floodplain (m/s)	Flood hazard	Flood hazard increase
Bodmin	2.6	<0.25	Moderate	Increase
Boscastle	3.6	0.5	Extreme	Increase
Bude	1.5	0.5	Significant	Increase
Camelford	1.3	0.25	Significant	Increase
Lanivet	1.8	0.25	Moderate	No change
Lerryn	2.2	0.5	Significant	No change
Looe	3.6	0.5	Extreme	Increase
Lostwithiel	3.6	0.5	Extreme	Increase
Newquay	1.5	0.5	Significant	No change
Polperro	6.4	0.5	Extreme	Increase
Port Isaac	1.3	0.5	Moderate	No change
Stratton	2.1	0.5	Significant	No change
Tremar	4.1	0.25	Significant	No change
Wadebridge	3.8	1.0	Extreme	No change

Flood Hazard Ranges:
Moderate: Danger for some including children, the elderly and infirm.
Significant: Danger for most including the general public
Extreme: Danger for all including emergency services

We can see from Table 4.13 that we expect the hazard caused by flooding to increase in Bodmin, Boscastle, Bude, Camelford, Looe, and Lostwithiel. The increase in hazard at Bodmin is due to the fact that it is likely that the flood alleviation scheme will be exceeded in a 1 per cent a.p flood event in 2100, therefore, where we show No hazard for the current situation, in the future this is a Moderate Hazard. This is also the case at Polperro, where we expect an Extreme Hazard to be posed from flooding in 2100. The locations where flooding could pose the greatest hazard and the greatest risks to life are Boscastle, Looe, Lostwithiel and Wadebridge.

Social vulnerability

We know from current information that social flood vulnerability levels within East Cornwall are mainly between 3 and 4, with a small number of people at level 5 most at risk of suffering long- term damage from flooding. We do not know how vulnerability levels will change with time across the area, but we can say that if they remain at a similar level then the impact of flood risk will be felt more widely and to a greater extent in the future.

Social/community assets

We have also assessed the community assets that could be at risk in the future due to increased flood extents. There is unlikely to many community assets affected from a 1 per cent annual probability river flood in the future, however increased tidal flood extents due to sea level rise could mean that an

additional number are at risk. These assets include banks and a social club in Wadebridge, two museums, a dentist and the Seaman's Mission in Padstow, a fire station and church in the Bude area and a post office in Lerryn.

Possible actions to reduce the risks to people due to flooding from rivers and the tide include:

- timely flood warnings and evacuation plans (where appropriate)
- maintenance (and improvements) to existing flood alleviation schemes
- attenuation of water using upland storage, and wetlands
- land management improvements to reduce runoff from farmland
- adherence to the requirements of PPS25 to avoid increasing the numbers of people and vulnerable assets in flood risk locations.

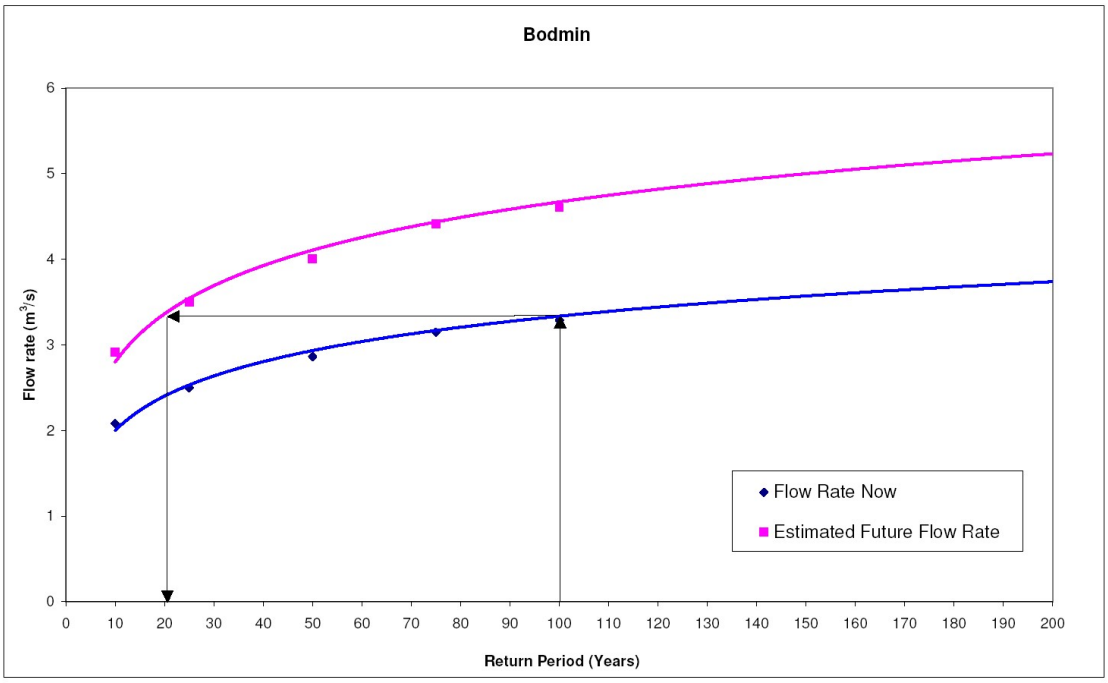
4.3.2 Risks to property, assets and infrastructure

An increase in both flood extents and depth mean that more properties and more agricultural land are likely to be affected by flooding. Existing flood alleviation schemes are likely to be exceeded by increased flows.

We have assessed the flood alleviation schemes that currently provide protection from the 10 per cent a.p flood event and the 1 per cent a.p flood event to find out how the level of protection they provide may be affected by future flows.

As an example, the assessment undertaken for Bodmin is shown in Figure 4.2.

Figure 4.2 Estimated future standard of protection offered by existing flood alleviation scheme in Bodmin



The results tell us the level of protection provided by the scheme may reduce to a 5 per cent a.p flood event (shown as 1 in 20 year event in Figure 4.2). The results for all the key sites are shown in Table 4.14.

Table 4.14 Estimated future standard of protection of existing flood alleviation schemes

Key site	Source of flood risk with alleviation scheme	Current flood alleviation protection (% a.p flood event)	Future flood alleviation protection (% a.p flood event)	Protection from future 10% a.p flood event?	Protection from future 1% or 0.5% a.p flood event?
Bodmin	Bodmin Town Leat	1.0	5.0	YES	NO
Boscastle	Jordan	1.0	1.3	YES	NO
	Valency	1.3	1.7	YES	NO
Bude	Neet	Unknown	Unknown	Unknown	NO
	Tidal	Unknown	Unknown	Unknown	NO
Camelford	Camel	2.5	7.7	YES	NO
Lanivet	Lanivet	10.0	20.4	NO	NO
Lerryn	Unknown	No scheme	n/a	n/a	n/a
Looe	Tidal	No scheme	n/a	n/a	n/a
Lostwithiel	Fowey	2.0	7.7	YES	NO
	Tidal	Unknown	Unknown	Unknown	NO
Newquay	Trenance	2.0	6.3	YES	NO
Polperro	Pol	1.0	3.2	YES	NO
Port Isaac	Port Isaac Leat	No scheme	n/a	n/a	n/a
Stratton	Strat	4.0	11.1	NO	NO
Tremar	Unknown	No scheme	n/a	n/a	n/a
Wadebridge	Camel	1.0	3.2	YES	NO
	Tidal	Unknown	Unknown	Unknown	NO

This demonstrates that the level of protection provided by all of the existing schemes will decrease. Some schemes will still be able to protect from the 10 per cent a.p flood event in 2100, but none of the schemes will be able to provide protection from the 1 per cent a.p flood event in 2100. The exact level of protection that they will provide in the future needs detailed modelling which is not part of the CFMP.

Although we cannot be confident with the exact standards we have estimated, we can be confident in about where we should take existing defences into account when calculating future damages. This allows us to directly compare future damage estimates against current damage estimates taking defences into account.

The estimated Annual Average Damages in 2100 are shown in Table 4.15.

Table 4.15 Economic flood damages for key sites – Annual Average Damage in 2100

Key site	Annual Average Damage (Commercial) (£)	Annual Average Damage (Residential) (£)	Total damages (£)
Bodmin	82,832	224,830	307,662
Boscastle	74,720	98,268	172,988
Bude	365,793	156,769	522,562
Camelford	123,111	3,808	126,919
Lanivet	3,834	23,547	27,381
Lerryn	0	3,134	3,134
Looe	1,199,135	163,518	1,362,653
Lostwithiel	81,370	127,461	208,830
Newquay	0	37,774	37,774
Polperro	422,705	450,754	873,458
Port Isaac	3,812	14,392	18,151
Stratton	22,035	66,104	88,139
Tremar	0	143,181	143,181
Wadebridge	1,378,292	999,722	1,722,865

Annual Average Damages are greatest where there are most properties at risk of flooding. Wadebridge and Looe both have estimated annual averages damages of over £1 Million. Lerryn has the least Annual Average Damage with an estimated £3,000.

Table 4.16 shows that an increase in flooding at some key sites is expected for the 10 per cent a.p flood event in 2100. Table 4.16 also presents the number of properties estimated to be at risk of flooding from a 10 per cent a.p flood event in 2100. The table also shows the percentage by which this has increased compared to the numbers of properties at risk from the same flood event now.

Table 4.16 Properties at risk from 10 per cent a.p flood event in 2100

Key site	Number of commercial properties at risk			Number of residential properties at risk			Total number of properties at risk		
	Now	2100	Increase (%)	Now	2100	Increase (%)	Now	2100	Increase (%)
Bodmin	0	0	0	0	0	0	0	0	0
Boscastle	0	0	0	0	0	0	0	0	0
Bude	0	36	n/a*	0	98	n/a*	0	133	n/a*
Camelford	0	0	0	0	0	0	0	0	0
Lanivet	0	0	0	2	4	n/a*	2	4	n/a*
Lerryn	0	0	0	2	4	100	2	4	100
Looe	45	92	104	5	89	1680	50	181	262
Lostwithiel	0	10	n/a*	0	76	n/a*	0	86	n/a*
Newquay	0	0	0	0	0	0	0	0	0
Polperro	0	0	0	0	0	0	0	0	0
Port Isaac	1	1	0	1	10	900	2	11	450
Stratton	0	3	n/a*	0	34	n/a*	0	37	n/a*
Tremar	0	0	0	42	45	7	42	45	7
Wadebridge	0	136	n/a*	0	105	n/a*	0	241	n/a*

* no commercial/residential properties at risk in current 10 per cent a.p flood extent so percentage cannot be calculated

The increase in properties at risk of flooding at a 10 per cent a.p flood event in 2100 is reflected in the damage estimates calculated for this scale of event. These are shown in Table 4.17.

Table 4.17 Commercial and residential damages estimated from a 10 per cent a.p. flood event in 2100

Key site	Commercial damages (£)			Residential damages (£)			Total damages (£)		
	Now	2100	Increase	Now	2100	Increase (%)	Now	2100	Increase (%)
Bodmin	0	0	0	0	0	0	0	0	0
Boscastle	0	0	0	0	0	0	0	0	0
Bude	0	7,272,410	n/a*	0	2,552,404	n/a*	0	9,824,814	n/a*
Camelford	0	0	0	0	0	0	0	0	0
Lanivet	0	0	0	43,165	106,907	147	43,165	106,907	147
Lerryn	0	0	0	24,259	34,196	41	24,259	34,196	41
Looe	6,324,588	20,947,034	230	256,850	2,718,504	958	6,581,438	23,665,538	260
Lostwithiel	0	912,888	n/a*	0	1,948,191	n/a*	0	2,861,079	n/a*
Newquay	0	0	0	0	0	0	0	0	0
Polperro	0	0	0	0	0	0	0	0	0
Port Isaac	58,846	58,846	0	18,304	188,895	932	77,150	239,934	211
Stratton	0	314,929	n/a*	0	1,004,625	n/a*	0	1,319,554	n/a*
Tremar	0	0	0	1,302,638	1,562,057	20	1,302,638	1,562,057	20
Wadebridge	0	25,091,141	n/a*	0	7,006,404	n/a*	0	32,097,546	n/a*

* no commercial/residential properties at risk in current 10 per cent a.p flood extent so percentage cannot be calculated

Table 4.18 shows that an increase in flooding at all key sites is expected for the 1 per cent a.p or 0.5 per cent a.p flood event in 2100. Table 4.18 presents the number of properties estimated to be at risk

of flooding from a 1 per cent a.p or 0.5 per cent a.p flood event in 2100. The table also shows the percentage by which this has increased compared to the numbers of properties at risk from the same flood event now.

Table 4.18 Properties at risk from 1 per cent a.p or 0.5 per cent a.p flood event in 2100

Key site	Number of commercial properties at risk			Number of residential properties at risk			Total number of properties at risk		
	Now	2100	Increase (%)	Now	2100	Increase (%)	Now	2100	Increase (%)
Bodmin	0	35	n/a*	0	95	n/a*	0	130	n/a*
Boscastle	29	35	21	27	46	70	56	81	45
Bude	33	61	85	110	137	25	143	198	38
Camelford	19	19	0	2	7	250	21	26	24
Lanivet	0	4	n/a*	14	26	86	14	30	114
Lerryn	0	0	0	3	11	267	3	11	266
Looe^	138	138	0	49	103	110	187	241	29
Lostwithiel^	9	63	600	89	98	10	98	161	64
Newquay	0	0	0	26	40	54	26	40	54
Polperro	0	85	n/a*	0	91	n/a*	0	177	n/a*
Port Isaac	1	2	100	12	15	25	13	17	30
Stratton	4	6	50	40	50	25	44	56	27
Tremar	0	0	0	49	52	6	49	52	6
Wadebridge^	126	154	22	200	212	6	326	366	12

* no commercial/residential properties at risk in current 10 per cent a.p flood extent so percentage cannot be calculated

^ Key sites with tidal flooding dominant are affected by 0.5 per cent a.p. flood event rather than a 1 per cent a.p. flood event.

Table 4.19 shows the estimated future commercial and residential damages we can expect in 2100.

Table 4.19 Estimated commercial and residential damages from a 1 per cent and 0.5 per cent a.p. flood event in 2100

Key site	Commercial damages (£)			Residential damages (£)			Total damages (£)		
	Now	2100	Increase (%)	Now	2100	Increase (%)	Now	2100	Increase (%)
Bodmin	0	1,571,765	n/a*	0	4,266,218	n/a*	0	5,837,983	n/a*
Boscastle	1,367,012	1,417,839	77	612,253	1,864,669	205	1,979,265	3,282,508	66
Bude	6,733,713	6,941,048	3	2,363,337	2,974,735	25	9,097,050	9,915,784	9
Camelford	1,767,949	2,336,078	32	67,396	72,246	7	1,835,345	2,408,328	31
Lanivet	0	72,745	n/a*	395,953	446,822	13	395,953	519,567	31
Lerryn	0	0	0	39,763	59,478	50	39,763	59,478	50
Looe	19,395,402	22,753,976	17	2,517,133	3,102,815	23	21,912,535	25,856,792	18
Lostwithiel	845,267	1,544,018	83	1,803,881	2,418,610	34	2,649,148	3,962,628	50
Newquay	0	0	0	582,737	716,767	23	582,737	716,767	23
Polperro	0	8,020,963	n/a*	0	8,553,200	n/a*	0	16,574,163	n/a*
Port Isaac	59,348	72,328	22	219,645	272,094	24	278,993	344,423	23
Stratton	366,196	418,114	14	1,168,169	1,254,343	7	1,534,365	1,672,458	9
Tremar	0	0	0	1,816,346	2,716,912	50	1,816,346	2,716,912	50
Wadebridge	23,232,538	26,153,555	13	6,487,412	6,538,388	1	29,719,950	32,691,944	10

* no commercial/residential properties at risk in current 10 per cent a.p flood extent so percentage cannot be calculated

Total damages for a 1 per cent and 0.5 per cent a.p flood event in 2100 again reflect the number of properties at risk. Wadebridge and Looe stand out as the communities where flooding would cause the most economic damage, followed by Polperro and Bude.

Table 4.20 shows the damages grouped into catchment areas. Similar catchments in the same vicinity have been grouped together and damages for a 1 per cent a.p. flood event and Annual Average Damages are shown for economic and agricultural damages.

Table 4.20 Total estimated damages for a 1% a.p or 0.5% a.p flood event in 2100

	1% a.p. flood event damages (£)			Annual Average Damage (£)		
Catchment areas	**Economic**	**Agriculture**	**TOTAL**	**Economic**	**Agriculture**	**TOTAL**
Neet, Stratton	£36M	£109K	£36M	£1.9M	£5.7K	£1.9M
Valency, Polzeath	£31M	£15K	£31M	£1.6M	£0.8K	£1.6M
River Camel (Tidal)	£66M	£71K	£66M	£3.5M	£3.7K	£3.5M
River Camel, Camelford	£34.5M	£128K	£34.5M	£1.8M	£6.7K	£1.8M
Newquay, Gannel, Menalhyl	£11.5M	£75K	£11.5M	£0.6M	£3.9K	£0.6M
Bodmin Moors area	£3.2M	£37.5K	£3.2M	£0.17M	£1.9K	£0.17M
River Fowey, River Pol	£36M	£129.5K	£36M	£1.9M	£6.8K	£1.9M
Fowey, Seaton, Looe, Lostwithiel	£165M	£27K	£165M	£8.6M	£1.4K	£8.6M
Catchment total:	**£383M**	**£0.6M**	**£383M**	**£20M**	**£31K**	**£20M**

Damages for the whole East Cornwall catchment from a 1 per cent a.p and 0.5 per cent a.p flood event in 2100 have been estimated to be around £383,000,000. This is an increase of 19 per cent on the current estimated damages.

The damages results presented in this section are not intended as absolute values. They are useful within the CFMP because they highlight where flooding is likely to cause the highest economic damage. This shows us where the impacts of flood will be greatest and can help us to prioritise flood management within the catchment.

Possible actions to reduce the risks of flooding to property from rivers and the tide include;

- maintenance (and improvements) to existing flood alleviation schemes
- maintenance at targeted areas of channel and at structures to reduce blockage risk
- attenuation of water using upland storage, and wetlands
- land management improvements to reduce runoff from farmland
- flood Warnings and self-help actions to reduce flooding to property
- adherence to the requirements of PPS25 to avoid building new homes in flood risk locations

We also need to consider other impacts of flooding, such as on critical infrastructure, social and environmental implications, when considering damage caused by flooding.

Critical infrastructure

We do not expect any additional infrastructure to be at risk in 2100, but the infrastructure that is currently at risk is expected to experience increased flooding.

We would expect increased flooding to have an effect on the transport network. In most areas of the catchment it is likely that roads and railways that are already affected could be flooded more often and/or for longer, with greater damage caused by deeper floodwaters. Other minor roads could also be disrupted and extra maintenance will be needed to make sure they do not deteriorate quicker due to extra surface water.

Other flooding (surface water, groundwater and drainage)

Climate change could lead to more intense periods of rainfall and therefore in areas served by combined sewers the number of incidents of flooding due to overloading or blockage of the sewer

network could increase. Intense rainfall could also mean that situations when the drainage network is unable to cope also increase. Both these sources of flood risk could increase the number of flood incidents caused by surface water, particularly in urban areas.

Flooding from ground water is not currently a problem in the catchment according to records in FRIS. Very few incidents have been reported in the past. With annual average rainfall predicted to decrease in the South West, the recharge of groundwater may become less, resulting in lower water tables. However, with winters expected to become wetter by up to 30 per cent, levels of groundwater may increase during winter months, increasing the risk of flooding from this source in isolated locations.

It is likely the economic damage related to these sources of flooding will increase, however this is difficult to quantify within the CFMP.

Actions to reduce the risks of flooding from surface water, drainage and ground water include;

- Land management improvements to reduce runoff from farmland
- Surface Water Management Plans to manage surface water and drainage
- Attenuation of rainwater throughout the system, using SuDS
- Investigations of how mine workings affect water transfer between catchments
- Self-help actions to reduce flooding to property

These actions are the responsibility of a number of organisations including ourselves, local authorities and Natural England.

4.3.3 Flood risk to the environment

Increased flood extents and depths and sea level rise, in general are unlikely to lead to significant changes in the key landscapes across the East Cornwall area. However, valley features may be altered near watercourses and estuarine areas may see a loss in mudflat, saltmarsh and reedbed features.

Water quality
More frequent flooding and increases in flood extents and depths of floodwater are likely to have a negative effect on water quality. One possible effect could happen as increased flood extents create new pathways for conveying pollutants into watercourses. More frequent flooding could also convey pollutants faster. It is difficult to predict how much water quality will be affected and so we need to carry out detailed investigation in areas at risk of pollution.

Biodiversity
Across the catchment it is likely that the status of designated sites will change as habitats deteriorate due to increased and/or flood extents and depths, particularly the River Camel SAC. In the worst case another 1.4km^2 of SSSI could lie within the one per cent annual probability flood area including River Camel and Tributaries, Bude Coast and Amble Marshes. There are currently no plans for future environmental designated sites. In some areas there could be positive changes in the BAP habitats, with some getting bigger, for example floodplain grazing marsh, and others getting smaller, for example reedbed, depending on their location. Across the catchment other areas of Grade 2 and 3 land could become flooded, although the effects this has on the land will depend upon the frequency and duration of the flooding.

As a whole, the biodiversity interests of the catchment are not considered to be sensitive to flooding, therefore increased flood risk will not have a significant impact. Constraints may occur at the project level due to the extensive level of designated sites.

Historic Environment
The increase in flood extent and depth affects some of the Scheduled Monuments (SMs), Historic Parks and Gardens (HP&G) and Conservation Areas in the catchment. Where these are already within the 1 per cent annual probability flood area, deeper flooding could cause the structures to

deteriorate quicker, leading to further maintenance costs. How much damage is caused will depend on the frequency and duration of flooding. Some areas will be affected more than others.

In a worst-case scenario, there could be another 1 SM and 0.14km^2 of Historic Parks and Gardens at risk from a 1 per cent annual probability flood. This is not considered to be significant at the catchment level.

4.4 Summary of flood risk at key sites

Table 4.21 summarises the flood risk at the key sites in the East Cornwall catchment as described in Section 4.3 for a 1 per cent a.p (river) and 0.5 per cent (tidal) flood event in 2100.

Table 4.21 Summary of future flood risk at key sites

Key site	Main source of flood risk	Estimated number of people		Speed of onset (hrs)	Hazard	AAD percentage increase to 2100
		At risk	In community			
Bodmin	Bodmin Town Leat	214	13,160	Fast	Moderate	1,209
Boscastle	Valency/Jordan	103	1,154	Moderate	Extreme	66
Bude	Neet/Tidal	309	5,370	Slow	Significant	9
Camelford	Camel	16	1,584	Slow	Significant	31
Lanivet	Lanivet	59	881	Moderate	Moderate	13
Lerryn	Unknown	25	360	Slow	Significant	50
Looe	Tidal	232	4,961	Moderate	Extreme	18
Lostwithiel	Fowey/Tidal	221	1,591	Moderate	Extreme	50
Newquay	Trenance	90	11,260	Fast	Significant	23
Polperro	Pol	205	604	Moderate	Extreme	1,416
Post Isaac	Port Isaac Leat	34	1,278	Moderate	Moderate	23
Stratton	Strat	112	1,558	Moderate	Significant	9
Tremar	Unknown	117	924	Fast	Significant	50
Wadebridge	Camel (Tidal)	478	6,834	Moderate	Extreme	10

We estimate that the number of people at flood risk will increase the most in Bodmin and Polperro. This is because the flood alleviation schemes that provide protection up to the 1 per cent a.p flood event today will not do so in 2100 without investment to enable them to cope with increased river flows. This is reflected in the damages caused by flooding, which is expected to increase by over 1000 per cent at these locations. The estimated flood hazard at Bodmin and Polperro will also increase to Moderate and Extreme respectively if the schemes are not improved over time.

The other locations were we expect flood risks to increase significantly are Boscastle (again related to the standard of protection of the scheme reducing over time), Lerryn, Tremar and Lostwithiel. We do not expect the flood hazard to increase at Tremar and Lerryn, but we think it will at Lostwithiel.

5 Catchment objectives

5.1 Introduction

This chapter sets out catchment objectives. These are the main aims of the CFMP, which we have developed with the Steering Group and through public consultation of the Scoping Report. We use these objectives in the policy appraisal process. They provide the benchmark against which we assess the policy options to establish which policy will best meet the objectives we are seeking to achieve for East Cornwall. We then develop actions that are designed to achieve the objectives in accordance with the selected policies.

We have also considered what else is going on in the catchment that our objectives may help to achieve (opportunities) and also what could limit our success in achieving them (constraints). These have been developed through consultation with the Steering Group.

5.2 Catchment opportunities and constraints

Specific opportunities and constraints are listed in Table 5.1. They are based on the policies and plans presented in Section 1.4. We have tied the opportunities and constraints into the objectives that they relate to.

'Opportunities' can be work we do or information we use to improve current protection against flood risk, manage flood risk and predict floods better, make people better prepared for flooding and improve habitats and recreation in the area.

'Constraints' would have a negative effect on or stop us using different ways of managing flood risk.

5.3 CFMP objectives

Objectives are essential when developing and selecting CFMP policies. The objectives are broken down into three main areas: economic (property, assets and infrastructure), social (people, society and communities) and the environment. We need indicators for each objective so that we can measure how well we are achieving them over time. Where possible, the selected indicators focus on providing an objective and quantifiable measure for each CFMP policy.

The CFMP project team originally drafted the objectives and presented them to the Steering Group to discuss and develop. We then included the objectives within the East Cornwall CFMP Scoping Report and issued this for public consultation. Following the comments we received, we developed the objectives and indicators further to use in the policy appraisal process. The objectives include receptors which are deemed to be vulnerable to future flood risk. These were identified in Section 4.3 and appraised in Appendix B, Annex B.

The objectives, indicators and targets are shown in Table 5.1. The objectives and appraisal indicators focus on measuring the potential effects of a wide range of policies. The monitoring indicators will help us to measure how well we have achieved these objectives in the future. Where possible, we have developed the targets for the catchment based on the constraints and opportunities.

Table 5.1 East Cornwall CFMP objectives, indicators and targets

Objective	Opportunities	Constraints	Appraisal Indicators	Monitoring Indicators	Targets
Economics					
To reduce flood risk to residential, commercial and industrial property especially in locations such as Bodmin, Camelford, Bude, Wadebridge, Polperro, Lostwithiel, Liskeard, Boscastle, Newquay, Fowey and Looe.	▪ Opportunity to implement Surface water management plans at Bude and Flexbury, Bodmin, Newquay, Wadebridge and Camelford to help known problems. ▪ Inform and engage riparian owners in maintenance measures and advice to reduce flood risk. ▪ Improve warnings and telemetry in upper catchments e.g. north of Lerryn, Liskeard, Crows Nest etc. to achieve a better flood warning service. ▪ Remove/ divert problematic culverts where possible. ▪ Potential to remove flood banks and therefore attenuate flooding at Mawgan Porth, St Mawgan, Amble Marshes, Bude Marshes, Wadebridge, Sladesbridge and Helebridge. ▪ Examine measures to	▪ There are numerous steep small catchments where fast flows may need to be accepted and the risk managed accordingly including Porthcothan, Harlyn, Polmorla, Port Isaac, Crackington Haven, Welcombe/ Marsland Water and Polperro. ▪ Catchments off Bodmin Moor are steep and fast reacting, limiting opportunities for attenuation of flows. ▪ Significant increased development is expected around Newquay. ▪ Retrofitting SuDS – there could be a constraint in the amount of volume the groundwater can take.	▪ Calculated annual average damages for residential, commercial and industrial property. ▪ Number of properties within the 1 per cent flood area.	▪ Number of residential, commercial and industrial properties at risk of flooding. ▪ Number of new developments that include flood resistance and resilience measures within areas at risk of flooding ▪ Number of permissions granted for redevelopment in areas at risk of flooding that include flood resistant and resilience measures ▪ Percentage of development allocations directed to areas at lowest risk of flooding	▪ Reduce annual average damages. ▪ Decrease in the number of residential, commercial and industrial properties at risk of flooding.

Objective	Opportunities	Constraints	Appraisal Indicators	Monitoring Indicators	Targets
	maintain water levels in Red Moor, Retire Common, River Camel Valley and Tributaries, Trelow Downs and Upper Fowey Valley to attenuate storm water runoff. ▪ Examine measures to utilise Colliford Lake, Siblyback Lake and Crowdy Reservoir as additional flood storage.	▪ Future housing requirements could restrict the potential to create flood storage areas/ set back flood defences.		▪ Number of applications permitted for change of use in areas at risk of flooding from residential to less vulnerable or water compatible uses. ▪ Number of areas identified as functional floodplain within SFRAs	
To reduce flood risk to critical infrastructure such as hospitals, STW, WWTW, electricity substations, and roads in particular the A30 and A38 and railways.	▪ Highways authorities could be encouraged to provide reimbursements to farmers to undertake works/management to prevent flooding (e.g. alteration of field access). ▪ Inform and engage riparian owners in maintenance measures and advice to reduce flood risk. ▪ Appropriate management of hedges, ditches and road drains could minimise and reduce localised flooding and flood risk. ▪ Remove/ divert problematic culverts where possible. ▪ Examine measures to	▪ Difficulty in setting obligations and agreements with landowners. ▪ There are numerous steep small catchments where fast flows may need to be accepted and the risk managed accordingly including Porthcothan, Harlyn, Polmorla, Port Isaac, Crackington Haven, Welcombe/ Marsland Water and Polperro. ▪ Catchments off Bodmin Moor are steep and fast reacting, limiting	▪ Count of affected assets within the 1 per cent flood area. ▪ Depth of flooding over assets.	▪ Recorded infrastructure at risk of flooding e.g. hospitals, STW, WWTW and roads.	▪ No disruption to critical infrastructure and access due to flooding at the 1 per cent a.p flood event.

Objective	Opportunities	Constraints	Appraisal Indicators	Monitoring Indicators	Targets
	maintain water levels in Red Moor, Retire Common, River Camel Valley and Tributaries, Trelow Downs and Upper Fowey Valley to attenuate storm water runoff. ▪ Examine measures to utilise Colliford Lake, Siblyback Lake and Crowdy Reservoir as additional flood storage.	opportunities for attenuation of flows. ▪ Future housing requirements could restrict the potential to create flood storage areas/ set back flood defences.			
To minimise disturbance to agricultural land.	▪ Increase uptake of Environmental Stewardship. ▪ Inform and engage riparian owners in maintenance measures and advice to reduce flood risk. ▪ Appropriate management of hedges, ditches and road drains could minimise and reduce localised flooding and flood risk. ▪ Change land management in the non-designated Bodmin area to attenuate runoff.	▪ Could be difficult to influence/control land use management practices.	▪ Annual average damages to agricultural land. ▪ Area of agricultural land uses within the 1 per cent flood area.	▪ Area of land disturbed by flood defence schemes. ▪ Annual average damages to agricultural land.	▪ Reduce annual average damages to agricultural land.
Social					
To reduce flood risk to vulnerable/ deprived communities (particularly in Looe) and community assets, and to protect and improve recreation facilities	▪ Increase areas of accessible watercourses available for public recreational benefit and promote enjoyment of natural rivers within the catchment, and combine with green corridors in or near to urban areas.	▪ Tourism levels likely to rise increasing adverse recreational impacts on watercourses, and increased wear and erosion from visitor traffic (creating bare earth and increasing	▪ Count of community assets within the 1 per cent flood area. ▪ Location of deprived communities in 1	▪ Number of assets at risk of flooding. ▪ SFVI ▪ Number of policies to secure and protect	▪ Reduce risk to schools and surgeries. ▪ Reduce disruption or damage to community assets due to flooding.

Objective	Opportunities	Constraints	Appraisal Indicators	Monitoring Indicators	Targets
where possible.		runoff and soil erosion).	per cent flood area	green infrastructure along river corridors	▪ Reduction in SFVI within 1 per cent flood area
To prevent injuries and loss of life from flooding.	▪ Increase public awareness and preparedness of flooding and flood risk and what causes it. ▪ Improve warnings and telemetry in upper catchments e.g. north of Lerryn, Liskeard and Crows Nest etc. ▪ Increase the number of flood warning gauges across the catchment.		▪ Number of households in the 1 per cent a.p. flood area. ▪ Number of households within the 1 per cent a.p. flood area in flood warning areas. ▪ Recorded injuries from flooding. ▪ Recorded deaths from flooding. ▪ Depth of flood water.	▪ Number of people at risk of flooding.	▪ Reduce health risk and risk to life posed from flood events. ▪ No injuries from 1 per cent a.p flood events.
Natural Environment					
To protect and work with natural river processes and to restore watercourses to their natural state, particularly St. Neot River, De Lank River, River Camel, River Fowey, River Gannel and Menalhyl River.	▪ Flood attenuation opportunities for disused China Clay reservoirs on Bodmin Moor. ▪ Opportunities for private managed retreat. ▪ Remove/ divert problematic culverts where possible.	▪ Need to protect unmodified watercourses and sensitive habitats, e.g. River Camel SAC. ▪ Future housing requirements could restrict the potential to create flood	▪ River Habitat Modification Score of reaches (i.e. number of pristine, semi-natural, predominantly unmodified, obviously modified and significantly	▪ Number of reaches returned to natural state ▪ River Habitat Modification Score	▪ FRM positively contributes towards WFD geomorphological targets.

Objective	Opportunities	Constraints	Appraisal Indicators	Monitoring Indicators	Targets
.	▪ Potential areas for floodplain restoration and wetland re-creation for use as storage areas in the Bude area, Mawgan Porth catchment, the lower Fowey and Looe Area. ▪ Potential areas for managed retreat in undeveloped areas of Liskeard/ Moorswater. Looe, Golant, Lerryn and Lostwithiel. ▪ Potential to remove flood banks and therefore re-connect the river to the floodplain at Mawgan Porth, St Mawgan, Amble Marshes, Bude Marshes, Wadebridge, Sladesbridge and Helebridge.	storage areas/ set back flood defences.	modified). ▪ Length of maintained watercourses.		
To ensure no deterioration of SACs (such as Phoenix United Mine and Crow's Nest), or SSSIs (such as Amble Marshes, Boconnoc Park), and help achieve favourable conditions on designated sites and BAP habitats and species, and to create conditions which encourage increased	▪ Increase uptake of Environmental Stewardship. ▪ Extension of the lowland heathland BAP using agricultural land in catchment headwaters. ▪ Flood attenuation opportunities for disused China Clay reservoirs on Bodmin Moor. ▪ Potential for floodplain restoration and wetland re-creation for use as storage areas in the Bude area, Mawgan Porth catchment, the lower Fowey and Looe	▪ Need to protect unmodified watercourses and sensitive habitats, e.g. River Camel SAC. ▪ Future housing requirements could restrict the potential to create flood storage areas/ set back flood defences.	▪ Area and condition status of designated sites within the 1 per cent flood area. ▪ Area of BAP habitats in the floodplain.	▪ Areas of SACs, SSSIs and BAPs at risk of flooding.	▪ Flooding and flood risk management to have no negative impacts but long term positive impacts upon condition of designated sites. ▪ BAP habitats created or enhanced / habitat enhanced for the benefit of BAP species.

Objective	Opportunities	Constraints	Appraisal Indicators	Monitoring Indicators	Targets
biodiversity.	Area. ▪ Potential for creation of a combination of freshwater and tidal habitat in the Wadebridge area, lower Fowey and Looe area. ▪ Potential areas for managed retreat in undeveloped areas of Liskeard/ Moorswater. Looe, Golant, Lerryn and Lostwithiel. ▪ Examine measures to maintain water levels in Red Moor, Retire Common, River Camel Valley and Tributaries, Trelow Downs and Upper Fowey Valley to attenuate storm water runoff. ▪ Limiting livestock on the east side of the catchment off Bodmin Moor could improve vegetation and runoff. ▪ Reduce sediment loads to salmon spawning gravels.				
To protect water quality and prevent the pollution of watercourses and groundwater as a result of flooding of urban and agricultural land, and mines.	▪ Opportunity to implement SuDS at Bude and Flexbury, Bodmin, Newquay, Wadebridge and Camelford to help known problems. ▪ Increase uptake of Environmental Stewardship. ▪ Reduced sediment loads	▪ Potential mine water issues (both flow surges and water quality) in the south Bodmin and Liskeard area.	▪ Number of mines and landfill sites within the 1 per cent flood area. ▪ River Ecosystem Grade of Watercourses.	▪ Number of potential pollution sources at risk of flooding. E.g. landfill sites, mines, WWTW.	▪ Reduce the risk of polluting incidents as a result of flood events. ▪ No reduction in water quality to result from flooding at the 1 per cent a.p flood event of landfill sites and mines.
To protect the quality of land (particularly Grade 2 land in the	▪ Increase uptake of Environmental Stewardship.	▪ Soils in wet upland areas have a low Winter Rainfall	▪ Area of land in the ALC grades within the 1 per	▪ Areas of land being farmed under the Single	▪ No loss or detrimental effects on the quality of

Objective	Opportunities	Constraints	Appraisal Indicators	Monitoring Indicators	Targets
Camel River catchment, Fowey River Catchment and the Looe Estuary), and encourage changes in land use management to reduce runoff.		Acceptance Potential, which contributes to high surface runoff.	cent flood area. ▪ Schemes/management initiatives reducing runoff from agricultural land.	Farm Payment System for environmental enhancement. ▪ Grade 1 and 2 land at risk of flooding.	Grade 1 or 2 land as a result of flood defence schemes. ▪ Increase in farming practices that reduce runoff.
To protect and enhance heritage and archaeological features, and where appropriate prevent flood related deterioration of SMs and Historic Parks and Gardens.	▪ Opportunity to implement SuDS at Bude and Flexbury, Bodmin, Newquay, Wadebridge and Camelford to help known problems. ▪ Inform and engage riparian owners in maintenance measures and advice to reduce flood risk. ▪ To reduce the risk of damage to SMs, Historic Parks and Gardens and non-designated historic assets.	• To avoid damage to historic environment assets caused by flooding. • To avoid damage to sites and their settings from flood risk management actions. • Requirements to protect assets may limit flood risk management options.	▪ Number of heritage assets within the 1 per cent flood area adversely affected by flooding. ▪ Proportion of conservation area at risk from flooding. ▪ Number of significant environmental assets and their settings affected by flood risk management actions.	▪ Number of historic and archaeological assets at flood risk.	▪ No increase in flood risk to designated historic environment assets at the 1 per cent a.p flood event. ▪ Reduce flood risk in Conservation Areas and Areas of Great Historic Value.
To protect and enhance landscape character and visual amenity, and where appropriate prevent flood related deterioration of the Cornwall AONB.	▪ Potential for floodplain restoration and wetland re-creation for use as storage areas in the Bude area, Mawgan Porth catchment, the lower Fowey and Looe Area. ▪ Potential for creation of a	▪ Future housing requirements could restrict the potential to create flood storage areas/ set back flood defences.	▪ Area of AONBs within the 1 per cent flood area. ▪ Areas of change in landscape character (from Cornwall Landscape	▪ Area of AONB at risk of flooding (AONB management plan). ▪ AGLVs at risk of flooding.	▪ To positively contribute towards AONB Management Plan objectives. ▪ No increase in area of AGLVs within 1 per cent a.p. flood

Objective	Opportunities	Constraints	Appraisal Indicators	Monitoring Indicators	Targets
	combination of freshwater and tidal habitat in the Wadebridge area, lower Fowey and Looe area.		Character Study).		area or deterioration in landscape character.

6 Policy appraisal

6.1 Introduction

Policy appraisal aims to look at the impact of flood risk management policies on the catchment. We assign a preferred policy to various parts of the catchment, which help us achieve our objectives. The flood risk management policies are designed to assess the scale and priority of the flood risk problem for a specific location (policy unit) and to consider the most appropriate and effective action that we can take. In managing flood risk we need to first consider if we are able to eliminate and avoid the risk by removing people and property from the floodplain. If this is not possible, we need to decide if we are prepared to accept the risk, before we try to reduce, transfer or share the risk, possibly with other areas within the catchment.

The East Cornwall CFMP area is divided into eight policy units. These are areas where a particular policy and certain actions, will apply. These units range in size from 63 to 245 square kilometres.

To identify the geographical areas covered by each of the eight policy units we used a number of characteristics and criteria such as:

- current level of flood risk
- hydraulic characteristics
- land use
- links to other plans
- position in the catchment
- topography

We have assigned one of the six flood risk management policies we were able to choose from to each policy unit. The policy choices are shown in Table 6.1 This has been achieved by bringing together the information we presented in the earlier sections of this report on Catchment Overview, Current Flood Risks and Management, Future Flood Risk and our Catchment objectives.

Table 6.1 Flood risk management policies

Policy Option	Policy
P1:	No active intervention (including flood warning and maintenance) continue to monitor and advise.
P2:	Reduce existing flood risk management actions (accepting that flood risk will increase over time).
P3:	Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline).
P4:	Take further action to sustain the current level of flood risk into the future (responding to the potential increases in risk from urban development, land use change and climate change).
P5:	Take further action to reduce flood risk.
P6:	Take action to increase the frequency of flooding to deliver benefits locally or elsewhere (which may mean an overall reduction in flood risk, e.g. for habitat inundation).

We have selected the most appropriate policy for each policy unit by appraising the indicators. We can then see how they achieve each of the set objectives for East Cornwall and which is the best policy to manage flood risk in each policy unit over the long-term. The policies were agreed through public consultation and with the Steering Group.

6.2 Policies for the East Cornwall CFMP area

The appraisal of these policies is based on Strategic Environmental Assessment (SEA) guidelines. These were extended to assess social and economic impacts. These guidelines make sure that decisions are made by clearly and objectively weighing up the options. You can see the data we analysed and assessed during the policy appraisal process in Appendix B, Annex B (Forms 12.1 - 12.10). Table 6.2 shows the content of these forms. As the objectives set out in Section 5 are the same for the East Cornwall area as a whole, we fine-tuned them for each policy unit to make them more specific to individual locations. Our assessment was based on information and data we collected throughout the study and we consulted with the Steering Group to agree a preferred policy for each policy unit.

Table 6.2 Appendix B contents

Form	Contents
12.1	Purpose of the CFMP.
12.2	Meeting Legal requirements and Environment Agency Corporate Objectives.
12.3	Summary of Flood Risks and associated Source-Pathway-Receptor (S-P-R) Components.
12.4	CFMP Policy options.
12.5	Summary of current and future levels of and responses to flood risk.
12.6	Screening of Policy Options against Appraisal Objectives.
12.7	Summary of the Relative Overall Losses and Gains demonstrating the rationale behind selecting the preferred option.
12.8	Summary of the preferred policy.
12.9	Requirements for further policy development and appraisal.
12.10	Indicators for Monitoring, Review and Evaluation.

Significance of impacts

To quantify the impact of these flood risk management options we have made a number of assumptions. This is in order to assess their relative effects. We have reviewed future levels of flood risk to find out what the positive or negative effects will be in line with the policy choices.

We identified the potential impacts associated with each policy by:

- using GIS to find out baseline and future assets at risk of flooding
- using percentage change calculations
- comparing the standard options against the indicators and objectives
- knowing the impacts of similar actions

Where possible, we have tried to quantify the effects of future flood risk. We have applied the method described in Section 4.3 and used this information to find an average amount by which to increase the Flood Map across each policy unit. This gives us an indication of what flood extents might be like in 2100.

We have used our datasets to provide information on assets at risk of flooding now and in the future using our 2100 flood extent and used this information to assess how the policy choices may affect these assets at risk.

The figures shown in the policy appraisal tables are estimates and are not intended to be read as absolute values. Across each policy unit (and between catchments) there will be a high degree of variability. Therefore the figures are to be used as a guide that provides the best indication of the relative scale of change at a policy unit level. This allows us to compare change within policy units and more widely across the CFMP area.

Where possible figures are stated within text such as “approximately”, “around” or a range of values are given. This reinforces the approximate nature of the values and that they should be viewed in terms of relative change.

An impact of an action is based on the existing baseline environment and any change in characteristics. Where possible, we have evaluated positive and negative effects based on their scale and significance. Where there are irreversible impacts these are indicated separately. Each impact is identified using the following objective criteria:

Magnitude - the area or number of receptors (factors) be affected by the impact locally and regionally
Duration - whether the impact is short-term or permanent
Certainty - the likelihood or risk of the impact occurring

We have described these impacts as either: beneficial or adverse, direct or indirect, short, medium or long-term, and reversible or irreversible.

Where we can quantify an impact, thresholds have been applied to determine its significance. These will vary considerably depending on the characteristic of the impact. An impact that is irreversible will have a far greater significance than one that is not for example. The thresholds are presented in Table 6.3. Where quantification is not possible we have used a subjective scale to find out the significance. Where we have used qualitative descriptions of significance these have been defined. These scales are also presented in Table 6.3.

Table 6.3 Quantitative and qualitative criteria for significance of impacts

Impact significance	Quantitative	Qualitative
Low	<10 per cent of population / asset / resource	The impact is likely to affect assets of local importance, or result in a limited impact on assets of regional or national value. Local assets include local roads, non-designated habitats, non-designated landscapes, etc.
Medium	10 per cent to 25 per cent of population / asset / resource	The impact is likely to affect assets of regional or significant local value, or assets of national value may be affected to a lesser degree. Assets of regional and high local value include regional roads, listed buildings, conservation areas, BAP habitats and species, community assets, etc.
High	>25 per cent of population / asset / resource	The impact is such that a significant effect or possible effect would arise against a specific asset or assets of national or international importance, for example, major roads, railways, SMs, National Parks, NNRs, Heritage Coast, AONBs, SACs, SPAs and SSSIs.

Table 6.4 show shortened versions of the policy appraisal summaries. For the full summaries, which include the opportunities and constraints talked about in Chapter 5, and the actions which we present in Chapter 7, please refer to tables 12.8 in Appendix B, Annex B.

Table 6.4 Policy appraisal summaries for each policy unit

Bodmin Moor	
Problem / Risk	Policy Unit Bodmin Moor includes the De Lank River and the headwaters of the River Fowey. It has no major conurbations. The policy unit is sparsely populated however there are a number of settlements at risk of flooding directly from rivers and from surface runoff including Blisland and St Neot. Soils are poorly drained, impermeable and have a low Winter Rainfall Acceptance Potential. Due to their limited capacity to absorb moisture, the soils can generate large volumes of surface runoff during periods of rainfall, which can contribute to flooding. The onset of flooding within the policy unit from start of rainfall could be rapid. There are no flood alleviation schemes within the policy unit. There are however specific flood warnings available for the River Fowey headwaters as far as Doublebois, and Flood Watches can be issued for the majority of the area to warn of low impact flooding, providing less than 2 hours notice of flooding. The northern part of Bodmin Moor is within the catchment of the River Camel while the southern part drains to the River Fowey catchment. Drainage practices mean that the capacity of the moor to store water is reduced. This means that water will enter into the Camel and Fowey rivers more quickly and therefore making flood risks worse downstream. There are a number of reservoirs and disused china clay workings in the catchment, which can act as informal water storage areas, regulating flows downstream. There is no critical infrastructure in the policy unit. As a significant part of the policy unit is designated as an Area of Outstanding Natural Beauty (ANOB), we do not expect any significant development to occur in the policy unit.
Policy	**P6: Take action to increase the frequency of flooding to deliver benefits locally or elsewhere.**
Justification	The scale of flood risk within the policy area of Bodmin Moor is such that the estimated damages to residential, commercial and industrial properties are: £3.1M for a 1 per cent annual chance event with an additional £34,000 of agricultural damages expected at this scale of event. There are 28 properties at risk of flooding under the 1 per cent annual probability flood event. It is also expected that around 5.5km of minor roads would also be subjected to flooding in this scenario. Over the next 100 years, the expected annual damages across the policy unit could increase by 4 per cent as a result of the impacts of climate change and land use management. The number of properties at risk is expected to increase by 1. Any development in the policy unit should be carefully designed as not to increase flood risks. Policy Options P1 - P3 were rejected as there are a number of social and economic assets currently at risk from flooding including vulnerable population groups. In addition there will be impacts to landscape and heritage assets and no significant environmental benefits. Selection of these options would preclude benefits to downstream policy units. Policy Options P4 and P5 were rejected as the number of social and economic assets currently at risk of flooding would not be reduced; there would be a minor decrease in the extent and duration of flooding of road. In addition there are no significant environmental benefits. Selection of these options would preclude benefits to downstream policy units. Policy Option P6 was selected as it has no adverse environmental impacts and will

Bodmin Moor	
	have a cumulative benefit on the Fowey and Seaton Valley and Camel Valley Policy Units, particularly at settlements like Lostwithiel. Under this policy option it could be possible to store more water on the moor which will attenuate flows, prolong greater base flow, and reduce sediment loading through reduced erosion. These outcomes could contribute to a decreased risk of flooding downstream, while not adversely affecting flood risk within the policy unit itself.

Fowey and Seaton Valleys	
Problem / Risk	Policy Unit Fowey and Seaton include the Rivers Fowey, Pol, East and West Looe, and Seaton and the towns of Liskeard and Polperro. The rivers in the policy unit flow through incised valleys with little floodplain storage which react quickly to rainfall. Flooding is caused by rivers overtopping banks and surface water, particularly at Tremar. Surface water flooding has been recorded at a number of settlements, and along the A38 in the Glynn valley, which is an important transport link Flood risk is made more complex due to the presence of mine and mineral workings in this policy unit and upstream in the Bodmin Moor policy unit. There is a flood alleviation scheme at Polperro which provides protection up to the 1 per cent a.p flood event for about 130 properties; however Polperro could be at flood risk from this scale of event in the future. The policy area is covered by two Flood Watch areas, which warn that low impact flooding is likely. There are specific flood warnings available for properties at risk from the River Fowey, and on the River Seaton with less than 2 hours notice of flooding available on these rivers. There is a Major Incident Plan in place for Polperro if severe flooding is expected. However there is less than 2 hours notice available for this warning. There is 1 Waste Water Treatment works that lies in the 1 per cent and 0.1 per cent a.p flood extent. There are two electricity sub stations, near Tremar and Polperro which are in the 1 per cent and 0.1 per cent a.p flood extent. New development in the policy unit is likely to be around Liskeard.
Policy	**P4: Take further action to sustain the current level of flood risk into the future.**
Justification	The scale of flood risk within the policy area of Fowey and Seaton Valleys is such that the estimated damages to residential, commercial and industrial properties are £24M for a 1 per cent annual probability flood event with an additional £92,000 of agricultural damages expected at this scale of event. There are 290 properties at risk of flooding under the 1 per cent annual probability flood event. It is also expected that two A roads, including the A38 key route, two B roads and 11km of minor roads would also be subjected to flooding in this scenario. Over the next 100 years, the expected annual damages across the policy unit could increase by 50 per cent as a result of the impacts of climate change and land use management. It is estimated that the number of properties at risk could increase in number by around 14. Any development in the policy unit should be carefully designed so as not to exacerbate flood risks further. Policy Options P1- P3 were rejected as they would lead to an increase in the number of

Fowey and Seaton Valleys	
	social and economic assets flooded, increased flooding of roads and increased pollution risk. There would also be impacts to landscape and heritage assets. Policy Option P5 was rejected because of the limited benefits of reducing flood risk across the wider policy unit area; the main area of flood risk already having adequate flood risk management measures in place. Policy Option P6 was rejected as there is insufficient availability to transfer risk to acceptable/ beneficial locations. In addition, there is the potential to impact on Boconnoc Park and Woods SSSI and the benefits are limited in comparison to P4. Policy Option 4 was selected as the most appropriate option to manage increasing flood risk in the long term, particularly at Polperro. The flood alleviation scheme at Polperro provides an appropriate level of flood protection today for about 130 properties, however in the future this level of protection will reduce unless the scheme is sustained. If the scheme is not sustained to provide a high level of flood protection, the risk to life in Polperro due the nature of the rapidly reacting catchment would increase. Our studies have also shown a significant flood risk at Tremar, although this is not supported by historical records. This option allows for further work to assess the flood risk at Tremar. This policy choice allows us to respond to future change by employing a wide range of flood risk management measures.

South Coast Tidal	
Problem / Risk	Policy Unit South Coast Tidal includes the Fowey Estuary and a significant section of coastline. The main towns are Lostwithiel, Fowey and Looe. Flooding within the policy unit is generally caused by high tides overtopping river banks and harbours or rivers affected by tide-locking. This has been recorded at Bodinnick, Fowey, Golant, Hessenford, Lerryn, Looe, Lostwithiel, Millendreath, Milltown, Polruan, Sandplace, and Seaton. Looe has around 62 properties at risk from a 10 per cent flood event, with flooding occurring on a yearly basis. River flooding has been recorded at Downderry, and Lanteglos. Surface water has also caused flooding in Fowey, Looe, Lostwithiel, and Seaton often in combination with tide-locked drains at high tide. There are flood alleviation schemes within the policy unit, located in Lostwithiel, and Seaton. The scheme in Seaton is designed to protect properties from combined river and tidal flooding up to and including the 20 per cent a.p event. The scheme in Lostwithiel is designed to protect from river flooding up to the 2 per cent flood event and tidal flooding up to the 0.5 per cent flood event, however recent 'Areas Benefiting from Defences' mapping work has shown that protection from the 0.5 per cent a.p tidal flood event is not provided (the actual standard of defence however is unknown). The policy unit is covered by a Flood Watch, which warns that low impact river flooding is likely. There are specific flood warnings available for the River Seaton providing less than 2 hours notice of flooding can also for the River Fowey at Lostwithiel, providing less than 2 hours notice of flooding. Tidal flood warnings are issued for the whole of the Cornish south coast and so are not tailored to the conditions necessary to cause flooding at specific communities.

South Coast Tidal	
	There are two electricity substations at risk of flooding, of which the one in Looe is in the 1 per cent, 0.5 per cent and 0.1 per cent a.p flood extent. The electricity substation near Lostwithiel is at risk from the 0.1 per cent a.p flood event. There are two emergency response centres in the 1 per cent, 0.5 per cent and 0.1 per cent flood extent. These are the police station at Looe and a St John's Ambulance centre. There is no other critical infrastructure in the policy unit. Any development that takes place in this policy unit is likely to be concentrated around the Looe, Fowey, Lerryn and Lostwithiel areas.
Policy	**P5: Take further action to reduce flood risk.**
Justification	The scale of flood risk within the policy area of South Coast Tidal is such that the estimated damages to residential, commercial and industrial properties are: £140M for a 1 per cent and 0.5 per cent annual probability flood event, with an additional £16,000 of agricultural damages expected at this scale of event. Damages are mainly caused by tidal flooding. There are 408 properties at risk of flooding under the 1 per cent and 0.5 per cent annual probability flood event. It is also expected that two A roads, two B roads, a railway and about 1.5km of minor roads would also be subjected to flooding in this scenario. Over the next 100 years, the expected annual damages across the policy unit could increase by 18 per cent as a result of the impacts of climate change and land use management. We estimate that the number of properties at risk could increase in number by around 70. Any development in the policy unit should be carefully designed so as not to exacerbate flood risks further. Policy Options P1 - P3 were rejected as there would be a significant increase in the numbers of social and economic assets flooded. There will also be impacts to heritage and landscape assets and limited environmental benefits. Policy Option P4 was rejected due to the limited scope to respond to the high levels of current flood risk and the uncertainties surrounding the impacts of sea level rise in the future. Policy Option P6 was rejected as limited improvements to habitats were identified and there is insufficient availability to transfer risk to acceptable/ beneficial locations. Policy Option P5 was selected as the most appropriate option to manage increasing flood risk in the long term. A number of economic and social asset are currently at risk of flooding. In addition, the long-term level of risk due to sea level rise could be significant. This policy option allows the scope to respond to this risk now and in the future, particularly in the communities of Looe, Seaton, Fowey, Polperro (tidal) and Lostwithiel, using a range of flood risk management measures. Limited impacts to the environment may occur from this option and they should be mitigated against through the careful design of flood risk management measures.

Camel Valley	
Problem / Risk	Policy Unit Camel includes the River Camel and tributaries. The major towns are Camelford and Bodmin. The rivers in the policy unit spring on high ground and moorland, where the area is underlain by impermeable granite so the rivers respond quickly to rainfall. This makes the rapid onset of flooding more likely, particularly at upstream settlements, such as Camelford. The rivers flow through narrow wooded valleys with limited floodplains for storage and therefore settlements are at risk of flooding, particularly where structures cross the rivers and blockages can occur. Flood risks are made more complex by the presence of mine workings in the policy unit, and more workings upstream in Bodmin Moor policy unit. There have been some incidents of flooding from field runoff within the policy unit. The major risk of flooding is at Bodmin, both from the Bodmin Town Leat and from surface water. A flood scheme in Bodmin has reduced this risk as protection is provided up to the 1 per cent a.p flood event. There is also a flood alleviation scheme in Camelford designed to protect properties and the A39 up to the 2.5 per cent flood event. A scheme also exists in Lanivet, which is designed to protect some properties in the village at risk of smaller but more frequent flood events, up to the 10 per cent a.p event. The policy unit is covered by a Flood Watch, which warns that low impact flooding is likely. Specific flood warnings are available on the River Camel and the River Allen, providing less than 2 hours notice of flooding on the River Allen. There is a Major Incident Plan (MIP) in place for Bodmin and Camelford. There is less than 2 hours notice of severe flooding in Bodmin, and up to 6 hours notice of severe flooding in Camelford. There is 1 emergency response centre in the 1 per cent and 0.1 per cent flood extent. This is the fire station in Bodmin. There is no other critical infrastructure at risk in the policy unit. Development is likely in the policy unit, and will be concentrated around Bodmin.
Policy	**P4: Take further action to sustain the current level of flood risk into the future.**
Justification	The scale of flood risk within the policy area of Camel Valley is such that the estimated damages to residential, commercial and industrial properties are £26M for a 1 per cent annual probability flood event with an additional £97,000 of agricultural damages expected at this scale of event. There are 214 properties at risk of flooding under the 1 per cent annual probability flood event, with protection provided for 130 properties for this scale of event. It is expected that one A road, two B roads and 5km of minor roads would also be subjected to flooding in this scenario. Over the next 100 years, the expected annual damages across the policy unit could increase by 31 per cent as a result of the impacts of climate change and land use management; particularly on reducing the standard of protection offered by existing flood alleviation schemes. We estimate the number of properties at risk of flooding could increase in number by around 30. Any development in the policy unit should be carefully designed so as not to exacerbate flood risks further, especially in the Bodmin area. Policy Options P1 –P3 were rejected as there would be a significant increase in the numbers of social and economic assets flooded. These assets include the critical asset of Bodmin fire station and 5 community assets. There will also be impacts to

Camel Valley	
	heritage and landscape assets and limited environmental benefits. Policy Option P5 was rejected as only minor benefits would be expected at the policy unit level. This is because the major flood risk location of Bodmin has adequate flood risk management measures in place. Policy Option P6 was rejected as limited improvements to habitats were identified and there are insufficient opportunities to transfer risk to acceptable/ beneficial locations. Policy option P4 was selected as the most appropriate option to manage increasing flood risk in the long term. The number of social and economic assets currently at risk of flooding would be reduced, with 130 properties, 5 community assets and 1 fire station benefiting from continued defence at Bodmin. This option also allows the current flood risk management measures in place for Camelford and Lanivet to be sustained, resulting in a minor decrease in the extent and duration of flooding of roads, including the A39 at Camelford and continued protection for properties in these communities. A range of flood risk management measures is proposed to sustain current levels of flood risk into the future. These measures include responding to increased rainfall intensities through surface water management plans, targeting channel maintenance at known risk locations and improving the flood warning service.

Camel Tidal	
Problem / Risk	Policy Unit Camel Tidal includes the Camel Estuary. The major town is Wadebridge. The major source of flood risk in the policy unit is tidal flooding, with Wadebridge being the main flood risk area. River flooding is also a risk at places such as Polmorla and Sladesbridge, where the nature of the catchments means that the onset of flooding can occur rapidly. Tide-locking is a factor that makes flood risk worse in these areas. There is little floodplain storage potential upstream of settlements within the policy unit and there are a number of small catchments that respond rapidly to rainfall. Surface water and inadequate drainage have also caused flooding in Wadebridge and Padstow. There are flood alleviation schemes at Polmorla, Wadebridge, and Sladesbridge, with tidal defences at Rock and Padstow. The tidal defence schemes in Sladesbridge and Padstow are designed to protect properties from frequent flooding and for more extreme events, up to and including the 0.5 per cent a.p tidal flood event. The river defence scheme in Sladesbridge is designed to protect properties at risk up to the 1.3 per cent a.p event. The river defence scheme in Polmorla is designed to protect properties at risk of smaller but more frequent flood events, up to the 4 per cent a.p flood event. The tidal defence scheme in Wadebridge is designed to protect properties from frequent flooding and for more extreme events, up to and including the 0.5 per cent a.p tidal flood event, however recent Areas Benefiting from Defences mapping work has shown that protection from the 0.5 per cent a.p tidal flood event is not provided (the actual standard of defence however is unknown). The policy unit is covered by a Flood Watch, which warns of low impact flooding. Specific flood warnings are available on the River Camel for the Sladesbridge and Wadebridge areas and for the River Allen at Sladesbridge. There is less than 2 hours notice of flooding available for these flood warnings. There is a Major Incident Plan (MIP) in place for Wadebridge in case of severe flooding, with up to 6 hours notice of flooding from the River Camel available. Tidal flood warnings can be issued for the whole of North Cornwall Coast, which covers Padstow and Wadebridge, although warnings are not specifically tailored for these communities. There is 1 emergency response centre that lies in the 1 per cent, 0.5 per cent and 0.1 per cent a.p flood extent. This is the fire station in Wadebridge. There is also 1 electricity substation which lies in the 1 per cent, 0.5 per cent and 01 per cent a.p flood extent. Development within the policy unit is likely to take place mainly in the Wadebridge area.
Policy	**P5: Take further action to reduce flood risk.**
Justification	The scale of flood risk within the policy area of Camel Tidal is such that the estimated damages to residential, commercial and industrial properties are £60M for a 1 per cent or 0.5 per cent annual probability flood event with an additional £51,000 of agricultural damages expected at this scale of event. These damages are mainly caused by tidal flooding. There are 390 properties at risk of flooding under the 1 per cent or 0.5 per cent annual probability flood event. It is also expected that one A road, two B roads and 3.5km of minor roads would also be subjected to flooding in this scenario. Over the next 100 years, the expected annual damages across the policy unit could

Camel Tidal	
	increase by 10 per cent as a result of the impacts of climate change and land use management. We estimate that the number of properties at risk could increase in number by around 60. Any development in the policy unit should be carefully designed so as not to increase flood risk. Policy Options P1- P3 were rejected as they would lead to an increase in the number of social and economic assets flooded increased flooding of roads and increased pollution risk. There would also be impacts to landscape and heritage assets. Policy Option P4 was rejected as the number of social and economic assets currently at risk of flooding would not be reduced and only minor environmental benefits would be expected at the policy unit level. Improvements to existing flood risk management measures are likely to be needed at Wadebridge to provide an adequate standard of protection against current risks, which is not appropriate under this policy option. Policy Option P6 was rejected as there is insufficient availability to transfer risk to acceptable/ beneficial locations. For example there would be little benefit from set-back upstream of Wadebridge due to combined tidal-river flood risks. Policy Option P5 was selected as the most appropriate option to manage current risk and increasing flood risk in the long term. The major flood risk area is Wadebridge, where adequacy of current flood risk management measures is unknown, and future impacts due to sea level rise could increase the frequency of flooding. The number of commercial and residential properties currently at risk of flooding would be reduced by 344 and there would be a minor decrease in the extent and duration of flooding of roads. Community assets would also benefit from improved standards of defences. A range of flood risk management measures should be employed to decrease flood risk across the policy unit. These include creating community based tidal flood warnings and sustaining existing assets (or improving where feasible).

Gannel and Mawgan Vale	
Problem / Risk	Policy Unit Gannel and Mawgan Vale includes the Rivers Gannel and Menalhyl. The major town is Newquay. The major risks of flooding in the policy unit are from rivers and surface water. Some tidal flooding has been recorded at Newquay. The rivers are of low gradient, however because of the underlying geology, they still respond rapidly to rainfall, with the small catchments responding quickest. Surface water and inadequate drainage have also caused flooding at a number of locations. There are some flood alleviation schemes within the policy unit. Defences at Newquay are designed to provide protection up to the 2 per cent a.p flood event, with defences at St. Columb Major and Mawgan Porth designed to provide protection up to the 5 per cent a.p flood event. The policy unit is covered by a Flood Watch which warns of general low impact flooding; however there are no specific flood warnings available. Tidal flood warnings are also available for the North Cornwall coast; however these are not tailored to individual communities. There is no critical infrastructure in the policy unit. Development is likely in the policy unit, particularly in the Newquay area.

Gannel and Mawgan Vale	
Policy	**P3: Continue with existing or alternative actions to manage flood risk at the current level.**
Justification	The scale of flood risk within the policy area of Gannel and Newquay is such that the estimated damages to residential, commercial and industrial properties are £9.3M for a 1 per cent annual or 0.5 per cent probability flood event with an additional £55,000 agricultural of agricultural damages expected at this scale of event. There are 283 properties at risk of flooding under the 1 per cent or 0.5 per cent annual probability flood event. It is also expected that three A roads, two B roads and 4km of minor roads would also be subjected to flooding in this scenario. Over the next 100 years, the expected annual damages across the policy unit could increase by 23 per cent as a result of the impacts of climate change and land use management. We estimate that an additional 17 properties will be at risk of flooding in the future. Any development in the policy unit should be carefully designed so as not to exacerbate flood risks further. Policy Options P1 and P2 were rejected as there are predicted to be significant social and economic impacts and limited environmental benefits. These options would also lead to an increased risk to life which is not acceptable. Policy Option P4 was rejected as the social and economic benefits are not sufficiently higher than P3 to justify this option. In addition there are no significant environmental benefits. Existing flood defences benefit a limited number of properties in locations where we do not think numbers of properties at risk will significantly increase in the future. Policy Option P5 was rejected as social and economic benefits are not sufficiently higher than P3 to justify this option and the impacts anticipated to arise from the future scenarios are not significant. Policy Option P6 was rejected as limited improvements to habitats were identified and there is insufficient opportunity to transfer risk to acceptable/ beneficial locations. In addition, social and economic benefits are not sufficiently higher than P3 to justify this option Policy Option P3 was selected as the most appropriate option to manage increasing flood risk in the long term. A number of economic and social assets are at risk of infrequent flooding in the long-term, and while flood risk to these assets will get worse, this remains a relatively low number of assets. Risk to life is not estimated to increase. Furthermore, this option does not result in any significant impacts on the environment. Future flood risks in Newquay, which could be exacerbated by urban development should be avoided through ensuring PPS 25 requirements are met for new development.

North Coast Rivers	
Problem / Risk	Policy Unit North Coast Rivers includes the River Valency and River Jordan and the villages of Boscastle and Port Isaac. It has no major conurbations. River flood risk is dominant with all watercourses springing on high ground and flowing directly to the sea, draining small catchments.

North Coast Rivers	
	All rivers are of high gradient and vulnerable to “flash” flooding caused by short, intense rainfall events and surface runoff. Flooding has been recorded at Boscastle, Crackington Haven, Port Isaac, Porth, Rumford, Tintagel, and Trebarwith. The extreme event in 2004 at Boscastle caused severe flooding and risk to life. Blockages caused by trees being washed downstream contributed to the risk to life posed by the flood. There is a flood alleviation scheme at Boscastle on the River Jordan and the River Valency which provides protection up to the 1.33 per cent and 1 per cent a.p flood event. A residual risk however has been identified in the Valency Valley Tree Management Study undertaken as part of the flood risk management programme at Boscastle. The policy unit is covered by two Flood Watches, which warn that low impact flooding is likely. There are no specific flood warnings available for watercourses in the policy unit, partly due to the flashy nature of the rivers. There is 1 electricity substation at risk of flooding. This is near Boscastle and it lies in the 1 per cent and 0.1 per cent flood extent. There is no other critical infrastructure at risk. It is not thought that significant amounts of development will take place within the policy unit, however infill development could occur.
Policy	**P4: Take further action to sustain the current level of flood risk into the future.**
Justification	The scale of flood risk within the policy area of North Coast Rivers is such that the estimated damages to residential, commercial and industrial properties are £25M for a 1 per cent annual probability flood event with an additional £5,000 of agricultural damages expected at this scale of event. There are 106 properties at risk of flooding under the 1 per cent annual probability flood event. It is also expected that two B roads and 1.5km of minor roads would also be subjected to flooding in this scenario. Over the next 100 years, the expected annual damages across the policy unit could increase by 23 per cent as a result of the impacts of climate change and land use management. We estimate that the number of properties at risk of flooding in the future will increase in number by around 20. Any development in the policy unit should be carefully designed so as not to increase flood risk. Policy Options P1- P3 were rejected as the catchment responds rapidly to rainfall and these options could result in a rapid on-set of flooding and increase flood depths to over 2m. This could result in an increased risk to life. Policy Option P5 was rejected as only minor benefits would be expected at the policy unit level and while the impacts anticipated to arise from the future scenarios are significant, these can be adequately addressed under the P4 scenario. Policy Option P6 was rejected as limited improvements to habitats were identified and there is insufficient opportunity to transfer risk to acceptable/ beneficial locations. Policy Option P4 was selected as the most appropriate option to manage increasing flood risk in the long term. A limited number of economic and social assets are at risk of infrequent flooding in the long-term, and maintaining the current level of risk is acceptable. Although the impacts that may arise as a result of future scenarios are significant, they can be managed by maintaining the current standards of flood risk in the policy unit using a range of flood risk management measures. These range from

North Coast Rivers	
	sustaining the new flood alleviation scheme at Boscastle, through to creating specific flood warnings for at risk locations, and implementing actions from the Rapid Response Catchment study. Targeted channel maintenance is important in this policy unit as the rivers are flashy, and so there is little time to respond to blockages during flood events. The selection of this policy option does not result in any significant impacts on the environment.

Bude and Stratton Area	
Problem / Risk	Policy Unit Bude and Stratton include the River Neet and River Strat. The major towns are Bude and Stratton. A number of locations within the policy unit are vulnerable to flooding caused by short, intense rainfall events. The topography of the area makes flooding directly from rivers overtopping their banks and from surface water runoff a risk. The Bude area is at risk of river and tidal flooding. Flooding within the policy unit has been recorded at Bude, Flexbury, Helebridge, Marhamchurch, New Mills, Stratton, Week St. Mary, and Woolstone Mill. There are flood alleviation schemes at Stratton, Bude, Flexbury and Helebridge. The standard of protection provided by defences at Bude is unknown. Defences at Flexbury are designed to protect up to the 1.33 per cent a.p flood event. Defences at Stratton are designed to protect up to the 4 per cent a.p flood event and defences at Helebridge are designed to protect up to the 10 per cent a.p flood event The policy unit is covered by a Flood Watch, which warns that low impact flooding is likely. Specific flood warnings are available for the River Neet and the River Strat. These specific flood warnings provide less than 2 hours notice of flooding. Specific flood warnings can also be issued for the River Neet at Bude, with up to 6 hours notice of flooding provided. There is 1 emergency response centre at risk of flooding. This is the fire station at Bude and it is at risk from the 1 per cent, 0.5 per cent and 0.1 per cent a.p flood event. There is also one care home at risk of flooding from the 1 per cent and 0.1 per cent a.p flood event near Flexbury. Development is likely in the Bude and Stratton areas.
Policy	**P5: Take further action to reduce flood risk.**
Justification	The scale of flood risk within the policy area of Bude and Stratton is such that the estimated damages to residential, commercial and industrial properties are £33M for a 1 per cent and 0.5 per cent annual probability flood event with an additional £76,000 of agricultural damages expected at this scale of event. These damages are caused by both river and tidal flooding. There are 338 properties at risk of flooding under the 1 per cent and 0.5 per cent annual probability flood event. It is also expected that one A road and up to 4km of minor roads would also be subjected to flooding in this scenario. Over the next 100 years, the expected annual damages across the policy unit could increase by 9 per cent as a result of the impacts of climate change and land use management. We estimate that around 30 additional properties will be at risk of flooding in 2100. Any development in the policy unit should be carefully designed so as not to exacerbate flood risks further.

Bude and Stratton Area	
	Policy Options P1 - P3 were rejected as there would be a significant increase in the numbers of social and economic assets flooded. There will also be impacts to heritage and landscape assets and limited environmental benefits. Policy Option P4 was rejected due to the limited scope to respond to the current uncertainties surrounding the standard of protection afforded by the current flood alleviation scheme at Bude and the impacts of sea level rise in the future. Policy Option P6 was rejected as limited improvements to habitats were identified and there is insufficient availability to transfer risk to acceptable/ beneficial locations. Policy Option P5 was selected as the most appropriate option to manage increasing flood risk in the long term. A number of economic and social assets are at current risk of flooding, and this option allows flood risk management measures to respond to current risk as well as over the long-term as sea levels rise. This policy option allows the scope to respond to this risk now and in the future, particularly in the community of Bude, where the adequacy of the current flood risk management measures is not sufficient. A range of flood risk management measures could be used to reduce risk in the policy unit including; community based tidal flood warnings at Bude, improvements to lead time for warnings on the Neet and Strat, and sustaining the current levels of protection afforded by existing flood alleviation schemes. This policy option results in limited impacts to the environment, however should be mitigated against through the careful design of flood risk management measures.

Welcombe and Coombe Valleys	
Problem / Risk	Policy Unit Welcombe and Coombe Valleys includes the Marsland Water and the villages of Morwenstow and Kilkhampton. It has no major conurbations. River flood risk is dominant with all watercourses springing on high ground and flowing directly to the sea, draining small catchments. All rivers are of high gradient and vulnerable to “flash” flooding caused by short, intense rainfall events and surface runoff, however no property flooding has been recorded in the policy unit. There are no flood alleviation schemes or any maintenance undertaken in the policy unit. The area is covered by a Flood Watch, which warns of general flooding; however no specific flood warnings are available. There is no critical infrastructure in the policy unit. Significant development in this policy unit is unlikely, however some infill development may occur.
Policy	**P1: No active intervention (including flood warning and maintenance). Continue to monitor and advise.**
Justification	The scale of flood risk within the policy area of Welcombe and Coombe Valleys is such that the estimated damages to residential, commercial and industrial properties are £300,000 for a 1 per cent annual probability flood event with an additional £9,000 of agricultural damages expected at this scale of event. There are 9 properties at risk of flooding under the 1 per cent annual probability flood event.

Welcombe and Coombe Valleys	
	Over the next 100 years, the expected annual damages across the policy unit could increase by 5 per cent as a result of the impacts of climate change and land use management. We do not expect the number of properties at risk to increase. Any development in the policy unit should be carefully designed so as not to increase flood risk. Policy Options P2 and P3 were rejected as there are currently no flood risk management measures in place and the impacts and benefits are not significantly different to P1. Policy Options P4 and P5 were rejected as no flood warning or flood defence is currently provided. Therefore this option is not achievable. Policy Option P6 was rejected as limited improvements to habitats were identified and there is insufficient availability to transfer risk to acceptable/ beneficial locations. Policy Option P1 was selected as the most appropriate option to manage increasing flood risk in the long term. There is no increase in the number of properties at risk of flooding, and there are no community assets at risk. There is the potential that Coombe Mill SSSI may be impacted by an increase in frequency, depth and duration of flooding. This will be as a result of future change, not the actions of the CFMP, therefore it is considered to be acceptable.

Due to the strategic nature of the CFMP the policy appraisal process and the policy options chosen have a number of risks, uncertainties and dependencies that apply broadly to all the policy units:

- The damages to property and infrastructure estimated from future flooding are considered great enough to justify the cost of further investigations into reducing flood risk. However, more detailed assessments will be required to identify the actual level of investment that can be justified and its relative priority with other flood risk management work.

- Sources of flood risk within the policy unit are now reasonably clear due to sources of incident information such as FRIS. However it is not clear how potential sources of flood risk will combine and respond in the future, particularly under climate change conditions. In order to implement effective flood risk management strategies, more work needs to be undertaken to establish the likely source-pathway-receptor information under changing conditions.

- The wide range of flood risk management responses identified could result in potential adverse impacts, due to factors outside of the control of this CFMP.

- Determining environmental impacts at this stage is difficult, due to the wide range of variables that could be implemented, such as changes in land management and specific measures that could be undertaken.

- The success of informing and influencing could have significant beneficial results, but could have little or no results, as these would depend on the location of scheme, uptake and the measures implemented.

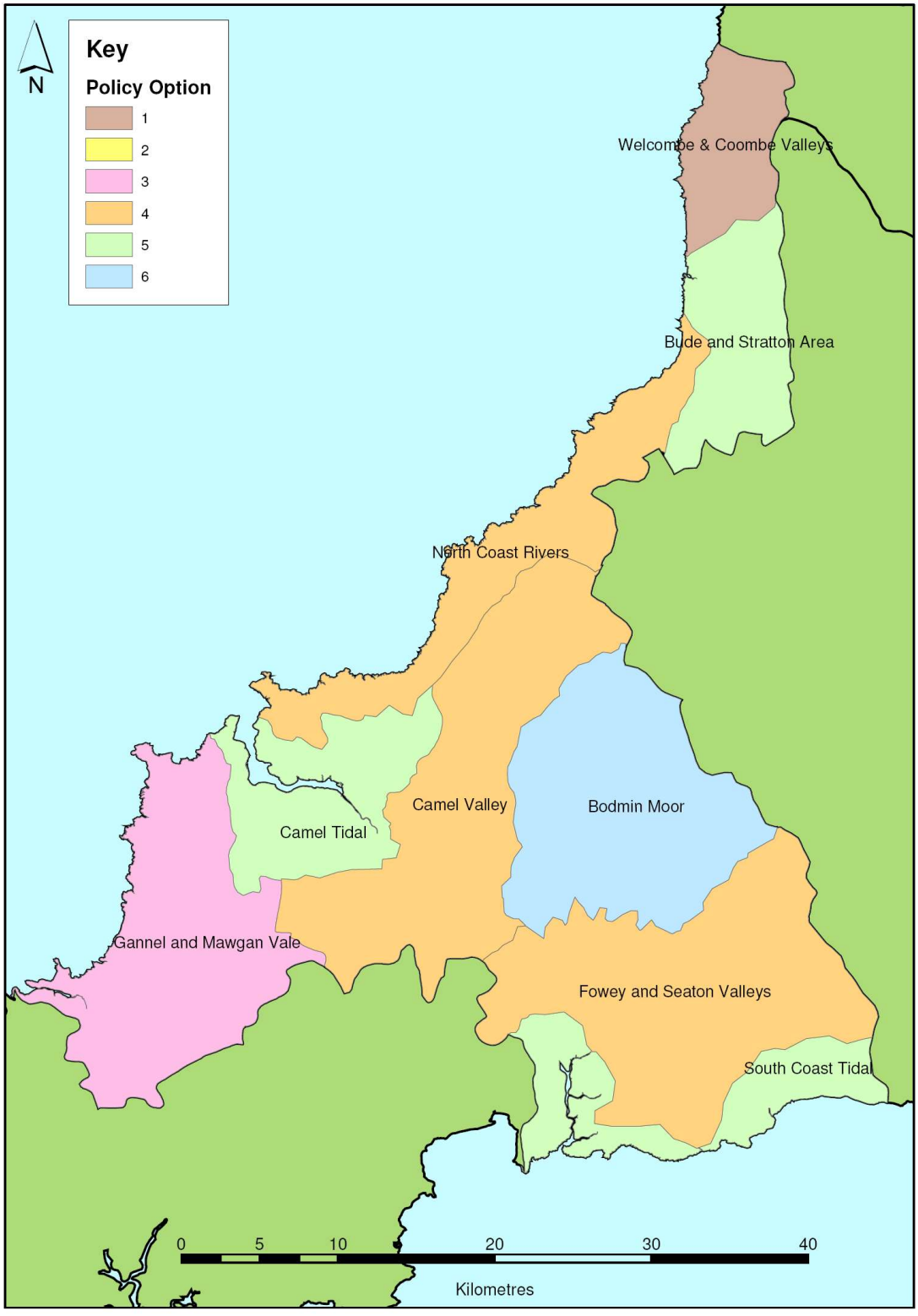
- Catchments that respond rapidly to rainfall can be unpredictable with regard to identifying potential flood risk.

- Climate change estimates for river flows and sea level rise is based on available government guidance at the time of undertaking the analysis in June 2006. This

guidance relating to allowances for sea level rise was revised in October 2006. We do not think that the change in guidance will change our policy decisions.

Each unit is named and colour coded according to which policy option we have selected. This is shown in Figure 6.1.

Figure 6.1 Selected Policy Options for each policy unit



Prioritisation of Policy Units

It is important to prioritise the policy units to ensure that our resources are used appropriately. The priority areas should be those that have the largest number of people and property at risk of flooding. Therefore the priority policy units for tackling flood risk across East Cornwall are:

1. South Coast Tidal
2. Camel Tidal
3. Bude and Stratton Area
4. Fowey and Seaton Valleys
5. Camel Valley
6. North Coast Rivers
7. Gannel Mawgan Vale
8. Bodmin Moor
9. Welcombe and Coombe Valley

7 Implementing the CFMP

7.1 Action Plan

To help us deliver the policies selected for undertaking flood risk management strategies across East Cornwall, we need to identify some actions – things that we can do that will help us achieve the objectives of the CFMP. These actions have been developed through the policy appraisal process by considering the best way to respond to increasing flood risk taking into account the opportunities and constraints already identified within East Cornwall. To follow the development of possible responses to flood risk for each policy unit into actions, please refer to Appendix B, Annex B (Forms 12.1 - 12.10).We have set out the proposed actions in the action plan shown in Table 7.1. The actions relevant for each policy unit are set out in the table. The actions are not listed in any particular order.

Key to Table 7.1:

Objectives and Indicators
These show what objectives the actions are aiming to achieve. Specific place names have been removed for ease of reading. Please note these are not the full objectives, which are listed in Table 5.1. The full objectives have been used in the policy appraisal process. Monitoring indicators are linked to the objectives.

Success Criteria
The success criteria outline what we hope to achieve from implementing the actions.

Partners
We have identified who will be responsible for delivering the actions -whether ourselves, or our partners, with the lead organisation in bold; in most cases this is the Environment Agency. The actions were included within the draft CFMP and consequently have been seen by all consultees during the consultation process. Although these organisations are in broad agreement with the contents of the action plan, their specific involvement in each particular action would be dependent on their own particular resourcing and funding situation at the time. It would also be dependent on the specifics of how to deliver each particular action to a level of detail beyond that provided in this action plan. The action plan is therefore not meant to commit organisations to deliver these actions, but rather to suggest ways in which we can work in partnership to manage flood risk.

Timescale
The timescales identified for the actions give an indication of when the actions could be achieved.

Priority
Priority is based on how effective the action is likely to be in achieving the objective, expressed as Low, Medium or High.

Funding
One: Funding currently identified and approved
Two: Funding to be identified and approved
Three: Funding to be sought outside of the Environment Agency

Notes:
Where actions discuss the potential creation of wetland areas we have assumed that this would be carried out with the agreement of the landowner and that any negative outcomes, such as potential loss of business, will be allowed for where possible. Where specific BAP habitat is affected by a project, habitat enhancement and re-creation measures should be

undertaken; and where specific Scheduled Monuments (or other locally important archaeological sites or buildings) could be affected by a project, suitable investigation and subsequent measures to avoid or minimise impact (e.g. through use of appropriate materials) should be undertaken.

An assessment has been carried out of likely effects on European Sites (as required by the Habitats Directive). This is recorded in Appendices E and F. Appendix F identifies the potential impacts and mitigation on these sites, which should be considered when implementing the following actions.

Table 7.1 East Cornwall Action Plan

Bodmin Moor - Policy 6 Take action to increase the frequency of flooding to deliver benefits locally or elsewhere.							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
1.1 Further investigate the links between land management practices, runoff and flood risk. Consider options for influencing land management practice to reduce flood risk, including encouraging landowners to join Environmental Stewardship programmes and changing drainage practice to attenuate runoff where this is likely to have an impact. Any studies would need to consider land management requirements of the River Camel SAC.	To protect the quality of land (particularly Grade 2) and encourage changes in land use management to reduce runoff.	Area of land being farmed under Environmental Stewardship schemes.	Reduction in runoff from agricultural land.	Environment Agency Rural Services Unit Catchment Sensitive Officers Natural England National Farmers Union	2014	High	Two / Three
	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding					
	To reduce flood risk to critical infrastructure.	Recorded infrastructure at risk of flooding e.g. railway and roads (A30).					
	To reduce flood risk to vulnerable/ deprived communities and community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding. • SFVI					
	To ensure no deterioration of SACs and SSSIs, and help achieve favourable conditions on designated sites and BAP habitats and species, and to create conditions which encourage increased biodiversity.	Area of SACs, SSSIs and BAPs at risk of flooding.					
	To protect water quality, and prevent the pollution of watercourses and groundwater as a result of flooding of urban and agricultural land, mines and landfill sites.	Number of potential pollution sources at risk of flooding. E.g. landfill sites, mines.					

Bodmin Moor - Policy 6 Take action to increase the frequency of flooding to deliver benefits locally or elsewhere.							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
1.2 Investigate opportunities to reduce flood risk downstream by creating flood storage. Options include enhancing wetland habitat in the Upper Fowey and using Siblyback Reservoir, Colliford Lake and disused china clay workings. Should any flood storage be created the following mitigation must be implemented to avoid negative impacts to the River Camel SAC: • Any storage options must not result in degraded water quality. • At least 90 per cent of the naturalised daily mean flow should remain in the river throughout the year. • Fish passage should not be impeded. • Consider changes in flow regime to ensure no detrimental change to woodland area and structure.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding	Reduced flows downstream. Increased wetland habitat.	Environment Agency Natural England China Clay landowners	2014	Medium	Two / Three
	To reduce flood risk to critical infrastructure.	Recorded infrastructure at risk of flooding e.g. railway and roads (A30).					
	To reduce flood risk to vulnerable/ deprived communities and community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding. • SFVI					
	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding.					
	To ensure no deterioration of SACs and SSSIs and help achieve favourable conditions on designated sites and BAP habitats and species, and to create conditions which encourage increased biodiversity	Area of SACs, SSSIs and BAPs at risk of flooding.					
	To protect and work with natural river processes, and to restore watercourses to their natural state.	Number of reaches returned to natural state RHM score.					
	To protect and enhance landscape character and visual amenity, and prevent flood related deterioration of the Cornwall AONB.	▪ Area of AONB at risk of flooding (AONB management plan).					
1.3 Use programmes to raise and maintain awareness of flood risk and self-help measures.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding.	An increase in sign up to Flood Warning Direct.	Environment Agency	Ongoing	High	One

Fowey and Seaton Valleys - Policy 4 Take further action to sustain the current level of flood risk into the future							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
2.1 Sustain existing standard of protection of current river defences at Polperro. To avoid impacts to the Polruan to Polperro SAC the following mitigation must be implemented: • No culverts to be introduced to watercourses which support shore dock populations. • Action must be modelled to ensure maintenance of the variety of hydrological and drainage patterns on site. • Also, ensure actions consider possible changes in water quality.	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding.	No increase in flood risk at Polperro	Environment Agency	Ongoing	High	One
	To prevent loss of life	Number of people at risk of flooding					
	To reduce flood risk to vulnerable/ deprived communities and community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding. • SFVI					
2.2 Use programmes to raise and maintain awareness of flood risk and self-help measures.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding.	An increase in sign up to Flood Warning Direct.	Environment Agency	Ongoing	High	One

Fowey and Seaton Valleys - Policy 4 Take further action to sustain the current level of flood risk into the future							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
2.3 Support the unitary authority in the preparation of its Strategic Flood Risk Assessments and associated Local Development Framework Documents	To reduce flood risk to residential, commercial and industrial property	Number of residential, commercial and industrial properties at risk of flooding Policies included to secure flood resistance and resilience measures within areas at risk of flooding Number of permissions granted for redevelopment in areas at risk of flooding that include flood resistant and resilience measures Development allocations directed to areas at lowest risk of flooding	SFRA completed for each Development Plan Document Flood risk management policy included in relevant Development plan Documents Allocations directed to areas at lowest flood risk	Cornwall Unitary Authority Strategic Planners Planning Environment Agency	Ongoing	High	One
	To reduce flood risk to community assets and to protect and improve recreation facilities where possible.	Number of assets at risk of flooding.					
2.5 Further investigate the links between land management practices, runoff and flood risk. Consider options for influencing land management practice to reduce flood risk, including encouraging landowners to join Environmental Stewardship programmes where this is likely to have an impact.	To protect the quality of land (particularly Grade 2) and encourage changes in land use management to reduce runoff.	Area of land being farmed under Environmental Stewardship schemes.	Reduction in runoff from agricultural land.	Environment Agency Rural Services Unit Catchment Sensitive Officers Natural England National Farmers Union	2014	High	Two / Three
	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding					
	To reduce flood risk to critical infrastructure.	Recorded infrastructure at risk of flooding e.g. railway and roads.					

Fowey and Seaton Valleys - Policy 4 Take further action to sustain the current level of flood risk into the future							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
	To reduce flood risk to vulnerable/ deprived communities and community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding. • SFVI					
	To ensure no deterioration of SACs and SSSIs, and help achieve favourable conditions on designated sites and BAP habitats and species, and to create conditions which encourage increased biodiversity.	Area of SACs, SSSIs and BAPs at risk of flooding.					
	To protect water quality, and prevent the pollution of watercourses and groundwater as a result of flooding of urban and agricultural land, mines and landfill sites.	Number of potential pollution sources at risk of flooding. E.g. mines, WWTW.					
2.6 Improve A38 drainage in Glynn Valley, east of Bodmin	To reduce flood risk to critical infrastructure.	Recorded infrastructure at risk of flooding	Reduced flooding on A38 near Bodmin Parkway	Highways Agency	2014	Medium	Three
2.7 Review flood risk at Tremar	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding.	Reduced flood risk at Tremar	Environment Agency	2020	Medium	Two
2.8 Targeted channel maintenance at known risk locations	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding.	No increase in properties at risk	Environment Agency	Ongoing	High	One

Fowey and Seaton Valleys - Policy 4 Take further action to sustain the current level of flood risk into the future							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
	To protect and work with natural river processes and to restore watercourses to their natural state.	Number of reaches returned to natural state RHM score.					
2.9 Improve flood warning lead time on River Pol	To prevent injuries and loss of life from flooding	Number of people at risk of flooding.	Improved flood warning lead time	Environment Agency	2050	High	Two
2.10 Research impact of mine workings on flood risk. In particular the impact on drainage and the transfer of water between catchments.	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding.	Improved flood flow predictions	Environment Agency	2020	Low	Two
2.11 Progress with the outcomes of the Rapid Response Catchment Study when available. This is likely to apply to Polperro in particular.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding	Reduction in injuries and loss of life from flooding	Environment Agency	2009	High	One

South Coast Tidal - Policy 5 Take further action to reduce flood risk							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
3.1 Support the unitary authority in the preparation of its Strategic Flood Risk Assessments and associated Local Development Framework Documents. Ensure PPS 25 implemented for developments in particular for Fowey, Looe, Lerryn and Lostwithiel.	To reduce flood risk to residential, commercial and industrial property	Number of residential, commercial and industrial properties at risk of flooding Policy to secure resilience and resistance measures for development in areas at risk of flooding Number of applications permitted for change of use in areas at risk of flooding from residential to less vulnerable or water compatible uses.	Complete an appropriately detailed SFRA for each development plan document Policies included to address climate change adaptation in relation to flood risks Allocations directed to areas at lowest flood risk	Cornwall Unitary Authority Strategic and Development Control Planners Environment Agency	Ongoing	High	One
	To reduce flood risk to community assets and to protect and improve recreation facilities where possible.	Number of assets at risk of flooding. Policy to secure and protect green infrastructure along river corridors Number of applications permitted within areas at risk of flooding for change of use to water compatible recreational uses					
3.2 Sustain existing standard of protection of tidal defences at Polperro	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding	Flood risk does not increase	Environment Agency	Ongoing	High	One
3.3 Create community-based warnings for areas at risk of tidal flooding.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding.	Operational warning service	Environment Agency	2010	High	One (Scoping) Two (Implement ation)

South Coast Tidal - Policy 5 Take further action to reduce flood risk							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
3.4 Investigate the possibility of installing a tide gauge at either Fowey or Looe for flood warning	To prevent injuries and loss of life from flooding	Number of people at risk of flooding.	Improved flood warning.	Environment Agency	2010	High	Two
3.5 Further investigate the links between land management practices, runoff and flood risk. Consider options for influencing land management practice to reduce flood risk, including encouraging landowners to join Environmental Stewardship programmes where this is likely to have an impact.	To protect the quality of land (particularly Grade 2) and encourage changes in land use management to reduce runoff.	Area of land being farmed under Environmental Stewardship schemes.	Reduction in runoff from agricultural land.	Environment Agency Rural Services Unit Catchment Sensitive Officers Natural England National Farmers Union	2014	High	Two / Three
	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding					
	To reduce flood risk to vulnerable/ deprived communities and community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding. • SFVI					
	To ensure no deterioration of SACs and SSSIs, and help achieve favourable conditions on designated sites and BAP habitats and species, and to create conditions which encourage increased biodiversity.	Area of SACs, SSSIs and BAPs at risk of flooding.					
3.6 Investigate measures for reducing flood risk at Looe, Fowey, and Seaton, from tidal and surface water flooding.	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding	Reduced tidal flood risk at Looe, Fowey, and Seaton	Environment Agency	2017	High	Two
	To reduce flood risk to critical infrastructure.	Recorded infrastructure at risk of flooding e.g. elec.					

South Coast Tidal - Policy 5 Take further action to reduce flood risk							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
	To reduce flood risk to vulnerable/ deprived communities and community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding. • SFVI					
	To prevent injuries and loss of life from flooding	Number of people at risk of flooding.					
	To protect and enhance heritage features and where appropriate prevent flood-related deterioration of SMs, and Conservation Areas.	Number of historic and archaeological assets at flood risk.					
3.7 Review options to reduce flood risk at Lostwithiel, including improving lead time for flood warning and improving the standard of protection of current defences. Undertake work to reduce risk if justified.	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding.	Reduced risk at Lostwithiel if justified	Environment Agency	2014	High	Two
	To reduce flood risk to critical infrastructure.	Recorded infrastructure at risk of flooding e.g. railway and roads.					
	To prevent injuries and loss of life from flooding	Number of people at risk of flooding					
	To reduce flood risk to vulnerable/ deprived communities and community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding • SFVI					
3.8 Use programmes to raise and maintain awareness of flood risk and self-help measures.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding.	An increase in sign up to Flood Warning Direct.	Environment Agency	Ongoing	High	One

Camel Valley - Policy 4 Take further action to sustain the current level of flood risk into the future							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
4.1 Sustain the current scale of flood risk management in Camelford, Lanivet, and Bodmin. Opportunities include wetland creation at Slaughterbridge, and removing existing structures in watercourses Any flood risk management measures must implement the following mitigation to avoid negative impacts to the River Camel SAC: • Any storage options must not result in degraded water quality. • At least 90 per cent of the naturalised daily mean flow should remain in the river throughout the year. • Fish passage should not be impeded. • Consider changes in flow regime to ensure no detrimental change to woodland area and structure.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding	Risk to life does not increase.	Environment Agency	Ongoing	High	One
4.2 Use programmes to raise and maintain awareness of flood risk and self-help measures.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding.	An increase in sign up to Flood Warning Direct.	Environment Agency	Ongoing	High	One

Camel Valley - Policy 4 Take further action to sustain the current level of flood risk into the future							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
4.3 Support the unitary authority in the preparation of its Strategic Flood Risk Assessments and associated Local Development Framework Documents. . Ensure PPS25 implemented for development and in particular at Bodmin.	To reduce flood risk to residential, commercial and industrial property	Number of residential, commercial and industrial properties at risk of flooding Policy to secure resilience and resistance measures for development in areas at risk of flooding Number of applications permitted for change of use in areas at risk of flooding from residential to less vulnerable or water compatible uses.	Complete an appropriately detailed SFRA, including a Surface Water Management Plan for Bodmin Allocations directed to areas at lowest flood risk	Local Authorities Strategic Planners Planning Environment Agency	Ongoing	High	One
	To reduce flood risk to community assets and to protect and improve recreation facilities where possible.	Number of assets at risk of flooding. Number of applications permitted within areas at risk of flooding for change of use to water compatible recreational uses					
4.4 Further investigate the links between land management practices, runoff and flood risk. Consider options for influencing land management practice to reduce flood risk, including encouraging landowners to join Environmental Stewardship programmes where this is likely to have an impact. Any studies would need to consider land management requirements of the River Camel SAC.	To protect the quality of land (particularly Grade 2) and encourage changes in land use management to reduce runoff.	Area of land being farmed under Environmental Stewardship schemes.	Reduction in runoff from agricultural land.	Environment Agency Rural Services Unit Catchment Sensitive Officers Natural England National Farmers Union	2014	High	Two / Three
	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding					
	To reduce flood risk to critical infrastructure.	Recorded infrastructure at risk of flooding e.g. hospitals, STW, WWTW and roads.					

Camel Valley - Policy 4 Take further action to sustain the current level of flood risk into the future							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
	To reduce flood risk to vulnerable/ deprived communities and community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding. • SFVI					
	To ensure no deterioration of SACs and SSSIs, and help achieve favourable conditions on designated sites and BAP habitats and species, and to create conditions which encourage increased biodiversity.	Area of SACs, SSSIs and BAPs at risk of flooding.					
4.5 Undertake study to increase warning times on the Rivers Camel and Allen and the Bodmin Town Leat.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding	Improved warning times on Rivers Camel and Allen and Bodmin Town Leat.	Environment Agency	2014	Medium	Two
4.6 Targeted channel maintenance and review of structure capacity at known risk locations, to reduce incidents of blockage	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding.	No increase in properties at risk	Environment Agency	Ongoing	High	One
	To protect and work with natural river processes and to restore watercourses to their natural state.	Number of reaches returned to natural state RHM score.					
4.7 Research to improve understanding of impact of mine workings on flood risk. In particular the impact on drainage and the transfer of water	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding.	No increase in properties at risk	Environment Agency	2020	Low	Two

Camel Valley - Policy 4 Take further action to sustain the current level of flood risk into the future							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
between catchments, particularly within the River Camel SAC.	To protect and work with natural river processes and to restore watercourses to their natural state.	Number of reaches returned to natural state RHM score.					
4.8 Investigate feasibility to relocate Bodmin Fire Station.	To reduce flood risk to critical infrastructure.	Recorded infrastructure at risk of flooding e.g. Bodmin Fire Station.	Risk to life does not increase.	County Council	2050	High	Three
4.9 Progress with the outcomes of the Rapid Response Catchment Study when available. This is likely to apply to Camelford in particular.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding	Reduction in injuries and loss of life from flooding	Environment Agency	2009	High	One
4.10 Undertake a Surface Water Management Plan for Bodmin. Include proposals for implementation.	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding.	Reduced flood risk from surface water in Wadebridge	Local Authority Strategic Planners Environment Agency South West Water	2014	High	Two / Three
	To reduce flood risk to critical infrastructure.	Recorded infrastructure at risk of flooding e.g. Fire Station and elec sub sta.					
	To reduce flood risk to vulnerable/ deprived communities and community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding. • SFVI					

Camel Tidal - Policy 5 Take further action to reduce flood risk							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
5.1 Use programmes to raise and maintain awareness of flood risk and self-help measures.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding.	An increase in sign up to Flood Warning Direct.	Environment Agency	Ongoing	High	One
5.2 Support the unitary authority in the preparation of its Strategic Flood Risk Assessments and associated Local Development Framework Documents. Ensure PPS25 implemented for development and in particular at Wadebridge.	To reduce flood risk to residential, commercial and industrial property	Number of residential, commercial and industrial properties at risk of flooding Policy to secure resilience and resistance measures for development in areas at risk of flooding Number of applications permitted for change of use in areas at risk of flooding from residential to less vulnerable or water compatible uses. SFRA identifies rapid inundation zone behind defences in Wadebridge	. Complete an appropriately detailed SFRA for each development plan document Policies included to address climate change adaptation in relation to flood risks Allocations directed to areas at lowest flood risk	Cornwall Unitary Authority Strategic and Development Control Planners Environment Agency	Ongoing	High	One

Camel Tidal - Policy 5 Take further action to reduce flood risk							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
	To reduce flood risk to community assets and to protect and improve recreation facilities where possible.	Number of assets at risk of flooding. Number of applications permitted within areas at risk of flooding for change of use to water compatible recreational uses Policy to secure and protect green infrastructure along river corridors					
5.3 Sustain existing standard of protection of defences on Rivers Allen and Camel at Sladesbridge	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding.	No increase in properties at risk	Environment Agency	Ongoing	High	One
	To prevent injuries and loss of life from flooding	Number of people at risk of flooding					
	To reduce flood risk to critical infrastructure.	Recorded infrastructure at risk of flooding e.g. A389.					
	To reduce flood risk to vulnerable/ deprived communities and community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding. • SFVI					

Camel Tidal - Policy 5 Take further action to reduce flood risk							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
5.4 Create community-based warnings for areas at risk of tidal flooding.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding.	Operational warning service	Environment Agency	2010	High	One (Scoping) Two (Implementation)
5.5 Undertake a Surface Water Management Plan for Wadebridge and Padstow. Include proposals for implementation.	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding.	Reduced flood risk from surface water in Wadebridge	Local Authority Strategic Planners Environment Agency South West Water	2014	High	Two / Three
	To reduce flood risk to critical infrastructure.	Recorded infrastructure at risk of flooding e.g. Fire Station and elec sub sta.					
	To reduce flood risk to vulnerable/ deprived communities and community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding. • SFVI					
5.6 Review standard of protection and condition of defences at Polmorla and Wadebridge. Undertake work to reduce risk if justified.	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding.	Reduced risk at Wadebridge and Polmorla.	Environment Agency	2019	Low	Two
	To reduce flood risk to critical infrastructure such as roads and railways.	Recorded infrastructure at risk of flooding e.g. Wadebridge WWTW					
	To reduce flood risk to vulnerable/ deprived communities and community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding. • SFVI					

Camel Tidal - Policy 5 Take further action to reduce flood risk							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
	To protect and work with natural river processes and to restore watercourses to their natural state.	Number of reaches returned to natural state RHM score.					
	To prevent injuries and loss of life from flooding.	Recorded injuries from flooding.					
5.7 Progress with the outcomes of the Rapid Response Catchment Study when available. This is likely to apply to Polmorla in particular.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding	Reduction in injuries and loss of life from flooding	Environment Agency	2009	High	One
5.6 Further investigate the links between land management practices, runoff and flood risk. Consider options for influencing land management practice to reduce flood risk, including encouraging landowners to join Environmental Stewardship programmes where this is likely to have an impact.	To protect the quality of land (particularly Grade 2) and encourage changes in land use management to reduce runoff.	Area of land being farmed under Environmental Stewardship schemes.	Reduction in runoff from agricultural land.	Environment Agency Rural Services Unit Catchment Sensitive Officers Natural England National Farmers Union	2014	High	Two / Three
	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding					
	To reduce flood risk to critical infrastructure.	Recorded infrastructure at risk of flooding e.g. roads.					
	To reduce flood risk to vulnerable/ deprived communities and community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding. • SFVI					

Camel Tidal - Policy 5 Take further action to reduce flood risk							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
	To ensure no deterioration of SACs and SSSIs, and help achieve favourable conditions on designated sites and BAP habitats and species, and to create conditions which encourage increased biodiversity.	Area of SACs, SSSIs and BAPs at risk of flooding.					

Gannel and Mawgan Vale - Policy 3 Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time)							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
6.1 Continue to maintain existing defences at Mawgan Porth and St Columb Major	To prevent injuries and loss of life from flooding	Number of people at risk of flooding	Risk to life does not increase.	Environment Agency	Ongoing	High	One
6.2 Continue to use programmes to raise and maintain awareness of flood risk and self-help measures.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding.	An increase in sign up to Flood Warning Direct.	Environment Agency	Ongoing	High	One
6.3 Support the unitary authority in the preparation of its Strategic Flood Risk Assessments and associated Local Development Framework Documents. Ensure PPS25 implemented for development and in particular at Newquay	To reduce flood risk to residential, commercial and industrial property	Number of residential, commercial and industrial properties at risk of flooding Policy to secure resilience and resistance measures for development in areas at risk of flooding	Complete an appropriately detailed SFRA for each development plan document Surface Water Management Policy included for allocation of major development within or around Newquay Allocations directed to areas at lowest flood risk	Cornwall Unitary Authority Strategic Planners Environment Agency	Ongoing	High	One
	To reduce flood risk to community assets and to protect and improve recreation facilities where possible.	Number of assets at risk of flooding.					
	To ensure no deterioration of SACs and SSSIs, and help achieve favourable conditions on designated sites and BAP habitats and species, and to create conditions which encourage increased biodiversity.	Area of SACs, SSSIs and BAPs at risk of flooding.					
6.4 Review flood risk in Newquay and take action to ensure it does not increase as a result of new development.	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding.	Flood risk in Newquay does not increase	Environment Agency	Ongoing	Medium	One
	To prevent injuries and loss of life from flooding	Number of people at risk of flooding					

Gannel and Mawgan Vale - Policy 3 Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time)							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
	To reduce flood risk to critical infrastructure.	Recorded infrastructure at risk of flooding e.g. A392.					
	To reduce flood risk to vulnerable/ deprived communities and community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding. • SFVI					
6.5 Further investigate the links between land management practices, runoff and flood risk. Consider options for influencing land management practice to reduce flood risk, including encouraging landowners to join Environmental Stewardship programmes, where this is likely to have an impact.	To protect the quality of land (particularly Grade 2) and encourage changes in land use management to reduce runoff.	Area of land being farmed under Environmental Stewardship schemes.	Reduction in runoff from agricultural land.	Environment Agency Rural Services Unit Catchment Sensitive Officers Natural England National Farmers Union	2014	High	Two / Three
	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding					
	To reduce flood risk to critical infrastructure.	Recorded infrastructure at risk of flooding e.g. roads.					
	To reduce flood risk to vulnerable/ deprived communities and community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding. • SFVI					
	To ensure no deterioration of SACs and SSSIs, and help achieve favourable conditions on designated sites and BAP habitats and species, and to create conditions which encourage increased biodiversity.	Area of SACs, SSSIs and BAPs at risk of flooding.					

North Coast Rivers - Policy 4 Take further action to sustain the current level of flood risk into the future							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
7.1 Act upon the outcomes of the Valency Valley Tree Management Study.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding	No increase in flood risk at Boscastle	Environment Agency National Trust Landowners	Ongoing	High	One
	To ensure no deterioration of SACs, SPAs and SSSIs and help achieve favourable conditions on designated sites and BAP habitats and species, and to create conditions which encourage increased biodiversity.	No adverse impact on Minster Church SSSI					
	To protect and work with natural river processes and restore watercourses to their natural state	Number of reaches returned to natural state RHM score.					
	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding					
	To reduce flood risk to critical infrastructure.	Recorded infrastructure at risk of flooding e.g. electricity sub station.					
	To reduce flood risk to community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding. • SFVI					
7.2 Sustain existing standard of protection for Boscastle.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding	No increase in flood risk on the Valency	Environment Agency	Ongoing	High	One

North Coast Rivers - Policy 4 Take further action to sustain the current level of flood risk into the future							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding.					
	To reduce flood risk to critical infrastructure.	Recorded infrastructure at risk of flooding e.g. electricity sub station.					
	To reduce flood risk to vulnerable/ deprived communities and community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding. • SFVI					
7.3 Use programmes to raise and maintain awareness of flood risk and self-help measures, for both permanent and temporary residents.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding.	An increase in sign up to Flood Warning Direct.	Environment Agency	Ongoing	High	One
7.4 Create specific flood warnings for at risk locations, such as Boscastle.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding.	Improved flood warning lead time	Environment Agency	2014	High	Two
7.5 Support the unitary authority in the preparation of its Strategic Flood Risk Assessments and associated Local Development Framework Documents.	To reduce flood risk to residential, commercial and industrial property	Number of residential, commercial and industrial properties at risk of flooding Policy to secure resilience and resistance measures for development in areas at risk of flooding Functional floodplain at Boscastle, Crackington Haven, Port Isaac, Porth, Tintagel and Trebarwith is identified within the SFRAs.	Complete an appropriately detailed SFRA for each development plan document Allocations directed to areas at lowest flood risk	Cornwall Unitary Authority Strategic Planners Environment Agency	Ongoing	High	One

North Coast Rivers - Policy 4 Take further action to sustain the current level of flood risk into the future							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
	To reduce flood risk to community assets and to protect and improve recreation facilities where possible.	Number of assets at risk of flooding.					
7.6 Progress with the outcomes of the Rapid Response Catchment Study when available.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding	Reduction in injuries and loss of life from flooding	Environment Agency	2009	High	One
7.7 Further investigate the links between land management practices, runoff and flood risk. Consider options for influencing land management practice to reduce flood risk, including encouraging landowners to join Environmental Stewardship programmes where this is likely to have an impact. .	To protect the quality of land (particularly Grade 2) and encourage changes in land use management to reduce runoff.	Area of land being farmed under Environmental Stewardship schemes.	Reduction in runoff from agricultural land.	Environment Agency Rural Services Unit Catchment Sensitive Officers Natural England National Farmers Union	2014	High	Two / Three
	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding					
	To reduce flood risk to critical infrastructure.	Recorded infrastructure at risk of flooding e.g. roads.					
	To reduce flood risk to vulnerable/ deprived communities and community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding. • SFVI					
	To ensure no deterioration of SACs and SSSIs, and help achieve favourable conditions on designated sites and BAP habitats and species, and to create conditions which encourage increased biodiversity.	Area of SACs, SSSIs and BAPs at risk of flooding.					

North Coast Rivers - Policy 4 Take further action to sustain the current level of flood risk into the future							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
7.8 Targeted channel maintenance at known risk locations	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding.	No increase in properties at risk	Environment Agency	Ongoing	High	One
	To protect and work with natural river processes and to restore watercourses to their natural state.	Number of reaches returned to natural state RHM score.					

Bude and Stratton Area - Policy 5 Take further action to reduce flood risk							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
8.1 Review existing flood risk in Bude and undertake work to reduce risk if justified.	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding	Flood risk does not increase	Environment Agency	Ongoing	High	One
	To prevent injuries and loss of life from flooding	Number of people at risk of flooding.					
	To reduce flood risk to residential, commercial and industrial property	Number of residential, commercial and industrial properties at risk of flooding					
8.2 Sustain existing standard of protection of defences at Stratton, Flexbury, and Helebridge	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding	Flood risk does not increase	Environment Agency	Ongoing	High	One
8.3 Use programmes to raise and maintain awareness of flood risk and self-help measures.	To prevent injuries and loss of life from flooding	Number of people at risk of flooding.	An increase in sign up to Flood Warning Direct.	Environment Agency	Ongoing	High	One
8.4 Support the unitary authority in the preparation of its Strategic Flood Risk Assessments and associated Local Development Framework Documents.	To reduce flood risk to residential, commercial and industrial property	Number of residential, commercial and industrial properties at risk of flooding Policy to secure resilience and resistance measures for development in areas at risk of flooding	Complete an appropriately detailed SFRA for each development plan document Allocations directed to areas at lowest flood risk	Cornwall Unitary Authority Strategic Planners Environment Agency	Ongoing	High	One
	To reduce flood risk to community assets and to protect and improve recreation facilities where possible.	Number of assets at risk of flooding.					
8.5 Review current facility for recording tide levels at Bude and improve if required.	To prevent injuries and loss of life from flooding.	Number of people at risk of flooding	Improved flood warning at Bude	Environment Agency	2008	High	One

Bude and Stratton Area - Policy 5 Take further action to reduce flood risk							
Action	**Relevant objectives**	**Relevant monitoring indicators**	**Success criteria**	**Partners**	**Indicative timescale**	**Priority**	**Funding**
8.6 Create community-based warnings for areas at risk of tidal flooding.	To prevent injuries and loss of life from flooding.	Number of people at risk of flooding	Active flood warning service	Environment Agency	2010	High	One (Scoping) Two (Implementation)
8.7 Review and improve flood warnings on the Neet and Strat if feasible	To prevent injuries and loss of life from flooding.	Number of people at risk of flooding	An increase in sign up to Flood Warning Direct.	Environment Agency	Ongoing	High	One
8.8 Further investigate the links between land management practices, runoff and flood risk. Consider options for influencing land management practice to reduce flood risk, including encouraging landowners to join Environmental Stewardship programmes where this is likely to have an impact. .	To protect the quality of land (particularly Grade 2) and encourage changes in land use management to reduce runoff.	Area of land being farmed under Environmental Stewardship schemes.	Reduction in runoff from agricultural land.	Environment Agency Rural Services Unit Catchment Sensitive Officers Natural England National Farmers Union	2014	High	Two / Three
	To reduce flood risk to residential, commercial and industrial property.	Number of residential, commercial and industrial properties at risk of flooding					
	To reduce flood risk to critical infrastructure.	Recorded infrastructure at risk of flooding e.g. roads.					
	To reduce flood risk to vulnerable/ deprived communities and community assets and to protect and improve recreation facilities where possible.	• Number of assets at risk of flooding. • SFVI					
	To ensure no deterioration of SACs and SSSIs, and help achieve favourable conditions on designated sites and BAP habitats and species, and to create conditions which encourage increased biodiversity.	Area of SACs, SSSIs and BAPs at risk of flooding.					

Welcombe and Coombe Valleys - Policy 1 No active intervention.
No action is proposed in this policy unit. We will continue to monitor and advise.

7.2 Consequences of Our Actions

We can look at the results and consequences of CFMP policies through actions for each of the policy units. As many of the actions apply to several of the policy units, the consequences are in response to actions rather than on a policy unit basis. These are outlined in Table 7.2 and are not listed in any order of priority.

Table 7.2 Summary of Actions and Associated Consequences

Action	Consequences
Use programmes to raise and maintain awareness of flood risk and self-help measures.	Reduce injuries and loss of life by making people aware and prepared for flooding.
Investigate the links between land management practices, runoff and flood risk including review of measures outlined in the Valency Land Use Management Study.	Reduce runoff from land and consequently a reduction in risk from inappropriate land management.
Create flood warnings for communities at risk of flooding from the sea.	Reduce risk to life and damages caused by flooding by providing people with information they trust and can act upon.
Undertake research to improve understanding about the impact of mine workings on flood risk on a catchment level	Assess the risk of flooding that mine workings pose and how they affect catchment hydrology.
Act upon the relevant outcomes of the Rapid Response Catchment Study	Identification of these catchments in East Cornwall.
Encourage landowners to join Environmental Stewardship programmes.	Encourage best practice in order to reduce soil erosion, surface runoff and diffuse pollution. Therefore reduce the risk from surface water runoff.
Support the unitary authority in the preparation of its Strategic Flood Risk Assessments and Local Development Framework Plans.	Flood risk management planning to provide more detailed insight into flood risk and planning guidance for Local Authorities under PPS25. Allocations directed to areas at lowest flood risk.
Undertake Surface Water Management Plans for urban areas	Reduce the risk and potential damages from surface water flooding.
Review existing, improve or maintain current standards of protection of defences at various locations	Ensure defences are at an appropriate standard of protection to cope with future flood risk.
Investigate the use of existing water bodies and reservoirs to store more water.	Increasing the amount of water stored in upstream bodies of water could reduce flood risk downstream by reducing peak flows and providing regulated amounts of water downstream (flow attenuation).
Investigate opportunities to enhance wetland habitat in upper catchments to attenuate run off.	Creation of wetland provides new areas for water to collect and be stored. This reduces flood risk downstream through the resulting flow attenuation and creates BAP habitat and increased amenity value for local communities.
Review the quality of flood warning criteria on specified rivers	Help to ensure more timely warnings which will improve lead times and ultimately reduce the risk to life and economic damages etc.
Targeted channel maintenance at known risk locations	Reduce incidents of blockage at structures and other risk locations.
Apply PPS25 to new development	Flood risk is considered in the design of new development.

The actions listed in Table 7.2 contribute to the implementation of the overall policy aspirations for each of the policy units.

Over the long term we expect the proposed policies to have the following main benefits across the East Cornwall catchment and provide a number of potential opportunities under a scenario of a 1 per cent a.p flood from rivers and a 0.5 per cent a.p flood from the sea.

The significant impacts likely to result from the CFMP are as follows:

- Avoidance of future flooding of 221 properties, 1,290 properties would benefit from an improved standard of flood defence.
- A reduction in run off would benefit approximately 100 properties.
- Increased flood warning would benefit approximately 40 properties.
- Changes to land management and drainage systems would benefit approximately 15 properties.
- Reduced run off as a result of reduced flooding (in North Coast Rivers, Fowey and Seaton Valleys, Bude and Stratton, South Coast Tidal and Camel Tidal Policy Units).
- Reduced risk of pollution as a result of reduced flooding (in North Coast Rivers, Fowey and Seaton Valleys, Bude and Stratton South Coast Tidal Camel Valley and Camel Tidal Policy Units).
- Avoidance of flooding of up to 17 community assets.
- Reduction in depth of flooding by up to 0.5m (in Bodmin Moor, South Coast Tidal and Camel Tidal Policy Units), this will reduce the risk to life and impacts to vulnerable communities.
- Avoidance of flooding of up to 2.4m.
- Increased geomorphological diversity and floodplain connectivity.
- Naturalisation of watercourses.
- Avoidance of impacts to woodland features from increased frequency of flooding to St Nectan's Glen SSSI, Boconnoc Park and Woods SSSI, Crow's Nest SSSI and Phoenix United Mine and Crows nest SAC.
- Improved condition of Rosenannon Bog and Downs SSSI and Retire Common SSSI
- Creation of fen and wet woodland BAP habitats.

- Failure of flood defences would put an additional 30 properties at risk
- Additional flood risk to approximately 23 properties
- Long term deterioration to vulnerable communities as a result of continued flood risk.
- Increased flooding of 1 A road and small lengths of minor road,
- Increased depth of flooding by up to 0.3m, (Gannel and Mawgan Vale and Welcombe and Coombe Valleys Policy Unit) this will have impacts on health and will particularly affect vulnerable communities.
- Increased risk of pollution as a result of increased flooding (Gannel and Mawgan Vale and Welcombe and Coombe Valleys Policy Units)
- Potential impacts to up to 3 SMs
- Potential deterioration of valley features, particularly in settlements.
- Potential impacts to Bude Marshes as a result of construction of improved flood defences.

7.3 Monitoring, Review and Evaluation

We are responsible, with the Steering Group and Consultation Group, for implementing this CFMP. We will achieve the following by continuing to monitor and review:

- that the CFMP is being implemented as it should
- that the policy and actions of the CFMP are being implemented appropriately
- that any unexpected impacts of the CFMP are picked up quickly and mitigated
- that the monitoring data will be fed back into the CFMP when it is reviewed in the future

Table 7.3 shows the indicators that we will monitor and includes the source of data we used to quantify the indicator. We will be monitoring the action plan on a regular basis across the whole of the Environment Agency as well as within Flood Risk Management Team. This will help support implementing the action plan by creating, developing and improving existing actions.

Table 7.3 East Cornwall Monitoring Indicators and Data Sources

Objective	Monitoring Indicators	Data Source
Economic		
To reduce flood risk to residential, commercial and industrial property especially in locations such as Bude, Wadebridge, Lostwithiel, Newquay, Fowey and Looe.	Number of residential, commercial and industrial properties at risk of flooding.	From Environment Agency Flood Map.
To reduce flood risk to critical infrastructure in particular the A30 and A38.	Recorded infrastructure at risk of flooding e.g. hospitals, STW, WWTW and roads.	From Environment Agency Flood Map.
To minimise disturbance to agricultural land.	Area of land disturbed by flood defence schemes.	No current data source. Suggest Environment Agency record losses for new schemes.
Social		
To prevent injuries and loss of life from flooding.	Number of people at risk of flooding.	From Environment Agency data.
To reduce flood risk to vulnerable/ deprived communities and community assets, and to protect and improve recreation facilities where possible.	Number of assets at risk of flooding. SFVI	From Environment Agency Flood Map and data.
Environmental		
To protect and work with natural river and to restore watercourses to there natural state, particularly St. Neot River, De Lank River, River Camel, River Fowey, River Gannel and Menalhyl River.	Number of reaches returned to natural state River Habitats Modification score.	Environment Agency indicator.
To ensure no deterioration of SACs (such as Phoenix United Mine and Crow's Nest), or SSSIs (such as Amble Marshes, Boconnoc Park), and help achieve favourable conditions on designated sites and BAP habitats and species, and to create conditions which encourage increased biodiversity.	Area of SACs, SSSIs and BAPs at risk of flooding.	Environment Agency indicator.
To protect water quality and prevent the pollution of watercourses and groundwater as a result of flooding of urban and agricultural land, and mines.	Number of potential pollution sources at risk of flooding. E.g. landfill sites, mines, WWTW.	From Environment Agency data.
To protect the quality of land (particularly Grade 2 land) in the Camel River catchment, Fowey River Catchment and the Looe Estuary) and encourage changes in land use management to reduce runoff.	Areas of land being farmed under the Single Farm Payment System for environmental enhancement.	From Defra.
To protect and enhance heritage and archaeological features and where appropriate prevent flood-related deterioration of SMs.	Number of historic and archaeological assets at flood risk.	From English Heritage. From Environment Agency Flood Map.
To protect and enhance landscape character and visual amenity and where appropriate prevent flood related deterioration of the Cornwall AONB.	Area of AONB at risk of flooding (AONB management plan).	From Environment Agency data

Glossary of Terms

Area of Outstanding Natural Beauty (AONB)

Areas of Outstanding Natural Beauty (AONB) were formally designated under the National Parks and Access to the Countryside Act of 1949 to protect areas of the countryside of high scenic quality that cannot be selected for National Park status due to their lack of opportunities for outdoor recreation (an essential objective of National Parks). Natural England is responsible for designating AONBs and advising Government and others on how they should be protected and managed. Further information on AONBs can be found at: http://www.aonb.org.uk

ArcMap

A Geographical Information System (GIS) computer Package produced by ESRI. Further information can be found at www.gis.com and also at www.esri.com.

Appropriate Assessment (AA)

Where there is likely to be a significant effect on a European site, an appropriate assessment must be carried out. An appropriate assessment determines whether a likely significant effect will occur as a result of a proposed plan, policy or project.

Benefits

Those positive measurable and immeasurable changes that a plan will produce, including damages avoided.

Biodiversity Action Plan (BAP)

An agreed plan for a habitat or species, which forms part of the UK's commitment to biodiversity. For further information consult the BAP website: http://www.ukbap.org.uk

Birds Directive

European Community Directive (79/409/EEC) on the conservation of wild birds. Implemented in the UK as the Conservation (Natural Habitats, etc.) Regulations (1994). For further information consult Her Majesties Stationary Office website: http://www.hmso.gov.uk/si/si1994/Uksi_19942716_en_1.htm

Catchment

A surface water catchment is the total area that drains into a river. A groundwater catchment is the total area that contributes to the groundwater part of the river flow.

Catchment Abstraction Management Strategies (CAMS)

CAMS are strategies for managing water resources locally. They will make more information the allocation of water resources available and balance the needs of abstractors with those of the water environment by consulting with local interested parties.

Catchment Flood Management Plan (CFMP)

Catchment Flood Management Plans (CFMPs) are a large-scale strategic planning framework for managing flood risks to people and the developed and natural environment in a sustainable way.

Catchment Opportunities and Constraints

Main issues in the catchment, which are identified based on a combination of catchment characteristics (e.g. designated areas the need protecting or improving), Government policy/targets (e.g. Defra 'High Level Targets', 1999) and/or catchment initiatives (e.g. existing local authority strategies). Catchment policies/measures should aim to 'take account of constraints' and 'promote opportunities' through the CFMP appraisal framework (economic, environmental and technical). Designated sites have Water Level Management Plans (WLMPs) that set out water level management needs in certain parts of the catchment and some floodplain areas have nature conservation or heritage interest that benefit from more frequent flooding.

Catchment Sensitive Farming

Catchment Sensitive Farming is a pro-active approach to diffuse pollution. By reducing agricultural sources of diffuse pollution within river catchments, through land management practices, we can ensure that emissions to water are consistent with ecological requirements. Forty catchments across England, have been identified as priority areas for action, and will be targeted under a range of measures aimed at improving farm practices and reducing water pollution from agriculture. Advisers will work on a one to one basis with farmers, as well as leading a series of initiatives including workshops and farm demonstrations to encourage best practice.

Catchment Policies

The results of the CFMP, which are the stated policies for flood risk management within a defined flood risk area, based on the generic catchment policies.

Communication Plan

A plan that sets out the CFMP consultation programme and specific arrangements for internal (Environment Agency) and external consultation.

Consultation Group

A group of people who represent interested parties who we consult on the CFMP as agreed with the Project Board. The Consultation Group should be identified within the Communication Plan.

Countryside Character Areas

Countryside Character Areas are parts of England, which have a similar countryside character. There are 159 Character Areas in England on which strategies for both ecological and landscape issues can be based. Natural England extensively uses this framework to describe and shape objectives for planning and managing the countryside.

Countryside and Rights of Way Act (CRoW)

The Countryside and Rights of Way (CRoW) Act 2000 came into force on 30 January 2001. The Act applies in England and Wales and has five parts:

1. Access to the countryside;
2. Public rights of way and road traffic;
3. Nature conservation and wildlife protection;
4. Areas of outstanding natural beauty;
5. Miscellaneous and supplementary.

Part 3 is the most relevant in terms of catchment flood management as it gives biodiversity a statutory basis, revises SSSI notification procedures, greatly increases protection for SSSIs and strengthens the advisory role of EN / CCW, increases the scope of some wildlife offences and increases penalties. For further information refer to Her Majesty's Stationery office website:

http://www.hmso.gov.uk/acts/acts2000/20000037.htm

Critical Ordinary Watercourses (COWs)

Stretches of non-main watercourse that have been defined as critical in terms of flood risk management through consultation between us and Local Authorities.

Defra

Department for Environment, Food and Rural Affairs. The department of central Government responsible for flood management policy in England.

Digital Elevation Model (DEM)

A digital elevation model is a representation of the topography of an area and gives the elevation of the upper surface whether it is the ground, vegetation or a building.

Digital Terrain Model (DTM)

A digital elevation model is a representation of the ground surface with buildings and vegetation removed. With airborne techniques automated filters have been developed which can detect buildings and remove them and fill the gap with interpolated data.

Department for Communities and Local Government (DCLG)

The department that is responsible for local communities and social issues.

Department for Transport, Local Government and the Regions (DTLR)

The former department of central government responsible for policy on planning and other issues. Now replaced by the Office of the Deputy Prime Minister which has subsequently been replaced by the Department for Communities and Local Government (DCLG).

Environment Agency

Non-departmental public body responsible for implementing government policy relating to the environment and flood risk management in England and Wales.

Environment Agency Vision

Our 'vision' for the environment and a sustainable future is: 'A healthy, rich and diverse environment in England and Wales, for present and future generations'. To achieve the targets that will make the 'vision' a reality we have identified nine key 'themes' or 'frameworks for change' which we will use to work for a more sustainable future.

1. A better quality of life: We will work with all sectors to improve the quality of the environment and the services it provides – for business, anglers, the boating community and other users of the waterways, farmers, planners and all sections of the community;
2. An improved environment for wildlife: We will make sure that our work and the work of those we authorise does not threaten important species and habitats;
3. Cleaner air for everyone;
4. Improved and protected inland and coastal waters: We will work to clean up polluted waters and to reduce the risk of further pollution;
5. Restored protected land with healthier soils;
6. A 'greener' business world;
7. Wiser sustainable use of natural resources;
8. Limiting and adapting to climate change;
9. Reducing flood risk: We will improve flood defences and information on flood risks.

For further information refer to our website: http://www.environment-agency.gov.uk

Environmentally Sensitive Areas (ESA)

ESA schemes were introduced by the Ministry of Agriculture, Fisheries and Food (MAFF; predecessor to Defra) in 1987 and are designated under the provisions of sections 18 and 19 of the 1986 Agriculture Act and Environmentally Sensitive Area (Stage II) Designation (Amendment)(No2) Order 2001. They are governed by Defra and offer incentives (on a 10 year agreement with a 5 year break clause) to encourage farmers to adopt agricultural practices which would protect and improve parts of the country of particularly high landscape, wildlife or historic value. Further details can be found on Defra's website: http://www.defra.gov.uk/erdp/schemes/esas/default.htm

Environmental Stewardship

Environmental Stewardship is a new agri-environment scheme, which provides funding to farmers and other land managers in England who deliver effective environmental management on their land. The scheme is intended to build on the recognised success of the Environmental Sensitive Areas scheme and the countryside Stewardship Scheme. Environmental stewardship has three elements:

1. Entry Level Stewardship (ELS): The aim is to encourage a large number of farmers across a wide area of farmland to deliver simple yet effective environmental management.
2. Organic Entry Level Stewardship (OELS): The aim is to encourage a large number of organic farmers across a wide area of farmland to deliver simple yet effective environmental management.
3. Higher Level Stewardship (HLS): The aim is to deliver significant environmental benefits in high priority situations and areas.

FEHCALC

Spreadsheet designed by John Packman from the Centre for Ecology and Hydrology, Wallingford to calculate peak flows, based on the rainfall-runoff methodology detailed in the Flood Estimation Handbook. Procedures are outlined within the MDSF guidelines.

Flood Defence

A structure (or system of structures) for reducing flooding from rivers or the sea. Flood Estimation Handbook (FEH) provides the current ways for estimating flood flows for the UK.

Floodplain

Any area of land over which water flows or would flow if there were no flood defences. It can also be a place where water is stored during flooding.

Flood Map

The Flood Map is our public map for floodplain information. It shows the Flood Zone extents, which ignore defences, the location of raised defences and the area benefiting from defences. Available on our website, it also provides information on the chance of general areas of land flooding.

Flood Risk

The level of flood risk is the frequency or likelihood of the flood events together with their consequences (such as loss, damage, harm, distress and disruption).

Flood Risk Management

Modifying the frequency or consequences of flooding to an appropriate level (equal to land use) and monitoring to make sure that flood risks remain at the proposed level. This should take account of other water level management requirements, and opportunities and constraints. It is not just about applying physical flood defence measures.

Flood Zones

We have produced flood zones in response to Planning Policy Guidance (PPG 25) and to provide planning authorities with quality assured flood risk data. The zones show the area at risk if there were no defences and are classified as follows:

Zone 1 - annual probability of flooding of less than 1000:1 (0.1 per cent);

Zone 2 - annual probability of flooding between 1000:1 (0.1 per cent) and 1:100 (1.0 per cent) for river flooding or 200:1 (0.5 per cent) for coastal flooding; and

Zone 3 - annual probability of flooding greater than or equal to 1:100 (1.0 per cent) for river flooding or greater than or equal to 200:1 (0.5 per cent) for coastal flooding.

Fluvial

Relating to a watercourse (river or stream).

Freshwater Fisheries Directive Designation

EC Directive 78/659/EEC on the Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life ('The Freshwater Fish Directive') aims to protect and improve water quality and forms part of our water quality monitoring programme. Under the Directive, the UK Government was required to designate two categories of water: those suitable for salmonids (waters that have the potential to support fish of the family Salmonidae, mainly salmon and trout but also grayling) and those suitable for cyprinids (from the family Cyprinidae plus pike, perch and eel).

The Directive sets standards to protect freshwater fisheries, mainly relating to the quality of the water, and requires certain designated stretches of water to meet these standards so that fish can live or breed. For further information please consult our website:

http://www.environment-agency.gov.uk/

Geographical Information System (GIS)

A GIS is a computer-based system for capturing, storing, checking, integrating, manipulating, analysing and displaying data that are spatially referenced.

Geomorphology

The sediment erosion, deposition of transport processes that create the topography and shape of a river and its floodplain.

Groundwater

Water occurring below ground in natural formations (typically rocks, gravels and sands).

Highest Astronomic Tide (HAT)

The highest tide that can occur due solely to the arrangement of the moon, sun and planets.

Historic Flood Map

Shows the mapped extents of known historical flooding.

Hydrological Model

Estimates the flow in a river from a certain amount of rainfall falling into the catchment. Such models typically account for factors such as catchment area, topography, soils, geology and land use.

Inception Report

Provides a detailed description of the work carried out during the CFMP Inception phase. This includes a summary of catchment data collection and preliminary understanding of the main issues to be considered for effective flood risk management during subsequent phases of the CFMP process.

Indicative Floodplain Maps (IFMs)

Maps showing our best estimate of the extent of the floodplain. These cover all main rivers and some ordinary watercourses. The floodplain is defined as the area having a 1 per cent per annum risk of fluvial (river), or a 0.5 per cent per annum risk of tidal inundation. Defended areas are also shown. These maps are sometimes referred to as Section 105 maps. These maps have been replaced by the flood zone map.

Indicative Standard of Protection

The range of level of protection to be considered for flood defences, based upon how the land being protected is used. They do not represent any entitlement to protection or minimum level to be achieved.

Interferometric Synthetic Aperture Radar (IFSAR)

Interferometric Synthetic Aperture Radar is a comparison of two or more radar images collected at slightly different geometries. This process extracts phase differences caused by changes in elevation relative to a reference point, producing Digital Terrain Elevation data. The technique is able to collect large areas of high-resolution data quickly and affordably no matter the conditions, night or day.

Land Use

Various designations of activities, developments, cropping types, etc for which land is used.

Land Management

Various forms of activities relating to agricultural, forestry, etc and other practices.

Local Development Documents (LDD)

These documents make up the Local Development Framework (LDF).

LiDAR

Light Detection and Ranging (LIDAR) is an airborne mapping technique, which uses a laser to measure the distance between the aircraft and the ground.

Local Authority Development Plans

These statutory land development plans generally cover a 10-year period from when they are adopted. However, the local authorities currently review these plans every five years. A District Council and a Unitary Authority will produce a Local Plan and a County Council produce a Structure Plan. A Structure Plan guides the Local Plans of several District Councils.

Local Biodiversity Action Plan (LBAP)

A local agenda (produced by the local authority) with plans and targets to protect and improve biodiversity and achieve sustainable development. We are committed to Biodiversity Action Plans and work with central Government (Rio Earth Summit, 1992) to meet LBAP objectives.

Local Environment Agency Plan (LEAP)

An Environment Agency non-statutory plan based on the river basin (or sub-catchments or groups of smaller catchments) providing environmental baseline information and actions/objectives for that river basin (largely replaced the National Rivers Authority's Catchment Management Plans (CMPs)).

MAFF

The former Ministry of Agriculture, Fisheries and Food – all functions now incorporated within Defra.

Mean High Water Springs (MHWS)

The average of the spring tides which occur every two weeks.

Main River

Watercourses defined on a 'Main River Map' designated by Defra. We have powers to carry out flood defence works, maintenance and operational activities for Main Rivers only. Responsibility for maintenance however rests with the land owner.

Modelling and Decision Support Framework (MDSF)

The Modelling and Decision Support Framework - a GIS based decision support tool developed specifically to help the CFMP process by automating parts of the analysis.

National Nature Reserve (NNR)

National Nature Reserves are designated under the National Parks and Access to the Countryside Act 1949 or the Wildlife and Countryside Act 1981 (as amended) mainly for nature conservation, but can also include sites with special geological of physiographic features. They were set up to protect the most important areas of wildlife habitat and geological formations in Britain, and as places for scientific research. All NNRs are "nationally important" and are best examples of a particular habitat/ecosystem. They are usually owned or leased by English Nature, or managed in accordance with a Nature Reserve Agreement with the landowner or occupier. At the end of March 2000 there were 200 NNRs in England covering 80,533 hectares. NNRs receive SSSI designation under The Countryside and Rights of Way Act 2000 and The Wildlife and Countryside Act 1981 (as amended). Further information about NNRs can be found on English Nature's website site:

http://www.englishnature.org.uk/special/nnr/nnr_search.asp

National Parks

The National Park Authority's duties and powers are derived from a number of Acts of Parliament and statements of Government policy, most recently the Environment Act 1995. The statutory purposes of National Parks are:

- to conserve and improve the natural beauty, wildlife and cultural heritage of the area;
- to promote opportunities for the public to understand and enjoy the area's special qualities.

In following these aims, it is also our job to try to cost effectively encourage the economic and social well being of the communities within the National Park. For further information please consult the National Park Authority's website at:

http://www.anpa.gov.uk/

National Flood and Coastal Defence Database

The DEFRA High Level Targets requires flood and coastal defence operating authorities to develop the National Flood and Coastal Defence Database (NFCDD). We are leading the development but working with local authorities and internal drainage boards to make sure the database is successfully implemented.

Natural Area Profiles and Landscape Character Areas (LCAs)

Natural Areas are parts of England that have specific wildlife and natural features. There are 120 Natural Areas in England and each has a unique identity due to the combination of wildlife, landforms, geology, land use and human impact. Further information about Natural Areas can be found on English Nature's Internet site:

http://www.englishnature.org.uk/science/natural/NA_search.asp

Landscape Character areas - The Countryside Character Initiative is a programme of information and advice on the character of the English countryside. It includes descriptions of the features and characteristics that make the landscape, and guidance documents on how to carry out Landscape Character Assessments. Further information about Landscape Character Areas can be found on the Natural England internet site:

http://www.naturalengland.org.uk/planning/landscape/default.htm

Non-main River

Non-main rivers are all watercourses not designated as Main River's (see above). The Local authority has powers to maintain these rivers but the land owner is responsible for maintaining them.

Ordnance Datum Newlyn

Ordnance Datum Newlyn (ODN) is a traditional vertical coordinate system, consisting of a tide gauge datum with initial point at Newlyn (Cornwall) and a Terrestrial Reference Frame observed by spirit levelling between 200 fundamental benchmarks across Britain. Each benchmark has an orthometric height only (not ellipsoid height or accurate horizontal position). This coordinate system is important because it is used to describe vertical positions of features on British maps (for example, spot heights and contours) in terms of height above mean sea level. The word Datum in the title refers, strictly speaking, to the tide gauge initial point only, not to the national levelled bench marks.

Other historic features

English Heritage (EH) is the national body responsible for identifying and protecting historic buildings by recommending the most important of them for "listing". There are three grades of listed buildings depending on their relative importance:

- Grade I buildings are those of exceptional interest
- Grade II* buildings are particularly important buildings of more than special interest
- Grade II buildings are of special interest, warranting every effort to preserve them

Local authorities have the power to designate Conservation Areas in any area of "special architectural or historic interest", whose character or appearance is worth protecting or improving. These qualities are judged against local and regional criteria, rather than national importance, as with listed buildings. In England, the main sources of information on recorded

archaeological remains will be the Sites and Monuments Records (SMR) and the National Monuments Record (NMR). The SMR should contain information about all known archaeological remains. For further information refer to the English Heritage website: http://www.english-heritage.org.uk

Planning Policy Statement 25: Development and Flood Risk (PPS25)

One of a series of Planning Policy Statements issued by DCLG to advise local planning authorities and developers. While Planning Policy Statements are not statutory, planning authorities are obliged to consider them when preparing plans and determining planning applications. PPS25, issued in December 2006 (replacing PPG25 issued (2001), raises the profile of flood risk, which should be considered at all stages of the planning and development process and across the whole catchment. It emphasises the need to act in a precautionary way and to take account of climate change. It provides advice on future urban development in areas subject to flood risk, subjecting proposals to a sequential response (depends on the amount of risk) and promotes the concept of Sustainable Drainage Systems (SuDS) in new development or redevelopment. For further information please refer to the Department for Communities and Local Government website:

http://www.communities.gov.uk/index.asp?id=1504640

Pre-feasibility study

A pre-feasibility study is a preliminary study to determine if a feasibility study or project appraisal is needed.

Problem areas

Areas within the catchment at risk from flooding.

Probability of occurrence

The probability or chance of a flood event being met or exceeded in any one year.

Project Appraisal

The process of defining objectives, examining options and evaluating costs, benefits, risks, opportunities and uncertainties before making a decision.

Project team

The project team is responsible for producing the CFMP and is made up of Environment Agency staff helped by consultants.

Property

A property is defined here as one household, such that one building may house numerous properties. Property data has been taken from the National Property Dataset (NPD).

Ramsar Site

The Ramsar Convention on Wetlands of International Importance, Especially as Waterfowl Habitat (1971) requires the UK Government to promote using wetlands wisely and to protect wetlands of international importance. This includes designating certain areas as Ramsar sites, where their importance for nature conservation (especially with respect to waterfowl) and environmental sustainability meet certain criteria.

Ramsar sites receive SSSI designation under The Countryside and Rights of Way (CRoW) Act 2000 and The Wildlife and Countryside Act 1981 (as amended). Further information can be located on the Ramsar convention on wetlands website: http://www.ramsar.org/

Regional Planning Guidance (RPG)

Planning Guidance issued for the South West by the Government Office for the South West Regional Assembly.

Regional Spatial Strategy (RSS)

This will replace the RPG. It sets out a regional framework that addresses the 'spatial' implications of broad issues like healthcare, education, crime, housing, investment, transport, the economy and environment.

Risk assessment

Considering the risks in a project, which leads to developing actions to control, reduce or accept the risks.

River Quality Objective (RQO)

Rivers and canals are monitored under the requirements of the Water Resources Act, 1991.

This legislation gave the Secretary of State for the Environment and for Wales the power to set Statutory Water Quality Objectives to meet specific water quality standards. To meet this we, as the nominated statutory body, have introduced the River Quality Objective (RQO) classification system.

Currently, RQOs are classified using a River Ecosystem (RE) Classification, which is based on a set of chemical water quality measures defined within the EC Freshwater Fish Directive (78/659/EEC). There are five river ecosystem classes, from RE1 to RE5. The RQO classification system provides an indication of the water quality conditions that we would like to see in all significant rivers but there are no legal requirements directly connected with it. Instead the RQO system provides an indication of the 'ideal' quality of waters and so shows their relative importance. For further information consult our website: http://www.environment-agency.gov.uk

Scenario

A possible future situation, which can influence either catchment flood processes or flood responses, and the success of flood risk management policies/measures. Scenarios will usually be made up of the following: urban development (both in the catchment and river corridor); change in land use and land management practice (including future environmental designations); or climate change.

Scheduled Monuments, Scheduled Ancient Monuments

To protect archaeological sites for future generations, the most valuable of them may be “scheduled”. Scheduling gives nationally important sites and monuments are legal protection by placing them on a list, or ‘schedule’. English Heritage identifies sites in England, which the Secretary of State for Culture, Media and Sport should place on the schedule. The current legislation, the Ancient Monuments and Archaeological Areas Act 1979, supports a system of Scheduled Monument Consent for any work affecting a designated monument. Further information can be found on English Heritage’s website: http://www.english-heritage.org.uk

Section 105

Section of the Water Resources Act under which floodplain mapping is carried out. Level A was the initial Section 105 modelling, level B modelling has been carried out to look at main areas in more detail. For further detail refer to Her Majesty’s Stationery office, now Office of Public Sector Information website:

http://www.hmso.gov.uk/acts/acts1991/Ukpga_19910057_en_12.htm

Shoreline Management Plan (SMP)

Non-statutory plans to provide sustainable coastal defence policies (to prevent erosion by the sea and flooding of low-lying coastal land) and to set objectives for managing the shoreline in the future. They are prepared by us or maritime local authorities, acting individually or as part of coastal defence groups.

Site of Special Scientific Interest (SSSI)

Sites of Special Scientific Interest (SSSIs) are notified under the Wildlife and Countryside Act 1981 (as amended) and the Countryside and Rights of Way (CRoW) Act 2000 for their flora, fauna, geological or physiographical features. Notification of a SSSI includes a list of work that may harm the special interest of the site. The Wildlife and Countryside Act 1981 (provisions relating to SSSIs) has been replaced by a new Section 28 in Schedule 9 of the CROW Act. The new Section 28 provides much better protection for SSSIs. All cSACs, SPAs and Ramsar sites are designated as SSSIs. For further information refer to English Nature’s website: http://www.english-nature.com

Soil Moisture Deficit

Plants will extract water from the soil when there is not enough rain to match evaporation or transpiration, creating a soil moisture deficit. This deficit increases until there is more rain to refill the available water capacity.

Special Area for Conservation (SAC)

SACs are internationally important sites for habitats and/or species, designated as required under the EC Habitats Directive. All SACs have now had their former candidate status confirmed.

SACs are protected for their internationally important habitat and non-bird species. They also receive SSSI designation under The Countryside and Rights of Way (CRoW) Act 2000; and The Wildlife and Countryside Act 1981 (as amended). For further details refer to the following The Joint Nature Conservation Committee website http://www.jncc.gov.uk

Special Protection Area (SPA), Proposed Special Protection Area (pSPA)

A site of international importance for birds, designated as required by the EC Birds Directive. A pSPA is a proposed site, but has the same status as a confirmed site. SPAs are designated for their international importance as breeding, feeding and roosting habitat for bird species. The Government must consider the conservation of SPAs in all its planning decisions.

SPAs receive SSSI designation under The Countryside and Rights of Way (CRoW) Act 2000 and The Wildlife and Countryside Act 1981 (as amended). For further details refer to the European Commission: website: http://europa.eu.int/

And The Joint Nature Conservation Committee website at:

http://www.jncc.gov.uk/ukspa/sites/spalistA-C.htm

Steering Group

The Steering Group oversees the production of the CFMP and is made up of Environment Agency staff together with staff from other operating authorities or major interest groups.

Strategy plan

A long-term (usually 50 years or more) documented plan for river or coastal management, including all necessary work to meet defined flood and coastal defence objectives for the target area. A Strategy Plan is more detailed and usually covers a smaller area than a CFMP.

Strategic Environmental Assessment (SEA)

Applying Environmental Assessment to earlier, more strategic, tiers of decision-making policies, plans and programmes

Strategic Flood Risk Assessment (SFRA)

A broad scale assessment of flood risk carried out by a unitary authority or district council. These documents are drafted so that proposed developments can be quickly appraised to Planning policy Guidance.

Structure Plan

A statutory plan made up of part of the development Plan, prepared by County Councils or a combination of unitary authorities, containing strategic policies that cover main planning issues over a broad area and provide a framework for local planning, including Unitary Development Plans (UDPs).

Sustainability

A concept, which deals with man's effect, through development, on the environment. Sustainable development is 'development which meets the needs of the present without compromising the ability of future generations to meet their own needs' (Brundland, 1987). The degree to which flood risk management options avoid tying future generations into inflexible or expensive options for flood defence. This usually includes considering other defences and likely developments as well as processes within a catchment. It should also take account of, for example, the long-term demands for non-renewable materials.

Sustainable Drainage Systems (SuDS)

Management practices and control structures designed to drain surface water in a more sustainable way than some conventional techniques (may also be referred to as sustainable drainage techniques).

Telemetry

How a data signal is transferred to a remote control centre by the telephone network.

Unitary Development Plan (UDP)

A statutory plan produced by unitary authorities, made up of part of the Development Plan and written in two parts: Part I – a written statement which contains the authority's general policies for their area; Part II – both a written statement and an ordnance plan, describing the policies in detail and illustrating them on a geographical basis. A UDP replaces Local Plans within unitary authorities.

Water Framework Directive (WFD)

European Community Directive (2000/60/EC) on integrated river basin management. The WFD sets out environmental objectives for water status based on: ecological and chemical measures; common monitoring and assessment strategies; arrangements for river basin administration and planning; and a programme of measures to meet the objectives. For further detail consult the European Commission website: http://europa.eu.int

Wildlife & Countryside Act

The Wildlife and Countryside Act 1981 (as amended) is the main mechanism for legally protecting wildlife in Great Britain. The Wildlife and Countryside Act is divided into four parts.

- Part I is concerned with the protection of wildlife;
- Part II relates to the countryside and national parks (and the designation of protected areas);
- Part III covers public rights of way;
- Part IV deals with miscellaneous provisions of the Act.

The designation of protected species is included in Schedules 1, 5 and 8 of the Act, which list protected birds, protected animals and protected plants, respectively.

List of Abbreviations

AA	Appropriate Assessment
AAD	Annual Average Damage
AONB	Area of Outstanding Natural Beauty
BAP	Biodiversity Action Plan
CAMS	Catchment Abstraction Management Strategies
CFMP	Catchment Flood Management Plan
COW	Critical Ordinary Watercourse
CRoW	Countryside and Rights of Way
CSO	Combined Sewer Overflow
Defra	Department for Environment, Food and Rural Affairs
DEM	Digital Elevation Model
DTLR	Department for Transport, Local Government and the Regions
DTM	Digital Terrain Model
ESA	Environmentally Sensitive Areas
FEHCALC	Flood Estimation Handbook (calculates peak flows)
GIS	Geographical Information System
HAT	Highest Astronomic Tide
IFMs	Indicative Floodplain Maps
IFSAR	Interferometric Synthetic Aperture Radar
LBAP	Local Biodiversity Action Plan
LCA	Landscape Character Area
LDD	Local Development Document
LDF	Local Development Framework
LEAP	Local Environment Agency Plan
LiDAR	Light Detection and Ranging
MAFF	The Ministry of Agriculture, Fisheries and Food
MDSF	Modelling and Decision Support Framework
MHWS	Mean High Water Springs
NFCDD	National Flood and Coastal Defence Database

NNR	National Nature Reserve
ODN	Ordnance Datum Newlyn
OPUS	Operation Public Safety
PPS25	Planning Policy Statement 25: Development and Flood Risk
pSPA	Proposed Special Protection Area
RA	Risk Assessment
Ramsar	The Ramsar Convention on Wetlands of International Importance
RPG	Regional Planning Guidance
RQO	River Quality Objective
RSS	Regional Spatial Strategy
SAC	Special Area for Conservation
SM	Scheduled Monuments
SEA	Strategic Environmental Assessment
SFRA	Strategic Flood Risk Assessment
SMP	Shoreline Management Plan
SNCI	Site of Nature Conservation Importance
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
UDP	Unitary Development Plan
WFD	Water Framework Directive

References

Caradon District Council: Caradon District Local Plan 1999-2009;

Cornish Mining World Heritage Site Management Plan 2005-2010

Cornwall County Council Cornwall Local Transport Plan 2006-2011.

Cornwall County Council Cornwall Minerals & Waste Development Framework.

Cornwall County Council: Cornwall County Structure Plan (Adopted September 2004).

Cornwall County Council: Cornwall Local Transport Plan 2001-2006.

Cornwall County Council: Cornwall Minerals Local Plan 1998-2011.

Cornwall County Council: Economy of Cornwall articles (www.cornwall.gov.uk/index.cfm?articleis=2001) accessed 04/04/2008

Countryside Agency (now Natural England): Landscape Character Assessment: Guidance for England and Scotland. Topic Paper 9: Climate change and natural forces – the consequences for landscape character.

Environment Agency Shoreline Management Plans (SMP).

Environment Agency: Level B 2002-4 South Coast tidal mapping study, Royal Haskoning 2002-4.

Environment Agency: East Cornwall Catchment Flood Management Plan, Scoping Report, Royal Haskoning, January 2006.

Environment Agency and South West Observatory (2005). State of the Environment in the South West.

EU Habitats Directive

EU Water Framework Directive: River Basin Classification studies.

North Cornwall District Council: North Cornwall District Local Plan 1999-2009;

River Restoration Centre: The West Country Rivers Trust. In: River Restoration News, November 1999, Issue 4.

South West of England Regional Development Agency: Regional Economic Strategy 2003-2012.

South West of England Regional Development Agency: Regional Economic Strategy Review.

South West Regional Assembly Regional Spatial Strategy for the South West 2006–2026 for Consultation.

South West Regional Assembly Regional Spatial Strategy Examination in Public report.

South West Regional Assembly: Our Environment: Our Future. The Regional Strategy for the South West Environment 2004-2014.

South West Regional Assembly: South West Regional Waste Strategy (2004-2020).

South West Water: Periodic Review (Asset Management Plans).

Restormel Borough Council: Restormel Borough Council Local Development Framework May 2005

www.ukbap.org.uk/: Cornwall Biodiversity Action Plan (BAP).

www.ukbap.org.uk/: Devon Biodiversity Action Plan (BAP).

Bibliography

See References.

Would you like to find out more about us, or about your environment?

Then call us on

08708 506 506 (Mon-Fri 8-6)

email

enquiries@environment-agency.gov.uk

or visit our website

www.environment-agency.gov.uk

incident hotline 0800 80 70 60 (24hrs)
floodline 0845 988 1188

Environment first: This publication is printed on paper made from 100 per cent previously used waste. By-products from making the pulp and paper are used for composting and fertiliser, for making cement and for generating energy.