



# Natural Environment Adapting To Climate Change



**defra**

Department for Environment  
Food and Rural Affairs

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# Ministerial Foreword



Climate change presents our society with a big challenge. We urgently need to reduce greenhouse gas emissions in order to slow the rate at which the world is warming. At the same time, we need to adapt to a changing climate.

All major government departments including Defra have published plans to show how they are taking action on climate change. The natural environment has emerged as a priority from this process because in the short term the impacts of climate change will be seen most clearly in natural systems which are vital in supporting our economy and society to adapt. I hope that this document will encourage debate about how we should manage our environment in a changing climate.

The impacts of climate change on the natural environment are already becoming apparent. We can see the effects of changes to the timing of seasonal events such as spring leaf growth, flowering, and breeding patterns. Over half of farmers believe that climate change is having an effect on their farm now and nearly a third are already taking action to adapt. As the climate continues to change we can expect to see more changes to things we value such as our beautiful English landscapes and the plants and animals that live in them. This will raise questions about land management and our conservation priorities.

These choices won't all be straightforward. Some will require us to weigh up the costs and benefits of the different things we want from the environment. At the same time, we know that our environment is one of our most important assets. Managed effectively, natural systems can help us limit the impacts of heatwaves on towns and cities, control flooding, capture and store drinking water; clean our air and produce food sustainably.

We now understand more about how natural systems work and the benefits they provide to us than ever before. We need to use this knowledge wisely as we respond to the challenges posed by a changing climate.

We can't avoid change but by facing facts and starting to act now we can reduce the impacts and help safeguard our environment, prosperity and quality of life.

A handwritten signature in black ink, appearing to read 'Hilary Benn'.

**The Rt Hon Hilary Benn MP,  
Secretary of State for Environment,  
Food and Rural Affairs**

**Natural Environment** Adapting to Climate Change

# Introduction



## Introduction

# Why adapting to climate change is important

The environment we see around us, in our towns and cities as well as in the countryside, is a result of current and past interactions between humankind and nature and it is constantly changing. However, due to climate change, as well as to demographic shifts and changing patterns of work and habitation, the pressures and demands on our environment as the century unfolds will be unprecedented. This will present both threats and opportunities to which we as a society will need to adapt.

At the same time, our natural environment is our greatest asset: the basis on which we can build a future in a rapidly changing climate. It provides the services that clean our air and water, and give us food, medicines, energy, and raw materials. Natural systems regenerate soils and pollinate crops, regulate the climate, cool urban areas, capture and store drinking water; and help to control floods.

Defra's role is to help secure a healthy environment, in which we and future generations can prosper.

## Climate change: the risks of inaction

**Without action to adapt to a changing climate, some of the possible consequences for our natural environment include:**

- Detrimental **impacts on habitats and species**, including changes to the composition of plant and animal communities and changes in the timings of seasonal events such as spring leaf growth, flowering, and breeding.
- Negative impacts on **ecosystem services** including: **air quality**, especially in urban areas which may be adversely affected by heatwaves; **availability of water** – reduced summer rainfall, particularly in Southern England, may affect the amount of water available for important biodiversity and habitats; and **soil quality** which will be influenced by changes in temperature, rainfall patterns and the increased frequency of extreme weather events.
- **Difficulties for farmers and land managers** including drought, leading to lack of water for crops and livestock, extreme hot weather, storms and heavy rainfall, causing increased soil erosion, water pollution, and storm damage. Subsequent changes to crop yields, different growing seasons, the introduction of new varieties of crops and livestock could all have major **implications for our landscapes** and the natural environment.
- Serious **impacts on native woodlands** and timber production driven by changes in water availability, particularly in the south and east of England towards the end of this century.
- **Increased frequency of flooding** with consequences for ecosystems, agricultural production, people and businesses. Changing patterns of rainfall and sea-level rise will mean an increased risk of flooding and coastal erosion, and may also put pressure on cherished landscapes;
- Ocean acidification, caused by increased amounts of carbon dioxide, is a **threat to many organisms in our seas**.

This is a challenge for all parts of society.

Defra is responsible for coordinating a national programme of action to support individuals, businesses, government and public authorities in adapting to the challenge of a changing climate.

In March 2010, all Government Departments published a Departmental Adaptation Plan to identify and begin to tackle the main climate risks to their policy and delivery goals. Defra's plan established three major priorities:

- Securing the basics for human well-being.
- Enhancing the resilience of ecosystems.
- Building adaptive capacity.

This discussion-document sets out our approach to sustaining the benefits we receive from the natural environment in the face of a changing climate and highlights the crucial importance of a healthy natural environment in enabling society to adapt.

**Natural Environment** Adapting to Climate Change

# A Strategic Approach

A Strategic Approach

# Working together – a whole-system approach to adaptation

The natural environment underpins all aspects of our lives. It will be affected by climate change, and yet we will be increasingly reliant on it to help us manage the impacts that a changing climate will bring. It is a complex system that is affected by a vast range of people and organisations across all sectors and a range of pressures beyond those to do with the changing UK climate. This is a new kind of challenge and will require new approaches from all of us.



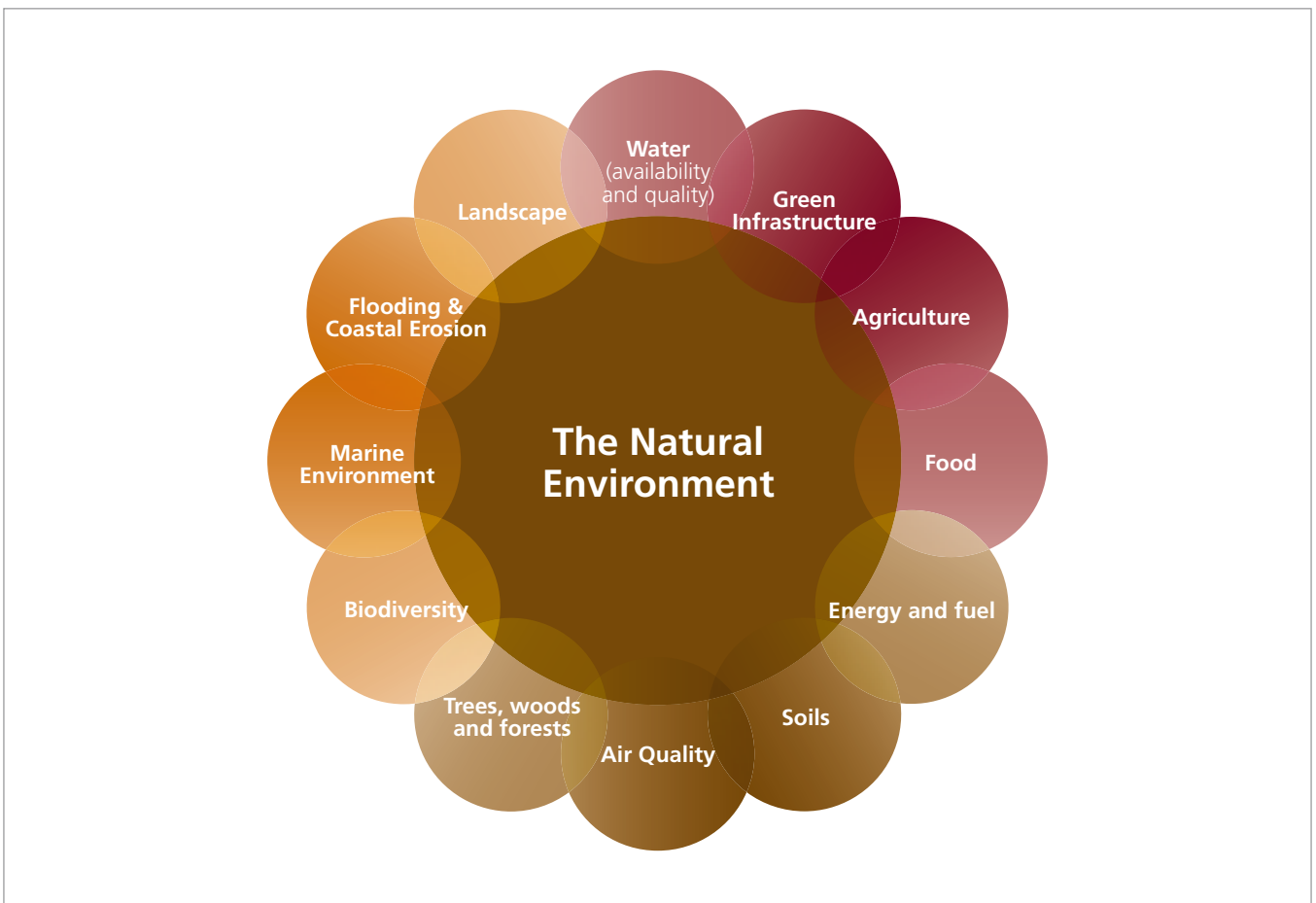
Box Hill



**A complex challenge requiring integrated solutions**

As the climate changes we will need to develop mechanisms for managing changing demands and competing pressures on our natural resources. These will include opportunities to expand agricultural production, pressure to find space for new forms of energy generation, impacts on the quality and quantity of our water supply, and the demands of a growing population for housing, land for recreation and new infrastructure. In responding to these pressures, we must also consider how adaptation actions by some policy and decision-makers which may create benefits could also serve to complicate future impacts on the natural resources and services that other parts of society value.

The climate change risks and priorities that we are dealing with are highly interconnected and we need to ensure that we work in a way which seeks to reflect this. The resources and services that we receive from our environment cannot be adequately understood in isolation from one another. We will be able to find more efficient and effective solutions to the challenges posed by a changing climate if we consider individual parts of the system, such as water, biodiversity, agriculture and landscape as components of a complex and highly interconnected whole. We need to develop sustainable solutions that work effectively for people, the economy and the natural environment. There is a strong case for close and collaborative working with other experts, stakeholders and delivery partners to encourage a coherent response to the challenges ahead.



**Figure 1:** The natural environment

## **Working in partnership to deliver adaptation**

Climate change presents everyone – central government, local authorities, emergency services, other public sector organisations and the private sector – with an enormous challenge and also some important opportunities. Our water resources, health, coastal communities, cherished places and landscapes, even our food supply, face impacts from a changing climate that we need to prepare for. Government, local authorities, businesses and individuals all have a part to play in addressing this challenge. This means working in partnership at every level from local communities to the cross-Government Adapting to Climate Change Programme.

### **The natural environment – supporting the delivery of cross-Government policy outcomes**

The impacts of climate change on the natural environment have implications for a range of Government departments as well as Defra. Departmental Adaptation Plans (DAPs)<sup>1</sup> are being published by major central government departments, and will be shared with their stakeholders and key delivery partners. In their Adaptation Plans, individual Government departments have highlighted the importance of a well-adapted natural environment to their agendas. The environment is recognised as playing a critical role in providing services that support the health and wellbeing of the population, and for vital underpinning of the whole economy. Across Government as a whole, the DAP process has served to highlight the natural environment as one of the most important areas for joint attention in the future.

***“Creating greener neighbourhoods and improving the assessment of populations and areas at risk can contribute to approaches that improve adaptation to the increased frequency of flooding and heat waves. This can prevent the onset of mental ill health related to poor quality housing and post-event stress.”***

***“Planting trees and vegetation and the creation of green spaces to enhance evaporation and shading are other options, as temperatures in and around green spaces can be several degrees lower than their surroundings.”***

*Department of Health<sup>2</sup>*

***“We are consulting on strengthened planning policy on a natural and healthy environment, bringing together policies on open and green spaces in rural and urban areas, and advising planning authorities to look more strategically at the functions green spaces can perform. The draft PPS requires local development frameworks to set out a strategic approach for the creation, protection and management of networks of green infrastructure, particularly in locations where it will assist in reducing the impacts of climate change by providing flood water storage areas, sustainable drainage systems, urban cooling and local access to shady outdoor space; and to avoid development being located in areas which result in the fragmentation or isolation of natural habitats.”***

*Communities and Local Government<sup>3</sup>*

***“DfT’s Rail Division is working with the rail industry and Highways Agency to look at improving drainage systems including the use of Sustainable Urban Drainage Systems (SUDS) to be more resilient to increased rainfall. Management of the “soft estate (verges, embankments and un-trafficked paved areas) could be adapted to increase drainage capacity, reduce runoff, prevent flooding and landslides.”***

*Department for Transport<sup>4</sup>*

These initial plans are only a first step – they will be reviewed annually, more substantially in 2 years’ time and again every 5 years, to ensure that further progress is being achieved in terms of government risk assessment, decision-making and capacity-building to deal with climate change.

<sup>1</sup> Available at: <http://www.defra.gov.uk/environment/climate/programme/across-government.htm>

See section 3 on Work in Progress and Next Steps for further detail

<sup>2</sup> Department of Health Adaptation Plan Available at: <http://www.defra.gov.uk/environment/climate/programme/doh.htm>; and

*The Heatwave Plan for England*. Available at: [http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH\\_099015](http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_099015)

<sup>3</sup> Communities and Local Government Adaptation Plan Available at: <http://www.defra.gov.uk/environment/climate/programme/clg.htm>

<sup>4</sup> Department for Transport Adaptation Plan Available at: <http://www.defra.gov.uk/environment/climate/programme/dft.htm>

**Defra delivery partners****The Environment Agency**

Climate change is a corporate priority for the Environment Agency. All major delivery functions have undertaken a climate change risk assessment and considerable progress is being made. The Agency's Long Term Investment Strategy for Flood and Coastal Risk Management, which sets out the investment priorities for the next 25 years, is based on modelling using the UK Climate Change Projections 2009 (UKCP09). The Thames Estuary 2100 project has developed a tidal flood risk management plan to protect London from sea level rise, which is at the leading edge of adaptation policy. It is a strong example of how to implement the Green Book's Supplementary Guidance on Adaptation. The Agency has a Climate Change Training Programme being rolled out to all staff, with specific modules in development to increase knowledge and skills for particular roles, such as engineers, environment protection, flood risk, and water resources.

***“Climate change is already affecting the UK and the challenges we face as a result are only going to get tougher... Our new plans set out our approach to protect more people from flooding, clean up their local rivers, and help businesses reduce the resources they use. We all have our part to play to help protect the environment for future generations.”***

*Dr Paul Leinster, Environment Agency Chief Executive*

**Forestry Commission**

The Forestry Commission already has a comprehensive climate change research programme (largely undertaken by its research Agency, Forest Research). They have established a climate change communications initiative and commissioned the independent Read Report 'Combating Climate Change: a Role for UK Forests'<sup>5</sup>. The Forestry Commission has also set up a new Centre for Forestry and Climate Change to study the effects of environmental and climate change on forestry, and how the sector can play its part in adaptation and

mitigation of climate change. Key adaptation objectives for the Forestry Commission are: to increase the resilience of trees, woods and forests to climate change; to increase the role of trees and woodland in adapting the rural landscape to climate change; to enhance the role of street trees and urban woodland in minimising the impacts of climate change on our towns and cities; and, to use trees, woods and forests to help communicate and improve understanding of climate change issues and bring about behavioural change.

***“British woods and trees will not only play a key role in storing carbon and cutting the emissions causing global warming, but also help wildlife and people cope with impacts such as hotter summers and increased risk of flooding”.***

*Tim Rollinson, Director General of the Forestry Commission*

**Joint Nature Conservation Committee**

The Joint Nature Conservation Committee (JNCC) is the statutory adviser to Government on UK and international nature conservation, on behalf of the Council for Nature Conservation and the Countryside, the Countryside Council for Wales, Natural England and Scottish Natural Heritage. The JNCC's work contributes to maintaining and enriching biological diversity, conserving geological features and sustaining natural systems.

***“The natural environment is an integral part of the climate system, it is both affected by and effects climate globally and locally. To implement effective adaptation measures in the UK account of both needs to be taken. [ . . . ] It is important adaptation measures take an holistic, cross-sectoral approach bringing together different sectors. Taking an integrated approach to action may result in mutual benefits by reducing emissions, climate change impacts and biodiversity loss.”***

*JNCC, Evidence to the Royal Commission on Environmental Pollution*

<sup>5</sup> Available at: [www.forestry.gov.uk/readreport](http://www.forestry.gov.uk/readreport)

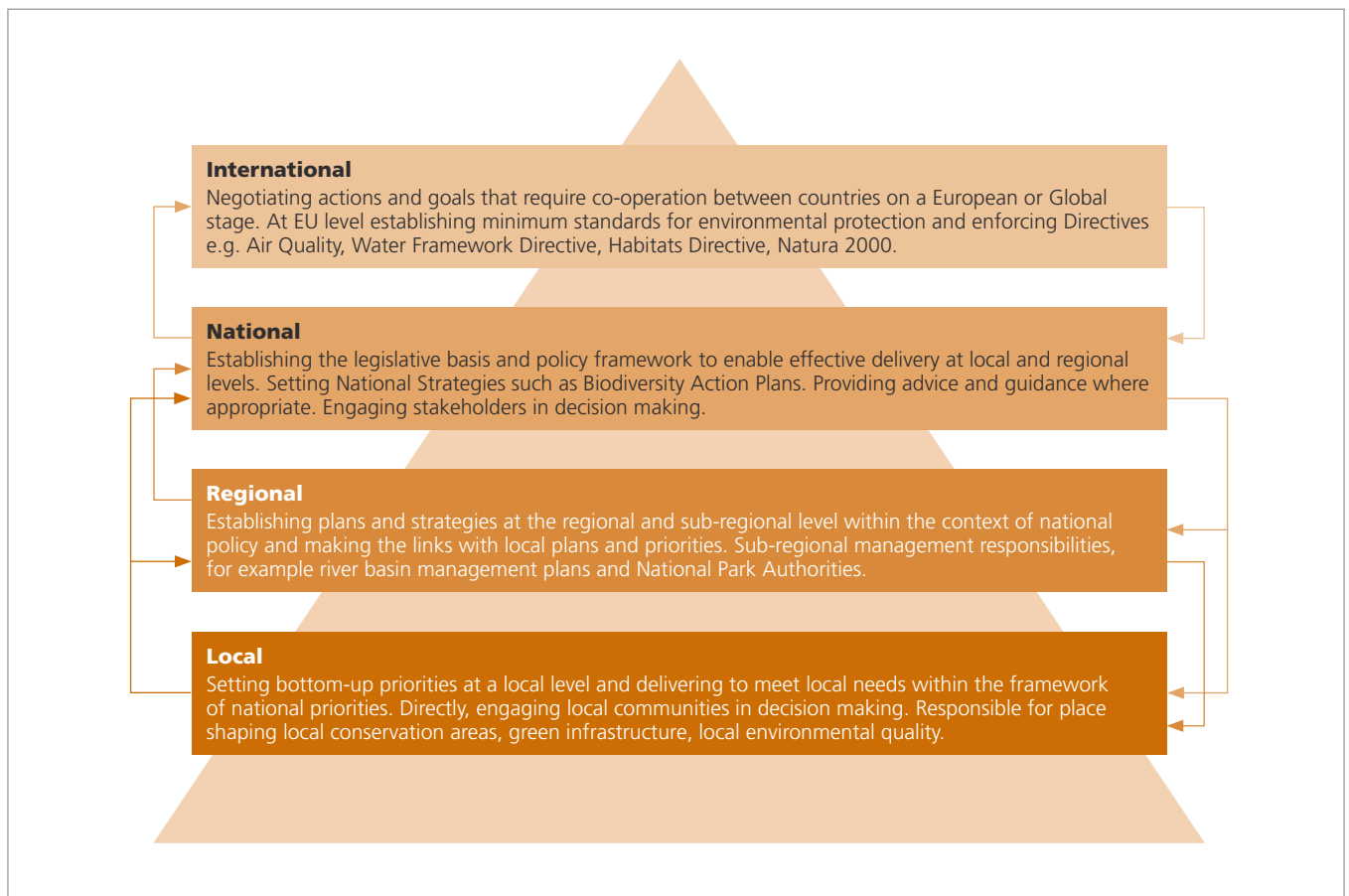
### Natural England

Since its inception in October 2006 Natural England has placed sustainable climate change adaptation at the heart of its operational policy, decision making and advice. In March 2009, Natural England published assessment of landscape scale climate change adaptation options for the Norfolk Broads, Cumbria High Fells, Shropshire Hills and Dorset Downs. The project has now been extended across England into a number of other character areas and regional scale studies. Natural England manages approximately £0.5 billion a year of agri-environment funding to farmers and other private land managers and have integrated climate change adaptation and mitigation objectives into Environmental Stewardship schemes. Natural England is developing a coordinated

programme to train staff, assess threats and opportunities from climate change across all its areas of work, and to identify opportunities to contribute to wider adaptation and mitigation goals. Natural England has a climate change evidence programme, researching and developing adaptation and mitigation, working with Defra and other partners.

*“The imperative of **conservation** is no longer – if it ever was – about preservation: it’s about adaptation and enabling the environment to function naturally.”*

*Helen Phillips, Chief Executive of Natural England*



**Figure 2:** Making decisions at the appropriate level

## A Strategic Approach

# Understanding the issues

Climate change will add to the pressures we already place on natural resources whilst increasing our reliance on the services we receive from them. This will present us with difficult decisions to make about how to adapt and how to cope with unavoidable change. It is important that we are honest about these impacts, frank about the uncertainties that we face, and therefore flexible in our responses. Here we set out our understanding of the challenges, and clarify Defra's approach to addressing change across the range of our priorities.

### **1. Change is unavoidable**

Our natural environment is changing. However much we cut our greenhouse gas emissions now and in the future, we can expect at least 30-40 years of temperature rise due to past human activity. The speed and scale of these changes will be unprecedented, presenting both threats and opportunities. Direct impacts will be seen most clearly in our vital natural systems.

We can expect warmer, wetter winters; hotter, drier summers, warmer more acidic seas; and an increase in the frequency of extreme weather events, resulting in changes to species distribution and habitats. Valued landscapes will change and some features may be lost or significantly altered. Both mitigation activities and adaptive actions in other sectors may increase pressures on the natural environment. In some cases these associated impacts are likely to be seen in advance of the more direct impacts of climate change.

The natural environment will make its own adjustments in response to changes in climate. However, sustaining and optimising the benefits we receive from ecosystems (from the aesthetic qualities of our countryside to the provision of healthy food and clean water) will require some human intervention. Difficult decisions about priorities for future management of land and other natural resources will need to be made. These will need to be informed by the best available science but must also respond to the views of the communities of place and interest that value different aspects of our natural environment.



Lavender in Surrey

## **2. Healthy natural systems underpin the adaptive capability of the economy and society**

It is increasingly well recognised that our quality of life – from the ‘livability’ of our communities to the stability of our economy – is dependent upon maintaining healthy natural systems. In planning our response to the social and economic challenges posed by a changing climate we need to understand and capitalise on the crucial role played by the natural environment.

Well planned ‘green infrastructure’ in the form of green spaces, street trees, modern, sustainable drainage systems, and open waterways can help us reduce and manage the impacts of heat waves and surface water flooding in urban environments as well as providing a range of additional social, health and economic benefits. On key issues like access to clean water during hotter, drier summers or managing flood risk in the face of increased numbers of extreme weather events; we can’t respond effectively to projected climate pressures without effective environmental management, which balances the multiple demands we place on ecosystems. An understanding of the value of these ecosystem services will be central to our capacity to manage the risks associated with climate change.

We have passed the stage where we can behave as though there were a choice between the environment and economic growth or improving social outcomes. Living sustainably means pursuing all three goals together, recognising that safeguarding our natural environment is now absolutely vital for the future of our economy and society.

## **3. Non-climate pressures will continue to drive change**

In the short and medium term existing, non-climate pressures on the natural environment, such as population change, housing growth, marine development and the provision of infrastructure to support growth, will continue to be significant and will need to be addressed alongside the impacts of climate change.

Over time, these pressures are likely to be exacerbated by climate change, for example population and housing growth may create additional demand for water at a time when summer water availability is decreasing – particularly in the most densely populated parts of the country. Similarly, there will be ongoing competition between different potential land uses – such as housing, food, renewables, recreation, managing flood risk and biodiversity.

We will need to develop decision-making tools which support the active management of these tensions. The facts about climate change may mean that we need to re-think the costs and benefits of certain courses of action and reconsider priorities in the light of new information about risks.

We will always need to strike a balance between space for nature and the other multiple demands that society places upon land. What is increasingly clear however, is that in future this balance will need to more accurately reflect the true value of the services provided by a healthy natural environment.

#### **4. Improved environmental quality remains a viable goal**

Many of our existing definitions of success were developed on the basis of limiting and, where possible, reversing harm done to the environment over the past century. However, we now know that over the long term our natural environment will be quite different to anything we have seen to date. If we accept that maintaining the status quo or restoring the environment to an historic state are no longer realistic options we will need to rethink the way we approach these goals.

The challenge will be to recognise the changing context brought about by climate change whilst maintaining continuity of purpose in seeking opportunities to improve environmental quality. This means using our improved evidence base and building on existing commitments to safeguard and enhance our future environment.

We cannot control the direct impact of changes in climate on landscapes, habitats and species, but we can make active decisions about how we utilise our environment and where to intervene, recognising the key role played by healthy natural systems in underpinning society, supporting the economy and enabling adaptation. We will need to develop a more flexible approach to policy and delivery that allows us to respond to issues as they unfold and set this within a clear overarching vision of functioning, sustainable ecosystems.

Difficult tradeoffs will continue to be made at all levels but these can be managed in a context that continues to actively seek net improvements to the quality of our environment. We need to accept the reality of change but we must also recognise that crucial decisions about the quality of the future natural environment remain in our hands and relate directly to our future quality of life.



Green Infrastructure in West London. © Form Associates

## A Strategic Approach

# The future natural environment – projecting impacts and responses

Our natural environment has changed considerably over the last two centuries because of industrialisation, urbanisation, changing farming practices, improved transport infrastructure and now climate change. Climate change is likely to accelerate these changes in the coming decades with impacts for the environment, people and the economy. However, it is also important to recognise that within this changing context our environment will retain many valued qualities and may also develop new features that we wish to protect and enhance.

A key component of adaptation will be to aid people's understanding of the drivers of change and to enable people to think about the opportunities as well as the threats. The land management and conservation decisions we take in response to climate change will need to reflect a range of factors – important amongst these are the views of the people who value the natural environment.



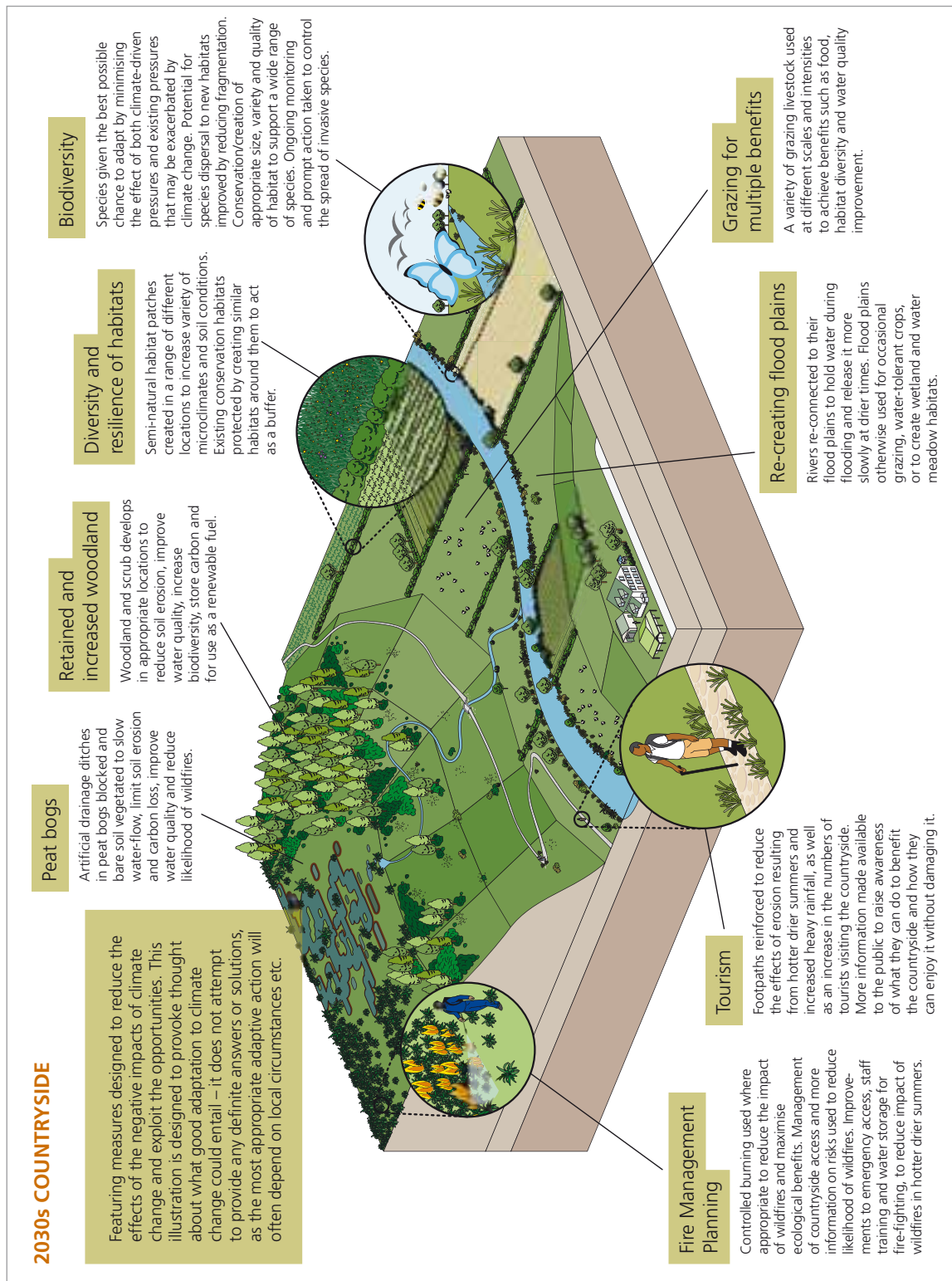


Figure 3: Future worlds: 2030s Countryside<sup>6</sup>

<sup>6</sup> The Adapting to Climate Change Programme has developed a series of images to show what a well-adapted world may look like by the 2030s. The images suggest some of the features that can help to reduce the negative impacts of climate change and exploit the opportunities.

## Climate Change Impacts on Landscape Character Areas

Climate change will have a range of direct and indirect consequences for different aspects of the natural environment. These impacts can be best considered and addressed by looking at the likely vulnerability of the natural environment, and developing adaptation strategies, at a 'landscape scale', i.e. across a sufficiently large geographic area to be able to consider large scale natural ecosystem processes, the way people use and value an area, and the interactions between them. The aim of such an approach is to sustain the full range of benefits we receive from the natural environment.

Natural England has adopted this approach by studying four of England's 159 National Character Areas in detail, assessing the potential impacts of climate change and setting out some possible management responses.<sup>7</sup>

**Cumbria High Fells: a mountainous landscape likely to be affected by an increase in temperature and an increase in winter rainfall.** Impacts are likely to include a move of species towards north facing slopes and higher ground, with those on the highest tops being at risk of extinction; peat bogs drying out and consequential increased carbon losses to the atmosphere; reduction in lake levels and increasing lake & river water temperatures. Footpaths being eroded by a combination of increased drought, recreational pressure and intense rainfall events. Adaptive actions will include encouraging native woodland regeneration in higher areas to help species migration, the restoration of peat land, a more holistic approach to water management in the uplands, and continuing projects which improve the resilience of footpaths, such as 'Fix the Fells'.

**The Norfolk Broads: a low lying wetland landscape which is likely to be affected by coastal erosion and sea level rise.** Impacts on the Broads are likely to be more significant than for some of the other areas featured in this work as salt water increasingly intrudes into the freshwater lakes, causing habitat change and species loss, and due to the increased likelihood of both flood and drought. Adaptive actions might include revision of river dredging regimes, planting wet woodland in flood plains and restricting recreation at times of poor water quality. Working closely with regional and local partners the Broads Authority is currently revising the Broads Plan to take account of climate change and the need for adaptation. This will involve a public consultation and look at social, economic and environmental impacts.

**Shropshire Hills: a farmed landscape that is likely to be affected by higher temperatures and less rain in summer (but more in winter).** Impacts here include a loss of mature trees in the landscape as these succumb to extended droughts and more severe storms; changes in the viability of some crop varieties and livestock breeds; damage to historic buildings, caused by an increase in soil erosion during peak rainfall events. Adaptive actions include extending existing areas of semi-natural habitat and creating new areas; promoting a variety of tree species to eventually replace existing mature trees.

**Dorset Downs and Cranborne Chase: a chalk landscape which is likely to face drought.** If we do not reduce greenhouse gas emissions, by 2080 the climate of the area may resemble parts of Portugal. The natural communities that currently characterise the landscape will change. For example, the shallow rooting beech, which is

<sup>7</sup> Available at: <http://naturalengland.etraderstores.com/NaturalEnglandShop/NE118>

## Climate Change Impacts on Landscape Character Areas *continued*



© Cranborne Chase and West Wiltshire Downs AONB

common in Dorset is likely to decline, but small leaved lime needs warmth to set seed and will probably be able to increase. Veteran trees of all species are more likely to be felled by storms. However, in woods the impact of these storms can also be positive, creating glades that species adapted to sunlight can occupy. Adaptive actions include re-establishing chalk grassland or native

woodland adjoining water courses to reduce downstream flooding; and creating naturally functioning floodplains to allow greater water storage and the evolution of new wetland habitats. Following the completion of the study, Natural England has produced a video in which a resilient natural landscape is described, in pictures and words, by a range of partners.

**Natural Environment** Adapting to Climate Change

# A Framework for Action



Farmland – grass maize oats

This document shows how climate change and other social and economic trends will intensify the pressures on our natural environment as the century unfolds. But by working with nature to a much greater degree, we can also help ourselves to respond to the challenges that climate change may bring. Because of the complexity of the issues and the highly interconnected nature of our environment, ecosystem services, and other societal needs, it is important to develop principles which can guide our analysis and decision-making. The Government uses five key principles of adaptation

1. Any adaptation action needs to be **sustainable**.
2. Action should be **flexible**.
3. Action needs to be **evidence-based**.
4. Our response to climate impacts should be **prioritised**.
5. Adaptation measures need to be **effective, efficient, and equitable**.

In this section we illustrate the relevance of these principles to natural environment policy and delivery in the context of a changing climate and identify a range of issues and questions for further consideration and debate

## A Framework for Action

# Any adaptation action needs to be sustainable

This means that our responses should not add to climate change, or limit the ability of other parts of the natural environment, society or business to carry out adaptation elsewhere. Our responses must avoid any detrimental impacts on other parts of society, the economy or the natural environment.

### **Managing secondary impacts of adaptation in the farming sector**

A good example of these crucial inter-linkages between society, business and the natural environment is the farming sector, which is amongst the first to experience the direct effects of a changing climate. A recent survey indicates that over half of farmers believe that climate change is having an effect on their farm now and nearly a third are already taking action to adapt<sup>8</sup>. Agricultural land represents around 75% of the UK and provides a wide range of environmental, social and economic benefits to society with an influence that goes well beyond its primary purpose of producing food and non-food crops. These benefits include employment and other contributions to thriving rural communities; essential environmental processes such as water cycling and purification, maintaining air quality, reducing erosion and flooding, carbon storage and climate regulation; habitats for wild flora and fauna; and land for recreation.

*“The productivity of agriculture must be enhanced while simultaneously reducing its environmental burden. This requires new investments in technologies, knowledge and skills to improve the future sustainability of agricultural land use. This will require diverse collaborations amongst many stakeholders, public and private, with interests in the future of land and the services it provides”.*

*Land Use Futures: Making the most of land in the 21st century<sup>9</sup>*

Some impacts will have a direct effect on both farming and the natural environment, e.g. flooding caused by increased storms and heavy rainfall – but there are likely to be secondary impacts on the natural environment as a result of measures taken by farmers to adapt to a changing climate, such as the introduction of new crops and livestock varieties, which may have either positive or negative effects on ecosystems and landscapes.

<sup>8</sup> Available at: <http://www.farmingfutures.org.uk/documents/Article%20Attachments/Farming%20Futures%20Results.pdf>

<sup>9</sup> Available at: <http://www.foresight.gov.uk/OurWork/ActiveProjects/LandUse/lufoutputs.asp>

Climate change impact	Possible response by agriculture	Risk to natural environment of response <sup>10</sup>
Warmer conditions and longer growing seasons	Increased yields and the opportunity to grow new crops or existing crops further north. Introducing new livestock varieties.	Changes in wild plant and animal communities reliant on previous crops/livestock, impacts on soil and water quality from new crop types, potential new pests and diseases, and changes to landscape.
	Harvesting/planting earlier and producing two crops	More intensive production and greater use of energy, fertiliser and pesticides, would have a detrimental impact on biodiversity, habitats and water quality.
Drought	Over abstraction of water for crops and livestock.	Impacts on water quality and availability and associated impacts on habitats and biodiversity.
	Planting more drought-tolerant species.	Changes in wild plant and animal communities reliant on previous species. Less biodiversity and habitat types if significant move to growing small number of tolerant species.
Extreme hot weather	Over abstraction of water to cope with fires.	Reduced water availability and associated impacts on habitats and biodiversity.
	Building more animal shelter, refrigerated stores and fitting vehicles with air conditioning.	Unless sustainable energy sources are used, greater energy consumption will increase emissions with repercussions for the natural environment.
Storms and heavy rainfall	Abandonment of land at risk of flooding.	Impacts on biodiversity and habitats from abandoning land.
	Using farmland for flood storage	Impacts on biodiversity and habitats.
	More animal housing.	More building increases flooding risk and reduces space for wildlife.

These risks may be compounded by other changes to agricultural practices, for example pressures to increase production to feed a growing global population or to grow more fuel crops. Therefore adaptation by agriculture will be managed most effectively by taking a whole-system approach and addressing production, conservation of the natural environment, and social and economic benefits in an

integrated way. In a small, relatively crowded country where agriculture occupies three quarters of the land, an understanding of the wider picture will be essential if we are to avoid solving one set of problems at the cost of making others worse. We therefore need to all work together – central Government and delivery bodies, local Government, farmers, land managers and NGOs – to manage adaptation.

<sup>10</sup> This table highlights a range of potential risks or unintended consequences for the natural environment that could result from some actions taken to respond to climate change. Such 'mal-adaptation' can be avoided by assessing the risks and adopting appropriate management practices. There is also a range of adaptation opportunities associated with agricultural land management – these are described on the following page.

### **Green infrastructure<sup>11</sup> – a sustainable approach to managing climate risks in both town and country**

At the same time, appropriate land management can provide some of the most sustainable and cost effective ways of helping to protect society from the effects of a changing climate, as well as benefiting agricultural production. For example:

- Trees and other vegetation which sequester carbon, thus helping to mitigate climate change, also have a number of adaptation benefits. Trees can provide shade and shelter for crops, buildings and livestock; reduce runoff and soil erosion and slow the movement of floodwater; help to maintain water and habitat quality through shading and by filtering pollutants; support biodiversity including crop pollinators; as well as providing an alternative or additional crop (for renewable fuel or timber) to increase farm income and hedge bets against climate risks. Increasing woodland cover can also have recreation and cultural benefits.
- Sustainable drainage systems (SUDs) – which include porous surfaces, infiltration trenches, filter drains, ponds and wetlands, and grass buffers – slow the flow of water and increase its infiltration into the soil. This can help to both capture and store water at wet times of year to reduce the risk of shortages during drier times and reduce the risk of flood damage to areas downstream. It also benefits biodiversity.
- Peat restoration, especially in upland blanket mires, helps maintain huge stores of carbon, and can help to improve water quality and supply, and when in good condition may reduce flood risk, in areas downstream. It also has significant benefits for the conservation of biodiversity, and helps to maintain a valued landscape that contributes to a well-developed and important tourist industry.

### **Alkborough Flats**



Alkborough Flats

The multi-objective Alkborough Flats Project occupies a site, where the Rivers Trent and Ouse meet, comprising 440 hectares of what was previously intensive arable farmland – reclaimed from the estuary over many years. The land now has multiple objectives, balancing flood risk management, biodiversity and economic farm management.

Part of the old defences have been demolished to create new mudflats and salt marsh, providing flood protection for the estuary and counteracting the effects of sea level rise. Additional parts of the defence have been lowered, providing further storage capacity for extreme surge events. The land was once farmed intensively for wheat and rape. It is now being returned to grass and grazing land and farmed for a mixture of cattle and sheep.

Since 2006, there has been a significant increase in biodiversity – 150 different species of birds have been recorded including avocet, lapwing, golden plover, and shelduck. Fourteen species of mammals, 20 types of butterflies and 14 species of dragonfly and damselflies have also been recorded.

The Project Manager, Anna Moody says: “People might think Alkborough Flats is just a wildlife reserve, but it’s a working site and families are still using it to earn a living. We can’t deliver the objectives without their support... it’s a partnership approach at every level.”

<sup>11</sup> Green Infrastructure is frequently defined as ‘a strategically planned and delivered network of high quality green spaces and other environmental features’



### The natural environment supporting quality of life in urban areas

Natural England has emphasised that green infrastructure doesn't stop at the city limits – at its best it links across a network of green spaces and corridors, rivers and waterways through urban areas and the urban fringe and out into the wider countryside. It helps break down the barriers between people and the natural environment.

Well-designed and managed green infrastructure can deliver a wide range of environmental and quality of life benefits in towns and cities. Trees, parks and other green spaces, green roofs and walls and water – rivers and waterways, lakes and ponds – can all help to cool urban areas, counter the urban heat island effect, and help to address urban flood risk. Trees have an important part to play, for example in sustainable drainage systems (SUDs), while targeted floodplain woodland creation upstream of our towns and cities can help to delay and reduce peak flood flows. Green infrastructure can assist in providing cleaner air by filtering dust and harmful chemicals; roadside trees can trap up to 90% of traffic-related airborne dust particles. It can also increase sustainability by lowering energy costs (through reducing our reliance on air conditioning), and reducing the costs of tackling health problems during heatwaves.

Finding more ways to work with nature and provide essential green infrastructure will help to buffer the country as a whole from the effects of climate change. In many cases these are the most cost effective and efficient adaptation options currently available to us as well as delivering a wide range of additional social and economic benefits. The multiple benefits from good land management, and the role of farmers, land managers and place shapers in delivering sustainable adaptation, will become increasingly important as the climate continues to change.

## Bedfordshire and Luton Green Infrastructure Consortium

The population of Bedfordshire and Luton is set to grow significantly over the coming years. The Bedfordshire and Luton Green Infrastructure Consortium is a partnership which includes local authorities and voluntary organisations as well as the Forestry Commission, the Environment Agency and Natural England. It has identified a need for green infrastructure planning and delivery in order to protect and sustain the environment for existing as well as future generations to enjoy.

The pressures on the area will include a need for an increased supply of affordable housing, as well as improved transport infrastructure and issues around urban deprivation and regeneration. The partnership recognises the potential pressures of climate change on the environment; as well as the role it can play in helping to adapt to potential impacts, through flood storage or by using woodlands and forestry as well as parkland to counter the "heat island effect".

The partnership have identified 11 'green corridors' which will create a green infrastructure network across the region. The network is made up of urban and country parks, amenity open spaces, natural and semi-natural habitat for wildlife, nature reserves, Sites of Special Scientific Interest, designated landscapes, heritage sites and public rights of way. It also incorporates better connected cycleways and footpaths to enable healthy exercise and environmentally sound travel. Projects that are currently underway to deliver this green infrastructure network include Bedford's Green Gateway, the Chalk Arc, the Bedford Green Wheel, Bedford River Valley Park, Bedford River Corridor and Bedford and Milton Keynes Waterway Park.



*Rosie, Felix and Hector in an urban tree*

## **Policy and Practical Challenges for the Future**

### **Identifying and managing risks of mal-adaptation**

There is wide-spread recognition of the potential for adaptation actions that benefit one sector or part of society to have unintended impacts for other sectors or parts of society. It is easy to agree that adaptation actions must be sustainable but much harder to forecast the potentially negative consequences of changes in behaviour. In particular, it will be challenging to assess the cumulative impacts of a wide range of new trends and approaches. We are in the early phases of what is likely to be a period of experimentation in the land management, farming and conservation sectors. Across all of these sectors, there will be a need to build capacity for capturing and evaluating the impact of climate-driven changes in practice. An ability to do this better will enable promotion of the most effective approaches as well as alleviation of negative impacts.

### **Developing new skills sets to deliver innovative approaches**

A changing climate will create a demand for a range of new skills and competencies in delivering adaptation strategies. For example, delivering a network of green infrastructure capable of supporting climate change adaptation will require new skills in planning, design and management as well as more community involvement and empowerment. *'World Class Places'*<sup>12</sup> – the Government's strategy for improving the quality of place (May 2009) identified green infrastructure as one of the four elements of quality places and identified the need for a step-change in the provision of green infrastructure to help meet the challenges of climate change. Likewise in *Grey to Green*<sup>13</sup>, the Commission for Architecture and the Built Environment (CABE) highlighted a gap in the skills needed to green our cities to help adapt to climate change and improve people's quality of life.

Evidence from local authorities suggests they may lack the key skills to deliver effective green infrastructure. Other evidence highlights labour shortages of over 90% in landscape architecture and urban design sectors.

12 *World class places: The Government's strategy for improving quality of place*, HMG 2009 Available at: <http://www.communities.gov.uk/publications/planningandbuilding/worldclassplaces>

13 *Grey to green: How we shift funding and skills to green our cities*, CABE, 2009. Available at: <http://www.cabe.org.uk/grey-to-green>

## A Framework for Action

# Action should be flexible

Although there is still uncertainty over the future climate, we need to consider options now and make decisions that maximise future flexibility – in many cases it is failure to take decisions that locks us into inflexible pathways.

### **Conserving biodiversity in a changing climate by maximising flexibility and resilience**

Biodiversity is a strong example of an area where we need to be prepared to act in the short-term in order to avoid limiting our options in the future. We may not know the precise effects, the exact costs or the definite timing of climate impacts, but we already know enough to start taking action. Climate change means that we need to adopt an increasingly dynamic approach to managing ecosystems and conserving our biodiversity. In 2008 the England Biodiversity Group published a set of adaptation principles, designed to help guide the approach to conservation of biodiversity:

- Take practical action now;
- Maintain and enhance ecological resilience;
- Accommodate change;
- Integrate action across all partners and sectors;
- Develop knowledge and plan strategically.

There is a need to ensure that biodiversity, habitats and ecosystems are in the best possible condition, so that they are able to continue to function effectively in the face of new or increased pressures.



We must continue our efforts to conserve and manage protected sites to bring them into favourable condition, as well as taking a landscape-scale approach, building in habitat enhancements to reduce other pressures on biodiversity and developing habitat networks to aid the dispersal of species. The challenge is to take the right action at the right time to minimise losses, facilitate change and take advantage of new opportunities.

One of the key challenges we have to face is designing conservation targets and objectives for the future that are demanding, but also achievable and sufficiently flexible to cope with the unpredictable nature of both climate change and society's response to it. The EU has a target to halt the decline in biodiversity by 2010 and the European Council re-stated its commitment to this goal in 2008. On the world stage, a global target exists to reduce the rate of biodiversity loss by 2010<sup>14</sup>. New targets at

both the European and global level are expected to be negotiated this year, showing an ongoing commitment to biodiversity conservation and enhancement.

It is possible that as the climate changes, sites that were designated for one set of species may not retain them at the previous levels of abundance, regardless of the level of conservation effort, even though those protected sites will remain a vital resource for many

### Porlock Ridge – an example of adaptive management



Porlock Ridge; © Natural England

An important aspect of adaptation to climate change will be the need to accept change and reconsider current practices. At Porlock Ridge, an SSSI on the Severn Estuary, adaptive management means that one high quality habitat is being naturally replaced with another.

This shows how change can be accommodated successfully so that while one set of valued assets may be lost a new set is created.

A storm in 1990 breached the shingle ridge separating the marsh, which was designated as an SSSI, from the sea and the marsh was inundated with seawater. The damage was repaired but – recognising the likelihood that ridge would continue to be breached in future – work was commissioned to consider a sustainable long-term solution. Since a further storm in 1996 Natural England have initiated a “managed retreat” on the site which will slowly allow the land to return to the way it was 200 years ago, with a low, wide ridge of shingle and a lagoon behind. Land use has changed – the area is now grazed very much less, and the coastal path has been formally diverted. Birds and flora are being monitored, as is the changing shape of the ridge.

The previous habitat of Porlock Marsh has now largely been destroyed by inundation, but a new saltmarsh has been created which is one of largest on Severn Estuary. This is first time an SSSI has been renotified after natural coastal processes have operated and changed an area.<sup>15</sup>

<sup>14</sup> Available at: <http://www.cbd.int/2010-target/>

<sup>15</sup> It is important to note that, as with all adaptation case studies, the principles illustrated here are highly relevant to other situations, but the appropriate action in other cases will depend on the circumstances, costs and benefits of different courses of action and the objectives for that particular area.



*Semi-natural woodland in the New Forest, © FC Picture Library*

other valuable species and may become part of the distribution ranges for other protected species. It is possible that some iconic species or those that currently characterise a particular habitat may change their distribution or frequency too. In future, therefore, the emphasis is likely to be on improving and buffering the capacity of existing sites to cater for a wider range of species. Reducing fragmentation of habitats will also allow some species to move around the landscape more easily and find patches of suitable conditions.

There is a case for reconsidering traditional approaches in the face of substantial future challenges. Re-examining how we frame conservation objectives for individual sites could be needed, as well as different perspectives on governance. In future, our targets may need to be less informed by a historical perspective and perhaps more focussed on managing habitat condition so that sites are better able to withstand current and future stresses, enable the movement of species where necessary and continue to provide vital ecosystem services.

### **Taking the long view – promoting flexibility and diversity in woods and forests**

Another good example of an area where we need to take decisions in the short-term with a view to maintaining flexibility and retaining benefits in the long-term is forestry. Because trees have a long lifespan any adaptive measures need to be appropriate to both current and future climatic conditions. By the end of the century, some native tree species are likely to lose ‘climate space’<sup>16</sup>, particularly in southern England. The range and ability of the majority of priority woodland species (both flora and fauna) to persist will change as a result of climate change; some will decline further, others will benefit.

Many uncertainties remain about both the future climate and the response of trees and woodland ecosystems to climate change. Expanding the range of tree species to increase resilience – at stand<sup>17</sup> or landscape scale – when restocking existing woodlands or planting new ones, represents the most appropriate adaptation response at this time. This type of ‘no-regrets’ approach can also provide additional insurance against the uncertain future impacts of pests and diseases.

<sup>16</sup> The area of land which has a climate suitable for a particular species or habitat.

<sup>17</sup> Stand – a group of trees that can be managed as a single unit.

## Marine and Coastal Access Act

The Marine and Coastal Access Act 2009, the first of its kind anywhere in the world, introduces a single piece of legislation for the protection of the marine environment. Through a new marine planning system we will be able to manage our environmental, social and economic needs together, and an ecologically coherent network of Marine Protected Areas (MPAs) will be created by 2012.

Marine Conservation Zones are a new type of MPA. They will be designated to conserve flora, fauna, habitats whether rare or threatened or representative of UK biodiversity, as well as geomorphological features. Levels of protections will be site specific and dependent upon a site's conservation objectives. These are expected to range from sites which have little or no restrictions to sites where all damaging activities are excluded. Existing Marine Nature Reserves are converted into MCZs under the Act, Lundy became an MCZ on 12 January 2010.

Our seas are already showing the effects of climate change and with increasing use of the sea by many competing interests, we must make sure that the marine environment can cope with changing conditions. We have a duty to look after our seas for future generations. It is envisaged that our network of MPAs will contribute to halting the decline in biodiversity by conserving representative UK habitats and species, and areas where there are rare and threatened species and habitats.

Marine Conservation Zones are a flexible mechanism. They can be decommissioned, modified, or moved to ensure they are still protecting the feature they were designated to protect, or to ensure they continue to fulfil their contribution to the network. This is particularly relevant in relation to climate change. The UK network of MPA will contribute to protecting UK biodiversity, providing some respite from other pressures in the face of climate change.

The Forestry Commission is preparing a Climate Change Action Plan for the Public Forest Estate in England. The Plan benchmarks existing management practice and will initiate actions to enhance species diversity and genetic diversity through appropriate provenance mixtures. Changes in woodland management systems will also be considered, including those that promote diversity in age and structure and promote natural regeneration. The Plan will also ensure sufficient diversity within timber species at landscape and, in some cases, stand level. It will also require that less common and some relatively untried species are planted – in part a response to the reduced range of 'conventional' species as a result of recent pest and disease outbreaks. This will require that sub-optimally performing species (under current climatic conditions) are planted to provide the required diversity and, as a consequence, resilience to changing climatic conditions or the threat posed by pests and diseases.



Broadleafed woodland in the Chilterns, © FC Picture Library, Isobel Cameron

### Balancing a flexible approach with continuity of focus

A key challenge for the future, for all parties with an interest in conserving the natural environment, will be developing flexible policies and setting targets that can adapt to reflect changing contexts; while continuing to recognise the value of biodiversity and ecosystems and their contribution to wellbeing and prosperity. Wildlife is under threat for a number of reasons – such as pollution, habitat loss and development and climate change can exacerbate all of these pressures.

It is important, however, that we are able to distinguish between present threats, pressures that are likely to develop in the short or medium term and those which



may only develop under certain scenarios in the longer term. While we will have to accept that some changes are unavoidable, we will also need to develop capacity to distinguish between: avoidable climate-driven changes, avoidable changes driven by other pressures and those changes that we cannot realistically avoid. In all of this we need to continue our work to protect biodiversity so that we can continue to benefit from the ecosystem services our natural environment delivers.

### **Policy and Practical Challenges for the Future**

#### **Recognising opportunities as well as threats**

Climate change is unquestionably a threat to the natural environment. Consequently, much of the focus is, quite rightly, on managing the risks and enhancing resilience. It is important however that we recognise the opportunities where they do occur. Climate change could be beneficial for some species in Britain allowing them to spread northwards and increase their range. A well-known example of this is the spread of Dartford Warbler, which used to be confined to small parts of Dorset due to cold winters, but which are now found as far afield as Suffolk and Staffordshire.

Given that some native species may become threatened in southern parts of their present-day distributions, taking a flexible approach may include welcoming the establishment in the UK of new



species. For example the Little Egret has become a welcome sight in the south since its arrival in the UK in the late 1990s. We will need to make such judgements on a case by case basis, using sound science. It will be important to monitor the situation and control measures may become necessary where a non-native species does become invasive and a threat to conservation objectives.

## A Framework for Action

# Action should be evidence-based

Making full use of the latest research, data and practical experience (including the UK Climate Projections 2009) so that decision-making is well-supported and informed.

### **Defra's Evidence Investment Strategy**

The major global challenges of climate change, protecting ecosystem services and ensuring a sustainable food supply call for quality evidence and innovation to contribute to good policy making and sound government. Defra recognises this and invests heavily in evidence: approximately £240m to evidence-related activities, including research, surveillance and scientific specialists in 2009/10.

*"It is absolutely essential that all the policies that we formulate are based on sound evidence. We now understand more about the challenges facing the earth's climate, ecosystem services and the supply of sustainable and healthy food. There has never been a time when there was a greater need for good quality evidence to contribute to policy making and sound decisions."*

*Prof. Bob Watson – Defra's Chief Scientific Adviser*

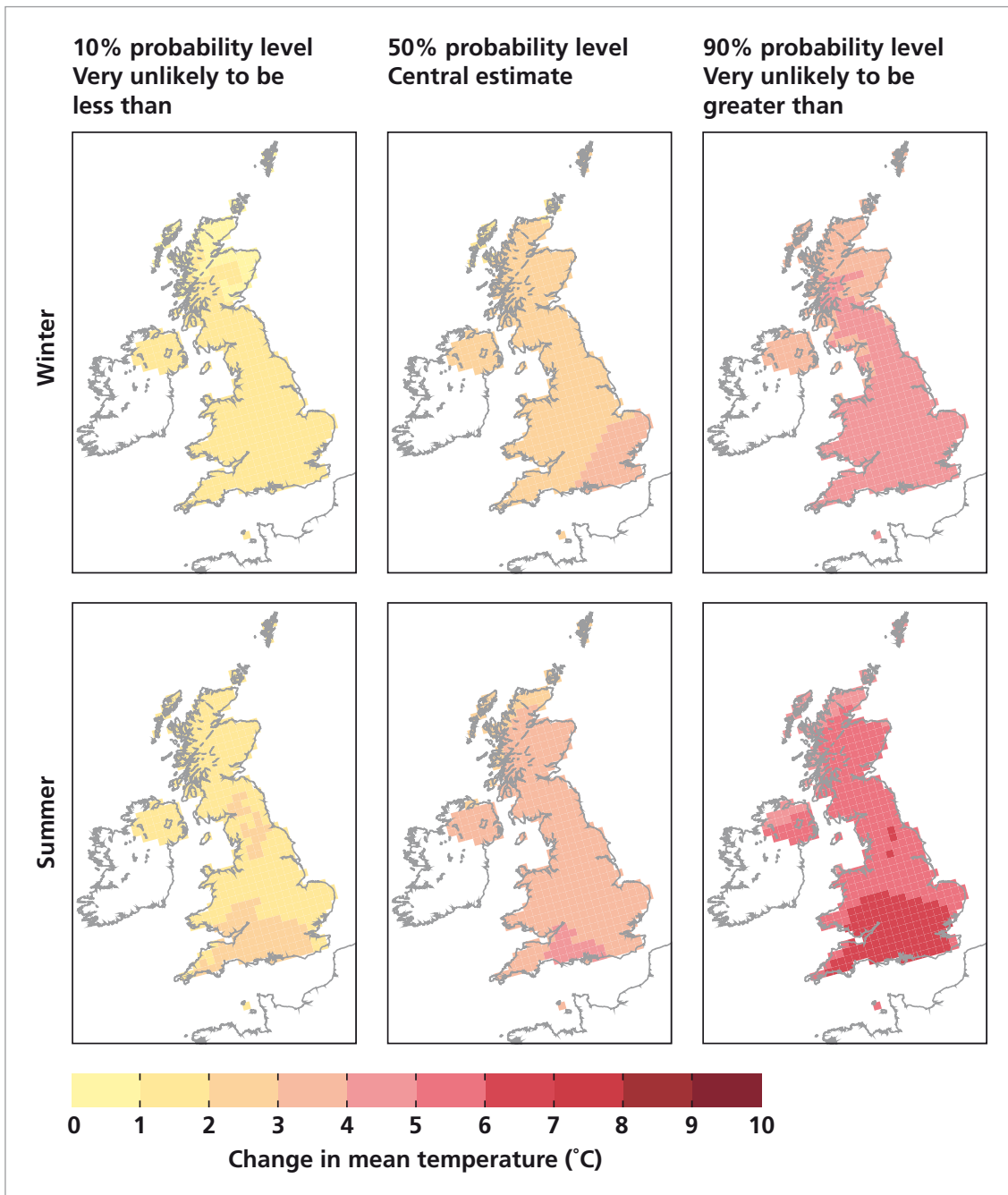
There have always been compelling arguments for protecting individual ecosystems on the basis of their aesthetic and cultural values. However, Defra's new Evidence Investment Strategy (EIS)<sup>18</sup> published in

January 2010 emphasises that it is becoming increasingly clear how our natural environment offers more tangible benefits to the economy, lifestyles and even survival.

The strategy highlights protecting ecosystem services as one of the three big interlinked evidence challenges for the Department and recommends that more evidence investment needs to be directed to these big enduring challenges. Not only will habitats and species be affected directly by climate change and sea level rise, they will also be affected by policy and behavioural shifts in sectors such as agriculture, water, transport and energy. While the general principles and direction of climate change impacts on biodiversity in the UK are understood, the details and timing of impacts on individual species, habitats and sites are very uncertain. Key areas identified for further evidence gathering include the implications of climate change for species (including non-native species) and ecosystems, and on wildlife disease. This is a long-term agenda, requiring a more sophisticated understanding of the value of ecosystem services and the relationship between economic and environmental performance.

<sup>18</sup> Available at; <http://www.defra.gov.uk/evidence/science/how/strategy.htm>





**Figure 4:** 10, 50 and 90% probability levels of changes to the average daily mean temperature (°C) of the winter (upper) and summer (lower) by the 2080s, under the Medium emissions scenario. © UK Climate Projections 2009<sup>19</sup>

<sup>19</sup> Available at: <http://ukclimateprojections.defra.gov.uk/>

## **Policy and Practical Challenges for the Future**

### **Dealing with uncertainty**

A challenge – for all organisations – is to plan for the uncertainties that still remain over the impacts of climate change and to keep options flexible if the climate or other risks change faster, or more slowly than we believe they will at the moment. UKCP09<sup>20</sup> shows a range of climate changes up until the end of the century with associated probabilities to give a measure of the strength of evidence for each outcome, based on current science from the Met Office Hadley Centre, and including information from observations and other climate models.

UKCP09 represents a comprehensive survey of the spread of plausible outcomes consistent with current understanding, and illustrates clearly that it would be wrong to plan a strategy to deal with just one single projection (such as the central estimate for the medium emissions scenario). In addition, the projections are likely to be updated in the future as understanding and modelling technology improves. Therefore adaptation plans will need to be robust to known uncertainties captured in UKCP09, and also sufficiently flexible to allow modification in the light of new projections as they emerge.

### **Getting to grips with both the temporal and spatial dimensions of climate change**

It is clear that climate impacts will be felt differently in different parts of the country and that the impacts will change over time. A common challenge for all organisations seeking to assess and manage climate change risks based on sound evidence will be to move from a broad appreciation of the general impacts (warmer, wetter winters, hotter drier summers etc.) to a more specific understanding of the probable impacts on key outcomes and objectives in a given area over a given timescale. This will be important in ensuring that adaptation responses are both timely and proportionate.

### **Building capacity and capability to plan ahead**

Whilst continuing to build the evidence base and improve the modelling are crucial elements in building our capacity to adapt, it should be recognised that these are only part of a wider story. Understanding how best to work with probability and projected scenarios, how to establish priorities based on an effective analysis of risks and how to plan for the long term all pose challenges for individuals and organisations in all sectors. All of us will need to improve our capacity and capability to work in ways which may be new to many of us. This will be an iterative process that will require a culture of ongoing learning and a willingness to share and evaluate new approaches.

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20 Available at: <http://ukclimateprojections.defra.gov.uk/>

## Action Research

Whilst we have an increasingly sophisticated evidence base addressing the potential impacts of climate change both spatially and over time, much less is known about the factors influencing the capacity of organisations and individuals to respond to this information. Defra is currently undertaking research to improve our understanding of both the practical processes and the strategic choices and challenges involved in applying the UK Climate Projections (UKCP09) to land management for environmental purposes.

The project aims to enhance our understanding of the full range of factors influencing land management organisations seeking to incorporate climate risks into their planning processes. The project focuses on a package of action-learning delivered to four case study organisations.

**Clinton Devon Estates – focussing on Clinton Farms** to provide an insight into climate change adaptation with an environmental focus on agricultural land. Environmental considerations are a key priority, including heathland management, river management and forestry. Concerns for the future include impacts on forests and woodland as a result of climate change and the potential for an increase in exotic diseases and pests.

**Lake District National Park – focussing on the Windermere Catchment Restoration Programme;** a partnership programme involving a variety of other organisations including the Environment Agency. Their key concern is to

improve water quality and preserve the natural ecology of the catchment and lakes, which in turn will help to support a healthy, local economy. Climate change is a key concern in improving land management plans to take into consideration potential future risks including increased levels of flooding and erosion.

**Lea Valley Regional Park Authority** seeks to meet the leisure, recreation and nature conservation needs of London, Hertfordshire and Essex. **Focusing on Walthamstow Marshes on the margins of east London**, an SSSI and one of London's last natural floodplain grasslands. Climate related concerns include issues around too much water causing flooding; too little water from drought or over abstraction; water quality which affects users for consumption and leisure (e.g. canoeing) and an increase in visitor numbers (as a result of warmer summers) leading to environmental pressures.

**Royal Society for the Protection of Birds** – the RSPB promotes conservation and the protection of birds and the wider environment as well as managing 200 nature reserves. **Focusing on Dearne Valley Reserve near Barnsley in South Yorkshire.** Climate related concerns include cost and damage to the environment as a result of invasive species and changing migration patterns. Changing rainfall patterns may be exaggerated within the Dearne Valley as it receives floodwater for the surrounding urban areas leading to additional concerns around flood defence and increasing spring droughts.

## A Framework for Action

# Our response to climate impacts should be prioritised

For example, by focusing more attention on policies, programmes and activities that are most affected by the weather and climate, those which have long timescales for implementation or long-term implications, where significant investment is involved or high values are at stake, or where support for national infrastructure is involved.

### **Managing flood and coastal erosion risks – high impact, high priority**

Flooding and coastal erosion already cause significant damage and disruption in England. Changes in sea level and weather patterns are expected to increase the frequency and intensity of all types of flooding and coastal erosion with impacts for people and the economy. These will also pose new challenges for the natural environment. Increased flooding could result in more soil, debris and pollutants being washed into watercourses, with consequences for biodiversity. Sea level rise against fixed defences could lead to the loss of ecologically important coastal habitats such as intertidal flats and marshes and threaten the sustainability of supra-tidal habitats such as sand dunes and shingle banks. This will also increase the risks as these habitats lose their capacity to break the destructive force of wave energy reaching the coast. Saltwater flooding may adversely affect vulnerable freshwater habitats at the coast. Action to meet these challenges needs to be planned well in advance.

Different approaches to flood risk management will be needed in the future, including those that work with nature. Hard defences to reduce the risk of flooding and erosion (such as concrete barriers) cannot easily adapt to rising sea levels and may make erosion worse. Also, they could impact on biodiversity by altering the physical properties (hydromorphology) and diversity of river corridors, wetlands and coastal areas. Faster coastal erosion could lead to destruction of sewers or exposure of old rubbish dumps, with consequences for human health and the environment. And loss of development land to inundation or erosion could place further pressures on the environment, as we seek to move or replace homes, roads and other infrastructure.

There are also opportunities to manage the increasing risks in ways which both enhance the environment and mitigate the impacts on people. For example:

- Creating “blue corridors” to make space for water within urban areas could have wildlife and amenity benefits – Defra is researching the viability and benefits of this approach.



- The realignment of defences to more sustainable locations could create ecologically valuable intertidal areas and fluvial habitats which also help dissipate wave energy and reduce the risks to people.
- Restoring wildlife rich wetlands and natural flood retention areas could reduce flood risk downstream.
- Restoring habitats such as woodland in catchments and improving land and soil management could reduce run-off and local flood damages as well as sustaining the capacity of land to support agriculture in the long term.
- Increasing the use of Sustainable Drainage Systems (SUDS) can improve water quality and public amenity, improve the attractiveness of urban developments through the incorporation of ponds and reedbeds, and help to tackle flooding from surface water run-off by reducing the volume and flow of water to sewers. SUDS also offer biodiversity benefits by creating habitats for biodiversity.

In future a mix of both 'hard' and 'soft' approaches to managing flood risk and coastal erosion are likely to be required to ensure we meet the needs of people, businesses and the wider environment. This will need to take account of both the nature of the risks involved and the full range of costs and benefits associated with alternative options.

The Environment Agency estimates that in order to maintain current levels of protection against river and sea flooding alone, investment in flood and coastal risk management assets needs to increase by 80% in real terms by 2035<sup>21</sup>. However, because of the serious nature of the risks involved, work to improve the way we manage flood and coastal erosion risk in England is already well advanced. For example:

- The Environment Agency's Long Term Investment Strategy sets out the scale of investment needed in flood and coastal defences over the next 25 years (2010 – 2035), taking account of the impacts of climate change.
- Shoreline Management Plans set out flood and coastal erosion risk management policies for 20, 50 and 100 years into the future.
- Catchment Flood Management Plans (CFMPs) give an overview of the flood risk across each river catchment and estuary. They recommend ways of managing those risks now and over the next 50-100 years.

<sup>21</sup> The Environment Agency's assessment is based on the 'medium' scenario set out in the UK Climate Projections 2009 (UKCP09)



Large Scale Sustainable Drainage System, © Urban Water Technology Centre, Abertay

## **Water – managing multiple demands on a limited resource**

Climate change will affect the spatial and temporal distribution of rainfall in this country. Summer rainfall will reduce, particularly in Southern England, and less water may be available for abstraction, e.g. from rivers for irrigation. Recent work by the Environment Agency suggests that the net effects of changing rainfall patterns will reduce river flows by 15% by the 2050s<sup>22</sup>. Climate projections also suggest that winter rainfall could increase in some regions by as much as 30% by the 2080s, while rainfall intensity could increase both in winter and summer. In England, our public water supply systems take advantage of rainfall from October to March to replenish reservoirs and aquifers, with relatively little dependence on summer rainfall. However, agriculture tends to rely on summer rainfall for crop growth.

Because water is essential for life, changes in rainfall distribution have wide-ranging implications for the natural environment:

- Water quality and aquatic flora and fauna could be affected as reduced river flows will make it harder to dilute or disperse pollutants.

- A lack of water may affect fragile habitats such as chalk downs leading to changes in species and their distribution.
- Farmers and businesses may suffer through a lack of water for food production and processing.
- An increased frequency and severity of summer drought is likely to represent the greatest threat to woodlands from climate change.
- Low flows could affect tourism on our waterways by preventing navigation activity in the summer months.
- Rising sea levels may lead to saline intrusion into fresh water sources, affecting water affordability and quality.

We need to achieve more sustainable use of water despite a range of different demands (for domestic use, industry, agriculture, the natural environment, tourism, housing, etc.) both now and in the future. These demands have implications beyond the direct impacts of water scarcity and the need to reduce water use in water stressed areas while increasing the capacity of the landscape to capture and store water safely throughout the year.

<sup>22</sup> Reported in: *Water for People and the Environment*, Environment Agency 2009 water resources strategy. Available at: <http://publications.environment-agency.gov.uk/pdf/GEHO0707BMXQ-e-e.pdf>



The Environment Agency's abstraction licensing regime is the main mechanism for achieving sustainable management of water resources. Extensions to the scope of the licensing regime from 2009 mean that all sectors are now controlled<sup>23</sup> and could have their allocations of water changed, if necessary, to respond to climate impacts. New proposals to time limit existing abstraction licences provide a further way to proactively manage the impacts of climate change on catchment areas. Defra has recently consulted on these proposals with a view to setting out a revised approach.

Because managing multiple demands for water is such a fulcrum issue, achieving and maintaining a sustainable water abstraction regime is the icon indicator for adapting to climate change under PSA27: *Leading the global effort to avoid dangerous climate change*<sup>24</sup>. Achievement of this objective means that the overall regime for water management is adapting well to climate change.

23 Where the quantity taken exceeds the threshold of 20 cubic metres per day.

24 Available at: [http://www.hm-treasury.gov.uk/d/pbr\\_csr07\\_psa27.pdf](http://www.hm-treasury.gov.uk/d/pbr_csr07_psa27.pdf)

## Setting Priorities – Agriculture and Climate Change Adaptation Project

Defra has been working in partnership with key stakeholders including Natural England, the Environment Agency, the Forestry Commission and the Rural Climate Change Forum<sup>25</sup> to identify a range of priority adaptation actions that are likely to reduce vulnerability to multiple climate risks without causing other problems for the environment and/or have multiple benefits for agricultural production, ecosystems and climate change mitigation. To respond effectively to all the threats and opportunities that climate change will bring, farmers and land managers will need to take a wide range of actions, including:

- planning, risk assessment, and monitoring; land management actions that will create important 'green infrastructure' to benefit both farms and wider society;
- changing farm types, crops and livestock;
- introducing new technology; and
- improving management of water, crops, livestock and inputs such as pesticides and fertilisers.

Many of the priority adaptation actions identified within these categories have **significant co-benefits for the natural environment** and are already considered best practice. Therefore their additional role in adaptation gives extra incentive for farmers to pursue them. For example, 'green infrastructure' measures such as planting trees, putting in buffer strips next to watercourses, reconnecting rivers and their flood plains, restoring

or creating ponds and wetlands, are excellent examples of ways that farmers can cope with several climate change impacts that also have significant benefits for biodiversity, habitats, soil and water quality. Similarly, optimising fertiliser and pesticide inputs to increase yields, save costs and cope with new or increased pests and diseases will be highly beneficial for biodiversity and water quality.

Meanwhile potential adaptation measures that could have detrimental impacts on the natural environment have been identified (see section on secondary impacts of farming sector adaptation measures on pages 22 to 23) – and will need to be approached in a sustainable way. It is in everyone's interests that any adaptation by agriculture enhances, or at the very least does not harm, the natural environment as healthy biodiversity and **ecosystems are vital for future food production**.

Many farmers say they just need good information on the impacts and possible responses in order to adapt their farm to climate change. The Agriculture and Climate Change Adaptation Project is working with industry to encourage farmers to take up the most beneficial adaptation measures, by enhancing existing advice and guidance (e.g. the industry-led Farming Futures,<sup>26</sup> Government skills and advice programmes) and demonstrating best practice. National monitoring and R&D will be important to ensure that adaptation by the farming sector is sustainable and does not solve one set of problems while creating another.

<sup>25</sup> Chaired by Dr John Gilliland (representing the Sustainable Development Commission), the other members of the Forum are Defra, the NFU, CLA, AIC, the Agriculture and Horticulture Development Board, Carbon Trust, Environment Agency, Forestry Commission, National Trust, Natural England, and RSPB.

<sup>26</sup> The industry-led initiative Farming Futures is an online communications collaboration which encourages action on adaptation as well as mitigation by providing over 40 case studies and fact sheets, events and workshops on how to prepare for the impacts, opportunities, risks and responsibilities that climate change brings, available at: <http://www.farmingfutures.org.uk/>



## Policy and Practical Challenges for the Future

### Assessing climate risks and building adaptive capacity

All organisations involved in managing or advising on the natural environment should take a systematic approach to identifying climate risks and opportunities and plan how best to respond to these. For example by:

**Examining how the delivery of their objectives has been affected by extreme weather events in the past.** For example in addressing its responsibilities for flood risk management, the Environment Agency draws on past experience to provide support for individuals, communities and businesses to prepare for flooding. This involves following some simple steps including signing up for free flood warnings, making a flood plan and researching ways to reduce the impact of flooding on homes and properties.

**Considering a wide range of possible risks to their activities – including any indirect impacts, such as disruption to supply chains, or changing customer needs.** For example, the Rural Climate Change Forum (RCCF) do this by bringing together industry, non-governmental organisations and Government bodies, to provide a forum for dialogue with, and advice to, Government. The forum provides advice, awareness-raising and leadership for rural stakeholders, and identify research needs on climate change and other rural land management issues.

**Examining which of these are the priority risks that require an early adaptation response (these include significant risks that organisations are already facing, and those where it is important to take steps now because it could take some time to plan and implement an effective response).** For example, the forestry sector has to plan ahead (fifty years or more). Adaptive measures need to be appropriate to both current and future climatic conditions so detailed planning and capacity building is required now. The Forestry Commission is working with Defra and other partners in order to build adaptive capacity and implement adaptive actions.

**Identifying areas where the immediate priority is for further research and analysis to understand impacts and build a stronger basis for future decision-making.** For example, in March 2009, a joint Natural Environment Research Council, Defra and DECC Ocean Acidification Research Programme, worth £12 million, was launched. The programme will run over 5 years, and outputs will support work on adaptation.

**Considering which of the risks they are dealing with could best be taken forward in conjunction with their partners, stakeholders, suppliers or customers.** For example, the National Park Authorities and the Broads Authority have committed to engage with residents and visitors on the future of our National Parks to ensure we all plan for the inevitable changes ahead and to promote understanding of the adaptation work planned and underway.

**Improving their organisational capability through embedding adaptation risk management into their existing business planning and risk management processes and ensuring staff have access to relevant information and training.** For example a range of organisations involved in land management have volunteered to take part in 'Action Research' sponsored by Defra with the aim of enhancing their capacity to address the challenge of climate change (see page 35).



Moorland River, © Ali Taylor

## A Framework for Action

# Adaptation measures should be effective, efficient, and equitable

Effective – reducing the risks from climate change without introducing perverse effects; efficient – long-term benefits of adaptation actions should outweigh the costs; equitable – the effects of the activity on different groups and where the costs should fall should be taken into account.

## **Effective – reducing the risks from climate change without introducing perverse effects**

We have argued that ecosystem services underpin our wider adaptive capacity and that an approach focused on maintaining and managing healthy natural systems provides us with a framework for ensuring that adaptation actions are effective and limit the risk of perverse outcomes.

Ecosystem services can be defined as services provided by the natural environment that benefit people. These benefits include:

- resources for basic survival, such as clean air and water;
- a contribution to good physical and mental health, for example through access to green spaces, both urban and rural, and genetic resources for medicines;

- protection from hazards, through the regulation of our climate and water cycle;
- support for a strong and healthy economy, with raw materials for industry and agriculture, or through tourism and recreation;
- social, cultural and educational benefits, and wellbeing and inspiration from interaction with nature.

Through the Ecosystems Approach Action Plan (EAAP)<sup>27</sup>, Defra have commissioned, supported and monitored a growing body of research related to ecosystem services and their use as a framework for planning and decision making. Initiatives such as the National Ecosystem Assessment (NEA) see page 50 are providing us with a much better understanding of what UK ecosystems have the potential to deliver, and how we can continue to benefit from the services they can provide.

27 Available at: <http://www.defra.gov.uk/environment/policy/natural-environ/change/government.htm>



Walkers in the Countryside

Five core principles underpin an ecosystems approach:

1. Taking a more holistic approach to policy-making and delivery, with the focus on maintaining healthy ecosystems and ecosystem services;
2. Ensuring that the value of ecosystem services is fully reflected in decision-making;
3. Ensuring environmental limits are respected in the context of sustainable development, taking into account ecosystem functioning;
4. Taking decisions at the appropriate spatial scale while recognising the cumulative impacts of decisions
5. Applying adaptive management of the natural environment to respond to changing pressures, including climate change.

These are supported by an approach that identifies and involves all relevant stakeholders in the decision and plan making process.<sup>28</sup>

### **Efficient – long-term benefits of adaptation actions should outweigh the costs**

Understanding the economic value of the resources and services that the environment provides to society is essential if we are to make the necessary investments in maintaining and enhancing the natural systems that

## **Green Book Guidance**

HM Treasury's Green Book: Appraisal and evaluation in central government encourages an holistic assessment of the whole life costs and benefits to UK society of a policy, spending or regulatory proposal. It is therefore well-suited to taking account of the wider environmental costs and benefits of proposals. A range of supplementary guidance exists on environmental and sustainability issues including intergenerational wealth transfers and social discounting, valuation of changes in biodiversity, and a guide to sustainability and value for money.

In June 2009, new guidance on 'Adaptation' was jointly published by Defra and HM Treasury. This is designed to enable public bodies to take account of expected climate changes and the increased risks and uncertainties resulting from current and expected future atmospheric greenhouse gas levels. In future, all departments will ensure that their major policy and investment decisions take account of the latest supplementary guidance on adaptation.<sup>29</sup>

<sup>28</sup> Available at: <http://www.defra.gov.uk/environment/policy/natural-environ/change/government.htm>

<sup>29</sup> Available at: [http://www.hm-treasury.gov.uk/data\\_greenbook\\_supguidance.htm#Adaptation\\_to\\_Climate\\_Change](http://www.hm-treasury.gov.uk/data_greenbook_supguidance.htm#Adaptation_to_Climate_Change)

provide them. It will help us to make better decisions that enable society to benefit more fully from those services now, and also to avoid the potentially significant costs of having to replace these services in future should our natural systems become less effective at producing them.

New practical tools for valuation and a growing evidence base mean there is increasing scope to value environmental impacts in policy appraisal<sup>30</sup>. Economic valuation can help us to understand the direct and indirect impacts of climate change on the natural environment and how this will affect society. For example, the Stern Review has supported action to reduce CO<sub>2</sub> emissions by concluding that, if we don't act now, the overall costs and risks of climate change will be equivalent to 5-20% of global GDP each year. Valuation can also help us to assess the potential for investment in the natural environment to contribute to adaptation responses.<sup>31</sup> A healthy, effectively managed natural environment delivers quantifiable economic gains for example:

- It is estimated that UK businesses could save £0.4 billion through more efficient use of water.
- The pollination of strawberries, apples, pears and other crops, is estimated to be worth around £200 million a year.<sup>32</sup>
- The natural environment makes a significant contribution to the economy through tourism and recreation, with estimated expenditure on rural leisure visits amounting to £10.6bn in 2006.

### **Equitable – the effects of the activity on different groups and where the costs should fall should be taken into account**

The Millennium Ecosystem Assessment<sup>33</sup> showed how, across the world, we are already eroding the “infrastructure” of our natural systems – our soils and seas and the communities of plants and animals that live on and in them – estimating that 60% of the

## **W.A.T.E.R**

The Environment Agency is a partner, together with the Westcountry Rivers Trust and South West Water, in a new EU project called WATER – Wetted land: the Assessment, Techniques and Economics of Restoration.

This 3.8 million euro project will work with partners across the North Coast of France and the South Coast of England to develop a market-based catchment restoration scheme which will be based on a Payments for Ecosystem services (PES) model and aims to identify both delivery and funding mechanisms to lever private investment for catchment restoration. It will achieve this by developing a set of five robust cost/benefit guides that demonstrate how investment from private companies in catchment restoration can make a long-term impact on their profitability and competitiveness.

Ultimately, the aim is that the people and businesses that benefit from good ecosystem function will directly pay the people who deliver good ecosystem function because they have a clear understanding of the economic, social and environmental benefits shown by this project.

services we get from our environment are being used unsustainably. The Economics of Ecosystems and Biodiversity (TEEB)<sup>34</sup> project has taken this argument further, suggesting that we are losing services with a value equivalent to around 50 billion euro from land-based systems alone. These losses are equivalent to around 7% of GDP by 2050 and are forecast to intensify with climate change. Both locally and globally the financial and human costs of overstressing these resources do not necessarily accrue to those who receive the benefits and vice versa. For example:

30 Further information available at: <http://www.defra.gov.uk/environment/policy/natural-environ/using/value.htm>

31 For example see: [http://www.naturalengland.org.uk/Images/nochargev2\\_tcm6-14259.pdf](http://www.naturalengland.org.uk/Images/nochargev2_tcm6-14259.pdf)

32 The health of livestock and honeybees in England, National Audit Office, 2009

Available at: [http://www.nao.org.uk/publications/0809/the\\_health\\_of\\_livestock.aspx](http://www.nao.org.uk/publications/0809/the_health_of_livestock.aspx)

33 Available at: <http://www.millenniumassessment.org/en/index.aspx>

34 *The economics of ecosystems and biodiversity* (TEEB), Available at: [www.teebweb.org](http://www.teebweb.org)

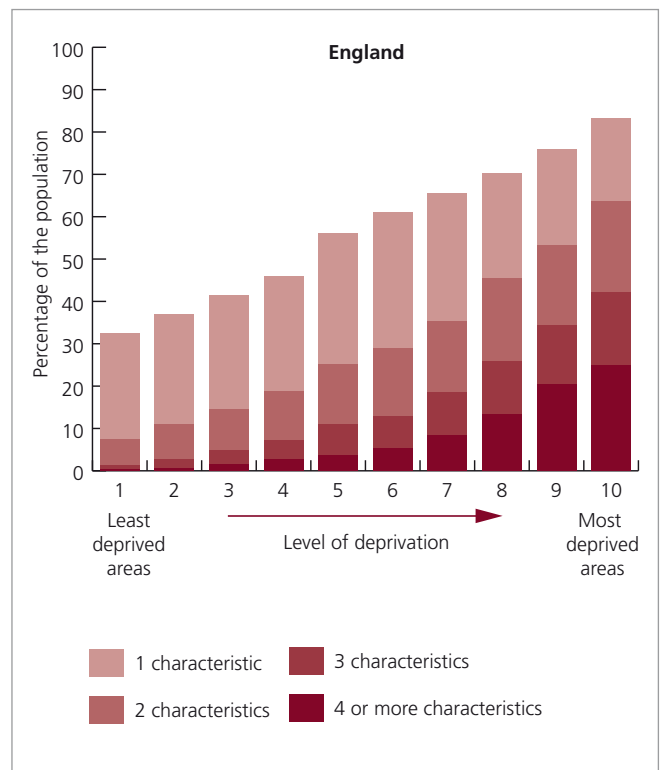
- Soil erosion in England alone is estimated to cost the agriculture sector around £45m a year, and may cause further costs by reducing water quality and increasing flood risk when that soil enters our rivers.
- In 2002, water customers paid over £90m to remove nitrates and pesticides from drinking water sources.

However, the TEEB initiative does not only highlight the economic scale of a degraded environment, it also shows the possibilities of making the transition to an economy which recognises and takes into account the role of biodiversity and ecosystem services. This growing evidence base is supported by practical action on the ground demonstrating how markets for services such as water purification or recreation and tourism can make these values real for landowners, incentivising them to use and manage their land for multiple purposes. For example, managing our soils, restoring natural habitats next to water bodies, and reducing the inputs from farming and sewerage could greatly reduce the costs associated with soil erosion and water quality, as well as protecting wildlife in our lakes and rivers.

Effective adaptation is a question of social justice. The negative effects of a poor natural environment often affect poorest people most. In deprived areas, there is typically more air pollution, less green space, fewer trees, more derelict land and lower levels of biodiversity, resulting in real impacts on the quality and length of people’s lives.

For example:

- Increasing physical activity through universal access to quality green spaces could save the NHS around £2.1bn every year<sup>35</sup>;
- Air pollution reduces the average life expectancy of people living in the UK by 6 months, at an annual cost of £15 billion (in the range £8 – £17 billion)<sup>36</sup>.



**Fig 5:** Defra Environmental Equality Indicator<sup>37</sup>

However, we also know that investing in the natural environment can help us to improve quality of life and manage risks that are set to increase in a changing climate, for example properly managed, urban green spaces can help us manage surface water flooding, filter pollution and cool the city air. The Department of Health’s Heatwave Plan for England<sup>38</sup> recognises that creating greener neighbourhoods can improve adaptation to the increased frequency of heat waves and help to prevent associated negative health impacts.

35 For information please see: [http://www.naturalengland.org.uk/Images/TIN055\\_tcm6-12519.pdf](http://www.naturalengland.org.uk/Images/TIN055_tcm6-12519.pdf)

36 For more information see: <http://www.defra.gov.uk/environment/quality/air/airquality/strategy/documents/air-pollution.PDF>

37 Level of deprivation is determined by the Index of Multiple Deprivation. Eleven environmental conditions or characteristics have been included: river water quality, air quality, green space, habitat favourable to biodiversity, flood risk, litter, detritus, housing conditions, road accidents, flytipping and presence of ‘regulated sites’ (e.g. waste treatment, industrial or landfill sites or sewage treatment works). For each of these conditions the population living in areas with, in relative terms, the 10 per cent least favourable conditions have been determined. Data mainly from 2005 to 2007-8. For further information see: <http://www.defra.gov.uk/sustainable/government/progress/national/60.htm>

38 Available at: [http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH\\_099015](http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_099015)



River Glenridding, © Crown Copyright

## **Policy and Practical Challenges for the Future**

### **Making it happen**

We know that the benefits to society at large of maintaining the integrity and health of natural systems can substantially outweigh the individual (and often more immediately marketable) benefits of over-exploiting individual parts of the system. As the climate changes we will need to brigade the existing levers available to us (including market mechanisms, incentives, planning and regulation) to produce the necessary level of cooperative action needed to ensure that our environment continues to benefit individuals and society in a changing climate. Our growing knowledge of how these natural systems work together underlines the case for encouraging a strategic approach to managing land and ecosystems.

This is a challenge that will require a joined up approach across different sectors and parts of Government to ensure that we sustain and, where possible, optimise the adaptive and other benefits we receive from natural systems. This will ensure that individual policies complement one another and that integrated delivery of multiple policy objectives can be achieved, with any necessary trade-offs in the longer term made based on an analysis of the full range of costs and benefits: economic, environmental and social.

We have the knowledge and the tools to deliver a healthy natural environment and the scientific and economic arguments point to action now being both necessary and cost effective. If we work with each other and with natural systems, we will have real opportunities to increase the efficiency of delivering many of the services that society needs and values. And if we balance our demands rather than overloading natural systems, we can reduce the risk of leaving our children and future generations with higher costs for the essentials of life and a poorer planet to support them.

**Natural Environment** Adapting to Climate Change

# Work in Progress and Next Steps

The components of Defra's ongoing work to address the future challenges and opportunities of climate change to our natural environment include a substantial focus on developing our evidence base, further and more sophisticated risk assessment as our skills and knowledge continue to improve, the identification and delivery of practical actions to promote and protect our precious landscapes and biodiversity, and an emphasis on further engagement with stakeholders.

### **The Adapting to Climate Change Programme**

The cross-government Adapting to Climate Change Programme (ACC Programme) was established in 2008 to bring together and drive forward work in Government and the wider public sector on adaptation in England and the UK for reserved matters. The ACC Programme is directed by a Programme Board with senior representatives from most central Government Departments. The Department for Environment, Food and Rural Affairs (Defra) provides the ACC Programme delivery team, but responsibility for embedding adaptation into individual government policies is the responsibility of the relevant government Department. The focus of activity for the ACC Programme involves:

- Developing a more robust and comprehensive evidence base about the impacts and consequences of climate change on the UK.
- Raising awareness of the need to take action now and help others to take action.
- Working across Government to embed adaptation into Government policies, programmes and systems.
- Measuring success and taking steps to ensure effective delivery.

### **Climate Change Act 2008 – Adaptation Reporting Power**

The Climate Change Act 2008 requires public bodies and statutory undertakings, such as utilities companies, to ensure that they are adequately prepared for the impacts of climate change. It prioritises those organisations that are responsible for our key public services such as energy, water, transport and health. Around 90 of these organisations will be required to

report to Government by the end of 2011 outlining their assessment of the risks climate change poses to them and the actions they are going to take in response. These bodies will need to talk to their stakeholders and customers and other organisations that they work with to ensure their plans are complementary and sustainable. Government will also use the information to inform the National Adaptation Programme which will be laid before Parliament in 2012. Under the Adaptation Reporting Power the Environment Agency will be issued with a Direction to report (joint with the Welsh Assembly Government). The Environment Agency will submit its report in September 2010. In addition a number of natural environment organisations have been invited to report voluntarily:

- the National Park Authorities and the Broads Authority;
- Natural England;
- The Forestry Commission; and
- British Waterways.

These organisations have expressed their willingness to be involved. For example, Natural England have agreed to be amongst the first to report by September 2010, and hope that their report will provide an excellent example of how climate risks to the natural environment might be managed. The National Park Authorities have all agreed that they will report and embed adaptation into their long term National Park Management Plans and aim to be exemplars on landscape scale adaptation.

### **Next steps**

- First round of reports requested February 2010
- First reports delivered November 2011



## Climate Change Risk Assessment

The Climate Change Act 2008 requires the first Climate Change Risk Assessment (CCRA) to be reported within three years of the Act coming into force (i.e. by 26 January 2012), and thereafter for one to be undertaken every five years. The Government's aim is for the CCRA to identify, assess, and where possible to monetise the key climate change risks and opportunities at UK, national and regional level to inform government policy and spending. This will include risks and opportunities to the natural environment, biodiversity, and landscape.

The CCRA will assess the potential impacts from climate change, using the latest Projections, across different sectors and regions, to identify the highest priority risks to the UK. It will assess the severity of the potential risks through combining understanding of these impacts across sectors with an assessment of their current and future vulnerability and capacity to adapt. Whilst central government is the primary customer, regional bodies and wider public, private and third sectors will be able to use these outputs to aid adaptation within their organisations. Delivery of the CCRA is closely linked with the Secretary of State's power to request reports from public bodies and statutory undertakers on how they are assessing the risks to their organisation of climate change (see section on the reporting power above).

### Next steps

- Climate Change Risk Assessment published – January 2012
- Publish first statutory programme for adaptation & second strategy on the use of the reporting power – 2012

## Climate Change Plan

In March 2010 all Government Departments published a Departmental Adaptation Plan. Defra's Climate Change Plan recognises that climate change is the most serious long term threat to the natural environment and human well-being, but at the same time our natural environment is our greatest asset: the basis on which we can build a future in a rapidly changing climate. Ecosystems provide the services that clean our air and water, and give us food, medicines, energy, and raw materials. They regenerate soils and pollinate crops, regulate the climate, cool cities; and help to control floods. Defra recognises the importance of enhancing the resilience of ecosystems, and of working effectively with natural processes to offer protection from climate change to homes, infrastructure, livelihoods, and human life. The Department's Climate Change Plan sets out a range of practical actions to tackle some of the immediate challenges facing our natural environment as a result of climate change.

### Next steps

More detailed discussion of these issues will be needed by Defra, other parts of Government, delivery partners and stakeholders in the next 12 months, with a view to developing more detailed approaches.

- Ongoing engagement with stakeholders will be crucial to this process, as will the sharing of information and experience to develop robust responses in the face of changing circumstances and future uncertainty.
- Defra's Plan will be reviewed in the first half of 2011, with more substantial updating in 2 years' time and again every 5 years. This will ensure that further progress is being achieved in terms of risk assessment, decision-making and capacity-building to deal with the impacts of climate change for Defra's policy agenda.
- All Departments will update their Climate Change Plans on a regular basis – the first of these updates will be available in 2011/12.

## National Ecosystem Assessment

The UK National Ecosystem Assessment (NEA) is the first analysis of the UK's natural environment in terms of the benefits it provides to society and continuing economic prosperity. Part of the Living With Environmental Change (LWEC) initiative the NEA is an inclusive process involving many government, academic, NGO and private sector institutions. The NEA will create compelling and easily understood explanation of the state and value of the UK's natural ecosystem services. It will be useful to institutions and individuals to raise awareness of the importance of ecosystems and the services they provide to society, as well as assisting in strengthening policy-making to ensure effective management in future.

### Next steps

Throughout 2009, the NEA has looked back 60 years to understand how our ecosystems and the services they provide have arrived at their current state and value.

- This year the assessment will look forward 50 years, developing scenarios for how those ecosystems may change in future, including how climate change is likely to affect them.
- It will then consider how society might respond to these changes to maintain and enhance the benefits, including adaptation benefits, that we all will continue to get from our natural environment in a changing climate.

## Lawton Review of England's wildlife and ecological network

Across England large areas of land are protected under environmental and landscape designations. Both within these designations and outside them the Government and others have invested in protecting, enhancing and restoring important wildlife habitats, including innovative approaches such as initiatives that promote the provision of ecosystem services. In September 2009 Environment Secretary Hilary Benn announced a review of England's wildlife and ecological network, including its links with our

National Parks and its ability to adapt to climate change and other pressures. The review will:

- examine evidence on the extent to which the collection of sites represents a coherent and resilient ecological network capable of adapting to the challenge of climate change and other pressures;
- examine the evidence base to assess whether a more inter-connected network would be more effective today and in the future and, if so, how this could be delivered;
- taking account of the ecological, economic and social costs and benefits, make costed and prioritised recommendations on any measures that should be taken including how Government and other organisations can work together to deliver the recommended model.

The review is chaired by Professor Sir John Lawton. Natural England will work closely with the review and provide the secretariat. The review will also complement the National Ecosystem Assessment.

### Next steps

- The review will report to the Secretary of State for Environment, Food and Rural Affairs by June 2010.

## Climate Change Action Plan for the Public Forest Estate

Adaptation measures will be introduced across Forestry Commission woodlands in England through implementation of the Climate Change Action Plan for the Public Forest Estate. Adaptation of woodlands in private ownership will be encouraged through grant-aid for woodland creation and management through the English Woodland Grant Scheme (eWGS: part of the Rural Development Programme for England)<sup>39</sup> and the requirement to apply the UK Forestry Standard and its underpinning Climate Change Guidelines.

### Next steps

- Climate change considerations will also be included in an ongoing review of eWGS.

<sup>39</sup> For further information go to: <http://www.forestry.gov.uk/ewgs>

### Natural England – Future Landscapes

Natural England's developing 'Future Landscapes'<sup>40</sup> policy will help us to identify the likely impacts of climate change on landscape character to aid adaptation. Future landscapes should emerge as a result of planned interventions using a landscape character approach. It's not just about how land looks but maintaining and increasing the ecosystem services provided by particular landscapes.

### Environment Agency – future research

Defra has an extensive joint research programme with the Environment Agency. This includes a number of current projects that are informing our policy on climate change adaptation, such as:

- building on UKCP09 to develop knowledge about the likely implications of climate change for flood and coastal erosion risk management;
- making properties more resilient to flooding;
- understanding how development of "blue corridors" could help make space for water in urban areas; and,
- helping coastal communities at risk from coastal flooding and erosion to understand the implications of UKCP09.

### Adaptation in the Planning System

Tackling climate change is at the centre of what Government expects from good planning. As well as contributing to the reduction of emissions, this also means planning and shaping places that are resilient to, and fit for our present and future climate. We are building into the whole planning system clear expectations on adaptation: draft National Policy Statements on nationally significant infrastructure projects, regional strategies and local development frameworks all take account of the need to adapt to a changing climate. New policy statements:

- Planning for a Natural and Healthy Environment<sup>41</sup>;
- Planning for Development and Coastal Change<sup>42</sup>; and
- Planning for a Low Carbon Future in a Changing Climate<sup>43</sup>

have been published for consultation. These combine to provide councils with a "green planning rulebook" so new sustainable developments are planned and built with the aim of reducing carbon emissions and with the future climate in mind. Proposals for the new climate change planning policy will ensure new developments are built in the right places, utilising sustainable sources of energy and encouraging the installation of electric car charging points.

### Next steps

- Consultation paper on a new Planning Policy Statement: Planning for a Natural and Healthy Environment – 09/03/10 to 01/06/10
- Consultation on a Planning Policy Statement: Planning for a Low Carbon Future in a Changing Climate– 09/03/10 to 01/06/10
- The Local Democracy, Economic Development and Construction Act 2009 sets out that new Regional Strategies are to include policies designed to contribute to the mitigation of, and adaptation to, climate change.
- PPS 25: Development and Flood Risk makes sure the impacts of climate change are taken into account in planning sustainable new development so that it will be safe over its lifetime from the risk of river, sea and other sources of flooding. We will be consulting later in the summer on improving delivery of the policies in PPS 25.

40 Available at: [http://www.naturalengland.org.uk/Images/futurelandscapes\\_tcm6-8638.pdf](http://www.naturalengland.org.uk/Images/futurelandscapes_tcm6-8638.pdf)

41 Available at: <https://ppsnheconsultation.communities.gov.uk/>

42 Available at: <http://www.communities.gov.uk/publications/planningandbuilding/coastalchange>

43 Available at: <http://www.communities.gov.uk/publications/planningandbuilding/ppsclimateconsultation>



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