

Adapting to Climate Change in the Yorkshire Dales National Park

An assessment of risks, opportunities and actions

Prepared on behalf of the
National Park Management Plan Steering Group
June 2011

Limestone pavement in front of Ingleborough



YORKSHIRE DALES
National Park Authority

NATIONAL PARKS
Britain's breathing spaces

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Enjoying the Yorkshire Dales National Park

Introduction

The Yorkshire Dales National Park is one of ten national parks in England. National parks contain the most beautiful, spectacular and dramatic expanses of countryside. Along with Areas of Outstanding Natural Beauty (AONBs) they are of national importance with designation conferring the highest status for the conservation of landscape and scenic beauty. They also contain a wealth of nationally and internationally important wildlife and geodiversity sites. Millions of visitors enjoy these qualities every year.

Unlike the 'wilderness parks' in some other countries, the national parks of England explicitly reflect the interaction of people and nature. It is this interaction that has, over time, produced areas of distinctive and unique character with incredible natural beauty, wildlife and cultural heritage. The presence and influence of people are at the heart of our national parks, and the vast majority of land within the national parks remains in private ownership.

Climate change will have a significant impact on the Yorkshire Dales National Park, potentially affecting many of the special qualities which cumulatively define what makes this area so important. National research predicts that average temperatures in the Yorkshire Dales will be more than 3°C warmer by the end of the century, while average precipitation will fall by almost a quarter in summer but increase by 15% in winter over the same period. Some change is already evident, for example through the earlier onset of spring seen across the country. The extremes of weather experienced in recent years, with instances of intense rainfall and at other times of year periods of drought, are projected to become more frequent and severe as the century progresses.

This report examines the risks and opportunities presented by a changing climate to the special qualities of the Yorkshire Dales National Park. It describes what is already being done to adapt to climate change and looks ahead to future action.



Birds-eye primrose – one of the plant species under threat from climate change

Management of the Yorkshire Dales National Park

National park purposes

The management of English national parks is guided by their two statutory purposes, as set out in Section 61 of the Environment Act 1995. These are:

- to conserve and enhance the natural beauty, wildlife, and cultural heritage of the national parks; and
- to promote opportunities for the understanding and enjoyment of the special qualities [of the national parks] by the public.

These purposes and duties are underpinned in law by what is known as the 'Sandford Principle', which makes clear that the first purpose should take precedence over the second in cases of conflict:

- if it appears that there is a conflict between those purposes,...greater weight [shall be attached] to the purpose of conserving and enhancing the natural beauty, wildlife and cultural heritage of the area.

Reflecting that the national parks are cultural landscapes that have supported communities and industry for thousands of years, and continue to do so, the national park authorities also have a duty under Section 62(1) of the Environment Act, in taking forward the national park purposes, to:

- seek to foster the economic and social well-being of local communities within the national park.

Effectively, this duty sets the purposes of national parks in the context of sustainable development, taking an integrated and balanced approach to environmental, social and economic considerations.



Curlew

Role of the National Park Authority

The Yorkshire Dales National Park Authority (NPA) is charged with delivering national park purposes. Importantly, this is carried out in partnership with a wide range of statutory and non-statutory organisations, communities, landowners, farmers and local businesses across the National Park. The need for a partnership approach is underlined by section 62(2) of the Environment Act 1995, which requires other authorities and relevant bodies to “have regard to” the purposes of national parks when carrying out their work.

The work of the NPA covers the following functions:

- planning;
- wildlife conservation;
- trees and woodlands;
- historic environment;
- farm conservation;
- sustainable development;
- outreach;
- sustainable tourism;
- access and recreation; and
- ranger services.

The NPA is the statutory local planning authority within the National Park.

Resources and funding

The NPA employs 110 full-time equivalent staff, as well as benefiting from the work of 250 ‘Dales Volunteers’. Staff costs represent the main expenditure, since the officers and their expertise are the NPA’s main asset. The NPA also owns two offices, several ranger bases, plus information centres, car parks and public toilets.

The NPA’s core funding is provided by the national park grant from Defra. In 2011/12 this is £5.1m. The NPA also ‘levers in’ around £1m of external funding each year for projects that it delivers directly or through partnerships.

For the full 2007-12 plan and annual progress reports see www.yorkshiredales.org.uk/yorkshire_dales_national_park_management_plan

The National Park Management Plan

The National Park Management Plan (NPMP) is a statutory plan, reviewed every five years, that sets out the over-arching vision and strategic direction for how the national park purposes and associated duties will be delivered in the Yorkshire Dales National Park. It provides a framework for the policies and activities of the NPA but also co-ordinates and integrates the plans, strategies and actions of all the *other* bodies operating within the National Park, insofar as they affect the national park purposes and duties.

The current NPMP covers the period 2007-12. It sets out the things that make the National Park special (its 'special qualities'). It then goes on to look in detail at seven different elements that are important to the make up of the Yorkshire Dales National Park. For each of the seven elements, the NPMP identifies:

- a long-term aim;
- the principles that should guide the achievement of this aim;
- the specific objectives to be achieved in order to make progress towards the aim, and;
- the interconnections between different elements.

These seven elements and the aims for each are set out in Table 1 on page 6.

In identifying the aims and objectives, the pressures on the National Park were considered. These include: pressures on farming; economic changes; recreational demands; changes in mobility; demand for housing; technological changes; military use; and climate change.

The NPMP also identifies common themes that underpin the aims and objectives. These are: ensuring sustainable development; working in partnership; providing equality of opportunity; changing people's perceptions; managing land in a sustainable way; and responding to climate change.

National Park Management Plan Steering Group

The production of the NPMP was led by the National Park Management Plan Steering Group, which includes the key statutory agencies and the three Local Strategic Partnerships. The steering group is now monitoring progress in delivering the NPMP's objectives and publishes annual monitoring reports. The group identifies areas where greater action is needed or where there are opportunities for the various bodies to work together to achieve the objectives.

Table 1:
Aims of the National
Park Management
Plan

Landscape
The beauty, distinctive character and 'sense of place' of the Yorkshire Dales National Park will be maintained and strengthened through the ongoing interaction between nature and the people who live and work there.
Communities and culture
Thriving and active local communities in the National Park will enjoy a high quality of life that helps to sustain the environment, local traditions and contemporary culture. All sections of these communities will have opportunities to influence and develop local services that meet their needs.
Access and recreation
There will be opportunities for access and recreation in the National Park for people of all ages and abilities and from every sector of society to enjoy the special qualities of the Yorkshire Dales and derive a sense of well-being from their experiences.
Understanding and enjoyment
There will be a greater awareness of the National Park and of the opportunities it offers to everyone to appreciate, enjoy and learn from its special qualities. People's enjoyment will encourage them to find out more, play a part in the National Park's conservation, and help forge ties between urban and rural communities.
Nature conservation
The characteristic habitats and species of the Yorkshire Dales National Park will be conserved and enhanced for this and future generations. Its nationally and internationally important biodiversity will help to support sustainable communities and the local economy.
Historic environment
The historic and cultural environment of the Yorkshire Dales National Park will be recognised, understood, appreciated and used, contributing directly to our understanding of ourselves, our sense of identity and pride of place. This rich inheritance will be conserved and enhanced for future generations, including through well-designed and appropriately-sited additions to the built environment.
Economy and employment
The National Park's special qualities will help to support a local economy that provides secure, diverse and sustainable high-quality jobs, maintains thriving, balanced communities and a healthy, cared for environment. Imagination and innovation will attract new types of business and develop a local economy that respects and draws on the area's assets and quality of life and looks to the future for its aspirations.



Tree planting at Great Gill West Scafton

Wider stakeholders

Many other people and organisations have an interest in the National Park. They range from the people who live and work here and visitors to the area, to organisations involved in conservation and tourism. There are many interdependencies between the various organisations. The principal stakeholder groups are shown in Table 2. All are able to comment on the development of the NPMP through the public consultation process and many are directly involved through their contributions to working groups drafting the NPMP.

Stakeholder group	Makeup of group
National Park communities	Individual residents, businesses, community groups
National Park land managers	Farmers, forestry managers, shooting estates, landowners
National Park visitors	Local, national and international tourists
Conservation organisations	Statutory and non-governmental organisations, including: Bradford Community Environment Project ¹ Dales Woodland Forum ¹ English Heritage ¹ Environment Agency Natural England ¹ National Trust ¹ Northern Mine Research Society ¹ Society for the Protection of Ancient Buildings ¹ North West Craven Heritage Trust ¹ Yorkshire Wildlife Trust
Land management organisations	Including: National Farmers Union Country Land and Business Association Moorland Association Dales Farmer Network Dales Rural Estate Network
Tourism and access organisations	Including: Dales Tourism Forum ¹ Yorkshire Dales & Harrogate Tourism Partnership ¹ Yorkshire Dales Local Access Forum ¹ Yorkshire Tourist Board (Welcome to Yorkshire)
Community and economic organisations	Including: York and North Yorkshire Local Enterprise Partnership Yorkshire Rural Community Council ¹ Yorkshire Forward ¹
Government	Local and National Government, including: Parish Councils Craven District Council ¹ Richmondshire District Council ¹ Cumbria County Council ¹ North Yorkshire County Council ¹ Forestry Commission ¹ Defra Government Office for Yorkshire and the Humber

Table 2: Stakeholder groups in the Yorkshire Dales National Park (organisations marked ¹ were members of the drafting groups for the 2007-12 NPMP)



The practice of moorland gripping has led to deep gullies of eroded peat

Evaluating the impacts of climate change

Defining the scope of the report

This report is part of the ongoing action to address the impacts of climate change in the Yorkshire Dales National Park. It forms the Yorkshire Dales National Park Authority's (NPA) response (on behalf of the National Park Management Plan Steering Group – see page 5) to the invitation from the Secretary of State for Environment, Food and Rural Affairs to report on adaptation planning in the National Park.

The National Park Management Plan (NPMP) provides a clear focus for evaluating the impacts of climate change in the National Park since, as explained above, the NPMP sets out the issues that are most important to the National Park. This is a landscape-scale approach to reviewing the projected impacts of climate change across the whole of the National Park, which allows for the identification of both National Park-wide and more localised impacts. This report is broken down into six areas, which equate broadly to the seven elements of the NPMP. It includes issues that contribute to what makes the National Park special, while excluding areas not directly relevant to national park purposes (and which will be dealt with through the adaptation reports prepared by other relevant bodies). The areas considered here are:

- access, recreation and tourism;
- biodiversity;
- community, culture and economy;
- historic environment;
- farming and land management; and
- landscape.

As well as looking at the implications for the National Park as a whole, the report also contains a section looking at the specific capacity for the NPA to continue its own business by considering risks to the NPA's business continuity.

Since climate change and the associated impacts will take place over a relatively long timescale, the report looks at the potential risks and opportunities at three time slices during the coming century.

Evidence base

The climate change impact assessment process has been informed by various local and national resources, combined with the expert opinion of specialist officers within the NPA and from external organisations. Resources include:

- *UK Climate Impacts Programme*, including the UKCP09 projections via <http://ukclimateprojections.defra.gov.uk>.
- *Yorkshire Dales National Park Authority Local Climate Impacts Profile*, AECOM, March 2010.
- *Yorkshire and Humber Climate Change Adaptation Study – Local Area Report for Craven District*, Yorkshire and Humber Assembly, 2009.
- *Yorkshire and Humber Climate Change Adaptation Study – Local Area Report for Richmondshire District*, Yorkshire and Humber Assembly, 2009.
- *Yorkshire and Humber Regional Adaptation Study “Weathering the Storm”*, Yorkshire and Humber Assembly, 2009 and website resource via www.adaptyh.co.uk.
- *ENPAA / Natural England Climate Change Workshop* – internal report, November 2009.
- *Conserving biodiversity in a change climate: guidance on building capacity to adapt*, Defra on behalf of UK Biodiversity Partnership, 2007.

The specialist officers at the NPA involved in the assessment were:

- Head of Park Management
- Senior Wildlife Conservation Officer
- Strategic Planning Officer
- Senior Historic Environment Officer
- Senior Farming and Countryside Officer
- Landscape Conservation Officer
- Head of Finance and Resources

Input was also provided by all members of the National Park Management Plan Steering Group (see page 5), with the most notable specialist input coming from Natural England and the Forestry Commission.

The Defra publication *Adapting to Climate Change: helping key sectors adapt to climate change* (2009) was used to inform the development of the assessment methodology and the range of information provided in this report.

Projected climate change in the Yorkshire Dales National Park

The UK Climate Projections provide national, regional and local information about the projected changes in the climate over the coming century. This report considers the following variables:

1. Mean summer temperature
2. Mean summer precipitation
3. Mean winter temperature
4. Mean winter precipitation

The UKCP09 projections, using the medium greenhouse gas emissions scenario and the central estimate, predict the following changes for the Yorkshire and Humber region.

Hotter, drier summers:

Time slice	Increase in average summer temperature is			Change in average summer rainfall is		
	very unlikely to be less than:	most likely to be:	very unlikely to be more than:	very unlikely to be less than:	most likely to be:	very unlikely to be more than:
2010-39	0.5°C	1.3°C	2.3°C	-24%	-8%	+10%
2040-69	1.1°C	2.3°C	3.9°C	-36%	-19%	+1%
2070-99	1.7°C	3.3°C	5.4°C	-44%	-23%	0%

Warmer, wetter winters:

Time slice	Increase in average winter temperature is			Change in average winter rainfall is		
	very unlikely to be less than:	most likely to be:	very unlikely to be more than:	very unlikely to be less than:	most likely to be:	very unlikely to be more than:
2010-39	0.6°C	1.3°C	2.1°C	-3%	+4%	+13%
2040-69	1.1°C	2.2°C	3.4°C	+1%	+11%	+24%
2070-99	1.6°C	3.0°C	4.6°C	+2%	+15%	+33%

A subjective variable “more extreme weather events” is also included in the assessment to allow for consideration of impacts such as flash flooding.

UKCP09 projections for the North West region were also considered, since the Yorkshire Dales National Park covers an area of east Cumbria as well as North Yorkshire. The projections for this part of the North West region are very similar to the above and so the Yorkshire and Humber projections are considered suitable to apply to the whole of the National Park.

Methodology

The English national park authorities have jointly developed a risk/opportunity template tool to guide the adaptation reporting risk assessment process. The template comprises thematic Excel spreadsheets linked to common themes in NPMPs across the English NPAs: landscape; biodiversity; historic environment; cultural heritage; farming and land management; access, recreation and tourism; and community and economy. The process encapsulated by the template is to identify areas of potential impact and then consider how the different projected changes to the climate will affect each area in terms of the risks/opportunities and subsequent consequences. In line with Defra guidance, the template tool uses a process that prioritises risk and considers risk/opportunity as it evolves over time.

Table 3: The likelihood of a risk occurring is rated from 1 to 5

Likelihood	1	Rare
	2	Unlikely
	3	Possible
	4	Likely
	5	Almost certain

Table 4: The impact of a risk/ opportunity if it did occur is rated from -5 to +5

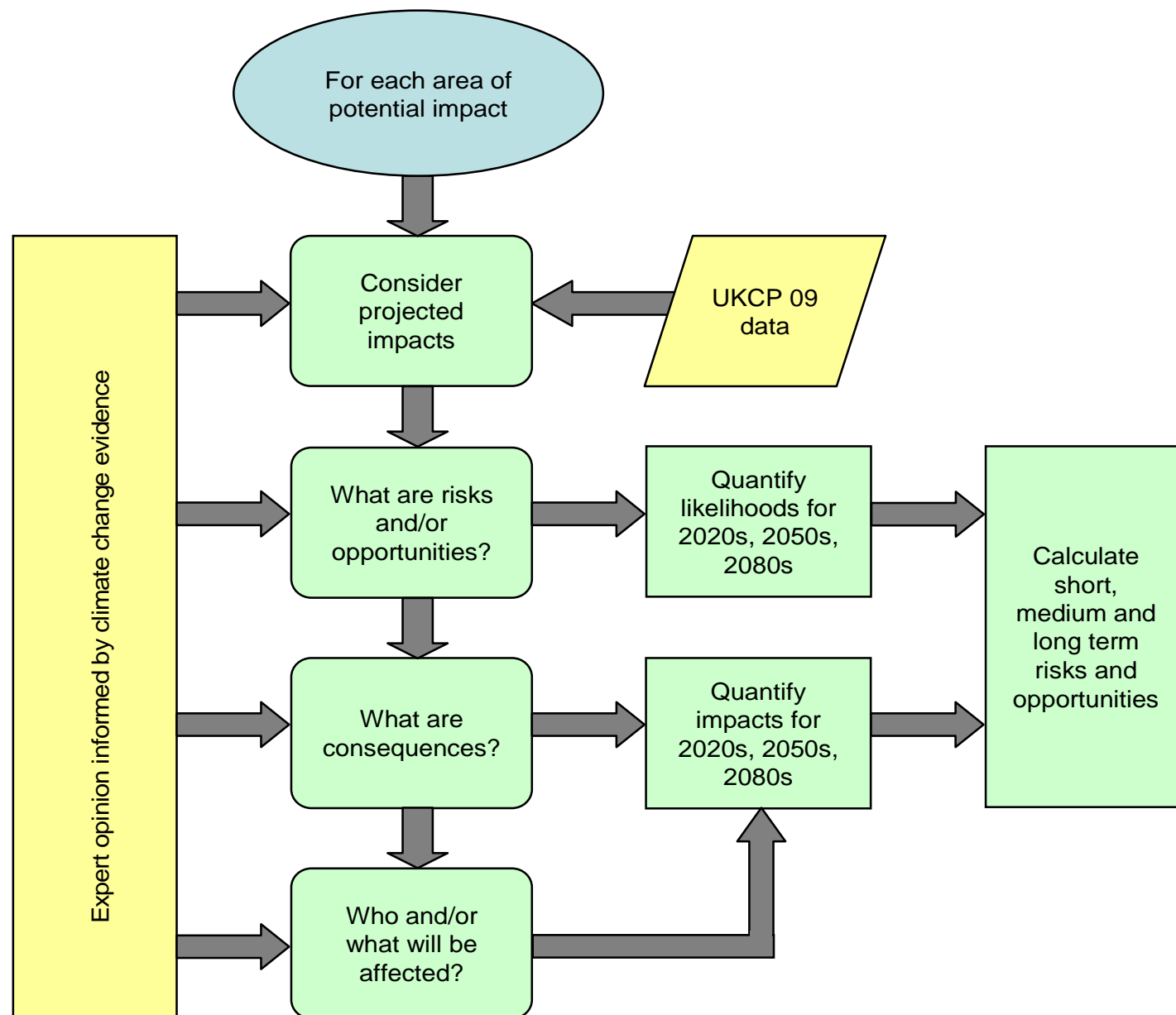
Risk	-5	Catastrophic
	-4	Major
	-3	Moderate
	-2	Minor
	-1	Slight
	0	No change
Opportunity	1	Slight
	2	Minor
	3	Moderate
	4	Major
	5	Fantastic

The risk/opportunity score is calculated by combining the likelihood and impact of any given risk/opportunity. The likelihood and impact is rated by expert opinion (using the scales set out in Tables 3 and 4, left) to give a potential value from 1 (minimum risk/opportunity) to 25 (maximum risk/opportunity). This scoring is carried out for the three UKCP09 time slices of the 2020s, 2050s and 2080s to examine how the risk/opportunity evolves over the coming century.

The flowchart at Figure 1 provides an overview of the assessment process.

As noted above, the UK Climate Projections 2009 were used in this study to provide projections of climatic variables across the coming century. The NPA took the decision to use the medium emissions scenario with the central probability estimate. This scenario is in line with the Government's assessment of the UK's position in terms of emissions at the time of the UKCP09 launch. It is not yet possible to make predictions about changes in, for example, the natural environment with sufficient accuracy to allow for a more precise 'thresholding' approach and as such the use of other emissions scenarios was not considered appropriate at the present time.

Figure 1:
Risk/opportunity
assessment process
used for each area of
potential impact across
the seven themes



Main findings

The complete risk/opportunity assessment is presented as the annex to this report. In this section the principal risks and opportunities identified by the process are set out by theme to provide an overview of the potential impacts of climate change in the Yorkshire Dales National Park over the coming century.

A red-amber-green rating is used to provide a simplified overview of the short, medium and long term risk/opportunity. This is related to the numerical score from the complete assessment as follows:

Risk/opportunity assessment score (+/-)	Simplified rating	
1 to 6	Low level of impact	
7 to 15	Medium level of impact	
16 to 25	High level of impact	

Current or planned actions that help to mitigate the impacts are also noted although a more complete adaptation action planning exercise, including identifying any new strands of work to address risks, will be carried out as part of the upcoming NPMP review as described on page 26 in the section 'Delivery Adaptation through the National Park Management Plan'.

Access, recreation and tourism

Every year millions of visitors enjoy the special qualities that the National Park has to offer. The impacts of climate change on this are likely to be demonstrated through the level of visitors coming to the National Park and the type of experience they have when they visit.

Potential impacts (risk/opportunity)	Rating			Current or planned actions
	2020s	2050s	2080s	
Increased frequency of wildfires on moorland leading to access restrictions (R).				North Yorkshire Wildfire Group set up to co-ordinate fire plans between landowners and Fire Service to provide improved incident management and a rapid response.
Increased visitor numbers, especially in the summer, putting pressure on infrastructure (R).				Review recreational activities policy as part of Integrated Access Strategy review.
Increased visitor numbers, especially in the summer, providing more opportunities for tourism businesses (O).				NPA is encouraging local businesses to take part in green tourism schemes under Europarc Federation European Charter for Sustainable Tourism.
Higher rainfall and more frequent flooding leading to increased water logging and erosion of rights of way, causing access restrictions and some routes becoming unusable (R).				Public Rights of Way Maintenance Plan used to record, monitor and plan work on rights of way.
Storm and flood events damaging infrastructure such as bridges, visitor attraction sites and buildings resulting in unreliable opening times, and restrictions to access (R).				Bridges on Public Rights of Way that are at risk identified. Bridge design reviewed for future re-fits.
Road closures and uncertainty about access after storm events leading to a drop in visitor numbers (R).				NPA will use positive media messages to raise awareness that National Park remains "open for business" following any extreme weather event.
Increased incidences of flooding and storms impacting on recreational activities such as caving and hill walking, and putting more pressure on rescue services (R).				

Biodiversity

Climate change research predicts a wide range of different outcomes for biodiversity and it is impossible to be certain about the exact impacts that will be experienced. This is not surprising considering how complex the interactions are between different species, and between species and the habitats they occupy.

Potential impacts (risk/opportunity)	Rating			Current or planned actions
	2020s	2050s	2080s	
Changes in distribution and balance of species (both flora and fauna) due to rising year-round temperatures: species emigration (uphill or north) or extinction at certain sites (for example, arctic juniper, red grouse); species immigration from south (for example, comma butterfly); loss of life-cycle synchronisation between interdependent species (R).				Coordinated programme of monitoring to understand changes to species and habitat as part of Local Biodiversity Action Plan programme. Development of resilient habitat networks through, for example, Forest Habitat Network mapping, and habitat opportunities mapping. Higher Level Stewardship is main vehicle for retaining and expanding habitat and species.
Changes to groundwater and springs during drier summers leading to increased vulnerability of sensitive habitats (wet flushes) and so to decline of scarce flora that rely on lime-enriched conditions (for example, bird's eye primrose, globeflower) (R).				Habitat opportunity mapping to identify best opportunities for improving habitat resilience, being carried out by Forest Research.
Increases in pests and diseases cause changes in species distribution or balance (for example, phythphora (R).				Monitoring of plant health, for example, by Forestry Commission.

Extensive areas of moorland containing important areas of upland heath and blanket and raised bog affected by drier summers, leading to peat shrinkage, further erosion, reduction in carbon stores and higher risk of wildfire (R).				Yorkshire Peat Partnership working with farmers and landowners to restore c14,000ha of blanket bog by 2013, with funding from Natural England. North Yorkshire Wildfire Group fire mapping includes locations of high conservation value, including deep peat, to aid prioritisation of any wildfire response.
Changes to upland hay meadow habitat structure through both drier summers (leading to increase in more drought-tolerant species) and warmer winters (leading to increased competition between grass and flowers) (R).				Higher Level Stewardship is main incentive to retain habitat. Yorkshire Dales Millennium Trust 'Haytime Project' restoring 200ha of haymeadow through offering farmers enhanced advice and practical delivery of meadow restoration, coupled with follow-up monitoring.
In drier summers increased biological respiration and lower dissolved oxygen content in streams will affect river species (for example, white clawed crayfish, aquatic moss, stonefly) (R).				Riparian tree planting schemes to provide increased levels of shade.
Upland woodland habitats are damaged through increased storm events (R).				New woodland creation uses tree species that best reflect topography and altitude of site. Planting follows good practice, with longer stakes and wind-permeable tree guards in wind-vulnerable areas.

Community, culture and economy

The impact of climate change on communities, their culture and the local economy are likely to be experienced in relation to housing, energy and water use as well as changes to employment opportunities and access to isolated communities.

Potential impacts (risk/opportunity)	Rating			Current or planned actions
	2020s	2050s	2080s	
Increasing demands for air conditioning due to higher summer temperatures cause visual intrusion into build landscape (R).				NPA has produced supplementary planning policy guidance on sustainability in building design.
Existing and new housing will require more storm proofing due to increased storm events, causing changes in appearance of built environment (R).				
Local economy boosted by increase in visitor numbers providing opportunities for small tourism-related businesses (O).				NPA is encouraging local businesses to take part in green tourism schemes under Europarc Federation European Charter for Sustainable Tourism.
Increasing potential for renewable energy (for example, solar in drier summers, hydro in wetter winters), leading to increased energy resilience of remote rural communities (O).				NPA carried out a National Park-wide hydro-power survey and has established a fund to support development of local hydro projects. NPA's Sustainable Development Fund helps with funding for design and build of small-scale renewable projects.
Changes to domestic water supply levels, with an increased need for winter water storage to balance summer water shortages (R).				
Remote communities become cut-off more frequently following increased storm events leading to increased isolation for residents (R).				National and regional programmes to install robust rural broadband.
Tourism economy becomes more seasonal as visitors avoid visiting during wetter winters leading to seasonal employment patterns (R).				NPA is encouraging local businesses to take part in green tourism schemes under Europarc Federation European Charter for Sustainable Tourism.

Historic environment

The National Park's intricate network of dry stone walls, traditional stone-built field barns, exceptional archaeology and legacy of former rural industries are also likely to be affected by changes in the climate.

Potential impacts (risk/opportunity)	Rating			Current or planned actions
	2020s	2050s	2080s	
Warmer wetter conditions exacerbate damage to structures and features for example from water intrusion, mould growth and dampness, as well as wind and rain damage increasingly affecting historic buildings after storm events (R).				Good practice guidance and advice available from English Heritage. NPA carries out awareness-raising and provides specialist advice through 'home owner' days and as part of day to day work of Building Conservation Officers.
Damage or destruction of features by wildfire during hotter, drier summers (R).				North Yorkshire Wildfire Group fire mapping includes information on areas of high archaeological value to aid prioritisation of any wildfire response.
Reduction in winter weathering effects on historic buildings through reduction in number of days experiencing sub-zero temperatures (O).				
Archaeological remains affected by drier conditions in summer (e.g. loss of palaeoenvironmental evidence due to peat drying and a loss of archaeological deposit as soils shrink) and wetter conditions in winter (e.g. damage to earthworks, disruption of buried sediments) (R).				Yorkshire Peat Partnership carrying out moorland restoration works. English Heritage, Natural England and NPA study to identify most sensitive archaeological sites.
Increased demand for and use of mining spoil to mend/resurface tracks and lanes affected by flooding, causing damage to archaeological mining remains (R).				Planning notification is required to remove mining spoil, ensuring control of issue; NPA contacting landowners to remind them of their responsibilities in this area. Management plan developed for nationally important Grassington Moor site.
Changes in land management towards arable resulting in more ploughing and less requirement for traditional dry				Subset of Historical Environment Record provides an input for Entry Level

stone wall boundaries and field barns (R).				Stewardship applications used by Natural England officers and applicants to avoid conflicts with important aspects of the historic environment. Farm Environment Plans identify appropriate management advice for the historic environment, which feeds into High Level Stewardship agreements.
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Farming and land management

The traditional pastoral landscape of the Yorkshire Dales has been shaped by centuries of farming practice. The onset of climate change is likely to be a key influence on how this landscape is managed in the future, with changes to land and farm management systems likely as growing seasons and habitats change.

Potential impacts (risk/opportunity)	Rating			Current or planned actions
	2020s	2050s	2080s	
Reductions in areas grazed by livestock (for example, drought susceptible limestone areas abandoned), reduced hay and silage yields and livestock welfare issues, caused by reduced water availability through hotter and drier summers (R).				Raydale Project has created woodland pasture adjacent to Semer Water for primary purpose of flood control, but with shaded pasture as a beneficial side effect.
Increased threats to livestock health through increase in pests and diseases as a result of warmer, wetter winters (R).				
Increased need to provide shelter for livestock and increased risk of water course pollution during wetter winters (R).				Catchment Sensitive Farming project assisting farmers with appropriate management techniques to reduce diffuse water pollution.
Loss of crops and livestock during flash flood events (R).				Forestry and Flooding programme is carrying out planting in targeted areas to slow flow of water run-off and increase flood water storage.

Diversification from grazing to arable and forage crops (for example, maize) as conditions become more favourable for them, most likely on the eastern edge of the National Park (O).				NPA to work with Natural England to recognise positive changes where appropriate through agri-environment schemes. Environmental Impact Assessment process provides control over changes (for example, from permanent pasture to arable).
Increased availability of grassland allowing higher, longer grazing periods during warmer, wetter winters, giving potential for higher stocking rates and introduction of different livestock breeds (O).				
Loss of moorland habitat for game birds through increased incidence of wildfire and increased difficulty in undertaking controlled moorland burns.				North Yorkshire Wildfire group aims to improve response to wildfires and also working to improve the quality of current burning practices.

Landscape

The National Park's landscape and its features – shaped by geology and natural processes as well as the interaction between people and nature – have evolved over thousands of years. Climate change impacts are likely to continue to shape the landscape.

Potential impacts (risk/opportunity)	Rating			Current or planned actions
	2020s	2050s	2080s	
Higher levels of soil moisture in winter and more flash flood events changing slope and soil stability with potential for more landslips and rock falls. Iconic features (for example, the Norber Erratics) more at risk of damage (R).				Targeted planting of both trees and scrub on vulnerable slopes; Woodland Siting and Design Guidance helps inform appropriate location of woodland creation in typical landscapes. Yorkshire Peat Partnership – moorland restoration aids stabilisation.
Reduced vegetation and soil surfaces less stable and more prone to erosion during drier summers, leading to a stonier landscape with steep slopes becoming scree				Stabilisation as above through tree and scrub planting, moorland restoration.

slopes (R).				
Loss of moisture in soils in drier summers leading to subsidence (with potential damage to properties) and groundwater contamination (with potential contamination of water supplies) in clay soils (R).				
Trees become more prevalent in the landscape providing shade for livestock, shading of water courses, river bank stabilisation and development of the bio-fuel market (O)				Forestry Commission provides good practice guidance. Forest Habitat Network mapping helps identify priority sites.
Impact of increased number of trees on characteristic open landscape of the Yorkshire Dales (for example, Karst landscapes and features, waterfalls, historic field patterns) (R).				Landscape character-based woodland siting design guide.
Changes to management of haymeadows on floodplains as a result of wetter winters leading to a loss of distinctive barns and wall scenery (R).				Landscape character guidance and appreciation of local distinctiveness to guide appropriate management regimes.
Trees affected by drought conditions during drier summers leading to increases tree losses, especially among newly established trees.				Change to species mix for new planting using Forest Research guidance for species selection.
Increased pressure on water supplies with potential demand for increased reservoir storage (R).				Continued engagement between NPA and water utility companies.

NPA business continuity

The Yorkshire Dales National Park Authority will need to adapt how it carries out its day to day work in response to climate change.

Potential impacts (risk/opportunity)	Rating			Current or planned actions
	2020s	2050s	2080s	
Disruption to service provision and work flow through impacts on staff welfare during increased extreme weather events (R).				Business continuity plan in place and tested on an annual basis.
Damage to NPA properties during flood events leading to disruptions to service provision to general public and partners; disruption to NPA work; and increased financial cost to NPA (R).				Property maintenance and monitoring – regular checks on buildings, clearing drainage channels, etc. Working from home and video-conference facilities in place for NPA staff.
Financial impact on NPA through increased insurance costs as a result of an increased perceived risk of damage (R).				
Higher demands on NPA car parks and visitor centres leading to overcrowding, demands for increased car park areas, reduced visitor satisfaction.				



Swaledale haymeadow

Interdependencies, barriers and opportunities

Interdependencies

Between organisations

Table 2 on page 7 sets out the principal stakeholders for the Yorkshire Dales National Park. Many of the organisations listed are involved in delivering parts of the National Park Management Plan (NPMP) and so there are many interdependencies. For example, the National Park boundary crosses county and district council boundaries, meaning that close liaison between the Yorkshire Dales National Park Authority (NPA) and a wide range of local government partners is crucial, particularly in terms of sustainable development and tourism. Natural England administers agri-environment schemes across the National Park and the NPA has worked with Natural England to arrive at the current situation where more than 80% of the land within the National Park is in agri-environment schemes.

Many projects are formed of even wider partnerships. The Yorkshire Peat Partnership, for example, brings together the Yorkshire Wildlife Trust, Yorkshire Dales National Park Authority, Natural England, North York Moors National Park Authority and the Environment Agency. It also receives support from Nidderdale AONB, Pennine Prospects, Environment Agency, National Trust, Yorkshire Water, Moorland Association, National Farmers Union and Yorkshire Dales Rivers Trust.

The high level of interdependency between organisations operating in the National Park should be seen as a strength, with many significant projects delivered through partnership working between the NPA and others.

At a landscape scale

The National Park is not an island. Some of the impacts of climate change – and the measures taken to adapt to those impacts – within the National Park will have potentially significant implications for areas outside it, and vice versa. For example, increases in storms and flood events within the National Park may have some local impacts but are likely to have much more severe ramifications for areas further downstream (for example, in York) because of the cumulative effects of increased flows on several rivers. Equally, work to develop resilient habitat networks within the National Park will depend to some extent on the presence of robust habitats in the surrounding areas.

These interdependencies are often highly complex and can only be addressed through landscape-scale approaches, such as those being developed for whole catchments under the Water Framework Directive and for ecological networks as part of the Government's new Natural Environment White Paper. The high level of interdependency and partnership between organisations operating within the National Park (see above) will need to be mirrored between organisations operating inside and outside the National Park boundary.



Chimney at site of former smelt mill on Grassington Moor

Barriers to action

Challenges at a landscape scale

The Yorkshire Dales National Park covers 1,762 square kilometres, of which 95% is in private ownership. There are 92,500 hectares (ha) of moorland, heathland and unenclosed grassland, 71,800ha of farmland and 6,000ha of woodland. This includes 50,769ha of nationally-designated Sites of Special Scientific Interest (most of which is also internationally designated as either Special Protection Areas or Special Areas of Conservation), and which includes 1,278ha of National Nature Reserves. There are 203 scheduled monuments, 1,799 listed buildings and 37 conservation areas. Access is available over 2,160km of Public Rights of Way and 109,300ha of designated Open Access land.

Clearly a landscape-scale approach to adaptation is needed, but the above statistics give an indication of the size of the challenge.

Funding

The National Park grant settlement for the NPA is set to fall from £5.1m in 2011/12 to £4.2m in 2014/15. Other publicly funded bodies that are closely linked to National Park delivery, such as the Environment Agency, Natural England and local government, are also experiencing significant budget reductions. This will make delivering national park purposes more difficult, including those aspects relating to climate change adaptation. There is likely to be a 'domino effect' where combined reductions in funding levels across different organisations lead to the loss of important projects due to different organisational priorities.

Wider acceptance

The threat of climate change is widely accepted by the majority of organisations with an interest in the National Park. There does, however, need to be a continued dialogue with all stakeholders including visitors, residents and landowners to openly discuss predicted risks to the National Park, so that there is an

understanding of the potential changes to come and consensus about the actions to take. This will be especially relevant if action (which needs expenditure, causes inconvenience or results in landscape change) is required now to address a future long term threat.

Opportunities from a changing climate

The assessment process was designed to highlight opportunities presented by climate change as well as risks. It is important to note that the number of risks from climate change significantly outweigh the opportunities. There are, nevertheless, some potential benefits from a changing climate for the Yorkshire Dales National Park.



The Archimedes screw at the River Bain hydro scheme

In particular, the predicted increases in visitor numbers would be very important for the National Park's economy (although, as set out in the assessment, there are also risks associated with increased visitor pressure). An increase in the use of renewable energy sources (for example, hydro, solar, biomass) by National Park communities may help increase the resilience of remote rural communities by decreasing their dependence on increasingly price-volatile oil-based energy sources. The National Park landscape may include more trees in the future, which would offer benefits (for example, habitat connectivity) as well as challenges (for example, changes to views). Species migration is likely to mean new species being found in the National Park, perhaps helping to some extent to balance the loss of other species forced northwards by rising temperatures.



Yorkshire Dales
National Park – a
special place

Delivering adaptation through the National Park Management Plan

The process of producing, and then implementing, a National Park Management Plan (NPMP) provides a robust mechanism to ensure that climate change adaptation planning is incorporated into decisions made about the future management of the National Park. Initial scoping work is underway for the next NPMP, which will run from 2012 to 2017. As was the case for the 2007-12 NPMP (described on page 5), the new NPMP will be developed by a core group of stakeholders – the NPMP steering group – but with the engagement of a much wider range of stakeholders and the general public.

As the 2012-17 NPMP is developed, the climate change impact assessment will be considered alongside other relevant factors to inform the analysis of current and future pressures on the National Park, which in turn will feed into the aims and objectives of the NPMP. By considering potential actions at this strategic level, adaptive actions that may be beneficial for one aspect of the National Park but might cause mal-adaptation in other areas can be avoided.

The NPMP subsequently informs the specific objectives and actions of the Yorkshire Dales National Park Authority (NPA), as set out in its annual Corporate Plan. It will also inform planning policy through the Yorkshire Dales Development Framework, which must have regard to the NPMP. As such, the NPMP ensures that adaptation is integrated across the whole of the NPA's work, as well as directly influencing the planning of the other organisations involved in the delivery of NPMP objectives.

Because there is a statutory requirement for National Park Management Plans to be reviewed every five years, there is a ready-made system to regularly re-assess climate change risks in the future. The next assessment, in 2016/17, would be informed by the new research and understanding that becomes available over the next five years and would feed into the 2017-22 NPMP. This approach will enable the Yorkshire Dales National Park Authority and its partners to continue to respond effectively to climate change impacts in the Yorkshire Dales National Park.