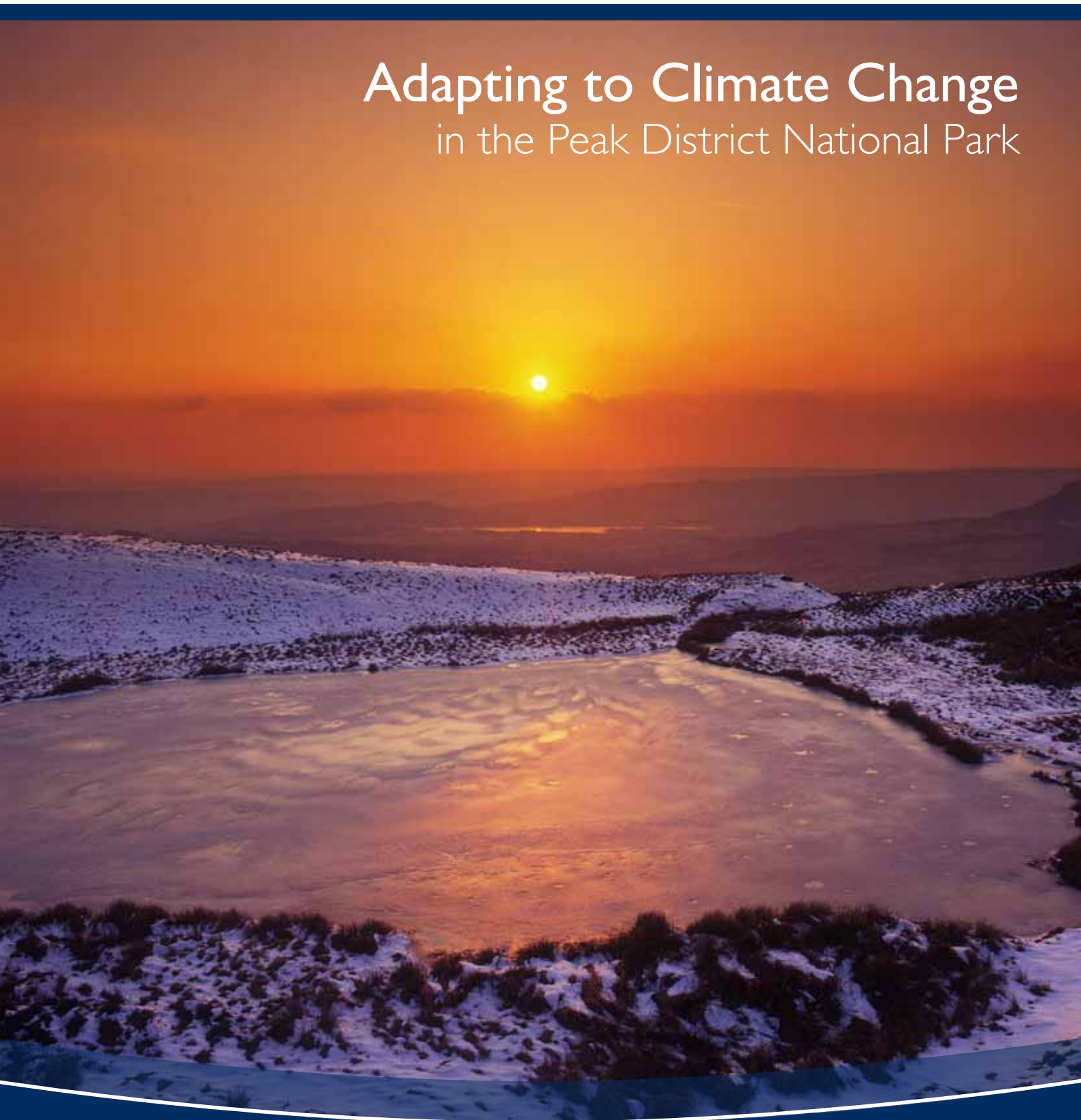


Adapting to Climate Change

in the Peak District National Park



First assessment of climate change risks,
opportunities and actions
September 2011

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Front cover image: Blake Mere, Staffordshire Moorlands

Introduction

The Adaptation Reporting Power contained within the Climate Change Act 2008 is used to direct organisations to produce reports that consider the risks from climate change, and the measures to deal with those risks. The English National Park Authorities accepted the invitation by the Secretary of State to produce an adaptation report which would cover both the risks to the National Park (the area) and the National Park Authority (the organisation).

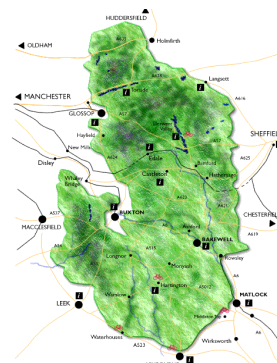
This report represents the first assessment of the climate change risks, and opportunities to the Peak District National Park. It explores the possible impacts on the special qualities of the National Park. It also begins the process of identifying current and potential adaptive actions that will enable the National Park to better cope with the projected changes in the climate over the coming decades.

The nature of the subject means there are, and will always be, many uncertainties. This report is a first step which will require future iterations to improve and respond to developing knowledge and understanding around potential climate change impacts, and adaption strategies. It is hoped that by identifying the risks and opportunities posed by a trend towards hotter drier summers, warmer wetter winters and more extreme weather events, a range of adaptive actions can be taken to ensure the Peak District National Park is best placed to provide the multiple benefits that people receive from the natural systems of the area. These ecosystem services include provisioning services such as food and water; regulating services such as flood control; cultural services such as spiritual and recreational benefits; and supporting services such as nutrient cycling.

Management of the Peak District National Park

The Peak District National Park ...

The Peak District National Park is an asset of national, regional and local importance. Covering 1438 sq Km (555 sq miles) and home to 38,000 residents it was the first of 15 national parks in the United Kingdom to be designated for their spectacular landscapes, cultural heritage and wildlife, and for people to enjoy. National parks provide a 'breathing space' and opportunities for learning, discovery and enjoyment for millions of people every year as well as a wide range of vital ecosystem services.



The significant urban populations that surround the Peak District National Park represent a huge opportunity for the promotion of this special place but with associated pressure and stress that comes with significant visitor numbers, cross park travel etc.

...& the Authority

The Peak District National Park Authority (PDNPA) is charged with supporting the delivery of the two national park statutory purposes as set out in Section 61 of the Environment Act 1995 (amending the 1949 Act). These are:

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



While carrying out these purposes the PDNPA also has a duty to seek to foster the economic and social well-being of the communities within the National Park.

The PDNPA is a statutory Local Planning Authority and has responsibility for setting the policy framework. During 2010/11 decisions were taken on 1,116 planning applications, including on mineral working sites. The Authority is also the access Authority for the purposes of managing public access to 37% of the National Park which, is open country under the Countryside and Rights of Way Act 2000.

The work of the PDNPA is guided by 30 members. In 2010/11 the organisation employed 400 staff (222 full time equivalents).

The Peak District National Park Management Plan

A National Park Management Plan (NPMP) brings together and co-ordinates the work of many different partners who help achieve the purposes of a National Park. The current Peak District NPMP runs until March 2012. At the time of writing the consultation period had recently closed for new Peak District NPMP which will cover the period 2012-17. The following four draft strategic themes have been agreed which will guide the work of the PDNPA and its partners over the coming years.



A DIVERSE WORKING AND CHERISHED LANDSCAPE

A resilient Peak District where the unique beauty of its working landscapes, its wildlife and environment, its tranquillity, cultural heritage and the communities within it, continue to be understood and valued nationally for their diversity and richness.

A WELCOMING AND INSPIRING PLACE

An inspiring Peak District where all are welcome to discover, enjoy, understand and value the special qualities of the national park; a place where people can develop a sense of wellbeing and belonging, and play a part in its future.

THRIVING AND VIBRANT COMMUNITIES

A lived in, sustainable, thriving and innovative Peak District that engages both local communities and people from neighboring villages, towns and cities, and promotes a high quality of life by conserving and enhancing the special qualities of the national park.

AN ENTERPRISING AND SUSTAINABLE ECONOMY

An enterprising and sustainable Peak District economy which capitalises on and enhances its special qualities and promotes a strong sense of local identity, reflecting the aspirations of local business, partners and communities.

Throughout consultation with stakeholders (see list on page 23) one of the key challenges identified was ensuring climate change considerations are embedded within the actions across the National Park. This adaptation report helps inform the NPMP Delivery Plan providing it with an appreciation of potential climate change adaptation actions.

Evaluating the impacts of climate change

Scope and structure of the report

This report forms the response by the PDNPA to the invitation from DEFRA to report on adaptation planning in the Peak District National Park. Adaptation entails changing behavior and practices to respond to the impacts of climate change. Successful adaptation should not only protect against negative impacts, but also seek to take advantage of any benefits resulting from a changing climate. It's important to ensure that adaptation responses complement actions to mitigate the causes of climate change.

In this report the potential impacts of climate change on the National Park are divided into the four strategic themes of the 2012-17 NPMP to ensure the adaptation report content is easily able to connect with the new NPMP. In addition to exploring implications for the National Park area the report also makes reference to climate change business continuity risks to the PDNPA as an organisation.

It should be noted that this is the first assessment of potential climate change risks to the Peak District National Park. Understanding and debate on climate change impacts and their relative risk is still developing – this report provides a ‘best guess’ approach and represents the start of an iterative process of improvement as the projected climate changes, resulting impacts and possible adaptive responses to the impacts become more refined and better understood. It is hoped that this report will prompt further discussion and raise issues of adaptation leading to a greater consideration of the potential adaptive actions by the PDNPA and its partners.

Projected climate change in the Peak District National Park

The UK Climate Projections released in 2009 (UKCP09) are used to provide the projected changes in the climate over the coming decades. This report considers mean summer and winter temperature and precipitation variables. The projections are available spatially through 25km grid squares with four grid squares (1274; 1275; 1313; 1314) covering the Peak District National Park. As there are only very minor variations in the projections for each grid square for simplicity's sake data from 1275 (covering the North West section of the National Park) has been used throughout this report. The medium greenhouse gas emissions scenario central estimate has been used in line with the government's assumptions at the time of the UKCP09 launch.

The UKCP09 projections, with the assumptions stated above, provide the figures in the tables below. This report also considers the expected “more extreme weather events”, such as intense periods of rainfall, on the National Park.

Hotter drier summers

Period	Time slice	Increase in average summer temperature (compared to the 1961 – 1990 average) is			Change in average summer rainfall (compared to the 1961 – 1990 average) is		
		very unlikely to be less than:	as likely as not to be: (central estimate)	very unlikely to be more than:	very unlikely to be less than:	as likely as not to be: (central estimate)	very unlikely to be more than:
2020s	2010-39	+ 0.5 °C	+ 1.4 °C	+ 2.4 °C	- 23%	- 7%	+ 11 %
2050s	2040-69	+ 1.1 °C	+ 2.4 °C	+ 4.0 °C	- 38%	- 18%	+ 5%
2080s	2070-99	+ 1.8 °C	+ 3.4 °C	+ 5.6 °C	- 44%	- 22%	+ 5%

Warmer wetter winters

Period	Time slice	Increase in average winter temperature (compared to the 1961 – 1990 average) is			Change in average winter rainfall (compared to the 1961 – 1990 average) is		
		very unlikely to be less than:	as likely as not to be: (central estimate)	very unlikely to be more than:	very unlikely to be less than:	as likely as not to be: (central estimate)	very unlikely to be more than:
2020s	2010-39	+ 0.6 °C	+ 1.3°C	+ 2.1 °C	- 3%	+ 4%	+ 12 %
2050s	2040-69	+ 1.1 °C	+ 2.2°C	+ 3.4 °C	+ 1%	+ 10%	+ 22%
2080s	2070-99	+ 1.6 °C	+ 3.0°C	+ 4.6 °C	+ 2%	+ 13%	+ 30%

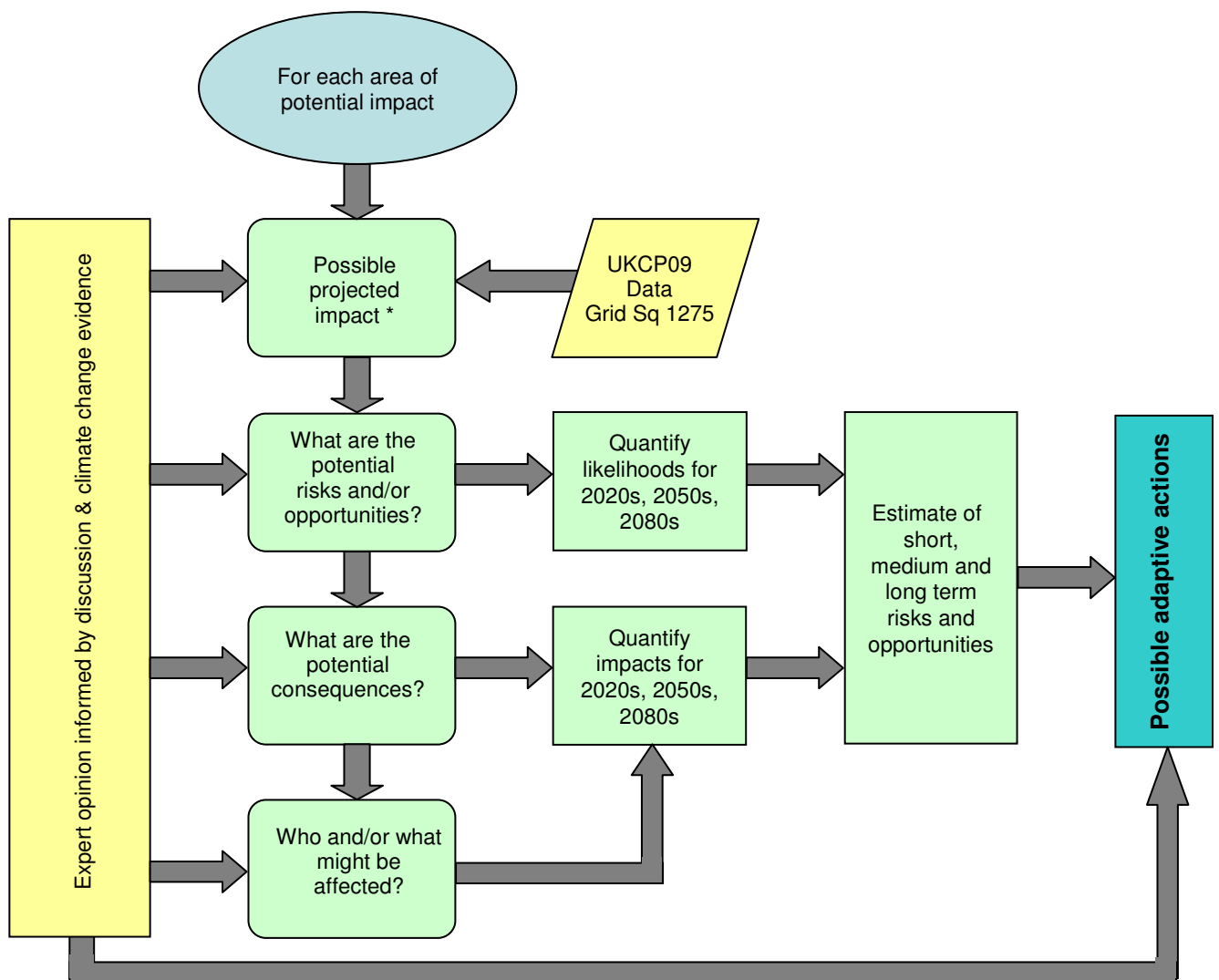
Methodology

Following the invitation by DEFRA for all of the English NPAs to submit adaptation reports the English National Park Authorities Association (ENPAA) Climate Change Working Group developed a template to act as a tool to support the process of identifying potential climate change risks and opportunities. The template covers 7 themes common to NPMPs across the English NPAs: landscape; biodiversity; historic environment; farming and land management; access, recreation and tourism; community, culture and economy, and NPA business continuity. Under each theme a range of ‘areas of potential impact’ were identified against which climate change risks and opportunities could be identified. To enable better linkages and cross referencing in this report the ‘areas of potential impact’ have been categorised under the emerging four strategic themes of the new 2012-17 Peak District National Park NPMP as follows:

ENPAA Template Theme	Area of potential impact	Peak District NPMP 2012-17 theme
Biodiversity	Flora (Plants) Fauna (Animals) Habitats (including protected areas)	A Diverse Working & Cherished Landscape A Diverse Working & Cherished Landscape A Diverse Working & Cherished Landscape
Access, Recreation & Tourism	Rights of Way & Open Access Visitor & recreational infrastructure Visitor usage & numbers Transport	A Welcoming & Inspiring Place A Welcoming & Inspiring Place A Welcoming & Inspiring Place A Welcoming & Inspiring Place
Community, Culture & Economy	Built environment Local economy Community life Energy & natural resources	Thriving & Vibrant Communities An Enterprising & Sustainable Economy Thriving & Vibrant Communities A Diverse Working & Cherished Landscape
Historic Environment	Historic buildings & settlements Archaeological remains Historic landscapes, parks & gardens	A Diverse Working & Cherished Landscape A Diverse Working & Cherished Landscape A Diverse Working & Cherished Landscape
Farming & Land Management	Livestock including game Crop management Field boundaries (stone walls, hedges)	A Diverse Working & Cherished Landscape An Enterprising & Sustainable Economy A Diverse Working & Cherished Landscape
Landscape	Geology & landform Soils & vegetation Trees & woodland cover Land use Settlement & buildings Water	A Diverse Working & Cherished Landscape A Diverse Working & Cherished Landscape A Diverse Working & Cherished Landscape An Enterprising & Sustainable Economy Thriving & Vibrant Communities A Diverse Working & Cherished Landscape

There is also a section covering Peak District National Park Authority business continuity.

To complete the template detailed consideration was given to each area of potential impact, to how the different projected changes to the climate might result in risks or opportunities and to the potential consequences resulting from these. An overview of the process is shown diagrammatically below:



Risk & opportunity assessment process completed for each area of potential impact (Based on Yorkshire Dales National Park Authority (2011))

* This report has focused on the key direct and associated indirect impacts from the projected changes in the climate. It has not explored indirect impacts that could result from potential *major* shifts in the national economy or responses to changes in world markets resulting from climate change.

Risk	-5	Catastrophic	-5	-10	-15	-20	-25
	-4	Major	-4	-8	-12	-16	-20
	-3	Moderate	-3	-6	-9	-12	-15
	-2	Minor	-2	-4	-6	-8	-10
	-1	Slight	-1	-2	-3	-4	-5
	0	No Change	0	0	0	0	0
Opportunity	1	Slight	1	2	3	4	5
	2	Minor	2	4	6	8	10
	3	Moderate	3	6	9	12	15
	4	Major	4	8	12	16	20
	5	Fantastic	5	10	15	20	25
			Rare	Unlikely	Possible	Likely	Almost certain
			1	2	3	4	5
			Likelihood				

The risk or opportunity score is calculated by multiplying the likelihood and impact rating for each of the UKCP09 time period (2020s, 2050s, 2080s). This provides an indication of how the risk or opportunity changes over time.

The impact of a risk (-) / opportunity (+) if it did occur is rated from -5 to +5. The likelihood of a risk / opportunity occurring is rated from 1 to 5. The combination of likelihood and impact leads to the risk / opportunity matrix table on the left.

To aid interpretation of the results the risks / opportunity scores were then assigned a simplified 'low', 'medium' or 'high' rating as follows:

Risk (-) / opportunity (+) score	Simplified rating
1 – 6	Low
7 – 15	Medium
16 – 25	High

The template has been populated by a mix of: comments from the NPMP Stakeholder Consultation workshops held in July & October 2010; responses to the 'Join our Conversation' NPMP consultation document; input from the ENPAA Climate Change Working Group; views from a range of PDNPA staff (see list on page 23); regional adaptation workshop discussions; Local Strategic Partnership NI188 work (which covers local authority work planning to adapt to climate change) and wider climate change adaptation literature (see page 24).

Summary of example short term medium & high risk impacts

This section provides a summary of where example **medium or high short-term risks (2020s)** have been identified.

The areas of potential impact have been grouped under the four strategic themes of the 2012-17 Peak District NPMP with a final section on PDNPA business continuity.

Relevant headline projection	UKCP09 local data (Grid Sq 1275)		
	2020s	2050s	2080s
Hotter, drier summers	+1.4 °C	+2.4 °C	+3.4 °C
	-7%	-18%	-22%
Warmer, wetter winters	+1.3 °C	+2.2 °C	+3.0 °C
	+4%	+10%	+13%

Plus more extreme weather events

Note: All figures are in comparison to the 1961-90 baseline

Risk (-) / opportunity (+) score	Simplified rating
1 – 6	Low
7 – 15	Medium
16 – 25	High

A full copy of the PDNP adaptation risk assessment can be seen in Appendix 1.

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Area of potential impact	Relevant headline projection	Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Short Term Risk (2020s)	Medium Term Risk (2050s)	Long Term Risk (2080s)	Actions already in place or planned	Potential actions
Flora (Plants)										
	Hotter, drier summers									
		Lowering of the water table (D)	Blanket bog peat at risk of drying out.	Peat dries out, becomes less stable, vegetation fails, leading to peat erosion	Loss of sphagnum, cranberry etc	-9	-16	-20	Grip blocking to maintain water table	

Area of potential impact	Relevant headline projection	Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Short Term Risk (2020s)	Medium Term Risk (2050s)	Long Term Risk (2080s)	Actions already in place or planned	Potential actions
		Increased visitor numbers (ID)	Increased trampling pressure at certain sites. Increased risk of wildfires	Vegetation cover is weakened, leading to risk of soil erosion. Wildfires damage vegetation and peat. Species loss at these sites.	Habitats: upland heathland, blanket bog. Species: heather, bilberry, grasses.	-9	-12	-12		Better visitor management may be required to protect vulnerable areas of habitat and flora, will need careful coordination between ecology, landscape and recreation interests. Raise greater awareness of risk and impact of wildfires. May require changes in moorland management, such as increased cutting of dwarf shrub at high risk locations to create fire breaks.

Area of potential impact	Relevant headline projection	Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Short Term Risk (2020s)	Medium Term Risk (2050s)	Long Term Risk (2080s)	Actions already in place or planned	Potential actions
Fauna (Animals)										
	Hotter, drier summers									
		Drier moorland habitats (D)	Decline in ground beetles and other invertebrates. Invertebrate availability becomes out of step with breeding waders	Upland breeding bird populations under significant threat from loss and decline	Breeding bird populations such as curlew, golden plover, etc. Decline in grouse shooting economy & consequent moorland management	-9	-12	-20	Scrape creation to increase areas of foraging habitat	
Habitats (including protected areas)										
	Hotter, drier summers									
		Blanket bog becomes drier (D)	Peak shrinkage leads to further break up of peat and increase erosion - peat oxidation and loss. Inability of peat building mosses to survive with reduced water table Sphagnum cuspidatum	Loss of specific Peak District habitat - links to mitigation works (avoided carbon loss through peatland erosion); decline in invertebrates could impact on breeding bird populations	Potential for carbon storage; species of breeding birds. Cloudberry and cowberry are at their southern range limit in the Peak District and will lose suitable climate space by 2050s. Sphagnum cuspidatum is more sensitive to changing water levels and could become more stressed or be lost during drier summers	-9	-12	-16	Moorland management plans, blanket bog restoration	

Area of potential impact	Relevant headline projection	Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Short Term Risk (2020s)	Medium Term Risk (2050s)	Long Term Risk (2080s)	Actions already in place or planned	Potential actions
		Upland heathland experiences increased incidence of wildfires (D)	Damage destruction of habitats affected by fire	Changes in habitat structure and mix of species, damage to peat and soils, leading to erosion.	Potential habitat composition change resulting in less heather and other dwarf shrubs, and more bracken; land managers affected.	-9	-16	-16	PD Fire Operations Group responses	Raise greater awareness of risk and impact of wildfires. May require changes in moorland management, such as increased cutting of dwarf shrub at high risk locations to create fire breaks.
		Increase in temperature in upland surface water (D)	Increase biological respiration and lower dissolved oxygen content in streams	Areas of anoxia may increase; lower stream flows followed by rainfall affect water quality and species viability. Loss of ponds. Changes in species may result, i.e. increase in invasive non-natives, increase in southerly species	Habitat structure; species such as crayfish, fish, aquatic invertebrates, amphibia.	-9	-12	-12		
Historic buildings & settlements										
	Warmer, wetter winters									
		Increased dampness and condensation in buildings (D)	Water intrusion; mould growth	Damage to structure / features and contents. Need for intrusive renovation work. Health risk for building occupants	Historic building owners & occupiers; historic fabric of buildings	-9	-9	-12	Good practice guidance available on internet	Proactive awareness campaign for high risk properties

Area of potential impact	Relevant headline projection	Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Short Term Risk (2020s)	Medium Term Risk (2050s)	Long Term Risk (2080s)	Actions already in place or planned	Potential actions
		Increased rainfall (D)	Buildings / settlements unable to cope with the additional rainfall / intensity	Water ingress causing structural damage to fabric of historic buildings & content	Historic building owners & occupiers; historic fabric of buildings	-9	-9	-12		Increase the size of gutters, downpipes and associated drainage
	More extreme weather events									
		Increased frequency of heavy downpours (D)	Deterioration in traditional building mortars	Water ingress causing structural damage to fabric of historic buildings & their contents	Historic building owners & occupiers; historic fabric of buildings	-9	-12	-12	Regular formal inspection and maintenance of NPA's own buildings	Review implications for historic buildings maintenance budget
Archaeological remains										
	Warmer, wetter winters									
		Increased risk of flooding & water logging (D)	Wetter soils, higher water table	Damage to earthworks; disruption of palaeoenvironmental evidence and buried sediments	Archaeological remains; visitors; researchers	-9	-12	-12		
			Change in chemical content of water within the soils	Damage / destruction of archaeological remains	Archaeological remains	-9	-12	-12		
			Extended growing season leads to more cultivation	Damaged to archaeological remains	Archaeological remains; farmers	-12	-12	-12		

Area of potential impact	Relevant headline projection	Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Short Term Risk (2020s)	Medium Term Risk (2050s)	Long Term Risk (2080s)	Actions already in place or planned	Potential actions
Historic landscapes , parks & gardens										
	More extreme weather events									
		Increased frequency of flash floods / severe storms (D)	Higher risk of wind or rain damage to historic settlements, parks & gardens e.g. tree throw	Loss of original planting schemes, historically important vistas; damage to structure / features leading to additional renovation / repair work or loss	Historic landscapes, parks & gardens; residents; visitors	-9	-12	-12		
Livestock including game										
	Hotter, drier summers									
		Loss of moisture in soils (D)	Increased difficulty in undertaking controlled moorland burn and increased chance of large scale wildfires on peat soils	Loss of moorland habitat for birds (native species e.g. waders, curlew, snipe and game) short term release of CO2 long-term effect on carbon sequestration and temporary effect on landscape appearance	People: Land managers; general public. Habitats: moorlands, and blanket bog. Fauna associated with moorland habitat	-12	-16	-20	Fire watch system in place once The Met Office Fire Severity Index reaches a certain point Fire plans for key sites	Develop further awareness amongst land managers and maintain resources for fire watch system
			Insufficient water to sustain livestock in areas already susceptible to drought (e.g. White Peak)	Area of viable grazing land reduced; limestone White Peak areas abandoned for grazing	White Peak / limestone habitats, farm business viability, livestock, farmers	-9	-12	-16		

Area of potential impact	Relevant headline projection	Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Short Term Risk (2020s)	Medium Term Risk (2050s)	Long Term Risk (2080s)	Actions already in place or planned	Potential actions
	Warmer, wetter winters									
		Waterlogged / flooded ground (D)	Boggier conditions result in reduced area for grazing. Livestock health affected, especially foot problems.	Change in grazing areas; reduced stocking rates; increased costs of feed and husbandry. Increased poaching. May lead to inappropriate drainage schemes on areas of conservation interest	Livestock; farmers; vets; farm business viability	-9	-12	-12	Envi Stewardship to reduce stock in watercourses by fencing.	Regulations through Envi Agency etc
	More extreme weather events									
		Increased frequency of flash floods / severe storms (D)	Livestock require additional shelter	Increased cost of building additional shelter; rise in livestock stress levels; reduction in stocking levels due to constraints on shelter space	Livestock; farm business viability; landscape	-9	-12	-12	Catchment sensitive farming scheme	
Soils and vegetation										
	Hotter, drier summers									
		Loss of soil moisture (D)	Reduced potential for plant growth / crop yield	Bare soil; increased erosion; fire risk; less carbon stored; loss of income from crops	Farmers / land managers; habitat	-9	-12	-12		

Area of potential impact	Relevant headline projection	Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Short Term Risk (2020s)	Medium Term Risk (2050s)	Long Term Risk (2080s)	Actions already in place or planned	Potential actions
	Warmer, wetter winters									
		Increased rainfall (D)	Increased erosion	Increased siltation / soil loss; rivers realigned	Land managers; water companies; aquatic and water loving species	-9	-12	-12		
Trees & woodland cover										
	Hotter, drier summers									
		Increased drought conditions (D)	Increased risk of fires	Loss of tree cover	Landscape; woodland; health & safety; land managers; visitors	-9	-12	-16		
	Warmer, wetter winters									
		Reduced incidences of frost; warmer damp conditions (D)	Increased prevalence of diseases and pests	Damage and death of trees e.g. Phytophthora	Landscape; woodlands; land managers	-9	-9	-16		
Water										
	Hotter, drier summers									
		Hotter summer temperatures and lower summer rainfall (D)	White Peak streams and rivers dry for longer periods of the year	Change to aquatic habitats & species	Habitats; land managers; farmers	-9	-12	-12		

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An inspiring Peak District where all are welcome to discover, enjoy, understand and value the special qualities of the national park; a place where people can develop a sense of wellbeing and belonging, and play a part in its future.

Area of potential impact	Relevant headline projection	Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Short Term Risk (2020s)	Medium Term Risk (2050s)	Long Term Risk (2080s)	Actions already in place or planned	Potential actions
Rights of Way and Open Access										
	Hotter, drier summers									
		Increased frequency of wildfires (D)	Rights of way / open access land is damaged	Rights of way / access land becomes unusable resulting in greater restrictions being put in place	Visitors, residents, landowners and land managers	-12	-16	-20	Peak District FOG fire plans and regular training helps reduce frequency and impact of wildfires	Additional mobile water storage tanks being placed at places of high fire risk
				Fire damaged areas become less attractive to visit	Visitors, residents	-8	-8	-20		
		More demand for shaded routes or those close to water (ID)	Increased pressure on certain rights of way / access routes close to water or in shade	Maintenance requirements increase.	Visitors, landowners, land managers, ROW maintenance teams	-8	-8	-15	Robust infrastructure at popular sites	Change in ROW maintenance plans to respond to changing visitor pressure
	More extreme weather events									
		Increased frequency of flash floods / severe storms (D)	Bridges and other access structures get damaged or washed away	Rights of way become unusable and access restrictions in place	Visitors, residents, landowners, H&S issues, land managers	-9	-16	-16	New and replacement bridge design specification changes to cope with greater volumes of water	Systematic review of existing bridges with associated work plans put in place

Area of potential impact	Relevant headline projection	Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Short Term Risk (2020s)	Medium Term Risk (2050s)	Long Term Risk (2080s)	Actions already in place or planned	Potential actions
Visitor & recreational infrastructure										
	Hotter, drier summers									
		More visitors in the Summer months (ID)	Increased pressure on infrastructure during hotter months	Overcrowding in popular areas - especially gateway sites close to urban areas; reduction in quality of visitor experience	Visitors, staff / businesses serving visitors; landowners; land managers; residents	-8	-8	-15	Differential pricing to encourage off & shoulder season visits Attract and disperse policy	More incentives to 'Park & Ride' at transport hubs
Visitor usage & numbers										
	Hotter, drier summers									
		Increased number of visitors to PDNP (ID)	Already popular sites e.g. Castleton, Dovedale, Fairholmes, Bakewell etc become even more overwhelmed	Loss of what made places special	Visitors, tourism related businesses, landowners, land managers	-8	-8	-12	Increased promotion of alternative means of access (e.g. Peak Connections, cycling trails)	More incentives to 'Park & Ride' at transport hubs
Transport										
	Hotter, drier summers									
		Increasing number of visitors using roads (ID)	Increased congestion & emissions; worsening air quality	Increased risk of injury on roads (especially walkers, cyclists, horse riders); higher demand for car parking; fall in visitor satisfaction; increased aggression / conflict	Road users; residents; visitors; businesses	-12	-12	-12	Reduced speed limits across the National Park	Greater provision of public transport options in to and within the National Park

Area of potential impact	Relevant headline projection	Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Short Term Risk (2020s)	Medium Term Risk (2050s)	Long Term Risk (2080s)	Actions already in place or planned	Potential actions
		Higher demand for public transport (ID)	Pressure for new routes and additional public transport capacity	Increase in visitors using public transport	Visitors, residents, transport companies	9	9	9	Promotion of existing public transport routes to visitors, particularly through Peak Connections	Greater provision of public transport options in to and within the National Park
		Increased likelihood of deteriorating transport infrastructure esp road melt (ID)	Increase in number of accidents due to pot holes etc / decrease in ride quality	Increased maintenance; repair and insurance costs. Decrease in travelers' experience and comfort	Visitors, residents, businesses	-12	-12	-12	Ongoing maintenance works	Change in maintenance regime and use of materials to better cope with prevailing climatic conditions
	Warmer, wetter winters									
		More prolonged rainfall, higher water levels & flooding (D)	Blocked drains / gullies on roads; erosion of road and rail routes	Worsening condition of transport infrastructure; greater maintenance demand	Road users, visitors, residents, transport companies, local authorities; businesses	-9	-9	-16	Gully and drain clearing works	Larger gullies and drain capacity.
		Longer growing season (D)	More road / rail and path side vegetation & overhanging trees	Increased maintenance requirement	Road users, visitors, residents, transport companies, local authorities	-12	-16	-16	Some extension to roadside cutting works (sensitive to wildflowers)	Additional resources put into roadside, trails and Rights of Way vegetation clearance works
	More extreme weather events									
		Transport routes closed by floods / storms / snow (D)	Disruption to transport routes & infrastructure; increased no. of accidents	Overall reduction in visitor numbers; increased maintenance costs	Road users, visitors, residents, businesses	-9	-16	-16	Road closed and diversion signs / notification via website	More real time road status updates available via Sat Nav & new media technologies

THRIVING AND VIBRANT COMMUNITIES

A lived in, sustainable, thriving and innovative Peak District that engages both local communities and people from neighboring villages, towns and cities, and promotes a high quality of life by conserving and enhancing the special qualities of the national park.

Area of potential impact	Relevant headline projection	Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Short Term Risk (2020s)	Medium Term Risk (2050s)	Long Term Risk (2080s)	Actions already in place or planned	Potential actions
Built environment - existing and new development										
	Hotter, drier summers									
		Higher interior building temperatures - housing and business premises (D)	Demand for cooling through air conditioning; increased demand for shading; ongoing legislative and policy changes seeking adaptation	Visual intrusion of air conditioning units & canopies into built landscape	Residents; built environment; planners	-9	-12	-15	Plans & policy guidance already being revised to facilitate adaptation & mitigation	Plans and policies may need periodic updating to reflect different legislation, policy drivers or results from monitoring.
	Warmer, wetter winters									
		Higher winter rainfall (D)	Increased flood risk to new and existing development	More flood protection measures required raising costs; less suitable land available for developments; stricter policies on development in flood risk areas	Landowners; households; businesses; planners	-9	-16	-16		Development of property flood response plans; physical flood protection measures installed

AN ENTERPRISING AND SUSTAINABLE ECONOMY

An enterprising and sustainable Peak District economy which capitalises on and enhances its special qualities and promotes a strong sense of local identity, reflecting the aspirations of local business, partners and communities.

Area of potential impact	Relevant headline projection	Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Short Term Risk (2020s)	Medium Term Risk (2050s)	Long Term Risk (2080s)	Actions already in place or planned	Potential actions
Crop management										
	Hotter, drier summers									
		Reduced soil moisture (D)	Crop germination affected	Reduce yield / profits; change in crops planted	Farmers; farm business viability	-9	-16	-16		Change in crop types
		Drier ground and longer 'ripening' season for crops (D)	Ability to move into arable crops, especially across the White Peak	Loss of grassland; potential removal of stone walls to enlarge field size; change in farm business model	Farmers; farm business viability; bird species; landscape	-12	-12	-16	Envi Stewardship arable options	
Local economy										
	Warmer, wetter winters									
		Increased rainfall (D)	Businesses at greater risk of flooding	Damage to buildings; loss of income; increased insurance; greater need for mitigation measures	Businesses; employees; residents; visitors	-9	-16	-16		Development of business flood response plans; physical flood protection measures installed

PEAK DISTRICT NATIONAL PARK AUTHORITY BUSINESS CONTINUITY

Area of potential impact	Relevant headline projection	Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Short Term Risk (2020s)	Medium Term Risk (2050s)	Long Term Risk (2080s)	Actions already in place or planned	Potential actions
NPA property & estates										
	Hotter, drier summers									
		Increased damage to buildings and estates (ID)	Properties & estates disrupted by fire / smoke damage; subsidence and changes to soil moisture around foundations	Damage to estate / injury to people & livestock; increase requirement for repairs; closure of buildings Greater demand on property management budgets	Habitats; key species; livestock; staff; public; visitors, tenants, tenant businesses	-9	-12	-16	Established plans to close moorland areas due to fire risk. Fire watch system in place once The Met Office Fire Severity Index reaches a certain point	Additional fire breaks Additional mobile water storage at high risk sites Further training and fire fighting equipment Fire watch sessions extended
		Drying up of springs (D)	Spring fed properties affected	Disruption to service(s) provided at spring fed properties. Disruption to domestic and agricultural supplies at tenanted properties	Hollin Bank, Trentabank & Derbyshire Bridge toilet blocks / spring fed properties, visitors, staff. Tenants, livestock,	-8	-10	-10	Close monitoring of security of spring supplies. Provision of temporary bowser supplies. Use of mains fed supplies when the opportunity arises.	Greater water efficiency at appropriate sites.
		Increased visitor numbers (ID)	Greater pressure on visitor centre, car parks, trails, cycle hire, field services etc	Congestion, reduced customer service levels, increased likelihood of aggression / conflict; greater income & costs	Staff; visitors;	-9	-16	-16		Promote alternative sites with lower visitor pressure and capacity to support more visitors

Barriers to adaptation and interdependencies

There are a wide range of barriers to taking action on adaptation risks or opportunities. Some of the key considerations from the Peak District National Park perspective are as follows:

Ecological	The ability of species and habitats to adapt to the speed of the expected climate change is still not fully understood. Challenges lay in deciding which species to work to conserve and enhance and which to support in their migration northwards or accept will be lost across the Peak District as the climate changes.
Economic	At a time when budgets are already under pressure requests for funding adaptation actions will be harder to approve due to both the uncertainty felt by some surrounding the projections and associated impacts as well as the fact that benefits may only be felt in the longer term. When actions are required from a range of organisations the challenge to secure a funding package will be even greater due to a range of competing corporate priorities.
Knowledge & understanding	Climate change adaptation is based on expected changes and projections which are open to challenge. To increase the likelihood of actions being implemented work is required to increase the knowledge and understanding of why decisions have been taken and change is required. This can be a slow and resource intensive process, especially when the reasons for change cannot always be directly observed by those affected.
Physical	The size of the Peak District National Park, the number of residents, visitors, land owners, SSSIs, SPAs, SACs, length of rights of way, volume of traffic etc all present significant physical challenges to specific adaptation actions being taken forward.
Political	Adaptation actions could suffer weaker political support due to the shorter term political horizons that exist in the British political system. Similar to the financial barriers – many adaptive actions will not necessarily offer a political (or financial) return in the short term putting them at risk of being a lower priority. This is coupled with the challenge of selling adaptive responses to a society which has recently become more sceptical of climate change.
Societal	Adaptive actions which challenge the 'status quo' and require additional funding or effort are likely to be met with resistance. This is due both to scepticism of the likelihood of the impact(s) and subsequent need for the action and ever greater scrutiny as to the benefits in a time of diminishing resources.
Technological	Some of the technological demands when planning adaptive actions may be beyond the current capability or capacity of organisations involved e.g. GIS data, local computer modelling and monitoring.

There are significant interdependencies when considering a subject as broad as climate change adaptation. Key areas include:

Geographical	The Peak District National Park covers three of the national Joint Character Areas (JCAs: Dark Peak; White Peak & South West Peak). Interdependencies result from the land and habitat management works being carried out in each of these areas as well as those JCAs which border the Park. Moves (further promoted in the Natural Environment White Paper) to take a landscape-scale approach to conservation work are requiring a greater consideration of the numerous interdependencies resulting from decisions. Whilst often complex a landscape-scale approach provides a valuable opportunity to consider climate change adaptation issues at a wider and potentially more effective scale.
Socio-political	The Peak District National Park covers thirteen different constituent councils requiring liaison and partnership working to deliver many elements of the NPMP. This is in addition to the other stakeholders ranging from government departments to voluntary and private sector organisations. Some of the most sizable projects within the National Park (such as Moors for the Future) are delivered through cross sectoral partnerships. These existing and historic interdependencies provide opportunities to successfully deliver adaptation actions supported by a range of organisations.

Delivering adaptation actions

The new Peak District NPMP (2012-17) is in the process of developing a Delivery Plan which will outline the actions required by the range of stakeholders to help the Peak District National Park move towards the NPMP outcomes.

Some of the adaptation actions highlighted in this report are a continuation of existing practices however many will entail new actions or ways of working. The long term nature of the adaptation means that not all actions can be taken forward at present providing the challenge of ensuring the subject is kept 'live' to the potential for adaptive actions to be incorporated into future work.

At an organisational level the PDNPA is currently revising its own corporate objectives so it is better placed to explore climate change adaptation issues alongside increasingly mainstream and embedded mitigation considerations.

The statutory requirement for the NPMP to be reviewed on a five yearly basis provides another opportunity to ensure adaptation actions are appropriately reflected across the Peak District National Park. Due to the rate of emerging thinking it is suggested that the list of adaptation actions be reviewed by the PDNPA and key stakeholders in 18 – 24 months time to ensure they are still fit for purpose as the delivery plan for years 3, 4 and 5 of the 2012-17 NPMP is finalised.

It is hoped that this report is the *start* of an iterative process of improving action on climate change adaptation across the Peak District. This first assessment of the risks and opportunities will help the PDNPA and its partners move forward in terms of awareness, understanding and debate around adaptation. Much is, and will always be, uncertain and open to debate but if this ensures the subject is more thoroughly discussed and closer to the minds of decision makers then the process will be beneficial in ensuring climate change adaptation actions are considered and taken where possible.

PDNPA specialists

Input was received from the following PDNPA staff:

Name	Title
Richard Campen	Director of Operations
Jane Chapman	Head of Environment & Economy
Hazel Crowther	Ecologist
Emily Davies	Transport Policy Manager
Jim Dixon	Chief Executive
Andy Farmer	Area Team Manager (South)
Suzanne Fletcher	Countryside and Economy Manager
Matt Freestone	Environmental Management Officer
Rachel Gillis	Head of Policy
Judy Gould	Recreation Strategy Team Manager
Faith Johnstone	Live & Work Rural Officer (Environmental Quality Mark)
John Lomas	Director of Development Planning
Ruth Marchington	Director of Corporate Resources
Emma Martin	Communities Policy Manager
John Moseley	Countryside and Economy Adviser
Mike Rhodes	Access and Rights of Way Manager
Karen Shelley-Jones	Ecologist (LBAP Co-ordinator)
Ken Smith	Cultural Heritage Manager
Pete Spriggs	Climate Change Co-ordinator
Brian Taylor	Policy Planning Manager
Rhodri Thomas	Natural Environment Team Manager
Robert Townsend	Countryside & Economy Adviser

Key Peak District National Park stakeholders

Segment	Stakeholder
Communities	Residents, businesses & community groups
Government / Statutory Agencies	DEFRA Natural England Environment Agency Forestry Commission English Heritage Emergency Services Primary Care Trusts Business Link
Constituent & neighbouring councils	Derbyshire CC, Staffordshire CC Sheffield, City Council Cheshire East Council Derbyshire Dales DC High Peak and Staffordshire Moorlands DC Tameside MBC Oldham Council Kirklees MBC Barnsley MBC North East Derbyshire DC Parish Councils Peak Park Parishes Forum Derbyshire Local Council Association Staffordshire Local Council Association Cheshire Local Council Association
Local land management organisations	Chatsworth Estate Tissington Estate Shuttleworth estate National Farmers Union Moorland Association Haddon Estate Local farmers Quarry operators Country Land & Business Association
Economic groups	Derbyshire Economic Partnership Local Chambers of Commerce Business Peak District
Utilities companies	Yorkshire Water United Utilities Severn Trent

Segment	Stakeholder	
Conservation groups	National Trust RSPB Derbyshire Wildlife Trust	Staffordshire Wildlife Trust Sheffield Wildlife Trust Yorkshire Wildlife Trust
Transport operators	East Midlands Trains Northern Rail	Network Rail Local bus companies
Voluntary sector groups	Peak Partners for Rural Action Rural Action Derbyshire Groundwork Derby & Derbyshire Local Volunteer Centres	Mosaic Project YHA Local CVSs
Tourism & access organisations	Visit Peak District Visit Yorkshire Enjoy Staffordshire Visit Chester	Local Access Forum Ramblers Sustrans Cycling England
Academic	University of Derby Sheffield Universities Manchester Universities	Keele University Stafford University
Energy & climate change	Nottingham & Derbyshire Local Authority Energy Partnership Staffordshire Climate Change Partnership Peak District Sustainable Energy Group	Climate East Midlands Transition Movement / Green / Sustainable village or town groups Peak District Hydro Forum
Associations / forum	Friends of the Peak District Campaign for National Parks Minerals Products Association Rural Housing Group	East Midlands Heritage Forum British Aggregates Association UK Minerals Forum LA World Heritage Forum

Glossary

Acronym	Stands for...
DEFRA	Department for Environment Food & Rural Affairs
ENPAA	English National Park Authorities Association
EQM	Environmental Quality Mark
GIS	Geographic Information System
JCA	Joint Character Areas
LBAP	Local Biodiversity Action Plan
NPMP	National Park Management Plan
PDNP	Peak District National Park
PDNPA	Peak District National Park Authority
SACs	Special Areas of Conservation
SPAs	Special Protection Areas
SSSIs	Sites of Special Scientific Interest
UKCP09	UK Climate Projections 2009

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Appendix 1 - Peak District National Park Climate Change Adaptation: Risk / Opportunities Assessment and Action Planner

Risk and Opportunity Assessment Definitions

Likelihood

The likelihood of a risk/opportunity occurring is rated from 1 to 5:

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

Impact

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

Risk / Opportunity Matrix

The combination of likelihood and impact leads to the risk / opportunity matrix:

Risk	-5	Catastrophic	-5	-10	-15	-20	-25
	-4	Major	-4	-8	-12	-16	-20
	-3	Moderate	-3	-6	-9	-12	-15
	-2	Minor	-2	-4	-6	-8	-10
	-1	Slight	-1	-2	-3	-4	-5
	0	No Change	0	0	0	0	0
Opportunity	1	Slight	1	2	3	4	5
	2	Minor	2	4	6	8	10
	3	Moderate	3	6	9	12	15
	4	Major	4	8	12	16	20
	5	Fantastic	5	10	15	20	25
			Rare	Unlikely	Possible	Likely	Almost certain
			1	2	3	4	5
			Likelihood				

Peak District National Park Climate Change Adaptation: Risk / Opportunities Assessment and Action Planner

National Park Management Theme: A Diverse Working & Cherished Landscape

Area of potential impact	Relevant headline projection	UKCP09 local data			Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Period: 2020s		Short Term Risk	Period: 2050s		Medium Term Risk	Period: 2080s		Long Term Risk	Actions already in place or planned	Potential actions
		2020s	2050s	2080s															
		+1.4 °C -7%	+2.4 °C -18%	+3.4 °C -22%					Likelihood (1 - 5)	Impact (-5 to 5)	(-25 to 25)	Likelihood (1 - 5)	Impact (-5 to 5)	(-25 to 25)	Likelihood (1 - 5)	Impact (-5 to 5)	(-25 to 25)		
Flora (Plants)	Hotter, drier summers																		
					Reduced ground and surface water availability - especially in the White Peak (D) but also the moorland in- by fringe habitats in Dark Peak and South West Peak (D)	Grassland habitats in particular become more vulnerable. Aquatic and marginal flora associated with rivers and ponds decline. Algal blooms become more frequent. Rush pasture habitats become drier and ground becomes physically harder. Scrapes become drier much earlier.	Decline of species, especially those at the edge of the current climatic envelope. Deep rooted species better adapted than shallow rooted, particularly in calcareous grasslands.	Habitats: Lowland calcareous grassland, rush pasture; relevant species - Jacob's ladder, globeflower, grass of parnassus	3	-2	-6	4	-3	-12	4	-3	-12		Manage sites for variation in topography and aspect; buffer important habitats with diverse, complementary habitats to reduce drying effect from bare ground or monocultures; further scrape creation in wettest areas; improve linkages between sites.
					Lowering of the water table (D).	Blanket bog peat at risk of drying out.	Peat dries out, becomes less stable, vegetation fails, leading to peat erosion	Loss of sphagnum, cranberry, cross-leaved heath, cottongrasses, bog asphodel	3	-3	-9	4	-4	-16	5	-4	-20	Grip blocking to maintain water table	Further grip blocking and stabilisation of slopes in priority areas.
					Increased temperatures on higher ground affect upland habitats (D)	Plant species become more diverse in upland habitats	Encroachment of new species into upland habitats and consequent decline in species special to the Peak District	Upland habitats - blanket bog; species special to the Peak District	3	-2	-6	4	-3	-12	4	-3	-12		
					Increased visitor numbers (ID)	Increased trampling pressure at certain sites. Increased risk of wildfires	Vegetation cover is weakened, leading to risk of soil erosion. Wildfires damage vegetation and peat. Species loss at these sites.	Habitats: upland heathland, blanket bog. Species: heather, bilberry, grasses.	3	-3	-9	4	-3	-12	4	-3	-12		Better visitor management may be required to protect vulnerable areas of habitat and flora, will need careful coordination between ecology, landscape and recreation interests. Raise greater awareness of risk and impact of wildfires. May require changes in moorland management, such as increased cutting of dwarf shrub at high risk locations to create fire breaks.
					Increased soil temperatures (D)	Increased release of nitrogen and also carbon to atmosphere	Change in species composition, early growing plants dominate community. May benefit invertebrates and reptiles where bare soil is at higher temperature.	Invertebrates, and therefore their food plants, and reptiles	3	-1	-3	4	-1	-4	4	-1	-4		Manage south facing grassland slopes for invertebrates, ensure food and host plants present, maintain mosaic of cover and bare ground. Increase linkages between site to enable species movement
					Increase in arable crops (ID)	Change from pastoral farming to more arable in the landscape.	Reduction of land in pastoral use, ploughing of flower rich grasslands. Increase in altitude of in-by line - ploughing of pastures/rush pastures used by waders.	Loss of flowery grassland and associated value to invertebrates. Loss of habitat for upland birds particularly waders.	2	-1	-2	3	-3	-9	3	-4	-12		Influence agri-environment agreements regarding appropriate locations for reversion to arable land, take advantage of positive impact on seed-eating birds. Secure long-term conservation agreements on highest value and linked sites in order to safeguard flower-rich grasslands.
					Species currently at their Southern limit in the Peak District retreat Northwards	Species dependent on colder conditions no longer thrive in the Peak District	Species emigration or extinction at certain sites	Habitats: relevant species e.g. globeflower, cloudberry, mountain pansy, Jacobs Ladder	3	-2	-6	4	-3	-12	5	-4	-20	Habitat enhancement, restoration at landscape scale	Diversify site management to ensure topographical and aspect variety is maximised
					Southern species no longer confined to their existing range (D)	Immigration of new species as they expand their range Northwards	Increase in species diversity positive for Southern species but potentially negative for Northern species displaced	e.g s of species moving into the area, possible increase in dwarf thistle (a southern species currently at its northern limit here)	3	-1	-3	4	-3	-12	4	-3	-12	Habitat enhancement, restoration at landscape scale	Diversify site management to ensure topographical and aspect variety is maximised

Peak District National Park Climate Change Adaptation: Risk / Opportunities Assessment and Action Planner

National Park Management Theme: A Diverse Working & Cherished Landscape

Area of potential impact	Relevant headline projection	UKCP09 local data			Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Period: 2020s		Short Term Risk	Period: 2050s		Medium Term Risk	Period: 2080s		Long Term Risk	Actions already in place or planned	Potential actions
		2020s	2050s	2080s															
		+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%					Likelihood (1 - 5)	Impact (-5 to 5)	(-25 to 25)	Likelihood (1 - 5)	Impact (-5 to 5)	(-25 to 25)	Likelihood (1 - 5)	Impact (-5 to 5)	(-25 to 25)		
	Warmer, wetter winters																		
					Longer growing season, plant growth promoted early in year, therefore increased demand for soil water resources in spring (D)	Change in distribution and balance of species	Some species lose out to other more dominant species, leading to a loss of diversity.	Habitats: plant diversity	3	-2	-6	4	-3	-12	4	-3	-12	Review of management techniques. Revision of management plans	More active intervention on more sites
					Impacts of pests & diseases on plants (D)	Change in distribution and balance of species	Some species go into decline	Habitats: species - recent incidence of Phytophthora pseudosyringae on bilberry	3	-2	-6	4	-3	-12	4	-4	-16	Accept that disease is natural part of ecosystem, seek to manage and monitor rather than prevent	
	More extreme weather events																		
					Increase in storms and high winds	Risk of storm damage to in-field and boundary trees and veterans	Loss of mature and veteran trees	Mature and veteran trees, deadwood associated invertebrates, fungi and lichens, bats. Houseowners risk of damage from falling trees.	2	-2	-4	3	-3	-9	3	-3	-9	Sensitive management of veteran trees to minimise health and safety threat but retain tree	Plant new trees near to existing veterans as ultimate replacements
Fauna (Animals)																			
	Hotter, drier summers	+1.4 °C -7%	+2.4 °C -18%	+3.4 °C -22%															
					Drier conditions in freshwater habitats (D)	Changes in water flow, level and quality	Habitats become more fragmented, loss of available ponds (particularly dew ponds in the White Peak), ponds become more seasonal, Increased eutrophication and High Biological Oxygen Demand, rivers more seasonal (especially in the White Peak) .	Ponds relevant species e.g. great crested newts, toads, frogs (PD predicted southerly English climate space under 2080s high scenario) also loss of drinking resource for wide range of animals such as swallow. Fish such as brook lamprey, bullhead, brown trout, aquatic invertebrates, including white-clawed crayfish, birds as source of drinking water generally as well as bird adapted to aquatic environments such as Kingfisher, yellow wagtail, dipper. Reduced aquatic habitat for use by both water vole and otter. Reduced prey availability for species such as otter. Fish & fishing interests	3	-2	-6	4	-3	-12	5	-4	-20	Management and restoration of networks of dewponds, will increase potential for species movement as ponds become drier.	Reduce sources of harm not linked to climate change - i.e. pollution, leaching, run-off of agricultural inputs, invasive non-native species. Investigate opportunities for wetland habitat creation in sheltered, north-facing, higher locations (including quarries) to maximise availability of water.
					Drier moorland habitats (D)	Decline in ground beetles and other invertebrates. Food sources for breeding bird populations threatened. Invertebrate availability becomes out of step with breeding waders	Upland breeding bird populations under significant threat from loss and decline	Breeding bird populations such as curlew, golden plover, dunlin etc. Decline in grouse shooting economy & consequent moorland management.	3	-3	-9	4	-3	-12	5	-4	-20	Scrape creation to increase areas of foraging habitat	Increase focus of efforts in key bird areas, link scrape creation and blanket bog re-wetting, consider changes to timing and type of moorland management.
					Drier ground; poorer hay yields (D).	Changes in cutting times of haymeadow habitats, increased inputs of fertiliser etc to improve yield (R)	Impacts on ground-nesting birds with earlier cut dates.Reduced pollen and nectar availability for a diversity of invertebrates	Species such as skylark, meadow pipit, curlew; land managers; habitats: hay meadows. Decline in invertebrates e.g bumble bees. Overall reduced feeding resource for birds from seed heads and invertebrates e.g twite	3	-2	-6	4	-3	-12	4	-3	-12	Sensitive management of meadows is already considered within Agri-environment schemes	Closer monitoring of meadows in A-E agreements

Peak District National Park Climate Change Adaptation: Risk / Opportunities Assessment and Action Planner

National Park Management Theme: A Diverse Working & Cherished Landscape

Area of potential impact	Relevant headline projection	UKCP09 local data			Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Period: 2020s		Short Term Risk (-25 to 25)	Period: 2050s		Medium Term Risk (-25 to 25)	Period: 2080s		Long Term Risk (-25 to 25)	Actions already in place or planned	Potential actions
		Likelihood (1 - 5)	Impact (-5 to 5)	Likelihood (1 - 5)					Impact (-5 to 5)	Likelihood (1 - 5)		Impact (-5 to 5)							
		2020s	2050s	2080s															
			Drier ground.	Reduction in availability of earthworms, and soil invertebrates generally, and berry crops. Hard ground prevents nest building for birds especially hirundines. Potential demand for water abstraction licences for farming but also increase for domestic purposes from those that currently rely on spring supplies. Rush pasture habitats become drier and ground becomes physically harder. Scrapes become drier much earlier.	Food supply scarce. Impact on natural water sources elsewhere e.g reduced flow in rivers, diversion of ground waters. Reduced breeding success of species such as waders and species that require mud/soft ground to build nests. E.g swallows	Ring Ouzel decline. Decline in breeding waders. Scandinavian winter migrants have reduced food source e.g fieldfares and redwings.	3	-2	-6	4	-3	-12	4	-3	-12	Scrape creation to increase areas of foraging habitat	Water saving measures for farms/businesses/domestic properties to reduce abstraction. Encourage diversity of land management, for example wetland/scrape/pond creation close to farm buildings utilised by swallows etc (through planning and agri-environment schemes). Encourage planting of mixed species in hedges, field edges etc to include greater proportion of berry bearing trees and shrubs.		
			Warmer conditions generally (D)	Changes in phenological events - i.e. migratory birds arrive earlier and stay longer; lack of synchronisation of breeding birds and invertebrate food source	Increased competition for food. Reduced food abundance at the end of the breeding season affects post-fledging and over-winter survival	Ring ouzel, golden plover, other invertebrate feeders, particularly those at edge of range	3	-2	-6	4	-3	-12	4	-3	-12	Appropriate management of habitats to ensure they are more robust and community composition is varied	Improve condition of existing high quality habitats which support relevant species, buffer these with diverse habitats, enhance corridors to enable species movement.		
			Warmer uplands (D)	Warmer spring weather advances laying dates of upland birds. Late summer warming reduces cranefly emergence in following year.	Reduced food source for upland birds, low chick survival and subsequently poor recruitment.	Golden plover, dunlin, red grouse,	3	-1	-3	4	-2	-8	4	-3	-12		Reduce sources of harm not linked to climate change - i.e. predation, unsuitable habitat management, changes to shooting season on grouse moors?		
			Drier ground and lower productivity (D)	Reduction in plant biodiversity and abundance, with knock-on reduction in invertebrates. Lack of adequate grazing.	Reduced feeding opportunities for waders which feed in wet grasslands. Stock densities reduced, leading to scrub encroachment.	Lapwing, snipe, curlew. Landowners, grazing livestock.	3	-1	-3	4	-2	-8	4	-3	-12	Targeted management of habitat for waders in 'hotspots', scrape creation, rush cutting and predator management	Increased efforts required over whole landscapes, particularly South West Peak		
			Drier woodlands - reduced humidity (D)	Reduced invertebrate availability and productivity of species requiring damp habitats.	Reduced feeding opportunities for birds and young. Decline in woodland birds	Range of woodland birds e.g. pied and spotted fly catcher, lesser spotted woodpecker	3	-1	-3	4	-2	-8	4	-3	-12	Forestry Commission Woodland Birds project targeted at woodland management for a suite of 16 woodland bird species.	Woodland creation at higher altitudes, in cloughs and on north-facing slopes		
			Change in woodland species composition (ID)	Beech trees more associated with southerly parts of Britain and sycamore likely to thrive	Changes in habitat structure and mix of species	Woodland species, ash and oak perhaps less well adapted in lower areas.	3	-1	-3	4	-2	-8	4	-3	-12		Need to accept some changes in species composition in some areas, Natural England may need to rethink their condition monitoring?		
			Switch from spring to autumn grown crops (ID)	Increased overwinter survival of birds (O). Increased use of pesticides (R)	Reduction in prey species	Increased overwintering success may be mitigated by increased use of pesticides and subsequent reduction in prey species, to achieve reatively stable population?	3	0	0	4	1	4	4	2	8		Encourage organic production in key bird areas		
			Increase in pressure for more land to be managed more intensively for food (ID)	Loss of semi-natural habitats and species. Increased use of chemicals. Increased polarization and fragmentation of habitats and species.	Affects all habitats and species to greater or lesser degree	Affects all habitats and species to greater or lesser degree	2	-2	-4	3	-3	-9	4	-4	-16		Consider planning for this on a landscape-scale - greater need for safeguard and buffering of biologically diverse sites, protection for watercourses imperative as increased risk of nutrient enrichment. Consider payments for ecosystem services.		

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		2020s	2050s	2080s					Likelihood	Impact		Likelihood	Impact		Likelihood	Impact			
		(1 - 5)	(-5 to 5)	(-25 to 25)					(1 - 5)	(-5 to 5)	(-25 to 25)	(1 - 5)	(-5 to 5)	(-25 to 25)					
	Warmer, wetter winters	+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%															
					Southern species no longer confined to their existing range (D)	Immigration of new species as they expand their range Northwards	Increase in diversity; positive for Southern species but negative for Northern species displaced	e.gs of species moving into the area Dartford warbler, firecrest	3	-1	-3	4	-3	-12	4	-3	-12		Subtly different habitat management may be required to suit new species, increase diversity of management and within site variation - mosaics of habitats across large landscapes become more important whilst ensuring that we do not try to manage for every eventuality.
					Reduction in occurrences of frosts and harsh winters (D)	Species move Northwards.	Species decline / disappear from the Peak District	E.g. red grouse, ring ouzel,	2	-2	-4	3	-3	-9	4	-3	-12	Work with neighbouring landowners and local authorities to the north of the Park to ensure habitat connectivity.	
					Wet conditions in the uplands (D)	Increase in gut parasites	Individuals more susceptible to heat stress in summer	Red grouse, moorland owners	2	-1	-2	3	-2	-6	3	-2	-6	May need alterations in grouse shooting season - don't forget red grouse is a BAP species.	
					Rapid plant growth earlier in the year - longer growing season (D)	Cooler spring micro climate in the sward	Some species become excluded from grasslands	Later flowering species in grasslands may be impacted, for instance common knapweed, devil's bit scabious.	2	-2	-4	3	-3	-9	3	-3	-9		
	More extreme weather events																		
					Increase in seasonal drought and flood events (D)	Risk to riparian species	Flooding of nests / burrows	Riparian species such as water vole, kingfisher, fish. Impact on recreational fishing.	2	-2	-4	3	-3	-9	3	-3	-9	Catchment Sensitive Farming scheme works with landmanagers to enhance land adjacent to water courses. Blanket bog restoration and re-wetting to retain water in the catchmen, e.g. Moors for the Future, SCaMP, Making Space for Water, Kinder Catchment Improvement projects..	Enhanced management of the floodplain to be as naturalistic as possible, work with the Environment Agency to avoid hard flood defences and build in 'soft' ones such as floodplain meadows, natural meanders, riverside trees (pollards) in appropriate locations. Also key is managing the upper catchment areas, so that moorlands and peatlands retain water for longer, reducing flash flooding.
Habitats (including protected areas)																			
	Hotter, drier summers	+1.4 °C -7%	+2.4 °C -18%	+3.4 °C -22%															
					Blanket bog becomes drier (D)	Peak shrinkage leads to further break up of peat and increase erosion - peat oxidation and loss. Inability of peat building mosses to survive with reduced water table.g Sphagnum cuspidatum.	Loss of specific Peak District habitat - links to mitigation works (avoided carbon loss through peatland erosion); decline in invertebrates could impact on breeding bird populations	Potential for carbon storage; species of breeding birds. Cloudberry and cowberry are at their southern range limit in the Peak District and will lose suitable climate space by 2050s. Sphagnum cuspidatum is more sensitive to changing water levels and could become more stressed or be lost during drier summers.	3	-3	-9	3	-4	-12	4	-4	-16	Moorland management plans, blanket bog restoration	Maintain momentum of restoration in the uplands, strengthen links between blanket bog, peat, carbon, water, ecosystem services and benefits to the tax payer in the public perception.
					Increased temperature and soil N availability (ID)	Heather growth favoured over bracken (O), but invasion by grass species likely (R). Increased potential for heather beetle damage	Increased competitive ability of heather, but change in community composition, and loss of biomass due to pest damage.	Upland heathland, associated flora and fauna, moorland managers.	3	-2	-6	3	-3	-9	4	-3	-12		Increased management needed to restrict invasion of grass, bracken and trees at lower levels; Seeding and use of heather brash may assist in spread of heather at higher altitudes
					Upland heathland experiences increased incidence of wildfires (D)	Damage destruction of habitats affected by fire	Changes in habitat structure and mix of species, damage to peat and soils, leading to erosion.	Potential habitat composition change resulting in less heather and other dwarf shrubs, and more bracken; land managers affected.	3	-3	-9	4	-4	-16	4	-4	-16	Peak District Fire Operations Group responses	Raise greater awareness of risk and impact of wildfires. May require changes in moorland management, such as increased cutting of dwarf shrub at high risk locations to create fire breaks.

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		Likelihood (1 - 5)	Impact (-5 to 5)	Likelihood (1 - 5)					Impact (-5 to 5)	Likelihood (1 - 5)		Impact (-5 to 5)							
				Moorland land management systems change to adapt to climate change (ID)	Increased stocking rates for grazing; changes to the shooting season dates	Changes in habitat structure and mix of species	Land managers; shooting estates; habitats and species - red grouse, birds of prey	2	-1	-2	3	-3	-9	4	-4	-16		Work with wide range of land owners/managers to find workable solutions and multiple benefits.	
				Grasslands experiences more drought conditions (D)	Habitat areas change in structure. Increased drought reduces bracken growth (O). Increase in ruderal species and deeper rooted species (R)	Current mix of species change to include more drought resistant species	Hay meadows, acid and calcareous grassland. Land managers; livestock management; mix of species.	3	-3	-9	4	-3	-12	4	-3	-12		Manage sites for variation in topography and aspect; buffer important habitats with diverse, complementary habitats to reduce drying effect from bare ground or monocultures; further scrape creation in wettest areas; improve linkages between sites.	
				Increase in temperature in upland surface water (D)	Increase biological respiration and lower dissolved oxygen content in streams	Areas of anoxia may increase; lower stream flows followed by rainfall affect water quality and species viability. Loss of ponds. Changes in species may result, i.e. increase in invasive non-natives, increase in southerly species	Habitat structure; species such as crayfish, fish, aquatic invertebrates, amphibia.	3	-2	-6	4	-3	-12	4	-3	-12		Buffer water course by appropriate catchment management.	
				Reduced water in rivers, particularly White Peak rivers (D)	Rivers Lathkill and Manifold become drier for longer period and over greater length. Flow becomes slower, water quality declines. Increased eutropication and higher Biological oxygen demand ,risk of algal blooms and associated fish deaths etc.	Change in composition of species to drier habitat. Loss of characteristic species	Fish such as brook lamprey, bullhead, brown trout, aquatic invertebrates, including white-clawed crayfish, birds as source of drinking water generally as well as bird adapted to aquatic environments such as Kingfisher, yellow wagtail, dipper. Reduced prey availability for species such as otter.	3	-3	-9	4	-3	-12	4	-3	-12		Increased sympathetic management will be needed; Abstraction and pollution may increase under low rainfall conditions in the future. Buffer water course by appropriate catchment management.	
				Reduced availability of water to specific SAC wet feature habitats (D)	Drying out of SAC habitat features such as alkaline fens (fed from perched water tables) in limestone Dales. Drying out of habitats such as basic flushes in gritstone uplands of Southwest peak.	change in composition of species to drier habitat. Loss of characteristic species	Loss of characteristic species such as butterwort	3	-2	-6	4	-3	-12	4	-4	-16		Buffer watercourses by appropriate catchment management.	
				Lower soil moisture levels (D)	Die back of woodland species, Invasion of drought tolerant species (R). Expansion in the ranges of oak species to higher altitude (O)	Change in community composition, change in habitat structure. Increase in beech within woodlands. Increase in deadwood availability.	Upland oakwoods, Upland Mixed Ashwoods, Wet Woodland, Wood-pasture & Parkland. Increase in deadwood invertebrates and fungi.	2	-2	-4	3	-3	-9	4	-3	-12	EWGS grants for woodland creation, some take up by large landowners. Efforts needed to support clough woodland restoration/creation and moorland fringe woodlands. Principle of moorland fringe woodlands needs 'selling' to grouse moor owners.	Encourage early regeneration and manage grazing levels to encourage regeneration. Planting of new forests as part of woodland initiatives and farm woodland schemes could encourage the extension of these habitats in appropriate areas, but this is a long-term solution.	
				Change in C:N ratio in plant leaves enhances nutritive value for insects (ID)	Increase in some insect species productivity (e.g. leaf hoppers)	Possible improvements in pollination, but also potential increases in 'pest' damage	Grasslands	2	0	0	3	-1	-3	3	-2	-6			

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		Likelihood (1 - 5)	Impact (-5 to 5)	Likelihood (1 - 5)					Impact (-5 to 5)	Likelihood (1 - 5)		Impact (-5 to 5)							
		2020s	2050s	2080s															
				Increased visitor numbers (ID)	Increased trampling pressure and consequential erosion at honeypot sites and adjacent to car parks/access points	Spill-over to other areas, trampling pressure over wider areas of land; increased fouling by dogs and associated nutrient enrichment	Potentially all open access land, specifically well-visited areas such as limestone dales, landmark woodlands and moorland estates; increase in rank species such as nettles, thistles etc	3	-2	-6	4	-3	-12	4	-3	-12	Better visitor management strategy, restricted access to vulnerable sites? visitor payback scheme?		
	Warmer, wetter winters	+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%															
				Hay meadows experience increased vegetation growth (D)	Meadows demonstrate increased competition between flowers and grass	Change in habitat structure and mix of species	Land managers; habitat structure and relevant species	2	-1	-2	3	-2	-6	3	-2	-6			
				Longer growing season (D)	More frequent; earlier cutting for hay meadows, verges and other habitats	Change in habitat structure and mix of species. Impacts on ground-nesting birds with earlier cut dates.Reduced pollen and nectar availability for a diversity of invertebrates	Land managers; habitat structure and relevant species e.g. late-flowering hay meadow species such as skylark, meadow pipit; land managers; habitats: hay meadows. Decline in invertebrates e.g. bumble bees. Overall reduced feeding resource for birds from seed heads and invertebrates e.g. twite	2	-1	-2	3	-2	-6	3	-2	-6	Sensitive management of meadows is already considered within Agri-environment schemes		
				Increased wet acid deposition (ID)	Loss of species productivity	Change in community composition, change in habitat structure	Upland oakwoods, Upland Mixed Ashwoods, Wet Woodland, Wood-pasture & Parkland	2	-1	-2	3	-2	-6	3	-2	-6			
				Wetter conditions and warmer temperatures will encourage growth of bog species (ID)	Increase in habitat (O).	Increase in habitat.	Blanket bog	2	1	2	3	2	6	3	2	6	Sphagnum propagation project (MFF)		
	More extreme weather events																		
				Blanket bog - high intensity rainfall events and more prominent wetting and drying cycles (D)	Increase in mass of peat slopes through increases in water content	Peat landslides; damage to destruction to habitats	Habitats; landscape; mitigation carbon store losses; land managers	2	-1	-2	3	-3	-9	4	-4	-16	Grip blocking, stabilisation and re-vegetation of bare peat, restoration of hydrological integrity		
				Increase in seasonal drought and flood events (D)	Habitats and species unable to recover from repeated events. Increased erosion, scour and sediment transfer during floods. Increased soil wash into rivers/streams associated with fields under crop cultivation etc.. High peaks of Biological Oxygen Demand and pollution associated with flushing of chemicals and manures over land into streams and rivers.	Change in habitat structure and risk of loss of species. Spawning river gravels are washed away or silted up. Fish eggs washed away or suffocated in deep silts. Erosion of bankside features and depositional features and associated vegetation and habitats used by species such as rare invertebrates, watervole . Watervole and otters drowned.Failed nesting of bankside birds. Eutrophication of freshwater habitats decline in flora and fauna species diversity.Marginal and aquatic vegetation (e.g. water cowfoot beds) washed away.	Ponds; great crested newts. Bankside mining bees, Dipper, yellow wagtail, sand martin, kingfisher, water vole, otter, brook lamprey, eels?, brown trout, bullhead. Range of invertebrates. General decline in species and habitat diversity. Cave flora and fauna? Angling clubs etc. Water companies. Land managers.	2	-2	-4	3	-3	-9	4	-4	-16	Maximise network of ponds by restoration and management. Reduce flood risk downstream through restoration of moorlands in headwaters by grip blocking to allow moorlands to soak up water and release more slowly.		
				Increase in storms and high winds	Risk of storm damage to veteran trees and parkland	Loss of mature and veteran trees	Mature and veteran trees in parkland and wood-pasture, deadwood associated invertebrates, fungi and lichens, bats. Houseowners risk of damage from falling trees.	2	-2	-4	3	-3	-9	3	-3	-9	Sensitive management of veteran trees to minimise health and safety threat but retain tree		

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		2020s	2050s	2080s															
									Likelihood (1 - 5)	Impact (-5 to 5)		Likelihood (1 - 5)	Impact (-5 to 5)		Likelihood (1 - 5)	Impact (-5 to 5)			
					Increase in seasonal drought and flood events (D)	Habitats and species unable to recover from repeated events	Change in habitat structure and mix of species	Rivers, riparian habitats, grasslands	2	-2	-4	3	-3	-9	4	-4	-16	More sensitive riparian management, fewer hard flood defences, management of whole riparian zone. Extensive grazing management of grasslands within the flood plain and beyond.	Manage river and floodplain as a whole unit, enhance floodplain habitats such as grasslands and woodlands to retain surface water during flooding
Historic buildings & settlements	Hotter, drier summers	+1.4 °C -7%	+2.4 °C -18%	+3.4 °C -22%															
					Drier soil conditions, especially peat (D)	Historic buildings at greater risk of subsidence	Damage to structure / features leading to additional renovation / repair work	Historic building owners & occupiers; historic fabric of buildings	2	-1	-2	3	-2	-6	3	-2	-6		
					Greater number of hours of sunlight (D)	Increased UV light exposure to historic buildings & interiors	Damage to structures, fixtures & fittings	Historic building owners & occupiers; historic fabric of buildings	3	-2	-6	4	-3	-12	4	-3	-12	Recommendations e.g. use of Shutters in Design Guide	
					Increased insect migration (native & non-native) (ID)	Greater risk of damage from insects e.g. wood boring wasps	Damage to structures, fixtures & fittings	Historic building owners & occupiers; historic fabric of buildings	2	-2	-4	3	-3	-9	3	-3	-9		
					Increased frequency of wildfires (D)	Historic buildings in areas susceptible to fire at risk of damage	Damage / destruction of structures / features	Historic building owners & occupiers; historic fabric of buildings	2	-3	-6	3	-4	-12	3	-4	-12		
	Warmer, wetter winters	+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%															
					Increased dampness and condensation in buildings (D)	Water intrusion; mould growth	Damage to structure / features and contents. Need for intrusive renovation work. Health risk for building occupants	Historic building owners & occupiers; historic fabric of buildings	3	-3	-9	3	-3	-9	4	-3	-12	Good practice guidance available on internet	Proactive awareness campaign for high risk properties
					Reduction in the number of days experiencing sub zero temperatures (D)	Reduced number of occurrences of freeze/thaw affecting historic buildings	Less weathering/damage impacted on historic buildings leading to reduced requirement of remedial work and hence financial savings	Historic building owners & occupiers; historic fabric of buildings	2	3	6	3	3	9	5	3	15	Regular formal inspection of PDNPA's own buildings	Review implications for historic buildings maintenance budget
					Increased rainfall (D)	Buildings / settlements unable to cope with the additional rainfall / intensity	Water ingress causing structural damage to fabric of historic buildings & content	Historic building owners & occupiers; historic fabric of buildings	3	-3	-9	3	-3	-9	4	-3	-12		
					Changing distribution & prevalence of disease (ID)	New diseases affecting flora	Loss of historically important species; change to character of buildings e.g. loss / dying back of ivy	Historic building owners & occupiers; historic fabric of buildings	2	-2	-4	3	-3	-9	4	-3	-12		
					Longer growing season (D)	Increase in wall flora e.g. ivy	Damage to structure / features leading to additional renovation / repair work	Historic building owners & occupiers; historic fabric of buildings	2	-1	-2	3	-2	-6	3	-2	-6		
	More extreme weather events																		
					Increased frequency of heavy downpours (D)	Deterioration in traditional building mortars	Water ingress causing structural damage to fabric of historic buildings & their contents	Historic building owners & occupiers; historic fabric of buildings	3	-3	-9	3	-3	-9	4	-3	-12	Regular formal inspection and maintenance of NPA's own buildings	Review implications for historic buildings maintenance budget
						Guttering, downpipes & drains unable to cope with amount of rainfall	Disturbance to ground from renewing drains, visual impact from enlarged gutters & downpipes	Historic building owners & occupiers; historic fabric & appearance of buildings	3	-2	-6	4	-3	-12	4	-3	-12		
					Increased frequency of flash floods / severe storms (D)	Increased incidences of damage to historic buildings / settlements	Damage / destruction of structure / features leading to additional renovation / repair work	Historic building owners & occupiers; historic fabric of buildings	2	-3	-6	3	-3	-9	4	-3	-12		
Archaeological remains	Hotter, drier summers	+1.4 °C -7%	+2.4 °C -18%	+3.4 °C -22%															
					Drier soil conditions, especially peat (D)	Soil shrinkage, exposure of archaeological features	Peat drying leads to loss of palaeoenvironmental evidence	Buried archaeological features; land owners; researchers; visitors; moorland areas	1	-2	-2	3	-3	-9	3	-3	-9		
					Changes in crop types & patterns (ID)	Increased / more frequent ground disturbance	Damaged to archaeological remains	Farmers; archaeological remains	2	-2	-4	3	-3	-9	3	-3	-9		
					Changes in grazing levels / stock behaviour (ID)	Undergrazing leads to increased scrub development	Damage to archaeological remains from scrub roots	Farmers; archaeological remains	3	-2	-6	3	-3	-9	3	-3	-9		
	Warmer, wetter	+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%															

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		2020s	2050s	2080s															
		+4%	+10%	+13%					Likelihood (1 - 5)	Impact (-5 to 5)	(-25 to 25)	Likelihood (1 - 5)	Impact (-5 to 5)	(-25 to 25)	Likelihood (1 - 5)	Impact (-5 to 5)	(-25 to 25)		
	winters				Rabbit / badgers numbers increase due to improved breeding success resulting from more plentiful food (ID)	Increase in burrowing activity	Increase in damage to archaeological remains as a result of burrowing activity	Buried archaeological remains; rabbits; badgers	2	-2	-4	3	-2	-6	3	-3	-9	Regular monitoring of rabbit numbers taking place on high risk sites and control measures adopted as necessary	Extend monitoring to all sites. Work with English Heritage and Natural England to incorporate rabbit control measures in Higher Level Stewardship schemes where appropriate
					Increased risk of flooding & waterlogging (D)	Wetter soils, higher water table	Damage to earthworks; disruption of palaeoenvironmental evidence and buried sediments	Archaeological remains; visitors; researchers	3	-3	-9	4	-3	-12	4	-3	-12		
					Change in chemical content of water within the soils	Change in vegetation patterns (ID)	Damage / destruction of archaeological remains	Archaeological remains	3	-3	-9	4	-3	-12	4	-3	-12		
					Threat to visibility and viability of archaeological remains	Extended growing season leads to more cultivation	Damage to earthworks; disruption of palaeoenvironmental evidence and buried sediments	Archaeological remains; visitors; researchers	2	-3	-6	3	-3	-9	3	-3	-9		
							Damaged to archaeological remains	Archaeological remains; farmers	3	-4	-12	3	-4	-12	3	-4	-12		
	More extreme weather events																		
					Increased frequency of flash floods / severe storms (D)	Increased incidences of damage to archaeological remains	Damage or destruction to archaeological features leading to additional renovation / repair work or loss	Archaeological remains	3	-3	-9	4	-3	-12	4	-3	-12		
						Increased tree throw	Uproots areas exposing, damaging or destroying archaeological remains	Archaeological remains; visitors; researchers	2	-3	-6	4	-3	-12	4	-3	-12		
Historic landscapes, parks & gardens																			
	Hotter, drier summers	+1.4 °C	+2.4 °C	+3.4 °C															
		-7%	-18%	-22%															
					Increase in visitors & associated infrastructure (ID)	Greater demand to see historic settlements, parks, gardens etc. E.g. Chatsworth, Haddon etc	Increase income from visitors; increased pressure / potential to cause damage from visitors	Historic landscapes, parks & gardens; visitors; tourism businesses	2	2	4	3	-2	-6	4	-2	-8		
					Change in growing season / conditions (ID)	Historic tree planting difficult to conserve	Loss of original planting schemes, replacement with non-native species	Historic parks & gardens	2	-1	-2	4	-3	-12	4	-3	-12		
	Warmer, wetter winters	+1.3 °C	+2.2 °C	+3.0 °C															
		+4%	+10%	+13%															
					Change in growing season / conditions (ID)	Historic tree planting difficult to conserve	Loss of original planting schemes, replacement with non-native species	Historic parks & gardens	2	-1	-2	3	-2	-6	4	-2	-8		
					Reduction in the number of days experiencing sub-zero temperatures (D)	Fewer pests killed off by cold temperatures	Increased damage from pests; new pests	Historic landscapes, parks & gardens; visitors	3	-2	-6	4	-3	-12	4	-3	-12		
	More extreme weather events																		
					Increased frequency of flash floods / severe storms (D)	Higher risk of wind or rain damage to historic settlements, parks & gardens e.g. tree throw	Loss of original planting schemes, historically important vistas; damage to structure / features leading to additional renovation / repair work or loss	Historic landscapes, parks & gardens; residents; visitors	3	-3	-9	4	-3	-12	4	-3	-12		
Energy & natural resources																			
	Hotter, drier summers	+1.4 °C	+2.4 °C	+3.4 °C															
		-7%	-18%	-22%															
					Greater number of hours of sunlight (D)	Increase in available solar energy to generate electricity / hot water	More demand for solar panels; move towards greater energy security	Built environment; planners; residents; businesses	3	2	6	4	2	8	4	2	8	Climate Change & Sustainable Building SPD update	
						Increased demand for solar energy installations - greater visual impact	Increasing need to preserve character of certain areas within the Park	Built environment; planners; residents; businesses	3	-2	-6	3	-2	-6	3	-2	-6		
					Lower summer rainfall (D)	Reduced potential for energy generation from hydro	Impact on hydro scheme viability	Built environment; planners; residents; businesses	3	-1	-3	4	-1	-4	4	-1	-4	SDF support for hydro projects	

Peak District National Park Climate Change Adaptation: Risk / Opportunities Assessment and Action Planner

National Park Management Theme: A Diverse Working & Cherished Landscape

Area of potential impact	Relevant headline projection	UKCP09 local data			Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Period: 2020s		Short Term Risk	Period: 2050s		Medium Term Risk	Period: 2080s		Long Term Risk	Actions already in place or planned	Potential actions
		2020s	2050s	2080s															
		+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%					Likelihood (1 - 5)	Impact (-5 to 5)	(-25 to 25)	Likelihood (1 - 5)	Impact (-5 to 5)	(-25 to 25)	Likelihood (1 - 5)	Impact (-5 to 5)	(-25 to 25)		
						Increasing need for rainwater harvesting systems	More rainwater storage / harvesting installations	Built environment; planners; residents; businesses	3	1	3	4	1	4	4	1	4	SDF support for rainwater harvesting projects	
	Warmer, wetter winters	+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%															
					Higher winter rainfall (D)	Increased potential for energy generation from hydro	Greater demand for hydro; move towards energy security	Built environment; planners; residents; businesses	3	1	3	4	1	4	4	1	4		
	More extreme weather events																		
					Increased frequency of flash floods / severe storms (D)	Damage to renewable energy installations & biomass	Cost of repairs; increased insurance premiums; lost income from missed generation / damage to timber / biomass	Renewable energy / biomass owners and users	3	-2	-6	3	-3	-9	3	-3	-9		
Field boundaries (stone walls, hedges)																			
	Warmer, wetter winters	+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%															
					Increased wall flora (ID)	Damage to dry stone walls	Increased maintenance costs; potential new habitat; more work for wall contractors	Farmers; landscape	2	-1	-2	3	-2	-6	3	-2	-6	Grant aid to restore walls through PDNPA / NE	
					Ground saturated / surface water run off (D)	Drystone walls less stable / more sections damaged	Increased maintenance costs; drystone wall removed and replaced with fencing	Farmers; landscape	2	-2	-4	4	-3	-12	4	-3	-12		
Livestock including game																			
	Hotter, drier summers	+1.4 °C -7%	+2.4 °C -18%	+3.4 °C -22%															
					Loss of moisture in soils (D)	Increased difficulty in undertaking controlled moorland burn and increased chance of large scale wildfires on peat soils	Loss of moorland habitat for birds (native species e.g. waders, curlew, snipe and game) short term release of CO2, long-term effect on carbon sequestration and temporary effect on landscape appearance	People: Land managers; general public. Habitats: moorlands, and blanket bog. Fauna associated with moorland habitat	3	-4	-12	4	-4	-16	5	-4	-20	Fire watch system in place once The Met Office Fire Severity Index reaches a certain point. Fire plans for key sites	Develop further awareness amongst land managers and maintain resources for fire watch system
						Loss of soil through wind erosion	Water contamination Reduced reservoir storage (sifting up) Reduced potential for plant growth and crop yields	Habitats: river ecology Water companies; Land managers; Rivers Trusts; fishing interests	2	-2	-4	3	-3	-9	4	-3	-12		
					Increased periods of drought (D)	Reduced drinking water availability for livestock	Dehydrated livestock, illness, lower yields, increased need for supplementary water supply, increased costs and lower returns for land managers. Change in livestock types with potential impact in conservation terms	Livestock, land managers	2	-1	-2	3	-3	-9	4	-4	-16		
						Insufficient water to sustain livestock in areas already susceptible to drought (e.g. White Peak)	Area of viable grazing land reduced; limestone White Peak areas abandoned for grazing	White Peak / limestone habitats, farm business viability, livestock, farmers	3	-3	-9	4	-3	-12	4	-4	-16		
					Lower summer grass yields (ID)	Reduction in yields of hay and silage	Increased cost of purchasing feed; reduction in stocking rate	Farm business viability; livestock; farmers; hay meadow habitats & pasture	2	-2	-4	3	-3	-9	4	-3	-12	Potential to use Envi Stewardship to protect habitats / stock / financial returns	
					Higher temperatures (D)	Increased heat stress of livestock	Impact on livestock welfare; increased demand for shelter / shade; additional demand for farm buildings & tree planting	Livestock; farmers; farm business viability	2	-2	-4	3	-3	-9	4	-3	-12		
	Warmer, wetter winters	+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%															
					Increased rainfall (D)	Greater rainwater storage potential	Increased demand for installation / construction of water storage facilities	Farmers; planners	2	-1	-2	4	-2	-8	4	-2	-8		
						Livestock require additional shelter	Livestock health worsen in wet / damp conditions; additional vet bills / husbandry issues etc	Livestock; farmers; vets; farm business viability	2	-1	-2	4	-3	-12	4	-3	-12		

Peak District National Park Climate Change Adaptation: Risk / Opportunities Assessment and Action Planner

National Park Management Theme: A Diverse Working & Cherished Landscape

Area of potential impact	Relevant headline projection	UKCP09 local data			Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Period: 2020s		Short Term Risk	Period: 2050s		Medium Term Risk	Period: 2080s		Long Term Risk	Actions already in place or planned	Potential actions	
		Likelihood	Impact	Likelihood					Impact	Likelihood		Impact								
		(1 - 5)	(-5 to 5)	(1 - 5)					(-5 to 5)	(1 - 5)	(-5 to 5)	(1 - 5)	(-5 to 5)	(-25 to 25)						
						Increased in pests and diseases as a result of warm and wet conditions	Increased threats to livestock health - pneumonia, lameness etc; use of GM pest resistant crops	Livestock; farmers; farm business viability	2	-2	-4	3	-3	-9	3	-3	-9			
						Waterlogged / flooded ground (D)	Boggier conditions result in reduced area for grazing. Livestock health affected, especially foot problems.	Change in grazing areas; reduced stocking rates; increased costs of feed and husbandry. Increased poaching. May lead to inappropriate drainage schemes on areas of conservation interest	Livestock; farmers; vets; farm business viability	2	-2	-4	4	-3	-12	4	-3	-12	Envi Stewardship to reduce stock in watercourses by fencing.	Regulations through Envi Agency etc
							Boggy conditons by watercourses	Increase in need for fenced areas alongside watercourses; increase in effluent entering watercourse (worsened by trampling)	Livestock; farmers; wetland habitats	3	-2	-6	4	-3	-12	4	-3	-12		
						Longer growing season (ID)	Greater availability of grassland.	Change in stocking rates; breeds used;	Livestock; farm business viability;	3	2	6	3	2	6	3	2	6		
								Potential to outwinter stock	Livestock, farm business viability	3	2	6	3	2	6	3	2	6		
					More extreme weather events															
						Increased frequency of flash floods / severe storms (D)	Livestock require additional shelter	Increased cost of building additional shelter; rise in livestock stress levels; reduction in stocking levels due to constraints on shelter space	Livestock; farm business viability; landscape	3	-3	-9	3	-3	-9	3	-3	-9	Catchment sensitive farming scheme	
Geology and landform																				
	Warmer, wetter winters	+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%																
						Increased rainfall (D)	Ground more frequently waterlogged	Changes to slope & soil stability; more material moved downhill into streams and rivers	Landscape, farmers, water companies, visitors	3	-1	-3	4	-2	-8	4	-2	-8		
	More extreme weather events																			
					More intense rainfall or sudden cold snap (D)	Damage to / instability of rock formations	Loss / modification of landscape features	Landscape, landmanagers, visitors	2	-1	-2	3	-2	-6	3	-2	-6			
Soils and vegetation																				
	Hotter, drier summers	+1.4 °C -7%	+2.4 °C -16%	+3.4 °C -22%																
						Loss of soil moisture (D)	Reduced potential for plant growth / crop yield	Bare soil; increased erosion; fire risk; less carbon stored; loss of income from crops	Farmers / land managers; habitat	3	-2	-6	4	-3	-12	4	-3	-12		
							Delay in revegetation post dry Summers	Change in habitats; loss of key species	Habitats; affected species; visitors	2	-2	-4	3	-3	-9	3	-3	-9		
	Warmer, wetter winters	+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%																
						Increased rainfall (D)	Floodplains restored	Increase in soil fertility and vegetation cover; loss of grazing land	Habitats; visual landscape; Land managers; relevant species	2	-1	-2	3	-2	-6	3	-2	-6		
							Increased erosion	Increased siltation / soil loss; rivers realigned	Land managers; water companies; aquatic and water loving species	3	-2	-6	4	-3	-12	4	-3	-12		
							Change of management on flood prone areas	Removal of structures and boundaries; introduction of new species	Visual landscape - change in pattern of landscape	3	-2	-6	4	-3	-12	4	-3	-12		
						Higher soil moisture content (D)	Change to slope stability; material moving downhill; waterlogging of soils	Greater sediment load entering watercourses; larger areas unsuitable for animals	Water quality; habitats; land managers; livestock	3	-2	-6	4	-3	-12	4	-3	-12		
	More extreme weather events																			
						More intense rainfall (D)	Flash floods increase likelihood of land slips	Vegetation washed away; slower recovery of soils / vegetation	Landscape; water quality; visitors; land managers; livestock	2	-3	-6	3	-3	-9	3	-4	-12		
						Snowfall / severe cold snaps (D)	Heavy snow drifts	Increased rock fall; loss of vegetation; damage to roads	Land managers; highways authority; residents; businesses; visitors	2	-3	-6	2	-3	-6	1	-3	-3		

Peak District National Park Climate Change Adaptation: Risk / Opportunities Assessment and Action Planner

National Park Management Theme: A Diverse Working & Cherished Landscape

Area of potential impact	Relevant headline projection	UKCP09 local data			Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Period: 2020s		Short Term Risk	Period: 2050s		Medium Term Risk	Period: 2080s		Long Term Risk	Actions already in place or planned	Potential actions
		2020s	2050s	2080s															
		+1.4 °C -7%	+2.4 °C -18%	+3.4 °C -22%					Likelihood (1 - 5)	Impact (-5 to 5)	(-25 to 25)	Likelihood (1 - 5)	Impact (-5 to 5)	(-25 to 25)	Likelihood (1 - 5)	Impact (-5 to 5)	(-25 to 25)		
Trees & woodland cover	Hotter, drier summers																		
					Trees become more prevalent within the landscape as morlands dry out (ID)	Improved shade for livestock, shading of water courses, river bank stabilisation and developing the bio-fuel market	Improved livestock welfare and yield, reduced temperature and evaporation of watercourses, reduced erosion during floods, improved local bio-fuel supply. More Beech woodland in the White Peak.	Landscape, livestock, aquatic flora and fauna, land managers, the public	3	2	6	3	2	6	4	2	8	Existing woodland management plans provide for increased tree planting	Assess local appetite and potential for increased planting
					Increased drought conditions (D)	Loss of trees, especially newly established & less drought resistant species	Increased need for replanting / replacement. Tree limb loss more prevalent	Landscape; woodland; land managers; visitors; H&S issues	3	-1	-3	3	-2	-6	4	-2	-8		
						Increased risk of fires	Loss of tree cover	Landscape; woodland; health & safety; land managers; visitors	3	-3	-9	4	-3	-12	4	-4	-16		
	Warmer, wetter winters	+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%															
					Longer growing season (D)	More extensive tree growth	Change in visual characteristics of landscape	Landscape; habitats; land managers;	2	1	2	3	-2	-6	4	-2	-8		
					Reduced incidences of frost; warmer damp conditions (D)	Increased prevalence of diseases and pests	Damage and death of trees e.g. Phytophthora	Landscape; woodlands; land managers	3	-3	-9	3	-3	-9	4	-4	-16		
	More extreme weather events																		
					Tree damage more prevalent (ID)	Tree damage; more trees felled due to H&S concerns	Reduction in tree cover; increase costs of insurance; increased costs associated with tree surgery / removal	Landscape; woodlands; arborists; visitors	3	-2	-6	4	-3	-12	4	-3	-12		
Water	Hotter, drier summers																		
					Hotter summer temperatures and lower summer rainfall (D)	Reduced levels within reservoirs	Increased demand for reservoir storage	Landscape; water companies; consumers	3	-2	-6	4	-3	-12	4	-4	-16		
						Change in flow levels	Harder to reach treatment standards; additional treatment required	Landscape; water companies; consumers	3	-2	-6	4	-3	-12	4	-4	-16		
						White Peak streams and rivers dry for longer periods of the year	Change to aquatic habitats & species	Habitats; land managers; farmers	3	-3	-9	4	-3	-12	4	-3	-12		
	Warmer, wetter winters	+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%															
					Increased rainfall (D)	Insufficient storage within reservoirs	Increased demand for additional reservoir storage	Landscape; water companies	2	-2	-4	4	-3	-12	4	-4	-16		
						Better return on hydro power schemes	More schemes developed	Aquatic habitat / species; planners; utility companies	2	2	4	3	2	6	3	2	6		
	More extreme weather events																		
					More intense rainfall (D)	Increased rate of soil erosion	Increased dissolved organic compound levels requires further water treatment; silting up of reservoirs; impact on aquatic habitats	Water companies; land managers; aquatic habitats	2	-1	-2	3	-3	-9	3	-3	-9		

Peak District National Park Climate Change Adaptation: Risk / Opportunities Assessment and Action Planner

National Park Management Theme: A Welcoming & Inspiring Place

Area of potential impact	Relevant headline projection	UKCP09 local data			Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Period: 2020s		Short Term Risk	Period: 2050s		Medium Term Risk	Period: 2080s		Long Term Risk	Actions already in place or planned	Potential actions
		2020s	2050s	2080s															
		+1.4 °C -7%	+2.4 °C +18%	+3.4 °C -22%					Likelihood (1 - 5)	Impact (-5 to 5)	(-25 to 25)	Likelihood (1 - 5)	Impact (-5 to 5)	(-25 to 25)	Likelihood (1 - 5)	Impact (-5 to 5)	(-25 to 25)		
Rights of Way and Open Access	Hotter, drier summers																		
					Increased frequency of wildfires (D)	Rights of way / open access land is damaged	Rights of way / access land becomes unusable resulting in greater restrictions being put in place	Visitors, residents, landowners and land managers	4	-3	-12	4	-4	-16	5	-4	-20	Peak District FOG fire plans and regular training helps reduce frequency and impact of wildfires	Additional mobile water storage tanks being placed at places of high fire risk
							Fire damaged areas become less attractive to visit	Visitors, residents	4	-2	-8	4	-2	-8	5	-4	-20		
					More demand for shaded routes or those close to water (ID)	Increased pressure on certain rights of way / access routes close to water or in shade	Maintenance requirements increase.	Visitors, landowners, land managers, ROW maintenance teams	4	-2	-8	4	-2	-8	5	-3	-15	Robust infrastructure at popular sites	Change in ROW maintenance plans to respond to changing visitor pressure
	Warmer, wetter winters																		
					Increased frequency for areas to be flooded / waterlogged (D)	Rights of way / open access land flooded, waterlogged or eroded	Harder to use rights of way; more maintenance required; more restrictions in place	Visitors, residents, landowners and land managers	3	-2	-6	4	-3	-12	5	-4	-20	Additional ROW improvement works as required	
					Longer growing season (D)	Greater volume and density of vegetation on rights of way and access land	Increased maintenance requirements on rights of way	Contractors, landowners, landmanagers, conservation volunteers, PDNPA staff, visitors, residents	4	-1	-4	4	-2	-8	4	-3	-12		
Visitor & recreational infrastructure	More extreme weather events																		
					Increased frequency of flash floods / severe storms (D)	Bridges and other access structures get damaged or washed away	Rights of way become unusable and access restrictions in place	Visitors, residents, landowners, H&S issues, land managers	3	-3	-9	4	-4	-16	4	-4	-16	New and replacement bridge design specification changes to cope with greater volumes of water	Systematic review of existing bridges with associated work plans put in place
	Hotter, drier summers																		
					More visitors in the Summer months (ID)	Increased pressure on infrastructure during hotter months	Overcrowding in popular areas - especially gateway sites close to urban areas; reduction in quality of visitor experience	Visitors, staff / businesses serving visitors; landowners; landmanagers; residents	4	-2	-8	4	-2	-8	5	-3	-15	Differential pricing to encourage off & shoulder season visits	More incentives to 'Park & Ride' at transport hubs
					Extended Summer visitor season (ID)	Increased pressure for longer period on infrastructure during hotter months	Increased likelihood of conflict between user groups; landowners; land managers; businesses and residents	Visitors, staff / businesses serving visitors; residents	2	-2	-4	3	-3	-9	3	-3	-9		
					Greater demand on areas of shade or close to water (ID)	Increased pressure on Upper Derwent; Goyt; Macc Forest; White Peak Dales; Reservoirs	Overcrowding in areas identified; increased pressure on infrastructure and visitor facing staff; business opportunities	Visitors, residents, landowners, land managers; business owners	3	-2	-6	4	-2	-8	4	-3	-12		New shaded sites developed / opened to cope with visitor pressure
	Warmer, wetter winters																		
					Higher groundwater levels / increased risk of flooding (D)	Water damage to visitor & recreational infrastructure - buildings / sites	Impact on access to / reliability of visitor facilities	Visitors, landowners, land managers; business owners	2	-1	-2	3	-2	-6	4	-2	-8		
					Longer growing season (D)	Greater volume and density of vegetation on or around visitor & recreational infrastructure	Increased maintenance required	PDNPA staff, visitors, residents, business owners	4	-1	-4	4	-2	-8	4	-2	-8		
	More extreme weather events																		
					Increased frequency of flash floods / severe storms (D)	Damage to visitor & recreational infrastructure - buildings / sites / paths etc	Infrastructure becomes unusable / unreliable opening times etc	Visitors, landowners, land managers; business owners	3	-1	-3	4	-1	-4	4	-2	-8		

Peak District National Park Climate Change Adaptation: Risk / Opportunities Assessment and Action Planner

National Park Management Theme: A Welcoming & Inspiring Place

Area of potential impact	Relevant headline projection	UKCP09 local data			Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Period: 2020s		Short Term Risk	Period: 2050s		Medium Term Risk	Period: 2080s		Long Term Risk	Actions already in place or planned	Potential actions
		2020s	2050s	2080s					Likelihood	Impact		Likelihood	Impact		Likelihood	Impact			
		(1 - 5)	(-5 to 5)	(-25 to 25)					(1 - 5)	(-5 to 5)	(-25 to 25)	(1 - 5)	(-5 to 5)	(-25 to 25)					
Visitor usage and numbers	Hotter, drier summers	+1.4 °C -7%	+2.4 °C -18%	+3.4 °C -22%															
					Increased number of visitors to PDNP (ID)	Greater demand for visitor services - accommodation; recreational activities; events etc	Expansion in visitor economy	Visitors, tourism related businesses , landowners, land managers	3	4	12	4	4	16	4	4	16	Increased promotion of alternative means of access (eg Peak Connections, cycling trails)	More incentives to 'Park & Ride' at transport hubs
						Already popular sites e.g. Castleton, Dovedale, Fairholmes, Bakewell etc become even more overwhelmed	Loss of what made places special	Visitors, tourism related businesses , landowners, land managers	4	-2	-8	4	-2	-8	4	-3	-12	Increased promotion of alternative means of access (eg Peak Connections, cycling trails)	More incentives to 'Park & Ride' at transport hubs
					Greater demand for 'cooler' visitor experiences e.g. woodland walks & rides, caverns, water based recreation (ID)	Increased pressure on limited number of sites	Insufficient capacity to cope with demand; potential conflict between different user groups / landowners etc	Woodland land owners / managers; visitors; residents	3	-1	-3	4	-1	-4	4	-2	-8		
						Opportunity to provide a new & different set of visitor experiences	Additional / varied recreational opportunities across the PDNP	Visitors, tourism related businesses , landowners, land managers	3	2	6	3	2	6	3	2	6		
	Warmer, wetter winters	+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%															
					Higher groundwater levels / increased risk of flooding (D)	Wet weather / floods discourage visitors	Fewer visitors during wetter months	Visitors; landowners/ managers; tourism businesses	3	-1	-3	3	-1	-3	4	-2	-8		
					Lower number of visitors during the winter (ID)	Smaller turnover for visitor reliant businesses	Increased seasonality / fewer jobs during winter months	Employees; residents; businesses	2	-1	-2	2	-1	-2	2	-1	-2		
					More extreme weather events														
					Increased frequency of flash floods / severe storms (D)	Outdoor recreation & events increasingly vulnerable to disruption	Loss of income; lower levels of visitor satisfaction	Visitors; event organisers; businesses	3	-1	-3		-2	-8	4	-3	-12		
				Increasing uncertainty about access to PDNP (ID)	Negative publicity; drop in visitor numbers; those less confident in accessing the NP	Loss of income to local economy	Visitors; tourism related businesses	2	-1	-2	3	-2	-6	3	-2	-6			
Transport																			
	Hotter, drier summers	+1.4 °C -7%	+2.4 °C -18%	+3.4 °C -22%															
					Increasing number of visitors using roads (ID)	Increased congestion & emissions; worsening air quality	Increased risk of injury on roads (especially walkers, cyclists, horse riders); higher demand for car parking; fall in visitor satisfaction; increased aggression / conflict	Road users; residents; visitors; businesses	4	-3	-12	4	-3	-12	4	-3	-12	Reduced speed limits across the National Park. Langsett Village declared an Air Quality Management Area in 2011.	Greater provision of public transport options in to and within the National Park
					Higher demand for public transport (ID)	Pressure for new routes and additional public transport capacity	Increase in visitors using public transport	Visitors, residents, transport companies	3	3	9	3	3	9	3	3	9	Promotion of existing public transport routes to visitors, particularly through Peak Connections	Greater provision of public transport options in to and within the National Park
					Increased likelihood of deteriorating transport infrastructure esp road melt (ID)	Increase in number of accidents due to pot holes etc / decrease in ride quality	Increased maintenance; repair and insurance costs. Decrease in travellers' experience and comfort	Visitors, residents, businesses	4	-3	-12	4	-3	-12	4	-3	-12	Ongoing maintenance works	Change in maintenance regime and use of materials to better cope with prevailing climatic conditions
	Warmer, wetter winters	+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%															
					More prolonged rainfall, higher water levels & flooding (D)	Blocked drains / gullies on roads; erosion of road and rail routes	Worsening condition of transport infrastructure; greater maintenance demand	Road users, visitors, residents, transport companies, local authorities; businesses	3	-3	-9	3	-3	-9	4	-4	-16	Gully and drain clearing works	Larger gullies and drain capacity.
					Longer growing season (D)	More road, rail and path side vegetation & overhanging trees	Increased maintenance requirement	Road users, visitors, residents, transport companies, local authorities	4	-3	-12	4	-4	-16	4	-4	-16	Some extension to roadside cutting works (sensitive to wildflowers)	Additional resources put into roadside, trails and Rights of Way vegetation clearance works
					More extreme weather events														
					Transport routes closed by floods / storms / snow (D)	Disruption to transport routes & infrastructure; increased number of accidents	Overall reduction in visitor numbers; increased maintenance costs	Road users, visitors, residents, businesses	3	-3	-9	4	-4	-16	4	-4	-16	Road closed and diversion signs / notification via website	More real time road status updates available via Sat Nav and new media technologies

Peak District National Park Climate Change Adaptation: Risk / Opportunities Assessment and Action Planner

National Park Management Theme: Thriving & Vibrant Communities

Area of potential impact	Relevant headline projection	UKCP09 local data			Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Period: 2020s		Short Term Risk	Period: 2050s		Medium Term Risk	Period: 2080s		Long Term Risk	Actions already in place or planned	Potential actions
		2020s	2050s	2080s															
									Likelihood	Impact		Likelihood	Impact		Likelihood	Impact			
		(1 - 5)	(-5 to 5)	(-25 to 25)								(1 - 5)	(-5 to 5)	(-25 to 25)	(1 - 5)	(-5 to 5)	(-25 to 25)		
Built environment - existing and new development	Hotter, drier summers	+1.4 °C -7%	+2.4 °C -18%	+3.4 °C -22%															
					Higher interior building temperatures - housing and business premises (D)	Demand for cooling through air conditioning; increased demand for shading; ongoing legislative and policy changes seeking adaptation	Visual intrusion of air conditioning units & canopies into built landscape	Residents; built environment; planners	3	-3	-9	4	-3	-12	5	-3	-15	Plans & policy guidance already being revised to facilitate adaptation & mitigation	Plans and policies may need periodic updating to reflect different legislation, policy drivers or results from monitoring.
						Demand for cooling delivered by innovative building design.	Housing / business premises without intrusive features that are healthy to live and work in.	Residents; occupiers of new housing and business premises	3	3	9	4	3	12	5	3	15		
					Drier summers (D)	Household / businesses water supply less reliable, spring fed properties	Water restrictions put in place e.g. hose pipe bans; Increased demand for domestic and commercial water shortage facilities	Residents; businesses water companies	3	-2	-6	4	-3	-12	5	-4	-20		Install rainwater harvesting systems; repair leaks;
	Warmer, wetter winters	+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%															
					Higher winter rainfall (D)	Increased flood risk to new and existing development	More flood protection measures required raising costs; less suitable land available for developments; stricter policies on development in flood risk areas	Landowners; households; businesses; planners	3	-3	-9	4	-4	-16	4	-4	-16		Development of property flood response plans; physical flood protection measures installed
	More extreme weather events																		
Community life					Increased frequency of flash floods / severe storms (D)	Damage to buildings from storms	Change in design of new buildings; need to retrofit flood / storm protection measures to existing buildings	Householders; businesses; planners; built environment	2	-2	-4	3	-3	-9	3	-3	-9		
	Hotter, drier summers	+1.4 °C -7%	+2.4 °C -18%	+3.4 °C -22%															
					Increase in summer outdoor events (ID)	Greater opportunities to be involved in local community events; more visitors attend events	Increased income generation potential; greater sense of community; reduced isolation	Residents; visitors	2	2	4	3	2	6	3	2	6	SDF support for community projects	
					Heat waves (D)	Increased rates of ill health due to the heat, especially in vulnerable groups	Higher demand on health services; trauma to community	Residents; visitors	2	-1	-2	3	-3	-9	4	-4	-16		Public education campaign on how to avoid heatstroke and treat the symptoms
	Warmer, wetter winters	+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%															
					Increased rainfall (D)	Community buildings at greater risk of flooding	Damage to buildings; loss of income; increased insurance; greater need for mitigation measures; cancellation of community event/groups	Community groups; residents	3	-2	-6	3	-3	-9	4	-3	-12		Development of property flood response plans; physical flood protection measures installed
					Decrease in visitor numbers (ID)	Fewer opportunities for businesses providing products & services serving visitors	Seasonal jobs, less buoyant economy during the winter	Businesses; residents; visitors	3	-1	-3	3	-2	-6	3	-2	-6		
	More extreme weather events																		
					Increased frequency of flash floods / severe storms (D)	Remote communities harder to access / provide services to	Communities cut off; increases self reliance of communities and volunteers within them	Residents; service providers	3	-2	-6	3	-3	-9	3	-3	-9	Local authority emergency response plans in place	
						Increased levels of stress following extreme weather events e.g. floods	Greater demand on health services and community support services	Health services; residents	3	-2	-6	3	-3	-9	3	-3	-9		

Peak District National Park Climate Change Adaptation: Risk / Opportunities Assessment and Action Planner

National Park Management Theme: Thriving & Vibrant Communities

Area of potential impact	Relevant headline projection	UKCP09 local data			Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Period: 2020s		Short Term Risk	Period: 2050s		Medium Term Risk	Period: 2080s		Long Term Risk	Actions already in place or planned	Potential actions
		2020s	2050s	2080s					Likelihood	Impact		Likelihood	Impact		Likelihood	Impact			
		(1 - 5)	(-5 to 5)	(-25 to 25)					(1 - 5)	(-5 to 5)	(-25 to 25)	(1 - 5)	(-5 to 5)	(-25 to 25)					
Settlement and buildings																			
	Hotter, drier summers	+1.4 °C -7%	+2.4 °C -18%	+3.4 °C -22%															
					Buildings become hotter (D)	Increased demand for adaptation measures - e.g. awnings for shade; airconditioning units	Damage / change to fabric of the buildings. Change in built landscape; increased number of planning applications	Building owners; planning officers;	2	-1	-2	3	-3	-9	4	-3	-12		
					Changes to buildings as a result of actions to reduce CO2 (ID)	Increase in insulation and micro generation measures installed	Damage / change to fabric of the buildings. Change in built landscape; increased number of planning applications	Building owners; planning officers;	3	-2	-6	4	-2	-8	4	-2	-8		
				Change in building design - domestic and commercial (ID)	Loss of traditional character	Impact on visual landscape	Visitors; building owners; planners	1	-1	-1	2	-2	-4	3	-2	-6			
	Warmer, wetter winters	+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%															
				Increased rainfall (D)	Buildings / settlements unable to cope with the additional rainfall / intensity - increased risk of flooding	Disruption to home and work life; increased insurance costs; buildings left empty	Building owners & occupiers; historic fabric of buildings	2	-2	-4	4	-3	-12	4	-4	-16	Environmet Agency floodline		
					Damage due to building collapse from water logged soils	Economic impacts; loss of homes and work places	Building owners, especially older properties	1	-1	-1	2	-2	-4	3	-2	-6			
	More extreme weather events																		
				Intense rainfall, storms and snow / cold snaps (D)	Increased damage to buildings	Settlements cut off. Roads inaccessible; loss of services	Building owners; residents; businesses	2	-2	-4	3	-3	-9	3	-3	-9	Local authority emergency response plans in place		

Peak District National Park Climate Change Adaptation: Risk / Opportunities Assessment and Action Planner

National Park Management Theme: An Enterprising & Sustainable Economy

Area of potential impact	Relevant headline projection	UKCP09 local data			Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Period: 2020s		Short Term Risk	Period: 2050s		Medium Term Risk	Period: 2080s		Long Term Risk	Actions already in place or planned	Potential actions
		2020s	2050s	2080s					Likelihood	Impact		Likelihood	Impact		Likelihood	Impact			
		(1 - 5)	(-5 to 5)	(-25 to 25)					(1 - 5)	(-5 to 5)		(-25 to 25)	(1 - 5)		(-5 to 5)	(-25 to 25)			
Crop management																			
	Hotter, drier summers	+1.4 °C	+2.4 °C	+3.4 °C															
		-7%	-18%	-22%	Reduced soil moisture (D)	Crop germination affected	Reduce yield / profits; change in crops planted	Farmers; farm business viability	3	-3	-9	4	-4	-16	4	-4	-16		
						Increased soil erosion	Loss of soil carbon; reduced soil fertility; silting up of nearby watercourses	Farmers; water quality	2	-2	-4	4	-3	-12	4	-3	-12	Use of appropriate Environmental Stewardship land management options	Regulations
					Heat waves / drought (D)	Crops / grassland damaged	Reduced yield / profits; change in crops planted; increased demand for irrigation; water storage	Farmers; farm business viability; planners	2	-2	-4	3	-3	-9	4	-3	-12		Move to organic farming systems
				Drier ground and longer 'ripening' season for crops (D)	Ability to move into arable crops, especially across the White Peak	Loss of grassland; potential removal of stone walls to enlarge field size; change in farm business model	Farmers; farm business viability; bird species; landscape	3	-4	-12	3	-4	-12	4	-4	-16	Envi Stewardship arable options		
	Warmer, wetter winters	+1.3 °C	+2.2 °C	+3.0 °C															
	+4%	+10%	+13%																
				Longer growing season (ID)	Increase in some crop yields	Reduced additional feed costs; change in habitats	Livestock; farmers	2	1	2	3	2	6	3	2	6			
				Increased potential for bio / energy crops (ID)	Reduced land for traditional farming	Change in habitats & landscape	Farmers; habitats; landscape	2	-1	-2	3	-2	-6	3	-2	-6			
				Financial opportunity for farmers	Income diversification for farmers / land managers	Farmers; habitats; landscape	Farmers; habitats; landscape	2	1	2	3	2	6	3	2	6			
				Increased incidence of pests and diseases due to fewer frosts (D)	Impact on crop yields	Greater need for chemicals - increased cost to farmers	Farmers; crops; habitats	2	-1	-2	3	-2	-6	3	-2	-6			
More extreme weather events																			
			Increased frequency of flash floods / severe storms (D)	Damage to / loss of crops; increased soil erosion	Loss of income; increased costs	Farmers; farm business viability	2	-2	-4	3	-3	-9	3	-3	-9	Natural use of floodplans encouraged through Envi Stewardship			
Land use																			
	Hotter, drier summers	+1.4 °C	+2.4 °C	+3.4 °C															
		-7%	-18%	-22%	Greater land area put over to arable crops (ID)	Farm diversification opportunities; change in land management practices	Loss of traditional landscape features e.g. hay meadows; stone walls & hedges; small scale farm units. Increase in number of mixed farms.	Landscape; farmers; residents; visitors	1	-1	-1	2	-3	-6	3	-4	-12		
	Warmer, wetter winters	+1.3 °C	+2.2 °C	+3.0 °C															
	+4%	+10%	+13%	More rainfall (D)	Less outdoor grazing due to unsuitable conditions for livestock	Increased demand for larger shelters	Visual landscape; land managers	3	-1	-3	4	-2	-8	4	-3	-12		Build / extend shelters for livestock	
Local economy																			
	Hotter, drier summers	+1.4 °C	+2.4 °C	+3.4 °C															
		-7%	-18%	-22%	Increase in visitor numbers (ID)	Greater number of opportunities for businesses providing products & services serving visitors	Job creation, more buoyant economy	Businesses; residents; visitors	3	1	3	3	2	6	3	2	6	Promote alternative sites with lower visitor pressure and capacity to support more visitors	
					More Visitor pressure on National Park especially already popular shaded areas and sites close to water	Insufficient capacity to cope with demand; potential conflict between different user groups, lower quality visitor experience	Visitors; businesses; residents	3	-2	-6	3	-3	-9	3	-3	-9			
	Warmer, wetter winters	+1.3 °C	+2.2 °C	+3.0 °C															
	+4%	+10%	+13%	Increased rainfall (D)	Businesses at greater risk of flooding	Damage to buildings; loss of income; increased insurance; greater need for mitigation measures	Businesses; employees; residents; visitors	3	-3	-9	4	-4	-16	4	-4	-16		Development of business flood response plans; physical flood protection measures installed	

Peak District National Park Climate Change Adaptation: Risk / Opportunities Assessment and Action Planner

National Park Management Theme: An Enterprising & Sustainable Economy

Area of potential impact	Relevant headline projection	UKCP09 local data			Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Period: 2020s		Short Term Risk	Period: 2050s		Medium Term Risk	Period: 2080s		Long Term Risk	Actions already in place or planned	Potential actions
		Likelihood	Impact	Likelihood					Impact	Likelihood		Impact							
		2020s	2050s	2080s					(1 - 5)	(-5 to 5)	(-25 to 25)	(1 - 5)	(-5 to 5)	(-25 to 25)	(1 - 5)	(-5 to 5)	(-25 to 25)		
	More extreme weather events																		
				Increased frequency of flash floods / severe storms (D)	Business premises at greater risk of damage	Increased costs associated with repair and insurance; disruption to business activity	Businesses; employees; customers; residents	3	-2	-6	4	-3	-12	4	-3	-12			
					Disruption to communication and utilities	Disruption to business; loss of income	Businesses; employees; customers; residents	3	-2	-6	4	-3	-12	4	-3	-12		Use of Cloud computing to ensyre off site backup and access to data from alternative sites. More robust rural broadband.	

Peak District National Park Climate Change Adaptation: Risk / Opportunities Assessment and Action Planner

Peak District National Park Authority - Business Continuity

Area of potential impact	Relevant headline projection	UKCP09 local data			Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Period: 2020s		Short Term Risk	Period: 2050s		Medium Term Risk	Period: 2080s		Long Term Risk	Actions already in place or planned	Potential actions
		2020s	2050s	2080s															
		+1.4 °C -7%	+2.4 °C -18%	+3.4 °C -22%					Likelihood (1 - 5)	Impact (-5 to 5)		Likelihood (1 - 5)	Impact (-5 to 5)		Likelihood (1 - 5)	Impact (-5 to 5)			
NPA Staff welfare & working practices	Hotter, drier summers																		
					Heat waves (D)	More aggression experienced on estates & trails, cycle hire, visitor centres due to hotter temperatures	Danger to staff and visitors	Staff; health & safety	2	-2	-4	3	-3	-9	4	-3	-12	Handling aggression training; Risk Assessments	More remedial actions e.g. no lone working for Field Staff
					Higher building temperatures (D)	Uncomfortable working conditions for staff, potential for heat stress or heat related illness.	Decrease in staff productivity, increase in absence	Staff; working conditions; IT equipment	3	-2	-6	4	-3	-12	4	-4	-16		Increased ventilation / fans / AC units in key areas; change in working hours to earlier mornings / later evenings; additional insulation to keep out heat
					Increased hours of sunshine (D)	Reduced time available to work outdoors	More potential for heat stroke / sunburn. Greater need for PPE; change of working hours	Staff; working conditions	2	-2	-4	3	-3	-9	4	-3	-12		Change in working hours to cooler mornings & evenings; additional PPE provision
	Warmer, wetter winters	+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%															
					Increased risk of flooding (D)	Greater demand on Field Services staff to respond to flood events	Other work areas impacted upon - work backs up; additional training requirements related to flood response; greater risk of injury / death	Staff; training demands; working conditions	2	-2	-4	4	-3	-12	4	-3	-12	Notification via Envi Agency flood warning system 'Floodline'	
	More extreme weather events																		
					Increased frequency of flash floods / severe storms (D)	Damage to property, displacement from homes	Increased stress level during & post extreme weather event; staff absenteeism to deal with aftermath / clear up etc	Staff	2	-2	-4	3	-3	-9	3	-3	-9		
NPA property & estates	Hotter, drier summers																		
					Increased damage to buildings and estates (ID)	Properties & estates disrupted by fire / smoke damage; subsidence and changes to soil moisture around foundations	Damage to estate / injury to people & livestock; increase requirement for repairs; closure of buildings	Habitats; key species; livestock; staff; public; visitors; tenants; tenant businesses	3	-3	-9	4	-3	-12	4	-4	-16	Established plans to close moorland areas due to fire risk. Fire watch system in place once The Met Office Fire Severity Index reaches a certain point	Additional fire breaks Additional mobile water storage at high risk sites Further training and fire fighting equipment Fire watch sessions extended
					Increased visitor numbers (ID)	Greater pressure on visitor centre, car parks, trails, cycle hire, field services etc	Congestion, reduced customer service levels, increased likelihood of aggression / conflict; greater income & costs	Staff; visitors;	3	-3	-9	4	-4	-16	4	-4	-16		Promote alternative sites with lower visitor pressure and capacity to support more visitors
					Drying up of springs (D)	Spring fed properties affected	Disruption to service(s) provided at spring fed properties. Disruption to domestic and agricultural supplies at tenanted properties	Hollin Bank toilet block & other spring fed properties; visitors; staff; tenants; livestock	4	-2	-8	5	-2	-10	5	-2	-10	Close monitoring of security of spring supplies. Provision of temporary bowser supplies. Use of mains fed supplies when the opportunity arises.	Greater water efficiency at appropriate sites.
					Higher building temperatures (D)	Uncomfortable working conditions for staff, potential for heat stress or heat related illness.	Visual impact of air conditioning units. Increased energy costs and CO2 emissions	Staff; working conditions; IT equipment; CO2 emissions	3	-1	-3	4	-2	-8	4	-2	-8		Additional shading provided by tree planting (long term) - blinds, louvers, sun shades (short term)
	Warmer, wetter winters	+1.3 °C +4%	+2.2 °C +10%	+3.0 °C +13%															
					Increased likelihood of flooding / waterlogging (D)	Properties & estates disrupted by flood damage	Damage to properties & estates, need to relocate people & livestock; greater need for building inspection / maintenance	Habitats, key species, livestock, staff; public	3	-2	-6	4	-3	-12	4	-3	-12	Avoiding new build in floodplain Clearing drainage channels etc Flood alert system	Retrofit flood protection measures Alter building / estate uses Abandon areas with high flood risk
						Work disrupted due to travel restrictions / property closure etc	Project deadlines affected Key services not delivered	Staff, public, reputation	2	-2	-4	4	-2	-8	4	-3	-12	Working from home systems in place Tele/video conference facilities	Expansion of working from home options for staff Additional tele/video conference capacity
					Reduced heating demand of NPA properties (ID)	Reduced energy use and CO2 emissions	Lower CO2 emissions; cost savings	Budgets; Carbon Footprint / CO2 emissions	3	1	3	4	2	8	4	2	8		

Peak District National Park Climate Change Adaptation: Risk / Opportunities Assessment and Action Planner

Peak District National Park Authority - Business Continuity

Area of potential impact	Relevant headline projection	UKCP09 local data			Projected impacts (Direct (D) and/or Indirect (ID))	Risks and opportunities	Consequences	What / who is affected?	Period: 2020s		Short Term Risk	Period: 2050s		Medium Term Risk	Period: 2080s		Long Term Risk	Actions already in place or planned	Potential actions
		Likelihood	Impact	Likelihood					Impact	Likelihood		Impact							
		(1 - 5)	(-5 to 5)	(-25 to 25)					(1 - 5)	(-5 to 5)	(-25 to 25)	(1 - 5)	(-5 to 5)	(-25 to 25)					
					Increased pressure on buildings & structures (damp, leaks, drainage etc) (ID)	Properties become unsuitable for their purpose	Greater need for inspection / maintenance; additional capital works & repairs required	Staff; visitors; property budgets	2	-2	-4	3	-2	-6	3	-3	-9		
	More extreme weather events																		
					Damage to properties & estates (D)	Properties & estates become unsafe and have to be closed	Disrupted service provision to public & partners; disruptive access to estates	Staff, partners, reputation, visitors	3	-2	-6	4	-3	-12	4	-3	-12	Regular checks on buildings to identify damage	Changes to building maintenance specifications to withstand stronger winds, more intense rainfall etc