



Asiantaeth yr
Amgylchedd Cymru
Environment
Agency Wales

enhancing... improving... cleaning... restoring...
changing... tackling... protecting... reducing...
create a better place... influencing... inspiring...
advising... managing... adapting...

Managing the environment in a changing climate

A report to Defra and the Welsh Assembly Government in
response to a direction to report under the provisions of the
Climate Change Act 2008

November 2010

Annex 2 – Risks and adaptation actions

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Introduction

This is an annex to our report *Managing the environment in a changing climate*, which sets out our climate risks and adaptation plans in response to a direction under the Climate Change Act 2008 from the Secretary of State for Environment, Food and Rural Affairs and the Welsh Ministers. It should be read together with the main report and the other annexes to understand the approach we have taken, our climate risks and adaptation plans.

This annex provides a tabular summary of the risk assessments and action plans compiled for our duties under twelve themes:

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Each summary consists of:

- (i) a conceptual model of the main drivers, pressures and impacts from climate change (for climate-sensitive objectives only);
- (ii) a characterisation of our climate change risks in terms of four key attributes (for climate-sensitive objectives only);
- (iii) a description of our forthcoming and completed adaptation actions and an indication of levels of resource;
- (iv) a description of potential opportunities associated with climate change;
- (v) a list of key references for our assessment of potential climate change impacts.

A key to the definitions of those key attributes and resource estimates is provided below.

Risk Characterisation

Attribute	Score	Definition
Importance <i>The extent to which climate change could compromise delivery</i>	Severe	Our objective could be unachievable with current resources and delivery and this could have major impacts on the wider organisation (for example, legal challenge or undermines licence to operate).
	Substantial	Our objective could be unachievable with current resources and delivery and this could have some impact on the wider organisation.
	Moderate	Our objective could be unachievable with current resources and delivery but this will have little or no impact on the wider organisation.
	Minor	There will be some impact on our objective with current resources and delivery.
	Negligible	There will be virtually no impact on our objective with current resources and delivery.
Proximity <i>When we need to take action</i>	Now	Current resources and delivery are already potentially unsustainable.
	Short-term	Current resources and delivery could be unsustainable by 2030.
	Medium-term	Current resources and delivery could be unsustainable by 2060.
	Long-term	Current resources and delivery could be unsustainable by 2100.
Resource <i>Effort needed to adapt</i>	Minor	We can reallocate resources from within the same department.
	Moderate	We will need to reallocate resources between departments.
	Substantial	We cannot fully adapt without some additional external resources.
	Major	We cannot fully adapt without significant additional external resources.
Inertia <i>How quickly we can adapt</i>	Long-term	Longer than two corporate planning cycles (10+ years).
	Medium-term	Within two corporate planning cycles (10 years).
	Short-term	Within one corporate planning cycle (5 years).
	Rapid	Within 2 years.

Confidence

Confidence in the evaluation of importance and proximity was expressed as:

- **very low** – based on expert judgement or weak evidence only;
- **low** – based on few, incomplete, inconclusive impact studies;
- **medium** – based on expert interpretation of a number of (potentially conflicting) impact studies;
- **high** – based on impact studies that give a consistent picture but do not explore uncertainty fully;
- **very high** – based on many impact studies that give a coherent picture and explore uncertainty fully.

Confidence in the evaluation of resource and inertia was expressed as:

- **very low** – we do not have sufficient understanding of the impact to be able to suggest any possible response;
- **low** – we do not have a good understanding of our response;
- **medium** – we understand the nature and scale of the response required (for example, change of policy, major legislative intervention etc);
- **high** – we have scoped the feasibility of specific responses;
- **very high** – we have scoped the feasibility of specific responses and have developed policy for best practice.

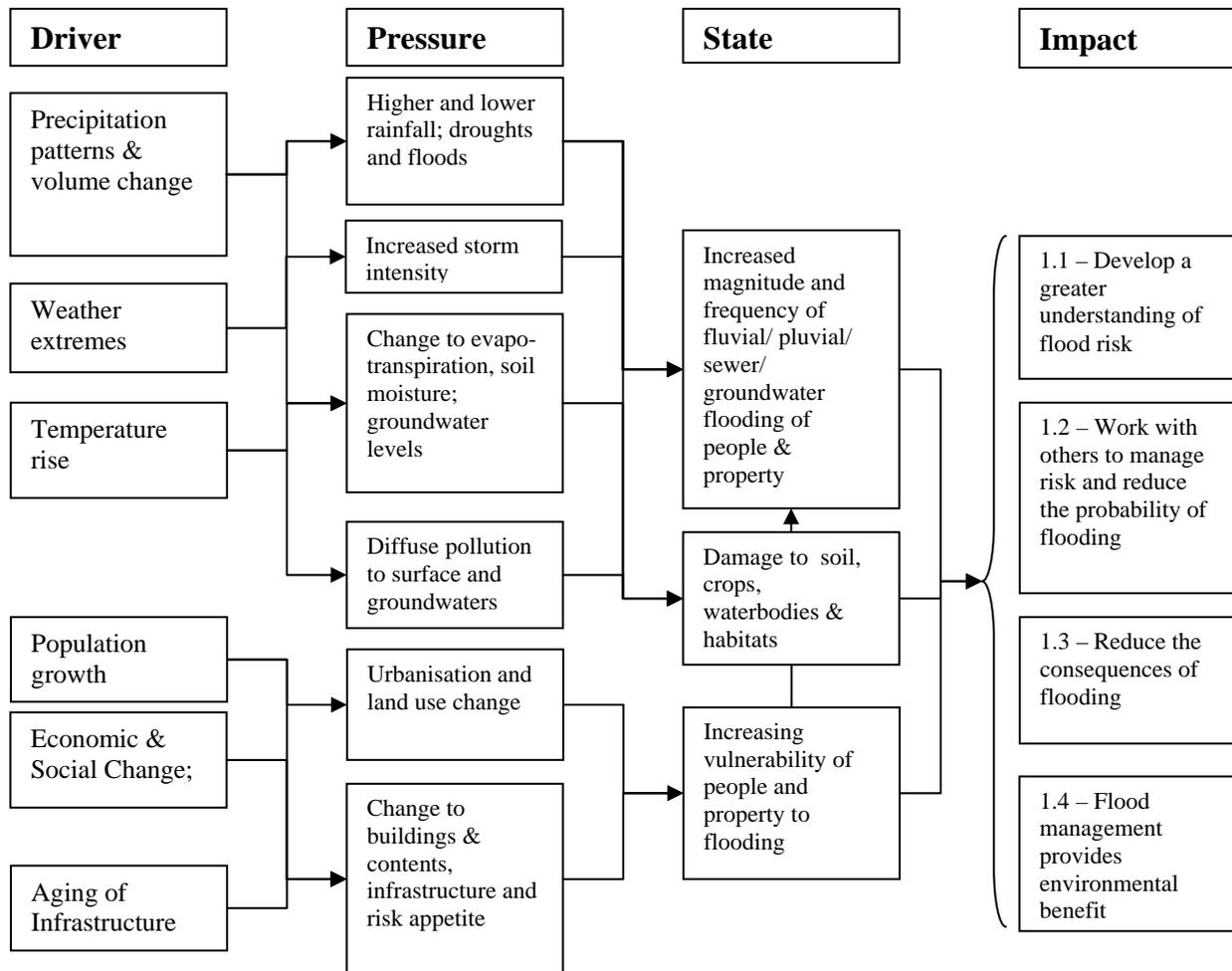
Costs

The indicative cost of actions is rated low (less than £50k), medium (£50-500k) or high (more than £500k). Where the costs of adaptation could not be disaggregated from normal business practice, total costs have been displayed in parentheses to indicate that adaptation is a sub-component of the proposed action. Costs rated as N/A

indicate that the proposed actions cannot be assigned an indicative cost given their strategic nature but where possible indicative costs will be assigned as these actions are developed further.

Inland flooding

Conceptual model of sensitive risks



Key evidence
- We have assessed the potential climate change impacts on river flood flows using UKCIP02/ UKCP09 projections, though we have not yet fully incorporated these into our flood risk models
- Our understanding of the characteristics of climate change risk, and the measures to manage risks and vulnerabilities have been developed through a number of Environment Agency, Defra and Office of Science and Technology studies and are incorporated in our Long term Investment Strategy
- We have undertaken our own research to understand when climate change may noticeably alter precipitation patterns and extremes. This is published in peer reviewed academic literature
- We rely on external research to help us better understand changes to extreme rainfall, which at present is not well represented in climate models, UKCP09 being an example

Risks and actions

1.1 - We, our professional partners and the public will have a greater understanding of inland flood risk.	
Impact	
	Rationale and uncertainty
Importance: Substantial	Current estimates of the risk from rivers have mostly increased as a result of better science and understanding of drivers and impacts on flood risk. We expect climate change to significantly change the quantum and spatial distribution of flood risk to people and property. This will challenge our ability to assess future inland flood risk.
Proximity: Short-term	<ul style="list-style-type: none"> We are confident that increasing temperatures will result in increasing winter rainfall totals and intensity. We are much less confident in changes to extreme summer rainfall. Change to river catchment response and flows will vary on location, and our understanding of this is still developing. We are also uncertain about non-climate factors around community and social change and the effects of very wide scale flooding. Climate models suggest we will be able to detect climate change increases in extreme events by the early 2020s. This is very dependent on our understanding and calculation of natural variability in rainfall, but we also know that climate models seem to be underestimating the changes to rainfall already recorded.
Confidence: High	
Response (to worst case impacts)	
Resource: Substantial	We need to understand how climate change will affect our understanding of flood risk, our ability to deliver flood forecasts and develop strategic, long term plans. We will need to communicate effectively with all our partners if we are to ensure a co-ordinated and sufficient response.
Inertia: Short-term	<ul style="list-style-type: none"> We will continue to adapt our work even though the uncertainty around climate change projections is significant. Use of risk-based approaches will enable this. We need to favour flexible solutions that don't foreclose the decisions that may need to be taken, and flexible plans that can be adjusted if a future begins to emerge that is different from the one we assumed at the start. We are working to put these concepts at the heart of our approach to adaptation.
Confidence: High	
Adaptation actions	
In the next year:	Costs
We are working to support Defra and the Welsh Assembly Government to understand how river flood flows may change in the future using UKCP09 projections.	M
We will continue to work with our professional partners to help them understand their risks using our Catchment Flood Management Plans to ensure co-ordination with the plans they are developing.	(L)
In accordance with Government policy we will seek to understand the implications on our current estimates of future flood risk from rivers and reconsider our current management approach.	(L)
We will improve our understanding of where and when climate changes will be distinguishable from natural variability in rainfall and river flows. This will help us prioritise work and effectively monitor for change.	M
In the next 5 years:	
We will implement better indicators to monitor change in river flows and to compare predicted climate change with the trends observed by our river gauges. This will help us re-evaluate our approach and seek to reduce the risks of under or over-adaptation.	M
We will revisit our strategic plans where suggested by climate change evidence and Government policy.	(L)
We will provide technical advice to our partners on representing climate change in their risk assessments.	(L)

We will provide technical advice to Defra, the Welsh Assembly Government and Lead Local Flood Authorities to enable climate change to be integral to achievement of Flood Risk Regulations, 2009.	(L)
We will further develop methods to ensure climate change is fully considered in flood estimation of current/ baseline conditions.	M

1.2 - We will work effectively with our professional partners and the public to manage risk and reduce the probability of inland flooding.

Impact

	Rationale and uncertainty
Importance: Substantial – Severe	Our National Flood Risk Assessment shows that a sizeable part of the important infrastructure and public services in England and Wales are in flood risk areas. This is especially so for water-related infrastructure that needs to be near rivers. We also expect climate change to significantly increase flood risk to people and property.
Proximity: Now	We expect the risk of inland flooding in the 2080s to increase by between approximately 4 and 6 times over present levels due to the impact of changes to precipitation. The effect in an urban conurbation protected by linear flood defences would be to increase the chance of flooding from 1 per cent in any given year to 6 per cent under a high emission scenario, for instance (Foresight Report, 2004). ¹
Confidence: High	We expect public scrutiny and challenge and need to plan adequately for flood risk over the long term. <ul style="list-style-type: none"> • Models suggest we will see a detectable increase in extreme events in the early 2020s. But many of our decisions are very long lived, so it is important that these consider climate change now. • There is uncertainty about the duration of asset deterioration although we can be certain that assets will deteriorate faster with climate change, for example erosion of soft defences and increased erosion / siltation rates during more frequent extreme events such as seen in Cumbria in 2009.

Response (to worst case impacts)

Resource: Major	This is the major focus of our inland flooding adaptation work. Whether providing new flood management assets, developing our modelling and mapping or through our leadership, we are putting climate change at the heart of what we do. <ul style="list-style-type: none"> • The eventual scale and spatial distribution of climate change impacts on inland flood risk are very uncertain. A complex set of variables interacts to result in change to flooding from rivers — catchment properties, such as geology, land cover, land management; as well as changes to urban extent, floodplain occupation and the value of property at risk.
Inertia: Short-term	
Confidence: High	

Adaptation actions

In the next year:	Costs
We will provide technical evidence to support the development of Government policy by Defra and the Welsh Assembly Government for climate change and Flood and Coastal Risk Management appraisal guidance	M
We will continue to seek to prevent inappropriate developments in areas at risk of flooding and future flooding, through our work under Planning Policy Statement (PPS) 25 (or equivalent) and Technical Advice Note (TAN) 15.	(L)
We will support the Department of Communities and Local Government and the Welsh Assembly Government with revision of government guidance for flood risk, climate change and spatial planning.	M
We will continue to ensure all new appraisals and scheme design and performance are tested against increased river flows to consider climate change in accordance with Government policy.	(H)

¹ High emissions risks are quoted here but this isn't what we use for risk assessment or planning purposes.

We will continue to encourage all local authorities to ensure that their plans include the recommendations from their local Catchment Flood Management Plans.	(L)
In the next 5 years:	
We will undertake research to assess the impact of climate change on reservoir safety and implement sustainable reservoir management through our leadership role.	M
We will provide technical advice to Risk Management Authorities on Government's policy through our strategic overview role.	M
We will explore the possibility of providing flood guidance to local authorities and leaving planning design to local decision.	(L)

1.3 - We will reduce the consequences of inland flooding.	
Impact	
	Rationale and uncertainty
Importance: Substantial – Severe	<p>We expect climate change to increase the frequency, extent, depth and velocity of flooding, though there will be very big differences locally. The combination of this occurring with increasing vulnerability could have serious consequences. It is imperative that we continue to advise on the location of new development to avoid the accumulation of vulnerable properties, industry and infrastructure in areas of flood risk. Our recent assessments of flood risk from rivers in England and Wales have documented that important infrastructure and public services are currently in flood risk areas:</p> <ul style="list-style-type: none"> • Water and wastewater treatment works and pumping stations are particularly at risk, since they tend to be located near rivers. We estimate that over 55 per cent of these sites in England and 80 per cent in Wales are in flood risk areas. • About 7,000 electricity infrastructure sites, some 14 per cent of all in England, are also at flood risk. In Wales, the figure is 800 sites (22 per cent). • We estimate that 10 per cent of main roads in England are at flood risk and 11 per cent in Wales. For railways the figures are 21 per cent and 33 per cent respectively. • Early indication from Environment Agency/Defra research using UKCP09 suggests that the national guidance of a 20% increase in peak flows — government's policy guidance for the design of new river plans — which was based upon UKCP02, is a pragmatic sensitivity test, but no longer precautionary for most catchments.
Proximity: Short-term	
Confidence: High	
Response (to worst case impacts)	
Resource: Major	<p>The eventual scale and spatial distribution of the climate change impacts on inland flood risk are very uncertain. There are a complex set of variables that interact to result in flooding from rivers — catchment properties, such as geology, land cover, land management; as well as changes to urban extent, floodplain occupation</p> <p>The existing building stock is replaced at a rate of less than 1% a year, and presents a significant challenge if we are to increase resilience to flooding. Action is needed to enable more flood resilient communities and infrastructure.</p>
Inertia: Short-term	
Confidence: High	
Adaptation actions	
In the next year:	Costs
We are providing guidance to help reporting authorities in their submissions to government as part of the Climate Change Act 2008. This will help some of our country's key service providers consider flood risk and climate change and their best response to those risks.	L
We will provide guidance and advice to site operators we regulate through environmental permitting to help them understand and prepare for climate change impacts on flood risk.	(L)
In the next 5 years:	
We will continue to provide guidance and advice to site operators and national infrastructure providers.	(L)
We will consider how major flood incidents may change with climate change.	M

1.4 - Our inland flood management programme provides environmental benefits.	
Impact	
	Rationale and uncertainty
Importance: Substantial	We expect climate change to have a major impact on the sustainability of water dependant habitats, although the response of these habitats is not well understood. Habitats we currently protect will also be impacted.
Proximity: Short-term	
Confidence: Medium	
Response (to worst case impacts)	
Resource: Major	Research is key to achieving this objective. Work is underway to determine the long term sustainability of wetlands under climate change.
Inertia: Short-term	
Confidence: Medium	
Adaptation actions	
In the next year:	Costs
Where cost effective, we will continue to work with natural processes to tackle flood risk, increasing the resilience of habitats to climate change including creating new wetlands and habitats that accommodate water and aid conveyance.	(H)
We will ensure that our Flood and Coastal Risk Management activities value the ecosystem benefits to the wider environment while meeting our targets and legal duties.	(H)
In the next 5 years:	
We will develop and implement a greenhouse gas reduction strategy for Flood and Coastal Risk Management activities.	M

Measures already implemented (for all Inland Flooding objectives)	Costs
We have developed catchment flood management plans for the whole of England and Wales. These help us to work with others to identify and agree policies for sustainable flood risk management for the whole catchment and for the long term (50-100 years). They consider the future impact of climate change on river flows and identify the most suitable policies for their management.	(M)
We have developed strategies for many of our main river sites looking to reduce flood risk and increase biodiversity in the long term.	(H)
We have ensured that all new appraisals and scheme design and performance are tested against increased river flows to consider climate change in accordance with Government policy.	(H)
We were consultees for regional flood risk assessments and advised on flood risk and solutions for regional and local authority plans.	(L)
We are statutory consultees on individual development plans and have sought to prevent inappropriate developments in areas at risk of flooding and future flooding.	(L)
We modelled the long-term investment needed in flood and coastal risk management over the next 25 years (2010 – 2035), taking account of the impacts of climate change (note that these figures include costs of managing risk from river and coastal flooding and erosion, but not surface water flooding). We used UKCP09 to derive the climate change factors in the long term investment plans. These reports are called <i>Future flooding in Wales: flood defences</i> and <i>Flood and coastal risk management in England – a long term investment strategy</i> .	(M)
We worked with Defra to better understand the potential changes to flood risk from climate change using new information from UKCP09. This work is on-going and will provide us with new techniques for risk assessment and an understanding of the responses required and their magnitude. The research also provided us with an understanding of how different catchment conditions affect their response to climate change. This research covers England and Wales.	M

We continue to advise our professional partners to help them understand the risks and policies in our Catchment Flood Management Plans to assist with the plans they are developing.	(L)
We have developed better indicators to monitor change in river flows, to compare predicted climate change with the trends observed by our river gauges.	M
We have researched when we might expect to see a significant change to extreme rainfall resulting from climate change. We are using this information to target our monitoring of rainfall and river flows to try to identify change as early as possible.	M
We have produced guidance in England for all organisations in England or Wales who have received a UK Government Direction or invitation to report under the Adaptation Reporting Power. This includes guidance to help them understand their risks from future inland flooding.	L

Opportunities

None identified.

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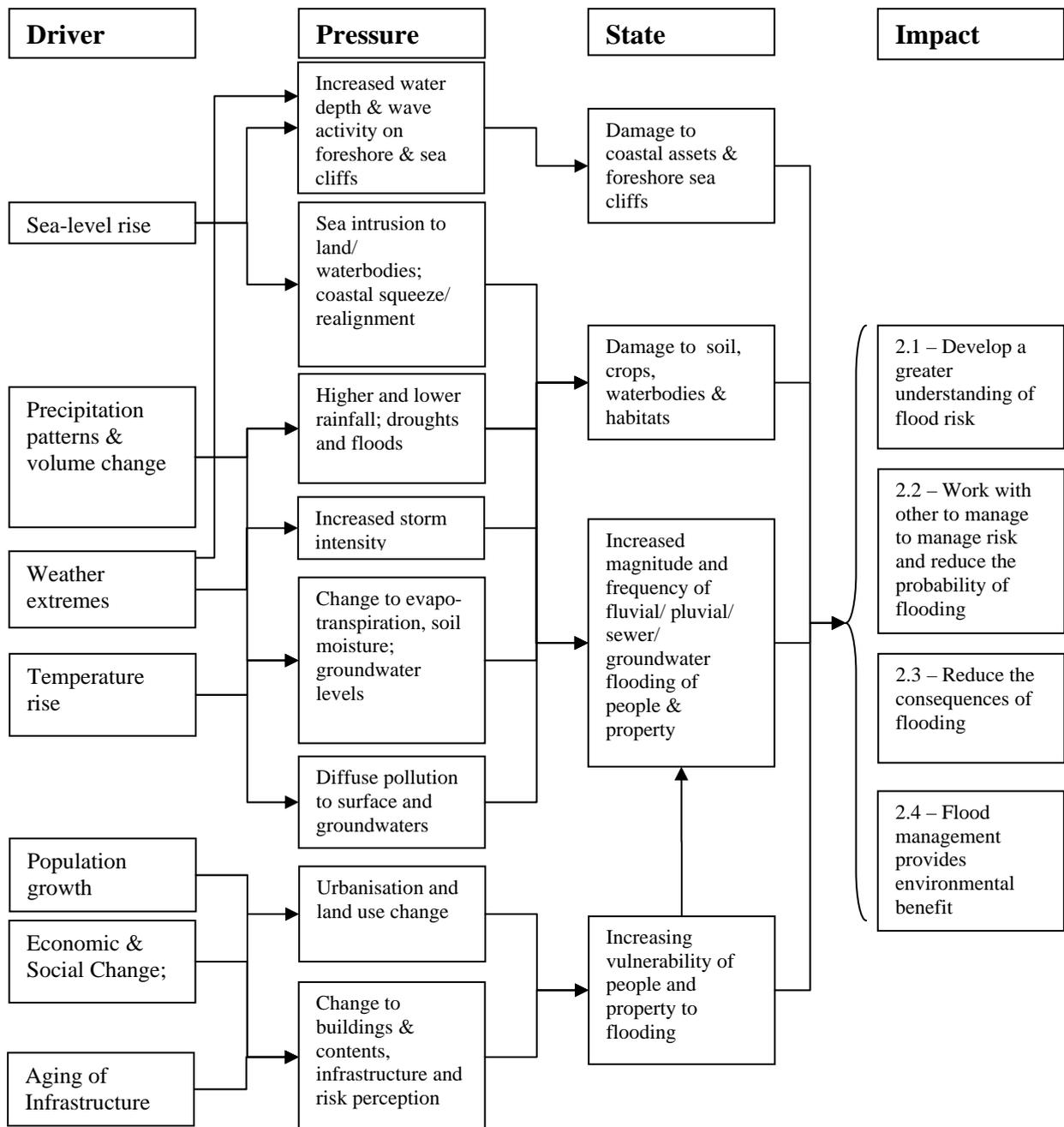
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Coastal erosion and flooding

Conceptual model of sensitive risks



Key evidence

- We have assessed potential climate change impacts on coastal erosion and flooding using UKCP09 projections, though we have not yet fully incorporated these into our flood risk models
- Our understanding of the characteristics of climate change risk, and the measures to manage risks and vulnerabilities have been developed through a number of Environment Agency Defra and Office of Science and Technology studies and are incorporated in our Long term Investment Strategy
- We have led the UK's research effort into changing time mean sea level rise and storm surges (both could greatly impact coastal flooding and erosion). This research, funded by our TE2100 project, greatly informed the first 6 chapters of the marine report in UKCP09

Risks and actions

2.1 - We, our professional partners and the public will have a greater understanding of coastal flood and erosion risk.	
Impact	
	Rationale and uncertainty
Importance: Substantial	<p>We expect climate change to significantly increase coastal flood risk to people, property and wildlife. This will challenge our ability to understand flood and coastal risks and their interactions.</p> <ul style="list-style-type: none"> • We have high confidence that increasing global temperatures will result in thermal expansion of the oceans. • We are much less confident in change from ice sheet loss and the contribution to more extreme sea level rise projections for 2100 and beyond. • There is also uncertainty in non-climate factors including property values and location of property development. • We can expect the more sea level rise, and potential increase to storminess, to bring accelerated asset deterioration and vulnerability.
Proximity: Short-term	<p>Changes in storm frequency and its contribution to flood risk over the past century have been primarily driven by natural climate variability over 10-20 year cycles. Local fluctuations in mean sea level can be of the order of 30cm. We could see 30cm rise by 2050s under UKCP09 projections. However, globally sea levels are rising now and likely to have an anthropogenic cause.</p> <ul style="list-style-type: none"> • Our assessment is very dependent on our understanding and calculation of natural variability in coastal extreme water levels and the regional oceanographic effects of UK and north east Atlantic waters.
Confidence: Medium	
Response (to worst case impacts)	
Resource: Substantial	<ul style="list-style-type: none"> • We will need to increase our efforts to deliver adaptation even though the uncertainty around climate change projections is significant. • There are physical limits to how far we can adapt and we will need to communicate the eventual risk to and potential loss of key coastal assets and land.
Inertia: Short-term	
Confidence: High	
Adaptation actions	
In the next year:	Costs
We will continue to work with others to help them understand their risks using Shoreline Management Plans to ensure co-ordination with the plans they are developing.	(L)
In the next 5 years:	
We will revisit our strategic plans where suggested by the climate change evidence and Government policy.	(L)
We will provide technical advice to our partners on representing climate change in their risk assessments.	(L)
We will provide technical advice to Defra, the Welsh Assembly Government and Lead Local Flood Authorities to enable climate change to be integral to achievement of Flood Risk Regulations (2009).	(L)
We are developing a coastal research strategy, part of the wide range of research and development we undertake to increase our understanding of coastal change and management.	M
We will further develop methods to ensure climate change is fully considered in flood and erosion estimation of current/ baseline conditions.	M

2.2 - We will work effectively with our professional partners and the public to manage risk and reduce the probability of coastal flooding and erosion.	
Impact	
Importance: Substantial – Severe	Rationale and uncertainty The latest UK Climate Projections (UKCP09) suggest that sea levels could rise by between 12cm and 76cm by 2095 around the UK with most of this rise attributed to thermal expansion of the oceans. A worst case projection which attributes more influence from glacial ice melt was also derived and is estimated at 1.9m at its highest. Changes in land use, and the location of larger populations and key services to coastal areas have both increased vulnerability, which is equally important in the calculation of flood risk. <ul style="list-style-type: none">• England has approximately 4,500km of coastline, of which 60 per cent is at risk of flooding and 40 per cent at risk of erosion• Wales has approximately 1,500km of coastline, of which 51 per cent is at risk of flooding and 49 per cent at risk from erosion• Across England and Wales, 91 per cent of the coastline at risk of flooding has flood (sea) defences that reduce the frequency of flooding (mostly protecting land against a 1 in 200 year event)• Most of the undefended flood plain is made up of saltmarsh or other land that benefits from flooding and also provides a buffer for coastal processes. No fully integrated assessment has been undertaken of the potential flood losses arising from the UKCP09 projections. However, there are a number of previous assessments that indicate the scale of the change. The Association of British Insurers estimated that a 0.4m sea level rise would increase the number of properties at risk in eastern England from 270,000 to 404,000. We should expect severe public scrutiny and challenge if we did not plan adequately for flood and coastal erosion risk over the long term. <ul style="list-style-type: none">• Sea levels are rising globally and no matter what greenhouse gas emission cuts are made some changes are inevitable and very long lived.• We can expect sea levels around the UK to rise, raising extreme coastal water levels too. We can expect these changes to continue for centuries to come. Decisions we make now must factor that in if we are to provide sustainable flood management solutions.
Proximity: Now	
Confidence: High	
Response (to worst case impacts)	
Resource: Major	This is the major focus of our flooding and coastal erosion adaptation work. Whether providing new flood management assets, developing our modelling and mapping or through our leadership, we are putting climate change at the heart of what we do. <ul style="list-style-type: none">• The eventual scale and extent of coastal flood risk is very uncertain. Equally, the impact of climate change on coastal erosion is strongly correlated to local conditions and drivers such as land use change and coastal management. There are a complex set of variables that interact to result in change to coastal erosion. The magnitude of damage from coastal flooding will be the result of floodplain occupation, the value of property at risk and the resources available to respond. There are also physical limits to how far we can adapt while retaining the existing coast line.
Inertia: Short-term	
Confidence: High	
Adaptation actions	
In the next year:	Costs
We provide technical evidence to support the development of Government policy by Defra and the Welsh Assembly Government for climate change and Flood and Coastal Risk Management appraisal guidance.	M
We will continue to seek to prevent inappropriate developments in areas at risk of coastal flooding and future flooding, through our work under Planning Policy Statement (PPS) 25 (or equivalent) and Technical Advice Note (TAN) 15.	(L)
We will support Department of Communities and Local Government and the Welsh Assembly Government with revision of Government guidance for flood risk, climate	M

change and spatial planning.	
We will continue to ensure all new strategies and scheme design and performance are tested against increased sea levels to allow for climate change in accordance with Government policy.	(H)
We will continue to encourage others to ensure that their plans include the recommendations from their local Shoreline Management Plans.	(L)
In the next 5 years:	
We will provide technical advice to Risk Management Authorities on Government's policy through our strategic overview role.	M
We will explore the possibility of increased localism by providing flood guidance to local authorities and leaving planning design to local decision.	(L)

2.3 - We will reduce the consequences of coastal flooding and erosion.

Impact	
	Rationale and uncertainty
Importance: Substantial – Severe	We expect climate change to increase the frequency, extent, depth and velocity of coastal flooding. We expect changes to cliff recession rates, and loss of foreshore material, but changes will be highly influenced by local conditions. The coastal floodplains of the south-east and east coast would experience the greatest increase in probability of flooding under current projections of sea level rise. Other areas, such as north Norfolk, south Wales and along the outer Humber Estuary, also exhibit significant increases. We can expect there to be increasing flood and erosion risk from rising sea levels and potentially at an accelerating rate through the century.
Proximity: Possibly short-term	
Confidence: Medium	
Response (to worst case impacts)	
Resource: Major	The eventual scale of the climate change impacts on sea level rise are very uncertain. <ul style="list-style-type: none"> Non-climate risk factors including property values and location of property development are highly influenced by regulation both at national and local scales. The influence of these drivers could have significant consequences for future economic losses and our ability to adapt.. Action is needed to make communities and infrastructure that could be vulnerable to future coastal flooding more resilient.
Inertia: Short-term	
Confidence: High	
Adaptation actions	
In the next year:	Costs
We are providing guidance and support to help reporting authorities in their submissions to government as part of the Climate Change Act 2008. This will help some of our country's key service providers consider flood and coastal erosion risk and climate change and their best response to those risks.	L
We will provide guidance and advice to site operators we regulate through environmental permitting to help them understand and prepare for climate change impacts on coastal flood risk.	(L)
In the next 5 years:	
We will continue to provide guidance and advice to site operators and national infrastructure providers.	(L)

2.4 - Our coastal flood and erosion management programme provides environmental benefits.

Impact	
	Rationale and uncertainty
Importance: Substantial	We expect climate change to have a major impact on the sustainability of intertidal habitats and protected habitats behind sea defences, especially freshwater habitats. The response of these habitats is well known. Habitats we currently

Proximity: Now	protect will be impacted.
Confidence: Medium	<ul style="list-style-type: none"> We have high confidence that increasing temperatures will result in increasing winter rainfall totals and intensity leading to increased cliff failure. Increased temperatures will also impact habitat health, as well as changes to salinity, rainfall, and river flow regimes. There is evidence that historic sea level rise has already impacted inter-tidal habitat health.

Response (to worst case impacts)

Resource: Major	<p>We deliver habitat management both through our estuary plans as well as for local schemes.</p> <ul style="list-style-type: none"> Where a sea wall shares a boundary with Special Protection Areas/Special Areas of Conservation, the Environment Agency/Local Planning Authority must consider whether a project to maintain or improve it in the face of sea level rise is likely to have a significant effect on the site. Defra encourages us to adopt a strategic approach to intertidal habitat re-creation and to compensate for sea level rise on an estuary wide basis to help avoid scheme delays. We use existing strategic planning approaches (such as Shoreline Management Plans and estuary strategies) to help anticipate habitat creation requirements and opportunities. Research is key to achieving this objective. Work is underway to determine the long term sustainability of wetlands under climate change as well as salt marsh condition and extent. There are coastal monitoring programmes we contribute too, as well as local biodiversity action plans.
Inertia: Short-term	
Confidence: Medium	

Adaptation actions

In the next year:	Costs
We will continue to create new wetlands and inter-tidal habitats that accommodate estuarine and coastal water where legally required.	(H)
We will ensure that Flood and Coastal Risk Management activities value the ecosystem benefits to the wider environment while meeting our targets and legal duties.	(H)
In the next 5 years:	
We will develop and implement a greenhouse gas reduction strategy for all Flood and Coastal Risk Management activities.	M

Measures already implemented (for all Coastal Erosion and Flooding objectives)	Costs
We have worked to support the development of 22 Shoreline Management Plans for the whole of the coast of England and Wales. They contain flood and coastal erosion risk management policies for 20, 50 and 100 years into the future. Currently, local authorities are revising 18 Shoreline Management Plans and the Environment Agency the remaining four; 20 will be complete by end 2010, the remaining 2, in Wales, will be completed by spring/summer 2011.	(M)
To support the shoreline management plans we have developed coastal erosion information to help all understand the risks we face. These include an assessment of the impact of rising sea levels and winter rainfall using UKCP09 projections.	(H)
We have developed strategies for many of our estuaries looking to reduce flood risk and increase biodiversity in the long term.	(H)
We have ensured that all new appraisals and scheme design and performance allow for increased sea levels from climate change in accordance with Government policy.	(H)
In England we are statutory consultees for regional flood risk assessments and advise on flood risk and solutions for regional and local authority plans.	(L)
We are statutory consultees on individual development plans and seek to prevent inappropriate developments in areas at risk of flooding and future flooding.	(L)
We modelled the long-term investment needed in flood and coastal risk management over the next 25 years (2010 – 2035), taking account of the impacts of climate change (note	(M)

that these figures include costs of managing risk from river and coastal flooding and erosion, but not surface water flooding). We used UKCP09 to derive the climate change factors in the long term investment plans. These reports are called <i>Future flooding in Wales: flood defences</i> and <i>Flood and coastal risk management in England – a long term investment strategy</i> .	
We have produced a long term flood risk management plan for London and the Thames Estuary through the Thames Estuary 2100 project. This plan has developed a flexible approach to adaptation and has been identified as best practice internationally. It is being used in other coastal cities such as Rotterdam	(H)
In England we worked in partnership with Defra and the Department of Communities and Local Government (CLG), to develop a toolkit that considers financial aid, planning choices, community self-help and social justice issues. All of these are important in encouraging and supporting people severely affected by coastal flooding or erosion to either move or accept the threat of increased risk.	(L)
We also advise and provide evidence to Governments on flood risk issues and on flood-related, coastal erosion and climate change adaptation helping them to develop policy.	N/A
In England we are working to develop inter-tidal habitats, and aim to create 200 hectares of protected habitat – half of which should be salt-marsh – each year. We have spent more than £3 million supporting saltmarsh and mudflat creation partnership projects over the past five years.	(H)
We encourage others to ensure that their plans include the recommendations from their local Shoreline Management Plans.	(L)
We have produced guidance in England for all organisations in England or Wales who have received a UK Government Direction or invitation to report under the Adaptation Reporting Power. This includes guidance to help them understand their risks from future coastal flooding and/or erosion.	L

Opportunities

None identified.

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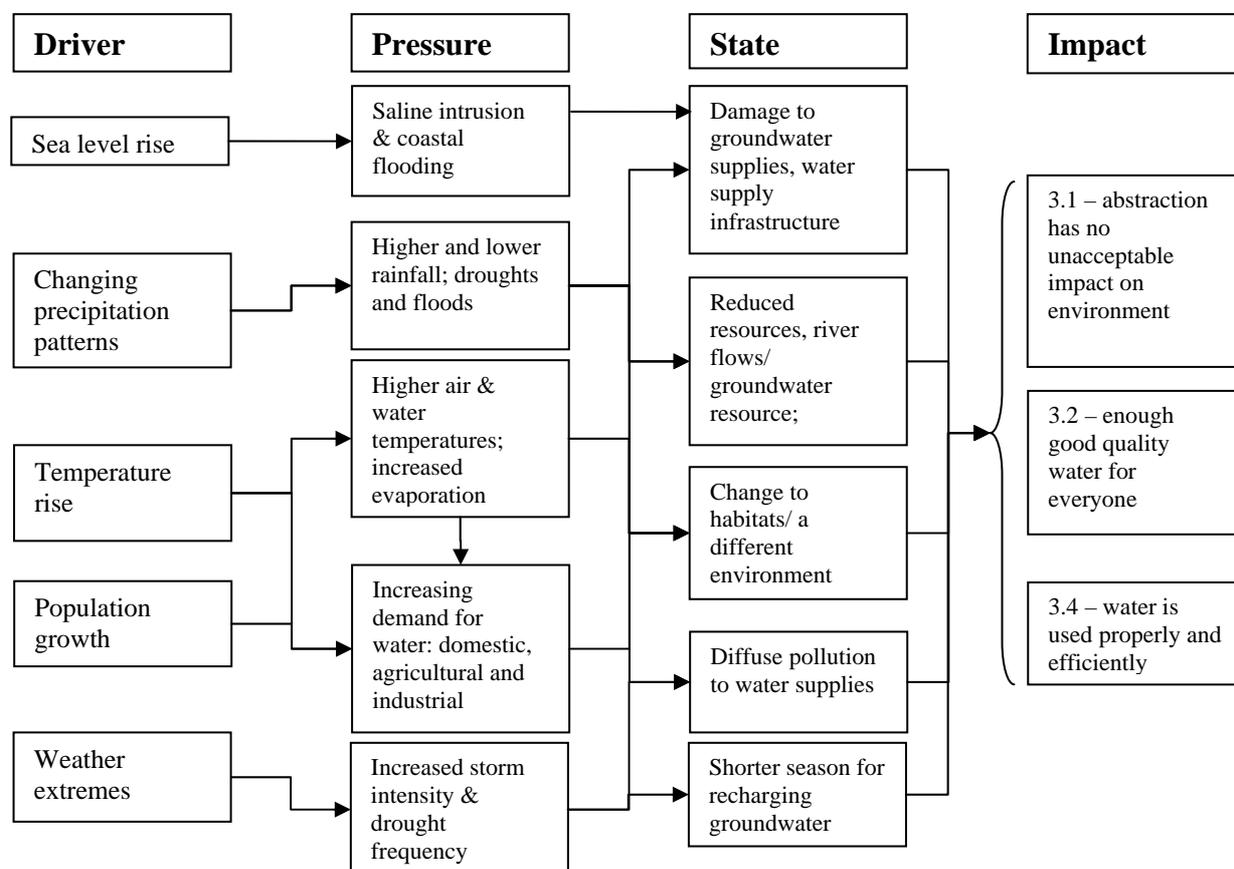
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Water resources

Conceptual model of sensitive risks



Key evidence
- We have modelled the potential climate change impacts on river flows in England and Wales by 2050, using UKCIP02 scenarios. These are currently being updated using UKCP09
- We have forecast the effects of non-climate drivers on water resources and potential increases in water demand by the 2050s. These are incorporated in our Water Resources Strategy 2009
- We have undertaken our own research to understand when climate change may noticeably alter precipitation patterns and extremes. This is published in peer reviewed academic literature
- We rely on external research to help us better understand changes to extreme rainfall, which at present is not well represented in climate models, UKCP09 being an example

Risks and actions

3.1 - We will aim to ensure that abstraction has no unacceptable impact on the environment or water users.	
Impact	
	Rationale and uncertainty

Importance: Substantial – Severe	<p>Our existing suite of water resource management measures will not be sufficient to manage the worst impacts of climate change. We may begin to attribute changes in extreme rainfall amounts to climate change within the next 15 years. It is possible however that the normal year to year variations in weather may mask shifts in climate over the next 20 to 30 years.</p> <p>Therefore we expect that the existing ways to regulate abstraction and manage drought should be able to cope with the impacts we expect to occur over the next 20 years. However, we will need to identify and evaluate options for the future management of water now so that we can respond more flexibly to future pressures. We have not yet fully assessed the importance of projected impacts on our objectives.</p>	
Proximity: Short-term	<ul style="list-style-type: none"> We assume an 18 per cent increase in population from 2006 levels by 2030. The population in some parts of the country is expected to increase by over 40 per cent. This will generate significant additional demand on water resources for domestic consumption, but also for the water used to produce food, energy and products. 	
Confidence: Medium	<ul style="list-style-type: none"> Additional demands and pressures on water resources may be felt more in areas where pressures already exist such as south east and eastern England. In East Anglia in particular, projected impacts from higher evaporation and reduced summer rainfall could have a major impact on agriculture and the demand for water to irrigate crops. In other parts of England and in Wales where the underlying rocks are of low permeability, the lack of natural water storage will mean that expected reductions in summer river flows will be more pronounced. Although we have identified the potential impact from sea-level rise and associated saline intrusion to groundwater resources, our initial assessment suggests that this is not a significant threat based on existing projections. This is due to the effective management by water companies of groundwater resources near the coast. 	
Response (to worst case impacts)		
Resource: Substantial	<ul style="list-style-type: none"> The existing actions within the Water Resources Strategy can provide a range of response options to cope with many possible short to medium term impacts. We need to undertake further studies to understand how robust our existing response options are to climate change. 	
Inertia: Short - Medium term		
Confidence: Medium		
Adaptation actions		
In the next year:		Costs
(1) We will work with Defra, the Welsh Assembly Government and Ofwat to develop and evaluate options for future access to and allocation of water.		M
(2) We will advise Government on water supply resilience, and in particular identify areas for improvement in supply connectivity and integration.		L
(3) We will continue to promote joint guidance on the construction and development of small scale storage reservoirs and water efficiency.		L
(4) We will develop our evidence base on the understanding of ecological responses to abstraction and related pressures. We will apply this understanding to climate change scenarios to inform our future approach and direction.		M
(5) We will seek opportunities to understand how greenhouse gas emissions are generated in other sectors of abstraction and wastewater collection and treatment. We will look to gather baseline energy/water-use data across other sectors (agriculture, industry and power generation), with a view to providing advice to Government and assessing options to reduce energy consumption relating to those abstraction and wastewater activities.		L
(6) We will develop an evidence-based, coordinated approach to climate change adaptation and mitigation for key types of abstraction, and wastewater treatment. We propose to develop information on adaptive management for water resources infrastructure and water resources management		M

(7) We will minimise emissions associated with our own and others' water related activities and deliver against the CRC Energy Efficiency Scheme, with a particular focus on how water resource schemes are operated and managed.	M
(8) We will review our advice on heat pumps and hydropower to ensure that we are actively supporting the UK and Welsh Assembly Governments' carbon reduction and energy production agendas, while maintaining environmental protection.	L
(9) We will develop a good understanding of the links between levels of service and deployable output for public water supply. We will update the Water Resources Planning Guidelines and Drought Planning Guidelines.	M
(10) We will identify actions to increase the resilience of water supplies that underpin food and energy security. We will work with Defra and the Welsh Assembly Government to develop a greater understanding of the potential impact from climate change on embedded water demands in goods and products, and any risks to water resources in England and Wales. We will collect and assess evidence on embedded water to enable us to provide advice.	M
(11) We will work with the Energy Savings Trust to advise the Welsh Assembly Government and others to ensure that water and energy efficiency are considered together in future retrofit programmes such as the Home Energy Efficiency Scheme and the Welsh Housing Quality Standard.	L
In the next 5 years:	
We expect components of the following measures to be carried out over the next 5 years: 2, 3, 4, 5, 6, 7, 9. For Wales we expect relevant linked actions to be carried out over the next 5 years including 11.	
We will factor the impacts of climate change, based on UKCP09 projections, into all of our work, but in particular in water resource planning and flood risk management. We will produce an 'archive' of future flows to the 2050s, using UKCP09, to ensure consistent application in impacts assessments by us and our partners	
We will work with water companies and others to avoid future water shortages.	
We will advise large water users, for example industry, agriculture and the energy sector, on ways to reduce water use and cut costs.	
We will advise Local Planning Authorities and developers on the availability of non-mains water supplies and water efficiency.	
We will carry out research and work with others to understand sector vulnerability (energy, agriculture, industry) and sector specific adaptation, minimising risks and ensuring efficiency. We will provide advice to Government to enable them to take a strategic overview.	
We will work to further understand the benefits of retrofitting, where practicable, Sustainable Drainage Systems (SuDS) to existing sewerage systems	
Specifically in Wales, we will advise and provide evidence to the Welsh Assembly Government, Ofwat, Dwr Cymru (Welsh Water) and relevant parties on how to improve water efficiency across all sectors.	
Longer term actions:	
We expect components of the following actions to be carried out over the longer term: <ul style="list-style-type: none"> • We will advise Government on water supply resilience, and in particular identify areas for improvement in supply connectivity and integration. • We will develop our evidence base on the understanding of ecological responses to abstraction and related pressures. We will apply this understanding to climate change scenarios to inform our future approach and direction. 	

3.2 - We will aim to ensure that there is enough good quality water for people, businesses, industry and agriculture most of the time.

Impact

Rationale and uncertainty	
Importance: Substantial	We have developed a catchment-level model of the impacts of climate change on river flows, and used this to understand the impacts on our objectives. This model (which used UKCIP02 scenarios) suggests that by 2050, natural river flows in winter may increase by 10 to 15 per cent but with lower flows in most rivers from

Proximity: Short - Medium term	April to December. Natural river flows in the late summer and early autumn could fall by over 50 per cent, and by as much as 80 per cent in some catchments. Overall, this could mean a drop in natural annual river flows of up to 15 per cent. Changes in the amount of reliable rainfall will affect the yields of existing supplies, and the economics of future options. Droughts could be more frequent, affecting supplies for people, business, industry and agriculture.
Confidence: Medium	<ul style="list-style-type: none"> We will need to identify and evaluate options for the future management of water now so that we can respond more flexibly to future pressures. We have not completed our investigation on how our decision making processes for water allocation will be affected by climate change.
Response (to worst case impacts)	
Resource: Substantial	The resource required to make changes to decision making processes and prioritisation is uncertain but it could take a significant amount of time to support regulatory change, support the development of new legislation and to develop and implement new procedures.
Inertia: Short - Medium term	
Confidence: Medium	
Adaptation actions	
As for 3.1 above	

3.3 - We will publish information on the demand for water and available resources.	
Impact	
	Rationale and uncertainty
Influenced by climate change but not sensitive	Climate change will not affect our ability to publish information on the demand for water and available resources. However we can use this objective to influence and encourage adaptation in the actions of others.
Adaptation actions	
In the next year:	Costs
We will carry out routine work and specific projects which contribute to climate change adaptation, such as the annual review of our drought plans to ensure they are fit for purpose and take account of climate change, reviewing water resource management plans and providing technical advice to Government.	L
We will identify effective methods of communicating with the different types of abstractors to ensure they are aware of the impacts of climate change.	L
We will monitor the effects of climate change and will continue to review our monitoring networks to ensure that they are fit for their intended purpose.	L
In the next 5 years:	
We will update guidance to water companies on developing statutory water resources management plans and drought plans to reflect the pressures from climate change.	M
We will work with others to assess how climate change will impact on the frequency and intensity of drought.	M
Longer term actions:	
We will continue to promote efficient water use and adoption of supply options that will be resilient to the impacts of climate change with water companies and other abstractors through our water resource strategy.	M

3.4 - We will aim to ensure that water is used properly and efficiently.	
Impact	
	Rationale and uncertainty
Importance: Substantial – Severe	Our concerns focus on water resources planning and water security in the context of greater demand and reduced availability. The risk of drought is also of major importance for the Environment Agency in terms of the implications for the

Proximity: Short – Medium term	environment and our duty to protect and enhance ecosystems and biodiversity, and also in terms of compliance with EU legislation such as the Habitats Directive. The combined pressures of lower water availability and increased water demand will present a big challenge to meet this objective.
Confidence: Medium – High	
Response (to worst case impacts)	
Resource: Moderate	Changes to decision making processes and prioritisation will probably not require excessive resources but it could take a significant amount of time to support regulatory change, support the development of new legislation and to develop and implement new procedures. Policy responses to climate change may impact on water resources. For example, the planting of perennial energy crops such as Miscanthus and short rotation coppice can reduce recharge to groundwater considerably.
Inertia: Short – Medium term	
Confidence: Medium	
Adaptation actions	
As for 3.1 above	

Measures already implemented (for all Water Resources objectives)	Costs
We have carried out initial research and worked with others to assess how climate change will affect water resources including impacts on: <ul style="list-style-type: none"> - river flows and groundwater levels; - water demand. This work provided evidence to support our water resources strategy published in 2009.	M
We published our Water Resources Strategy for England and Wales, and a separate strategy for Wales in 2009. They included evidence of expected climate change impacts and set out actions for managing water resources to adapt to climate change. We now have regional and national plans for progressing these adaptation actions.	M
We have reviewed all water company drought plans and have provided advice to the Secretary of State / Welsh Ministers. We have also reviewed and updated our own drought plans.	M
We have reviewed all draft water company water resources management plans including providing advice to the Secretary of State / Welsh Ministers, and have provided evidence to public inquiries on two company plans.	M
We have developed Catchment Abstraction Management Strategies (CAMS) and River Basin Management Plans for England and Wales. We will use them to assess the sustainability of abstraction of water. This will be used as an indicator to provide a measure of Government progress on adaptation to climate change.	H
We include time limits on all new abstraction licences (by law) and have a policy of applying time limits to varied abstraction licences. We are working with the UK Government and the Welsh Assembly Government to identify and assess future models for water management, which will include consideration of the flexibility required for the future.	M
We are encouraging abstractors and water users to adopt cost effective demand management measures by providing advice and active promotion.	M
We have advised the Welsh Assembly Government on adaptation and water resources through the Climate Change Commission for Wales and the forthcoming Climate Change Strategy for Wales.	L
We are carrying out work to review our hydrometric and groundwater monitoring networks to ensure they are fit for purpose for detecting climate change impacts.	M
We will advise the Welsh Assembly Government on the implications of ‘embedded water’ in support of the development of a new Food Strategy for Wales.	L

Opportunities

- A warmer climate may provide opportunities for growing different crops and increasing crop yields (possibly however at the cost of greater water demand for crop irrigation).
- Climate change is likely to drive incentives for investment and innovation in low carbon technology and in developments to improve water efficiency.
- There will be opportunities for working in partnership with the UK and the Welsh Assembly Government, statutory bodies and groups representing water users to pool knowledge and develop a co-ordinated approach to climate change adaptation.

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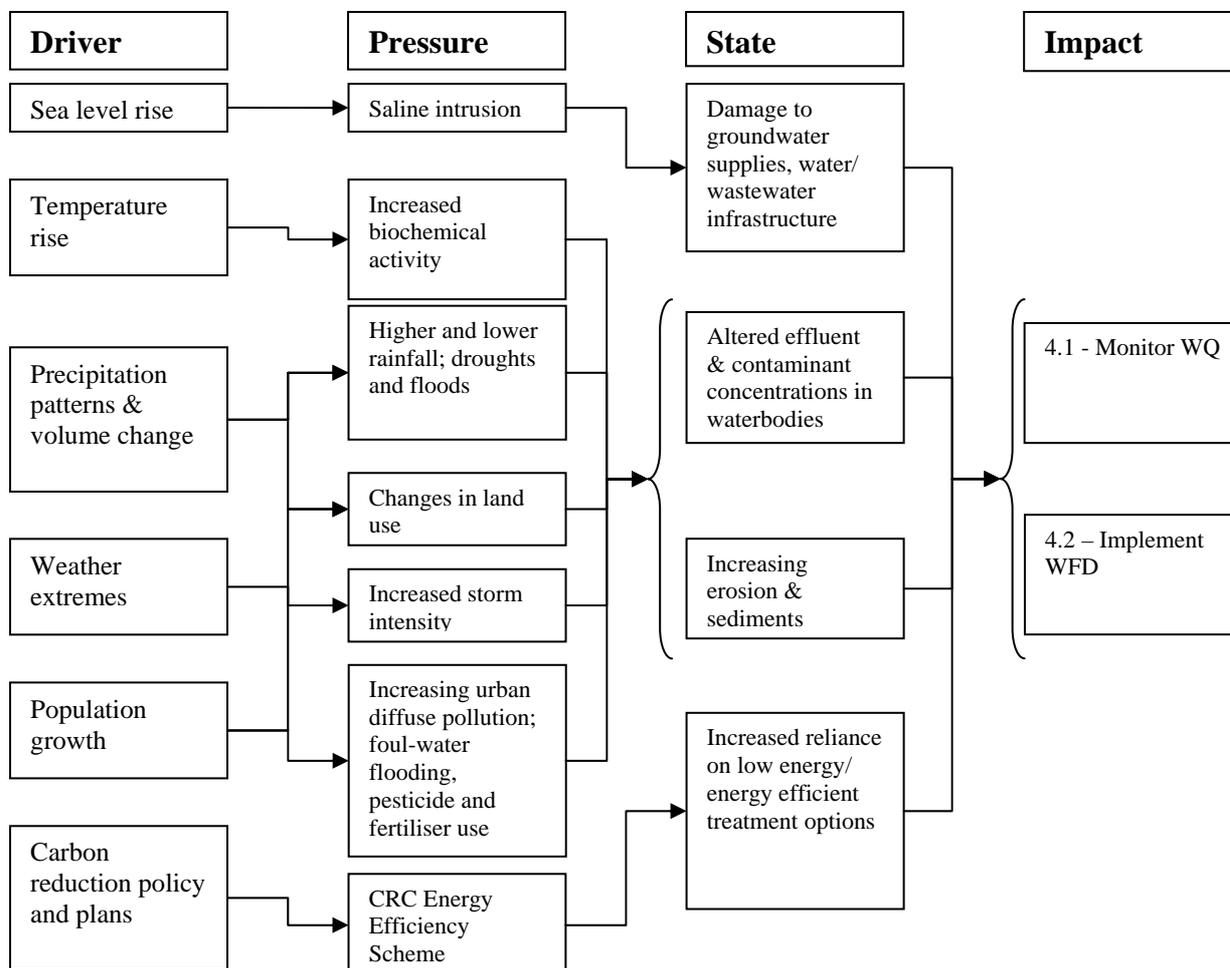
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Water quality

Conceptual model of sensitive risks



Key evidence	
-	We have modelled the potential climate change impacts on river flows in England and Wales by 2050, using UKCIP02 scenarios. These are currently being updated using UKCP09
-	We model the impacts of climate change on water quality and WFD objectives using our SIMCAT model and the outputs of our 2050s river flows model.
-	We have also assessed climate change impacts on water quality using The University of Reading's INCA model. We have also completed a review of the available academic literature.

Risks and actions

4.1 - We will monitor sewage treatment works and trade discharges, as well as the quality of freshwater, groundwater and tidal waters (up to three miles from the coast).	
Impact	
	Rationale and uncertainty
Importance: Minor	Our monitoring approach should be able to accommodate changing pollutant pressures and will not need to significantly change in the near future as a result of climate change. Our evidence is based on consultation with sampling teams to understand how we accommodate different types of weather conditions and a

Proximity: Short – Medium term	<p>qualitative assessment of how climate change will affect this.</p> <ul style="list-style-type: none"> We are unlikely to require a change in approach to monitoring in the short term. However, due to our yearly revision, monitoring may be adjusted in order to best allow detection of climate change impacts on the water environment.
Confidence: Medium	<ul style="list-style-type: none"> There may be changes in legislation which mean that our monitoring programme might need to change significantly, and thus the sensitivity to climate change may differ from that assessed for our current approach.
Response (to worst case impacts)	
Resource: Minor	Adjustments to monitoring will be required (for example how to deal with missing samples due to extreme weather events) but should not negatively affect the wider organisation. For example, an increased need for monitoring would require funding but could also benefit work to assess water quality compliance and impacts.
Inertia: Short - Medium term	
Confidence: Medium	
Adaptation actions	
In the next year:	Costs
We will work with internal partners to ensure consistent aims and objectives for future water quality monitoring requirements.	L
In the next 5 years:	
We will continue to use monitoring results to assess changes in the water environment, always using the most recent figures for river flows and rainfall when modelling for climate change.	L

4.2 - We will implement the EC Water Framework Directive and other EC directives; to ensure that all relevant water quality standards are met.	
Impact	
	Rationale and uncertainty
Importance: Substantial	<p>Our understanding of the effects of climate change on surface water quality is primarily based on mathematical (SIMCAT) modelling of climate change-driven changes (using UKCIP02 scenarios) in river and wastewater flows and temperature. This model is concerned primarily with the effects from point source discharges and their interaction with waterbodies. We have used it to estimate potential changes in water quality in terms of Water Framework Directive (WFD) definitions. Our models suggest that by the 2050s, a relatively small deterioration in quality will have occurred – approx 0.80 per cent of rivers are lost from High Status and 0.68 per cent enter Bad Status – assuming population and other factors remain constant. Our ability to achieve Good Status and Protected Area Objectives (for example for bathing, shellfish and drinking waters) is unlikely to be significantly impacted by climate change within the first three cycles of the WFD (up to 2027) since climate impacts are unlikely to be identifiable at a range beyond natural variability. However, other impacts resulting from initiatives to mitigate or adapt to climate change, such as land management change may have a positive or negative impact on surface and groundwater quality in the shorter term and we</p>

<p>Proximity: Medium term</p>	<p>will have to be responsive to significant changes. For groundwater, we set threshold values which may need to be revisited and reassessed as part of River Basin Management Planning.</p> <p>In theory the cyclical approach of river basin management under the WFD (and EC Directives on urban wastewater treatment, bathing waters, shellfish waters, freshwater fish and nitrates) should be robust to deal with most climate change impacts and if necessary can be refined. However our ability to maintain Good Ecological and Chemical Status, Good Groundwater Status and achieve Protected Area Objectives, could be substantially compromised in the latter half of the century at the higher end of projections of change (for example, effects from storms and reductions in river flows and groundwater recharge).</p>
<p>Confidence: Medium</p>	<ul style="list-style-type: none"> • We assume that initiatives to reduce carbon emissions do not significantly impact on the level of treatment of wastewater. Operators are likely to need to be more innovative. • The approach to River Basin Management under the WFD is applied across all EU Member States; therefore we assume that it already works across a range of climates. • Our evidence is based on a few studies and our modelling, but more information is required to understand the impacts from other drivers, for example diffuse pollution pressures. • Due to natural variability and variation in factors controlling water quality there are difficulties in attributing any present change to climate change. However, river water temperature has changed already and is expected to continue to rise, and this will impact on water quality. • We currently see some of the biggest groundwater quality problems in areas of intensive agriculture where rainfall is relatively low. With climate change, these problems could get worse. • Our SIMCAT modelling relies on a number of assumptions regarding the influence of diffuse pollution, and the dynamics and characteristics of a range of WFD regulated substances in the environment.
<p>Response (to worst case impacts)</p>	
<p>Resource: Moderate</p>	<p>Revision of the WFD and related directives' standards and conditions should be relatively easy to implement, and we would expect direction from the EU in the event, to adjust those standards and conditions. For groundwater threshold values that we derive, we are able to refine these as new information becomes available.</p>
<p>Inertia: Short-term</p>	<p>We are now expected by EU Water Directors to monitor our water bodies in a way that will observe climate change impacts on the water environment and allow us to adapt accordingly.</p>
<p>Confidence: Medium</p>	<ul style="list-style-type: none"> • We continue to review consents in light of changes to river temperature and flow assessed through Water Quality modelling. Our planning processes already provide the opportunity to review water quality and pressures upon it, for example through River Basin Management Planning and the water industry periodic review process. • Changes to a water's typology or designation could mean increased investment is needed to maintain the required environmental standards. Therefore it will remain important that we keep the applicability of our approach to modelling under review. • Resultant changes in ecological assemblages could require us to re-assess protection objectives taking a more strategic view on future investment.
<p>Adaptation actions</p>	
<p>In the next year:</p>	<p>Costs</p>
<p>We are planning to consult on the introduction of a consistent approach to setting numeric permit limits. For example benefits could be gained by reviewing permit conditions using improved estimates of discharge, river flow and water quality, and the correlation between these.</p>	<p>L</p>
<p>We will review risks in light of UKCP09. We will consider the impacts and costs across a range of probabilities of climate change projections, including the extremes. We will update our projections for the 2050s. This work is ongoing using flow duration curves provided by</p>	<p>L</p>

HR Wallingford and will support the national Climate Change Risk Assessment.	
Following the work above to review risks in light of UKCP09, we will assess the need for research on changes in the joint probability of intense rainfall during or after a long period of low river flow.	L
We will help to ensure that the carbon consequences of proposed EU water quality policy are considered.	L
In the next 5 years:	
We will continue to identify the benefits to surface and groundwater quality from action on the demand for water, the management of the risks of floods, the use of land, and the objectives for conservation.	L
We will work to understand if we can use UKCP09 projections to better understand climate change impacts on groundwater quality.	L
Longer term actions:	
We will consider possible direct climate change impacts (and secondary impacts) when developing methods for future cycles of River Basin Planning.	
Working with partners we will continue to develop water quality modelling capability to improve the assessment of the potential impacts of changing pressures.	
We will continue to identify the benefits to surface and groundwater quality from action on the demand for water, the management of the risks of floods, the use of land, and the objectives for conservation.	
We will reflect the costs of climate change in how decisions are made. We will make sure options are assessed by Net Present Cost, with costs to perpetuity. We will continue to calculate the costs and benefits of meeting water quality standards, and to present these costs and benefits in the form required for discussions on climate change.	
We will review our policies for barriers to reducing the use of energy, in cutting the emissions of greenhouse gases, and to using less water. We will determine if and how these policies should be changed. (This is limited for now to changes that do not affect the achievement of established objectives and water quality standards, as required, for example, for the stated ambitions of Governments for the Water Framework Directive).	

Measure already implemented (for all Water Quality objectives)	Costs
We have the opportunity to review water discharge activity permits every four years (or sooner on direction of the Secretary of State), so the permitting regime is not a barrier to adapting to climate change.	(L)
Inclusion of adaptation within the last periodic review of the water industry PR09. Several companies considered adaptation in their business plans. For example, 100 catchment schemes and investigations were included in the outcome of PR09.	L
We included a climate change chapter in our first River Basin Management Plans under the Water Framework Directive.	L
Modelling using the SIMCAT water quality model and UKCIP02 derived flow factors to assess the impact of changes in river flow on water quality objectives under the Water Framework Directive.	L
We have produced a science report on <i>The potential impacts of climate change on river water quality</i> (Science Report SC070043/SR1) including a literature review, the above SIMCAT modelling, and commissioned diffuse pollution modelling from Reading University.	L

Measures which have been ruled out	Rationale
Formal alterations to our monitoring of discharges and waters based on climate change projections.	The worst case impact of climate change on our ability to monitor and the rationale for monitoring is likely to be minor.
Inclusion of climate change impacts on river flow and rainfall into the calculations used for water quality planning (beyond what we do now to use the most recent figures for past river flows and rainfall).	Modelling of impacts using UKCIP02 derived flow factors in the SIMCAT model suggest impacts of decreases in flow will be relatively minor. In addition, due to uncertainty in future flow projections, it is sensible to delay action on consent standards until changes are manifest – installation of increased wastewater treatment to deal with tighter consent standards can be relatively rapid. There would be significant financial and carbon costs with taking a precautionary approach prematurely.

Opportunities
<ul style="list-style-type: none"> • There is potential for climate change to raise the profile of the water environment and the need for sustainable water management.
<ul style="list-style-type: none"> • There are a number of opportunities relating to specific management measures driven by climate change that might support better water quality generally (for example, catchment management initiatives or better soil and nutrient management).
<ul style="list-style-type: none"> • There is an opportunity to use climate change adaptation to help integrate delivery of WFD objectives with other EU policy (for example, Common Agriculture Policy).
<ul style="list-style-type: none"> • There are opportunities to improve water quality in the environment and lower the carbon footprint of supplying good quality drinking water, for example by using catchment management approaches rather than end of pipe treatment solutions at the point of abstraction.

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Regulated business

Conceptual model of sensitive risks

No sensitive objectives identified

Risks and actions

Waste Management	
5.1 – We will ensure that waste is recovered or disposed of in ways which protect the environment and human health, by regulating waste management operations (including collection, transport, treatment, storage and disposal) and enforcing waste management controls in a nationally consistent manner.	
Impact	
	Rationale and uncertainty
Influenced by climate change but not sensitive	Climate change will not affect the delivery of these regulatory activities. However it is important that we use this objective to encourage adaptation in others.
Adaptation actions	
In the next year:	Costs
We will develop our understanding of the changes to waste production and the risk to waste management that may be caused by climate change. This may involve research that builds on our current understanding of increasing vulnerability, and how improved site management can help to manage risks. We also need to develop a fuller understanding of the risks that extreme weather conditions will pose, for example flooding.	L
We will examine how we record information on our compliance and incident databases to make sure that we can clearly identify any causal link between extreme weather events and permit breaches or pollution incidents.	L
We will maintain an up-to-date climate change adaptation and waste briefing pack that includes case studies, relevant outputs from research, standard presentation, good practice advice and signposts to further information.	L
We will assess the vulnerability of waste management facilities to flooding by relating the location of facilities to mapping on flood risk from river, surface water and coastal sources.	L
In the next 5 years:	
We will improve and maintain our understanding of the likely impact of climate change on landfill, including the engineering and operation of new and existing sites and the impact on closed sites.	(L)
We will consider the developing evidence base and our knowledge of risk of climate change when (i) reviewing our guidance to staff and operators; (ii) reviewing permitting, compliance assessment and monitoring procedures and standards.	(L)
Longer term actions:	
We will continue to review our existing stock of permits in the light of new and emerging evidence on climate change.	
We will continue to monitor trends in pollution events and waste arisings to ensure that we have an accurate picture of the effect of climate change on waste management.	

5.2 - We will provide comprehensive monitoring data (in conjunction with local authorities, as necessary) to enable the amount of waste arising and the final disposal method to be tracked and recorded for each significant waste stream.	
Impact	
	Rationale and uncertainty
Insensitive to climate change	Our ability to provide monitoring data, and the scope and efficacy of that monitoring regime is insensitive to climate change.
Adaptation actions	
None	

5.3 - We will assist regional bodies and local government in developing waste plans and strategies that reflect the waste hierarchy and the national waste strategy.	
Impact	
	Rationale and uncertainty
Influenced by climate change but not sensitive	Climate change will not affect delivery of this objective. However it is important that we use this objective to encourage adaptation in others.
Adaptation Actions	
In the next year:	Costs
We will investigate and seek to understand levels of awareness to the risks from climate change in both regulated industry and local authorities.	N/A
In the next 5 years:	
We will influence government, local authorities, the waste sector and waste producers to adapt their systems and processes. We will: - Build climate change adaptation into our responses to strategies, plans and proposals at the regional and local level. - Identify exemplar sectors, target effort to those least aware, and focus our work with operators who are in the most vulnerable locations. - Raise awareness of the impacts of climate change on waste and waste management and explain how others should respond.	(L)
Longer term actions:	
We will improve and maintain our understanding of the likely impact of climate change on waste arising and our waste management infrastructure.	

Regulated Industry	
5.4 - We will encourage and determine applications for new and existing installations within the timescales laid down in the Environmental Permitting Regulations.	
Impact	
	Rationale and uncertainty
Influenced by climate change but not sensitive	Climate change will not affect the delivery of this objective. However it is important that we use this objective to encourage adaptation in others.
Adaptation actions	
In the next year:	Costs
We will ensure that 10 per cent of operators have considered and made appropriate	(L)

changes, or plans, to adapt to climate change within the next year.	
For sites covered by the Control of Major Accident Hazards (COMAH) regime, we will ensure climate change adaptation plans are discussed with high risk sites.	L
In the next 5 years:	
All the sites we regulate will consider and have made appropriate changes, or plans, as part of their adaptation to climate change.	N/A

5.5 - We will set permit conditions in a consistent and proportionate fashion based on Best Available Techniques and taking into account all relevant matters including sectoral and site-specific compliance costs; and the resulting local, national and trans-boundary environmental benefits.	
5.6 - We will control industry discharges to watercourses through the powers provided by the Environmental Permitting Regulations 2010.	
5.7 - We will work with local authorities towards delivering the objectives of the National Air Quality Strategy and to support the development of regional air quality strategies.	
Impact	
	Rationale and uncertainty
Influenced by climate change but not sensitive	Climate change will not affect the delivery of these regulatory activities. However it is important that we use these objectives to encourage adaptation in others.
Adaptation Actions	
In the next year:	Costs
We will consider climate change adaptation as a priority in the scheduled review of permits in the cement and lime sectors.	(L)
In the next 5 years:	
We will consider climate change adaptation as a priority in the scheduled review of waste permits.	(L)
Longer term actions:	
We will ensure that Best Available Techniques (BAT) continue to evolve taking account of merging techniques on climate change adaptation and mitigation, feeding that into ongoing permit reviews.	

Radioactive substances regulation	
5.8 - We will regulate aerial and liquid radioactive discharges, and solid radioactive waste disposal, in accordance with statutory duties, guidance and Government policy, and the security of radioactive sources used in non nuclear industry.	
Impact	
	Rationale and uncertainty
Influenced by climate change but not sensitive	Climate change will not affect the delivery of this objective. However it is important that we use this objective to encourage adaptation in others.
Adaptation actions	
In the next year:	Costs
None	-
In the next 5 years:	
In May 2011 we will receive a revised safety case for the Low Level Radioactive Waste Repository (LLWR). Climate change impacts on the evolution of the site will be important – we have required that these are addressed in the safety case and will carefully review these in the period 2011-13.	(L)

Longer term actions:
We will continue to use the most up to date evidence to ensure our regulation of radioactive substances is robust to climate change and that we effectively influence our regulatory partners.

Measures already implemented (for all Regulated Business objectives)	Costs
Waste and industry regulation	
We have prepared internal supporting guidance on ‘Pollution caused by floods at EPR activities’. The sites that we regulate have considered and made appropriate changes, or plans, to ensure resilience to both fluvial and run-off flooding.	L
Climate change adaptation has been highlighted as a priority issue in the periodic review of permits.	N/A
We use our influencing skills to raise the profile of climate change adaptation actions through other channels, such as trade association meetings.	(L)
Radioactive substances regulation	
The Health and Safety Executive (HSE) has an established lead regulatory role for nuclear sites – HSE requires them to maintain safety cases which include hazards influenced by climate change. Operators are required to review these every 10 years and must take into account updated climate change predictions when they do so. In 2009 we provided input to HSE’s draft guidance on external hazard assessment.	(L)
We regulate disposals of radioactive waste. In 2009 we updated our guidance on our regulation of disposals to account for climate change.	L
We published a revised ‘nuclear sector plan’ in 2009. This places a requirement on nuclear operators to link their safety cases and adaptation actions to the appropriate Shoreline Management Plans and Catchment Flood Management Plans.	(L)
We have developed flood risk principles for new nuclear build.	L
In 2010 we published guidance for non nuclear users of radioactive substances on the need to consider climate change driven risks, particularly flooding.	L
In 2010 we worked with the Small (non nuclear) Users’ Liaison Group to use our guidance to raise awareness of climate change driving risks and the need for users of radioactive substances to consider these.	

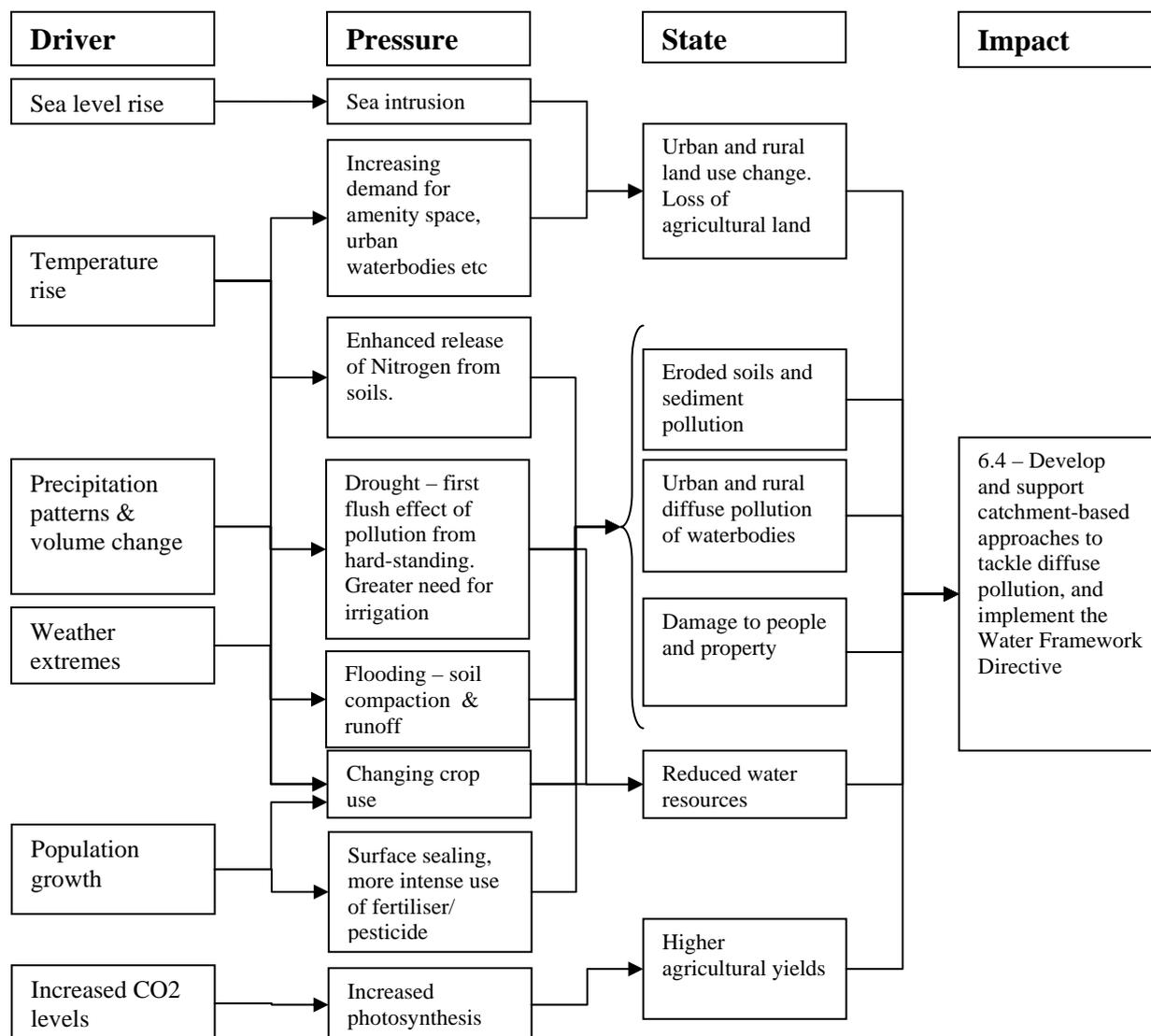
Opportunities
<ul style="list-style-type: none"> We will take the opportunity that climate change presents to increase biological treatment of waste, and harnessing the energy it produces.

Key references

UK Climate Impacts Programme, 2002. *Climate change scenarios for the United Kingdom*. UKCIP. Available online at:
http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=161&Itemid=291

Land quality

Conceptual model of sensitive risks



Key evidence

- We rely on the headline impacts provided by UKCIP02 scenarios and our understanding of the existing risks to land quality to draw conclusions about the potential risks from climate change
- We have undertaken our own research to understand when climate change may noticeably alter precipitation patterns and extremes. This is published in peer reviewed academic literature

Risks and actions

6.1 - We will act as advisors to Government on development of, or revision to, policies, strategies and legislation to ensure that they provide the right measures for effective resource protection and climate change adaptation and mitigation. For example review of the Sludge (Use in Agriculture) Regulations 1989; the Biowaste Directive; the proposed Soil Framework Directive; Contaminated Land Policy; the Rural Climate Change Forum; the review of the Common Agricultural Policy and Rural Development Plans for England

and Wales	
6.2 - We will support and contribute to the successful implementation of Government policies and strategies for example, the Defra Soil Strategy for England, the Welsh Assembly Government Environment Strategy or the sustainable use of soil policy.	
6.3 - We will carry out regulatory duties for example the Contaminated Land (England) and Contaminated Land (Wales) Regulations 2006; the Sludge (Use in Agriculture) Regulations 1989; Nitrate Pollution Prevention Regulations 2008; the Water Resources (Control of Pollution), Silage, Slurry and Agricultural Fuel Oil (England and Wales) Regulations 2010; Cross Compliance.	
Impact	
	Rationale and uncertainty
Influenced by climate change but not sensitive	Climate change will not affect the delivery of these regulatory, advisory and support activities. However it is important that we use these objectives to encourage adaptation in others.
Adaptation actions	
In the next year:	Costs
We will prioritise climate change adaptation in land quality business plans for at least the next 5 years. We will consider the suitability of existing and forthcoming measures, strategies and legislation to deliver the best outcomes for water quality, land quality and climate change (win-win, no regrets).	N/A
We will work with others to review climate projections (e.g. UKCP09 and other models) and identify future impacts on water and land. We will influence internal and external monitoring frameworks and research programmes to ensure we are able to detect signals of climate change in water and on land.	L
We will work with Defra to understand how we might use Water Protection Zones to tackle diffuse pollution and specifically the objectives of the WFD.	L
We will work with Defra and the Welsh Assembly Government to ensure that climate change adaptation is considered in developing and delivering EU and UK legislation and initiatives (for example the Common Agriculture Policy, proposed EU Soils Framework Directive; Revised Sludge Regulations; Biowaste Directive; Nitrates Directive; Catchment Sensitive Farming).	L
We will identify which organisations are best placed to help us deliver our climate change actions.	L
We will respond to the Floods and Water Bill on Sustainable Drainage Systems (SuDS); to improve our ability to develop initiatives to protect the environment against land use activities (for example agriculture and urban development) and adapt to climate change.	L
In the next 5 years:	
We will advise government on the need to build in increased winter rainfall projections into future guidance or regulation for the storage of slurry and dirty water; for example Silage, Slurry and Agricultural Fuel Oil Regulations (SSAFO).	L
We will continue to review and evaluate evidence (monitoring data, research findings) and assess how current and new measures perform in a changing climate. We will modify advice to Government accordingly for example on the proposed Biowaste Directive.	L
We will influence the revision of work programmes and processes or develop new processes to achieve the priorities of Government strategies and policies and our policies (for example, better targeting of farm inspections and more effective use of Anti-pollution Works Notices to tackle diffuse pollution).	L
Longer term actions:	
We will: <ul style="list-style-type: none"> - continue to assess how climate is impacting on land and water quality. - continue to review and evaluate evidence to assess how current and new measures perform in a changing climate. - continue to promote measures internally and externally, which deliver the best outcomes for land and water quality in a changing climate based on win-wins and no regrets, and implement revised 	

work programmes and processes where appropriate.

- advise government, trade organisations, other government agencies on revision to or development of new schemes/measures. (for example, the Common Agriculture Policy (CAP) and the Rural Development scheme); new approaches (for example, ecosystems services); or regulations.

6.4 - We will develop and support catchment based approaches to tackle diffuse pollution and improve water quality and other environmental objectives specified by the Water Framework Directive (that is, support the Environment Agency to fulfil our Competent Authority role for River Basin Management Planning). For example: pollution reduction programmes; Voluntary Initiative on Pesticides; the England Catchment Sensitive Farming Delivery initiative and Environment Agency Wales Catchment initiative; and the Campaign for the Farmed Environment.

Impact	
	Rationale and uncertainty
Importance: Substantial	<p>This objective may be unachievable under existing regulatory and resource provisions due to potential climate change impacts. Risks to water quality increases where soil-types and land management practices are likely to cause erosion or runoff, particularly where slopes or pathways connect these areas to a watercourse. We understand individual risks and processes reasonably well but, it is not always possible to predict what the ecological impact of increased pollution will be. We would expect the greatest impacts from climate change on land quality and associated impacts on water quality to occur in agricultural areas. However some of the impacts (for example from reduced precipitation) may be positive.</p> <ul style="list-style-type: none"> • We are uncertain about the future of measures – we are unclear how some of these will perform for example in Water Protection Zones. • We are uncertain of the ecological impact from climate change relative to other pressures, for example reduced flow, habitat fragmentation, and so on. • We understand the risks and processes of erosion and run-off causing water quality failures. • Population growth is likely to lead to more urban development, particularly in the south and east, and increasing agricultural intensity in previously low or non-productive areas, such as the uplands, both of which could cause higher levels of diffuse pollution. Cultivating upland soils could exacerbate the impacts of climate change through carbon release and increased flood risk.
Proximity: Medium - Long term	
Confidence: Low	
Response (to worst case impacts)	
Resource: Minor - Moderate	<p>We may require changes to land use in certain sensitive areas, rather than just changes to land management. We may need to influence how water quality improvements are assessed to reflect changes in the environmental baseline brought about by climate change, for example WFD Classification.</p> <p>We understand the nature and scale of possible responses however further scoping of options is required. Options are mainly process, regulatory and advocacy driven. We may need to change our regulatory approach where existing approaches through incentives and advice fail to effect the necessary level of change.</p> <p>Effective adaptation of land management would require a response not just from the Environment Agency but would involve local authorities, Defra, the Welsh Assembly Government, Natural England, Countryside Council of Wales and so on.</p>
Inertia: Medium - Long term	
Confidence: Medium	
Adaptation actions	
In the next year:	Costs
We will assess how current and new measures (for example, for Water Protection Zones) perform.	L
In the next 5 years:	
We will influence River Basin Management to improve the appraisal process for diffuse	(L)

pollution measures so it factors in climate change aspects into measures selection (2 nd cycle RBM Plans in 2015).	
We will continue to assess how current and new measures (for example for Water Protection Zones) perform in a changing climate.	(L)
We will review data on which measures deliver the best outcomes for water quality in a changing climate, based on win-wins and no regrets.	(L)
Longer term actions:	
We will influence our water quality management within the Environment Agency to revise how water quality improvements are assessed to reflect the impacts of climate change on the environmental baseline for example, Water Framework Directive Classification.	
We will advise government on the need to change our regulatory approach where existing approaches (incentives and advice) fail to effect the necessary level of change, for example where we recommend changes to land use, rather than to land management practices.	

6.5 - We will produce, or collaborate on, climate change and resource protection guidance for urban and rural land managers. Promoting practices and incentives that encourage land managers to protect soil and water, or clean up contaminated land. For example farming for the future fact sheets; <i>thinksoils</i> ; <i>Good Farming – Better Environment</i> ; and the sustainable management of contaminated land guidance.	
Impact	
	Rationale and uncertainty
Influenced by climate change but not sensitive	Climate change will not affect the delivery of this objective. However it is important that we encourage adaptation in others.
Adaptation actions	
In the next year:	Costs
We will provide support to the Rural Climate Change Forum and ensure our existing and future policies are climate change proofed.	L
In the next 5 years:	
We will work with others to develop new guidance and tools to promote measures which deliver the best outcomes for water quality in a changing climate, based on win-wins and no regrets for example the cost effectiveness measures database.	N/A

Measures already implemented (for all Land Quality objectives)	Costs
We have agreed a common approach to adaptation with key partners, particularly with regard to modernising rural delivery and local authorities to ensure effective joint action for example, work with the Rural Climate Change Forum (RCCF).	L
We are forging stronger links with Forestry Commission and Forest Research to gain a better understanding of the role and benefits of forests in mitigation and adaptation. We are developing policies on afforestation, bioenergy and carbon sequestration.	L
In partnership with others, we have considered climate change and built in measures for water, soil, and air into the revision of CoGAP (Code of Good Agricultural Practice); Best Farming Practice guidance and the forthcoming Good Farming Better Environment report.	L
We ensure Environment Agency advice and guidance adequately considers climate change in the assessment of risk from land contamination, prioritisation of sites and receptors and the remediation methods chosen.	(L)
We use rural development funding as a platform on which to build adaptation measures in all axes. For example, we advise on the make up and targeting of agri-environment schemes in England and Wales, to encourage better farming practices which will help meet WFD priorities.	L
Our advice on the latest Nitrate Pollution Prevention Regulations 2008 helped to significantly increase the amount of on-farm slurry storage within Nitrate Vulnerable Zones, allowing for wetter winters and reducing the need for farmers to spread slurry when soil conditions are unsuitable, a major measure to reduce diffuse pollution.	(L)

We ensure that all WFD measures for agriculture are climate proof and have developed measures that will reduce the impact of intensive rainfall.	L
We have produced a paper on <i>Limiting and adapting to climate change in the uplands</i> and contributed to partnership projects, for example the Sustainable Catchment Management Programme (SCAMP) and 'Moors for the Future' to investigate how we can preserve the peat and reduce flash flooding.	L
We have helped farmers to look ahead at climate change, by helping to revise the Soil Protection Review to include measures to increase carbon storage and organic matter levels; and through our thinksoils manual and training programme (2008).	L
We have worked with Farming Futures – a partnership between key Government agencies and NGOs – to produce fact sheets for farmers on how to use water more efficiently, reduce flood risk and address some of the issues around coastal realignment.	L
Measures which have been ruled out	Rationale
Build in increased winter rainfall predictions into future guidance or regulation for the storage of slurry and dirty water. For example, Silage, Slurry and Agricultural Fuel Oil Regulations 2010 (SSAFO) to include a minimum of 6 month storage including allowance for increased precipitation.	The SSAFO Regulations were needed urgently in order to implement the Nitrate Pollution Prevention Regulations 2008; amendments would have caused too much delay. However, we still hope to bring these changes forward in the next couple of years.

Opportunities
<ul style="list-style-type: none"> • With more carbon dioxide in the atmosphere, photosynthesis and plant growth will increase. This would improve nutrient take up and utilisation, so reduce losses to water and air. • In drought prone areas where lower crop yields are expected or different crops grown, less nutrients are needed, so fewer losses are expected. • Higher temperatures will reduce the likelihood of frosts so there will be less frost damage to stores or pipes, containing pollutants. • Revision of the Common Agricultural Policy (review in 2013) may benefit climate change adaptation objectives through facilitating changes to land management and use.

Key References

Defra, 2010. *Single Payment Scheme - Cross Compliance Guidance for Good Soil Management*.

Department of Environment Food and Rural Affairs/ Rural Payments Agency.

Available online at:

[http://www.rpa.gov.uk/rpa/index.nsf/0/2ba694d4a8a991478025768e005e67c0/\\$FILE/Cross%20Compliance%20Guide%20to%20Soil%20Management%202010%20edition.pdf](http://www.rpa.gov.uk/rpa/index.nsf/0/2ba694d4a8a991478025768e005e67c0/$FILE/Cross%20Compliance%20Guide%20to%20Soil%20Management%202010%20edition.pdf)

UK Climate Impacts Programme, 2002. *Climate change scenarios for the United Kingdom*. UKCIP.

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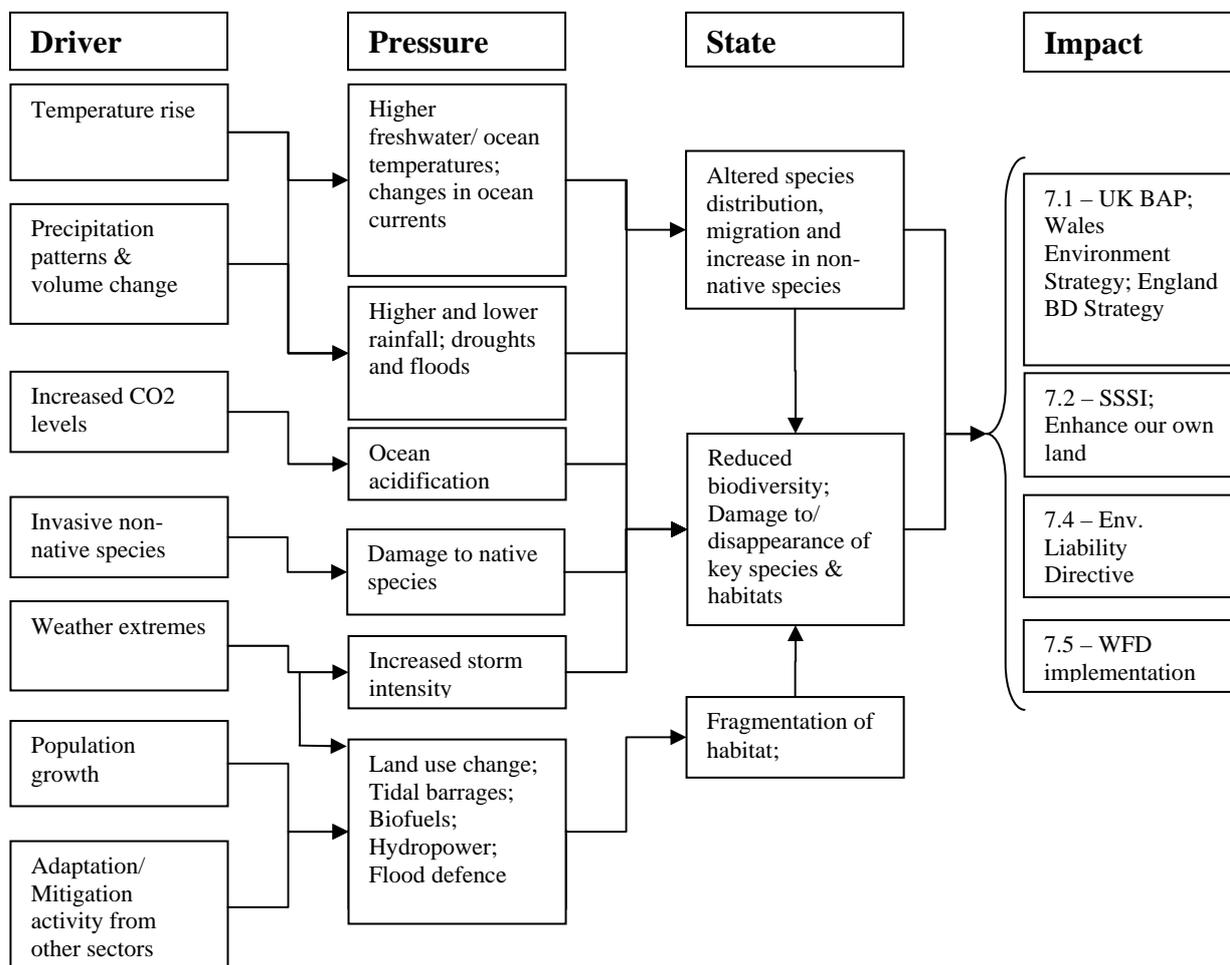
http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=161&Itemid=291

Wilby, R.L., Orr, H.G., Hedger, M., et al., 2006. Risks posed by climate change to delivery of Water Framework Directive objectives. *Environmental International*, **32**, 1043-1055.

Wildlife and habitats

Conservation and ecology

Conceptual model of sensitive risks



Key evidence
- For this assessment we rely on the headline impacts identified by UKCIP02/UKCP09, alongside academic literature, our own evidence programme and research partnerships, to understand our potential risks, the expected direction and scale of change, and how we should adapt. Much of the accumulated evidence from which we draw conclusions has relied on more detailed consideration of climate change projections.
- Our monitoring (and that of others) provides evidence of climate change already affecting wildlife, habitats and fisheries.

Risks and actions

7.1 - We will contribute to the implementation of the UK Biodiversity Action Plan, the England Biodiversity Strategy and the Wales Environment Strategy, and in particular the delivery of those actions for which the Environment Agency has lead responsibility.	
Impact	
	Rationale and uncertainty
Importance: Moderate – Substantial	Existing evidence suggests that the EU target to halt biodiversity loss by 2010 will not be met. Species extinctions are 1,000 times higher than the natural background rates, mainly due to habitat destruction, fragmentation and degradation (caused by development and intensive agriculture), as well as the impact of invasive non-native species and a lack of adequate action to deal with these pressures. Therefore our objectives are already at risk due to concurrent pressures; climate change will exacerbate these.
Proximity: Now	Predicted climate impacts would put intense direct pressure on wildlife and may cause secondary impacts such as an increased delivery of sediments to rivers, lakes and estuaries; loss of salt marshes and mudflats; and reduced dilution of pollutants during droughts. Our objectives will become increasingly difficult to achieve as a result. If we are seen to be failing our obligations for biodiversity then this is likely to have an impact on our reputation (particularly as the importance of biodiversity is rising up the political agenda). We assume that the importance of biodiversity will be increasingly recognised and that increasingly, policy decisions will take account of the value of ecosystem services. However:
Confidence: High	<ul style="list-style-type: none"> We are uncertain about how the climate will change in the future. While we are already failing our objectives, largely due to other pressures, the effects of climate change on ecology have already been recorded. Uncertainty is caused by the difficulty of allocating the proportion of change (for example, in abundance) to particular pressures. We are uncertain about society's response to future climate and the impact of that response on wildlife.
Response (to worst case impacts)	
Resource: Major	It is widely accepted that, as a society, we need to do more if we are to halt the decline of biodiversity in a changing climate. To reduce the existing pressures on wildlife and adapt to climate change, there would have to be a step change in behaviour and investment across a wide range of stakeholders.
Inertia: Rapid	We understand the nature of some of the responses required although there are many uncertainties: <ul style="list-style-type: none"> A key assumption is that reducing existing pressures on wildlife will increase an ecosystem's resilience to climate change.
Confidence: Medium	<ul style="list-style-type: none"> It is assumed that we will quickly learn how to improve our approach to climate change adaptation by using 'adaptive management' (learning by doing). The prediction of the impacts of climate change adaptation measures on biodiversity can only be very general due to the uncertainties involved. It is assumed that the costs will generally be marginal as our success will depend on influencing the application of resources invested for other primary purposes. It is assumed that there will be commitment at an EU and national level to halt the decline of biodiversity, the cost of which is high and outside the scope of this plan.
Adaptation actions	
In the next year:	Costs
We will develop and implement long-term plans to manage the landscape, to reduce temperature in rivers, lakes and estuaries and increase summer base-flows. Note that costs are high in future years but are shared across a range of stakeholders.	L

We will ensure climate change adaptation benefits are considered when prioritising fish passage projects.	L
We will promote our adaptation plan within the Environment Agency and to our partners. We will engage with the planning process to establish how we can best promote biodiversity adaptation measures, even for small scale projects.	L
We will identify those species and habitats that are most vulnerable by undertaking a vulnerability assessment. We will use the vulnerability assessment to better target existing measures. In consultation with experts, we will determine what additional action can be taken to reduce vulnerability.	L
We will commission systematic reviews to inform good operational practice within the Environment Agency. We will influence external R&D to meet our needs, track emerging literature as well as through a network of external expert contacts.	M
We will track the emerging adaptation and mitigation responses of other sectors (for example agriculture and energy) and assess the threats and opportunities for biodiversity.	L
Working with the conservation agencies and others we will review and, if necessary, revise objectives for species/habitat management to accommodate inevitable change (both positive and negative) while maximising biodiversity outcomes.	L
We will adopt adaptive management: monitor to allow us to learn from what we do. Where uncertainties are high, we will implement measures as robustly designed experiments.	L
We will work with relevant stakeholders who share our goals. We will develop shared plans for specific elements of this plan and develop suggested targets and actions that partnerships can deliver.	L
In the next 5 years:	
We will develop and implement strategic plans for relevant habitats in concert with others taking climate change into account (for example, Wetland Vision, 'Blue and Green Corridors'). We will manage the landscape and rivers to maintain and increase the generation of habitats through natural processes. We will encourage the creation of buffer zones around, rivers, lakes and coastal waters. We will make space for the natural development of rivers and coasts. Specific measures include: <ul style="list-style-type: none"> Engaging with new government tree planting scheme to target most appropriate sites and habitat types. Influencing Forestry Commission to target woodland creation schemes Promoting landscape restoration hierarchies. Ensuring our contributions to upland restoration schemes align with guidance/priorities of agencies (Natural England). Working with wetland vision to capture biodiversity adaptation benefits. 	L
Working in concert with conservation agencies, we will consider moving vulnerable species with poor dispersal capabilities particularly where suitable habitat is remote from the current location (for example, Whitefish).	L
We will ensure that training and information is provided on climate change adaptation principles and practice, adaptive management, the 'landscape scale approach', adaptation tools and no-regrets measures. For example, we are developing a tool for wetland managers that will help them factor climate change into management options	L

7.2 – We will further the conservation of Sites of Special Scientific Interest and in managing our own land, to enhance its biodiversity, cultural and recreational potential.

Impact

Rationale and uncertainty	
Importance: Moderate - Substantial	In general, climate change has not been accounted for in the objectives for Sites of Special Scientific Interest (SSSIs); they are set by the conservation agencies. A significant change in the climate would make some objectives more difficult to achieve and would require substantial investment. There are some specific examples where climate change has already had an impact on our ability to achieve objectives to the extent that we have acted (for example, 'coastal squeeze', salmon and probably eel conservation).
Proximity: Now - Short term	
Confidence: Medium - High	

Response (to worst case impacts)	
Resource: Moderate - Substantial	We are quite certain about the areas where we are already acting; however, the prediction of the impacts of climate change on biodiversity elsewhere can only be very general due to the uncertainties involved. We understand the nature of some of the types of response required although there are many uncertainties.
Inertia: Rapid - Short term	
Confidence: Low - High	
Adaptation actions	
As for 7.1 above	

7.3 - We will ensure that all Environment Agency consents where we cannot conclude no adverse effect on the integrity of a Special Protection Area, Special Area of Conservation or Ramsar site are reviewed and either affirmed, modified or revoked as appropriate, and that any new consents are dealt with in accordance with the requirements of the Conservation of Habitats and Species Regulations 2010.	
Impact	
	Rationale and uncertainty
Influenced by climate change but not sensitive	Climate change will not affect the delivery of these advisory and support activities. However it is important that we use these objectives to encourage adaptation in others.
Adaptation actions	
In the next year:	Costs
None	-
In the next 5 years:	
If and when changes in the climate lead to the need to tighten or relax a permission, we will seek to do that when a review occurs under the source legislation (that is, there is no requirement to periodically review permissions for the Habitats and Birds Directives).	M

7.4 - We will ensure that 'environmental damage' to protected species and natural habitats, and any imminent threat of such damage, in inland waters or from EA-regulated activities, is identified and addressed in accordance with the requirements of the Environmental Liability Directive.	
Impact	
	Rationale and uncertainty
Importance: Negligible	There will be virtually no impact under business as usual.
Proximity: N/A	
Confidence: Very High	
Response (to worst case impacts)	
Resource: None	There will be virtually no impact under business as usual.
Inertia: None	
Confidence: High	

Adaptation actions	
As for 7.1 above	

7.5 - We will implement the EC Water Framework Directive via the management of biological pressures, development and ownership of monitoring tools, and overseeing the design and implementation of Programmes of Measures.

Impact	
	Rationale and uncertainty
Importance: Substantial	River Basin Plans should make a significant contribution to the reduction of existing pressures on biodiversity. The delivery of these plans will become more difficult if the climate changes as predicted (for example, due to reduced flows in rivers concentrating pollutants and increased temperature reducing dissolved oxygen, ecological objectives are likely to be failed more frequently). Invasive non-native species are likely to become more invasive in a warmer climate and this will increase the risk of failure of ecological objectives. Significant resources may be required, however: <ul style="list-style-type: none"> • There is some uncertainty about how much resource will be invested in River Basin Management Plans. • There is much uncertainty about how invasive non-native species will respond to climate change. • From a WFD delivery view, climate change may not have a significant impact on ecological status as we measure it over the three cycles of WFD.
Proximity: Now - Medium term	
Confidence: Medium	

Response (to worst case impacts)	
Resource: Minor	To maximise the outcomes for biodiversity from River Basin Management Plans we need to modify these plans and their measures to maximise their benefits for climate change adaptation, while still achieving their primary objectives.
Inertia: Short-term	
Confidence: Medium to High	

Adaptation actions	
As for 7.1 above	

Measures already implemented (for all Conservation and Ecology objectives)	Costs
We have developed clear principles and guidance for climate change adaptation for biodiversity accepted across the UK Biodiversity Partnership (Defra publication).	L
Development and implementation of a single plan within the Environment Agency for climate change adaptation for biodiversity.	L
BAP habitat and 'No net loss' habitat created. 1716 ha of habitat have been created over the last 10 years.	H
Over 100 'on the ground' projects that contribute to climate change adaptation at marginal cost. (Note that there will be some overlap / double-counting with projects above).	L – M
We have developed and commissioned a range of R&D reports and publications that inform our actions by predicting the likely impacts of climate change on wildlife and wetlands, by assessing changes in water temperature and by assessing how fish and wildlife are currently responding to climate change.	M
We have decided what the priority research needs are, including how best to use and implement the new UKCP09 scenarios.	L

Opportunities

- It is likely that many of the new species that arrive as a result of climate change will be valued by people.
- Fish species that flourish in warmer climates (for example, roach, bream and carp) may increase in numbers potentially benefiting coarse fisheries.

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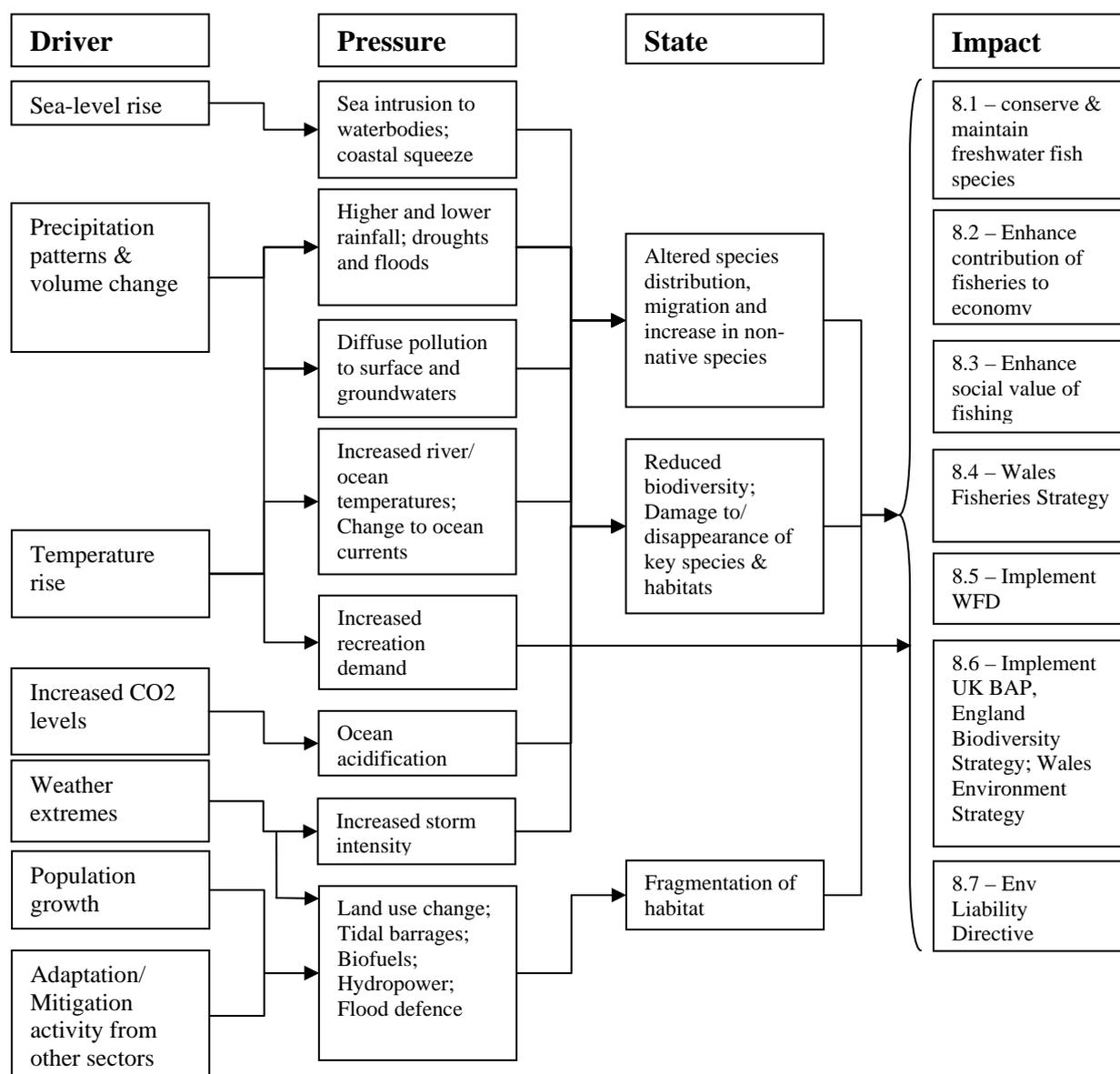
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Fisheries

Conceptual model of sensitive risks



Key evidence

- For this assessment we rely on the headline impacts identified by UKCIP02/UKCP09, alongside academic literature, our own evidence programme and research partnerships, to understand our potential risks, the expected direction and scale of change, and how we should adapt. Much of the accumulated evidence from which we draw conclusions has relied on more detailed consideration of climate change projections.
- Our monitoring (and that of others) provides evidence of climate change already affecting wildlife, habitats and fisheries.

Risks and actions

8.1 - We will ensure the conservation and maintain the diversity of freshwater fish, salmon, sea trout, eels, lamprey and smelt, and to conserve their aquatic environment.	
Impact	
	Rationale and uncertainty
Importance: Substantial	<p>Climate change presents an additional pressure on ecosystems already facing pressure from land-use change, pollution, over-fishing, demand for water, development pressures, renewable energy strategies and the introduction of non-native fish species. Further changes are expected in landscapes, ecological communities and populations structures as they respond to climate change impacts. This has the potential to devalue our freshwater and migratory fisheries and the contribution they make to the economy. Many of the predicted impacts may act in combination leading to further pressures on vulnerable species and habitats. Secondary effects are also likely to occur, such as changes in disease transmission, increased toxicity of pollutants, loss of salt-marshes and mudflats. Sea level rise and increased saline penetration would further compound the problems. This could make it harder to maintain the conservation and diversity of fish and could put our reputation at risk with our customers and stakeholders. Fish have evolved to cope with specific hydrologic regimes and habitat niches. Therefore, their physiology and life histories will be affected by alterations induced by climate change. Changes to water temperature leading to increased mortality of fish and changes in life history characteristics (size, run timing of salmon and trout) are already being seen in parts of the UK.</p> <p>Ensuring conservation of salmonids and their aquatic environments may be unachievable – there are signs that climate change is already having an impact in England and Wales. There is uncertainty about future climate predictions and therefore how climate change will impact on fish communities.</p> <ul style="list-style-type: none"> • Good evidence exists of salmon stock decline across its range despite increasing exploitation controls and improvements to waterbody environment – international advice is that this decline is heavily influenced by marine mortality linked to climatic effects. • Eel populations have changed dramatically in the last 30 years for a number of potential reasons including climate change. • It is assumed that changes may be less problematic for freshwater fish (for example carp, bream and roach) but this depends on the speed and degree of warming and whether/how soon habitats become fragmented and/or hostile. • Significant work still needs to be completed to establish the thermal preferences of fish.
Proximity: Now - Short term	
Confidence: Medium to High	
Response (to worst case impacts)	
Resource: Substantial	<p>We understand the nature of some of the types of response required although there are many uncertainties.</p> <ul style="list-style-type: none"> • A key assumption is that reducing existing pressures on wildlife will increase an ecosystems resistance and resilience to climate change. • It is assumed that we will quickly learn how to improve our approach to climate change adaptation by using ‘adaptive management’ (learning by doing) to reduce uncertainty. • The prediction of the impacts of climate change adaptation measures on fisheries can only be very general due to the uncertainties involved. • Climate change adaptation will need to be embedded into our current and future ‘ways of working’ in order to meet additional resource requirements.
Inertia: Rapid - Short term	
Confidence: Low to Medium	
Adaptation actions	
In the next year:	Costs
We will develop plans to manage the landscape to reduce temperature in rivers, lakes and estuaries, to increase summer base-flow in rivers, and to reduce diffuse pollution from sediment run-off.	M

We will ensure adaptation benefits are considered during development of a 'prioritisation tool' for fish passage needs and when prioritising fish passage projects.	L
We will continue work to investigate moving vulnerable species with poor dispersal capabilities, particularly where suitable habitat is remote from the current location (for example, Vendace, Schelly and other coregonids).	L
We will prioritise research needs to develop a strong evidence base to mitigate climate change impacts on fisheries.	L
We will take account of climate change impacts when providing technical input to Government for the development of new legislation and policies (for example, consultation for Fish Passage Regulations for all fish species). We will aid implementation of new legislation that will help mitigate climate change impacts (for example, resolve barriers to fish migration on structures we own/operate and review operating regimes for locks and weirs).	L
In the next 5 years:	
We will implement plans to manage the landscape to reduce temperature in rivers, lakes and estuaries, to increase summer base-flow in rivers, and to reduce diffuse pollution from sediment run-off.	M
We will continue to prioritise research needs and develop a strong evidence base. We will improve our understanding of climate change impacts on fish and fisheries to better inform ourselves, customers and help focus management action.	M
We will adopt ways of working in the implementation of new legislation that will help mitigate climate change impacts (for example, incorporate eel passes into our capital and maintenance programmes to meet requirements of the Eel Regulations 2009). This will help improve resilience of fish communities to climate change.	(H)
We will establish robust thermal standards for transitional and coastal (TraC) waters. For example, new nuclear power stations need large volumes of cooling water. They will be in operation (including decommissioning) for over 100 years. Partnership between the Environment Agency and our nuclear regulators to protect fish as much as possible by reducing fish impingement/entrainment and thermal discharges by exploiting new designs and methodologies.	(M)
We will identify those species and habitats that are most vulnerable by undertaking a vulnerability assessment. We will use the vulnerability assessment to better target existing measures. In consultation with experts, we will determine what additional action can be taken to reduce vulnerability.	M
Longer term actions:	
We will embed climate change into the strategic plan to tackle barriers to fish migration. Exploit opportunities to build fish passes in to new schemes (for example, capital asset maintenance and replacement, hydropower development, abstractions/discharges).	
We will adopt adaptive management: we will monitor to allow us to learn from what we do. Where uncertainties are high, implement measures as robustly designed experiments.	
Track the emerging adaptation and mitigation responses of other sectors (for example, renewable energy development) and assess the threats and opportunities for fish and fisheries.	
We will establish surveillance and early response plans for detecting the arrival of non-native invasive species.	

8.2 - We will enhance the contribution migratory and freshwater fisheries make to the economy, particularly in remote rural areas and in areas with low levels of income.

Impact

	Rationale and uncertainty
Importance: Minor - Moderate	Non-native species that are benign may become invasive under climate change scenarios, which could impact on the diversity of freshwater fish. There is a consequential risk of spread if the species is favoured by anglers. Climate change may have a significant effect on the fisheries of cold water species particularly

Proximity: Short-term	salmon and trout which make an important contribution to the economy particularly in remote, rural areas.
Confidence: Low	<ul style="list-style-type: none"> • While climate change may affect freshwater species available for fishing, this may not affect the economic viability of freshwater fisheries if anglers are willing to switch their target quarry. • However, there may be a greater risk to more remote rural economies that are more dependent upon salmonid fisheries and where there may be less opportunity and desire to fish for warm water species. • No impact on rod licence sales have been observed yet but salmonid net fisheries have declined – the number of licences issued has decreased by 70 per cent between 1985 and 2009. This has been driven by regulatory action for conservation reasons. • The biggest value associated with salmon and other fish is their existence and related values, especially as part of the wider ecology.
Response (to worst case impacts)	
Resource: Minor	There may be some switch from salmon and trout fishing to coarse fishing and also a switch to fishing in other parts of the UK but we are not yet picking up this change. If non-native species spread into our river systems this may reduce productivity of our native species due to disease transmission and competition for food and habitat. This could reduce the contribution migratory and freshwater fisheries make to the economy.
Inertia: Short-term	
Confidence: Low	
Adaptation actions	
In the next 5 years:	Costs
Increased partnership working – we will identify and influence external customers and third sector organisations who share our goals to aid development and implementation of fisheries strategies which will reduce pressures to fisheries and increase resilience to climate change impacts.	(M)
We will identify those species and habitats that are most vulnerable by undertaking a vulnerability assessment, especially salmonids. We will: <ul style="list-style-type: none"> - review current investments accordingly. - assess the value of commercial and recreational fisheries as species composition changes and varies spatially. - track effects on angling behaviour and trends in rod licence sales. 	L/M

8.3 - We will enhance the social value of fishing as a widely available and healthy form of recreation.

Impact

	Rationale and uncertainty
Importance: Minor	There will still be fish species to fish for – but the species composition may be different from now. It is assumed that people will be happy to fish for most species depending on what is available and that climate change itself will not diminish this desire. Impacts on cold water species are already being observed so the changes may occur by 2030, however this depends on the speed and degree of change and adaptation of native species. There may be a greater risk to more remote rural economies that are more dependent upon salmonid fisheries and where there may be less opportunity and desire to fish for warm water species.
Proximity: Short - Medium term	
Confidence: Low	
Response (to worst case impacts)	
Resource: Minor	We will change our approach to how we promote and enhance the social value of fishing.
Inertia: Short-term	
Confidence: Medium	

Adaptation actions	
As for 8.2 above	

8.4 - We will deliver the Wales Fisheries Strategy in collaboration with the Welsh Assembly Government.	
Impact	
	Rationale and uncertainty
Importance: Minor – Substantial	This objective is a combination of objectives 8.1-8.3, specific to Wales. Our assessment of risks are a combination of the assessments above. However, impacts on salmonid fisheries are likely to be proportionately greater in Wales due to their reliance on and the socio-economic value of these particular fisheries.
Proximity: Now – Medium term	
Confidence: Low – High	
Response (to worst case impacts)	
Resource: Minor - Substantial	As for risks 8.1-8.3 above.
Inertia: Rapid - Short term	
Confidence: Low – Medium	
Adaptation actions	
As for 8.1 and 8.2 above	

8.5 - We will implement the EC Water Framework Directive via the management of biological pressures, development and ownership of monitoring tools, and overseeing the design and implementation of Programmes of Measures.	
Impact	
	Rationale and uncertainty
Importance: Substantial	River Basin Management Plans should make a significant contribution to the reduction of existing pressures on fish. The delivery of these plans will become more difficult if climate changes as predicted. We are uncertain about how the climate will change. <ul style="list-style-type: none"> • There is some uncertainty about how much resource will be invested in River Basin Management Plans. • Uncertainty is also caused by the difficulty of allocating the proportion of change to particular pressures.
Proximity: Short term	
Confidence: Medium	
Response (to worst case impacts)	
Resource: Moderate	We have to reduce pressure on those fish species that are sensitive to predicted climatic changes now to reduce the rate of decline. However from a WFD delivery view, climate change may not have a significant impact on ecological status within the three cycles of WFD (to 2027). To maximise the outcomes for fish from River Basin Management Plans we need to modify these plans and their measures to optimise their benefits for climate change adaptation, while still achieving their primary objectives. Significant resources may be required. <ul style="list-style-type: none"> • We assume that we can work-out how to modify these plans to maximise their benefits for climate change adaptation for fish.
Inertia: Short term	
Confidence: Medium	

Adaptation actions	
As for 8.1 above	

8.6 - We will contribute to the implementation of the UK Biodiversity Action Plan, the England Biodiversity Strategy and the Wales Environment Strategy, and in particular the delivery of those actions for which the Environment Agency has lead responsibility.

Impact	
	Rationale and uncertainty
Importance: Moderate - Substantial	<p>Our objectives are already at risk due to concurrent pressures; climate change will exacerbate these. If we are seen to be failing our obligations for biodiversity then this is likely to have an impact on our reputation. We assume that the importance of biodiversity will be increasingly recognised and that increasingly, policy decisions will take account of the value of ecosystem services.</p> <ul style="list-style-type: none"> • While we are already failing our objectives, largely due to other pressures, the effects of climate change on ecology have already been recorded. • Uncertainty is caused by the difficulty of allocating the proportion of change to particular pressures. • We are uncertain about how the climate will change. • We are uncertain about society's response to future climate and the impact of that response on wildlife.
Proximity: Now	
Confidence: High	

Response (to worst case impacts)	
Resource: Substantial - Major	<p>It is widely accepted that, as a society, we need to do more if we are to halt the decline of biodiversity in a changing climate.</p> <p>To reduce the existing pressures on wildlife and adapt to climate change, there would have to be a step change in behaviour and investment across a wide range of stakeholders. This would require sufficient political will and willing support from stakeholders.</p> <p>We understand the nature of some of the types of response required although there are many uncertainties:</p> <ul style="list-style-type: none"> • A key assumption is that reducing existing pressures on wildlife will increase an ecosystem's resilience to climate change. • It is assumed that we will quickly learn how to improve our approach to climate change adaptation by using 'adaptive management' (learning by doing). • The prediction of the impacts of climate change adaptation measures on biodiversity can only be very general due to the uncertainties involved.
Inertia: Short-term	
Confidence: Low	

Adaptation actions	
As for 8.1 above	

8.7 - We will ensure that 'environmental damage' to protected species and natural habitats, and any imminent threat of such damage, in inland waters or from EA-regulated activities, is identified and addressed in accordance with the requirements of the Environmental Liability Directive.

Impact	
	Rationale and uncertainty
Importance: Negligible	Negligible impact
Proximity: N/A	
Confidence: Very high	

Response (to worst case impacts)	
Resource: None	Negligible impact

Inertia: None	
Confidence: High	
Adaptation actions	
As for 8.1 above	

Measures already implemented (for all Fisheries objectives)	Costs
Fish stocks are routinely monitored for conservation and fisheries management purposes and used to develop our fisheries strategies. Our monitoring seeks to provide us with an indication of changes in fish populations and potential causes, of which climate change may be one.	(M)
We have already commissioned studies to investigate climatic effects on fish and their populations.	M
Our fisheries strategies emphasise partnership working and we routinely work with external organisations to deliver our objectives. This will allow us to make a co-ordinated response to climate change and widely communicate the risk and responses required.	(M)
We work at a local level with landscape initiatives, such as Catchment Sensitive Farming, to improve conditions for fish; addressing diffuse pollution through Rural Sediment Tracing Project; projects associated with <i>Making Space for Water</i> policy which increase the areas of floodplains and reduce habitat fragmentation.	(M)
Delivery of over 100 multi-species fish passes were built last year through funding from Defra. These works will improve the resilience of fish species to climate change impacts and other pressures.	(H)
White fish translocation projects moving Vendace and Schelly from the Lake District to more suitable northerly locations in England and Scotland. This is a measure to ensure species do not become extinct and are able to better adapt to climate change.	(M)

Opportunities
<ul style="list-style-type: none"> Increased recreational opportunities arising from increased numbers of warm water coarse fish species, such as carp, bream and roach. In transitional and coastal (TraC) waters opportunities may be also be provided for commercially exploitable warm water species, such as bass.
<ul style="list-style-type: none"> Sustainable management of flood risk, such as creation of more wetland and coastal habitats and re-connection of floodplains. Urban habitat restoration programmes can provide a range of important functional benefits and are likely to have very significant social and educational benefits.
<ul style="list-style-type: none"> Evaluation of the main ecosystem services associated with inter-tidal habitat in TraC waters. Further elucidation will assist Cost Benefit Analysis of habitat creation options and help acquire additional funding support through cross-functional working. Similar opportunities may well apply with carbon offsetting, air quality improvement strategies and initiatives driven by WFD (for example, nutrient stripping function of TraC waters).
<ul style="list-style-type: none"> Increased opportunities for partnership working, for example working with Rivers Trusts to improve fish passage and habitats.
<ul style="list-style-type: none"> Influencing land management practices to enhance habitat connectivity and improve habitat for fisheries at risk from climate change impacts.

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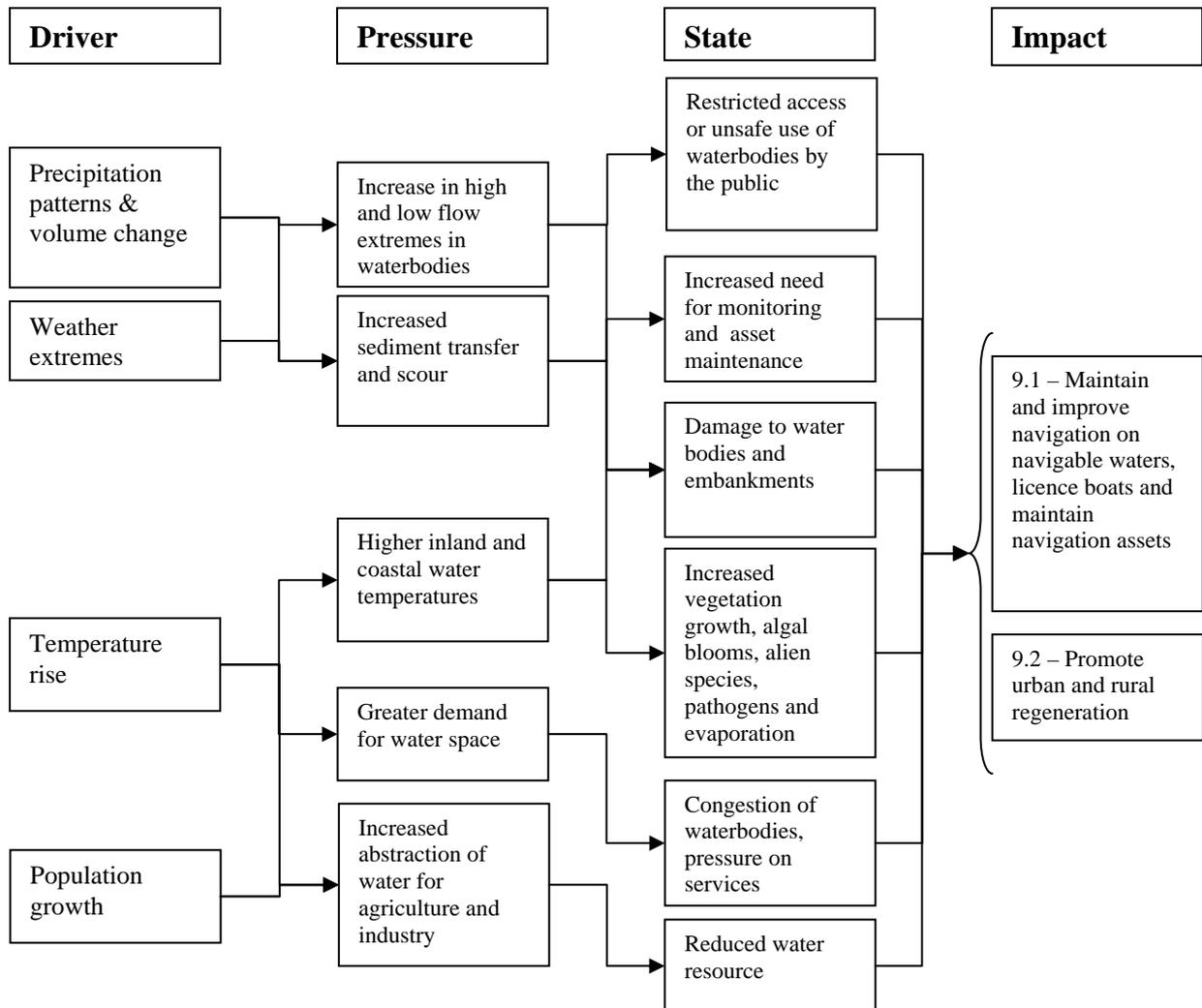
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Navigation

Conceptual model of sensitive risks



Key evidence

- We have modelled the potential climate change impacts on river flows in England and Wales by 2050, using UKCIP02 scenarios.
- We have assessed the impacts of climate change on high flow events and our use of “Strong-Stream Advice” notices using our 2050s river flows model
- We also rely on the headline impacts identified by UKCIP02 to understand the scale of potential risks to our Navigation objectives and how we should adapt

Risks and actions

9.1 - We will maintain and improve navigation on the navigable waters (mostly rivers) for which the Environment Agency has responsibility and licence boats using these waters as a statutory Navigation Authority; to maintain its assets in a condition which ensures the safe use of its waterways.	
Impact	
	Rationale and uncertainty
Importance: Moderate – Substantial	<p>Drought is the most important expected impact from climate change on our navigation responsibilities, and this impact will depend on a number of factors including how we manage water resources and water resource assets (for example reservoirs) in the future. High flow events are of less significance, are more short term and people generally don't want to navigate waterways during these events anyway.</p> <p>An increase in the frequency of extreme low flow events would limit navigation through inadequate depth for boat passage and restrictions on lock operation. An increase in the frequency and degree of high flow events would severely limit navigation by making it unsafe to navigate and would increase the risk of physical damage to our assets and their potential failure. Increases to the temperature of our waterways, reservoirs and rivers are likely to result in additional vegetation growth, alien species, migration of existing species, pathogens and evaporation which could restrict safe and sustainable use of water for some recreational activities and increase the levels of maintenance required. Resource demands for this objective during drought periods could adversely affect the delivery of other objectives and other departments in the Environment Agency, but there could also be an impact on the Environment Agency's reputation during low flow events. Physical impacts on embankments due to drought and flooding could be significant one-off costs, however our response is likely to be reactive.</p> <ul style="list-style-type: none"> • There is uncertainty about when a change to existing practice would be required. • A change to existing practice will involve a significant change to frequency of navigation restrictions, 'Strong Stream Advice' notices, maintenance requirements and so on. • Increased use of waterways due to population growth may have a negative impact on our navigation resource due to greater demand for facilities, congestion, competition for water space and pressure on services.
Proximity: Short - Medium term	
Confidence: Medium	
Response (to worst case impacts)	
Resource: Major	<p>We need to research and quantify how probable changes to river flows will affect the management of the navigation channel and other infrastructure (that is, in respect of dredging, scour and so on). Indicative estimates for the Thames, using (relatively dry) UKCIP-02 scenarios, suggest that our existing operating and asset management approaches are appropriate to respond to changes in flood flows. However, other probabilistic models, (UKCIP-09), are likely to demonstrate considerable variation between our regions. Further modelling is required at finer spatial and temporal scales to evaluate the specific impacts of high flows upon each of our waterways.</p> <p>One-off costs from embankment failure could cost several millions of pounds. With advance planning, reinforcing existing structures could be undertaken quickly (rapid), but the likelihood of occurrence are so small that it may not be worth taking action.</p> <ul style="list-style-type: none"> • There are a number of uncertainties around geomorphology, topography and their impact on low flows and navigation.
Inertia: Short-term	
Confidence: Medium	
Adaptation actions	
In the next year:	Costs
None	-
In the next 5 years:	

We will record, manage and compare data with other navigation authorities on frequency of operational measures to respond to environmental processes (such as spot dredging, weed growth, or changes to vegetation management across navigation assets). We will continue to consider and evaluate new climate change information/modelling undertaken by other functions to ensure that our maintenance of navigation assets is robust enough to react to change (including best available data modelling on high flow events, increases to evaporation rates, vegetation growth, spread of invasive non-native species and occurrence of algal blooms). We will review strong stream data and 30-day duration mean flows to highlight trends that could affect current risk-based approaches being taken to maintenance, asset management and strong stream advice/management.	L
Should risk of drought conditions occur we will develop practices to seek to maintain a minimum flow and manage lock movements.	L
Longer term actions:	
We will work to identify changes in management practices that may help adapt to climate change through WFD, fisheries and flood risk management.	

9.2 - We will promote urban and rural regeneration.

Impact	
Importance: Negligible – Minor	Rationale and uncertainty We will promote urban and rural regeneration in tandem with our delivery of objective 9.1
Proximity: Short – Medium term	
Confidence: Medium	
Response (to worst case impacts)	
Resource: Minor	
Inertia: Rapid	
Confidence: Medium	
Adaptation actions	
As for 9.1 above	

Measures already implemented (for all Navigation objectives)	Costs
We have reviewed our current baseline of Strong Stream Advice, low flow and other climate related data (SSA thresholds and 30 day duration mean flows have been adopted by waterway managers as a way of monitoring effects of climate change on our navigations).	L
We ensure engineering standards, performance and sustainability criteria are applied to navigation assets. Standards for more extreme high flows are aligned with Defra and current Environment Agency guidance and research for flood risk management.	L
We have reviewed current operational processes and how they may need to adapt to climate change (including health and safety, increased visitors and so on).	
We have developed a clear position statement for navigation and climate change for our external audience. <ul style="list-style-type: none"> We promote key messages with internal and external partners. We develop and deliver guidance for staff to promote climate change awareness and understanding, including the dissemination of the Recreation & Navigation climate change adaptation plan. 	L
We review and promote adaptation methods with external contacts and partners.	L
We assess – with wider external partnerships – the effect of climate change on a potential increase in interest in, and opportunities to develop waterways for freight.	L

Measures which have been ruled out	Rationale
Evaluate approaches, costs and potential value of maintaining a minimum flow during drought conditions.	Will be undertaken/developed in reaction to drought risk due to site specific and temporal differences in impacts.
Investigate opportunities to promote improved boat design, channel maintenance, and changes to locking practice.	This is for the boating sector to develop. Minimum channel maintenance will be undertaken to keep waterways open. Existing low-flow lock practices will be reviewed, amended and implemented as needed to respond to risk and balance environmental/economic demands.
Scope potential impacts of multi-season droughts and water framework directive on future operation of navigations under low flow conditions.	Some initial scoping work carried out to identify impacts and options. Limited impacts and risks found, with few alternatives to justify more in-depth investigation/investment.

Opportunities
<ul style="list-style-type: none"> • Increased potential for freight use on our waterways as carbon neutral alternative.
<ul style="list-style-type: none"> • Systems which safeguard minimum flow could help to conserve existing biodiversity and add to species' resilience.
<ul style="list-style-type: none"> • The threat of low flows could inspire improved boat design.
<ul style="list-style-type: none"> • Continue to monitor economic viability of green power generation schemes, carbon neutral solutions in towns and cities (for example use of water to cool buildings) for potential application across waterways.
<ul style="list-style-type: none"> • Where our navigation interests overlap with local sustainable transport initiatives, work with others to provide more sustainable solutions (that is, solar water taxi, commuting cycle/walking routes to town/city centres and so on).
<ul style="list-style-type: none"> • Act as an exemplar of best practice in low carbon, ethical design and build of replacement or new waterway structures and facilities.
<ul style="list-style-type: none"> • Providing local recreation opportunities on local waterways, therefore reducing the need for users to travel farther afield.

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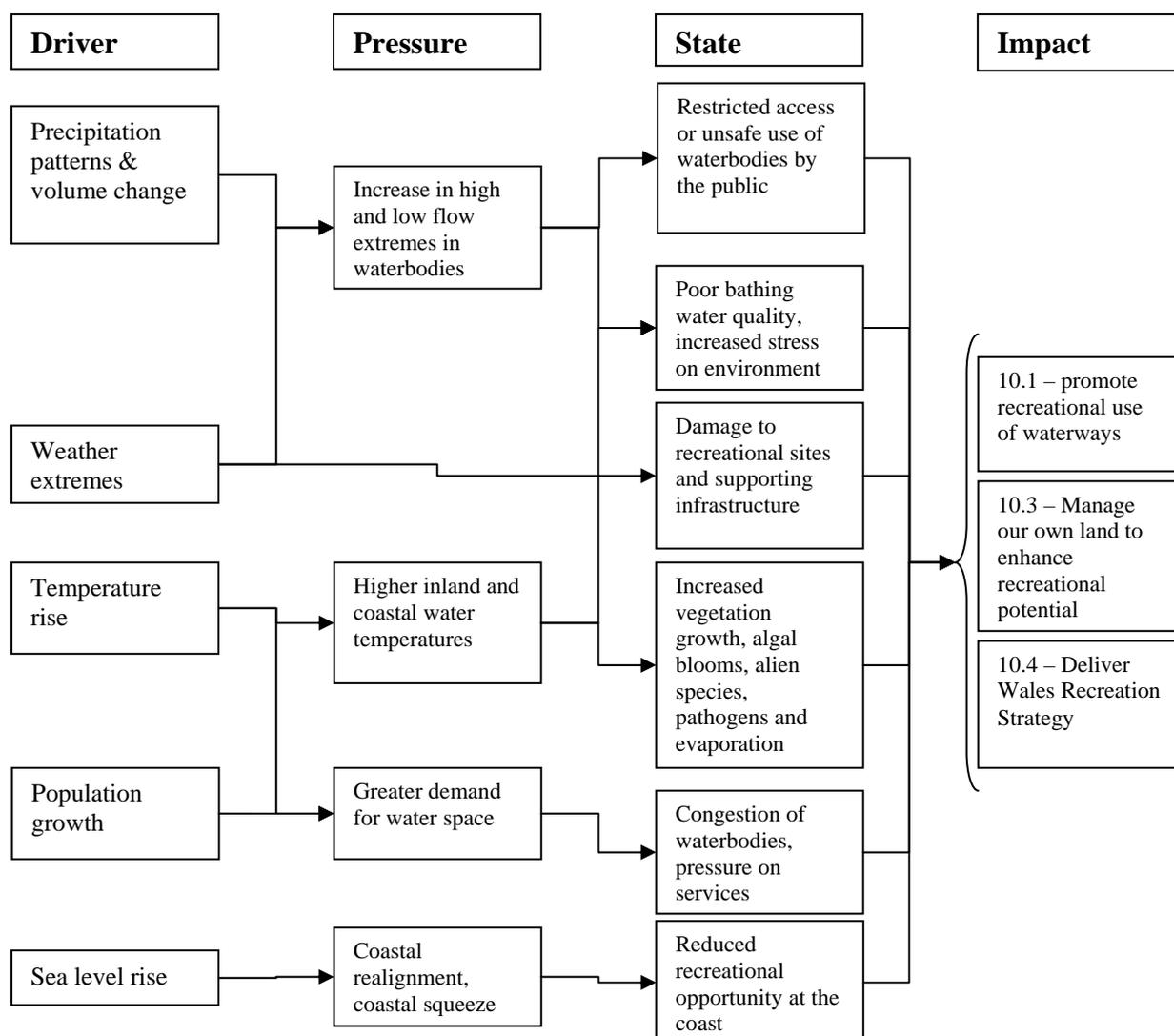
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Recreation

Conceptual model of sensitive risks



Key evidence

- We rely on the headline impacts identified by UKCIP02 alongside academic literature to understand the types of impact, the direction of change in people's behaviour, the potential risks to our objectives and how we can adapt

Risks and actions

10.1 - We will promote greater recreation, in particular for the use of waterways we manage by all sectors of society, and provide improved facilities for users.	
Impact	
	Rationale and uncertainty
Importance: Minor	We expect temperature increases will result in growing demand for water-related recreation activities. Demand will increase from a larger population, more UK tourists staying at home and a greater number of international visitors as traditional destinations nearer the equator become uncomfortably hot. Increased use may have a negative impact on the resource with greater demand, congestion, competition for water space and pressure on services. In the short to medium term many impacts may be positive rather than negative, and provide a number of opportunities to enhance the recreational value of waterways and our own land.
Proximity: Short - Medium term	Increases to the temperature of our waterways, reservoirs and rivers are likely to result in additional vegetation growth, toxic and algal blooms, alien species, migration of existing species, pathogens and evaporation which could restrict safe and sustainable use of water for some recreational activities and increase the levels of maintenance required. Higher evaporation rates, low summer rainfall and high demand for abstraction may severely limit the availability of many inland waters for recreational use. An increase in water retention times in low flow conditions may lead to more weed growth, which would increase the need for greater monitoring and maintenance.
Confidence: High	Storm damage to buildings, harbours, woodland/trees, gardens, caravan and camp sites, especially in exposed locations may become an increased threat. Temporary loss or closure of infrastructure - power lines, roads, rail lines, and coast paths severed by storm damage or flooding may also become a more frequent threat. <ul style="list-style-type: none"> • There is potentially a risk to our reputation. • We assume that there are no systemic delays; when the weather is warmer, there will be an immediate increase in visitor numbers. • Population growth is likely to increase pressure on our recreational objectives.
Response (to worst case impacts)	
Resource: Moderate	Climate change is unlikely to mean a change to what we do, we will just be doing more of it. For example, increased number of accidents will mean more inquiries, notices and so on. It is difficult to assess exactly when this may become a problem, given our existing knowledge of climate impacts. <ul style="list-style-type: none"> • We understand the dynamics of climate risks to people's behaviour, and understand what is needed to respond. • Land is managed by different parts of the Environment Agency. As impacts increase, resources may need to be redistributed across functions.
Inertia: Rapid	
Confidence: Very high	
Adaptation actions	
In the next year:	Costs
None	-
In the next 5 years:	
We will respond to high risk issues, particularly for land and water-access management issues (for land owned by the Environment Agency), Parliamentary Questions and media enquiries to promote safe, responsible use of our water and waterside holdings where demands and pressures change (including coastal realignment).	L
We will respond to external organisations and media in promoting safe, responsible use of water environment as demands/pressures change.	L
We will review probabilistic modelling of impacts prepared for other functions to identify any significant changes to our existing knowledge of nature, frequency and timescale of impacts.	L

Longer term actions:
We will review/climate change proof our practices for providing recreational opportunities on our holdings and our duty of care for increasing numbers of people who may trespass for recreational purposes.
We will consider projected climate change impacts in the way we broadly promote greater recreational use of water, in our provision of recreational facilities for users, and in the enhancement of the recreational and cultural potential of our own land.
We will help to inform debate on local conflict resolution as competition and demand for limited water/water space escalates.

10.2 - We will manage our own lands to enhance their cultural and recreational potential.	
Impact	
	Rationale and uncertainty
Importance: Negligible – Minor	Our own lands and their cultural and recreational potential will be subject to the same impacts described for objective 10.1.
Proximity: Short – Medium term	
Confidence: Medium	
Response (to worst case impacts)	
Resource: Minor	Our existing activity is unlikely to change until severe impacts force a reactive change (for example, restricting access to our land). Responses to extreme impacts are unlikely to be resource intensive and can be implemented quickly. Land is managed by different functions within the Environment Agency. As impacts increase, resources may need to be redistributed across functions.
Inertia: Rapid	
Confidence: Medium	
Adaptation actions	
As for 10.1 above	

10.3 - We will work to deliver the Strategic Plan for Water Related Recreation in Wales.	
Impact	
	Rationale and uncertainty
Influenced by climate change but not sensitive	Climate change will not affect the delivery of this objective. However it is important that we use this objective to encourage adaptation in others.
Adaptation actions	
In the next year:	Costs
None	-
In the next 5 years:	
We will ensure that implementation of the plan and new provision is undertaken with climate change in mind.	L

Measures already implemented (for all Recreation objectives)	Costs
We review current operational processes and how they may need to adapt to climate change (including health and safety, increased visitors etc).	L
<ul style="list-style-type: none"> We have developed a clear position statement on recreation and navigation and climate change for our external audience. 	L

<ul style="list-style-type: none"> • We promote key messages with internal and external partners. • We develop and deliver guidance for staff to promote climate change awareness and understanding, (including the dissemination of our climate change adaptation plan). 	
We assess with wider external partnerships the effect of climate change on recreational and tourism demand for waterways.	L
We review and promote adaptation methods with external contacts and partners.	L
Measures which have been ruled out	Rationale
Review of health and safety practices and procedures for our sites	Our current procedures are considered sufficiently robust to handle changes in trends, types and frequency of uses. Where this cannot reasonably be achieved then access to sites would be closed where public health and safety can no longer be controlled.
Further modelling of regional impacts of climate change	Greater probabilistic analysis of regional differences in the impact of climate change is unlikely to significantly alter the systems or advice in place to respond to changing pressures, risks and demands on our sites.

Opportunities

<ul style="list-style-type: none"> • Increased recreational and tourism demand. • Systems which safeguard minimum flow could help to conserve existing biodiversity and add to species' resilience. • Greater demand for recreational opportunities closer to where people live. • New recreation opportunities - shark watching, new tourism industries and so on. • Responding positively to the climate change agenda to develop renewable energy schemes on some of our assets. • Opportunity for climate change to be used a focus for regenerating waterbodies in towns and cities to provide carbon free sustainable transport spines. • Act as an exemplar of best practice in low carbon, ethical design and build of replacement or new waterway structures and facilities. • Influence better provision of water and land based recreation across land management functions to respond to strategic and targeted community needs (reducing need to travel significant distances for demanded leisure opportunities for example white water playsites in Anglian/SE).

Key references

Amelung B. and Viner D., 2006. The sustainability of tourism in the Mediterranean: Exploring the future with the Tourism Comfort Index. *Journal of Sustainable Tourism* Vol 14 Nos. 4 -.

UK Climate Impacts Programme, 2002. *Climate change scenarios for the United Kingdom*. UKCIP, Available online at:

http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=161&Itemid=291

Viner D., 2006. Tourism and its Interactions with Climate Change. *Journal of Sustainable Tourism*, Vol 14 Nos. 4 -.

Sustainable places

Conceptual model of sensitive risks

No sensitive objectives

Risks and actions

11.1 - Better local environments enhance people's lives and support a sustainable economy.	
Impact	
	Rationale and uncertainty
Influenced by climate change but not sensitive	Not sensitive to climate change but we may use this objective to work with others to adapt; or adjust its implementation to ensure that our work is not causing adverse responses from others.
Adaptation actions	
In the next year:	Costs
We will co-ordinate the prioritisation of environmental issues with local authorities. This will include objectives linked to adaptation.	L
In the next 5 years:	
Continue to support prioritisation of environmental issues with local authorities.	L

11.2 - New and existing developments have a reduced environmental impact and well planned environmental infrastructure.	
Impact	
	Rationale and uncertainty
Influenced by climate change but not sensitive	Not sensitive to climate change but we may use this objective to work with others to adapt; or adjust its implementation to ensure that our work is not causing adverse responses from others.
Adaptation actions	
In the next year:	Costs
Work with policy makers, developers and other partners to provide evidence on sustainable building standards for both new and existing developments. In the next year this will include work on retrofitting good practice and on energy and water efficiency.	L
Advise and support local staff to inform the delivery of significant housing growth projects, to ensure they mitigate negative impacts and maximise opportunities to enhance their local environments. This will include providing evidence to input into water cycle studies and environmental infrastructure studies.	L
In the next 5 years:	
As above.	

11.3 - Spatial and economic planning meets environmental standards and objectives, and addresses climate change.	
Impact	
	Rationale and uncertainty
Influenced by climate change but not sensitive	Not sensitive to climate change but we may use this objective to work with others to adapt; or adjust its implementation to ensure that our work is not causing adverse responses from others.

Adaptation actions	
In the next year:	Costs
In England, we will carry out work to ensure that Local Economic Partnerships are informed about environmental limits and take into account future climate risks. In Wales, continue to contribute, where appropriate, to the community planning process including Local Service Boards and Local Delivery Agreements and the Wales Spatial Plan groups.	L
We will advise Governments in England and Wales on reforms to national, sub-national and local planning decision making structures and forthcoming policy and legislation.	(L)
We will work with Planning Authorities in England and Wales to ensure that spatial strategies (local and sub-national) respect environmental limits and take into account future climate risks.	(L)
We will work with Governments in England and Wales and other stakeholders to help deliver the Planning Act and policy for Nationally Significant Infrastructure Projects.	(L)
We will maintain our good relationship with the Infrastructure Planning Commission and highlight climate change in our work with infrastructure developers.	(L)
We will work in partnership to promote the wider adoption of sustainable building standards for both new and existing developments.	(L)
We will help ensure Environmental Assessments address future climate impacts.	(L)
We will update our existing Guidance on Strategic Environmental Assessment (SEA) and Climate Change for external users, to encourage integration of climate change considerations in the SEA process.	(L)
We will liaise with the Department for Communities and Local Government and WAG to help include climate change considerations in future Environmental Impact Assessment (EIA) guidance.	(L)
We will use our statutory consultee role in planning to incorporate climate change considerations in SEA and EIA documents, and to Sustainability Appraisals.	(L)
We will work in partnership with Governments in England and Wales and the UK Climate Impacts Partnership to help advise planners and developers on UKCP09.	(L)
We will work in partnership with Governments and other agencies to help advise on climate change adaptation issues for the built and natural environment.	(L)
In the next 5 years:	
We will ensure our work uses good practice case studies.	(L)
We will ensure communications work integrates adaptation and resource efficiency messages.	(L)

Measures already implemented (for all Sustainable Places objectives)	Costs
We worked with the Department of Communities and Local Government and stakeholders to inform the criteria for development for eco-towns and growth point development so they are resilient to the long term impacts of climate change.	M
We worked in partnership with local authorities to deliver NI188 in England and our commitments in Local Delivery Agreement in Wales including outcomes that reduce climate change risks.	M
We commissioned evidence on future land use pressures particularly in relation to the impacts on water availability and flood risk management.	L
We have ensured that planning applications for major development which we have sustained an objection to on flood risk grounds are notified to the Secretary of State under the 'Call in' Direction (England only).	L
We have advised Governments on including climate change adaptation in national planning policy and through Strategic Environmental Assessments and Appraisals of Sustainability.	M
We have provided advice to our own staff on advising local authorities on climate change adaptation.	M

Opportunities
In England, realise opportunities arising through localism agenda, including the role of Local

Economic Partnerships, to address and respond to climate change adaptation.

Realise opportunities in planning reform in England for climate change adaptation including National Planning Framework, Community Right to Build and a new designation to protect green areas of particular importance to local communities.

Key references

UK Climate Impacts Programme, 2002. *Climate change scenarios for the United Kingdom*. UKCIP.

Available online at:

http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=161&Itemid=291

Climate change and energy

Conceptual model of sensitive risks

No sensitive objectives

Risks and actions

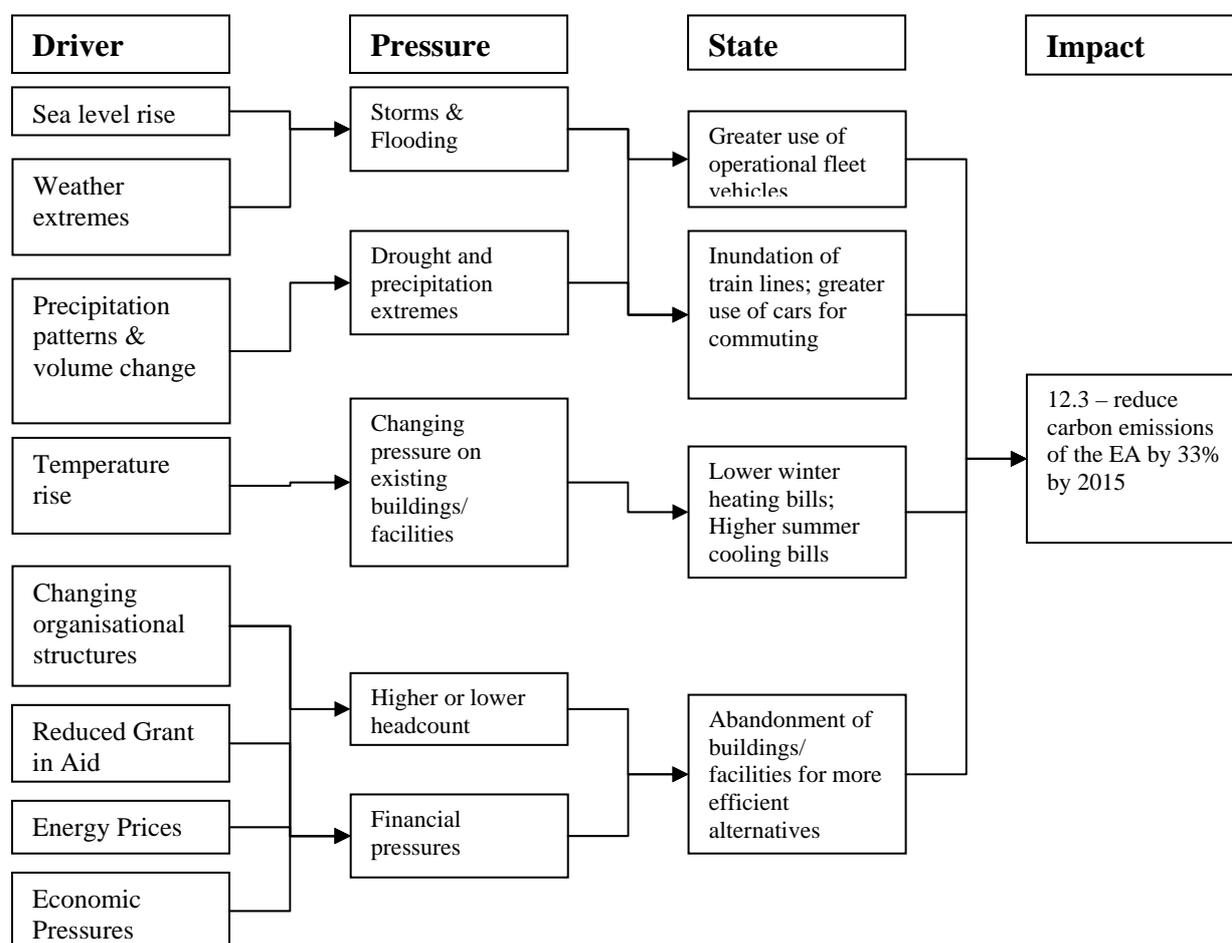
12.1 - We play our full part in helping England and Wales meet greenhouse gas emissions targets in ways that minimise other environmental impacts. This includes administering the EU Emissions Trading System and the CRC Energy Efficiency Scheme efficiently.	
Impact	
	Rationale and uncertainty
Influenced by climate change but not directly sensitive.	Climate change is unlikely to have a direct impact on our role in helping England and Wales to meet greenhouse gas emissions targets. However we must ensure that our efforts do not conflict with, and where possible help, the adaptation efforts of ourselves and others.
Adaptation actions	
In the next year:	Costs
We will carry out a project to research the energy sector's use of water. The project will explore the sustainability of the sector's demand for water given likely changes in energy generation and the impact of climate change on water availability.	L
We will publish our revised good practice guide for small scale hydropower which sets out the standards that we believe need to be met in order for them to be designed and delivered sustainably and not prevent future adaptation of freshwater species and habitats.	L
In the next 5 years:	
We will ensure that our mitigation activities consider the sustainability of low carbon technologies and, where appropriate, incorporate the need for climate change adaptation in their design and delivery.	L

12.2 - We help people and wildlife adapt to climate change and reduce its adverse impacts.	
Impact	
	Rationale and uncertainty
Importance: Severe	<p>Note: Risk 12.2 is not included in our strategic risk assessment since it is the cumulative effect of all other risks set out in this report.</p> <p>In summary, our assessment shows that:</p> <ul style="list-style-type: none"> Climate change will affect almost everything we do. Our priority risks are to inland flooding, coastal flooding and erosion, water resources and quality, wildlife and habitats. We need to manage specific risks in other areas of our business and adapt how we work to achieve the same outcomes. Partnership working is essential for adaptation and we are working closely with central and local government, local communities, businesses and the third sector. Many of our climate risks interact and need to be managed together. <p>We will update our risk assessment and adaptation plans as our evidence improves or our remit changes.</p>
Proximity: Now	
Confidence: V. low – V. high	
Response (to worst case impacts)	
Resource: Major	The other sections of this annex list the specific actions we have taken already and those we plan to take to address risks to individual business objectives. They span the full range of resources (some are simple and easy to do whereas others will require significant effort) and inertia (we can implement some very quickly
Inertia: Rapid - Medium	

Confidence: V. low – V. high	whereas others will take longer to be effective). We are very confident that some will have the desired effect but we are less confident about others and will implement flexible solutions and learn as we go, adjusting our approach as necessary. In addition to taking these actions we also need to ensure there is strong leadership, appropriate governance, structures and ways of working. Our adaptation programme will be structured and run to ensure that, as an organisation, we take steps to adapt in a holistic and integrated way. This includes prioritising our actions, learning from experience, developing adaptive capacity and ensuring that we gather and interpret evidence to improve our understanding of possible future impacts on our organisation.
Adaptation actions	
In the next year:	Costs
We will implement an adaptation programme to coordinate and integrate our actions to help people and the environment adapt.	M
We will continue to embed consideration of climate change in everything we do. This will enhance the way we understand and communicate about climate change, and how we work with impacts, risks and responses across the organisation.	L
We will continue to provide training, tools and guidance to our staff to ensure they have the skills and knowledge they need to address climate change in their roles. This will include guidance to all staff to allow them to use the UK Climate Projections (UKCP09) in an appropriate and consistent manner.	M
We will continue to share our experience, knowledge and data with key partners, such as Government departments, the Climate Change Commission for Wales, local authorities, businesses, and where appropriate, the public.	M
We will continue to collect and interpret data, undertake modelling (for example using UKCP09) and research to improve our knowledge and the evidence base to underpin our own decisions and the work we do with all our partners.	M
In the next 5 years:	
We will play our full part in the delivery, as required, of the first National Adaptation Programme, due in 2012.	M/H
We will monitor and report on progress in embedding consideration of the future climate in everything we do.	L
We will monitor delivery of this adaptation report and the wider adaptation programme and, if required, review and revise this risk assessment under subsequent iterations of the Reporting Power directions.	L

Our carbon emissions

Conceptual model of sensitive risks



Key evidence

- We rely on the headline impacts identified by UKCIP02/UKCP09 to understand the range and scale of potential impacts projected within the limited timescales of our emissions reduction objectives

Risks and actions

12.3 We will reduce the Environment Agency’s carbon emissions by 33 per cent by 2015 from 2006-07 levels.

Impact

Rationale and uncertainty	
Importance: Negligible	We may expect to see climate change impacts on our carbon reduction targets in the future. Increased frequency of flooding incidents may require more water pumping and operational use of vehicles and boats. Intense flooding events may cause damage to roads leading to greater need to take longer routes, or cause train lines to be inundated more often leading to an increased reliance on cars for travel. These types of impacts may lead to our Internal Environmental Management mileage and carbon dioxide targets being missed. However there are unlikely to be impacts on our current carbon reduction objective given the timescales involved. There are a number of competing economic, business continuity and statutory pressures which are likely to take
Proximity: Short-term	

Confidence: Medium	higher priority in the event of significant climate change causing a potential failure of our carbon reduction target over these timescales.
Response (to worst case impacts)	
Resource: Minor	The most extreme ranges of the most up to date climate projections (UKCP09) would be very unlikely to affect our current carbon reduction target. Business as usual fluctuations in our carbon emissions are more influential and we have many initiatives already underway to minimise them and to make our ways of working more efficient. It is likely that operational requirements will take priority over meeting carbon reduction targets in the future if there are worst-case impacts.
Inertia: Long-term	
Confidence: Medium	
Adaptation actions	
None	

Measures already implemented (for all Climate Change and Energy objectives)	Costs
We have completed a range of projects to understand the impacts from climate change and risks to our organisation, including: <ul style="list-style-type: none"> providing guidance to help us understand UK Climate Projections 2009 (UKCP09) and how to use them effectively in our work; understanding the potential climate impacts on river flows by the 2050s. 	(H)
We published our first adaptation strategy in 2005, updated it in 2008 and climate change now features prominently in our corporate strategy. We have been taking actions to understand climate risks and address them for several years and all this work has informed the content of this report.	M
We have a national training programme which ensures that all staff have at least a foundation-level of knowledge of climate change and our role in managing it. This has face-to-face and e-learning components, with important messages regularly reinforced through our main organisational communication channels.	L
We consider climate change as a key element in business planning, and we are monitoring progress to ensure that all parts of the Environment Agency are progressing their understanding of climate change impacts and developing and implementing appropriate responses.	L
We have integrated adaptation into key technical advice and guidance (for example flood risk allowances, water resource planning, land use planning guidance and the Water Framework Directive), which target other sectors.	M
We have developed opportunity maps for hydropower and biomass projects to ensure their location is sustainable and does not compromise our ability to adapt.	M
We ensure that existing guidance on environmental assessment includes adaptation.	L
We have implemented energy efficiency measures like Voltage Optimisation (VO). There has been approximately 10 per cent reduction in electricity use at all sites where VO has been installed. This will help us towards meeting our target despite extra A/C requirement.	M
De-carbonising our energy with renewables.	N/A
We continue to promote alternatives to travel such as web conferencing.	(L)

Opportunities
<ul style="list-style-type: none"> A smaller business is likely to lead to a smaller carbon footprint. Higher winter temperatures may decrease the need for heating in the winter, saving energy. Climate change impacts may lead to new legislation requiring and funding more renewable infrastructure, thus helping our efforts. Increased frequency of flooding may lead to abandonment of certain buildings to more efficient locations - our energy use at new buildings will be reduced compared to the abandoned ones. Wind patterns may become more favourable for turbine development, as may fluvial systems – We will buy less grid power, thus reducing our footprint. If our policy teams follow their adaptation plans and implement inventive solutions this may reduce our impact.

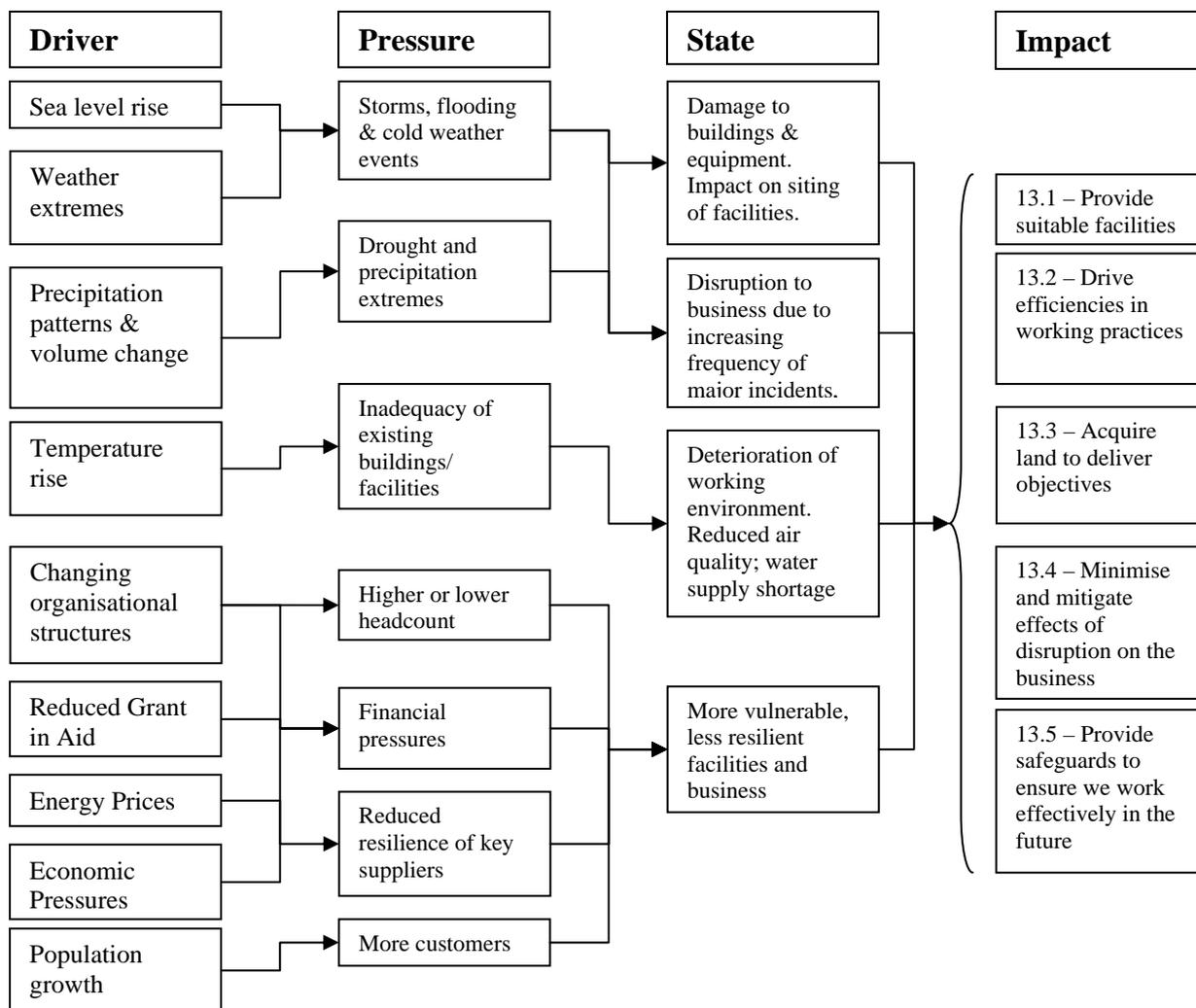
Key references:

UK Climate Impacts Programme, 2002. *Climate change scenarios for the United Kingdom*. UKCIP.
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UK Climate Projections, 2009. *Climate change projections for the United Kingdom*. UKCIP.
Available online at: <http://ukclimateprojections.defra.gov.uk/content/view/12/689/>

Our business continuity and estates

Conceptual model of sensitive risks



Key evidence
- We rely on the headline impacts identified by UKCIP02/UKCP09 to understand the range and scale of potential impacts on our incident management and contingency planning
- We assess flood and water resources risk to critical assets on a case by case basis using catchment-scale information.

Risks and actions

13.1	We will provide suitable facilities (property, fleet and other assets) to support employees roles and the delivery of our corporate strategy.
13.3	We will acquire land to deliver our functional objectives.
13.4	We will minimise and mitigate the effects of a disruption on the business from an unforeseen event, plus meeting the requirements of the Civil Contingencies Act.
Impact	
	Rationale and uncertainty

Importance: Moderate	<p>Currently we rely on very few individual sites for unique business critical functions (most are replicated elsewhere within the organisation), and therefore our vulnerability to climate change as a result of impacts to any individual site is low.</p> <p>Impacts on individual offices may be substantial, and the flexibility of our response may be constrained by the fact that we have long term leases on certain assets and sites (that is, it may be difficult to abandon a particular site). The way we work now (the ability to work remotely) gives us flexibility overall.</p> <p>Short-term impacts are unlikely to derail pretty robust procurement and business continuity systems for estates and facilities. The number of people and locations devoted to business critical systems is quite low, and our building location procedures, fleet procurement and so on are robust and unlikely to change substantially in the face of climate change. Climate change may eventually affect our working arrangements, but it is unlikely to impact the functionality of the wider organisation.</p> <ul style="list-style-type: none"> • We are becoming more dependent on third parties for key services – contracts must specify the need for resilience. In Wales there is a move to buy services from small and medium enterprises; the resilience of their service provision could be impacted upon in the same way as the Environment Agency’s if located in similar geographical locations. • We need to establish centrally which of our sites are in flood risk areas. • We haven’t undertaken detailed analysis of the vulnerability of our estates – this may be necessary.
Proximity: Medium-term	
Confidence: Low	
Response (to worst case impacts)	
Resource: Moderate	<p>We review our activities against a range of criteria (impact categories) as part of the BIRA (business impact risk assessment) process. These impact categories include legal/statutory, communities and people, environment, reputation, financial, internal functions and other agencies or Government departments. The effects of climate change, and our adaptation to them, including our incident management strategy, will be considered as part of this process, but cannot be disaggregated from it.</p>
Inertia: Rapid – Long term	<p>More of our buildings could become inaccessible and we may have to move staff around. We may also need to mothball sites which are vulnerable, however most climate change impacts are likely to be short term events and our response is likely to be reactive.</p> <p>We don’t think about long term impacts from climate change in terms of our Business Continuity Management and we may be vulnerable in that respect. None of our leaseholds have backup/contingency however the consequences of their failure is small given the low importance of individual sites and therefore our limited vulnerability.</p>
Confidence: Low - Medium	<p>We may also be moving toward sharing space with other government departments as a result of an impact. In Wales we are moving towards sharing space with other WAG sponsored bodies</p> <ul style="list-style-type: none"> • Long term leases mean that making changes to our property portfolio is medium term but financial constraint could mean it is long term. • Process changes and responses from staff and sites etc would probably be rapid.
Adaptation actions	
In the next year:	Costs
We will undertake further analysis to understand where our greatest vulnerabilities lie.	L
In the next 5 years:	
We will tackle our highest priority areas (causes of disruption) such as utilities supply.	L
We will put in place mitigation measures and identify alternatives for delivery.	L
Longer term actions:	

We will continue to take climate change into account when reviewing our incident management strategy and in the provision of suitable facilities to support employees roles.

13.2 We will drive efficiencies in our working practices and ensure high utilisation of our assets.

13.5 We will provide suitable safeguards to ensure our people, systems and property work effectively in the future. To find more efficient ways of coping with disruption, through contingency planning, alternative ways of working and so on.

Impact

	Rationale and uncertainty
Importance: Negligible – Minor	Efficiency targets may change and our objectives will be set relative to shifting priorities. Climate change may impact on our efficiency but this is likely to be a positive impact (we will make stronger commitments rather than weaker ones as a result of climate change). A change to our existing work practices will depend on climate change as well as concurrent pressures such as financial pressures on the Environment Agency, energy prices, technology development etc. Our objective to put systems in place to make our Business Continuity Management (BCM) more resilient will require us to consider in more detail the range of possible climate change impacts than we do currently. This is not necessarily an impediment to this objective, and considering climate change will make BCM more resilient overall.
Proximity: Short - Medium term	
Confidence: Very Low	

Response (to worst case impacts)

Resource: Minor	<ul style="list-style-type: none"> • Efficiency measures are likely to pay for themselves. • We need to ensure that our suppliers have sufficiently robust systems in place to ensure service to us. • We could reduce uncertainty by improving our understanding of the vulnerabilities of individual sites.
Inertia: Rapid	
Confidence: Medium	

Adaptation actions

In the next year:	Costs
We will review whether our suppliers are considering the resilience of their operations to climate change and that we test / confirm the suitability of existing contractual arrangements to be able to cope with climate change impacts. For instance, specific supply chain or supplier resilience, or how high a priority maintaining a service to the Environment Agency is relative to those services supplied to their other clients.	L
In the next 5 years:	
We will continue to take climate change into account in the provision of suitable facilities to support employees roles and our corporate strategy.	L
We will review our activities in more detail under BIRA (business impact risk analysis) review process in light of climate change adaptation. Build into the review a more detailed range of possible climate change impacts on our activities.	L
We will build greater resilience into our third party supply chain through procurement processes which highlight the need to consider and mitigate climate change issues.	L
Longer term actions:	
We will continue to consider climate change and its spatial variation in our contingency planning, alternative ways of working and the provision of suitable safeguards.	

Measures already implemented (for all Business Continuity and Estates objectives)	Cost
We have assessed the current risk of flooding to CIS systems and servers.	(L)
Operational and project management adaptation plans take increased level of asset deterioration due to climatic changes into account.	(L)
Our current policy is to achieve BREEAM ratings 'excellent' for new buildings we construct and BREEAM 'good' for those buildings we lease. This ensures a degree of	(L)

resilience to climate change impacts by ensuring we use resources efficiently and that buildings are better equipped to deal with climate extremes. However the availability of BREEAM “good” leased properties & land to build BREEAM excellent properties may be low in certain locations & this may affect our ability to be resilient to climate change.	
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Opportunities	
•	Operating costs of buildings may reduce.
•	Opportunity for a greener property portfolio which will be more efficient and better for the reputation of the EA – financial considerations is the key consideration.
•	Opportunity for greening our fleet. This is an ongoing task – we follow government standards and targets for government fleet, and this doesn’t have the same financial implications as greening our buildings.
•	In future it may useful to measure whether the frequency of disruptions to our business is reduced when the effects of climate change become more pronounced, and direct causal links can be identified.
•	Possible greater use of working with partners to maintain activities and meet response levels (shared resources).

Key references:

UK Climate Impacts Programme, 2002 *Climate change scenarios for the United Kingdom*. UKCIP. Available online at:
http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=161&Itemid=291

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