

Water today, water tomorrow

Ofwat's climate change adaptation report – technical paper

About this document

On 3 March 2010, we were directed by the authority of the Secretary of State to provide a report on climate change adaptation. This technical report and the supporting process document provide more detail to support our response and fulfil the requirements of the direction.

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1. Aims and objectives

This chapter explains our duties and functions, and our overall strategy to achieve them. We also explain:

- our objectives for this document;
- how climate change fits into our organisation; and
- our overall approach to climate change risks.

1.1 Our organisation's functions, mission, aims and objectives

We are the economic regulator of the water and sewerage sectors in England and Wales. We regulate the 10 water and sewerage companies and 11 water only companies in England and Wales. We also regulate 6 local service providers and 7 water supply licencees¹. The companies we regulate are responsible for delivering water and sewerage services to consumers.

Our duties are laid out in statute, primarily in the Water Industry Act 1991 (as amended) ("WIA 1991"). When exercising certain powers or discharging certain duties under the WIA91 (the "relevant powers and duties")², we must comply with our main duties to:

- further the consumer objective (protect the interests of consumers, wherever appropriate by promoting effective competition);
- secure that the functions of each undertaker are properly carried out in every area of England and Wales and that they are able to finance their functions, in particular by securing reasonable returns on their capital; and to
- secure that companies with water supply licences (that is, those selling water to large business customers, known as 'licensees') properly carry out their functions.

Subject to our main duties, we also:

- promote economy and efficiency by companies in their work;
- secure that no undue preference or discrimination is shown by companies in fixing charges;
- secure that consumers' interests are protected where companies sell land;

¹ Throughout this report, we refer to all these organisations as "the companies".

² See sections 2(2A), 2(3) and 2(6) of the WIA91.

- ensure that consumers' interests are protected in relation to any unregulated activities of companies;
- contribute to the achievement of sustainable development; and
- have regard to the principles of best regulatory practice.

It is important to note that, by law, “consumers” includes both existing and future consumers.

When exercising the relevant powers and duties, we must have regard to the principles of best regulatory practice, including the principles under which regulatory activities should be:

- transparent;
- accountable;
- proportionate;
- consistent; and
- targeted at only cases where action is needed.

These principles underpin the approach we are taking to the way in which we regulate the sectors.

In [‘Delivering sustainable water – Ofwat’s strategy’](#), which we published in March 2010, we explain how we will regulate the sectors in a way that fulfils our duties. It sets out our vision, goals and values. Our vision, which we derive from our duties, is:

“A sustainable water cycle in which we are able to meet our needs for water and sewerage services while enabling future generations to meet their own needs”

We cannot achieve this vision without adequate consideration of climate change adaptation. Our strategy explains how adapting to climate change is one of a number of major challenges that we face. It sets out the following goals for how we aim to address these.

- Ensuring a fair deal for customers.
- Keeping companies accountable.
- Making monopolies improve.
- Harnessing market forces;
- Contributing to sustainable development.
- Delivering better regulation.

Our programme of work is organised around achieving these goals.

We set out our overall policies with regard to climate change in our [2008 climate change policy statement](#), which covers both adaptation and mitigation issues. We highlighted the expected impacts of climate change on the water and sewerage sectors, and explained the actions and approaches we would adopt in order to deal with those challenges. Examples of the ways in which we have applied those policies can be seen in the outcome of our [2009 price review](#), which considered climate change risks and adaptation measures.

1.2 Key objectives of this document

The primary objective of this document is to satisfy the requirements of the statutory direction by providing:

- an assessment of the current and predicted impact of climate change in relation to our functions (including a summary of our functions, the methodology used for the assessment and our findings); and
- a statement of our proposals and policies for adapting to climate change in the exercise of our functions and timescales for introduction.

We also:

- present a reliable prioritisation of climate change risks to the sectors that we can use to inform our work;
- promote sound science by highlighting key uncertainties and areas for improvement in understanding;
- explain the ways in which we currently incentivise and enable the companies to cope efficiently with a changing climate;
- identify barriers and explain our response to them, and make recommendations for further work where appropriate;
- establish an internal process we can use in future to evaluate climate change risks and monitor how these change over time; and
- Inform our next climate change policy statement and our methodology for the next price review.

As specified under the Climate Change Act 2008, we will have regard to this report when carrying out our functions in the future.

We do not prescribe specific adaptation actions for the companies we regulate. They are responsible for delivering water and sewerage services now and in the future; our role is to protect consumers and incentivise the companies to deliver the service sustainably and efficiently.

There are limits to the robustness of any climate change risk assessment. Ours focuses on prioritising climate change risks relative to each other. It cannot be used as an indication of how much the companies are expected to spend on adapting to climate change. Nor can it be used to determine what the specific scale of impact on service will be. This is because of inherent uncertainty about the future that is not only related to climate change, but also in other drivers that will affect the sectors. For the purposes of this document, we have assessed additional climate change impacts and have generally assumed external circumstances remain static.

1.3 Our overall approach to adaptation

Adaptation is action that helps an organisation cope with the effects of climate change. It can take the form of delivering solutions on the ground to protect services directly, or institutional change. In our case, adaptation means institutional change. We would fail to achieve our strategic vision of sustainable water if we did not consider the risks from climate change when we made our regulatory decisions.

In the water and sewerage sectors, it is the companies that must adapt in order to meet their obligations. As the economic regulator, our role is to provide the right regulatory incentives to enable them to do this in an effective, efficient and equitable way, and to take action if the companies fail to meet their obligations.

We set out our approach to adaptation and explain who our key stakeholders are in this area in more detail in the supporting process document.

2. Risk assessment

2.1 Focus of the assessment

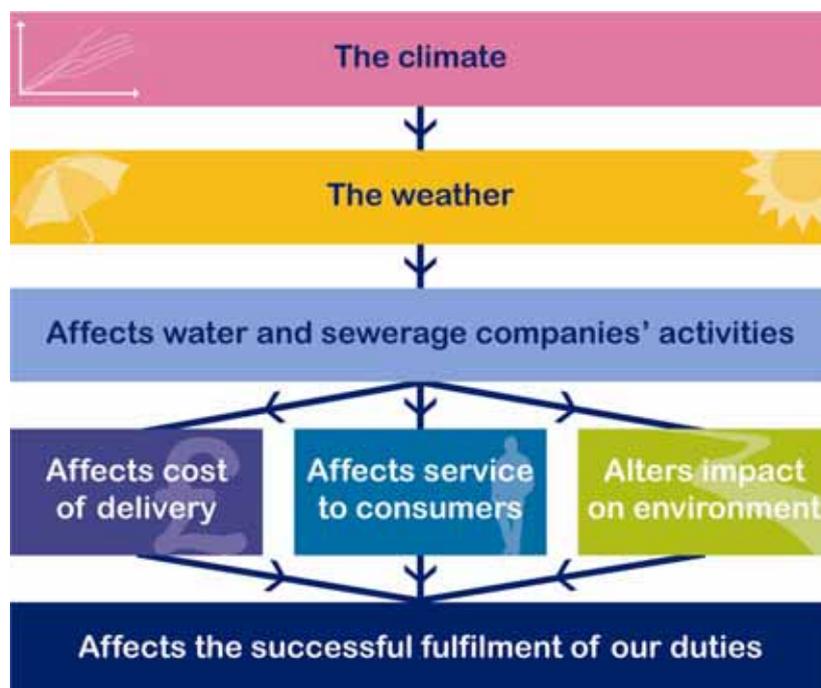
Under our direction to report, we have been tasked to produce “an assessment of the current and predicted impact of climate change in relation to [our] functions”

To do this, we have developed our understanding of how changes in the climate affect our regulatory functions. This requires an understanding of how the weather affects service, and how climate change will affect future weather patterns.

For the purposes of this document, we have taken our functions to mean all the actions that we carry out in order to contribute towards achieving sustainable water and hence fulfil our legal duties.

Because it is the companies we regulate that are responsible for delivering services, the relationship between the weather and our functions is indirect. We illustrate this in the diagram below.

Figure 1 How the climate affects us



As the diagram shows, the main ways in which the weather, and hence climate change, affects us is by having an impact on the companies' service, cost or environmental impacts.

In 'Allocating risk and managing uncertainty in setting price controls for monopoly water and sewerage services – a discussion paper', which we published in October 2010, we identified eight broad categories of risk in the sectors. This assessment builds on these categories. Of the eight that we outlined, environmental and operational risks are most affected by weather and climate. Climate change may also influence political and regulatory risks.

We have identified three main ways in which the weather (and hence climate change) can adversely affect the successful operation of our functions. These are:

- **directly** by hampering Ofwat's day-to-day functions. We explain these risks in the text box below;
- **indirectly**, by affecting the ability of the sectors we regulate to deliver water and sewerage services over the long term; and
- **indirectly**, by affecting the views and decisions of stakeholders in a way that influences our work.

Direct weather risks to Ofwat

We include in our internal processes the direct risks from climate change to our organisation's day-to-day work.

Currently, and in the medium term, we have assessed the direct weather risks to our work as low. This is primarily because of the very low likelihood of significant impacts, given the nature of our working practices and our existing capacity. Most of our work is desk or communication based. So, the main threats are to staff getting to the office and widespread communication system failures.

Our Birmingham office is at little risk of fluvial flooding, but there is some potential direct threat to our smaller office near to the Thames in London. In case of significant disruption to our main office, we have access to a disaster recovery centre. From this site, we can continue to operate until the main office becomes useable again.

We have provision for home working, directly mitigating many weather risks – especially the risk of disruptions to the transportation system. Also, much of our work has relatively long lead times. This means that temporary disruptions caused by extreme weather are unlikely to pose a significant threat to our duties. This gives us substantial capacity to cope with the weather.

We recognise that climate change is a major risk to the sectors on which we rely to carry out our day-to-day activities (such as the rail network and electricity distribution). But assessing these risks is beyond the scope of this document. In the near term, we operate on the assumption that these services will remain predominantly reliable. We review the risks to our organisation periodically.

The table below summarises the three main types of climate change risk that our organisation faces, and the assessment approaches we adopted for each type.

Table 1 How we have assessed different types of risk

Risk type	Primary risk bearer	Description	Response characteristics	Assessment approach
Direct operational and environmental	Ofwat	Risks of weather directly affecting our day-to-day work	Business operations – short-term management (<5 years)	Corporate planning – see text box on page 7
Indirect operational and environmental	Companies	Affects the water and sewerage operations and networks, which affects the companies' ability to deliver services. This in turn affects whether our functions are achieved successfully	Regulatory decisions affecting both the short and long term	Specific climate change risk assessment
Indirect political and regulatory risks	Stakeholders	Changing views and decisions of key stakeholders, which influence our work	Business decisions – short-term management (<5 years)	Organisational risk assessment, which is incorporated into our risk register

In terms of our duties, the two indirect categories of risk are by far the most important. We can only achieve our functions successfully if the sectors we regulate can systematically cope with the weather. So, we have focused on these risks. But we also recognise that climate change is likely to affect the views and decisions of other stakeholders. This can have a significant impact on the successful operation of our functions in terms of resources and processes.

To reflect the differences between the two types of indirect risk we have outlined above, we have carried out two risk assessments.

The first seeks to understand the indirect risks from climate change to our functions, based on assessing the relationships between weather, the water and sewerage companies' activities and us (as illustrated in figure 1). This is our most important risk assessment. We have set out our process for doing this, together with a detailed description of the risks and how we assessed them in the supporting process information that accompanies this document.

We have also considered the indirect political and regulatory risks associated with climate change issues. Impacts of these risks will usually be in the form of internal resource requirements. We have used our corporate risk assessment process to assess these risks.

We have incorporated the indirect political and regulatory risks we have identified into our organisational risk register. Our priority organisational risks are managed as part of our business.

2.2 Climate change risks

Figure 2 below sets out the main indirect operational and environmental climate change risks to us by the 2050s. This shows the relative likelihood and impact of each risk. We give brief descriptions of each of these risks below. This includes the opportunities we identified.

Each of these risks has a potential impact on the successful achievement of our functions. This will typically manifest itself through increases in environmental damage, service failures or through customers' bills.

We have grouped the identified risks into categories where the nature of the impacts are closely related. For example, changes in surface water flows, groundwater supplies and domestic demand all have an impact on a company's supply/demand balance and are therefore grouped under one heading.

Figure 2 Risk assessment results

Risk assessment results table for 2040 to 2070					
Magnitude of potential impact on Ofwat's functions	4		Increase in multi-year droughts		
	3		Reduction in groundwater resource yields in summers Increase in single year droughts Increased risk of company asset flooding Reduced river flows require increased discharge constraints Increases in CSO discharges Increased sewer flooding	Reduction in surface water resource yields in summers	
	2		Increased risk of power outages	Increased potential for surface water storage in winters Increase in demand for potablewater More SMD driven leaks and bursts Increased raw water demand	
	1		Increased algal blooms Increased pollution in raw water sources	Fewer frost driven bursts and leaks Increased sewer blockages due to low flows Accelerated asset deterioration Increased risks of coastal flooding of company assets Increases in diseases	
	0			Changes in water available for hydro power generation Increases in fires	
		1	2	3	4
Likelihood of impact occurring based on UKCP09 results					

Key	
A – SDB	D – Raw water quality
B – Infrequent external hazards	E – Drainage
C – Asset performance	F – Cross-sectoral
	Opportunities

2.2.1 Category A – Managing the supply/demand balance

- A1 Reduction in surface water resource yields in summers.** Changing rainfall patterns and increased temperatures are likely to reduce the surface water available for abstraction throughout the year, and particularly in summer. This increases conflicts between meeting demand and protecting the environment.
- A2 Reduction in groundwater resource yields in summers.** Groundwater sources are more resilient to climate change than reservoirs and materially more resilient than rivers. However, changes in rainfall volume and intensity are expected to reduce groundwater recharge rates, as well as increase the risks of saline intrusion into coastal aquifers.

- **A3 Increase in demand for potable water.** Increasing temperatures and reduced rainfall is expected to lead to increased demand for water from household and non-household consumers, and particularly affect demand peaks. However, the forecasts in this area remain highly uncertain.
- **A4 Increased potential for surface water storage in winters.** Increased rainfall in winter will present an opportunity for water resource planners as it increases the amount of water that can be captured and stored in winter.

2.2.2 Category B – Infrequent external hazards

- **B1 Increases in single year droughts.** Reductions in rainfall during summer months increase the risks of droughts, especially where the companies rely heavily on abstracting surface water.
- **B2 Increases in multi-year droughts.** Changing rainfall patterns increase the chances of several consecutive seasons of below-average rainfall. If winter rainfall fails to recharge aquifers and surface water resources, this can lead to significant reductions in the water available for use.
- **B3 Increased risk of company assets flooding.** On average, rainfall is expected to increase in winter and heavy downpours will be more frequent. This will increase the chances of the companies' assets becoming flooded because about 55% of them are on flood plains. Flooding can cause serious supply failures, lost revenue and reactive costs.

2.2.3 Category C – Asset performance

- **C1 More soil moisture deficit (SMD) driven bursts and leaks.** Soils will increasingly dry out in the summer, causing ground movement and cracking. In winter, soils will more often become waterlogged, which will also increase ground movement. Both of these effects increase the stresses on underground pipes, increasing the levels of leaks and bursts. This is exacerbated where changes in soil moisture content occur rapidly, rather than gradually.
- **C2 Fewer frost-driven bursts and leaks.** Milder winters are likely to result in fewer pipes busting. This is because the ground around the pipes – or the water in them – will freeze less frequently. This effect is beneficial in that it will mean fewer leakage and bursts during winters, when maintenance and planning can be more difficult.

- **C3 Increase in sewage treatment efficiency.** The biological and chemical processes involved in many sewage treatment processes work more efficiently at higher temperatures. So, increases in average temperatures may reduce treatment costs to a limited extent.
- **C4 Increased risks of coastal flooding of company assets.** Rising sea levels and changes in rainfall patterns will increase coastal erosion in many places. They will also increase the risk of flooding to coastal company assets. There is a strong interaction with coastal defence policies on this risk.
- **C5 Reduced river flows require increased discharge constraints.** Reduced summer rainfall will have significant impacts on river flow levels. This reduces the capacity of rivers to dilute pollution. Increased treatment or changes to operational procedures for releasing effluent will be required in order to maintain river water quality.
- **C6 Accelerated asset deterioration.** Changes in average temperatures and volumes of water, particularly in the sewers, can put increased stress on assets, affecting asset lifetimes. This can cause increases in costs, as assets need replacing or refurbishing more often.
- **C7 Increased odour problems.** Higher temperatures, particularly in summer, may drive increased septicity problems and result in more odour nuisance near treatment works. Odour problems can be expensive to solve.
- **C8 Changes in water available for hydro power generation.** Changes in the patterns of rainfall in particular may affect the operation of hydropower generation assets. But the net effect over a year is likely to be small.
- **C9 Increases in fires.** Warmer, drier summers may increase fire risk marginally. But the additional effect is likely to be low.

2.2.4 Category D – Raw water quality

- **D1 Increased pollution in raw water sources.** Increases in extreme rainfall events can reduce water quality by washing more agricultural and urban pollution into raw water sources, particularly during 'first flush' events. This can either increase the costs of treating raw water or cause drinking water quality problems.
- **D2 Increases in waterborne diseases.** Higher temperatures, reduced numbers of frost days and more heavy downpours can increase the prevalence of waterborne diseases. This is especially important as it can lead to more cryptosporidium washed into raw water sources, which is particularly difficult to remove.

- **D3 Increased algal blooms.** Climate change may increase the occurrence of algal blooms, which can cause water treatment issues and environmental problems.

2.2.5 Category E – Drainage

- **E1 Increases in combined sewer overflow (CSO) discharges.** Increased rainfall in winters and increases in the frequency of heavy downpours will increase the number of CSO discharges. In some circumstances, they can cause environmental damage, particularly if the dilution capacity of the receiving water is low.
- **E2 Increased sewer flooding.** Increases in the frequency and intensity of rainfall will increase the risks of combined sewers not being able to cope with the volume of water entering them. This can contribute to surface water and sewer flooding in and around properties. Blocked CSOs because of high river flows or rising sea levels can further exacerbate this problem. These issues can be very expensive to solve, particularly if no action is taken to tackle drainage in the wider urban environment.
- **E3 Increased sewer blockages due to low flows.** Reduced summer rainfall leads to lower flows within sewers. This increases the amount of suspended solids that settle inside the pipes, leading to more sewer blockages.

2.2.6 Category F – Cross-sectoral

The companies we regulate depend on a range of other services and products, including:

- communications;
- chemicals; and
- transport infrastructure.

They rely on a range of sectors across the economy being able to cope with climate change risks. We have set out the most important such risks below.

- **F1 Increased risk of power outages.** The energy sector faces significant risks from climate change, such as increased risk of asset flooding and changes to demand. Interruptions to energy supply prevent the effective operation of the assets of many water companies. More risks to energy supply will result in service failures, increased cost and/or increase the importance of backup arrangements.

- **F2 Increased raw water demand.** Public water supply is not the only reason for abstraction of raw water. Agriculture may react to climate change in a number of ways that could have a material impact on demand for raw water resources, especially during the summer months. Power stations also use sea and river water as a coolant for nuclear, coal and gas power stations. As surface water temperatures increase, they require a larger volume of water to achieve the same cooling effect, which may increase competition for abstraction.

2.2.7 Category G – Finance

Where climate change has an impact on the companies' operations or costs, this could affect their ability to finance necessary investment. There are two main risks in this area.

- The risk that climate change affects the cost of finance in the sectors.
- The risk that the companies are unable to finance the additional investment necessary to deal with the risks presented by climate change.

We screened these out from the full risk assessment as they are inherently determined by relatively short-term changes to regulatory decisions and economic circumstances rather than long-term climate change. The approach we take to regulation in the context of climate change can affect the cost and feasibility of raising finance on reasonable terms. The most significant risks in this area will only occur if we fail to remunerate the companies appropriately for necessary investments (either through our cost assumptions, the cost of capital or through changes to our price limits) or if we fail to balance risk adequately. This not a climate change-driven risk in its own right.

It is possible that additional costs required to deal with the climate change risks may be so large as to be unfinanceable, or financeable only at very high cost. This risk is related particularly to the 'lumpiness' of any necessary investment and the importance of other competing drivers. This risk is assessed as low in the short to medium term, provided the companies adapt to climate change in a stable and efficient way. We describe this issue in more detail in '[Financeability and financing the asset base](#)', a discussion paper that we published in March 2011.

3. Prioritising risks and identifying actions

So that we can regulate in a proportionate way, we need to focus on areas that carry the most material risks to the delivery of our duties. In order to determine whether we should take action, we need to establish which risks our regulatory framework needs to be able to cope with and which we can ignore.

3.1 Priority risks

The supporting process document that accompanies this paper sets out the method we have used to prioritise climate change risks. Using this method, we have separated the risks into three broad categories.

- **High-priority risks**, which have the potential to drive significant increased future costs and/or service failures. These risks will be the focus of our actions to enable adaptation.
- **Medium-priority risks**, which have the potential to drive non-trivial increased future costs and/or service failures. So, we should help to manage these risks by enabling adaptation to deal with them.
- **Low-priority risks**, which are considered to be minor because of very low impact or likelihood or, more usually, both. We expect these risks to be dealt with within existing capacity.

Table 2 below shows how we have categorised risks into different priority categories. This document concentrates on the high and medium risks. We have summarised how we have dealt with each of the medium and high risks in section 5.5.

Low-priority risks are of marginal impact to us and the successful operation of our duties. In most cases, they are risks over which we have very little influence. We expect the companies to treat these as normal business risks.

In the case of opportunities, we judged that we would simply accept them in all cases but not rely on them. As with other risks any material benefits from these opportunities will be shared between customers and companies through the regulatory system.

Table 2 Prioritisation of climate change risks

High-priority risks	Medium-priority risks	Low-priority risks
A1 Reduction in surface water resource yields in summer	A3 Increased demand for potable water	C7 Increased odour problems
A2 Reduction in groundwater resource yields in summer	C4 Increased risk of coastal flooding of company assets	C8 Changes in water available for hydropower generation
B2 Increases in multi-year droughts	C1 More soil moisture deficit (SMD) driven leaks and bursts	C9 Increases in fires
B1 Increases in single-year droughts	F2 Increased raw water demand	D1 Increased pollution in raw water sources
B3 Increased risk of company assets flooding	E3 Increased sewer blockages because of low flows	D3 Increased algal blooms
C5 Reduced river flows require increased discharge constraints	D2 Increases in waterborne diseases	
E1 Increases in combined sewer overflow (CSO) discharges	F1 Increased risk of power outages	
E2 Increased sewer flooding	C6 Accelerated asset deterioration	
	C2 Fewer frost driven busts and leaks	
	A4 Increased potential for storage of surface water in winters	
	C3 Increase in sewage treatment efficiency	

3.2 Identifying actions

The risk assessment enables us to prioritise the risks from climate change to the successful operation of our functions. We have used the findings of our risk assessment to identify which further actions we need to take.

The first step was to identify the types of action we, as an economic regulator, can take. This is important because we are not a delivery body of adaptation on the ground. We need to do this in order to understand how we can, as the guidance states, “set the right underlying framework for adaptation” and “create the information needed to make effective decisions”.

There are three main types of actions that an economic regulator can take to enable adaptation. We have set these out (with examples) in the table below.

Table 3 The types of adaptation action we can take

Type of action	Aims	Examples of actions
Enabling adaptive action	Set the right regulatory incentives and outputs for effective adaptation	<ul style="list-style-type: none"> Existing and establishing incentives Setting outcomes and outputs Specific regulatory decisions Investigating reforms Compliance and enforcement activity
Building adaptive capacity	Improve our own understanding and the evidence base available to the companies	<ul style="list-style-type: none"> Recommend or promote research Business case expectations Direct support for research or investigations
Monitoring and evaluation	Monitor the risks and the companies' performance to inform our own and others' actions	<ul style="list-style-type: none"> Indicators of the companies' performance Targeted investigations and studies Reappraisal of our own risks and plans

Having identified the actions we can take, we went through several steps to arrive at our adaptation action plan. We describe these steps in more detail in the process document that supports this paper. In summary, we considered:

- the existing regulatory system;
- existing barriers; and
- our ongoing programme of work.

After understanding how these interacted, we developed an action plan.

Adaptation is a continual process and there are no actions that we can take to eliminate completely the priority risks we have identified. The most important thing we can do to enable adaptation is to establish the right incentives. We need to think about climate change as part of our core activity if we are to do this effectively.

4. The underlying framework for adaptation

This chapter summarises the findings from our review of our regulatory framework. It also explains our future regulation programme. We summarise:

- how our regulation operates in relation to climate change risks;
- some of the key barriers to adaptation in our sectors that we identified;
- how our future regulation programme of work contributes to adaptation.

4.1 Adaptation and the existing regulatory framework

This section considers the regulatory framework that operated in the last price review (PR09). We are currently re-examining this framework, which may result in significant changes.

We do not have specific adaptation incentives. So to understand how we enable adaptation, we identified how the companies are incentivised to adapt to the climate change risks we have identified. We also needed to understand any gaps in the regulatory framework or perverse incentives that may impede the companies from adapting successfully.

Here, we explain the main mechanisms and regulatory policies that are relevant to climate change risks. These include both direct and indirect incentives. We have indicated which climate change risks each one helps to address.

4.1.1 Price reviews

Covers all risks

We set price limits to protect customers. The price review framework means that there are regular reappraisals of performance that take account of improved understanding and future risks. The framework also provides a set of incentives for the companies to plan effectively and efficiently and the means to finance necessary investment. The approach we take is designed to allocate risks efficiently and incentivise the companies to find solutions to mitigate risks and carry out activity as efficiently as possible. This general model has worked well over the past twenty years to improve service and address emerging risks in the sectors.

As part of the last price review, the companies also had to produce long-term strategic direction statements. These plans described how they planned to deal with future challenges. This has helped shift focus away from the five-year horizon of price limits and encouraged the companies to communicate their long-term plans to customers. Strategic direction statements included specific consideration of climate change.

Further information: <http://www.ofwat.gov.uk/pricereview/>

4.1.2 Measurement by service outcomes

Covers all risks

Following a price review, we monitor the companies' performance. This allows us to track progress regularly and take action if they fail to deliver the service customers have paid for. Guaranteed service standards also mean that compensation is provided to customers who do not receive adequate service. The service customers receive will be the primary measure of whether or not adaptation is successful. It will remain important to understand whether customers receive adequate service in a changing climate so that we can take appropriate and proportionate action.

Further information: http://www.ofwat.gov.uk/publications/los/rpt_los_2009-10

4.1.3 The service incentive mechanism

E2 – increased
sewer flooding

C7 – increased
odour problems

This mechanism focuses on customer service. It provides direct financial incentives for the companies to provide service that meets their customers' expectations. Because it operates irrespective of external risks – meaning there are no exemptions for extreme weather events – it incentivises the companies directly to be resilient to climate change.

Further information: http://www.ofwat.gov.uk/publications/prs_web_1003sim

4.1.4 Monitoring serviceability

E2 – increased sewer flooding	E3 – increased sewer blockages due to low flows	C2 – fewer frosts-driven bursts and leaks	C1 – more SMD-driven bursts and leaks	C6 – accelerated asset deterioration
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Serviceability is a measure of the companies' asset and service performance. It can be used to provide early warnings of problems that might be driven by climate change. The measures can also be used to track the ultimate success of adaptation measures.

Further information: http://www.ofwat.gov.uk/publications/los/rpt_los_2009-10 (in chapter 6 of the supporting information).

4.1.5 The security of supply index

A1 – reductions in surface water resource yields	A2 – reduction in groundwater resource yields	A3 – increased demand for potable water
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The security of supply index comprises a number of measures that give a picture of current risks and should reveal emerging supply/demand balance issues, including those driven by climate change. While the specifics of this measure and how it is reported might change over time, some indicator of the companies' ability to meet demand is needed. This is so that we and customers can know whether or not the companies have adapted adequately to meet demand.

Further information: http://www.ofwat.gov.uk/publications/los/rpt_los_2009-10 (in chapter 5 of the supporting information).

4.1.6 The change protocol

Covers all high-priority risks

The change protocol provides specific mechanisms that enable the regulatory framework to react flexibly to significant changes that occur between price reviews and hold the companies to account for failing to deliver outputs.

Further information:

http://www.ofwat.gov.uk/pricereview/pr09phase3/gud_pro_ddchgprotocol2010.pdf

4.1.7 Notified item for climate change

All category A
supply/demand
risks

At PR09, we included a notified item that will allow the companies to apply for an interim determination of price limits (IDoK) if they can provide evidence that they need to make significant new investments before the next price review to cope with the impacts of climate change on the balance of supply and demand.

Further information: http://www.ofwat.gov.uk/publications/rdletters/ltr_rd1310idok

4.1.8 Leakage and water efficiency targets

A1 – reduction in
surface water
resource yields

A2 – reduction in
groundwater
resource yields

C1 – more SMD-
driven bursts and
leaks

C2 – fewer frost-
driven bursts and
leaks

A3 – increased
demand for
potable water

We set specific targets on leakage and water efficiency to promote increased demand reduction activities. This is part of a twin-track approach to incentivising a secure supply/demand balance in the future. We set the targets in the context of long-term water resource management planning, which includes consideration of climate change.

Further information: http://www.ofwat.gov.uk/publications/los/rpt_los_2009-10

4.1.9 Metering

A1 – reduction in
surface water
resource yields

A2 – reduction in
groundwater
resource yields

A3 – increased
demand for
potable water

We think that metering is the fairest method of charging customers. We also recognise that it helps to reduce demand. This is because metered customers are incentivised directly to reduce waste and charges can be tailored more specifically to influence their behaviour. This is particularly important in areas that might be subject to future water stress because of climate change. We advocate increased metering where this is the most economic way to balance supply and demand for the future.

Further information: <http://www.ofwat.gov.uk/sustainability/waterresources/metering/>

4.1.10 Resilience to external hazards

**B3 – increased
risk of company
assets flooding**

**C4 – increased
risk of coastal
flooding**

It is important that the water and sewerage services are resilient to external hazards such as floods. We recognise the importance of resilience and the companies are already delivering greater protection to customers and the environment. We have encouraged best practice in this area, which includes the consideration of climate change within resilience proposals.

Further information:

http://www.ofwat.gov.uk/sustainability/climatechange/prs_web_1011resilience

4.1.11 Revenue correction mechanism

**A3 – increased
demand for
potable water**

Adapting to climate change risks in an efficient way is likely to require water efficiency measures to reduce demand as part of a twin-track approach to balancing supply and demand. We introduced the revenue correction mechanism so that the companies were not perversely incentivised to increase demand. This means that they will not recover less money through price limits if customers reduce their consumption.

Further information:

http://www.ofwat.gov.uk/pricereview/pr09phase3/ltr_pr0931_revcorrectmech

4.1.12 Enforcement

Covers all risks

We have a range of enforcement powers that we use to hold the companies to account. If they fail to adapt – and fail to meet their obligations as a result – we will take action to secure compliance where it is proportionate to do so. The threat of enforcement actions is a powerful incentive for the companies to meet these obligations.

Further information: <http://www.ofwat.gov.uk/regulating/enforcement/>

4.2 Key regulatory mechanisms operated by other regulators

As well as our own regulation and the legal obligations in place, we also rely on other regulators to act in a way that enables the sectors to adapt. We have set out below the most important mechanisms that other regulators operate, together with the relevant stakeholders and the main climate change risks that they should help to manage.

Table 4 Key areas where we rely on other regulators

Regulatory mechanisms	Key stakeholders	Relevant climate change risks	Further information
Water resource management plans	Environment Agency, Defra, Welsh Government	<ul style="list-style-type: none"> All category A supply/demand risks (high) B1, B2 – single- and multi-year drought risks (high) 	http://www.environment-agency.gov.uk/business/sectors/32425.aspx
Drought management plans	Environment Agency, Defra, Welsh Government	<ul style="list-style-type: none"> B1, B2 – single- and multi-year drought risks (high) 	http://www.environment-agency.gov.uk/business/sectors/123024.aspx
Surface water management planning	Local authorities, Defra, Welsh Government, Environment Agency	<ul style="list-style-type: none"> E1 – increases in CSO discharges (high) E2 – increased sewer flooding (high) 	http://archive.defra.gov.uk/environment/flooding/manage/surfacewater/plans.htm
Abstraction licensing	Environment Agency, Defra	<ul style="list-style-type: none"> A1 – reduction in surface water resource yields (high) A2 – reduction in groundwater resource yields (high) B1, B2 – single- and multi-year drought risks (high) F2 – increase demand for raw water (medium) 	http://www.environment-agency.gov.uk/business/topics/water/32026.aspx
Environmental quality regulations	Environment Agency,	<ul style="list-style-type: none"> C5 – reduced river flows (high) 	http://www.environment-agency.gov.uk/business/

	Defra	<ul style="list-style-type: none"> • E1 – increases in CSO discharges (high) • F2 – increased demand for raw water (medium) 	regulation/31833.aspx
Drinking water quality regulations	Drinking Water Inspectorate	<ul style="list-style-type: none"> • D2 – increase in waterborne diseases (medium) • D1 – increased pollution in raw water sources (low) 	http://www.dwi.gov.uk/
Coastal flood and erosion management	Environment Agency, Local authorities	<ul style="list-style-type: none"> • C4 – increased risk of coastal flooding (medium) 	http://www.environment-agency.gov.uk/homeandleisure/107621.aspx
Security and Emergency Measures Directive	Defra	<ul style="list-style-type: none"> • B3 – increase risk of company assets flooding (high) • E1 – increases in CSO discharges (high) • C4 – increased risk of coastal flooding (medium) 	http://www.defra.gov.uk/corporate/about/how/contingency/topics/water-supply.htm

4.3 Barriers and interdependencies

In this section, we set out the primary barriers that we have identified and explain how we seek to overcome them. We also discuss the interdependencies. Where we consider a barrier presents a material problem for adaptation, we have explained how we seek to address it. But overcoming many of these barriers – particularly on capacity – requires action across the sectors.

4.3.1 Uncertainty

Adaptation to climate change will always be subject to uncertainty. This is because of the complex nature of the climate system and feedback mechanisms and the long timescales.

This uncertainty can be in the form of actual 'randomness' and natural variability or uncertainty in data, modelling or assumptions. The UKCP09 scenarios present this as an inherent part of the scenarios, making it possible to build the uncertainty into a risk-based approach.

As well as the scale and impact of climate change itself, there are a range of other future uncertainties that are unrelated or only partially related to climate change, but which will have an impact on adaptation in the sectors. These include the following.

- Demographic change, the future projections for which indicate a significant challenge to the companies and increase the uncertainty.
- Historic and future increases in the amount of hard-standing area ('urban creep') presents significant problems for ensuring that the sewer and surface water drainage systems can cope with existing pressures and climate change.
- Meeting requirements of European legislation, such as the Water Framework Directive, needs careful prioritisation of investment and requires balancing of both mitigation and adaptation drivers.

Uncertainty can result in wasted resources, ineffective solutions or paralysis. Dealing with it requires effective risk management by the companies, based on a clear set of objectives and a proportionate use of the best available information. Similarly, we will regulate based on a balanced appraisal of the risks, taking into account the best available evidence. We can help to reduce the problem of uncertainty by improving our knowledge and understanding. We discuss actions to improve adaptive capacity in the sectors in section 5.2.

4.3.2 Information asymmetry

A problem for us in making regulatory decisions is our position of information asymmetry. While we can provide guidance and direction to the companies, we can only make decisions based on the quality of the information and business plans they provide to us. Addressing this barrier does not mean simply collecting more information. It means improving our understanding as a regulator and incentivising the companies to reveal information. As we explain in section 4.4, ensuring we have the right information is a major aim of our regulatory compliance project.

4.3.3 Cost

To protect the services that customers receive, there are likely to be costs associated with adapting the sectors to climate change. This means the incentives for investment must remain strong. As customers will pay for this investment we have to make sure that it delivers legitimate benefits to those customers. The actual impact on bills will depend on:

- all the different cost drivers;
- the degree of climate change, and
- other future circumstances.

We have to regulate in a way that incentivises the companies to adapt in an efficient manner that reflects their customers' needs.

The level of customers' bills will influence the pace of adaptation. For some people, the affordability of their water and sewerage bills is already a problem. The national context is also important – other prices and bill increases are placing additional pressure on household budgets. For example, rising energy bills to finance low-carbon energy generation may exacerbate affordability problems in the water and sewerage sectors. In order to fulfil our functions, customers' bills must be affordable and represent value for money. We work with the companies, customers and their representative bodies to find ways to enable this.

4.3.4 Economic justification for adaptation

It is difficult to define and measure adaptation outcomes and arrive at economic justifications for adaptation actions. The key challenges relating to economic justification for adaptation are:

- valuing and including future uncertainty in a quantitative cost-benefit analysis;
- assigning values to adaptation benefits that usually occur far in the future or are environmental in nature (this includes the difficulties in applying willingness to pay methods); and
- the use of discount rates, which reduce the relative value of long-term adaptation benefits.

This presents an issue for the companies when preparing business cases. It is also an issue for us when we consider:

- policy options;
- our incentive framework; and
- the companies' investment proposals.

Related to this is the inherent difficulty in monitoring success. Both we and the companies need to seek ways to address these problems. We are currently considering these issues as part of our future regulation programme, including how we should take customers' views into account when we set price limits in the future. We also have several actions relating to this, which we explain in chapter 5. Ultimately, effective adaptation will require some degree of judgement and assumption. We recognise that it is necessary to make some assumptions in long-term planning.

4.3.5 Corporate memory

Corporate memory is important for climate change adaptation because there is likely to be a significant time-lag between when solutions are implemented and when benefits are realised. This applies both to the effectiveness of our regulatory framework and the actions of the companies. Without good corporate memory, information on adaptation actions can be lost over time. We need to have good internal systems and processes in place.

4.3.6 Balancing the needs of the environment

There are occasions when conflicts between policy objectives arise and our risk assessment indicates that climate change will exacerbate some of these conflicts. For example, there is increasing tension between the need to abstract water for public use and the need to prevent environmental damage. This requires balanced analyses of social, environmental and economic considerations. It can be very difficult to do this if environmental impacts and tolerances are not clear. If environmental limits are overly onerous or based on poor evidence, this can cause significant social and economic problems.

Where environmental limits are involved, it is helpful for an authoritative body to establish robust boundaries based on the best available evidence. This provides a more certain context for decision-making and – as long as the limits are well-set – reduces the risk of environmental damage. Market mechanisms may be used within the context of these environmental limits to help achieve the most efficient solutions.

In many areas, including water resources, regulating environmental limits is the role of the Environment Agency. Where those environmental limits are set and understood, it becomes easier for us and the companies to find and execute the most efficient solutions to achieve sustainable water and sewerage services.

4.3.7 Interdependencies

The extent to which climate change has an impact on us fulfilling our functions successfully will depend – in part – on the actions of others. This creates additional uncertainty for us. The most important interdependencies identified in our risk assessment relate to the companies we regulate, but also to:

- the other regulators;
- the supply chain;
- non-public water supply consumption; and
- the various agencies involved in managing surface water.

There are also clear interdependencies in terms of the resilience of other critical infrastructure providers. Stable service in the future depends upon the energy and communications sectors in particular managing the climate change risks to their functions. We discuss this further in chapter 5.

4.4 Future regulation

To deliver our strategy, we are currently carrying out several projects on the future of regulation in the sectors. These projects form our future regulation programme. They consider issues such as how price limits will work in future and how regulatory compliance will operate.

This section discusses the key areas of focus for the future regulation programme and explains how our work relates to adaptation. As in 4.1, we have highlighted the priority risks each area of work is expected to help manage.

4.4.1 Future price limits

Covers all risks

With this project, we are reviewing the way we set price limits. We are investigating how we carry out price controls in the future to better meet our strategic aims. This means creating a flexible framework that enables the companies to finance investment needed to deliver sustainable services efficiently.

This includes investigating options such as changing the length of the price control period and setting separate price controls for different business activities in the sectors. We are also considering how we can incentivise the companies to achieve higher-level outcomes rather than specific outputs. We are also investigating other issues, including:

- financeability;
- customer engagement; and
- approaches to the assessment and recovery of operating and capital expenditure.

We will formally consult on our approach to future price limits later this year.

The way we set price limits will affect both the allocation of climate change risks and the incentives to adapt. For example, we could consider longer price control periods. This might promote more innovation and phased adaptation. But it may mean that we have fewer opportunities to take account of unexpected changes, materialising risks and improved knowledge. We are considering the approaches we can take to allocate and incentivise the companies to manage risks such as climate change as part of our work.

Further information: <http://www.ofwat.gov.uk/future/monopolies/fpl/>

4.4.2 Regulatory compliance

Covers all risks

Our regulatory compliance project focuses on improving the way we monitor and secure compliance. We intend to do this by developing a risk-based approach that reduces the overall regulatory burden and focuses regulatory effort on areas of high risk. We want the companies to be directly accountable to their customers, but – at the same time – we need to understand the companies' success in dealing with significant risks such as climate change, so that we can act where it is necessary and proportionate for us to do so. The project includes work to develop some key performance indicators for the sectors. This may include one for adaptation.

The aims of the project fit well in the context of climate change. In areas of low risk or where a company has proven able to adapt successfully, we will expect the companies to understand and manage those risks, without being subject to significant regulatory scrutiny. But in areas where there is a high risk – for example, in the area of water resources – or where a company cannot demonstrate that it is adapting well, we will continue to use a broad range of regulatory tools to monitor and incentivise compliance.

Further information:

http://www.ofwat.gov.uk/publications/focusreports/prs_web_1011regcompliance

4.4.3 Sustainable drainage

E1 – Increases in CSO discharges

E2 – increased sewer flooding

E3 – increased sewer blockages due to low flows

Given the range of pressures over the next few decades, the existing drainage system will not be able to cope with the climate change risks we have identified. Simply upsizing the sewer system in response to this threat is unsustainable, not least because it would be prohibitively expensive. For this reason, adaptation in this area will require multiple organisations to work together. This project helps develop understanding and considers how we can incentivise more sustainable solutions to drainage.

Further information: <http://www.ofwat.gov.uk/future/sustainable/drainage>

4.4.4 Future water charging

A1 – reduction in surface water resource yields

A2 – reduction in groundwater resource yields

A3 – increased demand for potable water

This project is driven by concerns about affordability, bad debt and future challenges such as climate change. It also considers what we can do to reduce waste and manage demand. So, it has significant potential to help to address the supply/demand balance risks from climate change. For example, the project explores how far and how best metering can play a part in reducing demand, and how charges could be arranged to incentivise reductions in demand.

Further information: <http://www.ofwat.gov.uk/future/customers/metering/>

4.4.5 Valuing water

A1 – reduction in surface water resource yields

A2 – reduction in groundwater resource yields

A3 – increased demand for potable water

F2 – increased demand for raw water

Currently, customers pay for the cost of delivering the service rather than the water itself. This means that we do not know the value of water. This may be a barrier to adaptation because it means that there is a lower incentive to reduce the extent to which water is wasted. The lack of geographic and temporal differences in the value of water can lead to over-abstraction in locations and at times where water is scarce and a surplus in other areas and at other times. This is because the value of water has not been appropriately taken into account in decisions over where and when to abstract or use water.

We are investigating means by which we can reveal a value for water and enable and incentivise its use in the companies' decision-making. This has the potential to promote more efficient adaptation by reducing the amount of water wasted and maximising supply in areas where the value is higher and the risks from climate change are greater. One way that the value of water might become visible is if more trading – both of abstraction licences and of water through bulk supplies – takes place. We are working with the Environment Agency, Defra and the Welsh Government on this subject to see how we can further promote trading of abstraction licences and water.

Further information: http://www.ofwat.gov.uk/competition/review/prs_web_1007value

4.4.6 Retail market reform

A1 – reduction in surface water resource yields	A2 – reduction in groundwater resource yields	A3 – increased demand for potable water
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The independent review of competition and innovation in water markets (the 'Cave review') made recommendations to the UK Government about promoting retail competition and separation of the retail functions of water and sewerage services from the rest of the regulated business. We are considering how retail market arrangements could operate.

Retail market reform is not expected to drive significant adaptation, but it could drive more customer water efficiency measures. This is because the structure of separated retailers will mean that it is likely to be more profitable for them to sell services (such as water efficiency services) than to re-sell water purchased at the wholesale level.

Further information: <http://www.ofwat.gov.uk/future/markets/retail>

4.4.7 Wholesale market development

A1 – reduction in surface water resource yields	A2 – reduction in groundwater resource yields	A3 – increased demand for potable water	F2 – increased demand for raw water
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We are also investigating wholesale water market reform, building on the recommendations from the Cave review. Introducing upstream markets in the sectors could help allocate water more efficiently between consumers and the environment. This would help deal with the most material risks to supply and demand from climate change.

We want to encourage those companies that have spare water, or that can develop water resources at low cost or are in areas where the value of water is relatively low, to sell their excess water to regions where the demand for water is higher. If we combine this system with a clear set of enforced environmental limits, this could also reduce over-abstraction in water-stressed areas.

We are considering the risks and benefits for adaptation as part of our work. We are considering in detail the mechanisms that might best enable co-ordination so that long-term adaptation benefits will be realised.

Further information: <http://www.ofwat.gov.uk/future/markets/upstream>

5. Further actions and our monitoring plan

This chapter sets out what further actions we will take to deal with the risks we have identified. These actions complement our future regulation programme. We also highlight what we are doing to encourage adaptive capacity, both within the sectors and across our own organisation. Finally, we set out our monitoring plan and outline recommendations for other stakeholders.

5.1 Further actions

Where we have identified medium and high risks to our functions that our existing regulatory framework or future regulation programme may not address adequately, we determined what further actions we should take before 2014.

5.1.1 Improve our understanding of adaptation in the sectors

We will consider the companies' adaptation progress, building on conclusions from their adaptation reports. If it is necessary and proportionate for us to do so, we will investigate further any material areas where there are shortcomings, or where we need more understanding. The findings will help inform the decisions we make on adaptation at the next price review.

5.1.2 Revise our climate change policy statement

We published our last climate change policy statement in July 2008. Circumstances have changed since then, and we have better information and understanding. We also expect to see changes when the projects in our future regulation programme are complete.

In 2012, we will reappraise our existing approach to both mitigation and adaptation. We will also make our expectations and general principles clear in a revised climate change policy statement. Developing and communicating our approach ahead of the next price review:

- reduces the risks of making poor decisions;
- aids transparency; and
- encourages consistency and better business planning.

The policy statement will build on this document and gives us an opportunity to take stock on how we have progressed the actions highlighted here.

5.1.3 Improve our approach to service resilience investment proposals

In recent years, we have been working with the Cabinet Office as part of its critical infrastructure resilience programme. This work has led to the recent publication of [‘Keeping the country running: natural hazards and infrastructure’](#), which is a guide to building resilience.

We are also involved with an academic research project to evaluate current levels of resilience in the sectors. We will build on this work and will clarify our regulatory approach to the companies’ proposals to improve resilience of service to external hazards. This is crucial in enabling us to promote efficient and equitable solutions to protect service against extreme weather events. We discussed this subject in more detail in [‘Prevention, protection and preparedness – how should resilient supplies be achieved?’](#), which we published in November 2010.

5.1.4 Review our approach to investment appraisal for adaptation

We need to develop an approach that incentivises the companies to propose efficient and equitable adaptation investment. A number of barriers arise from the difficulty of determining the costs and value of adaptation actions because of the long timescales involved. We can help to address these barriers by minimising uncertainty and making our expectations clear. In particular, where cost-benefit analysis is not possible or would be overly onerous, we need to clarify what other approaches can be taken.

5.1.5 Consider how the capital maintenance common framework operates in the context of climate change risks

The companies use the common framework to plan and prioritise capital maintenance investment. It is a long-term, risk-based approach. So, it is well suited to incorporate climate change risks. But evidence of this actually occurring is minimal and the framework draws heavily on experiences of the past to predict most likely future service performance. Because several of the asset risks we have identified are priority risks, we plan to explore if it is fit for purpose and develop examples of how the common framework principles could be employed to incorporate climate change risks into maintenance planning.

5.1.6 Consider serviceability indicators

This work will build on the UKWIR review of serviceability, which includes a consideration of how climate change might affect these indicators. Based on the conclusions of this work and our ongoing regulatory compliance project, we will consider whether regulation in this area needs to change over time to cope with climate change – for example, to include new indicators.

5.1.7 Carry out research on consumers' attitude to climate change adaptation

Our research will explore consumers' views and attitudes towards climate change and its impact upon the water and sewerage services they receive. We aim to gauge their:

- understanding of climate change risks to service;
- attitudes towards sustainability; and
- preferences regarding future service.

By doing this, we can better design policies and incentivise the companies to deliver outcomes that meet consumers' wants and needs. This work will inform how we will communicate in future and help us understand attitudes to behavioural change.

5.2 Improving adaptation capacity

Good adaptation requires an understanding of:

- the ways in which climate change could have an impact; and
- how the existing regulation and incentives can deal with these risks.

Both the magnitude of the impacts set out in our risk assessment and the uncertainties we have identified show that everyone across the wider water and sewerage sectors – including us – needs to improve understanding.

Below, we outline (with examples) the main ways we can help build adaptive capacity in the sectors.

- Sharing data and information that we hold, and which may help the sectors to adapt to climate change. For example, in March 2010 we published case studies of effective adaptation actions in '[Climate change – good practice from the 2009 price review](#)'.
- Directly commissioning applied research. For example, we commissioned and published a study on how the [return periods of extreme daily precipitation events might change this century](#).
- Providing input into research projects and policy groups and providing comments, data and ideas.
- Using regulatory guidance or business planning requirements to establish expectations on the companies. For example, at PR09 we developed an analytical framework for resilience that helped to promote good practice.

- Highlighting areas where we consider research in the sectors should focus – with the aim of encouraging work in that area.
- Bringing stakeholders together to discuss climate change issues. For example, in early 2010 we organised (jointly with the Met Office) a three-day workshop on adaptation.

5.2.1 Internal adaptive capacity

We carried out a self-assessment of our internal capabilities on climate change adaptation using the [PACT assessment tool](#). One key recommendation from this assessment was the need to take action so that non-specialists in the organisation understand the risks from climate change. Another was that we should have a process by which we can address climate change-related training and information needs.

As an organisation, we think that we have a good basic understanding of climate change issues. We also have dedicated climate change specialists. But we need to make sure that the key messages on adaptation are clear and communicated across the organisation, particularly when our understanding improves or where actions progress or change.

We have identified several internal actions that aim to improve our organisational capacity. Examples include:

- embedding consideration of climate change risks into our internal processes (for example, our process for carrying out impact assessments); and
- establishing a cross-divisional climate change group to share knowledge across the organisation.

5.3 Measuring progress

This section describes how we will measure progress on adaptation and update our assessments of risk.

We will rely primarily on existing measures to help us track the companies' ability to deliver service in a changing climate and to ensure our risk assessment and adaptation action plan remain up to date.

- We will re-evaluate our climate change risk assessment internally by May 2016. This will reflect the five-year cycles of the Climate Change Act 2008. There are also external triggers that will initiate a re-evaluation – including, for example, if a new set of climate change scenarios are released or the findings of the National Climate Change Risk Assessment differ substantially from our own assessment.
- We will consider any future adaptation reports that the companies provide in response to Defra's directions to report, or submit voluntarily, on adaptation. As with this round of reporting, we will use the reports to inform our decisions.
- We are working with the Environment Agency on the climate change guidance for the companies' water resource management plans. These plans are an important means of assessing risk on water resource issues. We will review the companies' water resource management plans and use the findings to inform our regulatory decisions.
- We have identified some early warning indicators for each of the high- and medium-priority risks, which will help us understand how the risks change over time. These indicators may evolve as risks and understanding change.
- We will continue to monitor the overall security of supply (currently through the security of supply index or 'SoSI') as a key means to check whether the companies are able to meet demand with available supply. Because this indicator is forward looking, we should be able to take pre-emptive regulatory action if risks begin to materialise and threats are not dealt with adequately.
- We will continue to use serviceability as a key method to assess whether the companies are able to provide their services to customers and the environment in changing circumstances. This enables us to take a proactive regulatory approach where service may be under threat, before significant service failures materialise. Provided the measures remain fit for purpose over time, the success of adaptation action can be assessed using serviceability measures.

Climate changes risks will not be treated in isolation. We aim to regulate in a way that places these risks in the context of others. Fundamentally, it is the overall services levels that are important. We will monitor service outcomes as part of the risk-based approach to compliance which we are developing.

5.4 Where others need to act

In this section, we include some recommendations for other stakeholders that can help promote good adaptation in the sectors. We are engaging with our stakeholders to make sure our work and theirs is optimised to deliver the best outcomes.

5.4.1 Independent advice

Successful adaptation in the sectors relies on sound science. Ultimately, the companies we regulate must understand the risks to their systems and take effective and efficient action to deal with them. But a common underpinning evidence base, coupled with readily available independent advice is an essential starting point. Over the past few years the advice, products and tools delivered by UKCIP, under contract from Defra, have played a significant role in helping stakeholders to understand and prioritise adaptation in the water and sewerage sectors. Free access to the underpinning climate change scenarios, and independent advice and expertise on adaptation should be maintained so that adaptation is equitable and efficient.

5.4.2 Urban drainage

There is a need to develop more sustainable planning, drainage and land management solutions to reduce the demand we place on the sewerage system. The Flood and Water Management Act 2010 includes several provisions targeted to improve drainage in the future. If these provisions are implemented well, this should prompt action that will help the drainage system cope with future climate change. In particular, local authorities must have the expertise and resources necessary to oversee sustainable drainage on new developments and maintain them in the future.

5.4.3 Environment

For adaptation to be successful, it is vital to understand the needs of the environment in a changing climate. It is also important that environmental interests are represented adequately. Where climate change risks to the environment materialise – for example, if there abstraction levels become unsustainable – we rely on the Environment Agency to understand and communicate these fundamental natural limits so that the companies can plan activity to act within those limits.

In order for adaptation to be efficient, environmental regulation needs to be risk based and focused on those activities that do the most damage. For example, the implementation of the Water Framework Directive and the National Environment Programme should be sensitive to the impacts of climate change and the costs of adaptation.

5.4.4 Interconnectivity

One response to some of the high-priority risks from climate change is greater interconnectivity so that water can be moved from areas where there is a surplus to those where it is scarce (or 'water stressed'). Defra and other stakeholders have identified the physical, institutional and regulatory barriers in this area. We will continue to work with Defra, the Welsh Government and the Environment Agency on abstraction licence reforms to help address these concerns.

5.4.5 Interdependencies

Successful adaptation to climate change will require action, both from the companies and their essential suppliers. While we have mechanisms to encourage the companies to adapt, we have little influence over other sectors of the economy. Work is being done to address interdependencies at a national level. For example, the Cabinet Office's work on improving resilience to critical national infrastructure encourages interdependencies to be considered. We recommend that national policy continues to work to encourage sectors across the economy to deal with long-term risks to their functions, particularly where failure in one area could cause knock-on side effects to critical services such as water supply.

5.5 Summary of climate change risks and actions

Table 5 below presents the priority climate change risks alongside the regulatory mechanisms that enable the companies to adapt to those risks. This is illustrative of how our regulation and future work should help manage each risk. Some overarching measures – such as our future price limits work – will influence adaptation to all of the risks. Similarly, work to build capacity in the sectors covers all of the risks.

We have also included some of the key mechanisms related to each risk that other regulators own. This is to highlight the important interdependencies.

The table shows that there are regulatory measures in place that enable the companies to adapt to the most important risks we have identified. This is not a reason for complacency. Successful adaptation in the sectors will depend on the decisions that are made within the context of these mechanisms.

Table 5 Summary of priority risks and regulatory measures which help manage them

Risk	Regulatory tools managed by us	Future regulation	Measures managed by others
<p>A1 – reduction in surface water resource yields in summers</p> <p>A2 – reduction in groundwater resource yields in summers</p> <p>A3 – increased demand for potable water</p> <p>A4 – increased potential for storage of surface water in winter</p>	<p>Security of supply index</p> <p>Notified item for water resources and climate change</p> <p>Revenue correction mechanism</p> <p>Water efficiency targets</p> <p>Sustainable economic level of leakage</p> <p>Metering policy</p>	<p>Establish our approach for the next price review</p> <p>Valuing water</p> <p>Future water charging</p> <p>Wholesale market development</p>	<p>Water resource management plans</p> <p>Abstraction licensing framework</p>
<p>B1 – increases in single-year droughts</p> <p>B2 – increases in multi-year droughts</p>	<p>Security of supply index</p> <p>Notified item for water resources and climate change</p>	<p>Future water charging</p> <p>Valuing water</p> <p>Service resilience guidance</p>	<p>Water resource management plans</p> <p>Drought plans</p>
<p>F2 – increased raw water demand</p>	<p>Supply/demand balance measures</p>	<p>Valuing water</p>	<p>Abstraction licensing framework</p>
<p>B3 – increased risk of company assets flooding</p> <p>C4 – increased risk of coastal flooding of company assets</p>	<p>Provision for resilience</p>	<p>Service resilience guidance</p>	<p>Resilience of critical national infrastructure (Cabinet Office)</p>
<p>E2 – increased sewer flooding</p> <p>E3 – increased sewer blockages because of low flows</p>	<p>Serviceability</p> <p>Service incentive mechanism</p> <p>Measurements by service outcomes (sewer flooding)</p>	<p>Establish our approach for the next price review</p> <p>Sustainable drainage project</p>	<p>Provisions of the Flood and Water Management Act 2010</p>

<p>E1 – increases in CSO discharges C5 – reduced river flows require increased discharge constraints</p>	<p>Wastewater quality programme (in price reviews)</p>	<p>Sustainable drainage project</p>	<p>Quality regulation (National) Quality directives (EU)</p>
<p>C1 – more soil moisture deficit (SMD) driven bursts and leaks C2 – fewer frost-driven busts and leaks</p>	<p>Serviceability Sustainable economic level of leakage</p>	<p>Review the capital maintenance common framework</p>	<p>Building regulations and quality standards</p>
<p>C6 – accelerated asset deterioration C3 – increased sewerage treatment efficiency</p>	<p>Serviceability</p>	<p>Review the capital maintenance common framework</p>	<p>Building regulations Quality regulation</p>
<p>F1 – increased risk of power outages</p>	<p>Provision for resilience</p>	<p>Service resilience guidance</p>	<p>Resilience of critical national infrastructure (Cabinet Office) Energy sector resilience measures Security and Emergency Measures Directive</p>
<p>D2 – increases in waterborne diseases</p>	<p>Water quality programme (in price reviews)</p>		<p>Drinking Water Inspectorate Health and safety standards (Health and Safety Executive)</p>

6. Conclusions

Our overall strategic aim is sustainable water. To achieve this, we must consider all the future challenges facing the sectors. This means that we must take the significant risks that climate change poses into account in the way we regulate.

This document represents our view of the risks that climate change presents to the successful operation of our functions. We set out our regulatory tools and further actions that enable adaptation to the priority risks.

The approach we have applied to produce this document has been subject to an audit by our internal audit team. Recommendations from the audit have been incorporated into the processes and conclusions in this document. It has been subject to internal consultation across the organisation. It has been agreed by our Board of directors and signed off by our Chief Executive.

Our report is underpinned by a thorough assessment of the climate change risks to the successful achievement of our functions. Our risk assessment highlights that there are a large number of possible impacts from climate change. We prioritised the risks in order to establish where we should focus our attention.

We used our risk assessment to identify whether the regulatory framework addresses the priority climate change risks. We have concluded that companies are already enabled and incentivised to adapt. But our analysis has identified a number of barriers and interdependencies which mean that – without change and further action – we cannot be sure that the right level of adaptation takes place.

We have also explained our future regulation programme in the context of adaptation. The programme aims to address the challenges of the future including (but not only) climate change. Our analysis shows this contributes towards effective adaptation by:

- improving incentives;
- developing understanding; and
- addressing barriers.

We will carry out further specific actions that help to build capacity to adapt, address some of the barriers, and better enable adaptation within the sectors. This has already led to changes within Ofwat. As specified under the Climate Change Act 2008, we will have regard to this document when carrying out our functions in the future.

We recognise that many of the wider reforms we are working on have uncertain outcomes. So, it is crucial that we reappraise our approach to climate change risks regularly in the future. As well as the impacts of these changes within our organisation, we recognise that as new information about climate change impacts arises and the interactions between climate change and other risks change, our existing adaptation plans may become outdated. So, we will reappraise our approach to ensure it remains fit for purpose.

Our actions alone will not be enough. The companies, other regulators and the wider stakeholder group will all have to play their part in adapting to climate change. The adaptation reporting power process, coupled with the forthcoming national climate change risk assessment, presents an important opportunity for learning, collaboration and the delivery of effective solutions. We look forward to working with Defra and the Adaptation Sub-Committee in making sure that this opportunity is realised.

We welcome views on our report and the actions we have outlined. We will continue to work with all our stakeholders as we address the climate change risks in the sectors and work towards sustainable water.



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