

---

# **Climate change – is the UK preparing for flooding and water scarcity?**

**Adaptation Sub-Committee  
Progress Report 2012**

---

## Foreword

During the first six months of 2012, the country suffered first from too little water, and then from too much water: drought followed by flooding. The year started with a second dry winter in a row. This together with an unusually hot and dry March caused drought conditions in many parts of England. Seven water companies imposed hose-pipe bans, affecting more than 20 million customers.

This was followed by the wettest spring (April – June) on record. Many parts of the country were affected by flash-flooding. Rivers burst their banks and roads turned to rivers as a result of surface runoff, after some areas saw a month's worth of rain in 24 hours. This led to serious flooding of at least 1,200 properties from Sussex in the south of the country to Cumbria, Lancashire and West Yorkshire further north. The news reports underlined the devastating impact of these floods on people's lives and livelihoods.

It is not possible to attribute current weather events to climate change. However, the latest climate models tell us that extremes of the kind seen this year are likely to become more common in the future. The Government's Climate Change Risk Assessment, published earlier this year, identified increasing frequency of floods and increased pressure on water resources as two of the most significant climate risks facing the country now and in the future.

The Adaptation Sub-Committee has analysed how well the country is preparing for these key climate risks. In this report we use national indicators to show that the country has become more exposed to future flood risk through continued development in the floodplain and paving over of front gardens. At the same time, climate change combined with population growth is likely to increase the risk of water scarcity.

The actions that the Environment Agency, water companies and local authorities are taking go some way to addressing these risks, for example through investment in flood defences and water supply infrastructure, and in the design of new development. Current efforts to manage flood risk, if they were to continue, would not keep pace with the combined effects of climate change and economic development in the future. Stronger policies may be required to sustain a continued, but necessary, reduction in household water use.

The Government's National Adaptation Programme provides an important step towards ensuring that the country is preparing well for climate change. The Programme can do this by encouraging greater action by households and businesses, for example through faster rollout of water meters to provide a clear incentive to save water. The Programme can also ensure that those making strategic decisions, such as local authority planners and water companies, build climate change into their long-term plans in a robust and transparent way.



**Lord John Krebs Kt FRS**

---

# Acknowledgements

The Adaptation Sub-Committee would like to thank:

**The core team that prepared the analysis for this report:** this team was led by Sebastian Catovsky and included Emily Beynon, Kathryn Humphrey, Clare Pinder, Kiran Sura, David Thompson, Lola Vallejo and Adam Ward.

**Other members of the secretariat that contributed to the report:** Tara Barker, Sharon Gaisie, David Kennedy, Jo McMenemy and Laura McNaught.

**Former members of the Adaptation Sub-Committee:** Dr Andrew Dlugolecki and Prof Tim Palmer.

**Organisations and individuals that carried out research for this report:** AEA Technology, Arup, HR Wallingford, Paul Watkiss Associates, Royal Haskoning, Alistair Hunt and Prof Rob Wilby.

**Funding partners in our research:** Environment Agency.

**Peer reviewers of our research and analysis:** Peter Bide (Independent Consultant), Dr Jeremy Carter (University of Manchester), Ian Gilder (Environmental Resources Management), Prof Robert Gurney (University of Reading), Dr Sarah Lindley (University of Manchester), Heather McGray (World Resources Institute), Prof Jean Palutikof (National Climate Change Adaptation Research Facility, Australia), Prof Gary Pender (Heriot-Watt University), Dr Nicola Ranger (Grantham Research Institute on Climate Change and the Environment, London School of Economics), Prof Edmund Penning-Rowsell (University of Middlesex), Dr Mark Stafford Smith (CSIRO Climate Adaptation Flagship, Australia) and Dr Steven Wade (HR Wallingford).

**Organisations that have provided feedback on our research and analysis:** Anglian Water, Association of British Insurers, Atkins, House Builders Federation, Department for Communities and Local Government, Department of Energy and Climate Change, Department for the Environment, Food and Rural Affairs, Dwr Cymru, Environment Agency, Institute of Civil Engineers, Local Government Association, Met Office, Northumbrian Water, Ofwat, Planning Officers Society, Royal Society for Protection of Birds, Severn Trent Water, Thames Water, United Utilities, Waterwise, Wessex Water, WWF and Yorkshire Water.

---

# The Adaptation Sub-Committee



## **Lord John Krebs, Chair**

Professor Lord Krebs Kt FRS is currently Principal of Jesus College Oxford. Previously, he held posts at the University of British Columbia, the University of Wales, and Oxford, where he was lecturer in Zoology, 1976-88, and Royal Society Research Professor, 1988-2005. From 1994-1999, he was Chief Executive of the Natural Environment Research Council and, from 2000-2005, Chairman of the Food Standards Agency. He is a member of the U.S. National Academy of Sciences. He is chairman of the House of Lords Science & Technology Select Committee.



## **Professor Samuel Fankhauser**

Professor Samuel Fankhauser is acting Co-Director of the Grantham Research Institute on Climate Change at the London School of Economics and a Director at Vivid Economics. He is a former Deputy Chief Economist of the European Bank for Reconstruction and Development.



## **Professor Jim Hall**

Professor Jim Hall FREng is Director of the Environmental Change Institute at Oxford University where he is Professor of Climate and Environmental Risks. A chartered engineer by background, Prof Hall has pioneered the use of probabilistic methods in flood risk assessment and water resource systems. He is Associate Editor of the Journal of Flood Risk Management and Fellow of the Royal Statistical Society.



### **Professor Anne Johnson**

Professor Anne Johnson is a public health doctor. She is Professor of Infectious Disease Epidemiology and Co-Director of the Institute for Global Health at University College London (UCL). She was a member of the UCL/Lancet Commission report on managing the health effects of climate change. She was previously Chair of the Medical Research Council Population Health Sciences Group. She became a Wellcome Trust governor in 2011.



### **Professor Martin Parry**

Professor Martin Parry is a visiting Professor at Imperial College and was Co-Chair of Working of Group II (Impacts, Adaptation and Vulnerability) of the Intergovernmental Panel on Climate Change's (IPCC) 2007 Assessment Report. He was chairman of the UK Climate Change Impacts Review Group, and a coordinating lead author in the IPCC first, second and third assessments. He has worked at the Universities of Oxford, University College London, Birmingham and University of East Anglia.



### **Sir Graham Wynne**

Sir Graham Wynne is a former Chief Executive and Director of Conservation of the RSPB. He is currently a Special Adviser to the Prince of Wales' International Sustainability Unit (ISU), Chair of the Harapan Rainforest Foundation in Indonesia, and a Trustee of Green Alliance. He was a member of the Policy Commission on the Future of Farming and Food, the Sustainable Development Commission, the Foresight Land Use Futures Group and England's Wildlife Network Review Panel. His early career was in urban planning and inner city regeneration.

---

# Executive Summary

The Adaptation Sub-Committee (ASC) has a statutory duty to report regularly to Parliament on the UK Government's progress in delivering its adaptation programme. In our first two reports, we developed and piloted a toolkit to assess progress in preparing for climate change, including use of adaptation indicators.

In this report we apply the toolkit at a national level to two of the largest risks to emerge from the UK's first Climate Change Risk Assessment (CCRA): flooding and water scarcity.<sup>1</sup> Many of the effects of climate change in the UK will be felt through changes in the water cycle. Climate change is likely to increase the frequency and severity of floods and droughts. Without action to prepare, this could lead to increasing costs and unnecessary damage and disruption.

## Key messages

- **Exposure to flooding.** The Government and local authorities should ensure more robust and transparent implementation of planning policy in relation to development in areas at risk of flooding.
  - Development in the floodplain grew at a faster rate than elsewhere in England over the past ten years.
  - While much of this development is well protected from flooding by the presence of community defences, one in five properties built in the floodplain were in areas of significant flood risk. Design features at the site level should have helped to make this development more resilient to flooding.
  - The current “build and protect” approach to floodplain development will leave a legacy of rising costs of protection and flood damage in the face of climate change. These long-term costs may outweigh the benefits of development in some locations.
- **Protecting existing properties from flooding.** The Government should support sustained and increased investment in flood defences from public or private sources; or in the absence of this identify ways to manage the social and economic consequences of more frequent flooding.
  - Current levels of investment in flood defences and uptake rates of protection measures for individual properties will not keep pace with the increasing risks of flooding. Climate change could almost double the number of properties at significant risk of flooding by 2035 unless there is additional action.

---

<sup>1</sup> Our statutory remit under the UK Climate Change Act is to assess progress two years after publication of the UK Government's adaptation programme. Because this programme covers UK-wide issues for reserved matters and England only issues for devolved matters, such as floods and water policy, our assessment toolkit develops specific indicators for England on floods and water. The toolkit is being developed in such a way that it has UK-wide applicability and could be used for the adaptation programmes in the devolved administrations if so requested.

- 
- By increasing investment in both flood defences and property protection measures, the number of properties at significant flood risk could be halved from current levels by 2035 accounting for climate change. The potential impact of climate change means that increased investment could lead to a four-fold reduction in risk when compared with a scenario of no additional action.
  - **Future water scarcity.** The Government and water companies should take further steps to increase efficiency in water use, including through water metering and pricing. Increased uptake of meters will be particularly important in locations with current and future risks of supply-demand deficits.
    - More efficient use of water is a powerful way to cope with future deficits in water supply. Improving water efficiency has a triple benefit: (i) it saves consumers money on water and energy use; (ii) it defers the need for costly investments in new supply infrastructure; and (iii) it limits damage to the natural environment arising from over-abstraction of water.
    - On current trends average water consumption could be reduced from 145 litres per person per day to 130 litres or less per person per day by 2035.
    - This is readily achievable by uptake of household efficiency measures, wider use of water metering and raising awareness. Reducing average consumption by 15 litres per day goes further than current water company plans and could halve the projected deficit from climate change and population growth.

## **Flooding: assessing preparedness for a changing climate**

### **Scale of flood risk today and in the future**

- Around one in seven properties (3.6 million homes and businesses) currently face some form of flood risk. Under current standards of protection, insured losses from flooding and other severe weather are modest, on average costing around £1.5 billion or 0.1% of GDP each year. Such events also cause substantial personal stress and hardship for affected households.
- Total costs of individual weather events can be much higher through disruption of essential services (power, water, and ICT) and business supply chains. Around 10% of critical infrastructure (power stations, water treatment works) and emergency services (fire, police and ambulance stations) are currently located in the floodplain.

- 
- Climate change could increase the number of properties in England with a significant chance of flooding<sup>2</sup> from rivers or the sea: from 330,000 now to between 630,000 and 1.2 million by the 2080s, according to the climate change scenarios used in the CCRA. The annual expected costs of flooding could increase from £1 billion now to between £1.8 billion and £5.6 billion (present day prices) over the same time period. These estimates assume no further action to prepare, no population growth and no change in the property stock.

### **New development and land use planning**

- Indicators show that development in the floodplain in England increased by 12% over the past ten years compared with a 7% increase outside the floodplain. Around 21,000 homes and business premises (13% of all new development) have been built in the floodplain every year over this time period. Since 2008 there has been a relative decrease in the rate of development in coastal areas.
- Planning policy ensures that this development is generally well protected from flooding. The majority of floodplain development proceeded in line with Environment Agency advice, because the developer incorporated adaptation features, such as raised ground and floor levels or safe evacuation routes.
- However, our analysis raises some questions about implementation of the policy.
  - While over 80% of floodplain development took place in locations well protected from flooding with community defences, one in five properties built in the floodplain were in areas of significant flood risk under today's climate.
  - In addition, the approval process is not sufficiently transparent or accountable. The Environment Agency only knew whether or not their advice had been followed in 65% of planning applications where they had objected.
  - Development in the floodplain may be a rational decision in cases where the wider social and economic benefits outweigh the flood risk, even when accounting for climate change. However, from a review of 42 of the most up to date local development plans we found mixed evidence on whether or not local authorities were transparently:
    - assessing the potential for accommodating growth elsewhere before deciding to allocate land for development in the floodplain; or
    - accounting for the long-term costs of flooding with climate change, both in terms of the increasing costs of flood damage and any additional costs of flood protection.

---

<sup>2</sup> Throughout this report, we use the Environment Agency categories of flood risk. Properties with a "significant" risk of flooding are those with a greater than 1 in 75 year likelihood of flooding in any given year.



---

## Protecting the existing property stock

- If current investment plans for flood defence continue into the future, the country will be faced with an increasing risk of flooding from climate change. Greater investment in flood defences, either from public or private sources, would help to stem this increasing risk.
  - Investment in flood defences has helped to reduce flood risk to 182,000 homes in the last three years and improved the condition of some defences.
  - Planned yearly spend on flood defences is lower for the current period (2011/12 – 2014/15) after taking into account the effect of inflation. This remains the case even allowing for additional spend generated from Environment Agency efficiency savings and contributions secured to date from local authorities and businesses.
  - The Environment Agency estimates that investment needs to increase by £20 million above inflation every year to keep risk levels constant in the face of climate change and deterioration of flood defence assets.
- Property-level protection measures, such as door guards and air-brick covers, could benefit properties in locations of lower population density where flood defences may not be cost-effective. However, uptake of such measures is around 20 – 35 times lower than the rate required to reach all 200,000 – 330,000 properties that could benefit within a meaningful timeframe (25 years).
- By 2035, the combined effect of increased investment in flood defences (£20 million per year on top of inflation) and faster uptake of property-level measures could reduce the number of properties at significant risk by half from current levels accounting for climate change. The potential impact of climate change means that increased investment could lead to a four-fold reduction in risk when compared with a scenario of no additional action.
- Managing water at the catchment scale to attenuate flood flows also plays an important role in adaptation to flood risk. The Committee's next progress report will look at this in more detail.

## Managing surface water flows

- Surface water flooding in urban areas is already increasing as a result of paving over green spaces in towns and cities. It may increase further with more intense rainfall due to climate change. Despite the scale of the risk, knowledge of the impacts of climate change on surface water flooding remains poor.
- Indicators show that in towns and cities the proportion of gardens that have been paved over increased from 28% of total garden area in 2001 to 48% in 2011. Total garden area in towns and cities has remained roughly constant at around 340,000 hectares of the 1.3 million hectares of total urban extent in England.

- 
- Our analysis identifies scope for greater use of sustainable drainage in new developments to slow down surface water flows in urban areas. By itself this is unlikely to be sufficient to stem the growing risk from surface water flooding. Using roads and paths as emergency flood channels can help keep surface water away from vulnerable people and property during extreme downpours.

## **Water scarcity: assessing preparedness for a changing climate**

### **Risks of water scarcity now and in the future**

- Over recent decades England has been affected by a drought every seven years on average. Security of supply has improved through continued investment by water companies. As a result, significant interruptions to public water supply from drought, such as those requiring the use of standpipes, are rare. Restrictions such as hosepipe bans and constraining the level of abstraction are more common. Current levels of abstraction are putting undue stress on the natural environment.
- Climate change is likely to alter annual and seasonal rainfall patterns, but the extent and timing of changes remain uncertain. Water companies estimate that without action to prepare nearly half of water resource zones could be at risk of deficit during a drought by the 2020s due to the combined effect of climate change and population growth. The CCRA suggests that the supply-demand deficit in the 2020s could range from negligible to 3 billion litres per day, with a central estimate of 1.2 billion litres per day (7% of existing supply).<sup>3</sup>
- In their latest plans water companies proposed measures to deal with around 1.4 billion litres of deficit by 2035. Just over half of their effort focussed on measures to improve supply, with the remainder of their effort split between reducing consumer demand or limiting leakage.

### **Reducing water use and limiting leakage losses**

- Our analysis identifies scope for greater action to manage demand in the face of the likely deficit from climate change combined with population growth. Low-regret actions, such as increased household water efficiency and basic rainwater harvesting, provide benefits today and against any future deficit. These should intensify given the lead-times required for altering household fixtures and fittings and behaviour change of consumers in relation to water use.

---

<sup>3</sup> This is for England and Wales combined and includes the effects of population growth as well as climate change.

- 
- Managing demand has other co-benefits:
    - saving consumers money on water and energy use;
    - deferring the need for costly investments in new supply infrastructure; and
    - reducing over-abstraction of water from the natural environment.
  - Indicators show that household use of water per person has declined since 2000. However, average water consumption in England, at 145 litres per day per person, remains one of the highest in north-western Europe.
  - If the current trend were to continue, water use would be reduced to 130 litres per day per person by 2035. This could save around 700 million litres of water per day, according to the CCRA, dealing with around half the deficit in the 2020s. In comparison, the latest water company plans deliver savings of 440 million litres of water per day by 2035 from reductions in water use.
  - A faster pace of reduction in water use could be readily achievable through sustained rollout of water metering, uptake of water efficiency measures and information campaigns. Previous ASC analysis suggests that reducing consumption to 115 litres per day per person could be achieved in a cost-effective way through uptake of water efficiency measures.
  - Leakage increased slightly to an average of 22% of public water supply in 2010, mainly due to cold winters causing increases in pipe bursts. Water company estimates suggest that leakage could be reduced to 20% of current total public water supply with further investment over the next 25 years, saving a further 240 million litres of water per day. Taking into account the effects of climate change on the long-run value of water would make further leakage reductions cost-effective.

## **Water metering**

- In order to put in place an effective system to manage demand, the price of water should reflect its availability and how much is used. Water metering will be a necessary component of any effective strategy for demand management.
- The number of households with water meters has increased by 2% per year in recent years, with 40% of households in England and Wales currently metered. If current trends were to continue, metering could reach 85% of households by 2035. However, a stronger policy framework may be required to sustain even this rate of rollout.
- A greater prevalence of metering in locations with higher risks of supply-demand deficits from climate change would provide the right incentive for achieving such reductions. At present, climate change is not taken into account in designating areas of water stress. This is a barrier to timely uptake of metering to deal with risks from climate change.

---

## Improving water supplies

- Reducing water use by households and tackling leakage is unlikely to deal with all of the deficit expected in the future – for example the mid-range deficit expected in the 2020s (1.2 billion litres per day) or any plausible deficit in the 2050s (2.1 to 8.2 billion litres per day).
- The degree of risk that water companies and regulators choose to plan for – and conversely how much risk to accept – should determine the scale and timing of supply-side measures required. For example, water sharing could contribute around 100 – 300 Ml/day to reducing the supply-demand deficit, according to the CCRA analysis. The water company price review in 2014 provides an important opportunity to factor in uncertainties in future climate transparently into long-term plans.

## Abstraction reforms

- The Government's Water White Paper proposes reform of abstraction licensing by the 2020s to establish a stronger market framework to ensure efficient allocation of water between all users, including power stations, heavy industry and agriculture.
- In the meantime there is a risk that policy decisions that are sensitive to water availability (such as in energy and agriculture) do not take full account of future water availability or the underlying requirement to support the natural environment. Taking climate risks into account will avoid lock-in to development pathways that lead to unsustainable levels of abstraction in the future.

## Advice on the UK Government's adaptation programme

- The National Adaptation Programme is an important step for the Government to outline its long-term approach to preparing for climate change. The programme should take a systematic and proportionate approach to addressing priority climate risks and assess existing and proposed policies against this. An important part of this will be to examine whether current and planned actions of public agencies, local authorities, businesses and households are sufficient to address the risks of climate change, or whether changes to the policy framework are required to enable and encourage action.
- The programme should set out tangible steps to remove outstanding barriers to adaptation action, in order to:
  - increase the uptake of low-regret adaptation measures, such as water efficient fixtures and fittings, sustainable drainage systems and property-level flood protection; and
  - ensure that those taking decisions with long-term or systemic consequences, such as local authorities and infrastructure providers, take account of climate change in a way that is transparent and acknowledges the uncertainties.

- 
- Box ES.1 sets out some specific advice on tackling barriers to action based on the analysis set out in this report.
  - The programme should establish an approach to monitoring the effectiveness of policies to address climate risks, and look to improve the evidence base on the impacts of climate change.

**Box ES.1: ASC advice for the National Adaptation Programme in relation to flooding and water scarcity.**

**Flooding**

- Ensure robust and transparent implementation of planning policy in flood risk areas, so that local authorities consistently and explicitly take into account the long-term risks of flooding when deciding the location of new development.
- Support sustained and increased investment in flood defences from public or private sources, given that current spending plans will not keep pace with increasing climate risk; or in the absence of this, identify ways to manage the social and economic consequences of more frequent flooding.
- Enable greater uptake of property-level measures to protect against floods and encourage greater use of sustainable drainage systems to manage surface water.

**Water scarcity**

- Take further steps to increase household efficiency in water use, including through water metering and pricing. This could include removing legal barriers to metering in areas with high risk of future deficit.
- Ensure that water companies are transparent about how the risks and uncertainties from climate change are factored into their long-term investment planning for future water resources.
- Ensure current policy decisions that affect future abstraction levels factor in the risks from climate change to avoid locking certain industries or regions of the country into unsustainable patterns of water abstraction.

**Next steps**

- Over the next two years, the ASC will apply its toolkit to other key climate risks and opportunities identified as priorities by the CCRA, including those affecting agriculture, forestry and the natural environment, impacts of heat and cold on human health and energy use, and changes to business supply chains and consumer demand. For each key risk or opportunity, we will aim to identify an appropriate set of indicators and use them to help assess how well each priority sector is preparing for climate change.
- This autumn we will also provide advice to inform early thinking on the second risk assessment, drawing on lessons from the first and from experience in other countries. This advice will also examine some of the important research gaps that need filling in the intervening years.