
OXFORD
FLOODS SPECIAL
OXFORD AND ABINGDON ON KNIFE-EDGE
WAITING GAME

Chapter 3: Building a better understanding of the risk

Summary

This chapter explores the challenges society faces in relation to climate change. It identifies the need for Government policy to prioritise adaptation to climate change, particularly in relation to flooding, where we may already be experiencing the impact.

To help us understand how climate change affects us, the chapter explores what further information and risk tools are required so that those on the ground at the local level can manage the change. It sets out some steps which can be taken quickly to address some of the most vital needs.

A changing climate

3.1 The summer 2007 floods cannot be attributed directly to climate change, but they do provide a clear indication of the scale and nature of the severe weather events we may experience as a result. The civil emergencies which followed the floods demonstrate that to minimise the impact of these events, we need to change the way we live our lives – and in particular how we organise our built and rural environments.

3.2 As the world climate warms up, there will be more extreme weather events. The latest report from the United Nations Intergovernmental Panel on Climate Change (IPCC) suggests that global temperatures are likely to rise between 1.1 and 6.4°C above 1990 levels by the end of this century, depending on world emissions. This will result in a significant sea level rise and changes in rainfall patterns. For the UK, some element of climate change is already inevitable.

3.3 The IPCC report makes it clear that even if current policies to slow the pace of climate change succeed, we will still feel the effects of climate changes well into the middle of the next century. To minimise the impact of those changes, we need to adapt our way of life now.

3.4 In 2003, the Government commissioned the Foresight[3] report from independent scientists. The report investigated how risks of flooding and coastal erosion in the UK might change over the next 100 years, and what options the Government and private sector could adopt in response. Foresight identified that the results of climate change, including changing rainfall patterns, rising sea levels and stronger storm surges, could greatly increase the risk of inland and coastal flooding. It used a number of

[3] Foresight: Future Flooding, Office of Science & Technology, 2004

scenarios to model projected changes in precipitation, temperature and sea levels associated with a range of greenhouse gas emission levels. From those models, it identified the following major impacts:

- Precipitation changes could cause a two- to four-fold rise in the risk of flooding across the country, with a heavily-increased probability of river flooding in some areas, especially the North and West.
- The risk of coastal flooding could rise between four and ten times over the next 100 years, particularly in the South East due to the combined effects of rising sea levels, surges and storms.

3.5 Foresight also identified other factors which could have a major impact on flooding levels, such as continued urban development. The annual cost of flood events in the UK could increase from around £1 billion today to £2 billion (at today's prices) by the end of the century, if flood management programmes were to be increased in line with the rising risk – but up to £27 billion if they were not. It concluded that the best and most cost-effective approach to managing flood risk would combine a range of engineering and non-engineering methods. To meet flood management needs, between £22 billion and £75 billion of new engineering might be needed by the 2080s.

3.6 The IPCC, Stern[4] and Foresight reports helped increase our understanding of the changing world. We now need as a society to face up to the challenge of adapting to climate change. We need to put in place the measures that will allow us to mitigate the effects of climate change and to be ready for the consequences, including flooding.

3.7 Our understanding of our climate will develop further when the UK 21st Century Climate Scenarios (UKCIP08) are published in October 2008. These scenarios are expected to be the most comprehensive package of climate information ever launched in the UK and will be of interest to anyone who needs to consider future climate in order to adapt to the risks.

The need for strong Government leadership

3.8 Adapting to climate change will be a challenge for more than just our generation. Logic suggests that the earlier it is started, the easier the job will be and the lower the overall cost. Timely decisions will allow organisations the flexibility to choose the most cost-effective measures, rather than being forced to act urgently and reactively. Early action will also avoid lock-in to long-lived assets such as buildings and infrastructure which are not resilient to the changing climate.

3.9 The Government has a powerful opportunity to influence the way in which our society adapts to a changing climate. It has shown through its actions on the international stage and here through the introduction of the Climate Change Bill to Parliament that it is prepared to take a leadership role on action to tackle climate change.

3.10 The Review welcomes the inclusion in the Bill of duties covering adaptation to climate change, and the Government's plan to publish its strategy for adaptation in spring 2008. The Review trusts that lessons from the summer 2007 floods and recommendations in this Interim Report will be reflected in the development of the Bill and the ensuing strategy.

[4] Stern Review: The Economics of Climate Change, Sir Nicholas Stern, 2007, Cambridge University Press.

IC 1 – The interim conclusion of the Review is that Government takes the lead in making the case for the need for adaptation to climate change and particularly in mitigating the potential impacts on communities.

IC 2 – The interim conclusion of the Review is that the Government develops a clear strategy and action plan to deliver the provisions of the Climate Change Bill to support adaptation to increasing impacts from flooding.

The contribution of science to building better understanding

3.11 Scientific and engineering techniques will play a crucial role in the adaptation strategy we put in place. If flood risk managers and emergency planners and responders are to prevent or reduce the impact of flooding, they must have dependable information on when and where it might flood, and what will happen if it does.

3.12 As Chapter 5 describes, current tools were used well, within their limitations, during the July fluvial flooding. However, scientific developments mean there is already room for improvement. The June floods indicated that the absence or limitations of some current information-gathering tools meant there were weaknesses in the information available to responders. The Review believes that modelling and risk tools can be substantially improved.

Modelling and mapping

3.13 Flood risk maps are used to indicate which areas are at risk from flooding. To produce a flood map, detailed aerial survey information about the height of the land is combined with data on river flows (or, for coastal areas, sea and wave data). Many flood maps and models use historic records of flows or levels from a network of gauging stations, others use rainfall run-off models. During the summer, many responders used maps based on historic flooding events.

3.14 The Environment Agency has over the years made good progress with its partners in modelling and mapping river and coastal floods. However during the summer, some of its models did not forecast the extent or speed of the flooding, leading in some cases to inaccurate forecasting and late warnings, as with Mythe water treatment works.

3.15 The Review believes that there is a clear need to extend the models for river and coastal flooding, drawing on data from the summer's floods, to analyse different extreme scenarios (including multiple flooding events occurring simultaneously or within overlapping time periods) and to capture the impact of saturated ground on flooding risk.

3.16 In contrast, flood risk maps for surface water flooding simply do not exist. As a result, those responding to surface water flooding in the summer were often dealing with the unpredicted and unexpected. The technical and practical challenges of mapping surface water flooding are clearly much greater than for coastal and river flooding and information needs to be collated from a range of different sources. Even small variations in the built environment such as the height of kerbs and location of street furniture can have a significant impact on water flow and thus the likelihood and scale of flooding. If flood risk modelling for surface water is to be effective, models need to incorporate detailed information on drainage infrastructure and other routes which water will take during a flood.

3.17 The Review recognises these complexities. Nevertheless, the scale of the surface water flooding problem faced in

summer 2007, and the growing likelihood of similar flooding in the future means there is a clear need for action.

IC 3 – The interim conclusion of the Review is that the Environment Agency further develops its tools and techniques for predicting and modelling river flooding, especially to take account of extreme and multiple events; and takes forward work to develop similar tools and techniques to model surface water flooding.

3.18 Whilst most of the summer floods were not of the high velocity experienced in Boscastle in 2004, in many areas they reached a significant depth. Some areas, such as Coalbrookdale in Ironbridge, flooded very quickly. The Environment Agency has identified catchments that could have a rapid response to rainfall as a result of their topography (for example, steep and narrow catchments) and will shortly be disseminating information about them to emergency planners. The Review welcomes this and considers mapping of depth and velocity in high risk areas to be a vital tool for emergency responders and planners to allow them to identify areas where rapid evacuation may be necessary or where certain rescue methods may not be practical.

IC 4 – The interim conclusion of the Review is that the Environment Agency revises its flood maps to identify areas where there is a risk of significant depths and velocity of water, to improve the effectiveness of emergency planning.

IC 5 – The interim conclusion of the Review is that the Environment Agency works more closely with Local Resilience Forums to provide information drawn from flood risk modelling and mapping tools to improve the accuracy and consistency of flood risk information in Community Risk Registers.

Visualisation and real-time tools

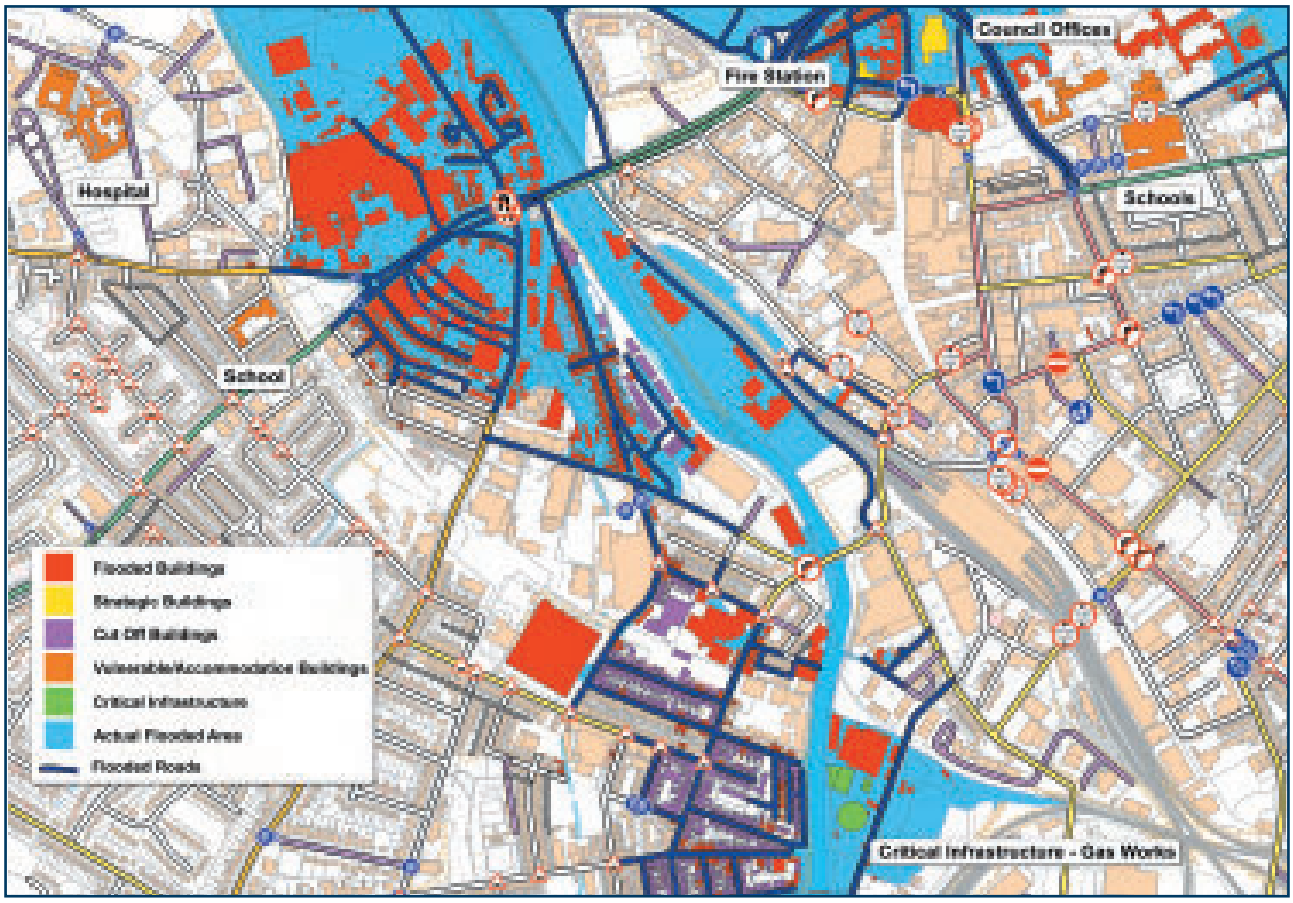
3.19 The events of summer 2007 also demonstrated how important it is for emergency responders to receive flood risk information with a practical, real-time application. Forecasting, modelling and warning systems could be linked together to give responders information that will help them manage fast-moving events more effectively. This is particularly important where the onset of flooding is rapid and the event does not follow historic patterns.

3.20 A number of submissions have been made to the Review about the value of visual, map-based tools that allow better spatial assessment of what is happening on the ground. These could potentially have pre-identified hot spots, drainage information or vulnerabilities at ground level. These tools could be used in flood planning exercises to run a range of scenarios to help local responders better prepare, and they could be used during flooding events to assess potential impacts.

3.21 One example of work underway to improve the forecasting and modelling of all types of flooding is the Atlantis Programme[5]. This brings together datasets from different organisations including river network data, flood models, and geological and topographical data. Figure 9 shows an example of a visualisation map that could be produced to aid flood risk management and response.

[5] The Atlantis Programme is being delivered through a partnership between Ordnance Survey, British Geological Survey, the Centre for Ecology and Hydrology, the Environment Agency, the Met Office and the UK Hydrographic Office.

Figure 9 – Impact of the Carlisle January 2005 flooding on the built environment



Source: Ordnance Survey – Strategic Flooding Document 2007 © Environment Agency Licence A809

3.22 The Review recognises that developing visualisation tools that can cope with the required volume and complexity of data may take some time and it will be important that such tools are cost-effective and easy to use. However, we believe that the Environment Agency and its partners should work to develop and bring such tools into use, and where necessary using simpler versions of these tools until more complex ones become available.

3.23 None of the advances in modelling and mapping described above will be of value if they are not designed to the needs of those who will use them. The Review believes that research into these tools should focus on how flood risk managers, emergency planners and responders could use them.

IC 6 – The interim conclusion of the Review is that the Environment Agency progressively develops and brings into use flood visualisation tools, designed to meet the needs of flood risk managers, emergency planners and responders.

Forecasting

3.24 Developing the tools described above will substantially help in flood risk management and emergency planning and could also support emergency responders. However the quality of data output in the run-up to a severe weather event will be greatly enhanced by more accurate input forecasts of where the rain will fall.

3.25 The Met Office already provides a range of weather forecasting services,

including a severe weather warning[6] service for emergency responders and the public. However, at a resolution of around 5km, its models cannot accurately assess the likelihood of heavy rain falling on particular urban areas.

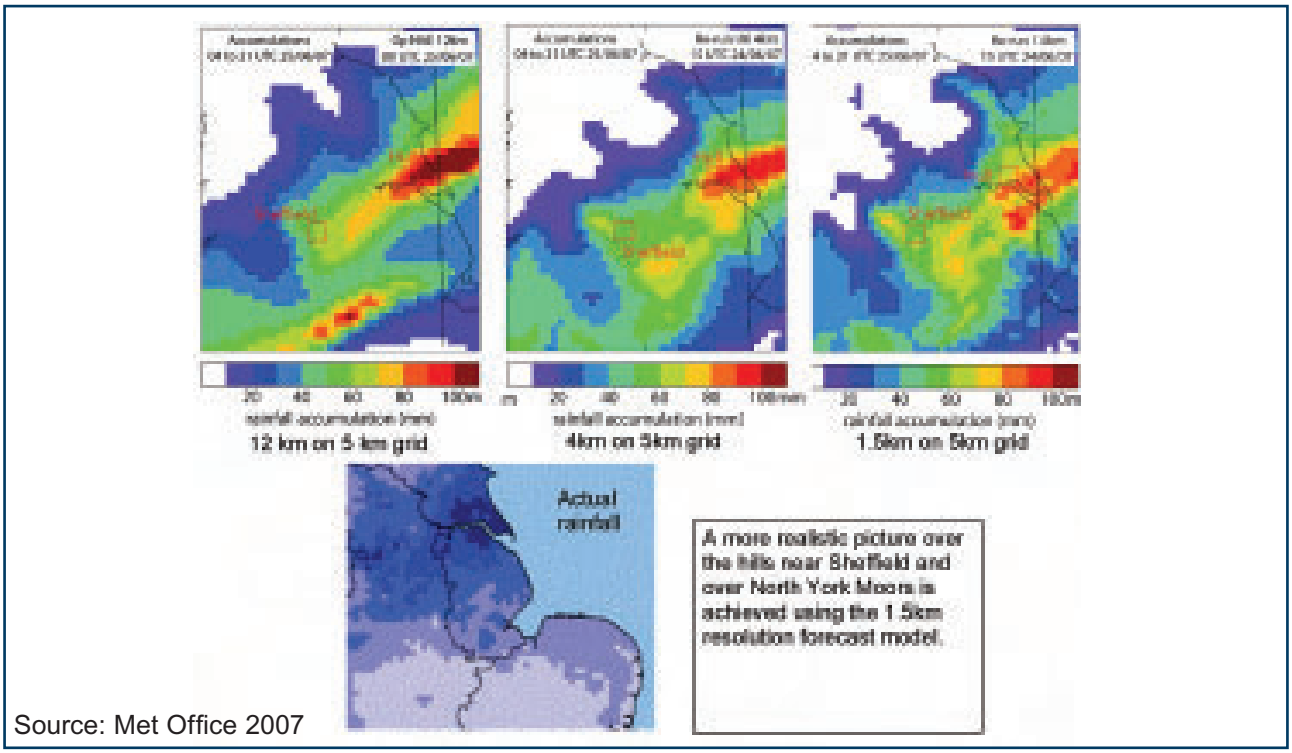
3.26 The Met Office has indicated that greater accuracy in precipitation forecasting may be achieved soon. During summer 2007, a higher resolution model at 1.5km was run for short periods to test its capabilities. The potential improvement in accuracy is demonstrated in Figure 10, which uses rainfall data for 25 June for Hull and Sheffield. If this higher resolution forecasting capability had been fully available in summer 2007, the accuracy of rainfall prediction would have been greatly improved and more specific warnings could have been made in areas like Sheffield and Hull. This would have allowed emergency services and local authorities to position their resources in the highest risk areas and focus their support more effectively.

3.27 Limitations in the capacity of the Met Office's IT systems mean that these models cannot be run routinely until a new supercomputer is purchased in 2009. The Review hopes that this purchase will go ahead as planned, and that superior forecasting capabilities can be introduced to emergency responders as soon as possible.

Short term action

3.28 The improvements described above will inevitably take time to implement. However, the events of the summer put a premium on more rapid action. The Review has identified some useful measures which can be put into place quickly in two areas.

Figure 10 – Met Office forecast models of the rainfall on 25 June 2007 over Hull and Sheffield using different resolutions



Source: Met Office 2007

[6] The threshold for a severe weather warning to be issued for heavy rain is that with a greater than 50 per cent chance of probability, it is expected to persist for at least two hours and to give at least 15mm of rainfall within a three hour period, or a period of rainfall of sufficient intensity to cause flooding on already saturated ground.

Groundwater Flooding

3.29 Groundwater flooding generally occurs in low-lying areas underlain by permeable layers. This type of flooding is easier to predict as water can build up over a number of months before flooding occurs. However, there is currently no organisation with responsibility to respond to groundwater flooding, although the Environment Agency does monitor and warn in some areas. This gap needs to be addressed.

3.30 Following the summer 2007 floods, the Environment Agency commissioned a report from the Centre for Ecology and Hydrology and the British Geological Society into the possibility of groundwater flooding this winter. The most recent update of this study has shown that some risk of groundwater flooding remains in areas such as the Chilterns, and parts of Yorkshire and Lincolnshire if winter rainfall is significant. The study's conclusions demonstrate that the risk of groundwater flooding should continue to be monitored.

REC 1 – The Review recommends that more frequent and systematic monitoring of groundwater levels at times of high risk should be undertaken by the Environment Agency, which should begin as soon as possible to predict and mitigate further serious groundwater flooding from this winter onwards.

Surface water 'hot spots'

3.31 The Review has noted that the Environment Agency is assessing the feasibility of developing a rapid, national topographic screening technique to show areas which are susceptible to surface water flooding from heavy rainfall. This information would not be sufficiently detailed or specific for it to be of practical use to the public, but it could help forecast the risk of surface water flooding until higher resolution forecasting is available. In the interim, even data on surface water flooding 'hot spots' will be of value to local responders.

IC 7 – The interim conclusion of the Review is that the Met Office and the Environment Agency produce an early assessment of the costs, benefits and feasibility of techniques which can predict where rain will fall and where surface water flooding will occur.

REC 2 – The Review recommends that the Environment Agency supported by local authorities and water companies, should urgently identify areas at highest risk from surface water flooding where known, inform Local Resilience Forums and take steps to identify remaining high risk areas over the coming months.