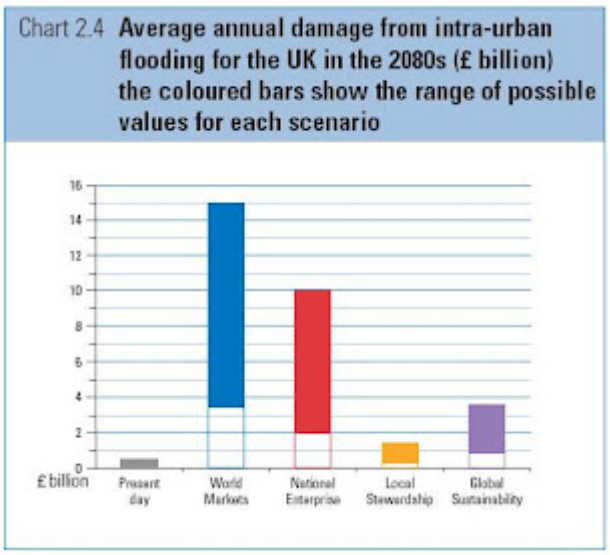
Urban flooding – 15 things to do



We've had some horrible urban flooding impacts recently. But the outlook is pretty bleak too – the chart is from the 2004 Foresight Report *Future Flooding*, showing both potentially high future costs (rising from £270m to up to £15 billion) and large uncertainties involved. Now we have been reminded how bad it can be, what's to be done? Let me set out some views on the problem, which is far from straightforward and little to do with flood defences, and then 15 ideas for how to respond…

How flooding works

'Flash flooding' has played a big role in the recent misery – this arises from very intense downpours overwhelming urban drainage systems creating dramatic surface water flows downhill into river basins. This creates immediate flooding wherever water can collect, fed by these surface flows. The pathways may be quite unpredictable – depending on building, roads, and even small obstructions like walls, and the 'flashiness' will depend on how absorbent the surface is and how much rain runs off over the surface and into drains and sewers. Eventually, water reaches the rivers and the whole catchment drains into the river causing the more predictable type of 'fluvial' (river) flooding, whereby river levels rise and overwhelm the river banks and may 'overtop' flood defences. The faster the catchment drains, the more severe the peak river level is likely to be. If the river level exceeds the banks or defences, water flows into the floodplain, gradually moving up the land contours until all the flow volume can be accommodated. Other types of floods come from the sea and groundwater (also see graphic at the end of this posting).

The basic strategy for dealing with flood risks is as follows:

- Characterise the risks and how they will change over time – producing flood risk maps and guiding investment strategy
- Avoid development in high flood risk areas

- Build defences to get the highest value for money in terms of risk reduction with the available funds
- Go with natural processes as far as possible to slow the movement of water, create buffering and flood storage
- Improve resilience – for example by having a warning system that enables all involved – householders, emergency services, infrastructure owners – to respond.

The government's 2004 flooding strategy has one of the best titles in the sense of communicating the governing idea of the approach: *Making Space for Water* [summary]. The government has been widening the approach to flooding to deal more effectively with flash flooding and is conducting pilots on different approaches [see January 2007 prophetic announcements]. Much work is going on, but this type of flooding presents quite a challenge.

Some of the difficulties

- Intense downpours and urban flash flooding have been a big factor in the recent floods and these risks are much harder to characterise than the more gradual (though highly destructive) flooding associated with high river levels. These have been truly extreme events – setting records for summer rainfall [Met Office] and there is some force to the argument that we will never be (and shouldn't try to be) geared up for *the most extreme* events. But the pattern of underlying risks is changing with climate change and we should expect more extreme and unpredictable events.
- Much development already exists in the flood plain (about £200 billion worth of property) and is unlikely to move – and in the case of urban flash flooding the problem is that water can't get into rivers fast enough, not that water is overflowing from rivers.
- Flood defences don't help much with urban flash flooding (and can hinder as they can block surface flows to rivers). Flood defences are built to a particular standard (usually designed to meet a 1:200 year event, though much more for London – the Thames Barrier was initially designed for 1:2000 year event). Flood defence investment is not an attempt to prevent all flooding – it is an attempt to trade-off costs and risks and give the best value for money in the trade off.
- Warnings for flash flooding are difficult to give – it depends on exact location, intensity and duration of downpours and surface characteristics

where the rain falls – and these are constantly changing. In the recent floods, the Met Office predicted heavy weather 6-7 days in advance, but it can only identify more precise locations much nearer to the event.
- In some case there was a 'system' failure – ie. roads failed due to landslide, meaning mobile flood defences couldn't be moved into position. It is extremely hard / expensive to guard against all possible scenarios for multiple failure.

Here are some of the things that need to happen…. we need to manage the critical infrastructure that control urban flooding. The means by which water is drained from the landscape into rivers or other water bodies is through drains and sewers, what might be termed 'Hidden Infrastructure' (which also includes water supply, wastewater, waste and flood protection). The Environment Agency proposes a four-pillar approach to hidden infrastructure (see Hidden Infrstructure report and more detailed Policy Briefing). The four pillars are: (I) getting the location for development right; (II) have a long term planning framework; (II) demand management; (IV) funding investment with the right incentives. This approach is implemented in the recommendations below.

I. Controlling development

1. Control development – there must be rigorous application of PPS-25: *Development and flood risk*. There isn't a straightforward choice between building and not building on the flood plain – and not all the flood plain is equally at risk. PPS-25 introduces a risk-based approach through its 'sequential test' – building on the lower risk areas in preference to the high risk areas. PPS-25 introduces greater focus on urban flash flooding and sources of flooding other than rivers and the sea. As a means to understand these sources of flooding, it requires local authorities to undertake an SFRA. Some local authorities have been reluctant to undertake SFRAs, but that has to change.

2. Objections to planning applications on drainage grounds. Under PPS25 and related regulations, it is possible for the Environment Agency to define flood risk areas to include those with critical drainage problems in the lowest flood risk zones (zone 1) and object to planning applications where it believes the development would increase the risk to others. If there was a dispute, the application would be 'called in' for resolution by the Secretary of State. This option became available in January 2007 under the Town and Country Planning

(Flooding) (England) Direction 2007. This power is new and has not been used so far, but should be in future.

3. Strengthen the building regulations to build in greater flood resilience to building design. This could be done as part of the government's ongoing review of the building regulations: *The Future of Building Control*. The government's 'living draft' guidance on implementing PPS-25 has advice on resilience at paragraphs 5.36-5.45. There is a case to examine if parts C and H of the 2000 Building Regulations (resistance to moisture and drainage respectively) should be strengthened, perhaps with higher flood resilience standards in areas of higher flood risk. It is, however, the stock of existing buildings that is most at risk. Here, insurers might start demanding policy conditions to improve flood resilience, just as they demand better locks in high crime areas.

4. Limitation of 'Permitted Development' (development that does not require planning permission) to reduce scope for sealing surfaces leading to increased run-off and to encourage the use of permeable paving etc. The government is consulting on changes to permitted development and wishes to widen the use of this approach to simplify the planning system as part of its Planning White Paper. It could make it simple to do the right thing.

II. Long term planning

5. Joined up planning – surface water management plans.

There are many organisations involved in urban drainage and flooding (local authorities, water companies, Environment Agency, Highways Agency, internal drainage boards, land managers, private property owners etc). It really does require a 'joined-up' approach to understanding the risks, preventing the worst impacts and effectively managing surface water. The place that has done best with this is Glasgow – following its 2002 flash floods. The Glasgow Strategic Drainage Plan has been Glasgow's response with the pain of hindsight [see presentation]. Few others had the foresight to follow Glasgow's example, though being no less at risk. However, things are happening: there are now 15 integrated drainage pilot projects in place. I hope and expect we will see more 'Surface Water Management Plans' arising from the Strategic Flood Risk Assessments required as part of regional and local development planning under the government's Planning Policy Statement 25: *Development and flood risk*.

6. Full implementation of existing emergency planning policy. The Civil Contingencies Act 2004 requires emergency services, NHS bodies, local government and the Environment Agency to be prepared for emergencies (schedule 1- responders), including floods (section 1 – what is an emergency).There are duties to assess risk from time to time, to prevent or reduce impacts, to plan a response, to have plans in place to maintain business continuity (including addressing the risk that emergency services will be disrupted by an emergency) and to warn the public (section 2 – duty to plan and advise.These legal duties should form the basis of a coherent multi-agency response to flood emergencies, with considerable effort undertaken pre-emptively. It should be clear for example, that the fire and rescue service are responsible for inland water rescue, and resourced to do the job.

7. Create necessary powers in the Climate Change Bill. It might be stretching 'prevention' duty under the Civil Contingencies Act (2.1.d) to cover more structural responses to reducing urban flood risk like sustainable urban drainage, green roofs etc. Section 37 of the Draft Climate Change Bill could be strengthened to: 1) create, deliver and report on a comprehensive adaptation programme; 2) introduce expert independent scrutiny; 3) create the means for the Secretary of State to allocate duties to particular bodies charged with addressing climate related risks, such as flooding.

8. New institutional arrangements. Clarifying roles, responsibilities and accountabilities would help a lot, and this is the subject of consultation at present. Local authorities should own the Surface Water management Plans, with the Environment Agency taking strategic overview role for all types of flooding, including urban flooding (where responsibilities are currently ambiguous). For example, the Environment Agency could sign off Strategic Flood Risk Assessments and advise on SWMPs. [see excellent Defra discussion of options]. In a similar move, the Environment Agency has been given the strategic responsibility for coastal flooding [announcement]. I don't agree with Dieter Helm (see his July 2007 commentary) that the flood management part of the Environment Agency should be spun out and a new Flood Agency created. If anything, there is a case for more, not less, integration in the management of different aspects of the water environment and also the link between water and land policies. The argument that it is too much put in a single organisation is plainly wrong: large private sector organisations run multiple businesses(think of

IBM, BP, or Barclays). A new nationwide organisation would create new inefficiencies and duplication (management, IT, premises etc) and add to inter-agency communication overheads. Finally, when there are peak emergency demands, it makes sense for the resources needed at the peak to have other things to do when there is no peak. I think a much more useful avenue for institutional reform is looking at the efficiency incentives of the bodies already involved, not adding another one.

III. Managing demand

9. Change the way water moves to manage the demand on drainage infrastructure. Move to much more widespread use of SUDS – sustainable urban drainage systems. The key on-the-ground strategy, is to make sure water in urban areas is slowed down, stored for use or soaked into the ground, rather than being moved quickly through a catchment. This can be achieved using a wide range of sustainable drainage systems (SUDS) techniques, including green roofs, rainwater harvesting, permeable pavements, wetlands and natural flood storage. To make these part of urban design we need both incentives (such as grants or other economic instrument) and requirements on developers to use the SUDS approach and on asset owners to adopt and maintain them. Section 106 obligations could be a way to achieve this. There is a considerable literature on Sustainable Urban Drainage Systems (SUDS). Time to put it into practice. See the following: The SUDS Manual & Site Handbook and the National SUDS Working Group: *Interim Code of Practice*.

10. Limiting the automatic right of connection to the drains and sewerage system, which may not always be designed to cope. The right is established in Section 106 of the Water Industries Act 1991. Removing the automatic right to connect will encourage developers to use innovative and more sustainable drainage solutions. There could be requirement on developers to show that SUDS approaches are not feasible before connection is permitted – ie. create a presumption in favour of sustainable drainage. As often happens with water, there is a 'boundary problem' – water companies are obliged to operate sewers, but the most cost effective options for increasing capacity may be by reducing the volume of water entering the system, rther than putting in bigger drains.

IV. Investment and incentives

11. Reinforce the duty of care on owners of sewers and drains. Failures of sewers and drains can create serious hazards to life and property during flood events. It is important that the ownership of these assets is clear and the owners have a **duty of care** to maintain them in good condition (they can easily fill with rubbish or debris and become ineffective at times of high flow). Owners should also identify safe routes for flows in excess of the design capacity of the system.

12. Enforce water company duties and investment. Under Section 94 of the Water Industry Act 1991 the sewerage undertakers have a duty to ensure that their areas are "effectually drained and that the contents of their sewers are effectually dealt with by means of sewage works or otherwise". Water company assets include public foul sewers (combined and separate) and public surface water sewers. The water industry regulator OFWAT, has performance standards for flooding from sewers [see target 5 here], but this could be strengthened by requiring a more thorough risk-based asset management regime (of the type the Environment Agency has for flood defences).

13. Define overland flood routes It will not be possible to defend against all flood events. So when floodwaters do rise they need to be given somewhere to go – they need to be established and managed by the local authorities who manage these areas and deal with events when they happen. This would be done as part of a Surface Water Management Plan.

14. Protect critical public and private sector infrastructure. An analysis(unpublished to my knowledge)of the National Flood Risk Assessment NaFRA by the Halcrow Group in 2005 showed the following to be at risk of flooding:

- 17% of emergency services properties, including 21% of fire stations, 16% of police stations, 17% of ambulance stations.
- 41% of major energy installations (risks to smaller installations within the distribution grids are unknown
- 37% of sewerage works
- 41% of water treatment works
- 12% of telephone exchanges
- 9% of major roads (A-roads and motorways) – note a single interruption can spread across a network
- 25% of railway stations

These should be taken as indicative rather than definitive, but nevertheless, it is important that a 'business continuity' approach is taken for critical infrastructure and that relevant responsible bodies and regulators secure a high level of resilience to flooding – that may be better defence, emergency temporary defence or other coping strategies. As the boss of the Environment Agency put it to the Daily Telegraph.

> *All public authorities and utility companies should, she says, have a legal responsibility to plan for severe weather conditions. "If you think about how close we came to losing power, there clearly needs to be a fresh look at how we protect some of these vital pieces of infrastructure. There are hundreds of electricity sub-stations that would cause chaos if they went out."*

For the emergency services, including the Environment Agency, the Civil Contingencies Act already requires business continuity planning for floods.For utilities, the flood proofing for critical water and electricity infrastructure should be considered within the OFWAT periodic review process and OFGEM distribution and transmission price control reviews.For rail, the Office of Rail Regulation ensures that Network Rail manages the infrastructure efficiently and safely. For roads infrastructure, the Highways Agency manages motorways and trunk roads (c. 7,800km) under the direction of the Secretary of State for Transport, with local authorities having responsibility for the rest (c. 40,000 km A-roads). Telecoms (and power) infrastructure is vital for business generally, but is also integral to the response to flooding – as 'telemetry' is used to monitor water levels in real time.

15. Recognise the investment case for flood defences. Although the current focus has been on urban drainage and surface water flash-flooding, this should not become an exclusive focus as there are steadily increasing risks from river and coastal flooding. In particular, new approaches are required to enable risk reduction and management of communities at the coast.The basic problem is one of under-investment in defence and prevention and overspending on dealing with the consequences. The marginal flood defence schemes have a benefit-cost ratio of about 6:1 – ie. they reduce the cost of mopping up and rebuilding by at least £6 for every £1 spent. That sounds impressive, but it means that there are a lot of projects with benefit-cost ratios of 5:1, 4:1 etc that are not done. In these cases, we are paying £5 or £4 in mopping up for every £1 not spent on prevention. This

is a colossal ‘allocative efficiency‘ failure arising from unwillingness to make cost-effective public spending investment and apparent indifference to the private costs that arise as a result – making society worse off overall. The Association of British Insurers (ABI) has summarised the case well in its briefing *A future for the floodplains*. Spending has been rising since 2000, and the governemt has committed to increase from £600m to £800m by 2010-11 [announcement]. The investment needs to rise steadily becfore that (ie. not all come in the last year) and then continue to rise to over £1 billion in real terms. The underlying risks are increasing because of climate change, construction price inflation at about 5% eats into the budget, there are particular challenges in dealing with coastal and urban flooding, and it keeping the £20 billion worth of flood defence assets maintained in good condition and dealing with the backlog takes another large slug. It’s expensive, but overall it’s worth the investment.

How flash flooding works…

Figure 1. Simplified illustration of the main routes for surface water flooding of land and properties in a combined sewer system