



Dealing with Floods

Price
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This note deals with inland, that is river not sea flooding, and some of the political problems raised by such floods.

What is a flood?

Rain which doesn't soak into the ground runs downhill converging and growing in volume. It finds or scours out a channel carrying sediment and/or debris towards the sea. The longer and heavier the rainfall the more likely the channel will overtop and water spill onto the land on one or both sides. Because the speed of the water over the land will be less than in the channel the sediment settles out. The area flooded increases until the rain eases and the flow downstream begins to drop. Water on the flooded area drains back into the channel carrying some sediment with it.

The action of flooding and draining creates virtually flat 'flood plains' adjacent to the river in its lower stretches. Geologists call the sediments that are left 'alluvial deposits' and by mapping them can get an idea of the highest flood in the past. The river channel itself will end up with the capacity of what is called the 'annual' flood, that is the maximum flow which occurs on average once a year. Most years then, nature ensures that a river will *not* overtop its banks. On the other hand every few years the river *will* overtop its banks and spill over the adjacent land. Flooding is a natural event. Though man can interfere and make things better or worse, flooding is not inevitably caused by man. Flooding 'stores' water and reduces the 'peak' flow in the river.

Voids in the soil, sub soil and rock cause a river valley or 'catchment' to act like a sponge so there is a lag between rain falling and a river rising. In the Midlands, for example, rain only falls about 5% of the time. In dry weather the flow slowly diminishes (and in hotter drier countries ceases altogether. Indeed in so called 'wadis' it may never ever reach the sea at all). Hydrologists record daily river flow, and can work out the highest flow which *on average* will occur, or have a 'return period' of, once every 2 years, every 10 years, every 200 and so on.

In the example given in Table 1 the flood flow with a return period of 200 years (the '200 year flood') is nearly two and a half times the flow of the 2 year flood. It is also

thirteen times the *average* flow at Bewdley which is only 61.6 cumecs

Changes in flooding over time

The apparent predictability of these estimates hides an important caveat. A change in the use of the land in the river valley can change its 'sponginess' and hence the frequencies and volumes of the floods. For example cutting down forest and converting to pasture, or covering pasture with

housing or roads, *reduces* the proportion of rain that can soak into the soil and *increases* the proportion which runs off directly to the river. Rain can not soak through normal tarmac surfaces. Consequently the peak flow is higher and the flood worse.

There is a second factor too. When a town puts up flood banks or other defences it reduces the area where flood water could formerly be 'stored'. It raises the flood level both upstream and downstream. *Before constructing any new flood defence it is vital to assess the knock on effects elsewhere.*

Development in a flood plain

Walking down a river valley one will see that the areas flooded regularly are usually made up of playing fields, campsites, pasture and so on all with relatively low land value use. Common exceptions however are the historic towns sited due to their convenient river crossing points. The Autumn 2000 floods on the Severn, the highest for 50 years, affected Shrewsbury, Bewdley, Worcester, Tewkesbury and Upton on Severn, all historic towns. York too suffers regularly. The other exception, which is far less excusable, arises where developers have been tempted to build houses on the conveniently flat land. When considering planning applications authorities are required to 'have regard' to the flood risk and so consult the Environmental Agency (EA), but the longer one goes without severe flooding the greater is the temptation to take risks, especially where there is pressure to find housing land.



*A flow of one 'cumec' is one cubic metre of water per second.
** Data kindly provided by the Environment Agency

Return Period (years)	Flow (cumecs*)
2	320
5	408
10	470
25	556
50	628
100	709
200	798

Table 1: Flood flows at Bewdley, River Severn**

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Alleviating the effects of floods

A flood may ruin a field of crops if the water stays too long but this is as nothing compared to the plight of householders, publicans, small businesses and others looking at ruined carpets and damaged furnishings and equipment. It is even worse where sewage backs up into streets and homes. Fortunately disruption to community life tends to be accepted with British stoicism and loss of life, even of livestock, is becoming increasingly rare due to the development of flood warning systems by the EA. Five people lost their lives and 1500 had to be evacuated in the Easter floods of 1998 but the real risk now is on short steep rivers. Here the flow can rise very fast reducing the time residents have to be warned. The Lynmouth disaster of August 1952 killed 34 people in a flash flood***.

Fortunately there were no deaths at Bocastle in August 2004 where 95 mm of rain fell in 11 hours including 75 mm in 2 of those, resulting in a 3 metre high wall of water carrying away 50 cars, but it was a close run thing. Clearly the warning system there and in similar places still needs improvement. It is these locations too which will be most threatened by the more intensive storms expected with global warming.

Flood peaks can now be predicted with much more accuracy. Radar is used to estimate the location and amount of rainfall and telemetry used to read river levels remotely. This means the EA can monitor river flow at different points on a river and its main tributaries and use computer 'models' to work out how the flood water will move downstream and where and by how much it will peak. In some cases the EA can partially 'manage' a flood by using sluices to hold back water in one place so that the peak flow arriving from one tributary does not coincide with another.

Early warning then allows those at risk to move out and either take their most valuable possessions with them or move them to higher floors before they go. This does not save all the anguish - mud, ruined plaster and so on - but it does save life. Perversely it makes the economics of flood defence less attractive. Commonly a probable life saved is estimated to be worth £1M of benefit.

The pros and cons of flood defence

The view from one's garden on a sunny day overlooking one of Britain's rivers is a thing of rare delight as well as adding £'000s to the value of one's house. Many pubs make fortunes from their attractive riverside locations. Constructing high banks which obscure the river view has a downside. In 1993 Shrewsbury declined a scheme to defend the town because it would have destroyed the river frontage. That a scheme is now under construction is due in part to the Autumn 2000 floods coming so soon after the last ones and in part because a clever demountable system has become available from Germany. In truth this is only a high tech version of the good old sandbag but it removes the need for an excessively high flood defence bank and it proved its worth in the winter floods in 2004. It cost almost £3m yet actually only prevented 70 old houses in Shrewsbury from flooding. Cynics have suggested it would be better to move the houses.

Other solutions are to straighten the river channel to increase its capacity but this is awfully bad for nature's river life which prefers bends, deep and shallow water,

overhanging trees and so on. It is possible to add capacity by cutting 'bypasses' or 'flood relief channels' but they are rarely attractive. Both solutions of course simply pass the problem on to other places downstream. The new Jubilee River channel protecting Maidenhead, for example could raise flood levels downstream by 300 mm.

Flood management strategies

So flooding has to be managed very sensitively and on a whole catchment basis. The first essential point to grasp is that rivers *need* to be able to flood and the art is in allowing them to do so in the most convenient place. The second is that the worse the flood the rarer it will be. River valleys are important places to live in and use. We can not avoid all risk. We cannot stop development because a 1000 year flood will come along one day. The third point to realise is that any change of use in a river valley can have knock on effects elsewhere. This we can do something about. Extra tarmac, whether it be for a car park or a widened front drive, will increase flooding and this could be prevented by using porous surfaces or constructing soakaways. Rain on new house roofs could fill rainwater tanks for later use on the garden or even to flush the toilet rather than be allowed to run away down a storm water sewer to a nearby brook. Compacting the ground by leaving livestock out later in the year or growing winter wheat will increase run off but this could be balanced by extending forestry or ploughing fields 'along the contour'.

If a change increases the risk of flooding somewhere *else* there is at least a moral case for the instigator to contribute to the necessary flood defences or be liable for subsequent flood damage.

Compensation

This last point is pertinent to the 'who should pay' debate. Government may well be expected to fund schemes for general improvement (and, indeed, does so) but it is not certain Government should meet the costs for individual cases. A house buyer for example should take account of the flood risk and insurance premiums of the property s/he is hoping to purchase and this risk should be reflected in the price. The British Geological Survey has maps at 1:50,000 scale showing alluvial deposits and the Environment Agency web site has an interactive facility showing the 100 year flood contours.

Two million properties are at risk from flooding and some 1.8 million of these are insured if the flood is more severe than once in 75 years. This leaves 200,000 who are vulnerable to more frequent floods and hence are uninsurable. They may have no alternative but to flood proof their ground floors, raise their electrical sockets and circuitry, and have a well planned evacuation strategy for themselves and their valuables. Even so compensation is only really due to those who have lived there since long before accurate assessments were made, or if their flood risk has been increased *after* they made their purchase, by the action of others.

So when the next TV cameraman interviews the next flood victim and the victim complains 'they' should have known this will happen, remember 'they' probably did and so should the individual concerned.

*** From 'The Earth in our hands', one of a series of notes produced by The Geological Society, Burlington House, London W1J 0BG available from their web site www.geolsoc.org.uk, and well worth reading.
