Dealing with Floods

Price 40p

2007 Summer floods

The UK has remarkably low but reliable annual rainfall. This is a huge unrecognised benefit to farmers, useful for cleaning our drains and responsible for the rich, envied, greenness of our countryside and vitality of our rivers. At the same time variations from day to day and month to month can be considerable. The early Spring 2007, including all of April, was a period of sunshine, near continuous blue skies and some early garden watering. Many older heads feared "We would pay for this later" and indeed the conditions which brought April's sunshine were at least partly to blame for the series of rain bearing depressions which tracked across middle England later. Here the ground, which is normally dry enough to soak up much of the intense rainfall which can fall in Summer, became saturated so new rain ran straight off the land onto roads and properties and then into rivers whose levels rose and eventually overtopped banks. In June estimates of 6,500 houses flooded in Hull and 7,500 across South Yorkshire appeared in the Press. Heavy rain around 20th July then gave rise to flooding, particularly along the Warwickshire Avon, Severn and Thames valleys which, according to an early Environment Agency report, affected 4703 more houses and businesses. These included up to 150 in Oxford, 570 in Abingdon, 400 in Pangbourne as well as others in Upton on Severn, Tewkesbury, Gloucester and elsewhere. The problems caused by the July floods were heavily compounded by the loss of the Mythe water treatment works which, though built above the highest ever recorded flood, was inundated to a depth of 30 cm. As this serves most of Gloucestershire it left about 150,000 households (about 350,000 people) - far more than those flooded - not only without water for drinking but washing and sanitation. The situation could have been even worse had the Walham electricity sub-station been lost as this serves 500,000 homes in the south west and Wales. Indeed one sub-station, at Castle Meads, serving 42,000 people was shut down. Damage was caused to roads and about 10,000 people were trapped on the M5 for a time. At least one railway line had to be closed. Business was lost and in some cases has taken weeks and even months to recover. Crops were lost. Insurers paid out £3bn in claims (though total damage was probably double that) some 5 times the sum spent annually on flood defence.

Every unusual weather event nowadays is attributed to the effects of global warming including this one, despite the prediction that global warming will lead to hot dry summers not cold wet ones! Indeed it is salutary to note dates of 3 earlier unusual summer floods in the Severn area: July 1875; 19th July 1587 and 24th June 1258! Global warming was not the fundamental cause.

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***

Lessons have been learnt and will be applied, but first it will be useful to understand a little about the science of floods.

What is a flood?

In open countryside, rain which doesn't soak into the ground runs downhill. The separate rivulets converge and grow in volume carrying sediment and/or debris down streams and rivers towards the sea. The longer and heavier the rainfall the more likely the streams and rivers will overtop their banks. Surplus water will spill onto open land on one or both sides. Because the *speed* of the water over the open land will be *less* than in the river some sediment will settle out. The area flooded will increase until the rain eases and the flow downstream begins to drop. Water on the flooded area will then drain back into the river carrying some but not all of the sediment with it.

Over the years the action of flooding and draining creates virtually flat 'flood plains' in the lower stretches of rivers. 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 temporarily so reducing 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 usually 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

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

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ceases altogether. Indeed in so called 'wadis' it may never even reach the sea at all). Hydrologists record daily river flow and can work out the highest flow which *on average* will occur or, in the jargon, have a 'return period of' once every 2 years, every 10 years, every 200 and so on.

An example of the River Severn is 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.

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 the land 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 so 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' so 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.*

Urban flooding

The Summer 2007 floods were unusual in that they showed the vulnerability of urban areas to so called 'flash' flooding: short periods of intense rainfall which overwhelmed drains and ditches, and made worse by land which was already saturated. Three types of drain or 'sewer' remove rainwater in urban areas. Post 1936 roads will contain 2 sewers. One, the 'foul' sewer, conveys water borne waste from buildings to the local sewage works. The other, the 'storm' water sewer, carries rainwater from road gulleys, and some household roofs and paved and tarmac areas to the nearest water course. In pre 1936 roads both foul and storm water flow in 'combined' sewers to the local sewage works but, because these sewers are not large enough for every storm, they are allowed to overflow into convenient watercourses when the flow exceeds a certain threshold. Though the overflow will contain human waste and carry a health risk, at the time (pre-1936) this was considered acceptable because the human waste would be diluted first by the rainwater in the sewer and then the rainwater in the receiving watercourse. A lot of investment has been carried out since 1974 to improve the performance and reduce the pollution from these overflows, including the construction of storm tanks which either store the overflow temporarily or at least allow some of the solid material to settle out.

It is not uncommon in storms for a sewer to 'back up' with water spurting up through manhole covers. Generally however this will be from storm water sewers in post 1936 areas and should not pose a health risk.

A great number of watercourses actually run through urban areas partly open (for example in parks) and partly in culverts. A screen will be placed at the culvert entrance but this can be blocked by natural and man made debris and suddenly the storm water has nowhere to go but overland. Blocked ditches and drains can cause the same problems (and did so in Summer 2007) from farmland adjacent to urban areas. Lastly some urban drainage in low lying areas needs to be lifted into rivers. In Hull some flooding arose because a major pump was out of action.

In 2007 a large number of properties were flooded due to these local problems rather than overflowing rivers. The solution of course is simply better maintenance and a local awareness which causes farmers, local residents and local councils to do quick inspections of known trouble spots if heavy rain is forecast.

Development in a flood plain

Most concern however has arisen over major river flooding. 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 want to build houses on the conveniently flat floodplain land and councils submit to the temptation to allow them. It is only in recent years that the Environmental Agency (EA) has had to be formally consulted and more recently still that the EA has been able to get an application 'called in' if a planning authority has ignored their advice. Nonetheless the longer one goes without severe flooding the greater is the temptation to take risks, especially where there is pressure to find housing land.

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 and only 3 lives lost (2 certainly and perhaps the third as well through misadventure) in 2007. The real risk to life is now on short steep rivers. Here the flow can rise very quickly 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 locations vulnerable to flash flooding that will be most threatened by the more intensive storms expected with global warming.

Flood peaks on major rivers can be predicted with great 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'

*** 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.

to work out how the flood water will move downstream and where and by how much it will peak. In 2007 'time to peak' was accurate to the nearest hour and height of peak to within a few centimetres enabling resources to be deployed extremely effectively. In some cases the EA can partially 'manage' a flood by using sluices to retain water in one place so that peak flows from different tributaries do not coincide.

Early warning then allows those at risk to leave and either take valuable possessions with them or move them upstairs. This does not save all the anguish - mud, ruined plaster and so on - but it does save life. Perversely it makes the benefits of flood defence less attractive. Currently a life saved is estimated to be worth around £1.5M. If this can be saved by a 'phone call, it cannot justify physical defence.

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 the good people of Shrewsbury declined a scheme to defend the town because it would have destroyed the river frontage. That defences have been constructed is due in part to the Autumn 2000 floods coming so soon after the earlier 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 as early as the winter floods in 2004. It cost almost £3m yet actually only prevents 70 old houses in Shrewsbury from flooding (and some have suggested it would be better to move the houses). Both Bewdley and Upton on Severn have similar protection though, this summer, blocked roads prevented both barriers and erectors reaching Upton and they were used at Walham instead. It is also now known that the Upton barriers would not have been high enough.

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 with 'flood relief channels' but they are rarely attractive. Both options of course pass the problem on to other places downstream. The new Jubilee River channel protecting Maidenhead, for example could raise flood levels downstream by 30 cm.

Flood management strategies

So flooding has to be managed very sensitively and on a whole river 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. London is built on a flood plain. We cannot stop development because a 1000 year flood will come along one day. The third 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 widened front drive, will increase flooding in sensitive areas if the rain drains to road gulleys but not if taken to soakaways or SUDS (Sustainable Urban Drainage Systems - basically small ponds) or if porous surfaces are used. Similarly rain on new house roofs could fill rainwater tanks for use on the garden or even toilet flushing. All could be made mandatory through extending the building regulations. Compacting the ground by leaving livestock out later in the year or growing winter wheat will increase run off but again 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 if not a legal case for the instigator to contribute to the necessary flood defences or be liable for subsequent flood damage to those affected.

Lessons from the 2007 floods

Rainfall in the 3 months May, June and July was 10% higher than ever recorded (though April 2007 was the 4th driest since records began). However flooding in the UK is not new and although 43,000 houses and 7100 business were flooded, this is less than 0.2% of all in the country despite this summer's severity. Nonetheless Sir Michael Pitt, asked to report on the floods, made a number of sensible suggestions. First that the security of our utilities and other vulnerable establishments needed to be re-assessed. Nationally 13 hospitals, 227 care homes, 99 police stations, 401 schools, 2215 electricity generating and sub-stations, 3 prisons and 1471 km of railway lie in flood plains at a greater than 1 in 75 year risk! Second, vulnerable new and existing houses and businesses need a degree of *resilience* to flooding, eg electrical wiring run above floor level. Third, more attention is needed by local councils to risks from flooding: the EA is only responsible for 'main' river, ie the lower stretches. Fourth, better liaison between the Agency and the Met Office would give householders earlier warning.

Compensation

There remains the key point as to 'who should pay'. Government funds general flood defences through the EA which also receives a small extra amount from local levies. Government is rightly being pressed to spend more but it is not certain it 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 EA web site has an interactive facility showing the 100 year flood contours though, worryingly, some are still based on historic records, not computer predictions based on current circumstances.

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 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 - or move! 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*. In this latter case the 'others' should be made liable and, indeed, the EA does consider the impact on 'others' at the planning stage of new development. Nonetheless 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. Floods occur. Flooding is a natural event.