

TRANSCRIPTION:

BUSINESS-SCIENTIST EXCHANGES: UNDERSTANDING LOCAL FLOOD RISK

Exchange between Richard Chatham (a businessman in Tewkesbury) Gloucestershire and Dr Jeff Neal (a hydrologist at Bristol University)

1. Introducing Richard and Jeff

Jeff Neal: Morning, Richard.

Richard Chatham: Jeff.

Jeff Neal: It's lovely to be here today, with Tewkesbury in the background. So, I'm a lecturer at the University of Bristol and my interest is in hydraulic modelling and the use of those models for flood risk assessment. So, I wonder if you can tell us briefly what your interest in Tewkesbury is.

Richard Chatham: Well, I come from a long-established Tewkesbury family (the family have been recorded in the town from 400 years ago), but I'm Chairman of the Stoke Orchard and Tredington Parish Council, which is the next parish up from Tewkesbury towards Cheltenham, and many of the streams and watercourses that feed into Tewkesbury come through our parish. I'm very keen and very interested in anything that happens in the locale, because I'm a member of the Tewkesbury Chamber of Commerce and I'm also Chairman of the Tewkesbury Business Breakfast Club, so these things affect the way that we run our town.

2. Lessons learnt by a small business that has been flooded

Jeff Neal: In 2007 you were flooded. What was your experience of that?

Richard Chatham: Well, we had two lots of floods at the golf course in 2007. June 22nd were the initial floods, which came through part of my buildings at around about 14 inches. We learnt an awful lot from that and that's one of the things that you have to do: we learnt where it came from; we learnt how to prevent it. So I put in a temporary barrier and looked at where we could improve and increase the drainage, which we did, but of course, [by] July 20th, nothing had settled down and the amount of water that we had, took it away. However, we put the barriers back in, sorted it all out, found a culvert that was blocked under the road outside, which had caused the main problem [and] put that all right. In 2008, we had further flooding in the area [and] we weren't affected at all. So we learnt by what had happened to us. It was a very emotional and a very disturbing and distressing time to be flooded. That is one of the things that people ... everybody says that it is so distressing to see your own property go under water. But, if you can learn by what happens, you can put these things right.

3. Why flooding happens: the example of Tewkesbury

Jeff Neal: Thank you, Richard. Well, thanks for taking us up to this lovely view point. What are we looking at here?

Richard Chatham: Well, basically, in front of us, we're looking at the end of the River Avon plain (flood plain). It will join the Severn, behind those trees over there. The Severn flows behind us all the way down from, of course, mid-Wales. A massive area ... collection area of water: the Avon comes all the way down from Stratford and above. So, again, two massive collection areas, but, apart from that, behind us you see Tewkesbury, the old town, and then there's a very extensive building and development further behind that. The collection area of the rivers and streams that flow into the town, into the Avon and the Severn, are basically from all those behind the trees that we can see there. From the middle of Cheltenham all the way round to Gotherington and Woolstone, they all come through here, and even as far as Winchcombe, come back into Tewkesbury from that massive collection area, which of course causes a lot of problems as far as drainage is concerned and the level of flooding.

Jeff Neal: It's interesting the context that Tewkesbury sits in, because it makes it very flood-prone, because you've got these hills around the town delivering water (particularly in 2007, where you had a lot of local run-off, producing very high river flows and some quite small streams), and then you've got the downstream end of those rivers, as they come into Tewkesbury they meet the Severn and Avon. The way flood hydraulics works is that, in low lying areas like this, it's very much that what happens downstream of the rivers will influence what happens to the water upstream. So you have this twin problem in Tewkesbury of local run-off coming off the hills and then meeting the Severn and Avon and, if they are high at the time when the river water comes down, you are going to get more extreme flooding than you would otherwise if those rivers weren't there.

Richard Chatham: That, of course, was shown in the 2007, July 20th floods, because we had the massive flooding (outlying flooding) on the 20th and 21st from the rainfall, and then it was exacerbated by the water coming down the two rivers which extended the flood period through the weekend. It wasn't until later, after the weekend, that in fact the water all started to subside.

Jeff Neal: Hmm ... and it makes it particularly difficult to assess the risk that someone's house is going to be flooded when you've got these multiple processes going on that are affecting the flooding. So not only have you got to work out what's going on downstream, but also what's going on in the catchment and how that's going to affect the flooding. Also, locally as well, you will have bridges and structures in the river that are affecting people's .. people's ... the local conditions around where people live.

Richard Chatham: Well this is quite true, because that was some of the it's very complex and that period, the July 20th period, was in fact very complex around here because a lot of the rivers and streams (the local streams) had not been maintained and even some of the storm water drains in the villages and part of the town lacked

cleanliness and lacked efficiency and that in fact flooded areas that had never been flooded before.

4. Why some floods are particularly severe

Jeff Neal: 2007 was an amazingly exceptional event, something that we've never seen before in the historical record, which is admittedly far too short to make a really accurate estimate of how likely these events are to happen. It was also a strange event in 2007 because of the amount of local rainfall that fell. Usually, traditionally in Tewkesbury you would have flooding from the Welsh mountains from snow melt or heavy rain up there in autumn and winter time and those are kind of ... you know the way that we often thought about flooding around this area until this 2007 event, where you've got this extreme summer rainfall. In fact, if you look at the records up at Bewdley (30-40 km upstream on the River Severn), in 2007 those rivers are not flooding - there is a reasonable amount of flow coming down, but there's really no flooding happening up there. Whereas down here, where you've got the local rainfall, combined with the levels in the Severn and the Avon, that's causing a lot of impact locally.

5. What a flood modeller does

Jeff Neal: My research looks into flooding inundation modelling, so I develop computer models and simulate the movement of water over the earth's surface and we use those primarily for risk assessment. So, a typical scenario is that you are looking to estimate how likely a flood event is in terms of the upstream inflow. You describe the topography over which the flood is going to occur, the geometry of the river, the roughness of the surface (that's the resistance that it poses to the water flow), and then the combination of that information and a computer program that solves the shallow water equations (which is our understanding of how water moves). The combination of those things allows us to say, for a given return period, rainfall event or upstream flow ... set of flow conditions, we can predict what the depth of water is going to be, in great detail actually, around an area of interest. So, typically, for example, the modelling that we've done in Tewkesbury in the past, we've gone right down to two metre resolutions, we've divided every bit of the city up into two metre squares and we've simulated the movement of water between those locations and that gives us, over time, the dynamics of the water. And, in turn, someone who is interested in flood risk in the town, can take those depth estimates, they can look at how they intercept with buildings and businesses and roads, and seek to make an estimate of the risk and the economic damage that might be caused by a flood event.

6. Why flood modelling can be helpful

Richard Chatham: The flood modelling that you're talking about will be very useful and exceptionally useful to those areas that haven't been flooded before. We must remember that above us, when I say above, above the catchment area here, are

another 3,000 houses being built at this present moment and another 8,000 houses already on the plans. Those will change dramatically the flow of water through the rivers and through the water courses affecting Tewkesbury and your modelling will help us to work out the difference it's going to affect ...the different ways it will affect Tewkesbury.

Jeff Neal: For undertaking risk assessments, it's why the Environment Agency will do that for new developments now. It's an attempt to understand how making a change in the catchment will affect the risk to populations both downstream, and upstream of course, of where they are, particularly in relatively low lying areas like this, where causing a blockage somewhere or a change in the hydraulics downstream of someone's house can have a profound impact on what happens.

7. Complexity of flood causes and how modelling tries to help

Jeff Neal: One of the reasons why we develop flood models and why we look to assess risk with computer simulations is to say, well, this location hasn't been flooded, but how likely *is* it to flood? Can we build a model that predicts with some degree of skill at least whether an area is at high risk or not and, if it is, then inform that local person, your house is at risk of flooding and you might want to consider taking a number of measures to make yourself more resilient to that. So that's really why we try to design these really quite complex models of towns and cities all over the UK.

Jeff Neal: OK, Richard, where have we moved to now?

Richard Chatham: Well, we've moved to probably one of the most photographed and painted areas of Tewkesbury and that, of course, is the Abbey Mill. The Abbey standing behind us there, less than a hundred yards away from this beautiful Mill Row here, is probably one of the worst flooded areas in the whole of town and yet the Abbey never flooded. The monks when they built it knew exactly where to build, on higher ground, which brings us to the point that of course flooding can be very local; some places (and you know if you live there), you get flooded, and then others, you don't. [This is] an area probably well known in Tewkesbury and shown on so many television programmes over the years.

Jeff Neal: Of course, it's incredibly important to understand your local context for flood risk. Like you say, it's very local, it depends on the topography around where you live, and also on what happens immediately upstream of you and downstream as well because of the back water effect you can have, and also the type of flood that you might be exposed to. In the UK, we have several types of flood risk: we have coastal; we have pluvial flood risk (which is heavy rainfall and localised flooding); we have fluvial flood risk (which is what we would expect to see down here with the large river going up and flooding this flood plain); and then we also have groundwater flooding of course that can cause very long duration flood events. In 2007, what happened in Tewkesbury here?

Richard Chatham: Well, basically, as we said earlier, this was a pluvial flood

because of the tremendous amount of rain water we had on July 20th and the evening before. June 22nd was also similar, but not of the quantity that we had on July 20th.

Jeff Neal: So, first, if I understand it correctly, first, you had in the catchments around Tewkesbury a very rapid pluvial flood after local heavy rainfall.

Richard Chatham: Absolutely.

Jeff Neal: And then, later on, after that initial flooding had started to clear, you had the rivers around here collecting the water from the wider catchment and then a fluvial flood extending over these other areas of Tewkesbury.

Richard Chatham: Absolutely, because the villages that lie behind us back towards the Cotswold Scarp probably cleared their storm water floods, their storm floods, in a matter of 18-24 hours, but of course in this part of Tewkesbury, the water coming down from the areas that were flooded above (Bredon, Eckington, on towards Evesham) they brought the water down here and that exacerbated the problem with the water clearing from the Scarp (the Cotswold Scarp) and meeting the water that was coming down the Avon and that increased over two or three days before the water actually could fall away.

Jeff Neal: One of the reasons why we develop computer models to simulate flood risk in areas is because you have many processes going on and somehow you've got to bring those altogether to look at the overall flooding context that you have in a particular location. So when we think about assessing the risk of flooding in a location, what we're really trying to do is to capture the run-off processes that generate the discharge in the river, the downstream processes that affect the river levels, the structures that there might be in the river system and the topography of the flood plain itself, in great detail. The combination of those things is just too complicated to think of in one person's head, and so we digitise that onto a computer and then we use our understanding of how water flows over the land surface. So we solve essentially what's known as the shallow water equations and these equations tell us how water moves from one location to another over the earth's surface. If we know enough information about how much water there was and the geometry of the river and the topography of the flood plain, then we can start to make a prediction of what water level might be reached and where water might go for a given size of storm. The problem with that, of course, is that we don't necessarily know very accurately how big storms are going to be in the future or, necessarily, how the topography of the land is in all locations and how the size of the rivers change from place to place. So that leads us to having very uncertain predictions of what's going to happen and this causes great difficulty for them, the local stakeholders, who have to deal with this situation where we can make predictions of flooding, but they are not necessarily always going to be 100% accurate.