

# Building local/lay flood knowledges into community flood resilience planning after the July 2007 floods, Gloucestershire, UK

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## ABSTRACT

A UK Cabinet Office review after the 2007 floods highlighted different types of knowledge needed for effective flood risk management, along with knowledge gaps. This paper explores key, emerging aspects of this expanded knowledge base, namely relationships between expert and local/lay knowledges, the changing nature of local knowledge of community flood risk, and how attempts are being made to incorporate local knowledge into science, policy and practice. Sustainable flood knowledge, as an aspiration, integrates expert, local and political knowledge to build community flood resilience. The research involved stakeholder interviews undertaken before and after the 2007 floods, Severn catchment, UK and examination of policy documentation. The paper focuses on scale issues in relation to knowledge types suggesting that local knowledge can be 'expert' in large-scale mapping of flood processes. It reflects on how local flood knowledges can be captured, shared, harnessed and used, and assimilated into governance structures for flood resilience planning. The paper recognises progress in integrating local knowledges in flood science and governance, but also highlights challenges. It concludes that the 2007 UK flood experience is generating new understandings of the value of local knowledges, and how these might be successfully used in flood risk management practice.

**Key words** | community resilience, flood memory, flood risk, governance, local knowledge, planning

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## INTRODUCTION

This paper reflects critically on the changing nature of, and relationships between, expert and local flood knowledges in community settings, based on research undertaken before and after the 2007 floods in Gloucestershire, south-west UK. The paper investigates how local flood knowledges are being captured, shared, harnessed and used, and integrated into both expert flood science and governance structures for flood resilience planning.

The paper integrates physical geography/hydrological perspectives with those of cultural geography to develop preliminary points about the generation and use of local flood knowledges, articulated in [McEwen & Jones \(2010\)](#). In addition to examination of policy documentation, primary data are based upon three main sources: a series of interviews conducted with local councillors and local

authority officers in Gloucestershire and Worcestershire after the 2007 floods (Natural Environment Research Council (NERC)-funded Gloucestershire's Inquiry into Flooding (GLIF) project); structured interviews/digital stories that captured accounts from community members along with community documentary and web resources ([JISC Community Flood Archive Enhancement through Story Telling project](#)); and action research as part of a flood science communication initiative with River Severn community members (2004–2007, Royal Society COPUS 'Connecting people to science' project; see [McEwen 2007](#)). The social science terms used in the discussion, namely 'local knowledges', 'memorialisation' and 'materialisation' are clarified as follows for a hydrological science readership.

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'Local', 'lay' or 'vernacular' knowledge is accrued by individuals or groups (e.g. interest groups; communities). It comes from direct experience of engagement with some or other 'subject' over time, rather than from training, education, and professionalisation. One example is the indigenous knowledges that non-modern communities have of their environment and which is the basis of their traditional livelihood which may handed down and developed between generations (Ingold 2000). A second example is the knowledge individuals and communities develop about their own locality – stemming from being in a place over time and also from the self (interest) people understandably have in their local environment. A third form, often in combination with the second, draws from peoples' hobbies and passions, for example in natural history. Although 'lay' in terms of being non-professional or trained or embedded in formal scientific networks, such forms of knowledge can be authoritative and expert in their own area (subject and locality). This paper is particularly interested in the latter two forms of knowledge of flooding, and how they can be incorporated into wider networks of 'professional/expert' hydrological knowledge. It is important to note that local knowledge cannot be considered separate from local politics and power relations (see Pottier 2003; Firoz 2010) and can be contested (as can all knowledge).

Memorialisation considers how flood experiences and their impacts are remembered by individuals and communities, for example, through oral history, local media, social media archives, photographs, diaries, flood marking, individual and collective memory. See [ESRC Sustainable Flood Memory project](#), available online.

Materialisation refers to how flood knowledge and memories become articulated and embedded into physical systems and artefacts. This occurs, for example, through physical or 'known' local points of reference, written records in local archives and museums, oral history, visualisation through art and sculpture, as well as the emerging use of new technologies including social networking sites. See [AHRC Living Flood Histories network project](#), available online.

### Changing contexts and policy responses

Over the last decade, significant developments have occurred in how different forms of knowledges (e.g. 'lay',

'local', 'senses/values of place') are being built into various policy processes in the United Kingdom, not least in sustainability planning and flood risk governance. The traditional knowledge locus of strategic government initiatives has been on the building and application of expert flood knowledge gained through research, and communicating that knowledge and its policy outfall to the public (Pielke 1999; Baker 2007). However, the value of local/lay/informal flood knowledges (hereafter 'local knowledges') held within communities is now being recognised, explored, and, as shown here, integrated into flood science and the governance matrix (network of agencies, decisions and information that make up flood policy).

This direction of travel has been fuelled by several factors. Since the 1990s, management of land and water in the UK has undergone a gradual transition towards more strategic, multi-method, integrated approaches (Tunstall *et al.* 2004). In relation to flood-related policy, this has involved shifts from 'flood defence' to 'flood risk management', and moves to more distributed approaches in dealing with flood risk. In this complex governance culture, there is a growing research and policy focus on how flood risk planning can be implemented at local or community level, and the changing knowledge bases needed to underpin this paradigm shift (Whatmore 2009; Lane *et al.* 2010).

The occurrence of a sequence of notable floods in England in the late 1990s and 2000s, including the July 2007 flooding of areas of Gloucestershire, Sheffield and Hull, UK, has linked flood incidence and climate change in the public psyche (Lane 2008), and placed management of increased future flood risk high on government agendas. Further impetus to rethinking the knowledge base that should underpin flood risk management occurred because existing warning, planning and response protocols failed to cope effectively in very extreme circumstances. The July 2007 floods, UK were caused by sustained high intensity rainfall over a wide area and combined fluvial, pluvial and groundwater flooding (Marsh & Hannaford 2007). The sheer scale of pluvial (rainfall) and surface water flooding, in interaction with existing urban and rural land use and drainage systems, challenged extant systems of planning and management.

'Surface water flooding was a striking feature of the summer 2007 flooding. Urban areas were particularly

susceptible, because sudden and intense rainfall cannot drain away as easily as in rural areas where the soil is exposed. In many urban areas, the natural land drainage has all but been removed by impermeable surfaces, so avoiding flooding depends almost entirely on piped drainage system and any subsequent pumping.’ (*Pitt Review, Cabinet Office 2008*, p. 97)

Concerns raised by the 2007 floods were further heightened by climate change scenarios (*UKCIP09*) that predict increased risk of high rainfall intensities and associated flood risk.

The 2007 floods proved to be one of the greatest civil emergencies that the UK has faced in recent times, with loss of life, houses/businesses devastated, and strategic transport, power and water infrastructures threatened, damaged and disabled (*Cabinet Office 2008*). In the aftermath, different agencies and tiers of government reviewed their procedures and planning with in-depth inquiries held at local level e.g. Scrutiny Inquiry 2007 (*Gloucestershire County Council 2007*) and nationally (*The Pitt Review, Cabinet Office 2008*; the *Government Response to the Pitt Review, DEFRA 2008*). The Government’s response (*DEFRA 2008*, p. 6) summarised the need for a re-worked knowledge base:

‘Getting a clear picture of where flooding is most likely, and how likely it is, is not a simple task. Need for better knowledge of where the risks (from all sources of flooding) are greatest and improved knowledge over time enabling better targeting and planning.’

### Towards local knowledge

These high profile reviews have increased the focus on community-lead adaptation, resilience and emergency planning as key approaches in dealing with residual risk left after official government mitigation measures have been implemented. In addition, the *The Flood and Water Management Act (2010)* has clarified different stakeholder responsibilities in flood risk management, including those that impact on surface water management such as Sustainable Urban Drainage (SUDS) developments.

There has also been intense self examination in various organisations about how they gather knowledge about flood

events, flood risk and how they implement strategies to develop community flood resilience. As part of the review processes, emphases have been on building *local community knowledge*, alongside flood risk awareness and preparedness. This approach combines both a deficit model (lack of official support), with the need to harness positive aspects of local knowledges for improved flood risk management. It also integrates with the promotion of increased community involvement and volunteer engagement as lower cost solutions. The ‘community lead’ agenda encourages communities to propose, and potentially part-fund, innovative schemes for local flood risk management (*DEFRA 2010*).

‘We have seen and heard of many local groups who want to take action to alleviate flood risk in their communities. At the moment, this kind of scheme can end up being too low a priority for the Environment Agency. The Government should be encouraging more local communities to promote innovative schemes, including contributing towards the costs themselves, with appropriate technical support from local authorities and the Environment Agency.’ (*Pitt Review, Cabinet Office 2008*, p. xix)

Matched with this, there is a perceived need to evaluate how the public in community settings can improve their understandings of local flood risk.

‘Better advice and help for people to protect their families and homes Risk and Regulation Advisory Council implements review of how the public can improve their understanding of community risks, including from flooding.’ (*Government Response to Pitt, DEFRA 2008*, p. 24)

In all these processes, evidence exists that important attempts are being made to take local knowledges seriously as ‘authoritative knowledge’ and to begin to incorporate them both into governance processes and into specific systems aimed at defining and managing flood risk, and engendering flood resilience.

Finally, while momentum to try to integrate local knowledges into flood risk governance structures and processes is underway, it is likely to gain new impetus by changes in overarching government approaches and the financial crisis. The notion of localism seeks to ‘devolve’ central

power and resources into local networks. In accordance with this, *The Flood and Water Management Act (2010)* gives local authorities a new role in leading management of their local flood risk.

### Establishing sustainable flood knowledge

At stake here is ‘sustainable flood knowledge’ – a term for knowledge that is shared within and between the governance matrix, communities, businesses and other groups which can ensure that society is resilient (and thus sustainable) as possible to future flood risks. Sustainable flood knowledge is of course an aspiration rather than an actuality but is likely to result from synthesising a whole range of flood knowledges – expert, local and political. Before the nature of ‘local flood knowledge’ is explored in the remainder of this paper, expert knowledge is briefly considered.

### Expert flood knowledge

Expert flood knowledge, which is ‘crucial in understanding flood risk’ (Cabinet Office 2008, p. 39) ranges from basic to advanced or ‘high science’. Significant blurring occurs in this continuum, e.g. around the sophistication of understandings of concepts such as ‘floodplain’, flood risk mapping and uncertainty. Expert knowledge development in science and engineering emphasises data collection technology and modelling for improved flood forecasting and prediction. Expert science in knowledge and skills is authoritative, has its own language and boundaries, and is used and validated by peers and experts. Concerns include: its accessibility and reliability to inform action by wider stakeholder groups; how concepts like probability, uncertainty and complexity are communicated and translated beyond the expert science community (Bell & Tobin 2007; Faulkner *et al.* 2007); and broader issues of trust in expert flood knowledge and experts. The traditional focus of expert science has been in establishing risk and mitigation of fluvial (or river) flooding on large water courses (‘main river’), with narrow definitions of what might be construed as science and expert knowledge, and a limited sense of historical, anecdotal and qualitative contexts. The public’s reception of the environmental regulator’s online floodplain mapping information (Environment Agency ‘Understanding flood risk’)

demonstrates the challenges of expert knowledge, and its public communication in terms of data quality, model resolution and uncertainties (Clark & Priest 2008; RISK MAP, Porter 2010).

A recognised lacuna after the 2007 floods is knowledge of pluvial or surface water mapping and modelling, and multiple flood events. The development of this expert science, and the filling of knowledge gaps, represents an important focus of the *Pitt Review* (Cabinet Office 2008).

‘The Environment Agency should work with partners to urgently take forward work to develop tools and techniques to model surface water flooding.’ (Cabinet Office 2008, p. xiv)

Key organisations like Environment Agency and Local Authorities need to use this improved flood knowledge rapidly to adapt post *Pitt Review* (DEFRA 2008).

Traditional ‘public understanding of science’ initiatives have sought to ‘transfer’ this expert science to communities and citizens. In the 21st century, however, dominant paradigms in ‘science and society’ have shifted both to broader constructions of science (and flood science), and from science ‘transfer’ to knowledge ‘exchange’ and ‘co-generation’ in community engagement (McEwen 2012). The latter provides new opportunities for sharing lay, bottom up, local knowledges. Although expert knowledge in flood science and engineering has developed rapidly through government research initiatives (e.g. NERC Flood Risk from Extreme Events programme; FREE), the nature and changing role of local flood knowledges remains largely untapped and un researched. Increasing recognition that local knowledges have value, however, integrates well with the UK Government’s ‘science and society’, community empowerment, sustainability, as well as ‘Big Society’/localism agendas.

### Nature of local knowledges

The concept of local knowledge relates to ‘vernacular knowledge’ and works on the premise that lay people (non-scientists) might have high quality knowledge about subjects they take ‘amateur’ interest in, and/or about their local area (often for understandable reasons of self interest). Both are relevant to flood knowledge. One area where such

knowledge has been recognised is in natural history recording and conservation (see *Degen et al. 2003* for the use of ‘vernacular knowledge’ in urban nature conservation). During extreme floods (as in July 2007), water behaves in a very detailed and precise way in relation to the local terrain. As such events develop, more and more ‘points of unanticipated flows’ will occur. Local observation to acquire local flood knowledge is focused on capturing these rare events – extremes of the range – that challenge ‘expert’ monitoring. Models and maps used by local authorities and the Environment Agency cannot at present capture all of these pressure points. Local knowledge of flood events might be particularly important due to its scale of application which can be considered to be 1:1, for example, how flow of flood water in a local street is affected by pavement levels. In these unique extreme events, ‘traditional’ expert knowledge struggles to model this resolution, which can be critical in how flood events play out at the local level. Local knowledge can, however, know what water actually does through witnessing on the ground.

‘I think what was accepted from the outset was that these were exceptionally unusual set of circumstances. This happened in the summer [2007] and the types of places that flooded, if memory serves, in conversations I had with the fire and rescue people, they were going to places they had never been to before. So it was unique. And it started us thinking more widely about the threat of flooding. Not just those places that are predictable to us, such as Upton upon Severn, Bewdley, which are low lying and right on the edges of the River Severn.... They were going to places they had never been to before, where small brooks had just exploded.’ (Member, Local Resilience Forum)

‘I think the summer and winter parameters have all changed.... That is one of the big learning points of 2007. [There is] perception that we deal with flooding in winter, and if we get through to about March we won’t have any flooding. We’ve always associated flooding with November through to February phenomena, but that has been challenged and turned on its head. We’ve had minor incidents of surface flooding water ever since. If it rained heavily now three or four hours we know there would be pinch points around the county

that will start to flood.’ (Head of Community Leadership, County Council)

So what forms can this local flood knowledge take? Local people as citizens or as groups who take an interest in the micro to macro-scale local water geographies begin to build up detailed knowledge of water courses, drains and culverts at the level and scale needed. They can observe in qualitative or quantitative terms a whole gamut of physical hydrological parameters including antecedent conditions to floods, their causes and response times to rainfall, intensifying factors, flood size and frequency, speed of onset, duration, relative velocities, spatial extent and pressure points, water quality – their unfolding processes and interactions, and local physical/human impacts.

In addition to ‘detail’ and ‘scale’, local flood knowledge has other defining characteristics (*McEwen & Jones 2010*): its potential for verification by repeat observation during successive floods; its accurate positioning of processes and impacts in space and time; its augmentation with other locally owned historical evidence, sense of place and heritage; and its ability to focus on the interaction of different flood types, particularly fluvial and pluvial flooding, that are challenging to model.

‘Detailed local knowledge is also essential in tackling surface water flooding, with risk assessment greatly dependent on local features and an understanding of areas of historical flooding.’ (*Pitt Review, Cabinet Office 2008*, p. 84)

This links with the notion of ‘citizen science’ and the involvement of individuals and communities in environmental monitoring (*Cooper et al. 2007*).

Local knowledges can also ‘know’ local information, such as obstructions and human detritus in urban watercourses, that expert systems can be unaware of and miss. For example, a poorly designed and maintained culvert, or a local urban stream choked with weeds or rubbish can become the point where heavy flows of water leave the path envisaged or designated for in models used by local authorities and the Environment Agency, and become ‘flood water’.

‘Yeah, the local water courses had been neglected. They admit that. Where as before, and we are talking quite a

number of years ago, they had a dedicated watercourse officer and such like, and a team of men, and they were cleaned out weren't they? But they admit things had fallen by the wayside. It is riparian ownership that gets in the way of everything.' (Local Councillor)

Local knowledge can also monitor effects of action on the ground, like the impact of opening up a flood relief ditch, or of land use changes.

'The real interesting thing though is .... there are some areas that will flood after two hours of heavy rain now, that did not flood in July 2007. It is really strange, and that is when you start to look, I wonder if the field has just been ploughed, how has that interfered with the natural water drainage out of that field.' (Head of Community Leadership, County Council)

Also integral is the importance of 'practice' with 'knowledge as doing rather than thinking'. In addition to monitoring flood levels, citizens often intervene, for example, with using sandbags to divert water, and learn how effective the intervention is, and how protection of property can be improved.

Like expert science, local knowledge evolves rapidly during and after extreme floods. For example, one learning point for the public after the 2007 floods was that flooding to property is still possible without living on a designated floodplain. Local knowledge may, however, need fine-tuning. Many residents in Tewkesbury, Gloucestershire, reported anxiety every time heavy rain fell after July 2007 in fear of future flooding.

'When you get heavy rain now, because of what happened in 2007, people get very twitchy. Oh, the rivers rising, and this was very obvious for a few months afterwards. Oh the river is rising again; we had a lot of panic calls. But I do think as you say we have been through that experience, we are far better prepared to cope with that, we are taking measures all the time to alleviate any problems that may arise next time.' (District Councillor)

As time progressed post-flood that fear has reduced. Residents now have a greater awareness of the need to check expert weather warnings for information about

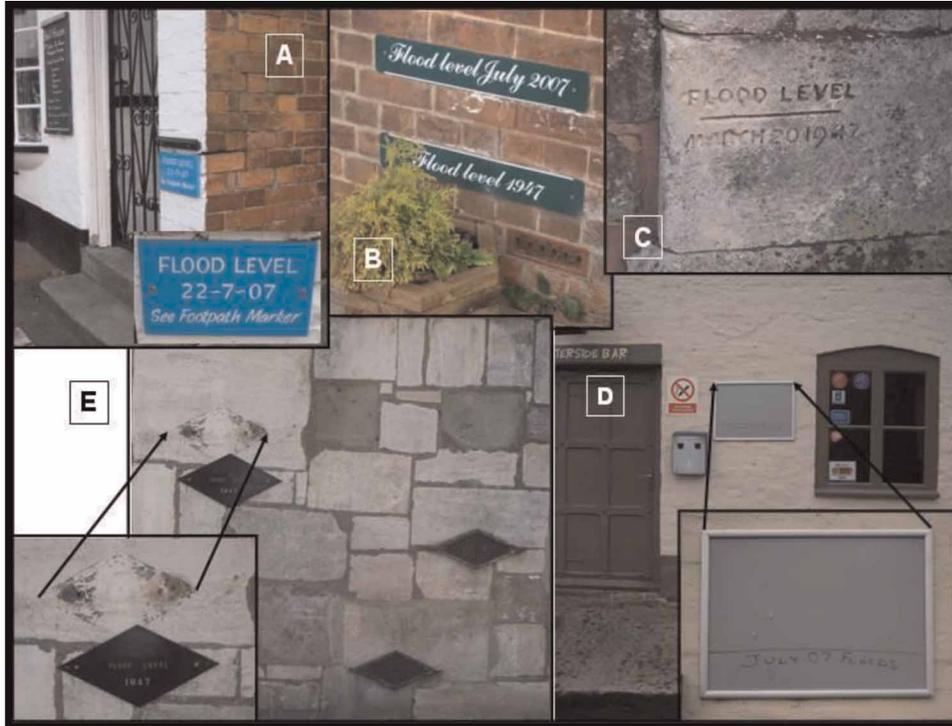
predicted rainfall intensities in the catchment area upstream of their communities.

These local empirical knowledges – which turn out to be so critical in understanding flood processes – are backed up by local values of place. People understandably care about and seek to protect their home and local community. At community level, major concerns can be too much water of wrong types (polluted) in the wrong place at the wrong time. Hence local knowledge is reinforced by the desire to act and to prevent local flooding. This poses important questions about how local knowledge can be captured and shared, and enrolled and connected into governance systems in terms of monitoring, preparedness and response.

### Capturing local flood knowledges

If local knowledge can be important knowledge of flood events and risk, how do local practitioners go about gathering it? Evidence shows that established and new technologies are being used in processes of knowledge capture, and in sharing within communities and with experts. Examples include: detailed observation through floods, recording of local surface water pathways over impervious suburban surfaces (e.g. by Longford Action Group, Gloucester); and archiving of sequential photographs of widespread surface water flooding in Cheltenham taken during the July 2007 floods by an amateur photographer from the local historical society. Local knowledge is also being extended through longitudinal observations of flood levels and their relative ranking, including epigraphic marking of new 2007 flood levels in focal community settings (churches, public houses, etc.) down the River Severn. Some epigraphic markers allow comparisons with previous flood extremes in March 1947 (Figure 1). Such marking has long been used to record local flood heritage for posterity (Macdonald 2007), so improving expert and local awareness of the frequency and magnitude of extreme events.

Examples of the use of new technologies include: collation of YouTube videos of the 2007 floods in Cheltenham and oral history capture by artist Fiona Meadley in a local Flood Archive (*Uncertain Weather* art exhibition, Cheltenham July 2009), and privately funded webcams monitoring small water courses on community or individual's websites. A Gloucester city councillor reported that in periods of high rainfall when



**Figure 1** | Flood marking in local settings—July 2007 and earlier floods. A. new 2007 flood mark at New Street, Upton upon Severn (already removed); B. New and re-painted (1947) flood marks – Red Lion Public House at Wainlode Hill, Lower Severn; C. 1947 flood mark on church gateway, Upton-upon-Severn, UK; D. Informal 2007 flood mark – Swan Inn, Upton-upon-Severn (now gone); E. Series of flood marks (with 1947 height recently corrected) at Upton-upon-Severn.

local anxiety about two local watercourses increases, he is able to check online to establish the state of one brook on a live webcam that another local resident has set up in their garden. This is real time monitoring of one location. Significant potential exists to extend the observation network from ‘expert’ monitored to local monitored sites in a nested hierarchy. This involves identifying, capturing, sharing, aggregating and disaggregating what is known about local physical flood risk. Longer term, historic flood chronologies can be captured and shared drawing on diverse archival sources (e.g. parish records; newspapers, postcards, videos; see [McEwen 2007](#); [Figure 2](#)) and oral history through new media like Web2.0 and digital stories ([Fyfe et al. 2009](#)). Web resources have been set up to share knowledge of local flood histories and flood risk within communities and with experts (e.g. [Lower Severn Flood Education Network](#)). Here personal photographs of past floods in their locality supplied by local residents were added to the Environment Agency’s geographical information system (GIS) flood maps of past historic flood inundation in Tewkesbury. Linking local knowledge with modern techniques like participatory GIS to record and analyse risk

related data is recognised as a way of engaging and mobilising community capacity in disaster management ([Tran et al. 2009](#); [Peters-Guarin et al. 2012](#)).

### Sharing local flood knowledges

Information gathered is not much use to the wider knowledge matrix if it is not somehow disseminated, shared and owned. In sharing local knowledges, local knowledge of flood history needs to be made overt and explicit to all stakeholders, and integrated into formal flood risk assessment and planning by different organisations with flood risk management responsibilities.

‘[Local knowledge] is with those people who have dealt with flooding in the past, for example we have a nursing home, close to the River Severn, up in the wide forest area towards Kidderminster. We all know that if we get so many centimetres rainfall that is likely to be cut off, not flooded but cut off, and we have to evacuate or consider evacuating the people in it. *But that is not written*



**Figure 2** | Other examples of flood materialisation A. 1990 Severn flood being marked as part of a series going back to 1757 (flood marks since removed with property redevelopment (Gloucestershire Echo); B: 'The Great Summer Floods' August 1912 (Worcestershire Advertiser); C: Oral history and digital stories – remembering 1947 floods at Elmore, Lower Severn; D and E: Postcards recording previous summer floods on lower Severn (both Church St, Tewkesbury) – June 1924 floods (source: Sue Norman) and May 1886 floods (source: Tewkesbury Historical Society).

*down anywhere. But it wasn't. It is now.* (Head of Community Leadership, County Council)

Community knowledge networks and pathways need to be identified, along with key bridge people in communities who are able and willing to act in representation and liaison capacities with organisations in partnerships with experts. These individuals and groups frequently have flood interests triggered by concerns about flood risk to local properties, often nested with wider interests in the river environment and local climate change impacts. Indeed some local action groups have formed with the purpose of gaining as full an understanding as possible of their local normally small watercourse. One example is the [Ruscombe Brook Action Group](#), whose members live by a stream just north of Stroud, Gloucestershire in a steep valley, which becomes both significant source of local flood risk and sewage contamination in times of high rainfall.

Various organisations are now starting to work with communities to use their local flood knowledge to inform

community lead adaptation planning for improved resilience. Local authorities are seeking to harness local knowledges of place in terms of immediate response to flood risk. They are trying to establish systems where local organisations or even individual citizens can feed information into the flood management systems, and take action where appropriate/possible. Interviewees highlighted the importance of lowest tiers of government (e.g. parish councils) as the 'eyes and ears' on the ground in accessing and sharing local knowledges. In particular, they emphasised the importance of communities in nominating one of their own (e.g. as flood warden). Here experts work with, and support, communities to establish systems that harness their local knowledges rather than taking a leading role.

'Don't forget we also have parish councils, we have five in the borough, I have had regular discussions with those parishes, because we see an opportunity, again falling out of the enquiry, falling out of Pitt, for parish councils to be our eyes and ears on the ground, and we are at this

moment bringing forward an arrangement where parishes will provide lead wardens, *they will nominate one of their own*, and we will support them in terms of equipment and so on, we don't want anybody to clamber into water courses or anything, but just to be the eyes and ears of a particular patch.... Because you know it is really useful having someone *local on the ground* that we can react to.' (Strategic Director of Environment, Borough Council)

Local knowledge needs a voice in environmental policy formation and enactment. Knowledge sharing between official organisations involved in flood risk management and community groups can be informed by models of good partnership beyond the catchment. Examples cited included community representation on Community Liaison Panels of water companies (e.g. as delivered by Wessex Water, south-west UK), and collaboration between different sectors in river management (e.g. Bourne Stream Partnership near Bournemouth, UK; [Bourne Stream Partnership 2010](#)). Evidence suggests significant opportunities occur to extend local knowledge sharing networks immediately after large floods.

Shared exploration of local physical flood knowledge can be undertaken both within communities and in collaboration with experts. This involves showcasing and evidencing what local knowledge has value both to experts and other community members so illuminating processes of use of local knowledge, and its value in expert science and community-level adaptation planning. This can be accomplished in various ways. Local knowledge can be shared in real time on site during floods as a means to confirming mitigation strategies.

'If communities are prepared to hold emergency meetings on site, with the water raging by a few feet from them, and they can see what has got to be done, and they take action immediately, more or less, and then worry about the costs afterwards in the knowledge that the district council did have money, they had to prove what they had done was right, but that is the way that local communities have been helping themselves [with council support].' (District Councillor)

Longer-term, community-led local conferences on local water management involving experts, e.g. as organised by

[Ruscombe Brook Action Group](#), can generate new shared understandings of the value of local knowledges.

### Using local flood knowledges

Once gathered and shared, how is local knowledge used? While local knowledges can be employed to develop local and expert understanding of the links between different parts of the hydrologic system – how 'the local' builds up into 'whole catchment' systems, further explorations are needed as to where and how this knowledge might be successfully used in practice. Local knowledges are already being used as an evidence base by communities to support their promotion of locally implemented, creative flood risk solutions.

'It is on a really steep slope, this SUDS system, it works effectively.... ironically they have got this huge attenuation pond to take the water, and it barely even started filling... All the other systems, even before it got to this overflow pond, were so effective that actually did not get to there... where previous companies had said you cannot put a SUDS system there, nonsense, yet it was put in, working and beautiful.' (Local Councillor; Founder of [Ruscombe Brook Action Group](#))

Local knowledges are also used as an evidence base to inform campaigning by communities for local maintenance of small water courses. Particular concerns were the impact of debris from rivers and local clearing of obstructions.

'Because the area I was particularly talking about, every year I have had to ask them to remove the leaves from there. Because residents who are now too elderly to remove those leaves themselves, always get on the phone to me and say, 'name: The leaves are accumulating again and we are concerned about the drains'. They are concerned about the drains because they get flooded.' (City Councillor, with particular interests in flooding)

Local knowledges are being marshaled to highlight gaps in expert knowledge – in the detailed mapping of surface water and fluvial flood risk mapping. Here local knowledges are augmenting, testing and ground-truthing expert flood modelling and mapping. Local data (e.g. photographic records of hydrological response through floods) collected

by citizens are being used by experts to calibrate and validate flood models. One Gloucester city councillor indicated that the regional flood model being developed by the Environment Agency cannot yet virtually create the actual flood events which took part in his local area. So he and his wife, who are heavily involved in local flood history and monitoring, have taken photos of flood events in situ and fed this information to the Environment Agency (EA) as they try to make their models replicate what happens on the ground.

‘We have a good relationship with the EA. We spent a morning over there two weeks ago. They have got all the data we collected – but how they can use it I don’t know. They are doing electronic models of the brook. They say it helps them. What surprised me – the EA only started doing this model test in 2004. And they started off with a blank sheet of paper – for the UK!! ... The chap who is in charge of that won’t accept [the model] at the moment, because they can’t reproduce the flood from last year ...’ (Local Councillor)

Local knowledges can challenge and contest expert knowledge. Expert knowledge of flood risk, particularly definition of floodplains on publicly available Environment Agency maps, is frequently contested by local communities and Flood Action Groups. For example, the [Severn and Avon Combined Flood Group \(2008\)](#) has vigorously challenged expert flood mapping on the Environment Agency’s website, and in doing so, has highlighted issues about mapping scale, probabilities and uncertainty. The group has also engendered debate around the effectiveness of SUDS in different local settings. From these examples, local knowledges are seen to have their own form of authority and expertise, and are recasting whose and what knowledge is perceived as ‘expert’. Local people can see themselves as experts on local flooding, and can be seen as such by other stakeholders, as evidenced in the power dynamics in public discussions around local flood risk management issues.

### Loss of local knowledges

Local knowledge can be lost in several ways. Epigraphic records or material flood marking can ‘disappear’ as

unprotected in planning and development processes. The nature of flood risk communities themselves is contested ([Coates 2009](#)); knowledge networks can break down in areas with intermittent and transient communities. Clashes can also occur between ‘expert knowledge’ and ‘local knowledges’ when attempts are made to ‘integrate’ them, e.g. local knowledge insists that leaves on street not swept up can cause blocked drains and increased flood risk, but local government does not acknowledge this.

The *Pitt Review* suggests that Local Authorities have lost much of their local knowledge.

‘Landform recently surveyed 107 members, 77 of whom were local authority officers and many of whom were engineers). The consensus was that: ‘most local authorities have lost their drainage expertise and with it their local knowledge. There was recognition of the importance of local expertise and many respondents were looking to the Environment Agency to help support this.’ ([Cabinet Office 2008](#), p. 92)

A Gloucester city councillor indicated that street cleaning, which is linked to flooding in terms of blocked drains, is now done by a contractor with headquarters in Slough. The contract was not drawn up to ensure that appropriate cleaning at street level is undertaken; teams doing the work often have not built up local knowledge of where problems might occur. Another perspective on this turn to local knowledges by governance agencies is that it represents an attempt to replace other forms of institutionalised local knowledge that have been lost through privatisation and fragmentation of public services that are cut, deregulated and privatised.

### Integrating local knowledges into planning and governance structures

So various government agencies, local authorities and other bodies are finally recognising the values of these local knowledges, and are seeking to connect them into governance systems in terms of monitoring, preparedness and response. This increased focus on the ‘local’ is step changing the roles of community groups in lead adaptation planning. For example, local community action groups formed to campaign around flood risk issues on specific stretches of water

courses in the River Severn catchment, before 2007 perceived themselves to be ‘crying in the wilderness’. The same groups are now being co-opted by expert agencies (e.g. Severn Trent Water and the Environment Agency) into planning and governance structures. As indicated earlier, parish councils, and even concerned/informed/active individual citizens, are being supported and encouraged to become part of the resilience and planning structures, by monitoring water courses and drainage systems at the most detailed, local, level, and having a means of linking their local information into wider knowledge systems.

The value of local knowledges can be reinforced by external agencies when local knowledge is linked to funding for action, directed through communities.

‘The other thing is we have set up an organisation with government money, that parish councils can seek grants, up to £10,000 each, for flood resilience work, or general resilience work. And so, simple things like, parish councils have set up their own flood teams, but they wanted money for fluorescent jackets, high-powered torches, chainsaws to clear debris from rivers, one even asked for a dinghy. So we have been able to supply them.’ (District Councillor)

Key practical and strategic questions are: how these local knowledges can best be enrolled and connected into governance systems in terms of monitoring, preparedness and response; and are current institutional processes and structures adequate to enable effective exchange and co-generation of expert and local knowledge? The Environment Agency, for example, does not have a pronounced local focus in terms of either its structure or management culture. Key posts like community engagement officers tend to be short-term initiatives, when evidence suggests the importance of long-term community engagement and the building of trust. This poses questions about how local and expert knowledge can be integrated to develop and formalise shared ‘corporate’ memory to develop community flood resilience. This involves validation of the ‘expert’ by the ‘local’ and vice versa.

Post 2007, some structured opportunities do now exist to incorporate local flood knowledge of place and history, and make it overt to all stakeholders and integrated into formal flood risk assessment and planning. One route is for the

adoption of more participatory approaches to river basin planning that integrate expert and local knowledges. Current UK Planning Guidance for *Development and Flood Risk* (PPS25, *Communities and Local Government 2006*) makes no reference to the garnering of local knowledge and community engagement in Strategic Flood Risk Assessments (SFRAs). However, the UK Environment Agency’s Local Planning Guidance indicates that developers, prior to carrying out a Flood Risk Assessment on a new proposed site, should take account ‘of local knowledge of flooding held in the community’ (*Flood Risk Assessment Guidance Note, 2*), as well as contacting official organisations in flood risk management (e.g. local government). The means of stakeholders systematically accessing local flood knowledge in the development process is less clear. This also applies to expert engineering solutions to flood risk that also need to access local flood knowledge.

In emergency planning, local knowledge can now be accessed through Community Risk Registers and Community Flood Plans set up by Local Resilience Forums.

‘In 2009, the Environment Agency will help Local Resilience Forums LRFs (comprise category 1 responders in emergencies) develop quality assured Community Flood Plans. The Community Risk Registers (Community Risk Register is an assessment of the risks within an area agreed by the Local Resilience Forum as a basis for preparing emergency plans, e.g. for Gloucestershire) prepared by LRFs will be used to target planning work on the areas at most risk. Indicative mapping of areas at risk from surface water flooding was provided by the Environment Agency to all local authorities in August 2008 to help this work cover all flood risk.’ Government’s Response to Pitt Review; Recommendations 60 and 61, *DEFRA 2008*, pp. 318–319)

Local flood knowledges then have the potential to be better applied by communities and experts in different stages of the Disaster Response Spiral – in preparation, anticipation in warning stages, but also in coping during an emergency, when official responses are challenged.

‘So it is interesting that you have the strategic stuff but resilience comes down to the local micro-detail.’ (District Councillor)

## Local knowledge, flood memory and community flood resilience

Broader interdisciplinary discussions can be had about the relationships between flood science, flood risk perception, and how floods are memorialised and flood knowledge materialised, generated and protected within communities. This connects to wider deeper ideas of place and sustainable flood memory. How can local flood knowledge capacity be developed and cascaded in communities in ways that are generative, link generations and are community focused? To what extent should flood education (to build sustainable empowered and resilient floodplain communities) involve social learning that integrates these local flood knowledges? Community flood education (Dufty 2008; Webber & Dufty 2008) is a critical part of this process, in realising the value of building local knowledge in the development of social capital. Tobin (1999) highlights the characteristics of sustainable and resilient communities in hazards settings, including: incorporation of partnerships and co-operation at different governmental levels, and strengthened networks for independent and interdependent segments of society and planning at the appropriate scale – all critical in knowledge sharing.

These processes of incorporating community representatives and local groups with their knowledge bases into governance systems have wider implications for local democracy and active effective citizenship. People are brought into the public sphere not just through voting or general abstract appeals to active citizenship; they are instead through a specific, practical single issue that is very important to them. Knowledge of flood risk is, however, linked to a whole range of issues such as planning, transport and emergency services.

## CONCLUSIONS

At the physical level of flood events, the detail of how water and watercourses behave ‘on ground’ and ‘in the moment’, their causes, intensifying factors, their unfolding processes and impacts – require intimate, often real-time knowing of local knowledge. In considering issues of scale in relation to types of knowledge, this paper suggests that local

knowledge can in fact be ‘expert’ in large scale mapping of flood processes. This detailed empirical local knowledge of very local water geographies, in effect, becomes a critical form of knowledge which makes expert knowledge workable. The scale of local flood knowledge is important in augmenting, validating and challenging expert knowledge.

These local knowledges are backed up by local values of place and local heritage. The capture and sharing of local knowledge is reinforced by the desire to act and to prevent flooding of home and local area, and to build resilience both by community action and also by campaigning. Flood knowledge therefore needs to be set in the wider context of the hydrosocial cycle (Swyngedouw 2009), combining physical, technical, political and social processes, and how communities live with water in all dimensions.

The *Pitt Review* (Cabinet Office 2008) of the 2007 flood experience places increasing focus on community level emergency planning, with emphasis on building community knowledge for flood awareness/preparedness. The value of local knowledge is now being recognised and rediscovered, and efforts are being made to enrol it, alongside consideration of how different types of flood knowledge and redistribution of expertise might be successfully used in the science, policy and practice of flood risk management. Local knowledges are beginning to be incorporated into governance processes, and into specific systems aimed at managing flood risk and engendering flood resilience. Local knowledge generation processes are increasingly recognised as important as well as the knowledge itself.

In all these processes, there is evidence that there are concerted attempts being made to take local knowledges seriously as ‘authoritative knowledge’ vital to successful resilience planning/management alongside more traditionally recognised expert flood science knowledge. Although progress has occurred in integrating local flood knowledges in governance, there are also challenges. Meeting these, requires a rethinking of traditional flood risk management systems that are centrally designed and administered by experts, and lack natural connections to the ‘local’. In principle, this integration and local voice in environmental policy formation and enactment is a positive step. It democratises knowledge, empowers local communities and is likely to give governance systems the chance to monitor and manage risk more effectively.

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