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Recommendations for flood mapping in  
England and Wales:

Findings from the RISK MAP ERA-NET CRUE project

Project: SC090015

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Miranda Kavanagh

**Director of Evidence**

# Executive summary

The aim of this project was to enhance communities' resilience to flooding by improving flood mapping. Risk maps not only inform people about the risk of flooding, but can also stimulate public participation in flood risk decision-making. This project had four central objectives:

- Develop participatory processes to incorporate local knowledge and preferences into flood risk maps.
- Improve flood maps with a multi-criteria risk tool to generate a more complete view of risk, simultaneously considering economic, social and environmental risks.
- Produce user-friendly and understandable risk maps, employing user-friendly terms and symbols and contrasting colours.
- Understand better how people read maps using an eye-tracking method and experimental graphic semiology.

To address these objectives, work was carried out in three steps and applied in four case studies across Europe. The first step looked at the status quo in different case studies, the second focused on improving flood risk maps and the third set out recommendations to improve flood maps and public involvement in the mapping process.

Given that flooding affects many parts of Europe, the project chose case studies in Austria, England, Saxony and Bavaria. The case study sites were selected to be representative of different geographical and geomorphologic conditions (lowland rivers, alpine foreland, alpine torrents) as well as different catchment sizes (rivulets, torrents, rivers and streams). The project adopted a workshop-based approach to participation, where at least two workshops were held for each of the case studies. The characteristics of participants differed to ensure a range of professional and public opinions were represented. Limitations and preferences for map content and visualisation were discussed. Based on these initial workshops and other findings, maps were revised before further discussion of the revised maps at a second workshop.

In terms of map content, the following were considered important to strategic planners:

- Detailed information on flood extent and depth for events with different probabilities. If also available, information on flow velocities.
- Information on the consequences of events, along with annual average damage.
- Information on social, cultural and environmental risks, to generate a more complete picture, including critical infrastructure such as bridges, power plants and hospitals.
- Aggregation of these risks on a single map to show risk hot spots.
- Information on existing defences, protected areas and residual risk in these areas.

Those involved in emergency management requested the following to be included on maps:

- Information on the extent of flood events with different probabilities, along with critical depth and velocities (when it is no longer safe to access certain areas).
- Information on existing flood defences and areas protected by these defences, to identify weak points in the defence line, and areas affected if defences fail.
- The number of people at risk, to be evacuated in an emergency.

- Critical infrastructure such as energy or water supplies, roads and bridges, along with the flood level at which, for example, roads can still be used or should be closed.
- Information on assembly points, evacuation routes, coordination centres and so on, along with the flood level at which these emergency facilities would be at risk.

Flood maps for the public should not be overly complex and should contain the following information:

- Inundation depth for different types of flooding. As people are not necessarily familiar with the concept of return periods or exceedance probabilities, such terms should be avoided. The extent and depth of historical floods could also be shown, as people can relate this information to their personal experience.
- The consequences of flooding in terms of damage do not need to be shown. However, buildings and roads should be shown so that people can easily orientate themselves and identify their own property. Affected buildings should be highlighted.
- Evacuation routes and assembly points, to guide people in an emergency.
- Self-explanatory symbols and text within the map to quickly gather the most important information.

The report makes the following recommendations:

- Different users have different requirements and therefore the potential for providing a layered map should be investigated, with the ability to turn the layers on and off.
- Members of the public prefer flood maps with hazard rather than risk information. Hazard maps for the public should be considered.
- Ways to help people understand flood risk in relation to their own property should be explored, and maps could potentially be revised to show a greater delineation of flood risk.
- Local knowledge and expertise should be valued. Public and professional participation should be a routine feature of flood mapping. However, mixed participation is best with a neutral facilitator to ensure balanced discussion.
- A standard process of local engagement and/or publicity when major changes are made to flood maps should be considered.
- Workshops are particularly valuable in communities where flood risk is complex, there are known controversies or where trust in authorities and/or maps is low.

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# 1 Introduction and aims of the project

The RISK MAP project was one of seven projects funded under the second call of the CRUE ERA-NET programme to develop resilience in communities at risk of flooding. The aim of this project was to enhance communities' resilience by improving flood mapping. RISK MAP assumed that risk maps not only inform citizens about the risk of flooding, but can also stimulate public participation in flood risk management and decision-making, by involving institutions, private companies and associations, alliances, interests groups, and citizens. RISK MAP had four central objectives:

1. Develop participatory processes to incorporate local knowledge and preferences into flood risk maps, as well as specifying the limits of flood maps, to foster communication and raise awareness of flood risks. In this process, specific needs related to risk management plans were addressed.
2. Improve the content of flood maps with a multi-criteria risk tool to generate a more complete view of risk, simultaneously considering economic, social and environmental risks, and capturing the preferences of those involved/affected during the mapping process.
3. Improve the visualisation of risk maps to produce user-friendly and understandable risk maps. In particular, employ user-friendly terms and symbols.
4. Gain in-depth knowledge and information using an eye-tracking method and experimental graphic semiology. This involved adopting a cyclical approach to mapping and map refinement (user-designer-user) which integrated feedback from the user and their visual and cognitive perceptions.

To address the objectives outlined above, work in RISK MAP was carried out in three steps and applied in four case studies across Europe. The first step looked at the status quo in different case studies (Work Package 1 (WP1)). The second step focused on improving flood risk maps (WP 2) and the third step set out overall recommendations (WP3). Each work package was applied in four regional case studies which were summarised in WP4. The work packages and respective tasks were organised as shown in Figure 1.1.

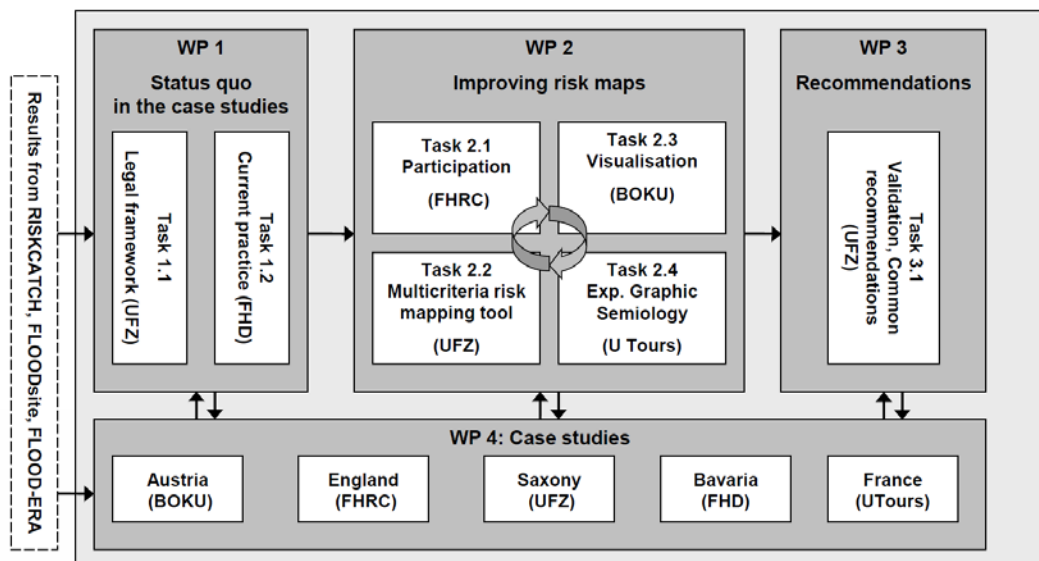


Figure 1.1: Structure of the project based on four work packages

The **major outputs** of RISK MAP are a better method to produce flood maps and recommendations on how to compile risk maps. This includes map content that more closely meets the requirements of the Flood Directive, and a target-oriented design that is adjusted to individual needs (such as affected citizens and/or professional users).

## 2 Approach

Given that flooding affects many parts of Europe, the project adopted regional case studies in Austria, England, Saxony and Bavaria. More detailed information about each of these case studies can be found in Sections 4 to 8 of the final project report (Meyer et al., 2011). The case study sites were selected to be representative of different geographical and geomorphologic conditions (lowland rivers, alpine foreland, alpine torrents) as well as different catchment sizes (rivulets, torrents, rivers and streams), thereby covering a wide range of conditions encompassed by the Flood Directive (FD) 2007. The main characteristics of each case study are presented in Table 2.1.

### 2.1 Workshop approach

Each case study followed the main thematic strands of RISK MAP. Accordingly, in the first phase (WP1) the status quo in risk mapping at each test site was investigated. Following this, the project adopted a workshop-based approach to participation, where at least two workshops were held for each of the case studies. The characteristics of participants differed to account for differences in organisations responsible for flood mapping and management, and to ensure both professional and public opinions were represented. Although the workshops differed in their exact approach and sequences of discussion, each took existing hazard and risk maps as a starting point. Limitations and preferences for map content and visualisation were then discussed, with additional risk criteria and specific needs defined. Based on these initial workshop findings, maps were revised (and certain elements tested via experimental graphic semiology) before further map refinement and discussion of the improved maps at a second workshop. While the single case study reports follow a similar rationale, they also differ to a certain extent to reflect the professional background of the researchers involved. The Bavarian and Austrian case studies focus on visualisation and content, while the English case study focuses on participation. The English case study held an additional workshop to trial a proposed participation approach. The Saxon case study investigated the creation of risk maps (as opposed to hazard maps) and the combination of flood risk variables using a multi-criteria approach employing the FloodCalc tool.

### 2.2 Experimental graphic semiology

Experimental graphic semiology was used to analyse map reading behaviour (Serrhini and Palka, 2011). The procedure was designed to complement social science methods (direct observation, group discussion, interviews, cognitive mapping) used in the workshops. Maps were improved following the initial workshops and a number were presented to a sample of participants (including staff from public authorities, experts in cartography and affected citizens) using an eye-tracking technique. By recording users' visual strategies when looking at onscreen maps, conclusions about how they view and understand mapped information could be drawn. In the eye-tracking, visual strategies were distinguished by three categories of eye movement: (1) continuous motion, (2) jerks, and (3) saccades, pursuits and fixations, with each of these elements being examined statistically to provide evidence of map preferences and understanding. This information was accompanied by a questionnaire survey and further workshop discussion about the results. Through analysis of the results, recommendations for the design and compilation of risk maps were developed.

### 2.3 Multi-criteria approach for creating risk maps (FloodCalc tool)

A further aim of this project was to extend the existing raster-based, participative, multi-criteria risk mapping tool known as FloodCalc (Scheuer, 2011). With this software tool, flood risk can be computed and mapped based on evaluation criteria and their respective criteria maps. Furthermore, the tool allows the integration of flood risks using multi-criteria analysis (MCA). The risk assessment in FloodCalc involves: 1) identification of evaluation criteria; 2) preparation of criteria maps; 3)

assessment of flood consequences; and 4) MCA flood risk evaluation and mapping (following the schema from Chen *et al.*, 2001; Malczewski, 1999; Smith and Petley, 2009). The project also aimed to extend FloodCalc to allow the use of different kinds of knowledge in the assessment process. Such integration aims to draw on all available knowledge.

**Table 2.1: Characteristics of case studies**

	Saxony, Germany	Bavaria, Germany	Austria	England	
<i>Case study</i>	<b>River Mulde, Saxony</b>	<b>Rivers Vils and Rott, Bavaria</b>	<b>River Wartschenbach and River Vorderbergerbach</b>	<b>River Thames and tributaries</b> flowing through <b>Chertsey</b> just south-west of London	<b>Croston, Lancashire</b>
<i>Flood characteristics</i>	Fluvial flooding, system represents both flood sources in the uplands with high discharge dynamics, including flash floods, and receptor areas in the lowlands.	Fluvial flooding with traditional floodplain areas which are used for agriculture, settlement and industry.	Alpine flooding (high velocity, fast onset, high debris).	Within the case study area there are areas at risk from fluvial, surface water and groundwater flooding.	The village is affected by flooding from the River Yarrow which runs through the village and also from brooks and other drainage channels. Impacted by defences protecting adjacent agricultural land.
<i>Case study area characteristics</i>	Non-navigable tributary to the Elbe River. Densely populated valleys, study site area has population of approx. 22,000 inhabitants.	Tertiary hill landscape, densely populated, agriculture as dominating factor.	Very localised flood risk.	Urban area of around 12 km <sup>2</sup> and population of around 16,000 (2001 census).	A Lancashire village of 2,679 residents (UK Census 2001) and civil parish in Lancashire, NW England located between the towns of Chorley and Southport
<i>Flood experience</i>	Extreme flood occurred in 2002.	2006, 2009, 2011 flood damage to agricultural areas, roads and forest areas, local flooding of buildings.	Wartschenbach previously flooded in 1999/2000. Vorderbergerbach previously flooded in 2003.	Chertsey last suffered from a major fluvial flood in 2003 with other notable events in 1947, 1978 and 2000.	Croston was last flooded by fluvial flooding in 1987 and 2000. Some surface water flooding occurred in 2011.
<i>Participants</i>	<b>Professionals</b> from a range of capacities from the state level, regional and district levels down to the local level.	<b>Professionals</b> from disaster control and emergency services (fire brigade, military, regional and district offices and Order of Maltese).	<b>Professionals</b> from the Austrian Torrent and Avalanche Control Service.	<b>Public:</b> Local residents from Chertsey including some members of local community groups such as the Chertsey society.	<b>Public:</b> Local residents including some members of local flood community groups.
<i>Participation experience/culture</i>	Much experience with intersectoral cooperation (but only a few examples of public participation).	Participants had no previous experience with participation or participatory workshop.	A lot of experience during the last decade due to national (and international research projects).	Participants had little/no previous experience of participation through workshops.	Some participants had some experience with public meetings about flooding, but little in workshops.
<i>Status of flood mapping</i>	Flood mapping was completed prior to the timetable of the EU Floods Directive.	Maps not currently publicly available in print format, only online. The interactive web map service is available to all.	Hazard maps available, highlighting flooding in addition to other natural hazards.	Flood maps available through Environment Agency website. Maps show flood extents for floods with a one in 100 or one in 1,000 chance of occurring in any given year, including defences and areas benefitting from defences.	

# 3 Project findings on flood mapping

This section reports the findings and recommendations for flood mapping from the workshops and graphic semiology exercise. As the project examined a wide range of issues with different users of maps, these findings are divided into general findings for flood maps (including professional as well as public recommendations) and the results of the workshops held with the public in the Chertsey and Croston case studies. The latter is further divided into findings related to mapped content and visualisation.

## 3.1 General findings

### 3.1.1 User-specific flood maps

The findings of this project confirmed the need to vary the content of flood maps depending on the end-user. Evidence for this was derived from most aspects of the research, including interviews and workshops with different participants articulating their needs based on their use of the maps. For target-oriented risk communication, therefore, flood maps should be adjusted to end-user needs as different users have different requirements for content and presentation. Recommendations are made for the following groups:

- flood risk strategic planners;
- the 'at risk' public (including engaged as well as unengaged and unaware residents);
- emergency planners and organisations involved in the emergency flood response.

However in the case of the public, mapping preferences and uses might be quite varied. For instance, in the public workshops some residents wanted to have access to much more information on flood risk (e.g. more than just extent and depth) than others. Given the range of information that could be presented, residents said that a layered approach would be preferable. Most participants would prefer to be presented with a basic map on which additional layers of information could be selected. They felt that such an approach would work well online, in a similar manner to the current Environment Agency maps available online. Further details regarding map calibration and modelling techniques could also be made available without cluttering the map. A handful of more engaged residents were keen to understand how the map and flood risk information had been developed, giving the impression that without this information they would be more likely to dismiss the map and ignore its message.

### 3.1.2 Idealised maps

In the questionnaires, users were asked about their preferences on the complexity of legend information, scale of the map, number of themes (such as environmental, social, economic) and type of hazard or risk information. Using the information from these surveys, the eye-tracking results and the workshop discussions, along with the findings from the RISKCATCH project (Fuchs et al., 2008), we developed 'idealised' maps for different users of and uses for a flood map.

#### *Flood maps for strategic planning*

Map users in this group are usually experienced with flood hazard and risk maps. In their work environment, strategic planners will normally have sufficient time to study maps in detail. Hence, they are able to deal with a high density of displayed information and complex contents. The main purpose of flood maps for this group is to show areas of high risk, where there is a need for risk mitigation. Maps serve also in economic appraisals of flood risk mitigation measures. For this, flood risk has to

be calculated with, and without, the planned measure(s) to estimate their risk-reducing effect. In terms of content, the following were considered important to this group of users:

- Detailed information on flood extent and depth for events with different probabilities. If also available, information on flow velocities.
- Information on the consequences of specific events, along with annual average damage in particular for economic appraisals.
- Information on social, cultural and environmental risks, to generate a complete picture of possible consequences. This should include critical infrastructure such as bridges, power plants, hospitals and so on.
- For strategic planning, an aggregation of the social, economic and environmental risks on a multi-criteria risk map to show overall risk hot spots.
- Information on existing flood protection, protected areas and residual risk in these areas.

The following were key visual components for strategic planners:

- Legends with a relatively high number of classes (4-5).
- Information on flood hazard and consequences on the same map.

From this information, a typical map for strategic planning was generated and is provided below (Figure 3.1). However, due the large amount of information requested by this user group, a layered GIS approach would be more useful. A comparison of these expressed preferences with existing Environment Agency products used for strategic flood risk planning (such as MDSF2) could be used to improve the presentation of flood risk.

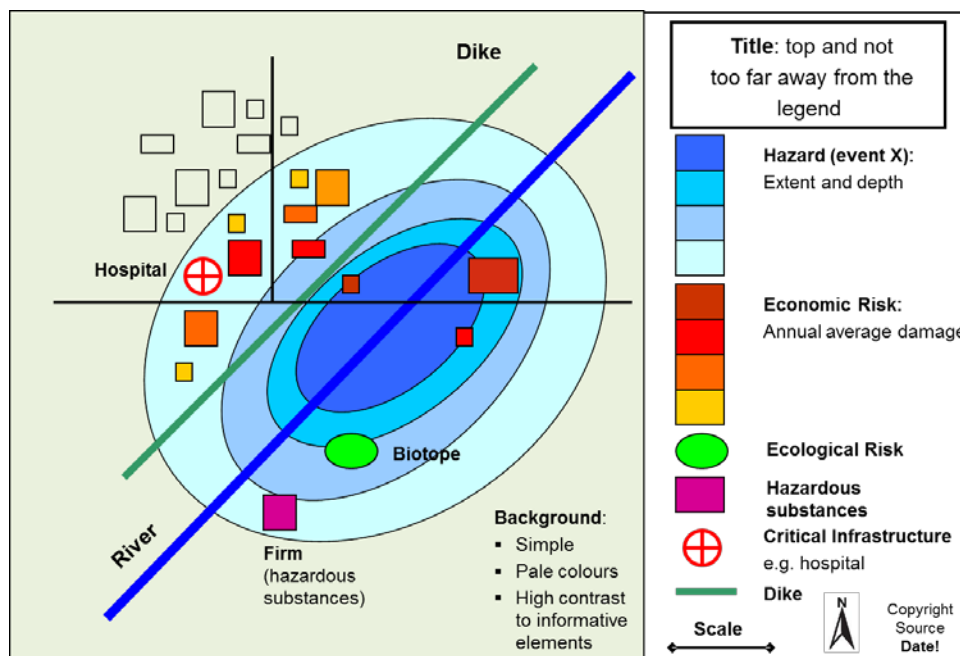


Figure 3.1: Idealised map for flood risk management strategic planners (Meyer et al., 2011; p294.)

### *Flood maps for emergency flood management*

The main purpose of flood maps for emergency flood management is to enable quick access to information on affected areas, people to be evacuated, critical infrastructure to be protected, evacuation routes and so on in the event of a flood. Maps are also used in the planning and preparation for emergency activities. The following points on the contents of such flood maps were made:

- Maps should include hazard information on the extent of events with different probabilities, as well as information on critical depth and velocities (when it is no longer possible or safe to access certain areas). These need to be linked to warning alert stages and critical water levels at gauges upstream.
- Information on existing flood defences and areas protected by these defences is important, to help identify weak points in the defence line at which a failure of defences is possible, and the areas affected as a result.
- The number of people at risk from a certain event should be shown, to establish the number of people to be evacuated in the case of an emergency.
- Critical infrastructure which needs to be protected, secured or evacuated, such as hospitals, energy or water supply facilities, roads and bridges should be shown. The map should also indicate the level of flooding at which, for example, roads can still be used or should be closed.
- Information on emergency management itself should be included, such as assembly points, evacuation routes, hospitals, coordination centres, gauging stations and so on. The level of flooding at which these emergency facilities would themselves be at risk, when certain evacuation routes would no longer be usable, should be included.

Although emergency managers will have time to review flood maps, during flood events, users of these maps may have little time to study the maps and make decisions. Therefore, visualisation of these maps needs to be simple. The following aspects should be adopted and are also presented in the idealised map (Figure 3.2) below:

- Classifications in the legends should have a maximum of three classes .
- Self-explanatory symbols and text within the map are good ways to quickly gather the most important information.
- Text can be used to quickly transmit information on, for example, the number of people to be evacuated, names of important locations and so on.
- Information on flood hazard and consequences should be shown on the same map.

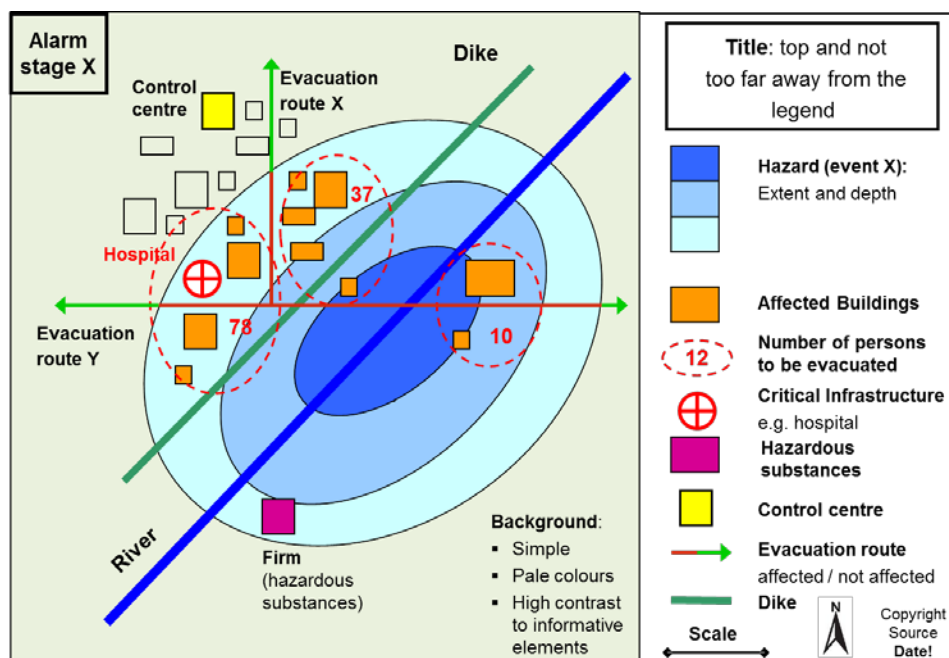


Figure 3.2: Idealised map for emergency flood management (Meyer et al., 2011; p295)

### General recommendations for flood maps for the public

This section covers general findings on user needs and preferences for public flood maps.

The third group to participate in the experimental graphic semiology was the public. This is a heterogeneous group of users with different experiences and competencies with maps and different needs in terms of flood risk information.

Many maps are aimed at the public (for example, to motivate them to prepare for flooding). Members of the public, in most cases, do not use maps on a daily basis and hence have different needs and requirements. Generally, we recommend that flood maps for the public should not be overly complex and should contain the following basic information:

- Inundation depth for different flood exceedance probabilities should be shown. As citizens are not necessarily familiar with the concept of return periods or exceedance probabilities, such terms should be avoided and replaced with “small, medium or extreme event”, for example. The extent and depth of historical floods could also be shown, as people can relate such information to their personal experience.
- The consequences of flooding in terms of damage do not need to be shown. However, buildings and roads in the area should be shown so that people can easily orientate themselves and identify their own property. Affected buildings should be highlighted.
- Some information on emergency management would be useful. In particular, information on evacuation routes and assembly points would guide people on what to do in an emergency.

Visualisation should also be kept as simple as possible:

- Classifications in the legends should have a maximum of three classes.
- Self-explanatory symbols and text within the map are good ways to quickly gather the most important information. The complexity and density of information should be minimised and only the most important aspects shown.

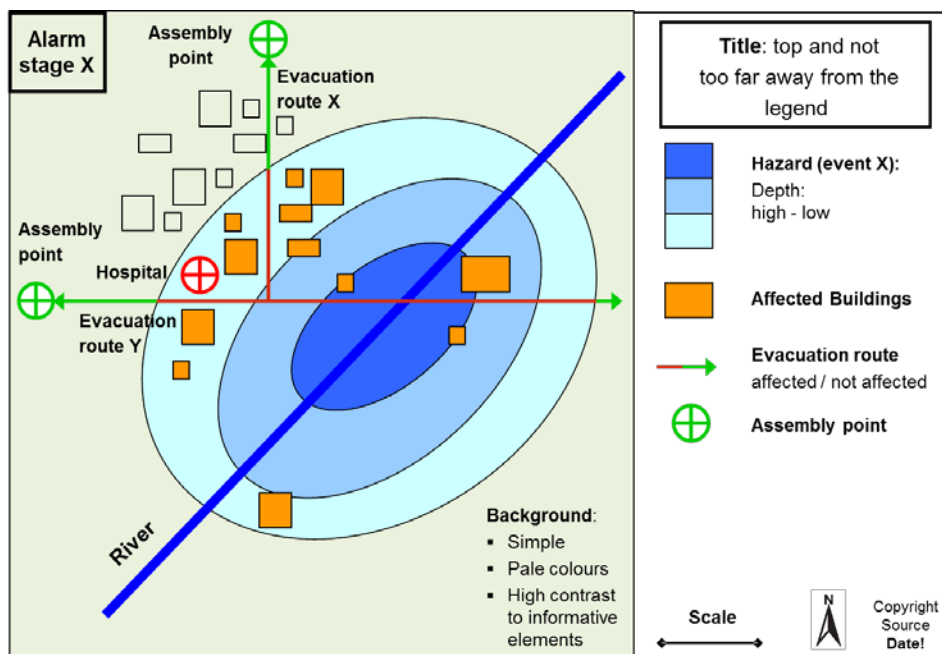


Figure 3.3: Idealised map for the general public (Meyer et al., 2011; p296)

A summary of the needs of different user groups for mapped content is presented in Table 3.1 below.

Table 3.1: Map contents required by different user groups

	Information density/ complexity	Hazard	Consequences/Risk	Additional information
<b>Strategic planners</b>	High	<ul style="list-style-type: none"> <li>▪ Flood extent and depth (for events with different probabilities)</li> <li>▪ Flow velocities where available.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Event-specific damage, but also annual average damages (for economic appraisals)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Existing flood defence, protected areas, residual risk.</li> </ul>



			<ul style="list-style-type: none"> <li>▪ Economic, social, cultural and environmental risks and critical infrastructure.</li> </ul>	
<b>Emergency planners</b>	High	<ul style="list-style-type: none"> <li>▪ Flood extent and depth (for events with different probabilities)</li> <li>▪ Critical depth and velocities</li> <li>▪ Link to alarm stages.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Number of people at risk (to be evacuated)</li> <li>▪ Critical infrastructure (to be protected or evacuated): hospitals, energy &amp; water supply, traffic infrastructure.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Specific emergency management information: assembly points, evacuation routes, hospitals, coordination centre, and so on.</li> <li>▪ Existing flood defence, weak points, protected areas, residual risk</li> <li>▪ Event-specific usability of e.g. evacuation routes, hospitals: Can they still be used or do they have to be closed/evacuated?</li> </ul>
<b>General public</b>	ILw	<ul style="list-style-type: none"> <li>▪ Flood extent and depth (for events with high, medium, low probability, if available also for recent or historical events).</li> </ul>	<ul style="list-style-type: none"> <li>▪ Buildings (affected)</li> <li>▪ Roads (affected)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Most important emergency management information: shelter, assembly points, evacuation routes, hospitals.</li> </ul>

### 3.1.3 Other findings from experimental graphical semiology on presentation of flood maps

The graphic semiology exercise (Serrhini and Palka, 2011) revealed that participants adopted two main visual strategies to view hazard maps: a linear model and a more dispersive model. Despite these different approaches, some characteristics were common to both strategies:

- The gaze is attracted by elements that are strongly contrasted or which have a colour with strong symbolic overtones (red or blue).
- The easily recognised elements are looked at early in the reading process (toponymic elements such as place names and other written information, pictograms and block-coloured elements).
- The more easily identifiable and comprehensible the information is, the simpler the path followed by the fixations.

The following four maps were those which scored most highly with participants in terms of attractiveness, innovativeness and usefulness. Certain elements are common to the four maps and should be considered when designing a flood map. All four maps represent flooding in blue and the impact of flooding in a high contrast colour (such as in red or easily seen pictograms). The area of interest is in the centre of the map and the background information is strongly contrasting. Therefore, any revisions to current Environment Agency flood maps should consider the use and strength of colour in the background graphics to improve the overall contrast. Additionally, the Environment Agency should consider combining blue hues representing flood extent with strongly contrasting colours (reds and yellows) to highlight affected properties (see Figures 3.4 and 3.5 as examples). The same principles should be adopted by risk maps produced by other authorities.

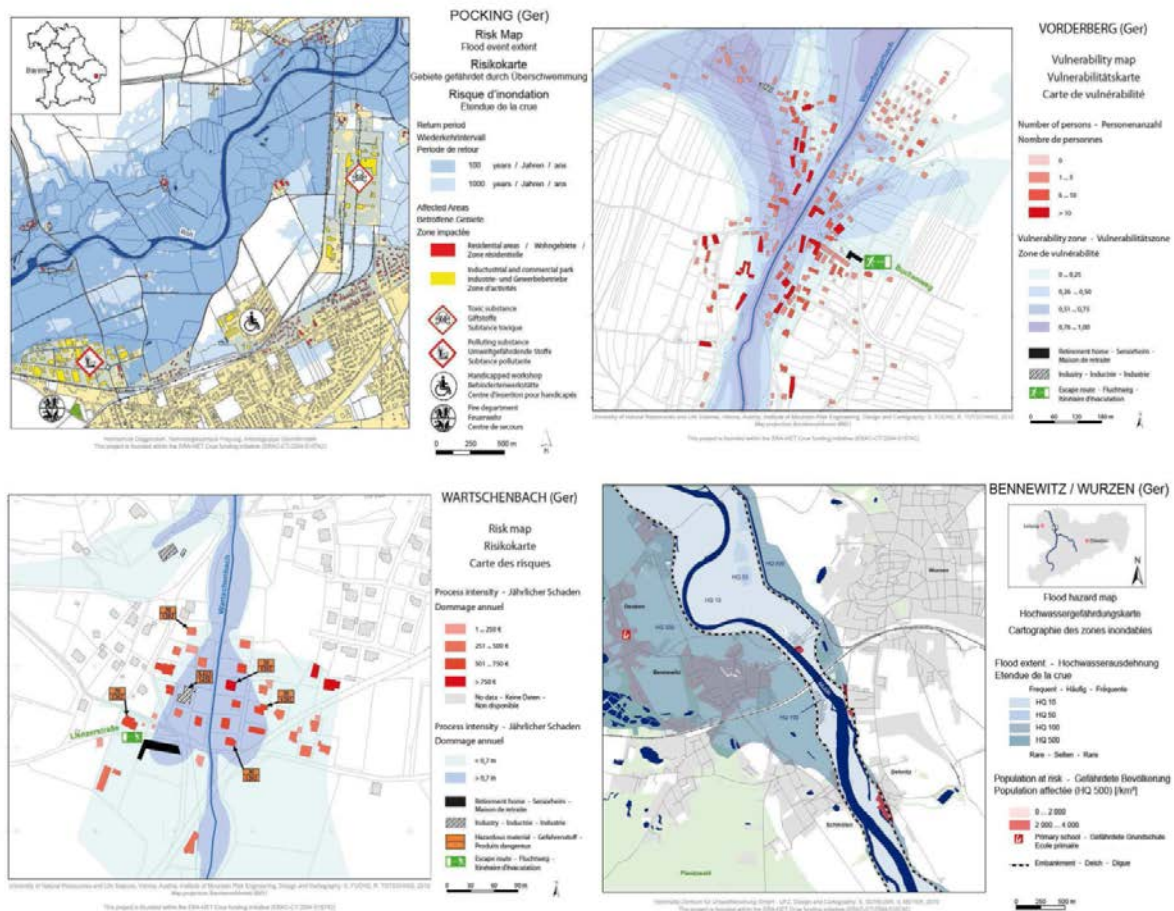


Figure 3.4: Those maps which scored highest for presentation, innovation and usefulness amongst graphic semiology participants (Serrhini and Palka, 2011; p52)

## 3.2 Findings for flood risk maps for the public

This section draws primarily on the workshops in Chertsey and Croston with ‘at-risk’ residents. Evidence presented here, where appropriate, has been supplemented with the results of the graphic semiology relevant to the visual strategies of the public and public understanding of flood risk maps.

### 3.2.1 Content of flood maps

#### *Level of mapped detail*

Residents require flood risk maps that are as personal and specific to them as possible. All small discussion groups in the Chertsey and Croston workshops mentioned the need to better understand their specific property-level flood risk. Their ideal flood maps would depict property-specific projections of flood risk; however, residents understood the challenges involved in producing such maps and would accept compromises. If maps showed the current flood extents or historical flood events but presented them by highlighting houses or streets instead of large areas, this might create a false impression of the accuracy and precision of the modelling outputs. However, property-level detail was considered to be the minimum, where anything vaguer would be deemed too inaccurate and result in residents denying or ignoring the maps based on an impression of inaccurate representation. Residents appreciated the efforts of flood mappers to provide additional scales of

view for the flood map, the provision of the flood map at the larger scale of 1:10,000 and the increased level of detail in the background map. Whilst they appreciated the difficulty in representing property-specific information, residents felt that efforts should be directed towards this and would be critical to residents taking action once they were aware of the risk to their property.

### *Information presented on the map*

The incorporation of information on flood depth was overwhelmingly popular. Residents highlighted the value of having flood extents that correspond to depths, as this increased detail helps reduce dismissal of risk. Information on flood depth allows for a better assessment of flood risk to individual properties. For instance, many properties are likely to be depicted as being within a flood risk area, but due to their raised position or higher threshold level are unlikely to experience flooding. As one Chertsey participant pointed out, the large mapped extents (in particular Environment Agency maps) do not depict subtle variations in topography. Whilst small changes may seem pedantic to pursue, residents said they can make a crucial difference to whether a property is flooded. As one participant commented, it's "*hard to get a map to discriminate between half a metre over Chertsey - it's going to be meaningless, but half a metre in this instance can make a hell of a difference*" and "*it's really important... if my garden gets flooded every day I don't care but if it comes into my house [I do]*." Depth was considered to be the most important additional factor to improve current Environment Agency flood maps.

Public users appear to be primarily interested in information on hazard (including flood extent in terms of likelihood and depths); few participants were interested in damages and many commented that economic information on flood maps was potentially detrimental. Participants presented with sample maps which showed alternative information (such as damages and vulnerable hotspots) said these were not of interest to them, but recognised their value for other groups (such as emergency responders, local authorities). In short, there was no real desire for flood *risk* information; residents were most interested in flood *hazard* information.

In the second round of workshops, a handful of residents said they found additional locations on maps (such as where to go in case of a flood) useful or comforting, but there was no real consensus on this issue. The presentation of features such as emergency shelters or evacuation routes are likely to depend on the types of flooding identified as being significant within an area. In situations, such as on the East Coast of England, with a long lead-time and where coastal flooding might prompt evacuation, depicting this type of information may be beneficial.

### *Improved use of historical information*

Many residents reported assessing the reliability of flood maps against their personal experience and observations of flooding. Where the maps did not match previous experiences, participants rejected the validity of the entire map even though the map may be presenting information outside of the experience of residents. As such, residents responded more favourably to the presentation of historical floods on the maps rather than hypothetical floods. In all workshops, flood experience provided valuable grounding and context to discussions of flood risk and therefore a greater use of historical information and local experiences would assist in raising awareness. Presentation of this information could improve trust in the mapped information as it would illustrate the difference between the historical flood event (with a designated flood depth and extent) and modelled return periods, thereby reducing confusion about what is being mapped. Maps showing historical outlines may also be a compromise between the desire to see frequency of flooding and extent. Historical outlines emphasise flood events that occurred within living memory. Where multiple historical outlines are available, this may help residents better understand how flood extents vary depending on the severity of the event, and reduce the confusion about the modelled return periods. Providing map users with the ability to view historical flood events alongside standard reference events (perhaps via the use of layered information) would likely help them contextualise flood risk information.

## 3.2.2 Visualisation and presentational preferences

### *Colour presentation*

Preferences for colours varied, with some favouring blue for its connotations of water but others preferring traffic light colours, deeming these more appropriate to represent danger or intensity of risk. Both options were deemed easy to interpret but would have a different impact on users; blue would demonstrate water but would not necessarily promote action as some considered it to be a relatively 'calm' colour. In contrast, traffic light colours would be interpreted as representing danger which might be more likely to attract attention and prompt action. The drawback of this colour scheme is that it might require more time to understand its link to water/flooding. In the second round of workshops, the use of blue hues for flood extent and red and amber to highlight properties was a popular solution to incorporate both preferences. The graphic semiology work also indicated that for all user groups, the maps which scored highest used a visualisation approach where the hazard was presented in shades of blue. These findings reinforce the use of blues for extent with current Environment Agency flood maps, but suggest adding other colours (perhaps as a traffic light scheme) to capture attention and promote action. Ultimately, the colour choice should match the objectives of the maps and the needs of users.

The flood hazard also needs to be presented in a manner that those at risk can engage with. The use of one in 100 and one in 1,000 chances of flooding occurring in any given year as reference events do not help users assess the severity of risk in terms that encourage a mitigation response. However, Chertsey and Croston workshop participants appreciated the usefulness of different return periods in distinguishing areas of higher and lower risk and expressed a preference for a greater delineation of flood risk, if only to demonstrate that other properties were at greater risk than their own. The knowledge that their property was located in a higher risk area (greater than one in 30 or one in 50 chance of flooding occurring in any given year) might be more likely to lead a resident to take action, whereas the current depiction of flood risk was not sufficiently refined to prompt such a decision. This would be particularly important in areas such as Chertsey where much of the area appears to be at the same risk and therefore 'blanket' coverage is depicted. Portraying those areas at greatest risk would encourage action. The importance of presenting a range of return periods, particularly the more frequent events, was reinforced by the Saxon case study, where the authorities dealing with public requests said that a more differentiated display of return periods was required for their work, in particular areas exposed more frequently to flooding.

### *Language of risk*

The language used to describe risk should be easily interpreted; however, preferences on language varied considerably. Residents liked the use of different flood probabilities and in particular the broad labelling of categories of low, medium and high risk. However, participants interpreted probabilities and return periods (in particular) to mean different things. The potential for widely varying interpretations can result in a confused message and dismissal of the severity of risk faced. The ease with which the one in 100 and one in 1,000 chance of flooding in any given year may be misunderstood is a key concern. Greater delineation of mapped risk would help improve the impact of the flood extents on users; however, participants felt that using terms such as 'low', 'medium' and 'significant', as is done in the NaFRA (National Flood Risk Assessment) map layers, would overcome the problems associated with terminology. However, these terms should continue to be defined.

### *Mapping scale*

The scale at which mapping is presented was investigated through the presentation and discussion of current flood maps at different scales and with different levels of background detail. When presented with alternative maps, residents preferred a map which enabled them to clearly locate their properties (where blocks of properties were located) but was not too detailed (individual properties not depicted), overlaid with flood risk information and having a zoom scale of 1:10,000. Being unable to easily locate their property is a fundamental barrier to raising flood risk awareness in residents. Participants

also suggested that the level of detail was important to prompt action; if the information was too vague, this would deter action. However, the ability to have a number of mapping scales was a key requirement, to be able to easily locate a general area and see the overall risk before focussing on an individual property or location of interest. Residents in the Chertsey workshop welcomed changes made in this vein to Environment Agency flood maps. Therefore, a maximum zoom scale of 1:10,000, greater number of zoom scales and current level of detail in background graphics should be retained in future mapping updates.

### 3.3 Recommendations for flood risk mapping

#### **Recommendation 1**

Different users have different requirements from a flood map and therefore the potential for providing a layered approach should be investigated. This might be an extension of the current approach on the Environment Agency website where users are already able to explore different types of flood risk information. Additional layered mapped information might be able to be 'turned on and off' or accessed via different maps and therefore explored according to users' needs.

#### **Recommendation 2**

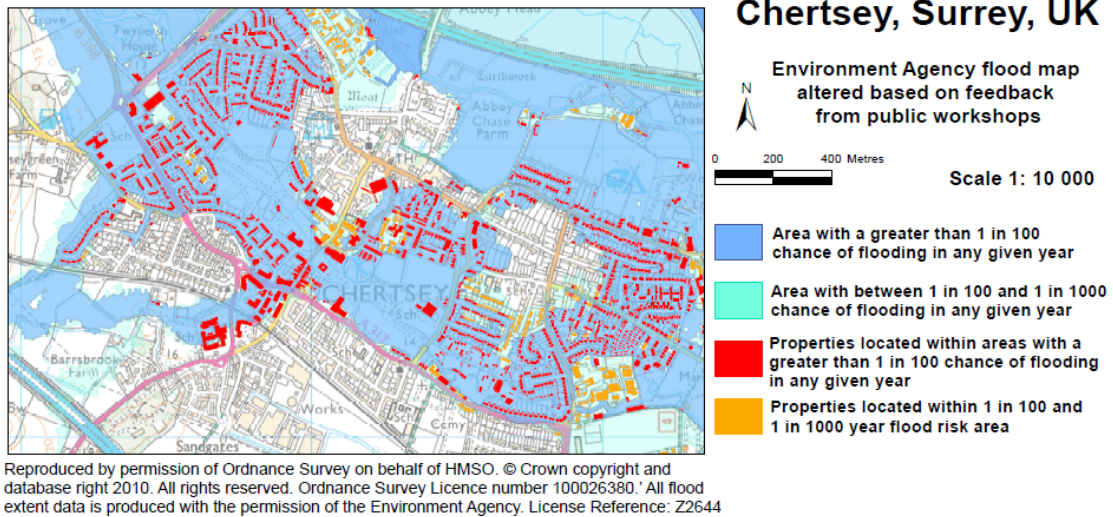
Members of the public prefer flood maps with *hazard* rather than *risk* information. Therefore, the Environment Agency and others should consider maintaining a hazard map for public awareness-raising activities. Residents recognised the need for flood risk to be presented as an extent, but this was not considered to be sufficient for some to assess flood risk; they also wanted information on buildings. In addition, 'colouring' buildings which could be flooded to more clearly depict properties at risk should be considered. This feature was favoured by participants in the Chertsey public workshops and the graphic semiology exercise.

#### **Recommendation 3**

Detailed information was seen as the most critical factor impacting on the understanding of flood risk and likelihood of residents responding. The Environment Agency and others should explore ways in which to assist the assessment of property-level flood risk, though depicting this level of risk on maps is resource-intensive and problematic. An alternative would be to develop guidance for residents on assessing flood risk to their property. This could be a step-by-step process based on mapped information combined with other local or property-level information such as floor height.

#### **Recommendation 4**

Revisions to flood maps to show a greater delineation of flood risk should be considered. Participants were less concerned with the more extreme floods and wanted to identify areas likely to experience flooding more frequently. Presenting this additional information (in locations where there is a variation in flood risks) would highlight the local subtleties in flood risk and permit residents to make more informed decisions on mitigation.



**Figure 3.5: Example flood map for Chertsey which includes the flood extent for two different events and highlights those buildings potentially affected**

# 4 Project findings on participation in flood mapping

This section discusses the findings from the participatory processes in this project. It draws upon the experiences and evaluations of the workshops held in each of the European case studies. Of particular interest are the four public workshops held in England; three in Chertsey and one in Croston. The section then makes a series of recommendations on participation in flood mapping..

## 4.1 Positive experiences of participation

Mapping workshops were found to have a positive impact in terms of raising awareness of flood risk (English case studies) and of new policies such as the Water Framework Directive (WFD) (Bavaria and Austrian case studies). They also enabled the sharing of knowledge; in particular, the Saxon case study highlighted the benefits of the workshops in developing cooperation between different agencies. In addition, participants found the workshops beneficial and enjoyed participating. Over three-quarters of participants at the first English case study workshop expressed an interest in further participation and nearly all participants felt their opinions had been valued and taken into account. Many participants reported satisfaction in the workshop outcomes, with three-quarters being very or completely satisfied and only two participants reporting dissatisfaction.

Observing and working with workshop participants allowed the pinpointing of misperceptions of flood maps. The workshops also enabled solutions to be identified and discussed.

## 4.2 Purpose of participation and tailoring of the approach

How a participatory flood mapping process should be set up and conducted depends largely on the purpose of the process itself. Defining the purpose should ideally be clarified at the start of the process. In a general sense, we distinguish between a substantive rationale (aimed at improving and verifying maps through local knowledge gained in the workshops) and an instrumental rationale (using a participatory approach to gain trust in the maps and raise awareness). More information on these different rationales is given in Section 3.1.1.5 of the RISK MAP final report (Meyer et al., 2011). A summary of the different processes and their features is presented in Table 4.1 below. This reinforces the need to tailor participation processes to the subject matter and the participants. The degree to which the instrumental and substantive rationales are accommodated within a participatory process need to match the overall objectives of the organisers. This need for tailoring was recognised within the different case studies of RISK MAP whereby the workshop approach was adapted and modified, enabling participants to fully contribute. Thus, the participation structure, participants and focus should be different depending on the goals and desired outcomes.

**Table 4.1: Recommendations for participatory processes for different aims**

	<b>1. Substantive (e.g. improving content)</b>	<b>2. Instrumental – substantive (e.g. verifying content)</b>	<b>3. Instrumental (e.g. raising risk awareness)</b>
<b>Participants</b>	Those with 'expert' knowledge on a subject (e.g. strategic planners, emergency managers and citizens with experience).	Open to all. Mixed groups of participants.	Members of the general public. Mixed groups of participants, including experienced and inexperienced but at risk. These groups might include professionals such as emergency or strategic planners.
<b>Process</b>	Series of meetings centred on production and verification of maps. Timing: prior to publication of new or updated flood maps.	Intensive and iterative engagement, repeated meetings to report and check changes.	One group workshop for raising risk awareness. Two or more meetings to improve trust and legitimacy. Timing: Awareness-raising meetings can take place at any point and on many occasions. Follow-up meetings should take place following updates or flood events.
<b>Focus</b>	Focussed on the development of content in particular, but also on verification.	Content selection, verification and visualisation.	Focussed on intuitive usability for a broad and general audience.
<b>Outcome</b>	Verified and corrected map outlines.	Raised awareness, maps tailored to end-user preferences, increased trust and development of co-operation networks.	Raised awareness, tailored maps to suit end-users, increased trust and legitimacy and opportunities for social learning. In addition, meetings provide opportunities to develop networks to assist flood risk management.

### 4.3 Methods of participation in hazard mapping

There is an abundance of methods and tools for participation in mapping. The findings of this research highlighted the value of workshops for participation. A face-to-face workshop enabled participants to directly share their knowledge of flood risk with colleagues and neighbours. This method provided a platform for two-way learning and knowledge exchange amongst participants, professionals and workshop facilitators. According to the survey completed by participants, all but two participants (23 out of 25) felt they had learned something new and of those, most found they had learned something new from workshop materials (15), workshop organisers (13) and other residents (11). Workshops also enabled participants to engage with each other, promoting the establishment of new networks and cooperation. In addition, the workshops enabled participants to better understand existing maps, mapping processes and the work of others in improving these. It also facilitated processes of social learning, permitted networks to be established and where Environment Agency staff were present, also permitted misunderstandings to be addressed.

However, workshops are resource intensive so, other types of participation might sometimes be more appropriate. The technique involved needs to be tailored to the purpose and the people being engaged. For instance, following a map update or re-launch the Environment Agency might hold a 'clinic' or roadshow to allow residents to find out more or ask questions. Table 4.1 at the end of this document summarises the value and weaknesses and the role of different types of participatory processes within flood mapping.



## 4.4 Value of participation

### 4.4.1 Verifying and improving modelling and mapped content

The substantive rationale places considerable emphasis on the value of participatory mapping for improving the accuracy of and confidence in maps. Participants, including members of the public (or lay experts), can provide 'expert' information to improve or verify the content of maps. An 'expert' may be any person with detailed knowledge of flood history and mechanisms in the area concerned. Experts might have built up their knowledge through their professional capacity or personal experience. Professional experts have traditionally been valued more highly than so-called local experts. As such, they tend to have a greater influence on decisions than public 'experts'. Public experts do not necessarily have to have flood experience; they may have witnessed flooding or lived in the area for many years and have developed an understanding of the mechanisms of flooding particular to that area. Participation can engage groups of experts who may be excluded from mapping in their traditional capacities. The Environment Agency should consider engaging these 'experts' in a more routine and consistent manner; to help verify and/or improve model outputs used to generate maps and increase confidence in the maps and the local Environment Agency teams.

This project also looked at the value of public contributions of substantive information. In both the Chertsey and Croston case studies, verification of previous historical event layers was possible and new information emerged. This was particularly the case in the Croston workshop, where Environment Agency staff participated and reported a positive experience which compared better to previous Environment Agency-led approaches to public engagement. One of the Environment Agency attendees was particularly impressed with the detailed local knowledge and level of understanding of public participants. As such, the workshops improved impressions of the value of public participation for sharing local knowledge. All three attendees from the Environment Agency reported benefits from the workshops, including new information, being alerted to problems and issues, verification of the maps and new connections made with residents. One Environment Agency attendee identified other issues with the current maps requiring further attention. Although Environment Agency staff would not rely solely on public information to make changes to the maps, they said they would investigate further some of the issues raised in the workshop.

Fluvial and coastal flood maps are mostly well developed. However, surface water flood maps are newer and have been less verifiable in many cases due to a lack of data on past surface water flooding. In both the Croston and Chertsey workshops, the issue of surface water flooding was raised; local residents had information on which areas commonly flooded due to runoff and/or drainage and flow routes commonly taken by surface water. Local knowledge even extended in some cases to the infrastructural causes of flooding (such as in-filled culverts and slopes on roads) and were eager to explore solutions with the local council and utilities companies. Lead local flood authorities, along with the Environment Agency, should consider the use of such workshops to verify and improve surface water flood maps.

### 4.4.2 Social learning with groups of mixed participants

The wider the variety of participants, the greater the potential for shared learning and network building. In workshops where professionals from the same department or agency comprised the total sum of participants (Austria), there was limited shared learning. However, where different groups that had not collaborated previously were brought together (such as in Saxony), the workshops provided a good basis for establishing new working relationships and a new understanding of the positions of others, as opposed to a pre-conceived expectation or impression.

In addition to hosting mixed groups, working in small groups was found to be beneficial. Small groups allowed time for each participant to contribute and prevented groups from breaking up into smaller discussions. Small groups of four or five people appeared to be ideal in the English case studies. Promoting engagement in mixed groups should be encouraged where possible to enhance these social learning opportunities.

### 4.4.3 Raising awareness of risk

Raising risk awareness is part of the instrumental rationale for a participatory process. Maps are useful tools in raising risk awareness and workshops offer the opportunity to consider the maps in a group situation. To raise awareness of flood risk through mapping workshops, participants should comprise small groups where those inexperienced and unaware of the risk are able to work alongside others who have experienced flooding. By working in such mixed groups, participants may interact with each other, allowing those affected by flooding in the past to share their experience(s) and the lessons they learned.

In addition to covering a range of perspectives, a participatory process that involves both end-users and those producing the maps can boost trust in the accuracy and credibility of those maps and those producing them. When asked what would help residents to feel more confident in the flood maps, responses included “*good information made by asking local residents*” (Chertsey) and “*taking note of participants’ points of view ... and constant update of maps from information given*” (Croston). The workshops engaging the public in Chertsey and Croston allowed much discussion about the contents of the map, what the flood risk meant and implications of this for residents. Face-to-face engagement of public users with map producers (and other flood risk operators) permitted misunderstandings to be corrected, where map producers were able to clarify terms or symbols. This process of participation for many improved comprehension of the maps. When asked what they learned from the workshops, some commented “*that my risk is more related to poor drainage than from the (defended) river*” and that “*impact of improvements in defences has not yet been fully incorporated in mapping*” (Croston). In turn, map producers were able to identify aspects of the maps that needed to be improved to enhance their readability and utility and in the case of Croston, areas where flood risk had been incorrectly mapped. The Saxon case study also reinforced the benefits of a thorough discussion of the content of maps and the misunderstandings often held. In interviews, a number of professionals viewed the maps as erroneous and too inaccurate for their daily work, and there was a strong desire for more meaningful exchange between producers and map users. Interviewees then reacted positively to the workshops which were held following these interviews.

Engaging with residents to discuss the flood maps promoted a greater understanding of the level of risk residents face, how and why the maps are produced and how they may help residents. Residents require reassurance that maps are accurate in order to give the risks serious consideration. The participatory process raises awareness of the issue and allows residents to seek answers to their queries over map production content and accuracy. Workshops are particularly valuable in communities where flood risk (and therefore the flood map) is complex, where there are known controversies and complaints or where trust in the Environment Agency and/or the map is low. In these situations, the Environment Agency should seek to engage with residents to clarify the flood risk situation, improve risk awareness and therefore responses to flood maps.

## 4.5 Timing of participation

Participation at an early stage in the process of map design and production is important to ensure that user input is taken into consideration and is not overly limited by decisions that have already been made. However, participation should take place at an appropriate point, where draft maps are available which participants can comment on and feed into. Engagement should not come too late for changes to be made to the map.

Updating of the map might also provide a good opportunity for engagement with professionals and the public. Researchers felt that opportunities for raising the profile of the flood maps are being missed in England and Wales. Typically, when flood maps are updated there is little public re-engagement or publicity on the changes. Thus, the public is not informed of any changes to their flood risk and the valuable work of the Environment Agency is not promoted. One participant commented that “*more work needs to be done to put out information to the public*” (Chertsey) while another participant felt that the workshop demonstrated “*that a great deal of work is being done to manage and project risk*”, highlighting the value of public engagement.

## 4.6 Iterative process of participation

In order to achieve the instrumental rationale, where participants feel their contribution has been valued, the participatory process should be iterative, with follow-up engagement to demonstrate how ideas have been taken into account. From the professional perspective, particularly where professionals from different departments and organisations were present, the project highlighted the importance of ongoing participation to develop and strengthen networks. Professionals require further opportunities to collaborate in order to enhance cooperative networks and overcome problems in traditionally separated departments that need to work together. This was particularly prominent in the Saxon case study where the workshops enabled negative views to be overturned by providing a platform for people to share their knowledge and intentions. Participants began to break down their preconceptions, but for this positive effect to continue further workshops or similar opportunities would be necessary.

Public participants expressed their satisfaction with the results and how their input had made a difference. For the public participants, the experience appeared to be one likely to be remembered in a positive manner, increasing the chances of further participation in the future.

An iterative process is essential to promote trust in the maps and the participatory process. As such, people should be presented with maps that have been modified based on their input. This enables participants to verify that any changes made to the drafts are satisfactory, in addition to demonstrating how comments and opinions have been valued. Such an iterative process may result in a more positive impression and trust in the agency producing the maps. Participation does not have to be solely based on workshops; an alternative may be an email or letter thanking participants for their input and explaining any changes that have been made.

## 4.7 Value and role of flood maps within a participatory approach

The workshops used maps to engage with participants on the broader issues of flooding and flood risk awareness, in addition to focussing on mapping preferences. The main RISK MAP report provides detailed descriptions of the activities undertaken and the purpose and value of each.

However, the benefits of using the flood maps and mapping within a participatory approach often went beyond discussion of residents' flood risk. Residents were observed discussing their experiences of flooding, flood insurance, responses during an event, and broader concerns about flood mitigation and warning. Therefore, although the basis for discussion was mapping and views on the appropriateness of the map, a broader topic of discussion emerged, which enabled residents to build local networks and voice their opinions, as well as enabling flood managers to reassure them about other elements of flood management. This highlights the broader role of flood maps as instruments for initiating discussions and providing a framework for dialogue, while exploring a range of flood-related issues.

## 4.8 Findings on participatory techniques

This section makes recommendations about techniques and best practices for participation within a mapping process.

### 4.8.1 Recruitment

To maximise the breadth and depth of knowledge to enhance and improve maps, participants should comprise a varied group representing many different interests and perspectives. Participants should include not only those involved in producing maps and the flood risk data depicted within them, but also end-users such as those involved in emergency response or the general public. Participation

should aim to include professionals with different but related responsibilities. Bringing these groups together under the unifying tasks of the workshop may help to develop networks and understanding.

In the project it became clear that open recruitment was vital to successful and productive participation. Where participants were keen to attend for their own interest, participation was most informative and interesting. However, in the Austrian case where professional participants were recruited through less open means and were obliged to attend, participation was less effective and less positive an experience. Many of these participants left with a negative impression which may have impacted on other participants originally keen to attend. The best method for ensuring a successful participatory process is an open recruitment system, ideally with no restrictions on the type of person invited. Participation should be by choice and participants should be under no obligation to attend. Equally, participation should be open to all stakeholders and should aim to include participants representing a broad range of interests.

Where public engagement is the goal, recruitment should be open to all residents to maximise the breadth and depth of knowledge. Recruiting at-risk participants who have not been affected by flooding directly can be challenging; however, local community groups can grant access to an audience that may be more supportive and trusting of the project. Using such 'gatekeepers' can help to promote the project and attain legitimacy.

#### **4.8.2 Neutral facilitation**

The presence of a neutral facilitator is vital to ensure that discussions focus on the subject matter. Neutral facilitation also plays a useful mediation role as it places all participants on a more level playing field to facilitate open discussion. This is particularly important where there are existing negative opinions of authorities. Facilitators are able to ensure that discussions are balanced with contributions from all participants, reducing the potential for some participants to dominate the discussions. One Environment Agency workshop attendee highlighted this, commenting that neutral facilitation "*allowed the discussion topics to focus purely on the mapping rather than the maintenance and political issues surrounding flooding*" (EA1). Facilitators need to be able to manage the process of participation in such a way, when required to do so. Whilst facilitation requires additional resources, these resources are justified as they ensure the process is efficient and productive. Therefore, the Environment Agency should employ neutral facilitation to ensure workshop discussions are focussed and fair.

#### **4.8.3 Evaluation**

To establish the benefit experienced by participants, it is necessary to evaluate the event. Questionnaires can capture participants' perspectives and any additional information not raised during the event. Questionnaires also allow participants to voice opinions anonymously, which should encourage an honest account and interpretation of impressions and experience.

Evaluation can be used to identify areas of success and areas for improvement or change. Thus, evaluation forms a key part of the design for a follow-up event.

### **4.9 Recommendations for participation in flood risk mapping**

#### **Recommendation 1**

The Environment Agency and others should continue to recognise and value local expertise, knowledge and understanding through an open and inclusive (but voluntary) participatory process.

**Recommendation 2**

Participation should be a routine and iterative feature of flood mapping for professional partners and the public. It should be tailored to the objectives/problem and local context, taking into account available resources. It should also take place at an early stage whereby drafts are available for comment, but where changes can still be made. A standard process of local engagement and/or publicity about significant updates to the flood map should be considered.

**Recommendation 3**

Participation processes that involve different groups of participants help to achieve social learning and raise risk awareness. However, mixed participation is best undertaken with a neutral facilitator to ensure balanced discussion.

**Recommendation 4**

Workshops as vehicles for face-to-face participation have many benefits over and above discussions about the flood map, including building trust between participants and the authorities, building networks within the community and cooperation between groups. However face-to-face participation in all at-risk locations is resource intensive. For instance, workshops are particularly valuable in communities where flood risk (and therefore the flood map) is complex, there are known controversies and complaints or where trust in the authorities and/or the map is low. In these situations, engagement with residents to clarify the flood risk situation, improve risk awareness and therefore responses to flood maps would be useful. Table 4.1 presents different participatory methods, their purpose and appropriateness and the values and weaknesses of each.

Table 4.1: Value and weaknesses of different methods of participation within a flood mapping process

Participatory method	Purpose	Participants	Resources		Timing in mapping process	Context/ appropriateness of use	Value for a flood mapping process	Disadvantages for a flood mapping process
			Scale	Intensity				
Interview	To identify key issues for potential map update (substantive)	Experienced local experts	Small	High	Very early in update, prior to draft maps	Where complex or particular problems are likely or known to exist or verification data are limited	<ul style="list-style-type: none"> <li>Highly detailed discussion can pinpoint particular issue(s).</li> <li>Complexities can be determined from local perspective.</li> </ul>	<ul style="list-style-type: none"> <li>Individual perspectives which may not cover the range of end-users.</li> </ul>
Questionnaire - face-to-face	To verify map content and possibly identify issues for update (substantive)	Experienced Local experts	Small-large (depending on scope of research)	Medium to high	When existing maps are being considered for update	Following a flood event when a map update may be under consideration	<ul style="list-style-type: none"> <li>Standardised set of questions but with opportunity to gain some additional detail through face-to-face contact.</li> <li>Demonstrates to participants that maps are reviewed.</li> <li>Potential to establish ongoing connection.</li> </ul>	<ul style="list-style-type: none"> <li>Less suitable for detailed discussions on complex issues.</li> </ul>
Workshop/ focus group	To access local opinions which can be taken into account in map update (substantive)	Experienced Local experts	Small-large (could be repeated in same or different locations)	High	At early stage, when drafts available to work on. Repeat after revisions to drafts.	Particularly useful where flood maps are complex and contentious or where updated modelling is likely to result in significant changes to the flood map. Or where there are common and known misunderstandings or misinterpretations of the map.	<ul style="list-style-type: none"> <li>Facilitates discussion to reveal complexities.</li> <li>Tasks can be designed to generate ideas and tangible outputs.</li> <li>Multiple opinions and responses gathered to cover range of end-users.</li> <li>Potential for community support networks to be formed.</li> <li>Presence of Environment Agency may help participants' understanding of the mapping process.</li> <li>Increases trust in modelling outputs.</li> <li>Raises awareness of local risk and mapping issues.</li> </ul>	<ul style="list-style-type: none"> <li>May require mediation where particularly controversial mapping issues are present.</li> <li>Is as representative as the participants attending: sample size is not as large as other methods.</li> </ul>
	To build trust in Environment Agency (instrumental)	Environment Agency and local residents (experienced and non-experienced)						
	Raising awareness	Experienced and non-experienced local residents. Maybe also EA						
Questionnaire - postal or internet	To raise awareness of flood map update and identify key issues for map update	Experienced and non-experienced local residents	Small-large (depending on scope of research)	Low to medium	Very early in update, prior to draft maps	Where changes to maps are expected to be minor or to gauge whether a more fundamental update may be necessary	<ul style="list-style-type: none"> <li>Provides standardised data and responses for consideration.</li> <li>Large sample sizes can potentially cover the majority of different end-users.</li> <li>Can identify priority areas for further participatory engagement and modelling and map update.</li> <li>Reminds residents of risk and of the map.</li> </ul>	<ul style="list-style-type: none"> <li>Basic responses, little opportunity for discussion or detail.</li> <li>Requires careful drafting to ensure clear and unambiguous questions.</li> </ul>
Leaflet/ newsletter	Raise awareness of existing map, any updates and how local views are incorporated (instrumental)	Local residents (experienced and non-experienced)	Large	Low	At any stage	Where general risk of flooding is present but no recent floods have occurred and map is not likely to be contended	<ul style="list-style-type: none"> <li>Reminds residents of the flood risk, location and availability of maps.</li> <li>Highlights any updates to maps, reminding residents to check changes.</li> </ul>	<ul style="list-style-type: none"> <li>General information not tailored to needs of different end-users.</li> <li>One-way communication.</li> </ul>

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