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Environment Agency

delivering benefits through evidence

Communicating impacts in flood warnings and forecasting

SC150013

Flood and Coastal Erosion Risk Management Research and Development Programme

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Professor Doug Wilson
Director, Research, Analysis and Evaluation

Executive summary

The strategic development and improvement programmes developed by the Environment Agency and Natural Resources Wales highlight the need to build capacity in their ability to effectively inform the public about the impact of a flood and the most effective responses the public and the agencies' partners can take to mitigate that impact. The current evidence base is clear about both the economic and social benefits of making these improvements.

The aim of this research project, which was carried out in 2017 to 2018, was to help build this capacity. This report reviews the existing evidence, explains the methodology and describes the outputs of the research.

Much existing and ongoing work is relevant to this project. In particular, the project built on the recent 'Public Dialogue on Flood Risk Communications' (SC120010) and 'Real-time Inundation Mapping for Flood Incident Management' (SC120023) projects, taking on board their findings and recommendations. As such, the objectives for this project were to develop and test innovative and effective approaches to describing impact and context information within flood forecasting and warning services to enhance the decision-making and behavioural responses of those receiving flood warnings.

Project methodology

The project used a phased approach to consulting and testing with members of the public and professional partners. The latter included the police, local authorities, utility and infrastructure providers, and Environment Agency strategic decision-makers and Flood Incident Management (FIM) duty officers.

Following an initial evidence review, 3 focus groups were conducted in July 2017 in locations with different flood characteristics with residents who were already 'engaged' with flooding and flood warnings. These focus groups were used to explore whether 'impactful' content would help to enhance attendees' current decision-making and their capacity to capture specific requirements and issues. Telephone interviews with a range of professional partners were also carried out to identify their requirements and the potential constraints of adopting enhanced impactful flood warning messages.

Based on this evidence, impactful messages were developed to be tested among the public. The focus group research was combined with the findings from an evidence review to develop a set of test sample flood warning messages in written format. These were tested at 3 workshops in February 2018 at locations that again reflected a range of flood characteristics and where members of the engaged at-risk public provided detailed feedback.

Key findings: at-risk public

The overall finding from the workshops was that impactful content is supported by residents as a way of conveying flood risk information to both enhance their decision-making and lead them to take action. Engaged members of the public are already supplementing the information in flood warnings with more locally specific information to aid their decision-making.

Impactful content is most meaningful when it is developed and delivered at a local scale, and draws on specific community characteristics and experiences. Understanding and engaging with the communities at risk of flooding in order to tailor and 'fine tune' messages is essential to achieve resonance with the recipients, thus better informing their decisions and improving their responses.

The research revealed confusion among the public about whether the current warning levels given in messages reflect the severity of flooding or a progression in certainty that it will occur.

In relation to the content of enhanced messages, the specific text used to describe impacts in the messages needs to be considered carefully and developed locally in partnership with residents.

There were mixed views on the ways to describe flood depth, although there was general agreement that this information should be paired with carefully chosen decision trigger locations. These locations need to be determined at a local level to identify sites that would resonate with the local community as a whole.

Developing and refining more impactful content will require both preparatory and post-event engagement with communities. This will also help to mitigate the erosion of trust in the warning system.

Key findings: professional partners

The strategic decision-makers consulted felt that enhanced content in flood warning would not have a direct impact on their decision-making leading up to and during an event. They considered the required information could already be obtained from internal technical sources or externally.

Local authorities considered that, being informed of enhanced impactful content before it was released, was important for their decision-making and preparations leading up to and during a flooding event.

FIM respondents stated that, for some locations, there may be technical and local information constraints to achieving impactful messages at present.

Possible future work

The research focused on already engaged residents. There is scope to:

- further explore impactful messaging among disengaged members of at-risk public groups
- undertake post-event monitoring of behavioural changes within affected communities receiving enhanced messaging

Warning messages are usually received by the public as audio messages. Further research could be carried out to explore this format and the technical abilities of audio delivery to satisfy the range of public information requirements revealed by this project.

Acknowledgements

We would like to thank all the public participants who provided their time at the focus groups and workshops, and acknowledge the role of National Flood Forum staff in organising these events.

Thanks are also due to the staff from the Environment Agency and its professional partner organisations for taking the time to be interviewed for this project.

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1 Introduction

The strategic development and improvement programmes developed by the Environment Agency and Natural Resources Wales include the need to build capacity in their ability to effectively inform the public about:

- the impact of a flood
- the most effective responses the public and the agencies' partners can take to mitigate that impact

The current evidence base is clear about both the need and the economic and social benefits of making those improvements.

This research project sought to help build this capacity. It was carried out by staff from the Flood Hazard Research Centre (FHRC) at Middlesex University London, CH2M (now Jacobs) and the National Flood Forum (NFF) in 2017 to 2018.

Much existing and ongoing work is relevant to this project. In particular, the project built on the recent 'Public Dialogue on Flood Risk Communications' (SC120010) and 'Real-time Inundation Mapping for Flood Incident Management' (SC120023) projects, taking on board their findings and recommendations. But while project SC120010 offered an excellent in-depth analysis of user needs for improved flood warning (Environment Agency 2015), it did not provide evidence of pragmatic actions to address these requirements.

As such, the aim of this research project was to investigate and identify the flood impact and historical/geographical context information that is most valuable to enable the public and the agencies' partners to take effective action before and during a flood. Based on these needs, the project set out to determine how those impacts can best be expressed throughout current and future services.

The project's main objective was to develop and test innovative and effective approaches to describing impact and context information within flood forecasting and warning services. Improved message content will allow new communication approaches that encourage the public to take appropriate action.

2 Methodology

A sequential methodology of tasks allowed the project to build an evidence base of research and stakeholder views on which to develop new message content. This content was then tested with a range of stakeholders. The key tasks are summarised in Figure 2.1 and explained in more detail below.

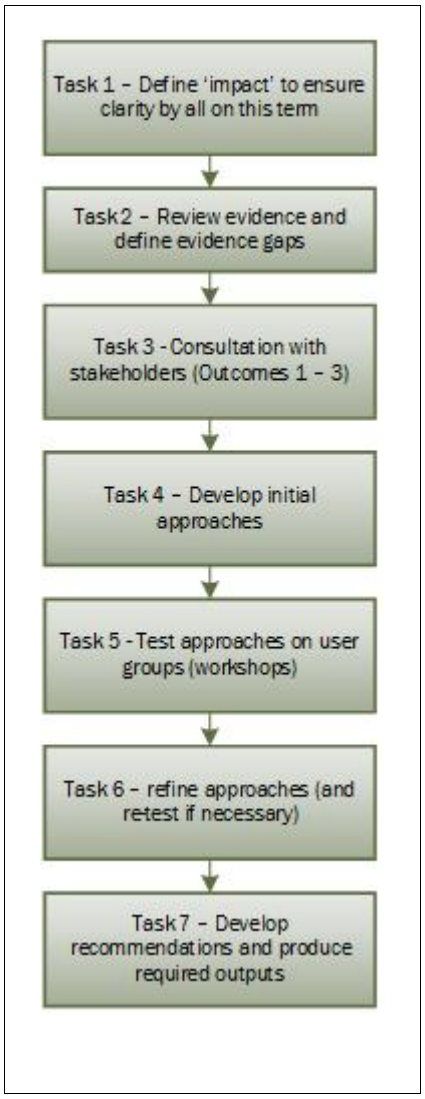


Figure 2.1 Methodology – key tasks

2.1 Task 1: Problem scoping and definition

The project team began by clarifying the definitions of flood impact and context in relation to flood warnings.

Typically, impact is defined as referring to the hazard characteristics (water speed, depth, duration and so on) and receptor types that might be affected (buildings, people) rather than the possible severity of the consequences for those receptors when flood occurs. Examples include fast-flowing water moving cars, river bridges collapsing and people being knocked over (that is, the actual impact of the hazard). It was therefore necessary to examine how to separate out hazard, receptor type and impact.

Secondly, the terms impact and context hold different meanings for the different stakeholders specified in each outcome. Furthermore, impacts throughout the hazard cycle (that is, in advance of the hazard, during it, and after the hazard has occurred) may change for the different stakeholders involved. As a result, user needs will also vary. Different definitions as initially understood by the researchers from their own and desktop research were collated and a refined definition was agreed with the project board to allow progress onto the next tasks. The outputs from this task are presented in Section 3.

2.2 Task 2: Review of evidence and identification of evidence gaps

A desk-based evidence review of international and national published papers, research reports and grey literature was performed to identify existing best practice for providing impact information and implementation examples. An important element of this step was to identify examples of messaging and delivery that have induced behavioural change.

A key output from this task was to identify gaps in evidence. This was done by undertaking a Rapid Evidence Assessment (REA), an approach used in the recent Defra Pathfinder project (Twigger-Ross et al. 2015). This approach offered a focused and purposeful review framework and a shared understanding of the review. The outputs from this task are presented in Section 4.

2.3 Task 3: Initial consultation with stakeholders to identify user impact requirements

To help address the identified knowledge gaps, the team carried out qualitative research with 3 stakeholder groups (see Table 2.1). Full details of this research are provided in Section 5. Ethical approval for the social research components was provided by Middlesex University.

Table 2.1 Task 3 stakeholder engagement

Stakeholder group	Summary of method used
At-risk public	For this initial stage, the project team engaged with members of the public who had experienced flooding to get them to supply lessons about the impact and context information that was and could be useful in enhancing their decision-making and behaviour. Three focus groups were arranged in 3 at-risk locations to capture experience of 3 different types of flood characteristics (fluvial fast onset, fluvial slow onset and coastal).
Category 1 and Category 2 responders	A range of Category 1 and 2 responders were identified and interviewed in order to capture organisations with differing information requirements and which covered different flood situations.
Strategic decision-makers	Telephone interviews were completed with members of the Environment Agency Operational Resilience team and the Environment Agency Area duty manager for Yorkshire to

Stakeholder group	Summary of method used
	gauge the impacts of a change in messaging would have on higher level decision-making.
Environment Agency Flood Incident Management (FIM) duty officers	Telephone interviews were conducted with Environment Agency FIM duty officers to identify: • the requirements for embedding impact messages within existing practices • any data, information or training needs

2.4 Task 4: Developing impact and context messages

The project team analysed the stakeholder responses to identify common themes and key issues. This research information, together with the evidence review, was used to develop test material with enhanced and new impact content. Specific messages were developed for each of the 3 focus group locations in order to incorporate local information. This local information was identified from:

- the lessons learnt from members of the focus groups
- desktop research of previous flood warnings
- available modelling outputs
- media reports of previous flood events

These ‘impactful’ messages were developed to adhere closely to the existing writing guidance and formatting criteria for flood warnings, but with small enhancements to bring in more impactful content.

In addition to the impactful messages, content was also developed to reflect ‘typical’ existing flood warning messages. These were used to help the focus groups compare and contrast between the 2 types of messages. When developing these typical messages, it was recognised that current messages do not always follow the writing guidelines due to a number of reasons identified by the FIM duty officers (constraints on data, certainty, time and so on). The content of these messages was based on previous flood alerts and warnings for each area and/or by modifying the flood warnings and alerts that were being issued in January and February 2018.

2.5 Task 5: Testing approaches on user groups

The aim of Task 5 was to test the enhanced impactful message content with each of the stakeholder groups. Table 2.2 presents a summary of the approach for the Task 5 stakeholder engagement.

For the at-risk public, workshops were used to:

- highlight lessons for the refinement of the impact and context messages, and how they should be provided to users
- identify potential feedback mechanisms for these processes

User testing involved consideration of 3 important aspects:

- Did the user understand the message and its presentation?
- Did the message and its presentation include all of the necessary or sufficient information to make a decision and undertake an appropriate response?
- Did the message and its presentation motivate an appropriate response?

The small workshops used to capture individual feedback also had the benefit of providing opportunities for in-depth group discussion across roles or experience. The original intention was to return to the same areas as the Task 3 focus groups. However, recruitment issues in the Keswick area in Cumbria meant that an alternative group was organised in Shipston-on-Stour in Warwickshire. Details of these focus groups are given in Section 7.

Table 2.2 Task 5 Stakeholder engagement

Stakeholder group	Summary of method used
At-risk public	Workshops were used to: • review example impactful messages to highlight lessons for their refinement • indicate how they should be provided to users As in Task 3, the workshops were conducted at 3 at-risk locations to capture experience of 3 different types of flood characteristics (fluvial fast onset, fluvial slow onset and coastal).
Category 1 and Category 2 responders[1]	Follow-up conversations with the Category 1 and 2 responders from Task 3 were conducted to obtain general feedback on the impactful message content and the overall findings of this research.
Strategic decision-makers[1]	Following feedback from Task 3, it was agreed that no further discussion was required with this stakeholder group.
Environment Agency FIM duty officers[1]	Follow-up telephone discussions were held with the FIM duty officers to review the impactful message content and the overall research findings. In particular, feedback was sought on what the recommendations would mean in terms of implementation.

Notes: [1] As part of Tasks 6 and 7

2.6 Tasks 6 and 7: Refine approaches and develop recommendations

Responses from the Task 5 stakeholder engagement were analysed to develop a range of project findings. These were in turn used to inform high-level and specific recommendations. The main project findings and recommendations are detailed in Section 8.

3 Problem scoping and definition

To clarify the breadth and complexity of the definitions, the project team performed a desktop assessment which included past research. Their findings were assessed by the research team and refined into agreed definitions with the project board. These agreed definitions of impacts in relation to flood warnings forming the output from Task 2 are set out in Box 3.1.

Box 3.1: Agreed definitions of 'impact' and 'context' in relation to flood warnings

Impact describes the characteristics of the evolving, occurring and resultant flood event which inform specific decisions and actions relevant to the stakeholders involved. For both FIM professionals and members of the public these include:

- the impact on buildings, key locations and infrastructure that will be affected by the predicted flood and how they might be affected
- the risk to life and health, water entering local streets and homes, loss of personal property (including vehicles), and individual and social disruptions (for example, local travel, school closures, amenity loss, evacuation)
- other information required for professional partner decisions on the timing and description of the hazard such as when a flood enters a community, how deep and fast-flowing the water will be, and the chance of high waves

Context can refer to the historical and physical references made by local and relevant stakeholders related to their decisions and actions:

- Historical context – how does a predicted flood compare with previous events
- Geographical context – which landmarks do river or sea level forecast heights relate to

4 Review of evidence and identification of evidence gaps (Task 2)

This section provides findings from the focused REA undertaken as part of Task 2. The research set out to identify existing best practice for:

- providing flood warning and forecast impact information
- implementation-induced behavioural change

The literature review adopted a focused approach drawing on the REA methodology. A framework for investigation was established in consultation with project members which defined the scope of the review. In line with the objective of informing further project stages of empirical research, the review identified gaps in the current literature relevant to the aim of the project. Literature was drawn from international and national published papers, research reports, grey literature (including organisational reports, work protocols and training manuals) and examples beyond flood risk.

The review framework took the form of a series of questions which sought to focus the researchers' attention on pertinent content and, where content was lacking (when taken across all the literature) identified the gaps in knowledge. The framework split broadly into knowledge relevant to the public and knowledge relevant to a range of professional groups. The researchers were mindful to only include references to work established by empirical research rather than commentary.

The framework questions relating to public and professional respondents are set out in Box 4.1. In some cases, the questions were not answered or only partially answered by the literature and so were identified as research gaps.

The evidence gaps relating to the various framework questions identified during the literature review are summarised in boxes at the end of each sub-section. Although the gaps identified that certain issues are transferable across different stakeholder groups, the impactful information requires a degree of specificity. This specificity relates to either to role, decision required, and locality and hazard characterisation that is not readily transferable. However, the principle has in some cases been explored, employed and supported to differing degrees.

Box 4.1: Framework questions

Public respondents (see Section 4.2)

- Who are the relevant public groups?
- What do these public groups need or say they need to know to take action?
- What aspects of warning and forecasting 'works' (that is, results in action) for the public groups?
- What results in inaction or behaviour considered by public groups to be inappropriate?
- Other concerns related to an impact-based flood warning?

Professional respondents (see Section 4.3)

- What actions can and/or should impact-based messages promote?
- What do the professionals need or say they need to know to take action?
- What do strategic decision-makers need or say they need to know to take action?
- What aspects of warning and forecasting 'works' (that is, results in action) for the professionals?
- What results in inaction or behaviour considered inappropriate by the professionals?
- Other concerns related to an impact-based flood warning?

4.1 Existing knowledge and lessons for impact-based warnings and forecasts

The review below first summarises and then divides the key evidence gaps revealed from the literature according to:

- those pertaining to the public
- those related to relevant professional practice

Professionals cover a broad spectrum of roles, but the focus here is on those described by the project.

The most important points are then summarised for both groups in relation to impact-based warnings and forecast messages.

4.1.1 Summary of key evidence gaps identified

In relation to different public groups

- Specific direction on the most effective local context cues informing local public response to warnings (based on literature which acknowledges that the use of such cues is effective)
- How the context cues for different public groups inform different actions in the build-up to flood inundation
- Public evaluation and understanding of currently presented forecast information
- How and why different sources of information including warnings and forecasts used by the public to make decisions for action combine and are evaluated by them
- The complex interactions of possible context information (local cues, historic experience, trust in defences both ability and management) in public decisions
- Public trust in different sources of information and when it is used in the evolution of an event
- What forecasting messages work with the public
- Specific guidance on disruptive or ineffective impact-related messaging particularly in forecasts but also in warnings

- Understanding of how trust in message sources can be built up quickly for different public groups
- What is considered inappropriate and appropriate behaviour from the point of view of different public groups?
- Impact and mitigation of false impact warnings and forecasts on public response

In relation to professional practice (in a range of roles)

- Technical capabilities required to deliver local community-specific and actionable warnings
- Lead times required across all professional roles to make decisions to deliver effective action and their interrelationships
- Scales of topographic information required to deliver impact warnings and forecasts
- Support in training and the materials required to deliver impact warnings and forecasts
- The requirements for the internal communication of messages as a framework for impact messages in decision-making (includes levels of uncertainty and forms of communicating that uncertainty)
- Impact and mitigation of false impact warnings and forecasts on professional decision-making
- Capabilities and resource requirements for utilising local knowledge from new media sources in professional practice

4.2 Public groups

4.2.1 Who are the relevant public groups (that is, the public respondents?

As identified by the public dialogues project (Environment Agency 2015) and supported by Parker et al. (2007), there are 2 important and different public groups worth consideration.

The first group is those people living in flood risk areas who are insufficiently aware of the flood risk and/or flood warning arrangements to take effective action in the event of a flood warning. This group was given the title ‘flood unaware’ in the public dialogues project.

The second group may be aware of flood risk and the flood warning arrangements, but either do not know what action they should take in the event of a flood or feel that there is insufficient information in the warning message to take effective action. This group is identified as the ‘flood literate’ in the public dialogues project.

The ‘Public Flood Survey 2013 to 2014’ report (Environment Agency 2016) provides an indication of how many are thought are in each group. It reports that:

> ‘Over half of those surveyed (54%) did not believe they were at risk of flooding and 29% of those flooded in the last 12 months did not believe they were at risk prior to the event’ (Environment Agency 2016, slide 12).

However, as indicated by Parker et al. (2007), these people will not be evenly distributed within or between areas at risk, as there will be areas where knowledge and flood experience will be higher due to more frequent and recent flooding. However, the Public Flood Survey report went on to state that:

> 'In general, flood warnings were seen as credible and the majority of respondents took action in response to them. In addition, those who received warnings through Floodline Warnings Direct were more likely to view the Environment Agency as trustworthy and effective. Encouraging further engagement with the service should help enhance the Environment Agency's reputation' (Environment Agency 2016, slide 13).

4.2.2 What do the public groups need or say they need to know to take action?

Reviewing existing literature on experiences from past flooding tells us much about the commonalities in the actions that people take and therefore the types of messaging that might be appropriate in related decisions. Although it is of course necessary to also encourage other (potentially more appropriate) actions, it does provide a starting point. These commonalities are highlighted below.

- Evacuation – though this is less common than in those countries where the severity of the flooding is higher
- Seek additional information or confirmation – issues around the consistency in messaging information (for example, from local radio, friends and neighbours, internet)
- Passing on information to others – 22% warned neighbours and 16% contacted family and friends (Parker et al. 2007)
- Action to prevent flood waters from entering the property – around 40–50% of people sought to block doorways and 5–10% fitted products (Parker et al. 2007, Environment Agency 2007a)
- Moving or raising property – 43% moved valuables and 18% cars (Environment Agency 2007b)

The public dialogues project identified a number of overarching principles derived from the requirements expressed in UK qualitative research among both types of the public (the 'flood literate' and 'flood unaware') (Environment Agency 2015). Intended as guidance to professionals designing warnings, the principles reflect the needs revealed by the public in the research (Box 4.2).

There is recognition in the literature that there is not just one public but different groups of the public as receptors of warning information. When designing a communication approach, it is important to understand that the differing behaviour of the public to the same warning information is based on their different heuristics of the hazard. Heuristics are the perceptions (or mental models) held by individuals that warning information informs and so drives their decisions in response. Such heuristics are influenced by past, or lack of, experience of the hazard and past coping behaviours with their satisfactory or inadequate consequences (Tversky and Kahneman 1973, Morgan et al. 2002).

Equally beyond natural hazards, not only must information be communicated in a credible and understandable way to the individual but also must also resonate with their individual heuristic for taking action (Wogalter and Mayhorn 2005). Equally, psychological decision biases can influence how warnings and forecasts are

interpreted. One such example identified by Weinstein and Klein (1995) and perhaps more familiar in appraisal activities is how optimism bias affects risk judgements: they found that people consistently underestimate the chances of adverse consequences in relation to their own situation.

Box 4.2: Overarching principles drawn from the public dialogues project

- Think about the needs of different audiences.
- Don't assume a little bit of information will scare people – telling the truth about risk and impacts is more likely to lead to action.
- Stop talking about probability and risk in mathematical language as it means very little to a lot of people.
- Be really clear with people on what is happening before, during and after a flood, and what actions they should take.
- If you are asking people to take individual actions, tell them (in the same communication) about what local/national organisations are doing too – that is, we're all in this together.
- Focus on making information local, with historical context.
- Don't just focus on the negative impacts of flooding, focus on what people can do about it.

Source: Environment Agency (2015, p. 51)

The principles listed in Box 4.2 address important issues raised by the public groups, and also expressed in the wider hazard literature, around the need to provide credible information in a way that is understandable to them. It also highlights the warning requirement for specific information relevant to the particular context of the public group. Specificity of information here does not just relate to accuracy but is connected to the public group's local cues of evaluation.

Sorenson (2000) takes this point part of the way by referring to information directing actions and arguing that the vagueness of information prevents public action. If more specific instruction can be provided, then it is more likely to lead to action. It is the vagueness of information that allows warning recipients to reinterpret a warning in a non-threatening way. More specific warning messages produce higher levels of warning belief and perceived risk (Drabek 1986). Therefore, as recognised by the initiation of this project grounded in the public dialogues project, impact-based warnings specific to context have the potential to really add value in this area.

It is not directly addressed in the literature, but a tension is revealed between the continued uncertainty faced by the warning providers and the specificity of the impact information. It appears that a balance needs to be struck in sufficient generalisation so as not to increase the incidence of 'perceived' false warnings or the undertaking of unnecessary or redundant action. A means of conveying the uncertainty is required, thus managing recipient expectations.

The issue of false warnings is widely acknowledged (Drabek 1986, Parker and Budgen 1998, Environment Agency 2007a). It is in part recognised by Emergency Management Australia in guidance based on the experience of public response; Emergency Management Australia advised that a warning not followed by a flood should be

explained to warning recipients (Emergency Management Australia 1999[1]). This should be done as soon as possible to ensure retention of warning credibility and trust. Parker et al. (2009) suggested admitting shortcomings in the flood warning process when they occur, which could help to prevent mistrust or inaction to future warnings. In terms of language, Emergency Management Australia advised 'warners' to convey uncertainty where it exists, using words like 'may', 'probably' and 'likely' to describe potential impacts. Even so, a warning message should still say what people should do.

Public actions in response to warning levels before flood inundation occurs are a key objective of delivering a warning. Although the public often generally wants sufficient lead time to take action, there is also evidence that some members of the public would welcome a short lead time warning with targeted messaging about the likely short time to respond (Environment Agency 2011). It was accepted that, in some cases, it was not possible to provide a longer lead time for warning. However, if a flood warning was still provided and this short lead time clearly communicated, public respondents reported being grateful for the opportunity to save irreplaceable or sentimental items or begin to make arrangements, even though significant damage saving would not be possible.

The literature was not found to address the topics listed in Box 4.3 which were identified as evidence gaps relative to the aim of the project.

Box 4.3: Evidence gaps – what do the public need to know to take action

- Specific direction on local context cues that is effective in informing local public response to warnings
- How the context cues of the different public groups inform different actions in the build-up to flood inundation
- Public evaluation and understanding of forecast information
- How sources of information, including warnings and forecasts used by the public to make decisions for action, combine and are evaluated by them

4.2.3 What aspects of warning and forecasting 'works' (that is, results in action?) for the public groups?

To answer this question it is necessary to look at:

- the evidence about where flood warning has been successful
- the literature related to behavioural change

Parker et al. (2009) highlighted the importance of 'context' when understanding and interpreting the response actions of individuals. Relevant context includes not only past experience of floods and flood warnings, but also the physical characteristics of the flood (severity, speed of onset). This therefore needs to be considered in light of impact-based warnings. For floods with a slower build-up, for instance, it may be possible for a continuum of impact-based information to be provided to build knowledge and encourage actions to be developed as the flood becomes closer and the forecast more certain. However, this will not be possible in the case of faster onset events.

There is evidence to suggest that, in practice, members of the public often receive flood warning information from multiple sources and base their decisions about action on this information, including even not taking any action if they are not able to confirm

[1] This has been superseded by Manual 21 Flood Warning in the A Australian Disaster Resilience Handbook Collection published by the Australian Institute for Disaster Resilience in 2009. (https://knowledge.aidr.org.au/media/1964/manual-21-flood-warning.pdf)

that warning (Drabek 2000, Parker et al. 2009, Environment Agency 2015). The consistency of the information provided is therefore an acknowledged issue with flood warnings. It is also one that needs to be considered when any new information (such as impact) is added to warnings. This potentially includes not only consistency between different types of warnings, but also consistency within a chain of warnings (that is, the need to acknowledge and update a previous warning provided during the same event) and providing a means for warning confirmation.

In its flood warning guidance, Emergency Management Australia has thought through what is required to add value to flood warnings by including impact information and has found that the following advice works. A flood warning message that is likely to elicit response from individual members of the community is exemplified by the following:

> 'At the predicted height, A, B and C are likely to happen and accordingly residents should do X, Y and Z' (Emergency Management Australia 1999).

The home page of the website of the University of Philippines National Operation of Hazards (UP NOAH) project visually attempted to translate actual flood levels into a language more easily accessible to the public (Figure 4.1).

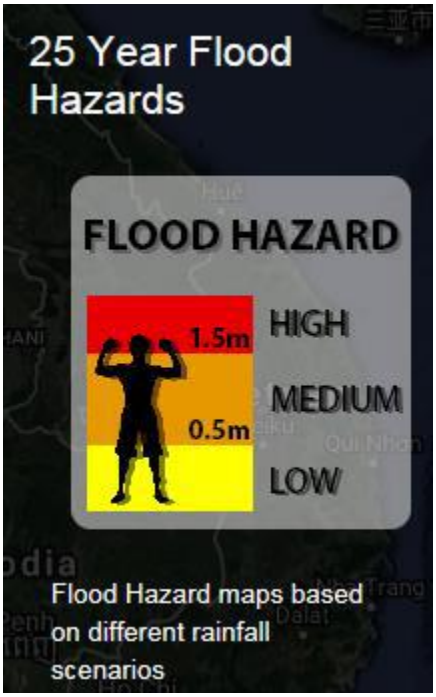


Figure 4.1 Example of warning illustration taken from the UP NOAH project in the Philippines

However, what is suggested from the literature takes this approach a number of steps further in developing inclusion of impact and context in the specificity of messages.

In its guidance, Emergency Management Australia advised that 'word pictures' that are 'forward looking' should be used. So instead of saying: 'A major flood of N metres on the town gauge is expected to arrive at time Y', the warning message should be:

> 'Serious flooding, reaching N metres on the town gauge, is expected by Thursday midday. Houses in A and B streets will be inundated, river flats between X and Y will be flooded and the Z bridge across the river will be closed' (Emergency Management Australia 1999).

This message reflects the concept-specific context or cues relevant to the local circumstances for public decisions and action, although the advice is to use only extremely well-known or visible landmarks. This reveals the tension in being specific to

different public groups and the warning message having a wider public relevance, particularly as relevant cues might be spatially widely distributed and different for different communities. It is suggested that additional information in the development of the incident can also be given with the flood warning messages also saying what has happened so far, such as 'The road from X to Y is closed at Z bridge'.

The value of historic benchmarking, identified in the public dialogues project, is also noted as useful giving the examples: 'This flood will be similar to the one in 1989' or 'This flood is expected to be significantly more severe than the flood of 1989'.

In relation to historic comparisons, however, communities may be aware of flood defence assets being put in place since that event or successfully being defended against more recent less severe events. Research by Scolobig et al. (2012) found that empirical evidence indicates that the public may have built trust in such mitigation and the authorities to defend them and, as in the case lack of trust in false warnings, incorrect heightened trust also means the public underestimate the danger and not respond to warnings. The authors advised agencies to communicate clearly that structural assets do not provide total safety. This implies that warning impact messages should include:

- information about the risk of flood walls or embankments overtopping or breaching
- the likely heightened impacts that this could create

So far, the focus has been on directing public decisions and then action. However, certain actions by the public may not be required or wanted by emergency managers and so information indicating what the flood will not do can also be useful.

Emergency Management Australia (1999) advised that a message might contain information about what the flood will **not** do, noting for example: 'At the predicted height, the flood is not expected to enter *the town of X'.* Attending to the issue that there are many different public groups, the advice from Emergency Management Australia (1999) is to prepare a number of messages 'with the needs of particular subsets of the community in mind … as well as general ones for mass communication purposes'. This, it is noted, increases relevance significantly.

Box 4.4 summarises the evidence gaps revealed by analysis of the literature on this topic.

Box 4.4: Evidence Gaps – what aspects of warning and forecasting 'works' (that is, results in action) for the public groups

- The complex interactions of possible context information (local cues, historic experience, trust in defences both ability and management) in public decisions
- Public trust in different sources of information and when it is used in the evolution of an event
- What forecasting messages work with the public?

4.2.4 What results in inaction or behaviour considered by public groups to be inappropriate?

It might be thought that not attending to the points promoting action will result in public inaction. Adopting a public education deficit model, Parker et al. (2009) identified 5 elements that those being warned need to understand to respond successfully to a flood warning. These elements involve perceiving and understanding:

(a) the risk of flooding

(b) the meaning of flood warnings of different types

(c) how to access and confirm flood warnings

(d) the most appropriate and effective range of responses to a flood warning

(e) how to respond actively

A lack of understanding or information about any of these elements could lead to inappropriate or ineffective behaviour.

Of course, impact-based warning messages will not be able to attend to all of these issues and the analysis assumes that just a lack of public knowledge challenges action. However, these elements or categories do provide a framework for considering the introduction of impact-based warnings. The first step is to think about:

- how an impact warning might be structured – that is, should potential actions within a structure of all actions be provided to satisfy point (d)
- how can they better include information about 'following' flood warnings or where to confirm them

Points (b) and (e) are fundamental to an impact warning – that is, that the impact warnings are clear and that they encourage positive, appropriate and effective actions that those at risk can take.

Impact information needs to be consistent with other information provided in say forecasting or warning. Although oriented towards the provision of warnings purely for surface water, the 'Surface Water Flood Warning Scoping' project (SC080034) did provide insights that were more generally applicable to other types of flood warning (Environment Agency 2011). When reviewing the potential for a surface water flood warning service, the project concluded that users were already suffering and potentially confused by the lack of a common language and colour coding between the different types of warning and alert services available. Although this will have improved for professionals following initiatives such as the Integrating Flood Services to Partners project, as noted above, more evidence is required to:

- identify clearly the types of messaging that would be suitable
- determine how specific (in terms of both locally and historically targeted) or general this messaging would need to be

But barriers to responding to warning messages are deeper than a deficit in the knowledge held by the at-risk public. In some cases, there is a considerable lack of trust of flood warnings and forecasts issued in authorities; this is a barrier to their current use and is likely to remain even when impact information is provided.

Environment Agency (2011) suggested that involving local people in the design and issuing of warnings would make them more reliable. Furthermore, behavioural literature (see, for example, López-Vásquex and Marvan 2003) suggests that when considering the community level, the public often place greater emphasis on the trust and credibility of authorities over specific types of information. This places even greater emphasis on developing local (contextual) impact messaging in partnership with local people being an appropriate approach, especially in areas where existing trust is known to be poor. But also obtaining the buy-in of local champions (such as flood advisory groups or flood wardens) to provide greater local confidence in the new warnings.

There are some variables, however, which may negate the effect of impact-based warnings, depending on what that warning is. For instance, Parker et al. (2009)

highlighted that fact that certain groups may display a lower than average response to flood warnings (impact or otherwise) for various socioeconomic reasons. These groups include:

- the elderly (Handmer and Ord 1986, Environment Agency 2004, Werrity et al. 2007)
- lower socioeconomic groups (Parker et al. 2007)
- those renting properties

These different groups may have differing constraints on their actions and therefore may require special consideration when developing impact-based messaging.

The evidence gaps on this topic are summarised in Box 4.5.

Box 4.5: Evidence gaps – what results in inaction or behaviour considered by public groups to be inappropriate?

- Specific guidance on disruptive or ineffective impact-related messaging, particularly in forecasts but also in warnings
- Understanding of how trust in message sources can be quickly built for different public groups
- What is considered inappropriate and appropriate behaviour from the public's point of view
- Impact and mitigation of false impact warnings and forecasts on public response

4.3 Professionals

4.3.1 Who are the professional responders?

A number of different types of professionals issue and also respond to warnings and forecasts. For the purpose of this review, 'professionals' are defined as:

- Environment Agency FIM duty officers
- Category 1 and Category 2 responders
- strategic decision-makers

Each professional type has between and within them specific roles, responsibilities and decisions prompting actions in the build-up, event and recovery periods. It is this specificity of requirements across all the roles and periods of the hazard cycle that this project has to address in relation to forecasts and warnings. The review draws out some general findings that can be considered across the groups within the project.

4.3.2 What do the professionals need or say they need to know to take action?

Emergency Management Australia (1999) identified that response agency professionals need the following to be provided in flood warnings:

- the time available before flood waters arrive or reach certain heights
- when the flood will occur (for example, during the day or at night)

- how long the flood will last (when it is likely to be safe for emergency service professionals and then the public to re-enter flooded areas)
- where the water will come from and where it will go
- the depth and velocity of the expected flood waters
- other factors which may affect safety

This is not to say that the public do not require the same information, but for professionals the delivery, format and scale might be different.

The results from Environment Agency (2011) following a review of professionals' experiences of the Extreme Rainfall Alert service responders suggested that to take action (other than awareness raising or seeking additional information), they would need a more specific warning (location and extent) with a high level of certainty to (c.70%). Professional partners questioned the economic efficiency of taking action below this threshold due to the high chance that this action would be redundant. However, they did state that earlier and less certain warnings are essential for making internal preparations and being ready to act. Furthermore, the results indicated that a minimum lead time of 2 hours was required for many actions (especially by local authorities) to ensure that they had specific time to respond. Any warning of impact needs to follow this timeframe. However, it is likely that impact lead times will differ greatly depending upon the response. It was also mentioned that, if the flood would occur outside general office hours, then an earlier warning would be essential for internal readiness to act.

The duration of an event was also considered important to professionals, in particular to enable staffing decisions to be taken and when personnel need to be retained on a standby basis or could be instructed to 'stand down' (Environment Agency 2011).

McCarthy et al. (2007) also found that forecasts immediately beyond the subsidence of flood water were important to the emergency services to:

- allow them to judge if it was safe to return their staff
- allow staff of the supporting organisation into the affected areas to continue working

In the surface water warning project, some professionals reported a lack of awareness of their local flood triggers and how to translate warning to impact. In order to provide useable impact flood warning messages, it may therefore be necessary for those issuing flood warnings to work with their local users to identify the key trigger points for different types of action.

In relation to the geographical scale of the warning, research also reported that partners wanted a minimum localised scale of impact at a borough, ward or city sector scale.

Box 4.6 summarised the evidence gaps for this question.

Box 4.6: Evidence gaps – what do the professionals need or say they need to know to take action?

- Technical capabilities required to deliver local community-specific actionable warnings
- Lead times required across all professional roles to make decisions to deliver effective action and their interrelationships

- Scales of topographic information required to deliver impact warnings and forecasts
- Support in training and materials required delivering impact warnings and forecasts

4.3.3 What aspects of warning and forecasting 'works' (that is, results in action) for the professionals?

In March 2011, the Met Office launched the impact-based National Severe Weather Warning Service. Each warning is given a colour based upon the likelihood and levels of impacts that may be expected from the forecast of severe weather.

The change of process required considerable training, much of which was provided by the team of Public Weather Service advisors, which now has 15 staff. However, feedback indicated that the local authorities, emergency services and other responders operating under the Civil Contingencies Act have obtained much benefit from the targeted and precise warnings provided (Harowsmith 2015). The primary route for the delivery of impact-based warnings to emergency responders is through the Met Office's Hazard Manager service. This provides headline information on the hazard probability and expected impact, and then offers a series of map layers of additional supporting information.

In terms of forecasting, the US National Weather Service has developed an Impact-Based Warning (IBW) tool[2] designed to convey impact information to professionals in severe weather forecast situations (tornados, floods and so on). The warning messages that go to professional partners (but not the public) now contain 'threat tag impact statements'. Table 4.1 gives examples of the threat tags and their associated impact statements for a tornado warning.

Table 4.1 Threat tags and their associated impact statements from the IBW tool for a tornado

Threat tag	Impact statement
Base	MOBILE HOMES WILL BE DAMAGED OR DESTROYED. DAMAGE TO ROOFS...WINDOWS AND VEHICLES WILL OCCUR. FLYING DEBRIS WILL BE DEADLY TO PEOPLE AND ANIMALS. TREE DAMAGE IS LIKELY.
Considerable damage	YOU ARE IN A LIFE-THREATENING SITUATION. MOBILE HOMES WILL BE DESTROYED. CONSIDERABLE DAMAGE TO HOMES...BUSINESSES AND VEHICLES IS LIKELY AND COMPLETE DESTRUCTION POSSIBLE. FLYING DEBRIS WILL BE DEADLY TO PEOPLE AND ANIMALS. EXPECT TREES TO BE UPROOTED OR SNAPPED.'
Catastrophic damage	YOU COULD BE KILLED IF NOT UNDERGROUND OR IN A TORNADO SHELTER. COMPLETE DESTRUCTION OF NEIGHBORHOODS...BUSINESSES AND VEHICLES WILL OCCUR. FLYING DEBRIS WILL BE DEADLY TO PEOPLE AND ANIMALS.

[2] www.weather.gov/impacts/

Source: Harrison et al. (2014, Table 1)

In focus group work on the tool's messages, weather forecasters expressed a great deal of scepticism about the need for the new tool, while emergency managers and broadcast meteorologists viewed it as something novel and effective. According to a Chicago broadcast meteorologist, the product added value because:

> 'the language is a lot more descriptive, urgent. It makes things easier for me because I can give this information out to the public in a clearer way' (Harrison et al. 2014, p. 8).

An evaluation of the tool reported that the strong and humanised language motivated a more urgent response. Emergency managers and broadcast media could simply copy and paste the simple and clear wording directly into their social media feeds, or repeat the warnings verbatim over the dispatch radio or television broadcast. This reduced their workload involved in digesting and translating the information. The evaluation report noted that:

- emergency managers with a lack of detailed knowledge of weather forecasting did not have to worry about misinterpreting the warning information
- the IBW product required less training to understand than previous National Weather Service products
- the enhanced language gave more confidence to emergency managers and broadcast meteorologists to make decisions

In addition, some emergency managers stated that they would make additional calls, heighten their level of preparedness, and distribute resources more efficiently if the IBW product was deployed (Harrison et al. 2014).

Am important issue for forecast and warning provision is the granularity of the information available. Use of local knowledge can enhance and build granularity in developing impact information in early warning systems (Cools et al. 2016). Local knowledge can complement scientific knowledge and measurements when formal data are insufficient (for example, to calibrate or validate the forecasting models). Cools et al. (2016) carried out case studies from Africa and Europe to demonstrate the use of early warning systems for flood emergency response. In Egypt, the local community provided field observations on the duration and peak water height of historic floods. In Mali, local knowledge was used to categorise the intensity of the floods. In Belgium, such knowledge was used to fine tune the alert thresholds.

With the growing capabilities of social media, opportunities of drawing on real-time local information either by monitoring social media chatter or gaining direct reports from – and dialogue with – the affected public can potentially enhance professional decision-making (WeSenseIt EU Framework Programme 7 project[3]).

Local knowledge is also instrumental in professional initiatives to strengthen communities' understanding and awareness of flood risk (Cools and Innocenti 2014), and in communicating flood risk. However, additional resources and staff roles are required for these activities, particularly where dialogue rather than monitoring is required.

No evidence gaps on this topic were identified from the literature review.

[3] https://cordis.europa.eu/project/rcn/106532/factsheet/en

4.3.4 What results in inaction or behaviour considered inappropriate by the professionals?

The inability of professionals to make decisions or to reach poor decisions might be considered inappropriate behaviour within this diverse group. Poor internal communication within professional organisations can be a barrier to effective action (Environment Agency 2011).

Although professional organisation communication is outside of the remit of this project, more specific impact warnings should hopefully provide more speedy and efficient decision-making within organisations and improve this factor. In addition, economic efficiency was an important consideration for professional partners in the project and therefore any impact-based warning information that led to more efficient taking of action would be welcomed.

The following concerns in relation to potential severe flood warnings were identified by this project:

- causing unnecessary and potentially costly response action
- desensitising warning recipients by overloading them with frequent warnings
- possibly causing confusion by adding a further 'type' of warning to those already existing

All 3 of these concerns are valid when considering the revision of the current service to provide impact-based warnings. However, questions are raised about when messages should suggest action that may have an associated cost. Although it is not expected that the introduction of impact messages will affect the actual rate of false warnings, it is necessary to consider whether providing different information will affect whether a warning is perceived to be incorrect and a false warning.

In the case of the US National Weather Service IBW tool, some forecasters felt the weather science and technology available did not allow for precision or accuracy in determining an appropriate IBW threat tag. Concerns were raised during an evaluation of the tool that there are too many unknowns to accurately communicate path, timing and duration for specific areas (Harrison et al. 2014). This introduces the question not only of technical capabilities, but also how to convey uncertainty between professionals. It was considered that impact statements should not be overly strong in their wording. Language used to convey confidence in messages may be too strong. For example, words like 'will' or 'confirmed' should be replaced with 'could,' 'may,' 'possible' or 'indicated'. Related to this is validation of the tag statement before release. Almost half of the weather forecasters emphasised the need for ground-truthing for the IBW product to be effective. Many concluded that trained spotter confirmation was critical to obtain the confidence to use a tag.

Finally, it is necessary to ensure that impact messaging does not add additional complexity to the array of warnings already provided. Importantly, understanding of a warning message cannot be taken for granted (Molinari and Handmer 2011). Impact-based flood warnings messages should therefore aim to add clarity to the warning rather than increase complexity. This may be a challenge considering the multiple groups receiving warnings. The evidence gaps on this topic are summarised in Box 4.7.

Box 4.7: Evidence gaps – what results in inaction or behaviour considered inappropriate by the professionals?

- The requirements for the internal communication of messages as a framework for impact messages in decision-making – includes levels of uncertainty and forms of communicating that uncertainty
- Impact and mitigation of false impact warnings and forecasts on professional decision-making
- Resource requirements for utilising local knowledge from new media sources in professional practice

5 Identifying user impact requirements (Task 3)

5.1 Stakeholder interviews and focus group design

Qualitative research was chosen throughout the project as an approach to enable sufficient flexibility to explore issues and processes as they were revealed by both professional and public stakeholders. This social research approach is robust and valuable in gaining insight into the issues and gauging the importance and relationships between them. Further social research in the form of a quantitative survey and/or real-life monitoring is required to evaluate proportionally the behavioural contribution of identified messaging changes among different at-risk public demographics, flood experience and overall in localities – in particular among the risk and warning unaware at-risk public which, for some communities, may be a majority.

5.1.1 At-risk public

Focus group interviews were conducted with the at-risk and flood experienced public in Keswick in the Lake District, Guildford in Surrey and Rhyl in north Wales. These locations were chosen to represent a range of flood hazard characteristics and provide spatial coverage across England and Wales.

Recruitment to the focus groups was organised by the NFF and they were facilitated by FHRC. The group attendees were all adult residents with flood warning experience and flood experience. The sample design was developed to capture relevant issues and processes among already engaged residents and, as such, reflects an older age group of the communities (40+ years). Recruitment was opportunistic rather than specifically reflecting the demographics of each community, with a focus on reflecting a range of experience and perspectives rather than specific demographics.

Each group discussion lasted up to 90 minutes. The discussions were saved using an audio recorder and later analysed. Table 5.1 gives details of each group. Summary notes from each group are provided in Appendix A.

Table 5.1 Details of public focus groups

Group	Date	Flood warning characteristics	Attendees
Keswick	10 July 2017	Rural, fluvial, fast onset	1 man, 2 women
Guildford	24 July 2017	Urban, fluvial, slower onset	4 men, 4 women
Rhyl	27 July 2017	Coastal/fluvial, slower onset	4 + 1 men,[1] 1 woman

Notes: [1] Included the disabled son of a participant with no verbal contribution.

5.1.2 Professional partners

A total of 17 telephone interviews were carried out with a range of professional partners as shown in Table 5.2. These interviews were undertaken by FHRC and CH2M, and were typically 60 minutes long. A summary of the approach and participants in the research is given in Table 5.2.

Table 5.2 Summary of professional partner research

Stakeholders	Approach	Partner details
Category 1 and 2 responders	9 telephone interviews Up to 60 minutes each July to August 2017	East Riding Yorkshire Council Medway Council Ashford Borough Council Kent Police Highways England Northern Powergrid Network Rail (x 2)
Strategic decision-makers	2 telephone interviews Up to 60 minutes each September 2017	Environment Agency Operational Resilience Environment Agency Area Duty Manager for Yorkshire
Environment Agency FIM duty officers	6 telephone interviews Up to 60 minutes each July 2017	West Midlands, Yorkshire, Devon, Greater Manchester, Merseyside and Cheshire, Warrington

Notes: [1] Two Monitoring and Forecasting duty officers and 4 Flood Warning duty officers

5.2 Findings: at-risk public

5.2.1 Engagement with flood risk

The focus groups identified 3 specific subgroups of the at-risk public:

- less engaged residents
- engaged residents
- highly engaged residents

The specific characteristics of each sub-group are shown in Table 5.3.

The composition of the initial public focus groups consisted of the 'highly engaged' and 'engaged' resident types to gain insights about messaging content that was considered valuable and less valuable to their decision-making. 'Less engaged' residents were the focus of the Task 5 message testing (see Section 2.5 for details).

Table 5.3 At-risk public subgroups

Sub-group	Characteristics
Highly engaged residents	• Indications are that this type is few in number in each community. • They are highly motivated, technically and experientially knowledgeable. • Flood warning levels, when available, currently act to support their interpretations of severity and progression. • They forecast and interpret local contexts, communicating them onto their local community of interest (email lists).

Sub-group	Characteristics
	• They receive and have tailored communications with local Environment Agency, Met Office and others.
Engaged residents	• Indications are that this type is larger in number in each community. • They are highly motivated and experientially knowledgeable. • Flood warnings dependent for alerting and understanding the level of severity (useful!) • Local observations inform individual forecasting and interpretation of impacts. • They are informed by tailored communications with highly engaged residents (if linked). • Their experienced-based reactions depend on individual anxieties and responsibilities.
Less engaged residents	• Indications are that this type makes up the larger part of the community.

It was notable that flood warnings content had to be introduced to the discussions in each group about decision-making. The natural focus was on the alert/warning levels and other sources of information used such as weather forecasts, river levels and other environmental cues that may raise concerns. However, the following were indicated.

- Warnings help to initiate awareness and the flood warning levels inform progression in severity of the event (that is, receiving a flood alert and then a flood warning).
- Warnings are mainly received via audio telephone calls.
- Alerts prompted actions for a few and were ignored by others based on their past experience.
- Responses for why alerts were ignored included that they were ‘irritating’ and ’worrying’. Others ignored the messages as they felt they were just a token gesture for communities that had benefited from investment in flood risk management defences (some residents felt ‘abandoned’).
- Warning levels, personal local observations, resident interactions and weather information dominated decision-making.

5.2.2 Example of current informative content

The highly engaged and engaged residents were able to identify and provide examples of informative of informative content that they thought worked well to inform their current decision-making. Some making. Some examples of this content and some of the observed details are given in

Table 5.4. The full content is provided in Appendix B.

Table 5.4 Examples of residents' informative content

Message type and originator	Observed details
Met Office email to a highly engaged resident	The email is tailored and with a tone that has been developed by dialogue over time to be warm and friendly. Impacts are: • severity summary in heading • time and local location specific • event progression illustrative • descriptive (from example, impacts on trees, heavy goods vehicles) The timing of further announcements is specified. The email acknowledges local past experience and anxieties. The email uses restrained humour. Reassurance of continued support is implied in the email.
Highly engaged resident email to email-linked residents	This is a tailored email sent to a large local circulation list that includes: • residents • local businesses and attractions • local organisational contacts The email uses an informal tone and contains elements of impacts: • local actions • locally specific • progression • personal urgency • bed & breakfast closure) The email contains: • reassurance of ongoing support • confirmation of the flood warning alert • local impact cues (locations) of lakes and flood defence 'glass panels'
Highly engaged resident content suggestions	Contain impactful elements addressing: • locally specific – location and times • possible progression and uncertainty • ongoing sources and further support BUT still includes historic references and still focuses on in-bank levels requiring specific knowledge rather than inundation impacts

5.2.3 Local impact cues

A number of local impact cues were mentioned across the 3 focus groups when residents described their decision-making (Table 5.5). These cues were used in the test messaging for Tasks 4 and 5. The cues identified include buildings, roads, bridges, carparks and flood defence assets.

Table 5.5 Local impact cues mentioned by focus group participants

Location	Local impact cues
Guildford	Millmead carpark
	Town bridge
	The Electric Theatre / riverside café
	Basement of Bridge Street carpark
	Basement of Bedford Road carpark
	Autologik garage on William Road – 'time to panic'
	Towpath near Stoke Lock
Keswick	Local lakes/reservoir levels
	Ground saturation
	Flood defence glass panels
Rhyl	Relevant immediate coastal frontage

5.2.4 Summary of at-risk public findings

Table 5.6 contains an overall summary of responses from the at-risk public.

Table 5.6 Summary of at-risk public findings

Key question	Response
Would more impactful information be welcomed?	Yes – more specific; topographically, temporally, locally relevant and resonant
Would it be acted on?	Yes, but actions vary depending on context of individuals and additional information sources used
What form is envisaged?	Local impacts with tiered enhancements addressing individual technical understanding and engagement with the hazard

5.3 Category 1 and 2 responders

Table 5.7 provides a list of the findings from interviews with Category 1 and 2 responders. An overall summary of these responses is given in Table 5.8.

Table 5.7 Category 1 and 2 responder findings

Category 1 or 2 responder's organisation	Finding
Kent Police	• All forms of Environment Agency warnings and Hazard Manager are monitored. • The Flood Guidance Statements at 10.30am are 'religiously awaited'. • Once formed, the Severe Weather Advisory Group is the main source of information via meetings and directly with already established membership relationships rather than warning content. • They are already knowledgeable about local impact cues. • More specific and impact content welcomed. • New content would require further training. • Issue if new content conflicts with their experience. • New content could be placed on the force's website.
East Riding Yorkshire Council, Medway Council, Ashford Borough Council	• They are focused on support and recovery. • Receive warning levels individually and as an organisation. • Reactions to warnings are dependent on the locations. • Severe Weather Advisory Group informs content issues which develops into the Tactical Coordinating Group. • Have internal experts but Severe Weather Advisory Group/ Tactical Coordinating Group interaction is key. • More specific information would help (inundation area). • Synchronisation between public and professional warnings vital if more specific in content, so that council can be prepared in time. • New content would be useful to feed into their public facing departments. • Familiar with uncertainty related to more specific content. Felt post-event feedback to the public would help mitigate false warnings. • Training might be required.
Northern Powergrid	• Inspection plans in part activated by Flood Guidance Statement levels plus wider hazard forecasts (for example, wind) and asset failure alerts. • Work one step behind Flood Guidance Statement levels. • Activate and rely on 'flood warning co-ordination inspectors' for visual onsite feedback and infrastructure activities (acceptable level of performance).

Category 1 or 2 responder's organisation	Finding
	• Use Environment Agency 'Flood Warnings for Infrastructure' application. • Uncertainty guidance could inform to save on upscaling decision costs on event mitigation actions.
Network Rail	• Requirement is highly specific to flood experience on rail route (for example, landslip, bridge scour). • Main decision support is the Network Rail Weather Service. • Where relevant, use local telemetry and direct links with the Environment Agency. • Key information obtained from reports by train drivers and inspections by ground staff. • Uncertainty guidance would be useful if specific to its assets.
Highways England	• Main information obtained from the Met Office Resilience regional contact. • Makes internal use of the Hazard Manager, Severe Weather Information System • Mainly uses Met Office alerts, Internal Hazard Manager and Severe Weather Information System • Joins Severe Weather Advisory Group for further updates. • Considered that most of its assets are out of risk. with impacts related to other organisations.

Table 5.8 Summary of Category 1 and 2 responders' findings

Key question	Response
Would more impactful information be welcomed and would it be acted on?	Yes, but information and support are already available from other internal and external direct sources
What form is envisaged?	Specific location of impacts: water depth at their impact, site concerns, number of houses affected Event progression

5.4 Strategic decision-makers

The telephone interviews with the strategic decision-makers highlighted that they were not end users of the flood warning service. This group has a role in developing high-level impact content on the numbers of properties and numbers of people affected. This information is fed into the 'slide packs' for strategic decisions with other professional partners.

The strategic decision-makers did make the comment that historic comparisons were useful for their understanding of the event (especially for new staff). They also felt assessment of smaller flood events would be useful in the future.

5.5 FIM duty officers

The telephone interviews with the FIM duty officers focused on 2 discussion areas:

- obtaining views relating to their understanding of the needs of both the at-risk public and the professional partners
- the current process of developing messages and identifying what changes might be needed to provide more impactful information

The current message creation process typically has the following main steps:

1. Modelling/forecast
2. Communication between Monitoring and Forecasting duty officers and Flood Warning duty officers
3. Consult procedures guidance for specific flood warning area
4. Possible contact with the flood warden
5. Use of a local tool to help write the message and save the last version of the message for future updates
6. Issuing of messages through the system
7. Updating messages through the system

For professional partners, additional content/deliverables are created including:

- direct phone calls with organisations to provide more detailed information and context
- pre-determined deliverables such as spreadsheets giving predicted levels against identified assets

In some areas, flood warning messages are issued with selective additional content included at the bottom of the message.

Each flood warning area has some form of tool or template to help compose or update the message. This varies between areas in terms of content but is either a PDF template, a Microsoft® Word document or a Microsoft Excel spreadsheet.

Each area has its own procedures guidance that may be tailored to each flood warning area.

In terms of using more impactful information, the following important observations were noted.

- There is a general focus on using the national generic guidance to simplify and provide consistency in message delivery.
- Where there are no available data, sections are often omitted. The availability and/or quality of the data was seen as a potential barrier to including more impactful information.
- As such, there is a tendency not to include specific community impacts/actions, but provide standard higher level information. Wider

research evidence indicates that less locally specific messaging is unlikely to result in action.

A common theme raised by the FIM duty officers was how uncertainty is dealt with. The following observations were noted,.

- There is variability in the quality and spatial/temporal resolution of the modelling and forecasting data.
- This leads to inconsistent confidence in the forecast.
- This can lead to inconsistent decisions about whether to issue a flood warning.
- The uncertainty/confidence affects the type and level of detail of impact information that can be contained in the message.
- Confidence is developed through relationships between the Flood Warning duty officers, the Monitoring and Forecasting duty officers and flood wardens. This can inform the impact content of the message.

6 Developing impact/context messages (Task 4)

The findings from the Task 2 evidence review and Task 3 research were used to develop the content of ‘impactful’ flood warning messages. These impactful messages were developed to adhere closely to the existing guidance on writing flood warnings, but with small enhancements to introduce more impactful content.

The team analysed the stakeholder responses and outputs from the evidence review to identify the most important impactful content. Specific messages were developed for each of the 3 focus group locations so that they could incorporate local information. This local information was identified from the Task 3 focus groups and through desktop research of previous flood warnings, available modelling outputs and media reports of previous flood events.

In addition to the ‘impactful’ messages, content was also developed to reflect ‘typical’ existing flood warning messages. These were used to help the focus groups compare and contrast between the 2 types of messages. The typical messages were developed recognising that current messages do not always follow the writing guidelines due to a number of reasons identified by the FIM duty officers (constraints on data, certainty, time and so on). The content of these messages was based on previous flood alerts or warnings for each area and/or by modifying flood warnings or alerts being issued in January to February 2018.

If the update and remove messages are included, there are currently 8 different types of flood warning message (Table 6.1).

Table 6.1 Types of flood warning messages

Flood alert level	Typical (base case)	Impactful
Flood alert	✔	✔
Flood warning	✔	✔
Severe flood warning	X	X
Flood alert update	✔	✔
Flood warning update	X	X
Flood alert remove	X	X
Flood warning remove	X	X
Severe flood warning remove	X	X

For testing, it was decided to focus on just 3 message types:

- flood alerts
- flood alert updates
- flood warnings

Severe flood warnings were not included as feedback from the focus groups indicated that residents' ability for preparatory decision-making and response was very limited at this level of warning. Also, the content of these messages is similar in nature to the flood warnings. Flood alert updates were included to see if impactful information was useful when describing how a flood event progresses. This was a requirement expressed by respondents in Task 3 focus groups.

The messages were developed in the form of written materials for the workshop participants to read. According to the focus groups, flood warning messages are usually received by residents as audio telephone calls. It was decided that, for this project, a focus on content would be better served in the non-audio format but audio representations should be considered for future research in relation to convenience of information and motivation.

An example of both the 'typical' and 'impactful' flood alerts, flood alert updates and flood warnings for the Shipston-on-Stour workshop[4] are shown in Figures 6.1, 6.2 and 6.3 respectively. The messages for the Guildford and Rhyl areas are provided in Appendix C.

A 'typical' flood alert

River Stour in South Warwickshire
The current level in the Shipston river gauge is 1.21 metres. River levels are rising on the River Stour, with flooding possible tonight. River levels are expected to peak between 2.9 and 3.1 metres at 2.00am.

Over the past 6 hours there has been 8 millimetres of rain. Further rainfall is forecast over the next 12 hours.

For a more detailed weather forecast for your area, please see the Met Office website (www.metoffice.gov.uk).

An 'impactful' flood alert

River Stour in South Warwickshire
Over the last 24 hours we have seen heavy rainfall in the Shipston area. This has meant that the River Stour is now rising and flooding is possible from 11pm today (Monday 5th February).

The main area of concern is around Mill Street, where forecasts suggest there could be flooding to low-lying land and areas close to the river and around the bridge at the Old Mill.

No flooding of property is currently expected. Further heavy rainfall is possible overnight and this would cause river levels to rise again. This message will be updated this evening or earlier if the situation changes.

People in these areas should consider taking action now. We urge all people to take care and not to drive through flood water.

We are constantly monitoring river levels and have staff in the area checking for and clearing blockages in this location.

[4] An alternative to Keswick (see Section 2.5)

Figure 6.1 'Typical' and 'impactful' flood alerts for the Shipston-on-Stour area

A 'typical' flood alert update

River Stour in South Warwickshire
River levels remain high on the River Stour in the Shipston area. Flooding to low-lying land and roads is expected to continue. Further rain showers are expected to continue on Tuesday and Wednesday.

We will continue to monitor the situation.

Take care near areas of concern and monitor your local weather conditions and the GOV.UK website.

An 'impactful' flood alert update

River Stour in South Warwickshire
Over the last 8 hours we have seen further heavy rainfall in the Shipston area and the River Stour has continued to rise.

The main areas of concern are Mill Street and the A3400, where our forecasts suggest that flooding of roads close to the river is possible. There has already been minor flooding of the car park near the bridge at the Old Mill.

River levels are now forecast to peak from 9am tomorrow (Tuesday 6th February).

People in these areas should consider taking action now. We urge all people to take care and not to drive through flood water.

We are constantly monitoring river levels and have staff in the area checking for and clearing blockages in this location.

This message will be updated tomorrow morning or earlier.

Figure 6.2 'Typical' and 'impactful' flood alert updates for the Shipston-on-Stour area

A 'typical' flood warning

River Stour in South Warwickshire
Up to 30 mm of rainfall has fallen in the last 24 hours, which has caused river levels to rise on the River Stour. Showers are continuing, with some intense bursts. It is expected that this warning will in place for a number of days.

The level at the Old Mill Bridge gauge is currently at 2.605 metres. Surface water ponding may already be affecting low-lying land and roads.

Flooding to properties is expected in the Shipston area later this evening (Tuesday 6th February) and into tomorrow morning (Wednesday 7th February). Immediate action is required.

Whilst the flood warning is in force, the Local Authority will close Mill Street and the A3400. Diversionary routes will be put in place and further updates will be available through local media.

This message will be updated as the situation changes.

An 'impactful' flood warning

River Stour in South Warwickshire
Heavy rain is currently falling in the Shipston area and will continue throughout the day (Tuesday 6th February). This is causing the River Stour to rise and it is forecast to continue rising through tomorrow morning.

Low-lying areas near to the Old Mill are already flooded. Properties and roads around Mill Street and the bottom end of Telegraph Street will start to flood first from around 10.30pm tonight. Further flooding could occur along the A3400 from 4am as river levels rise. River levels will be at their highest between 7am and 9am tomorrow (Wednesday 7th February).

Flood waters may be knee deep and fast-flowing in all these areas. Residents are strongly urged to take action now. Remain safe and be aware of your local surroundings.

We will be closely monitoring the situation throughout the night and this message will be updated as the situation changes.

Our staff are out in the area and will relay information and assist the emergency services and council.

Figure 6.3 'Typical' and 'impactful' flood warnings for the Shipston-on-Stour area

7 Testing approaches on user groups (Task 5)

The workshops with the at-risk public were again organised and recruited by NFF and were facilitated by FHRC and CH2M. Attendance at these workshops was incentivised (£20 per participant) to attract residents who satisfied the 'less engaged' group identified in Task 3.

The workshop participants were all adult residents with flood warning experience. At Guildford and Rhyl, some participants had also attended the initial focus groups but incentivisation meant at least half of all the workshops were made up of less engaged residents. Again, the sample design was developed to capture relevant issues and processes among already engaged residents and as such reflects an older age group from the communities (40+ years). Recruitment was opportunistic rather than specifically reflecting the demographics of each community, with a focus on a range of experience and perspectives. Each workshop lasted up to 90 minutes. Details of the 3 workshops are provided in Table 7.1.

Table 7.1 At-risk public workshops

Workshop	Date	Flood warning characteristics	Attendees
Shipston-on-Stour	5 February 2018	Rural, fluvial, fast onset	6 men, 2 women
Guildford	19 February 2018	Urban, fluvial, slower onset	6 men, 4 women
Rhyl	13 March 2018	Coastal/fluvial, slower onset	8 men, 3 women

Each workshop began with the introduction of each participant and details of their flood and warning experience. The participants were then divided into 2 smaller working groups based on more and less engaged residents.

Each group was facilitated individually and presented sequentially with the series of flood alerts and warnings developed during Task 4 (see Section 6). Participants were not told that some messages were 'typical' and that some were 'impactful'. With the presentation of each warning message, participants were encouraged to give a critique on the messages as a whole and on their individual elements. They were able to compare between the 'typical' and 'impactful' messages as they were gradually presented. Individual and group responses were elicited. The discussions were saved using an audio recorder, transcribed and later analysed (see Appendix D).

8 Findings and recommendations (Tasks 6 and 7)

This section draws together the outputs from Tasks 2, 3 and 5 to form a series of findings. From these findings, a number of recommendations were identified and are presented in Table 8.1 and 8.2.

8.1 Findings

The bulk of the findings relate to the use of impactful content in the flood warning messages. In addition, the project drew out a number of other wider observations and findings related to the creation and delivery of flood warning messages.

The methodology used in this project was developed to identify the key issues related to putting impactful information into flood warning messages. Qualitative research was chosen as the approach throughout the project to enable sufficient flexibility to explore issues and processes as they were revealed by both the professional and public stakeholders.

This social research approach is robust and valuable in gaining insight into the issues and gauging the importance and relationships between them. Further social research in the form of a quantitative survey and/or real-life monitoring is required to evaluate proportionally the behavioural contribution of identified messaging changes among different at-risk public demographics, flood experience and overall in localities – in particular among the risk and warning unaware at-risk public who for some communities may be a majority.

It should be noted that the test materials were in written format rather than the audio messages usually received by residents. An understanding of the content delivery and motivation via an audio format may benefit from further research.

8.1.1 Putting impactful content into flood warning messages

The overall finding is that impactful content is supported by residents as a way of conveying flood risk information that enhances their decision-making, leading to action. Impactful content is most meaningful when developed and delivered at a local scale.

However, there may be a number of technical and local information constraints to achieving this for all flood warning areas at this time. FIM officers are clearly concerned about their technical ability to provide more impactful locally specific message content in certain catchments. But both in this and other research, the evidence indicates less locally specific messaging on its own is unlikely to result in action.

The evidence also indicates that the public may have built trust in existing flood mitigation to defend them and, as in the case of lack of trust in of false warnings, incorrect heightened trust also means the public underestimate the danger and do not respond to warnings. This research questions the usefulness of issuing the formal warnings to these particular communities or, whether by engaging with these communities, more useful information can be provided to improve impactful warnings such as:

- local sensor triggers
- local weather stations
- proxy upper catchment information
- the centralised information sources already used by the residents to inform their actions

The impact of such additional activities on a resident's decision-making was not tested in this research.

The specific text used to describe impacts within messages needs to be carefully considered and developed locally in partnership with residents. There were mixed views on the ways to describe flood depth, but there was general agreement that this information should be paired with a carefully chosen locations. These locations need to be determined at a local level to identify sites that resonate with local communities as a whole. Producing more impactful content requires preparatory and post-event engagement with communities regarding flood warnings.

There was more consistent agreement that historical impact comparisons were likely to be confusing, as the local context may have changed since the historic event.

A full list of the findings related to the use of impactful content is provided in Table 8.1.

Table 8.1 Summary of main findings and supporting evidence for impactful content

Reference number	Findings and supporting evidence	
1	There is support for impactful content on fluvial flooding. However, it requires detailed local knowledge of common decision trigger locations for the local community concerned.	
	Detail:	In general, this information was desired as it enabled a locally specific impact to be described which residents said would help them understand and act. However, there are challenges in using reference locations. • Not everyone can relate to them – though there is the possibility of learning over time with use. • There is a risk that, if not articulated carefully in the message, these specified locations are seen as the only areas at risk and not a wider impact. • The approach is unlikely to work well in large areas – so in alerts they will be less effective if a flood alert area is very large.
	Evidence:	Consistent response from the Task 3 focus groups and Task 5 public workshops
2	Coastal communities focus on their at-risk coastal reach and weather characteristics (onshore wind direction) relevant to their home.	
	Detail:	Coastal communities have different information requirements. Notably, additional hazard information (onshore wind direction) enabled individuals to assess likely impacts at their home. There was a consistent

Reference number	Findings and supporting evidence	
		desire for this to be included in the message to enable an informed decision. There are challenges in using reference locations, particularly in coastal areas that have very large alert areas. These challenges include identifying localised at-risk locations and conveying them in a concise message.
	Evidence:	‘But what does it mean for me?’ ‘That’s not my area, so I won’t worry about it.’
3	The scale of flood warning and particularly flood alert areas was seen as a barrier to more local impactful information.	
	Detail:	• Flood alert areas are often much larger than the flood warning areas. • Large alert or warning areas may require several local impact markers; this is difficult to convey in a single message.
	Evidence:	‘I think we get one alert for all of north Wales – it means nothing so we don’t get them anymore.’ The research in the Guildford area highlighted how different points along the river were at risk of flooding. Some residents could not relate to some areas.
4	The use of historical comparison was favoured by some, but others had concerns. There was the potential to exclude the flood inexperienced and be misleading for the current local context	
	Detail:	• Not everyone will be aware of previous events. Some areas will not have a recent flood for comparison. • Flood defences may have been built and modified the flood risk. • The flood hazard and impacts at any specific location can vary significantly depending on the hydrology and antecedent conditions for each event.
	Evidence:	Responses from the Task 3 focus groups. These elements were not tested in the Task 5 workshops.
5	Describing depth of flooding: a range of descriptive phrases was used in relation to identified preferred locations, but all received mixed feedback.	
	Detail:	Ankle/knee/waist/neck deep was seen as very descriptive, but there were concerns as to how variations within a given location could be misleading and dangerous.
	Evidence:	‘It might be knee deep on the street, but ankle deep on the kerb.’

Reference number	Findings and supporting evidence	
		'Everyone knows the difference between knee deep and neck deep.' 'It depends if it is the top or the bottom of that street.'
6	Message order and 'punchiness'	
	Detail:	• Responses indicated that people wanted to know the 'what was going to happen' information first, followed by information about 'why', times and so on. • Impactful messages were longer than the typical messages. • Initial reactions from respondents were that they preferred the shorter 'typical messages'. However, further discussion around the content both in isolation and compared with the impactful messages did identify that there was additional information that they would find useful.
	Evidence:	'We want to know the key information first.' 'Messages should get to the point.'
7	Progression of flood events using local information (temporal)	
	Detail:	• In general, residents wanted to know what was going to happen. • Residents wanted to know the progression of events using impactful descriptions. • All residents use other information sources (for example, weather forecasts and observation). Engaged residents use more sophisticated information (for example, river telemetry, coastal wind direction, observations of soil saturation).
	Evidence:	There were lots of different viewpoints as some wanted to know what had happened and what had changed. Some engaged respondents did still want to make their own assessment of impacts based on the rainfall/river data.
8	The wording of the impacts in the messages should not be technical, but not over-simplified either.	
	Detail:	References points such as 'Asda', 'the doctor's surgery' and 'the 'pub car park' were all acceptable.
	Evidence:	When describing impacts or anything else: 'Use plain English, but don't dumb down too much.'
9	Timing information was viewed as generally useful but too many times were confusing.	

Reference number	Findings and supporting evidence	
	Detail:	Some messages provide high tide times and the time periods for which the risk of flooding is high for several days in advance.
	Evidence:	'This message has so many times, it is confusing.'
10	Context of community issues	
	Detail:	Need to consider local issues and the context in which an alert is being issued. There is a need to listen to what people in communities regard as significant local features, local priorities and information requirements. This will override information that is important elsewhere.
	Evidence:	'Warnings are seen as purely cosmetic if there are known issues that are not being addressed.'

8.1.2 Wider observations and findings

A number of wider observations and findings were also drawn out from:

- feedback at the Task 3 and Task 5 workshops
- the project team's observations when developing messages

These were captured and are shown in Table 8.2.

Several issues were consistently raised regarding the purpose of the flood warning messages and the meaning of the specific alert levels. Some viewed the alert levels as the trigger for appropriate action, while others felt that the content should indicate specific impacts and actions. The idea of being able to access increasingly detailed (cascading) information was widely supported. This was related to the issue of where and how recipients of the messages could obtain further information.

Another issue that was widely discussed was the tone of messages. This related to both the content and the voice used in the audio messaging system. Some respondents indicated that this format was not reassuring and was more likely to leave them anxious without being informed (Figure 8.1). Others felt the tone was too calm and not emphasising action.

> The tone of the audio warning message is 'not reassuring' and it is 'not easy to determine severity of impacts.

Figure 8.1 Example of feedback from an at-risk resident

Table 8.2 Additional wider observations on the creation, delivery and take-up of flood warning messages

Reference number	Findings and supporting evidence
1	The warnings and alerts currently being issued vary significantly. There are examples that align closely with the writing guidance and examples that differ significantly.

Reference number	Findings and supporting evidence	
	Evidence:	General observations while collating examples of messages issued in January to February 2018
	Note:	The project team is aware of projects looking at guidance for the flood warning message service to address national consistency and to develop local content.
2	A repeated response was that vague statements do not help describe what is expected to happen and do not encourage action.	
	Detail:	Words and phrases that were identified as ones to avoid included ‘could’, ‘should consider’ and ‘may lead to’. ‘Local media’ was mentioned as vague by several responders.
	Evidence:	Consistent response from the Task 5 workshops. • ‘If it’s not definitely going to happen then we’ll wait and see.’ • ‘It would be useful if we knew what media we should tune into.’
3	Some alerts and warnings are very concise and short – this may be due to constraints on the FIM duty officers or it may be that this approach has been agreed with local communities for certain flood warning areas. The Task 3 and 5 groups indicated that flood alerts could be very brief as the content was less important than the level which triggered a response.	
	Detail:	• Some messages are sent out blank. • Some messages have very limited information.
	Evidence:	• Feedback from Task 3 focus groups • Discussions with FIM duty officers: ‘We don’t have enough time – there is not enough warning or we have too many to issue.’ • For some residents, the mere ringing of all their subscribed phones at the same time was enough to alert them.
4	Flood alert levels are still not widely understood and inconsistently applied. There is generally not an awareness of whether the alerts are ‘ready, steady, go’ or ‘minor, bad, severe’. There is a wide range of views on what the primary purpose of the flood warnings and flood alerts is.	
	Detail:	• Warnings were seen to be many things, including: - a replacement for context-specific plans - information and tools such as evacuation plans

Reference number	Findings and supporting evidence	
		- locally developed community plans - an understanding of, and plans for, vulnerable people • Some flood alerts indicate that 'some flooding of properties may occur'.
	Evidence:	Review of recent flood messages and feedback from all focus groups
5	There was consistent acknowledgement that further information should be provided through links to other sources. Cascading information allowing more detail to be accessed was widely supported.	
	Detail:	• There is quite a high expectation that the linked information is adequate to their needs. • There was concern that this information should be consistent between sources. • There was recognition that different user groups would require information in different ways.
	Evidence:	'The message doesn't tell us … but that's probably because it is in the linked sources.' 'Older people can't access the internet.'
6	Using the phone system for more information: having a more complex phone system with cascading information would allow appropriate detail to filter to those who want it.	
	Evidence:	'Can we have a menu system where it says, 'push 1 for more information?'
7	There were consistent comments that the automated voice system disengages listeners.	
	Evidence:	'Is not reassuring' 'It is not easy to determine the severity of impacts.'
8	The tone of messages was identified as being important in getting a good balance between 'informative and action prompting' versus 'panic and anxiety inducing'.	
	Detail:	There was a significant difference in viewpoints. Responses indicated that more definitive wording would be more likely to lead to action, but that this wording was also more likely to cause 'anxiety and panic' to more vulnerable residents.
9	The issue of false alarms was raised consistently across all groups. This was particularly related to the high number of alerts that were received.	
	Detail:	• Too many alerts were seen as stressful, which could lead to them being ignored.

Reference number	Findings and supporting evidence	
		• Cancelling alerts without explanation reduced trust. • There was some confusion among residents about if they could opt out of receiving alerts.
10	The coastal community of Rhyl identified several coastal specific issues.	
	Detail:	• Onshore wind direction is a critical factor – 'this should always be included in the information'. It was noted that this would only be useful if the flood alert or flood warning area was small enough. • There can be separate flood warning areas for coastal and fluvial flood risk. This can be confusing to local residents who live in close proximity to each other, yet are receiving different messages.
11	Use of metric and imperial units	
	Detail:	• Residents consistently commented that the use of metric units was confusing and requested imperial units. • The use of technical references such as ODN [Ordnance Datum Newlyn] was not understood, and so had little relevance in the messaging.

8.2 Recommendations

The findings from all the tasks within this project were used to develop a series of recommendations. These have been grouped into 4 categories:

- putting impactful content into flood warning messages
- flood warning levels and delivery
- technology and media
- further investigation

8.2.1 Putting impactful content into flood warning messages

The overall recommendation is that including impactful content in the flood warning messages should be explored further for operationalisation as it has benefits to help understanding of flood risk and could encourage greater action. The following specific recommendations were identified.

Content

- While welcomed, it was indicated that more impactful messaging was not essential to decision-making for Category 1, Category 2 and strategic decision-makers. Development resources should be focused on at-risk residents and enabling FIM duty officers to provide such messaging.

- The existing warning writing guidelines should be followed as they provide a format generally favoured by residents. Not all messaging currently follows the nationally-consistent guidelines. These messages can be enhanced through the addition of impactful local content. It may be appropriate to deviate from guidance towards more concise flood alerts to be issued – perhaps for communities who receive these regularly.
- The possibility for at-risk residents to opt out of alerts could be promoted, but only following opportunities for those communities to experience the enhanced and more concise messaging.
- For fluvial catchments, specific marker cues and locations need to be identified with individual communities and a range of engaged residents. Impactful content such as 'flooding will be ankle deep' will only be informative when paired with a specific location such as 'in the Asda car park'.
- For coastal areas, consider smaller flood alert areas. This should reduce the number of false alerts and provide an opportunity to include more detailed information such as wind direction. The nature of coastal flood risk may mean that specific local impactful information is harder to identify and include in the message content. For these communities, warnings would be enhanced when grounded in local storm, high tide and onshore wind direction forecast information or linked information.
- In general, avoid historical comparison with past local flood events as this may not be meaningful to all residents, and may not reflect the different nature of each flood event or flood risk management changes since that event.
- Impact cues need to be carefully worded so as not to imply that they will be the only flooded areas. Possible wording could be clear about this, for example: 'flooding is expected to first affect the Asda car park at 9am on Tuesday before spreading further'.
- The use of imperial units was required for some of the engaged residents who pointed out that metric units were meaningless to them.
- For all warnings related to high tides, consider either (a) issuing new alerts for separate event days as individual sequential updates or warnings, or (b) giving a single long timeframe over which impacts may occur. Putting too many times in messages was found to be very confusing and discouraged the take-up of the flood warnings.

Message structure

- The message structure currently outlined in the writing guidance tends to follow a storyline approach. Our feedback suggests that the public would prefer to receive headline-driven messages with the most important impacts and actions at the beginning of the message. Figure 8.2 shows a comparison of the existing and recommended message structure. Impactful information may increase the message length and so care needs to be taken when including this content.
- Keep messages as concise as possible, especially for flood alerts. Avoid all duplication. Put key elements at the top – impacts and actions. There is no requirement to follow a storyline approach.

Existing

Weather > River/coastal conditions > Hazard > Reassurance > Further information > Generic actions

Recommended

Local impacts > Specific actions > Local weather > River/coastal conditions > Hazard > Reassurance > Further information

Figure 8.2 Existing and recommended message structure

Message tone

- Wider research has indicated that strong and humanised language motivates a more urgent response. The research for this project consistently identified that the automated voice system disengages listeners who 'switch off' while waiting for the key information.
- The public focus groups identified the need for a tone that strikes a good balance between 'informative and action prompting' versus 'panic and anxiety inducing'. The highly engaged residents highlighted examples of direct communications from other sources (for example, the Met Office and flood wardens) that adopted a much more human tone. These acknowledge local past community experience and the anxieties of a flood event. They also contain locally specific locations and times, plus reassurances of further support.
- As the majority of flood warnings are received via phone messaging, regional variations in tone or language should also be considered to improve engagement (human) and impact (urgency).
- The examples of communications provided by the highly engaged residents consistently showed awareness of local issues, acknowledged anxieties and provided reassurances of support. These human elements should be included in the messages where possible.

8.2.2 Uncertainty, flood warning levels and wider delivery

- Continued effort is required to provide clarity as to what the flood warnings are intending to achieve and what each alert level signifies. There is public confusion to whether they represent levels of certainty or levels of severity. There needs to be organisational clarity, which is conveyed to the at-risk public.
- It is important to recognise that, for all communities, the flood warnings act as just one piece of information which is used in conjunction with a wide range of other information sources to inform their decision-making and action. Examples of these other sources include past experience, neighbours, local observations and technical information from other sources.
- Working closely with communities to develop content will not only generate local impactful content, it will also identify wider context issues that may be affecting the take-up and response to flood warnings as revealed in the previous bullet points. These context issues may include past warning

experience and the ability of individuals to receive warnings and take action. Involvement of the relevant Environment Agency communication teams can assist in working with communities and identifying appropriate content to support FIM officers. Environment Agency local engagement with already engaged individuals in other organisations such as local authorities and the Met Office may make the process easier. Engagement should be ongoing to provide two-way feedback and further development following flood warning events to build trust and enhance the local warnings.

- Communicating to communities the reasons for false alerts and warnings can help to mitigate the erosion of trust in the warning system. Ideally this should be part of an ongoing dialogue with communities. There were indications that channels of communication via established flood warden and/or action groups may not, on their own, be effective in reaching all the recipients of false warnings.

8.2.3 Technology and media

- The existing audio system has a limited ability to communicate certain information that may significantly help encourage individual action. Providing more detailed information through the existing system or a new phone system could be explored (for example, using tiered menus and links).
- Linking message content with other (and more detailed) sources of locally relevant information would be likely to increase their usefulness and encourage action. Other sources should be clearly specified. However, care should be taken to ensure the other sources are providing consistent quality information. At present, highly engaged residents use various sources to enhance their decision-making. These varied across the research locations and respondents involved but included:
  - weather forecast sites including wind direction such as the Met Office, the BBC and even the Norwegian Metrological Institute forecast
  - river gauge levels, for example, the Shoothill GaugeMap (www.gaugemap.co.uk) and River Levels (https://riverlevels.uk)

  Coastal communities accessed tide height forecasts and onshore wind information directly.
- In some catchments, FIM duty officers acknowledged that current forecast technology may not be able to provide more impactful messaging in terms of location cues. Consolidating in one place residents' local alternative information sources as information or links may help inform their decisions.

8.2.4 Further work

Section 4 identified a range of evidence gaps for both the professional and public stakeholders. Specifically in relation to the aim of this project, the following research is suggested.

- Develop systematic approaches to inform local Environment Agency offices of ways to identify and test specific local impact cues and/or locations that will trigger community decisions for use in warning content.

- Undertake quantitative survey research (either bespoke or added to post-event surveys) to gauge if the message enhancements did have – or would have had – more impact on decision behaviour within communities. Such research would also enable further analysis regarding risk and warning engagement, demographic and catchment characteristics.
- Test the flood warnings as actual audio delivery. Test whether cascading information options, tone of delivery and the format of new impactful messaging enhance residents' decisions and motivation for action.
- This project purposefully focused on identifying the issues relevant to warnings for varying levels of engaged residents.
    - Further social research could investigate how specific subgroups (for example, age or ethnicity) interact differently to the impactful content of flood warnings to reflect the at-risk demographic profile of at-risk communities.
    - This research did not extend to temporary at-risk public (for example, tourists, day visitors, travellers, commuters and carers) and at-risk local businesses and public organisations (for example, care homes, hospitals and schools). Further research could be undertaken to reveal how these stakeholder groups might be informed and be influenced by more impactful flood warnings.
- For communities whose formal warnings are currently ineffective due to technical constraints of the wider catchment characteristics, research could be carried out to provide bespoke warnings utilising local sensor triggers, local weather stations, proxy upper catchment information and centralised information sources already used by those residents to inform their actions.

References

DRABEK, T.E., 1986. *Human System Responses to Disaster: An Inventory of Sociological Findings.* New York: Springer-Verlag.

DRABEK, T.E., 2000. The social factors that constrain human responses to flood warnings. In *Floods*, Volume 1 (ed. D.J. Parker), Chapter 23, pp. 361-376. London: Routledge.

COOLS, J. AND INNOCENTI, D., 2014. *Flood early warning in practice: lessons learned from a comparative analysis.* Input paper prepared for the 2015 Global Assessment Report on Disaster Risk Reduction. Geneva: United Nations Office for Disaster Risk Reduction.

COOLS, J., INNOCENTI, D., AND O'BRIEN, S., 2016. Lessons from flood early warning systems. *Environmental Science & Policy*, 58, 117-122.

EMERGENCY MANAGEMENT AUSTRALIA, 1999. *Flood Warning*, 2nd edition. Emergency Management Practice Volume 3, Australian Emergency Manuals Series. Canberra: Emergency Management Australia [Chapters 4 and 5 in particular].

FIELDING, J., GRAY, K. AND BURNINGHAM, K., 2002. *Flood warning for vulnerable groups: secondary analysis of flood data.* Draft report prepared for July 2002 meeting. Guildford: Department of Sociology and Centre for Environmental Strategy, University of Surrey.

ENVIRONMENT AGENCY, 2004. *The social performance of flood warning communication technologies.* Technical Report W5X-016. Bristol: Environment Agency.

ENVIRONMENT AGENCY, 2007a. *Public response to flood warnings.* Science Report SC20116. Bristol: Environment Agency.

ENVIRONMENT AGENCY, 2007b. *Response to flooding 2007. Response to flood events of January 2007 in Midlands Region and North East Region.* Bristol: Environment Agency.

ENVIRONMENT AGENCY, 2011. *Surface water flood warning scoping project.* Project Summary SC080034/S. Bristol: Environment Agency.

ENVIRONMENT AGENCY, 2015. *Public dialogues on flood risk communications*. Report SC120010/R1. Bristol: Environment Agency.

ENVIRONMENT AGENCY, 2016. *Public flood survey 2013 to 2014*. Project SC130037. Bristol: Environment Agency.

ENVIRONMENT AGENCY, 2017. *Investigating the needs, feasibility and benefits of real-time inundation mapping for flood incident management*. Project SC120023. Bristol: Environment Agency.

HANDMER, J.W. AND ORD, K.D., 1986. Flood warning and response. In *Flood Warning in Australia* (ed. D.I. Smith and J.W. Handmer), Section 17, pp. 236-237. Canberra: Centre for Resource and Environmental Studies, Australian National University.

HARRISON, J., MCCOY, C., BUNTING-HOWARTH, K., SORENSEN, H., WILLIAMS, K. AND ELLIS, C., 2014. *Evaluation of the National Weather Service Impact-based Warning Tool.* Submitted to National Weather Service Central Region Headquarters, April 10, 2014. Available from: http://www.iisgcp.org/pdf/glssn/IBW_finalreport.pdf [Accessed 29 January 2018].

HARROWSMITH, M., 2015. *UK Met Office – Impact based warnings & regional advisors*. UNISDR Scientific and Technical Advisory Group Case Studies — 2015. Geneva: UNISDR Scientific and Technical Advisory Group.

LÓPEZ-VÁZQUEZ, E. AND MARVAN, M., 2003. Risk perception, stress, and coping strategies in two catastrophe risk situations. *Social Behavior and Personality: an international journal*, 31 (1), 61-70.

MCCARTHY, S., TUNSTALL, S., PARKER, D., FAULKNER, H. AND HOWE, J., 2007. Risk communication in emergency response to a simulated extreme flood. *Environmental Hazards*, 7 (3), 179-192.

MOLINARI, D. AND HANDMER, J., 2011. A behavioural model for quantifying flood warning effectiveness. *Journal of Flood Risk Management,* 4 (1), 23-32.

MORGAN, M.G., FISCHOFF, B., BOSTROM, A. AND ATMAN, C.J., 2002. *Risk Communication. A Mental Models Approach.* Cambridge: Cambridge University Press.

PARKER, D.J. AND BUDGEN, P., 1998. *The Tropical Cyclone Warning Dissemination System in Mauritius*. London: Thomas Telford.

PARKER, D.J., TUNSTALL, S.M. AND MCCARTHY, S., 2007. New insights into the benefits of flood warnings: results from a household survey in England and Wales. *Environmental Hazards*, 7 (3), 193-210.

PARKER, D.J., PRIEST S.J. AND TAPSELL, S.M., 2009. Understanding and enhancing the public's behavioural response to flood warning information. *Meteorological Applications*, 16 (1), 103-114.

SCOLOBIG, A., DE MARCHI, B. AND BORGA, M., 2012. The missing link between flood risk awareness and preparedness: findings from case studies in an Alpine Region. *Natural Hazards*, 63 (2), 499-520.

SORENSEN, J., 2000. Hazard warning systems: review of 20 years of progress. *Natural Hazards Review*, 1 (2), 119-125.

TAPSELL, S., MCCARTHY, S., FAULKNER, H. AND ALEXANDER, M., 2010. *Social vulnerability and natural hazards*. CapHaz-Net WP4 Report. London: Flood Hazard Research Centre, University of Middlesex.

TVERSKY, A. AND KAHNEMAN, D., 1973. Availability: a heuristic for judging frequency and probability. *Cognitive Psychology*, 5 (2), 207-232.

TWIGGER-ROSS, C., ORR, P., BROOKS, K., SADAUSKIS, R., DEEMING, H., FIELDING, J., HARRIES, T., JOHNSTON, R., KASHEFI, E., MCCARTHY, S., REES, Y. AND TAPSELL, S., 2015. *Flood Resilience Community Pathfinder evaluation.* Final report FD2664. London: Department for Environment, Food and Rural Affairs.

WEINSTEIN, N.D. AND KLEIN, W.M., 1995. Resistance of personal risk perceptions to debiasing interventions. *Health Psychology*, 14 (2), 132-140.

WERRITY, A., HOUSTON, D., BALL, T., TAVENDALE, A. AND BLACK, A., 2007. *Exploring the social impacts of flood risk and flooding in Scotland*. Edinburgh: Scottish Executive Social Research.

WOGALTER, M.S. AND MAYHORN, C.B., 2005. Providing cognitive support with technology-based warning systems. *Ergonomics*, 48 (5), 522-533.

Bibliography

ENVIRONMENT AGENCY, 2008. *Communication and dissemination of probabilistic flood warnings.* Science Report SC070060/SR4. Bristol: Environment Agency.

ENVIRONMENT AGENCY, 2013. *Flood incident management investment plan.* Bristol: Environment Agency.

ENVIRONMENT AGENCY, 2013. *Applying probabilistic flood forecasting in flood incident management. Technical report – refined decision-support framework and methods.* Project SC090032. Bristol: Environment Agency.

ENVIRONMENT AGENCY, 2017. *Investigating the needs, feasibility and benefits of real-time inundation mapping for flood incident management*. Project SC120023. Bristol: Environment Agency.

HALCROW, 2016. *Performance measures for the flood warning service (2015-16).* Unpublished report.

HÖPPNER, C., BRÜNDL, M. AND BUCHECKER, M., 2010. *Risk communication and natural hazards*. CapHaz-Net WP5 Report. Birmensdorf, Switzerland: Swiss Federal Research Institute.

MCCARTHY, S., PARKER, D. AND PENNING-ROWSELL, E., 2006. *Pre-consultation social survey River Thames from Maidenhead to Teddington*. Unpublished report by the Flood Hazard Research Centre to Halcrow Group Ltd as part of the Lower Thames Study Phase 3.

PARKER, D.J., 2016. *Flood warning systems and their performance* [online]. DOI: 10.1093/acrefore/9780199389407.013.84. In *Natural Hazards Science*, Oxford Research Encyclopaedias, Oxford University Press.

PARKER, D.J. AND PRIEST, S.J., 2012. The fallibility of flood warning chains: can Europe's flood warnings be effective? *Water Resources Management*, 26 (10), 2927-2950.

PARKER, D.J., PRIEST, S.J., SCHILDT, A. AND HANDMER, J.W., 2008. *Modelling the damage reducing effects of flood warnings*. FLOODsite Report T10-07-12. Wallingford: HR Wallingford [Chapter 5 in particular].

PRIEST, S.J., PARKER, D.J., HURFORD, A.P., WALKER, J. AND EVANS, K., 2011. Assessing options for the development of surface water flood warning in England and Wales. *Journal of Environmental Management*, 92 (12), 3038-3048.

WOGALTER, M.S. (ed.), 2006. *Handbook of Warnings*. London: CRC Press.

List of abbreviations

FHRC	Flood Hazard Research Centre
FIM	Flood Incident Management
IBW	Impact-Based Warning [tool developed by the US National Weather Service
NFF	National Flood Forum

Appendix A: Feedback summary from Task 3 workshops

A.1 Public Focus Group: Keswick – 10 July 2017

A.1.1. Attendees

Simon McCarthy (FHRC), Paul Cobbing (NFF), Neil Blazey (CH2M)

M, L and J

A.1.2 Introductions

M – based in Carlisle; uses the flood warning to monitor the progression of a flood event.

J – parents based near Windermere; flooded 7 times since 2000. Doesn't really use the flood warning service as it is not specific enough for the area that she is interested in.

L – Keswick; does get the flood warning calls, but uses a lot of other information sources.

A.1.3 General views on flood warning service

- Could be better.
- Needs to be more specific – spatially and specific to each individual flood event.
- The flood warning areas are too broad.
- Needs specific information at the front of the message to stop people 'zoning out' – don't always listen to the end of the message.
- Environment Agency flood warning staff are not always local and don't have that local knowledge.
- There should be more gauges and the existing gauges should be better used.
- The problem of false issues 'crying wolf. After 2 false warnings, you stop following.
- Technology should be used more (apps, tables and so on).

A.1.4 Specific views of 2 types of followers

Knowledgeable

- Need more information than is provided in the flood warning service.
- These should have access to 'Hazard Manager'.

- Also use Met Office data.
- Use the other websites (Norwegian? other?).
- Other services are very readable, caring and 'funny'.
- Community messaging system – information that gets posted here is dreadful (for example, 'it's going to rain next week – be careful').

General public

- The phone service is a good 'heads up' for these people.
- We want to know that the flood warning officer is local and understands the local needs. We don't want it passed to another area to manage.
- We have years of experience and can interpret the information – we can also see how it compares with visual checks on water levels.
- We use lots of sources and we are already aware of any pending issues before the Environment Agency flood warning. Most people won't be able to do that.

A.1.5 Responses to specific questions

Q: What would be specific in a message that would make it helpful?

- Evidence of the progression of flooding.
- Some information is critical: flow; height at specific points on the river.
- Keswick has only 25 minutes warning – so we try to predict ahead.
- We spend a lot of time on the computer, using spreadsheets of telemetry to try and track and compare flood events.
- The Environment Agency does provide me with a very personalised message: not the general flood warning. It has detail on which gates will be opened/closed and so on.

Q: Would comparative information be useful?

- Don't like the naming of storms.
- It will help prepare people if it is comparative to a major storm from the recent past.
- But historical information must be considered in context: changing flood dynamics; changing flood defences may mean that this information is misleading. In Keswick, the flood events are often very different.
- But if we said 'the water will be a 2015 levels', everyone will know what this means.
- Comparison with specific data points may be useful [telemetry].

Q: Would relating to specific markers or monuments be useful?

- We have marker boards in the river that we use.
- We also informally talk about the 'glass boards' as a marker (these are the glass flood defences).
- We think the general public just want to know if the defences are going to be overtopped.
- But if the message is wrong, there will be more of a blame game. It would be very serious if they said it wasn't going to happen and it did. [Q: Would providing feedback about warnings help mitigate the bad perception when things go wrong? This would be useful for the knowledgeable user groups, so that they can improve their understanding of a flood event and help improve their predictions.]
- Information should be scaled as an event progresses – gradually 'adding meat to the bone'.
- For Lynne's messages she would indicate 'if the park would flood'.

Q: What methods should be used to communicate the flood warning?

- Phone probably the best, but emails, Facebook and so on [the group tended to use emails to communicate information].
- Some groups are very vulnerable and need specific help. Isolated rural communities with older people won't have access to technology.
- Some communities seem to not want to receive information – they are in denial. Everyone deals with these events in different ways.

Q: What impacts would be usefully described?

- The existing flood warning messages do vaguely have some of this information.
- Need to be careful not to indicate areas that don't relate well to all other areas.
- Braithwaite has a bridge that acts as a community marker point.

Q: What would the ideal message look like?

- Information on: start, peak and end times; how high it will be; 'when can I stop worrying about this'.
- Would like to know that someone local is looking at this.
- Would like to know that someone is monitoring the situation in the local incident room, especially at night.
- Would like to know that the council is doing something.
- Needs a personal touch.

A.2 Public Focus Group: Rhyl – 27 July 2017

A.2.1 Attendees

Simon McCarthy (FHRC), Paul Cobbing (NFF), Neil Blazey (CH2M)

5 attendees: a mixture of local residents and flood wardens

A.2.2 Introductions

D, M, B, R & T

A.2.3 General views on flood warning service

- The warnings are spatially broad: cover a long area of coast.
- The warnings don't help the very vulnerable communities in Rhyl.
- They no longer provide the flood alerts as part of the warning service – they were issued far too frequently and were just being ignored.
- The flood warden role is not clearly understood by Natural Resources Wales – there is too much expectation of them.
- There is a lot of apathy or denial towards flood risk: people just don't want to know or they are concerned about land values and so on.
- Confidence on current flood warning isn't very high – past floods have occurred without any warning.
- There is no advice as to at what point you need to take action.
- There are a lot of overlapping flood warning areas, which is very confusing. People living on the same street could get different warnings and different information.
- Current flood warnings are a bit 'Mickey Mouse'. They are too conceptual, too vague (for example, 'you may be evacuated').
- The confidence in the forecasting is better, but how does that help the communities?
- It is all very well issuing a warning, but the planning is more critical.
- Now that I am a flood warden and have looked at the information, I am more likely to take action when receiving a flood warning.
- Met Office site provides good information.
- Mentioning property level protection (PLP) leads to issues over affordability.

A.2.5 Views on specific issues

Challenge of vulnerable communities

- There is no safe facility to take people to during a flood.

- There are no appropriate vehicles and roads for safe access.
- The emergency services that are brought in don't know the area.
- The able-bodied can leave but the others need rescuing.
- There is a large seasonal population: 8,000 residents; 40,000 in peak times locally; 150,000 in peak times in wider area.
- Flood risk is a significant long-term issue for the community preventing development, investment and so on.
- The area has travellers that would not receive a flood warning. They would cause a distraction and disruption to the emergency response. They are not part of any emergency response plan.
- Need at least 2 hours' notice to move vulnerable people.
- Because it takes longer, we would act at the flood alert stage even if they were regular.
- Everybody takes different actions at different levels.
- There is an argument for people staying put and waiting for support.
- Useful to have sirens?

Notes on impact locations

- The coastal flooding means that the flood risk is more of an 'on/off' type response, so information on the specific locations is less important.
- 'It was a foot deep in Woodside Avenue.'
- 'It flooded both sides of Woodside Avenue.'
- 'It flooded the main road at the corner.'

Use of previous events

- Coastal conditions are very sensitive to a wide range of variables. Hard to predict exactly what will happen.
- The authorities will err on the side of caution.

% chance?

- More confusing
- 'I'd start worrying at 80%.'

Ideal message

- Provided with adequate time.
- Very high confidence
- Reminders to take insurance documents, medicines and so on.

Stand down?

- You can go online and get this information.

A.3 Public Focus Group, Guildford, Surrey – 24 July 2017

A.3.1 Attendees

Simon McCarthy (FHRC), Heather Shepherd (NFF), Neil Blazey (CH2M), Tabitha (NFF)

8 attendees from a range of flood action groups: Guildford; Leatherhead & Fetcham; Thorpe Lea

A.3.2 Introductions

S, L, M, A, E, N, B, C

A.3.3. General views on flood warning service

- Insufficiently regular when they need to be.
- Previous system was more useable: it had more relevant information all on one page (that is, the condition of a river at a given point). 'The Environment Agency pages were better than the GOV.UK pages.'
- No longer regular updates – it used to be regular 15-minute updates, but now it varies.
- Monitoring equipment is inadequate to measure flood conditions during an event; it's not always in the correct location.
- Alerts tend to be very high level and early or very late (too late when flooding has already occurred). Need something 'in the middle'.
- It isn't clear how upstream alerts will impact us.
- It would be better if the equipment was more automated.
- We have been on general flood warning level for 2 hours, then flooded, then received a severe flood warning.
- Multiple flood warnings mean you tend to ignore them.
- No indication of when the threat has passed.

A.3.4 Views on specific issues

Some general issues

- Can the local gauges be used more to inform local flood risk?
- Some two-stage events only have one severe flood warning – you think that the worst has passed when it hasn't.

- The elderly get very stressed and upset especially if they have flooded before. Frequent alarms and warning make this worse.
- The expected peak height and times are not in the warnings anymore.
- Sometimes there are flood alerts but no flood warning and then a major flood (that is, 2013); other times there are lots of alerts but no flood (winter 2016 to 2017).
- The updates of information are not frequent enough. Even 15-minute updates don't capture the speed that the river levels rise.

How do you receive the flood warning?

- Phones, email
- We also monitor the weather sites.
- Twitter, the app 'Flood Alert'[5] – easier to get the information
- I use a physical marker to inform me when there is a risk of flooding.
- Can there be a broadcast warning system that everyone can hear?
- Not everyone has access to the internet and mobile phones. Sometimes the power will go out.
- The phone messages go on forever – tend to switch off. May miss vital info.
- Would be better to have a very concise message with a link to more information.
- Sometimes the message is longer than voicemail storage.
- Sometimes the key part of the message is at the end – 'only local flooding and no impacts expected'.
- Could the Environment Agency use a Freeview channel? Or use radio more?

How do people who are not informed use the flood warning messages?

- People don't have the ability to interpret and cope with the data – they just think they will be flooded and want sandbags and insurance.
- Some people don't take enough responsibility to look after their own property – they wait for help.
- Some people listen to rumours rather than get the flood warning messages.
- People who have flooded previously are far more likely to follow the flood warnings.
- Some people feel there isn't much they can do, some are uninsured.

[5] www.floodmodeller.com/products/software/flood-alert/

- How are shoppers in the town supposed to know? People need to clear the area so that residents and businesses can get the help that they need. Can we ring the cathedral bells and so on?
- How are people who are out of town supposed to know?

Content: level of detail required?

- Messages used to have peak times, which was good. This is a very important piece of information.
- Messages should state 'water levels are now stabilising' – this is reassuring.
- There are established benchmarks in the community (for example, historic flood levels on the bridge in Guildford). They must be relevant to a specific area.
- The messages must manage people's expectations. If you know what is likely to happen, you are more likely to take action.
- Message should indicate the time of the actual gauge reading.
- Ideally each property should have a flood prediction and depth (using Ordnance Survey?).
- If more detail means more false warnings then the public may be more likely to ignore them.
- Would be useful to have 2 levels of detail – one for the layman and another for those more informed.
- It would be useful to have an indication of the severity of the floods.

Dealing with uncertainty

- Should information be given with a level of probability?
  - Yes: liked the red, amber, green format – just makes sense.
  - Sounds a bit like '1 in 10 year event', which is confusing to people.
- Is it possible to have a pre-warning? 'There is a chance that this will become a flood warning at some point.'

Historic context

- Everyone can relate to the last flood.
- People have poor memories.
- In general, there are too many variables: things change; improvement works; soil saturation; rented accommodation changes.

Networks/passing messages on

- We use email lists and community message boards.

- Sometimes we drop messages through people's doors.
- This works better in rural areas.

Feedback

- More explanation as to why false alarms were issued would be useful.
- This information is sometimes made available on the website.

Responsibility

- Not clear who is responsible and who is doing what.
- No-one owns the problem.
- Do the local authorities get the same information?

Appendix B: Sample communications provided by focus group attendees

B.1 Sample 1: tailored email from the Met Office to engaged resident

Notes:

- Tone is ‘warm and friendly’ informed by dialogue over time.
- Impacts are:
  - severity summary in heading
  - time and location specific
  - illustrates event progression
  - descriptive impacts (trees, heavy good vehicles)
- Further announcements timing is specified.

Met Office Advisor
Date: 20 December 2016 at 10:59
Subject: Message from the Met Office Advisor (NW ENG) - Yellow warning (medium impacts) issued for Fri/Sat

Good morning colleagues,

It had to happen. The quiet, rather stagnant weather of recent weeks could not go on indefinitely and there's nothing like Christmas appearing on the horizon to shake the weather out of its slumbers. True to form things are on the change with two lively Atlantic storm systems now threatening the northern half of the UK between Friday and Sunday.

The first of these has already acquired the name 'Barbara' and is set to pass between Scotland and Iceland during the course of Friday. The strongest winds on its southern flank will be reserved for the NW Scotland and the Isles, for which an amber warning has already been issued. However, the risk of impacts from the winds around 'Barbara' extends a good deal further south and is currently expected to include Cumbria and Lancashire, perhaps just fringing into Merseyside and Greater Manchester. For these areas a **medium impact yellow warning** has just been issued, attached above.

In terms of the weather sequence the current expectation is for the S to SW'ly winds to strengthen up during Friday morning. From late morning into the early/mid afternoon looks likely to be the windiest period which will coincide with the main band of rain associated with the system, some of which will be heavy. All in all a rough few hours with gusts of 60 to 70mph possible along exposed coasts and higher ground and 50 to 60mph possible inland. The winds alone could pose a threat to high-sided HGVs travelling over exposed sections of the M6 (J36 to 40) and no doubt a proportion of the weaker trees will fall victim to the stronger gusts. It is also worth including that damage to power transmission is also possible, more especially across Cumbria.

By mid to late afternoon the worst of the winds, along with the more persistent rain, will be on its way out, replaced by clearer intervals and occasional blustery showers. Nevertheless throughout Friday evening and overnight winds could still gust up to 50mph or so along the coast and over higher ground, particularly during showers.

Christmas Eve (Saturday) has a bright, windy look about it (gusts 50mph continuing along the coast), at least until the early afternoon, by which time the first sporadic rain from the second storm system could well be spilling across to parts of W and N Cumbria.

The latest forecast for **Christmas Day (Sunday)** paints an overcast, windy start to the day with rain at times, before a change to somewhat clearer, rather colder conditions with occasional blustery showers, mainly across Cumbria and N Lancashire where they may turn wintry over the fells later in the day. There may well be further wind warnings issued for Sunday (in regard to the second storm system) but these are more likely to appear tomorrow or Thursday and will be covered in subsequent briefings.

It is worth adding, given the time of year and the still very fresh memories of where we were this time last year, that the amounts of rain tied up with these two storm systems are NOT currently expected to cause issues in terms of flooding. Today's Flood Guidance Statement has all of the Northwest green (very low flood risk). I will, of course, update you on this if/as soon as the situation changes.

Finally, my initial impressions are that anyone desperate for a white Christmas will have to either i) get up to Cumbria for the 2nd half the day, brave the winds and ascend to a minimum of around 1500ft/450m in the hope of catching a wintry shower or two or ii) buy some of the artificial spray stuff and enjoy it in the warmth of their living room.

That just about covers things for now. A full update will be issued this time tomorrow morning. In the mean time have a good day and speak again tomorrow,

Regards,

FIRST NAME

http://www.floodready.co.uk/uploadedfiles/case_studies/11/WEATHERING%20THE%20STORM.pdf

B.2 Sample 2: emails from engaged resident to linked residents

Notes:

- Large local circulation list includes:
  - residents
  - local businesses and attractions
  - local organisational contacts
- Concerns raised in groups (all warning information):
  - unlisted residents (including self-excluded)
  - elderly (internet/ability)
  - temporary (shoppers, travellers, holiday makers)
- Shorter interpretation
- Tone informal
- Impacts:
  - local actions
  - locally specific
  - progression
  - personal urgency (bed & breakfast closure)
- Reassurance of ongoing support
- Flood warning alert confirmation
- Local cues of lakes and glass panels

Folks: I am pasting the Met Office latest assessment of the weather for this weekend below. This morning I asked the EA to close the flood gates later on today and to remember that we may need extra pump capacity. NAME of the EA phoned me about an hour ago to confirm that they will be closing the park gates later today and to assure me that the EA will have a team here right through clearing screens and keeping an eye on things. There will be a meeting of all the emergency services etc. around now and further details will be sent out as and when I know them.

I called to see NAME of ENGINEERING CONSULTANT and he says they have a spare pump if needed. His men will be off site over the weekend but he may send someone to check the area. He seems confident that the site is gale proof. It will be CCC's job to keep an eye on the pumps etc.

Right now it looks like we are in for a very wet time and I suspect the new defences my have their first real test. We have cancelled all the guests due in to our B&B just in case. With lake levels so high and Thirlmere overflowing there is little wriggle room for 24+hours of rain - why would anyone want to be here with the forecast anyway?!!

Will keep you updated.
FIRST NAME

Nothing there to cheer us right now, we might get through today unscathed but..... Come the weekend our local lakes are much higher to start with, the phones have just all done their flood alert call and we might even see the glass panels being a benefit before long!

Appendix C: Test material for Task 5 workshops

C.1 Shipston-on-Stour

Flood alert: 'typical' message format

Flood Alert

River Stour in South Warwickshire

The current level in the Shipston river gauge is 1.21 metres. River levels are rising on the River Stour with flooding possible tonight. River levels are expected to peak between 2.9 and 3.1 metres at 2:00am. Over the past 6 hours there has been 8 millimetres of rain. Further rainfall is forecast over the next 12 hours.

For a more detailed weather forecast for your area please see the Met Office www.metoffice.gov.uk.

Flood alert: enhanced message format:

Flood Alert

River Stour in South Warwickshire

Over the last 24 hours we have seen heavy rainfall in the Shipston area. This has meant that the River Stour is now rising and flooding is possible from 11pm today (Monday 5th February).

The main area of concern is around Mill Street, where forecasts suggest there could be flooding to low lying land and areas close to the river and around the bridge at the Old Mill.

No flooding of property is currently expected. Further heavy rainfall is possible overnight and this would cause river levels to rise again. This message will be updated this evening or earlier if the situation changes.

People in these areas should consider taking action now. We urge all people to take care and not to drive through flood water.

We are constantly monitoring river levels and have staff in the area checking for and clearing blockages in this location.

Flood alert update: 'typical' message format

Flood Alert Update

River Stour in South Warwickshire

River levels remain high on the River Stour in the Shipston area. Flooding to low lying land and roads is expected to continue. Further rain showers are expected to continue on Tuesday and Wednesday. We will continue to monitor the situation. Take care near areas of concern and monitor your local weather conditions and the GOV.UK website.

Flood alert update: enhanced message format

Flood Alert Update

River Stour in South Warwickshire

Over the last 8 hours we have seen further heavy rainfall in the Shipston area and the River Stour has continued to rise.

The main areas of concern are Mill Street and the A3400, where our forecasts suggest that flooding of roads close to the river is possible. There has already been minor flooding of the car park near the bridge at the Old Mill.

River levels are now forecast to peak from 9am tomorrow (Tuesday 6th February).

People in these areas should consider taking action now. We urge all people to take care and not to drive through flood water.

We are constantly monitoring river levels and have staff in the area checking for and clearing blockages in this location.

This message will be updated tomorrow morning or earlier.

Flood warning: 'typical' message format

Flood Warning

River Stour in South Warwickshire

Up to 30 mm of rainfall has fallen in the last 24 hours which has caused river levels to rise on the River Stour. Showers are continuing, with some intense bursts. It is expected that this warning will in place for a number of days.

The level at the Old Mill Bridge gauge is currently at 2.605 metres. Surface water ponding may already be affecting low lying land and roads.

Flooding to properties is expected in the Shipston area later this evening (Tuesday 6th February) and into tomorrow morning (Wednesday 7th February). Immediate action is required.

Whilst the flood warning is in force, the Local Authority will close Mill Street and the A3400. Diversionary routes will be put in place and further updates will be available through local media. This message will be updated as the situation changes.

Flood warning: enhanced message format

Flood Warning

River Stour in South Warwickshire

Heavy rain is currently falling in the Shipston area and will continue throughout the day (Tuesday 6th February). This is causing the River Stour to rise and it is forecast to continue rising through tomorrow morning.

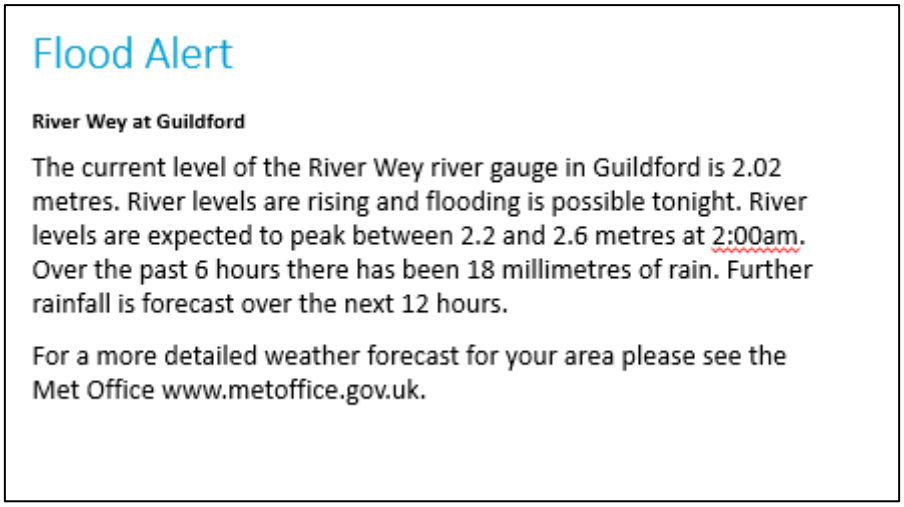
Low lying areas near to the Old Mill are already flooded. Properties and roads around Mill Street and the bottom end of Telegraph Street will start to flood first from around 10:30pm tonight. Further flooding could occur along the A3400 from 4am as river levels rise. River levels will be at their highest between 7am and 9am tomorrow (Wednesday 7th February).

Flood waters may be knee deep and fast flowing in all these areas. Residents are strongly urged to take action now. Remain safe and be aware of your local surroundings.

We will be closely monitoring the situation throughout the night and this message will be updated as the situation changes. Our staff are out in the area and will relay information and assist the emergency services and council.

B.2 Guildford

Flood alert: 'typical' message format



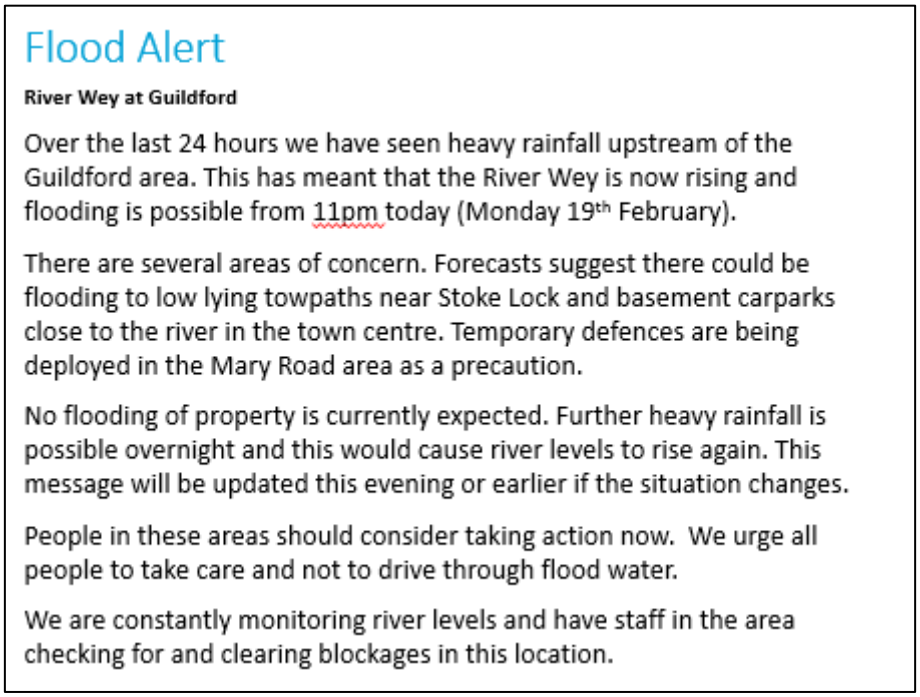
Flood Alert

River Wey at Guildford

The current level of the River Wey river gauge in Guildford is 2.02 metres. River levels are rising and flooding is possible tonight. River levels are expected to peak between 2.2 and 2.6 metres at 2:00am. Over the past 6 hours there has been 18 millimetres of rain. Further rainfall is forecast over the next 12 hours.

For a more detailed weather forecast for your area please see the Met Office www.metoffice.gov.uk.

Flood alert: enhanced message format



Flood Alert

River Wey at Guildford

Over the last 24 hours we have seen heavy rainfall upstream of the Guildford area. This has meant that the River Wey is now rising and flooding is possible from 11pm today (Monday 19th February).

There are several areas of concern. Forecasts suggest there could be flooding to low lying towpaths near Stoke Lock and basement carparks close to the river in the town centre. Temporary defences are being deployed in the Mary Road area as a precaution.

No flooding of property is currently expected. Further heavy rainfall is possible overnight and this would cause river levels to rise again. This message will be updated this evening or earlier if the situation changes.

People in these areas should consider taking action now. We urge all people to take care and not to drive through flood water.

We are constantly monitoring river levels and have staff in the area checking for and clearing blockages in this location.

Flood alert update: 'typical' message format

Flood Alert Update

River Wey at Guildford

River levels remain high on the River Wey in the Guildford area. Flooding to low lying land and several car parks is expected to continue. Further rain showers are expected to continue on Tuesday and Wednesday. We will continue to monitor the situation. Take care near areas of concern and monitor your local weather conditions and the GOV.UK website.

Flood alert update: enhanced message format

Flood Alert Update

River Wey at Guildford

Over the last 8 hours we have seen further heavy rainfall in the Guildford area and the River Wey has continued to rise.

The main areas of concern are in the town centre at Millmead and the Friary Bridge, where our forecasts suggest that flooding of roads close to the river is possible. There has already been minor flooding of the towpaths at Stoke Lock. Temporary defences have been deployed in the Mary Road area as a precaution.

River levels are now forecast to peak from 9am tomorrow (Tuesday 20th February).

People in these areas should consider taking action now. We urge all people to take care and not to drive through flood water.

We are constantly monitoring river levels and have staff in the area checking for and clearing blockages in this location.

This message will be updated tomorrow morning or earlier.

Flood warning: 'typical' message format

Flood Warning

River Wey at Guildford

Up to 60 mm of rainfall has fallen in the last 24 hours which has caused river levels to rise on the River Wey. Showers are continuing, with some intense bursts. It is expected that this warning will in place for a number of days.

The level at the Guildford gauge is currently at 2.55 metres. Surface water ponding may already be affecting low lying land and roads.

Flooding to properties is expected in the Guildford area later this evening (Tuesday 20th February) and into tomorrow morning (Wednesday 21st February). Immediate action is required.

Whilst the flood warning is in force, the Local Authority will close several roads including Millbrook and the Friary Bridge. Diversionary routes will be put in place and further updates will be available through local media. This message will be updated as the situation changes.

Flood warning: enhanced message format

Flood Warning

River Wey at Guildford

Heavy rain is currently falling in the Guildford area and will continue throughout the day (Tuesday 20th February). This is causing the River Wey to rise and it is forecast to continue rising through tomorrow morning.

Properties and roads around Millmead, Friary Bridge and the bottom end of the High Street will start to flood first from around 10:30pm tonight. Further flooding could occur along Millbrook from 4am as river levels rise. River levels will be at their highest between 7am and 9am tomorrow (Wednesday 7th February).

Flood waters may be ankle deep and fast flowing in all these areas. Residents are strongly urged to take action now. Remain safe and be aware of your local surroundings.

We will be closely monitoring the situation throughout the night and this message will be updated as the situation changes. Our staff are out in the area and will relay information and assist the emergency services and council.

C.3 Rhyl

Flood alert: 'typical' message format

Flood Alert

Kimnel Bay Area A

Flooding is possible – be prepared

This alert is in force for the tides on Thursday 15th March and Friday 16th March.

High tides may lead to localised flooding on the tides throughout the period between 4pm to 6pm on Thursday and 5am to 7.30am and 4.30pm to 8.30pm on Friday. Current forecasts indicate that this alert is expected to remain in force until Saturday 17th March.

These particularly high tides are because of the naturally occurring astronomical tide cycle. Conditions may apply two to four hours either side of high tide. We will monitor the situation and will update this information and issue warnings as required.

Flood alert: enhanced message format

Flood Alert

Kimnel Bay Area A

Flooding is possible – be prepared

This alert is in force for the tides on Thursday 15th March and Friday 16th March.

High tides and high winds may lead to overtopping and windblown spray along the promenade on the tides throughout the period between 4pm to 6pm on Thursday and 5am to 7.30am and 4.30pm to 8.30pm on Friday.

People in this area should consider taking action now. We urge all people to take care near coastal paths and promenades and not to drive through flood water.

These particularly high tides are because of the naturally occurring astronomical tide cycle and forecast high winds. Conditions may apply two to four hours either side of high tide. We will monitor the situation and will update this information and issue warnings as required.

Flood alert update: 'typical' message format

Flood Alert Update

Flooding is possible – be prepared

This flood alert remains in force due to the continued combination of high tides and high winds.

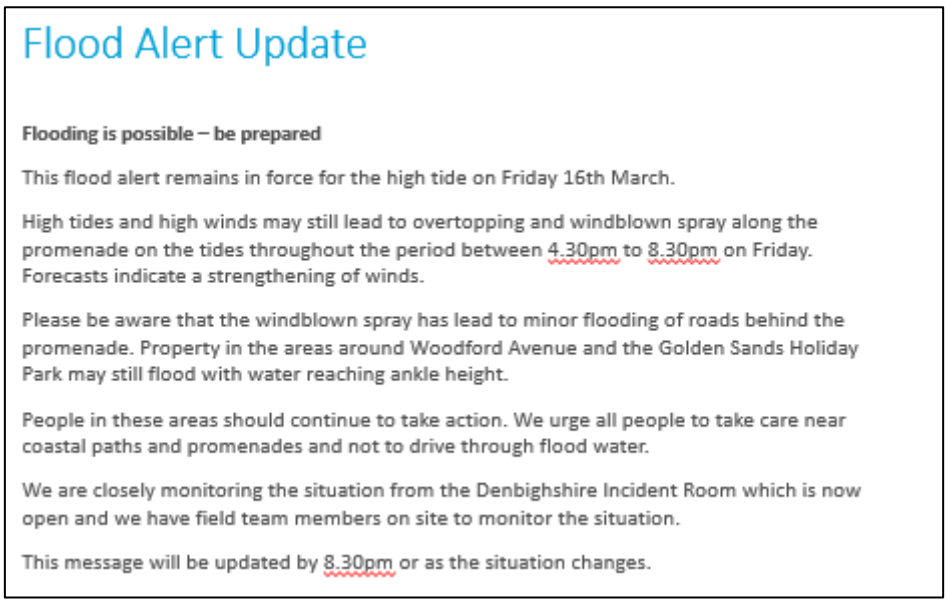
High tides may lead to localised flooding on the tides between 4.30pm and 8.30pm today, Friday 16th March. Current forecasts indicate that this alert is expected to remain in force until Saturday 17th March.

Please be aware that the windblown spray has lead to minor flooding of roads behind the promenade.

We are closely monitoring the situation from the xxx Incident Room which is now open and we have field team members on site to monitor the situation.

This message will be updated by 8.30pm or as the situation changes.

Flood alert update: enhanced message format



Flood Alert Update

Flooding is possible – be prepared

This flood alert remains in force for the high tide on Friday 16th March.

High tides and high winds may still lead to overtopping and windblown spray along the promenade on the tides throughout the period between 4.30pm to 8.30pm on Friday. Forecasts indicate a strengthening of winds.

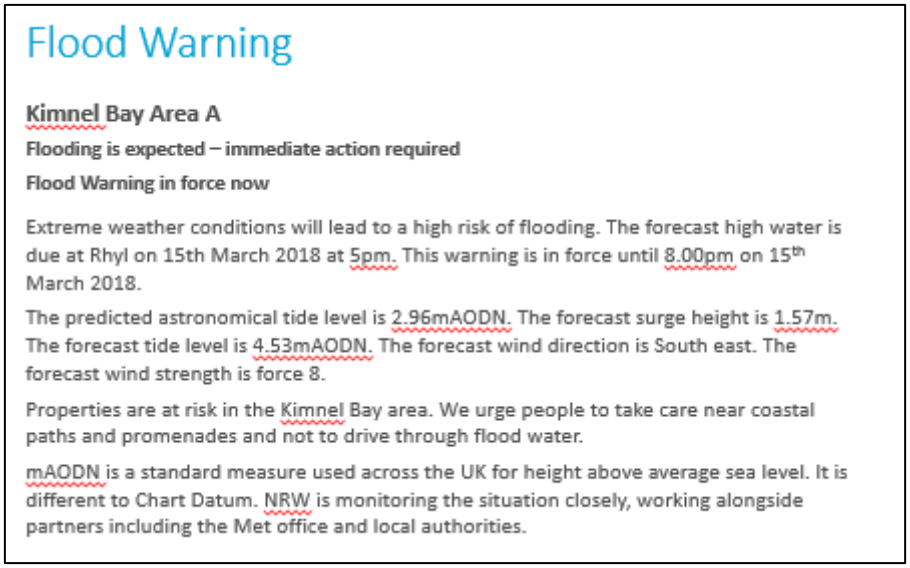
Please be aware that the windblown spray has lead to minor flooding of roads behind the promenade. Property in the areas around Woodford Avenue and the Golden Sands Holiday Park may still flood with water reaching ankle height.

People in these areas should continue to take action. We urge all people to take care near coastal paths and promenades and not to drive through flood water.

We are closely monitoring the situation from the Denbighshire Incident Room which is now open and we have field team members on site to monitor the situation.

This message will be updated by 8.30pm or as the situation changes.

Flood warning: 'typical' message format



Flood Warning

Kimnel Bay Area A

Flooding is expected – immediate action required

Flood Warning in force now

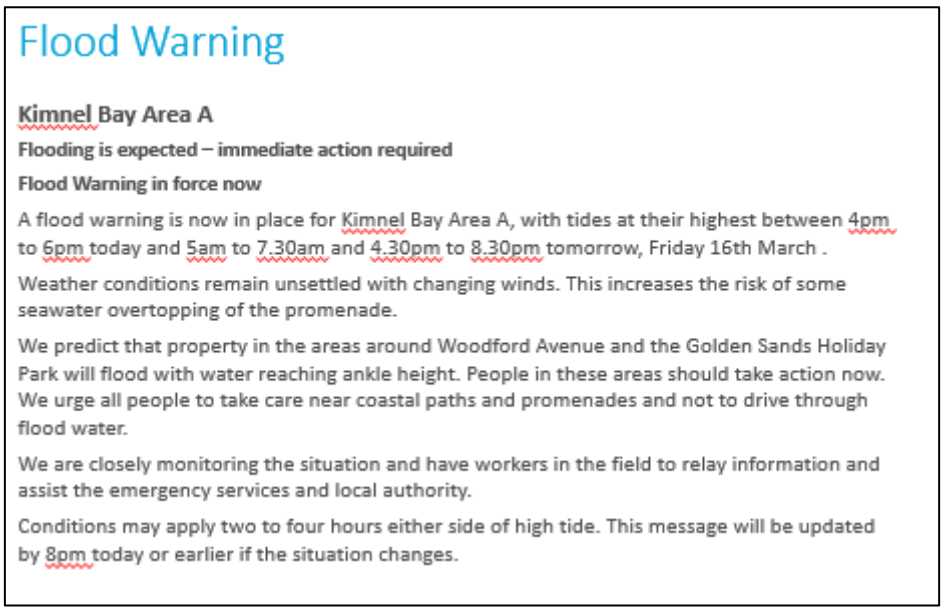
Extreme weather conditions will lead to a high risk of flooding. The forecast high water is due at Rhyl on 15th March 2018 at 5pm. This warning is in force until 8.00pm on 15th March 2018.

The predicted astronomical tide level is 2.96mAODN. The forecast surge height is 1.57m. The forecast tide level is 4.53mAODN. The forecast wind direction is South east. The forecast wind strength is force 8.

Properties are at risk in the Kimnel Bay area. We urge people to take care near coastal paths and promenades and not to drive through flood water.

mAODN is a standard measure used across the UK for height above average sea level. It is different to Chart Datum. NRW is monitoring the situation closely, working alongside partners including the Met office and local authorities.

Flood warning: enhanced message format



Flood Warning

Kimnel Bay Area A

Flooding is expected – immediate action required

Flood Warning in force now

A flood warning is now in place for Kimnel Bay Area A, with tides at their highest between 4pm to 6pm today and 5am to 7.30am and 4.30pm to 8.30pm tomorrow, Friday 16th March .

Weather conditions remain unsettled with changing winds. This increases the risk of some seawater overtopping of the promenade.

We predict that property in the areas around Woodford Avenue and the Golden Sands Holiday Park will flood with water reaching ankle height. People in these areas should take action now. We urge all people to take care near coastal paths and promenades and not to drive through flood water.

We are closely monitoring the situation and have workers in the field to relay information and assist the emergency services and local authority.

Conditions may apply two to four hours either side of high tide. This message will be updated by 8pm today or earlier if the situation changes.

Appendix D: Feedback summary from Task 5 workshops

D.1 Shipston-on-Stour

Date: 5 February 2018, 6pm

Location: Town Council Offices, New Clark House, West Street, Shipston-on-Stour CV36 4ND

Facilitators: Simon McCarthy, Neil Blazey, Paul Cobbing

Attendees: 8

Duration: about 1 hour 15 minutes

Payment incentive: £20

D.1.1 Format

- Attendees split into 3 groups according to experience of receiving flood warning messages
- Two distinct sessions: (1) looking at the whole message and (2) looking at specific elements of the message
- Notes were taken at an individual group level by Neil, Paul and Simon. These notes have been consolidated below – duplicate remarks are not indicated.

D.1.2 Details of group

1. On Town Council – not directly affected
2. Uses river Stour webpage and tries to learn from experience; also warning via mobile
3. Lives at Mill on the Stour. 1998 to 2007 experienced many floods but not in home; warnings from weather forecasts
4. Flooded 6 times in 9 years; received a lot of alerts and warnings (4 times a year) via the phone and text messages – anxiety rises with alerts
5. Newbold-on-Stour home flooded 1998 and 2007; usually garden and fields affected. On the Environment Agency system but using signs in the environment to decide if to take action (moving furniture). The warnings are useful except one while on holiday and one at 4am to say the flood was not going to happen. However, felt it was a very useful service.
6. Female. Did experience the Shipston flood. Not direct experience.
7. Female. No experience flooding or warning.
8. Cohabit with 7. No experience of flooding but uses the camera in the car park where you can see the river level.

Those who are experienced have gauges in their gardens, and also observe fields and roads as indicators of potential flooding. Usually have 6–7 hours for the waters to build up. One spoke about being cut off from home by road disruption, which was worrying with a family at home. Shipston is a designated rural area (?), so people have to come in for schools and the medical centre – so they can be disrupted as well.

D.1.3 Overall themes

- General support for the content of the impactful message types. Some concern that they might be a bit 'wordy'.
- General support for language that helped 'give a picture' of what was expected.
- Found it hard to relate to indicator areas (that is, Mill Street car park) as a way of creating this 'picture'. Not sure how it would relate to their location or for visitors and so on.
- Reaffirmed avoiding facts that don't have a meaning.
- Liked being given specific actions – the type of action seemed to indicate the 'severity' of the flood.
- In general they thought that linking to other information sources was a good idea, but had very high expectations about what information should then be available.

D.1.4 Comments about different types of messages

Flood alert – typical

- In general, respondents thought this was not clear about either what was going to happen or what they should do ('It just tells you facts, but it doesn't tell you what they mean', 'It's not clear if this is going to be a flood or not'). 'Those who have regularly flooded will know what this information will mean, others won't.'
- There were concerns over what would happen when a peak level was predicted overnight ('How would we know if something changes?').
- There was some confusion with how the amount of rainfall corresponds to a change in river level ('I wouldn't be worried, if there is only 8mm of rainfall when this is small compared to the river level of 3.1m').
- There was an acceptance that rainfall forecasts are uncertain and that things could easily change ('You can't guarantee how much rainfall there will be').
- Based on 1, 2, 3
- Shipston is affected by a lot by run off from the fields, so amount of rain really depends on the soil saturation, which is not indicated.
- Units in inches would be useful.
- Discussed the critical level at the bridge when flooding would occur. Discussed using previous flood levels as an indicator.

- The time between the alerts/warnings is critical – sometimes they come too close together.
- Generally liked this message – it showed a peak and the expectation/projection of an event.
- Any generic text is not useful.

Flood alert – impactful

- Generally preferred this alert ('This gives a good picture', 'Tells exactly what's happening and what is being done', 'tells what to do').
- The reference to specific area 'will click'.
- Liked being clear that no flooding of properties is currently expected.
- Like the timing of message updates.
- Liked the specific warning urging 'all people to take care and not drive through flood water'. Suggested that the action would indicate the severity of the flood ('This would make me think that it wasn't safe to drive to town/work, so I wouldn't').
- Liked that others were in the area taking action ('This makes you feel like you are not alone').
- Giving a specific location helps for people who park their cars near there or use the road there.
- Liked this one. Language is not so alarmist.
- Reads better. Heavy rainfall was thought to be better than volumes.
- Order was good and specificity was good.
- People with experience would use the bridge, but the Mill Street is visually more accessible to all the community.
- Have a plan with alerts for the community taking pictures so that the local pictures relate to the warning level.
- Local knowledge is important from experience of flooding that informs your actions at this stage.
- 'Woolly' and 'wordy'. Should incorporate local information on levels and trigger points.
- 'No flooding of property is currently expected but further rainfall is possible and this would cause river levels to rise again' is 'worrying but good'.
- The specific timing of future updates should be given (that is, '7pm not 'this evening').
- Could link to local specific sources of information of visual cues (that is, camera at the car park).

Flood alert update – typical

- Thought this was 'to the point'.

- Whenever the website was mentioned, there was a lot of expectation about what detailed would be provided ‘the website will have the detail we need [maps, advice for the elderly]’.
- The group was split on whether they would take action (‘I’d be worried’ versus ‘I wouldn’t worry’).
- Wondered if a time alert given with a sequence would help.
- Areas of concern – ‘areas of known historic flooding’ – but argued away – ‘areas of identified flood risk’, ‘known areas of concern’ maybe.
- ‘Factual’ – quite like it.
- What does ‘near areas of concern’ mean?

Flood alert update – impactful

- Like that this tells ‘what to do’.
- Liked that this was more specific.
- At first the feeling was that the message was a ‘bit wordy’, but then seemed to agree that ‘a bit more info is good’.
- Similar comments to the flood alert – impactful message (see above).
- Well written and balanced view.
- Time-specific good. Perhaps a time range or ‘9am onwards’.
- Recognised difficulty with the uncertainty
- Too wordy.
- Generally, the flood alerts are a ‘rubber stamp job’ just to raise awareness. Messages should be useful but not stressful.
- ‘Consider taking action’ – not sure what people will read into this.
- Should reference **specific** local media.
- Could reference specific major locations such as schools, shopping areas and hospitals.
- Questioned the benefit of stating what staff in the area were doing.

Flood warning – typical

- ‘Levels don’t mean anything to me.’
- Liked that the message will be updated.
- Would prefer to see specific local media being mentioned.
- Road closure information was useful.
- Liked ‘immediate action is required’.
- ‘How would out of towners know what to do?’
- Specific road information was good.

- ‘Certainly goes up a notch or two.’
- Liked the critical situation tone.
- Volumes and levels were liked.
- Level anticipated flooding to houses would occur (3.4) would be useful and then a link to the government telemetry page.
- Don’t say ‘this warning will be in place for a number of days’. Instead use ‘flooding will occur for a number of days’.
- Should include peak level and time.

Flood warning – impactful

- Liked that the message suggested that ‘You’re not on your own, but you need to do something as well’.
- Noted that this message doesn’t say ‘don’t drive through flood waters’.
- Message needed more paragraph breaks (‘It’s a bit wordy’, ‘Might struggle on the telephone to take it all in’).
- ‘Too many times are give – it’s confusing.’
- ‘Older people still work in feet and inches.’
- Saying that the water was ‘fast-flowing’ indicated ‘that the flood is dangerous’.
- Saying ‘knee deep’ would ‘depend on how tall you are’.
- Giving the specific locations ‘would help avoid those areas’.
- Liked that the actions of others included emergency services and the councils.
- ‘Knee deep’ too precise as it really depends on the specific location so needs to be specific to a location. Depends how tall you are – prefers levels.
- Like the message overall.
- Again, links to other websites for additional information.
- ‘The issue of warning not as important as the accuracy of the contained information.’
- Should say ‘at the bottom end of Telegraph Street it will be in the region of ‘… metres / … feet’.
- Should have these messages on the Town Council website or linked.
- ‘Be specific if mentioning roads.’
- Was uncertain on ‘knee deep’. Suggested ‘flood water will rise to a depth where vehicular access is unsafe’.
- Key information requirements: ‘are we in danger of flooding internally? Do we have to worry about family using schools or hospitals? When do I start moving furniture? When do I need to evacuate?

D.1.5 Comments about specific language elements

Indicator locations

- Some mixed thoughts on using an indicator location to describe the flood and enable action. Some acknowledged that 'the car park always floods first' but 'I wouldn't know if that meant other areas were going to flood'. Some cited a lack of confidence: 'just because it has flooded here before doesn't mean it will be the same this time'.
- Liked indicator locations with specific times. Didn't like woolly or vague statements.

Prediction

- Disliked: 'our forecasts predict that river levels could reach 4.65m'.
- 'Our forecasts predict that properties could flood in Mill Street'. Liked the specific location but were unsure if it meant that some or all properties at that location would flood. Liked but with 'predict properties and roads near the river could flood'. 'In the area' was considered too general.
- Didn't 'like' use of the word 'will' unless 100% certain, but did acknowledge that this would make them take action. 'You'd panic if it said 'will'.
- Using 'possible' 'would not lead to action'.
- Suggested warning: Our forecasts suggest that flooding of gardens and roads is **possible** in your area [this would actually be an alert]. Suggested warning update: Our forecast suggests that **properties will** flood in your area.
- Preferred an alert hierarchy of: Alert > Warning > Flooding based on hydrograph levels.

Flood description

- 'Flooding will be minor' – mixed views. 'This means not to panic or take no action' but 'was a good indicator of severity'; 'too general'.
- 'Flooding will be ankle deep' – in general the group liked this but did note that it 'Might vary from person to person' and 'woolly'.
- 'The river level will be 5.25m AODN' – disliked this. Didn't know what 'm AODN' was.
- Didn't like many of the statements and preferred 'properties will flood when the river level is xxx metres'.
- Imperial and metric units.

Actions

- 'People in these areas should consider taking action now' ('Consider' is a bit vague and not sure what to do'). The group discussed the content of the messages they receive from the schools when there is a closure. These

messages are always definitive (that is, 'the school will be open') but they do sometimes provide updates with contradictory messages and that is frustrating 'update: now the school will be closing'. People will often phone a neighbour and ask 'what are you going to do?'.

- 'Take appropriate action and following the recommendations at the end of this message': 'This sounds like an emergency – would be good when really needed.' 'What is appropriate?'
- Liked 'immediate action is required' and 'we urge all people to take care near and not to drive through flood water'. 'Remain safe …' liked as an end message.
- Liked 'people in these areas should consider taking action now'.

D.2 Guildford

Date: 19 February 2018, 5pm

Location: Council Offices, Millmead House, Millmead, Guildford GU22 4BB

Facilitators: Simon McCarthy, Neil Blazey

Attendees: 10

Duration: about 1 hour 15 minutes

Payment incentive: £20

D.2.1 Format

- Attendees split this time into 2 groups according to experience of receiving flood warning messages and experience of flooding.
- Two distinct sessions: (1) looking at the whole message and (2) looking at specific elements of the message.
- Notes were taken at an individual group level by Neil and Simon. These notes have been consolidated below – duplicate remarks are not indicated. Also present was an NFF member who arranged and observed the session.

D.2.2 Details of group

1. Residents highly engaged with flooding and flood warning issues (facilitated by Neil)
2. Mixed group of residents in engagement and experience of flooding and warnings (facilitated by Simon)

Description of Group 1

- Home flooded in 2000 and 2013, and in the last flood had to move out for 7 months for refurbishment. In 2013, only warning given when water entering the house. Uses weather forecasts, river level telemetry and observing weather/river conditions and experience to decide.

- In 2013, flooded to the outside of the house and void below floorboards. Received flood alerts but was on holiday. Recently received flood alerts but the river does not appear high. ‘While necessary somewhat nerve racking and unnecessary for our purposes.’ Car parks and path at Walnut Tree Close are visual cues of possible flooding.
- Female: same experience as last person. Wanted more information on possible impacts.
- Female: experienced about below floorboard flooding and loss of electric. Receives flood warnings and agreed that recent one seem unnecessary.

Description of Group 2

- Garden and shed flooded in 2000 and 2013, ‘but enough to be concerned as a few more inches would have been in the house’. Received warnings but was away on holiday.
- Female: no experience of flooding.
- Female: garden flooded in 2000 and 2013 up to back door. Received alerts but river rise was too fast to be useful. Again the alerts didn’t seem to relate to the river levels, so uses other local cues.
- Had experienced house void flooding.
- Bought house from council but no disclosure of flood risk. Was not signed up to warnings for the 2013 flood and house inundated to a foot. Made house flood resilient and signed up to the warnings but ‘caused us unnecessary worry’. Uses web river level telemetry and would like to select the threshold for SMS warnings.
- Representative from applied resilience. Experience in Lewis.

D.2.3 Overall themes

Group 1

- This was a knowledgeable group, with a good understanding of the local flood risk issues.
- This group wanted warnings that were informative but not panic causing.
- In general, this group wanted as much information as possible to help them understand what was happening.
- This group liked the use of localised information, but were concerned that this wouldn’t be useful as representative information to help describe the general extent and scale of flooding.

Group 2

- Mixed experienced group that mirrored the themes above.
- Some are already using telemetry river readings and so wanted that information in the impactful messages. Older participants wanted imperial measures as well.

- The message needs to start with the type of warning level in it so that they can self-select if they should continue to read or listen (more experienced).

D.2.4 Comments about different types of messages

Flood alert – typical

- Initially quite liked this message – 'concise and factual'. They understood what the specific levels meant.
- 'What does 2.2m mean for most people?' 'Needs some personal reference levels.' 'Wouldn't mean anything to some people.'
- Wanted to be sure that this information matched exactly what was displayed on other sources.
- Saying 'a lot of rain' is just scary.
- Felt it could be shorter, more concise and less verbose.
- Would like it in feet and inches as well.
- Would like to know the time of the peak upfront. Prediction is more important than current plus the critical level when flooding could occur.
- Important levels and time in bold if on a website.

Flood alert – impactful

- Liked that this message was more specific and thought 'the more info the better'. 'The more aware you are the more likely you are to do something.' 'There's a lot more that people can relate to – they can picture how bad it is going to look.'
- Don't 'drive through flood water is good' – lots of people still try to.
- Commented that each section of the message needs to align. 'Why would you raise temporary defences if no property of flooding was expected?' The group weren't sure if no flooding of property was expected was because of deployment of the barriers.
- Message is 'not too long'. 'Too long.'
- Would like to understand what is happening upstream.
- Group acknowledged difficulty of getting the right balance in the message – 'If it's too specific people may not read it all.'
- Would like some of the factual figures from the first message in this one.
- Forecasts 'locally'.
- Questioned why temporary defences were only being deployed in Mary Road – maybe more generalised is better but needs local knowledge of possible actions. Also why would they put these defences up at this level unless they were sure it would flood properties?
- What does 'property' mean? Does it include outbuildings and gardens.

- It is a more reassuring message.
- ‘Last 24 hours’ could be ‘day’.
- ‘Would get me looking at the website river levels.’
- ‘If there is a list of places that can flood I would like to subscribe alerts for those places.’

Flood alert update - typical

- This group had not had a flood alert update. They agreed that one would be useful to demonstrate a significant change: something has happened upstream or a physical change such as operating sluices.
- Updates need to retain all the relevant information from earlier messages. ‘That would be a problem.’
- ‘Could be comforting.’
- Need the specific link. This would be good in texts and emails.
- Need some numbers in brackets.
- A little woolly – ‘near areas of concern’.

Flood alert update – impactful

- ‘Consider taking action’ – not sure what people will read into this. ‘May lead to inaction.’
- Language should be specific. ‘If you go to this level of detail you’ve got to state that houses will or won’t flood.’
- The group could identify the specific locations but then asked ‘which bit’ of them was flooding. Would be better to identify markers that were unambiguous as to whether they flood completely or not at all.
- ‘River levels are now forecast to peak from 9am tomorrow (Tuesday 20th February)’ – this is definitely useful.
- Liked the reassuring elements of Environment Agency action and updates. Yes.
- Would still like to see some levels in brackets.
- When is the peak likely to end?
- Questioned the relevance of temporary defences. Sandbags would be nice.
- Saying it will be updated is reassuring that it is being monitored.
- Liked this one better. ‘Shorter the better but we are grown-ups and would listen.’
- ‘Needs to say what alert level it is at the start so can hang up if not needed.’

Flood warning – typical

- Should give the height and the speed of water.

- The message doesn't say where the flooding will happen.
- Would prefer to see specific local media being mentioned.
- Would like some kind of flood extent grading or some way of describing the flood extent. Distance/metres beyond the river?
- Start message saying the warning level.
- Need imperial units.
- Clarify 'Guildford area'.
- Closed roads information is useful.
- Would like to see some predicted level.
- Flooding of properties – buildings and gardens.
- 'Immediate action required' needs to further forward.

Flood warning – impactful

- The group felt that many different local indicators would be required so that everyone would have a reference point.
- They felt that having indicators may make some people 'turn off' if their area wasn't listed.
- The group suggested that a useful phrase may be: 'As an example, the following areas are predicted to flood … other areas will also flood' or 'As a reference point …'.
- Would prefer more human sounding messages – not automated robot voice. And a repeat button.
- Liked locations being more specific based on local knowledge
- Clarify 'Guildford area'.
- All warnings need to be on local radio.
- 'Ankle deep' – could not see the relevance unless connected to a specific location.
- 'Closely monitoring' was reassuring.
- Third paragraph 'doesn't help us know what to do immediately'. Where to get sandbags and assistance.
- A web link for further information would be helpful.

D.2.5 Comments about specific language elements

Indicator locations

- Some concern over using very specific locations. 'They'll say my road if it's my road that is going to flood.'
- Would like to use the phrase 'as a reference point …'.

- Double uncertainty words ('predict' with 'likely' or 'could') makes them fairly weak statements. The last one is more solid.

Prediction

- 'Depends whether you have been bitten before.'
- Using the word 'will' is definitely more impactful. It doesn't have to refer to all areas – just that flooding will occur somewhere.
- 'Is possible' and 'is likely' are very similar.
- 'Will' implies must act while the first 2 seek information.
- AODN useless – don't know what it means.
- Need a comparative threshold level when flooding will occur.

Flood description

- Needs something to correlate a level with an impact. A location with a depth. Yes.
- 'Properties could flood' is too open.
- 'Need to give a point if you are describing depth.'

Actions

- 'People in these areas should consider taking action now': 'consider is a bit vague and not sure what to do'. These areas? Alert level.
- Liked 'immediate action is required' ('punchy') and 'take appropriate action and following the recommendations at the end of this message'. Yes. Warning level. Web link required to actions.
- 'We urge all people to take care near and not to drive through flood water.: 'Too broad.' Not in a warning, more for radio.'

D.3 Rhyl

Date: 13 March 2018, 6pm

Location: The Community Resource Centre, The Square, Kinmel Bay, Rhyl LL18 5BT

Facilitators: Simon McCarthy, Neil Blazey, Paul Cobbing

Attendees: 11

Duration: about 1 hour 15 minutes

Payment incentive: £20

D.3.1 Format

- Attendees split into 2 groups according to experience of receiving flood warning messages.

- Took the form of one session spent looking at the whole message.
- Notes were taken at an individual group level by Neil, Paul and Simon. These notes have been consolidated below – duplicate remarks are not indicated.

D.3.2 Details of group

1. Female. Flooded December 2013, flood warden. Not everyone in Sandy Cove had received a flood warning. Does now receive flood warnings regularly but main problem is getting flood alerts from the Dee Estuary to the east coast of Anglesey. 'If flooding hits that whole area there is a serious problem!' 'I hear my landline and my mobile go at the same time, half the time I don't bother to answer them because most of the time they are so vague they are useless.' Uses online weather forecasts to see if there is anything to worry about.
2. No real experience of flooding, but had received alerts recently that were then cancelled. Had a personal explanation why from the flood warning leader, so understood why but not a good experience.
3. Female student undertaking project research in the area.
4. Kinmel Bay resident and landlord, and received a number of alerts. 'Had one the other day and the sun was out shinning and the wind was blowing the other way and why are we getting this?' Checks the weather, tide heights and wind direction.
5. Resident. Receives flood alerts but not home that often and checks the weather forecasts. 'When walking my dog I keep an eye on the sea.' 'Although we get the flood warnings they seem to be for us if you know what I mean.'
6. Resident and member of the flood forum. If gets a warning checks the internet weather and the sea. 'With the warnings now you get complacent.'
7. Resident involved in the 1990 flood when there was no warning. Difficult to understand the difference between alerts and a warning, and what the wardens should be doing.
8. Female resident. Too many alerts and they are vague. 'The tone of voice is completely wrong for what you are trying to make people do – too disengaged like a robot.'
9. Resident and town councillor. Concerned about the temporary residents – holiday makers and travellers.
10. Resident (flood warning leader). Concerned the advice is for multifloor houses when most in the area are single floor. Too many false alarms. Most warnings are irrelevant depending on the direction of the onshore winds and coastal facing direction.
11. Third year student undertaking project on Sandy Cove social resilience and community cohesion. Reported that from his research most residents were aware of the flood risk and had signed up to warnings. Was concerned about recovery.

D.3.3 Overall themes

- Coastal issues require specific elements to the flood alerts and warnings. The alerts don't currently seem to draw on all elements of the conditions that define a coastal event (wind, pressure, tide).
- The large flood alert areas mean there can be a lot of false alarms. 'You have to listen to the full message before you can delete it off your phone even if they are irrelevant.' In general, there seemed to be more concern with the alerts than the warnings.
- The community context and local issues should be considered when writing the messages. If there are wider issues that are not being addressed, the warnings can be seen as cosmetic. The warnings should be linked to local conditions and context.
- Mixed views, but on balance preferred more concise alerts, with greater descriptive elements left to the flood warnings.
- Need imperial units, depths relative to what and a possible further detail options.
- Coastal appears less focused on specific impact locations (streets, car parks and so on), but more concerned that the warning relates to their coastal section including direction of onshore winds relative to tides and pressure.
- Liked the descriptive style of the warning level provided a punchy concise start to the content is achieved. There also needs to be locally sensitive and specific actions.

D.3.4 Comments about different types of messages

Flood alert – typical

- The impacts (and the local context) are highly localised.
- What does 'localised' mean? Not specific enough.
- Timings were seen as useful, but there were too many times. Yes
- 'As a household we just need to know: are we going to get flooded or not? Too many words will make people switch off.'
- Some responders felt that more information was useful – they wanted to understand why the alerts and actions were being issued.
- Too wordy and some confusion about the level. Is this about to happen? 'They are not going to read all that and on the phone remember all that'.
- Don't group times together so 'high tide at …'. Then issue another alert for the next high tide.
- An alert can just be the first 2 paragraphs: the tide times, wind direction and flooding is possible to what level of impact – how serious. 'Short and sweet as possible.'

Flood alert – impactful

- ‘If the zoning was smaller we could be more precise in our prediction of flooding. This is why a lot of people opt out of the alerts.’
- Some responses liked being told specific actions.
- Some communities without proper infrastructure regularly have water ponding. Specific actions relating to driving through water. ‘Should they evacuate through the water or not?’ ‘Should they evacuate on foot?’
- The group felt that the alerts should be a drip feed of information – slowly upgrading the certainty and description of the event.
- Again too wordy on the phone, but as an email would read it.
- But liked its more descriptive style. Spray is less important than actual waves. ‘Once you see the spray you are expecting the worst really.’
- Felt the time period window was too big, but understood the uncertainty at this level.
- Getting the alert phone call raises their attention even before the content.
- Start with ‘there will be a high tide at XXX and overtopping may be possible’. The last part depends on the characteristics of the onshore wind strength and direction locally.

Flood alert update – typical

- Using the word ‘may’ will mean that people won’t take action.
- If you are going to have an alert that is useful and sensible, you need to get people thinking about what they are going to do if things get worse.
- ‘If you give people uncertain information they will need to gamble on what they do.’
- Each house should have its own specific flood level plan (yellow, amber, red) (and amber 1, amber 2 and so on) that would help guide individual responses.
- Would prefer for reassurance: ‘The situation is being monitored and will be updated at XXX’. Don’t need to know about the incident room unless you provide a telephone number but it would be inundated. Call it ‘control room’ – is there an incident.
- Liked the idea of links for further information. However, some residents will not be able to use links or don’t have computers, so suggested that another telephone number be provided or an options menu (press 3 now for additional / more detailed information).
- Still too wordy.

Flood alert update – impactful

- The language of the alert should reflect that the margin between overtopping and not overtopping is very fine. Any actions that people need to take must already have taken place.

- Spooking people into evacuation.
- Liked that this was more specific ‘be specific’.
- Need to be careful not to overcomplicate, though ‘the example of ankle height would depend on where in the street you were’. Needs to be realistic – example would be ‘a metre for this street’.
- Liked this one.

Flood warning – typical

- ‘Quite punchy – hits you straight away.’
- Split opinion about showing a level ‘I don’t know what that means’ versus ‘useful’.
- Suggested stating a wind direction that everyone will recognise such as ‘wind coming from the sea’.
- Need to give people some idea of where the water level will be ‘like a plimsoll line on a boat’.
- Get rid of ‘AODN’. Don’t know what it means.
- Need imperial units as well, otherwise meaningless.
- If depths are given what are they in relation to – normal high tide sea level, beyond the sea wall (flooding), specific location locally?
- Get rid of second paragraph; just have first and third and now you need to know what you need to do.

Flood warning – impactful

- Providing depth indicators received mixed responses. ‘I like the bit where it says reaching ankle height.’ ‘Saying ankle height, knee height, waist height and neck height will mean something to everyone’ but noted that ‘this will vary as you walk down a street’. ‘You’d need to be specific in giving a location with the depth.’
- Noted that the information on wind direction was not included.
- Noted confusion on splitting up actions by those directly and those indirectly affected.
- Some thought that the message was bulky. ‘You’d have to wait for several minutes to find the information that you want’. ‘These messages are trying to achieve too much.’
- Some did want the reassurance that others in the area were doing something.
- People don’t know the extent of the alert or warning areas – references to the area don’t mean much. People would know where ‘Sandy Cove’ was, but not specific streets. Suggested that we should reference clear landmarks such as ‘near the post office’. Suggested we should ‘speak in plain English but without dumbing down too much. ‘Dumb down without talking down.’

- ‘More informative and understandable for others than the previous content but again too wordy.’
- Not everyone will know what ‘Area A’ is.
- Remove the following day information as it is confusing just give another warning for that day.
- Remove repetition such as the titles ‘Flood warning is expected’ and ‘Flood warning in force now’. Basically needs what the warning is – description, what I should do and where to find out more detail.

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