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European Flood Risk Management Research

2nd ERA-NET CRUE Research Funding Initiative
Flood Resilient Communities – Managing the Consequences of Flooding
Final Report

CRUE Final Report

URFlood – Understanding uncertainty and risk in communicating about floods

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Funded by
Ministry of Agriculture and Forestry, Finland; Institute for Environmental Protection and Research, Italy; Office of Public Works, Ireland; Environment Agency, England; and the Scottish Government; in the framework of the 2nd ERA-Net Research Funding Initiative.

The Scottish Government · OPW · ISPRA Istituto Superiore per la Protezione e la Ricerca Ambientale · mmm.fi Ministry of Agriculture and Forestry · Environment Agency

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CRUE Research Report

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Published in August 2011

ERA-NET CRUE is funded by the ERA-NET Scheme under the 6th Framework Programme
General Directorate for Research in the European Commission
Contract number: ERAC-CT-2004-515742

Era-Net CRUE Funding Initiative

ERA-Net CRUE was funded within the Sixth EU Framework Programme and introduced structure within the area of European research on flood risk management (FRM). Its vision was to support and develop an extensive co-ordination and integration of regional, national, and European research programmes, projects and policies in the field of Flood Risk Management. Within the CRUE ERA-Net two funding initiatives were introduced.

The second ERA-Net CRUE Research Funding Initiative **"Flood Resilient Communities – Managing the Consequences of Flooding"** was launched in support of the EU Floods Directive 2007/60/EC, which was introduced as a result of several severe flood events causing loss of life and property. Within this initiative seven joint research projects with test sites all over Europe are funded and focus on a broad spectrum of issues related to the enhancement of resilience. Besides, the scientific coordination project CORE CRUE is funded within this second call, to support the implement of the call and to disseminate its results.

URFlood – Understanding Uncertainty and Risk in Communicating About Floods

CRUE Research Final Report

Funded by

Institute for Environmental Protection and Research, Italy	**ISPRA (IT)**
Ministry of Agriculture and Forestry, Finland	**MMM (FI)**
Office of Public Works, Ireland	**OPW (IRL)**
The Environment Agency, England	**EA (UK)**
The Scottish Government	**SG (UK)**

A project fact sheet can be found at the end of this document.

Summary for Decision-Makers

Headline summary message

This report focuses on communications about flooding: how they are understood and how they can be improved. Our primary activity was the exploration of how flood communications are understood, using a mixture of qualitative and quantitative methods to collect data in 11 case study sites, in four countries. We suggest eight guidelines for effective communications, and discuss specific ideas for implementing these recommendations. For effective communications, a mixture of methods is required to reach a full range of community members, and to provide different levels of information. Automated warning messages may be useful for delivering warnings, but personal approaches and community engagement may be more effective for building community capacity.

What the report is about and why the work is important

Floods cause billions of euros of damage to lives and livelihoods across the EU and beyond. Floods cannot always be prevented, but some of the damage and distress caused by flooding can be reduced or mitigated. This is the motivation for this project. In times of flooding, many people are not prepared or do not react appropriately to flood warnings. Experience shows that even where there have been efforts to communicate about flooding, these problems persist. We therefore focus on how communications about flooding can be improved to make them more effective, and produce intended responses from the public.

Rather than assuming an information deficit model (that simply providing more or better information will always lead to more 'rational' responses) we use the concept of knowledge systems, and how these affect processing of messages, to argue that the communication of uncertainty and risk must be seen in the broader context of social, institutional, cultural and psychological behaviour. In this project we seek key aspects of this context and use these to create a framework of guidelines for designing effective flood communications.

> ***"We are not sure about probability and exactly what it means – we just want to understand what is happening to us."***
> **Comment from a participant in a focus group in Scotland, in a discussion on terminology**

Aims of this research, and who may benefit

The aim of the research was to improve flood risk planning and responses to flood warnings by investigating and illustrating how flood risk communications are incorporated into the knowledge systems of different actors. (Knowledge systems are ways of seeing and understanding the world, based on a variety of forms of information. It is thought that difficulties in communication between experts and the public can arise because of differences in their knowledge systems.) The outputs of this research should benefit agencies and organisations responsible for designing communications about flooding and flood warnings, and ultimately at-risk communities, by improving their resilience and ability to react appropriately to flood warnings. This was encouraged for each the four countries hosting URFlood research, by consultation with national-level stakeholders (Figure 1) and setting up steering groups comprised of members representing organisations and agencies linked to flood communication.

Methodology of the research

We used a mixture of qualitative and quantitative approaches to probe experiences and perceptions of flooding and flood communications. We note that agencies and authorities have different perceptions and ideas of how messages are processed, which often do not match those of the public, but we focused on probing public perceptions of these issues, since they are the ultimate targets of communications about flood preparedness and flood warnings. We created organograms to make explicit the complex web of organisations that can be involved in flood communications. We used focus group discussions to explore issues, and questionnaires tailored to each country, to survey trends and relationships in attributes of respondents living in at risk areas in 11 study sites. We used hundreds of questionnaires and combined common questions into a cross-national database for analysis.

Figure 1 Discussing URFlood's work with national-level stakeholders.

Results and key findings

We found flood warnings and communication were important to the public at risk, and there was often a general wish for more information about floods, with some wanting situation-specific advice, and a desire for consistency and clarity between agencies involved in responding to flood risk. Messages from authorities are often misunderstood or not trusted, not helped by misunderstanding or confusion about some terms associated with risk and uncertainty. Although in some sites there have been past efforts at communication, there can therefore still be low preparedness for flood events, or uncertainty about how to react to flood warnings. However, although many people request more information, poorly educated and older groups may be less likely to be confident, whilst some of those with confidence may actually understand terms differently to scientists or source agencies. Messages and warnings should therefore be very clear and simple, but provide links to more complex information. Personalised contact and communications are very popular. Current web-information sources were not widely known in any of the partner countries, although popular when visited.

Implications for stakeholders and recommendations for decision-makers

We suggest that those charged with communicating about floods cannot assume that their terminology, messages and role are well understood by the public, even if there have been previous efforts to communicate about these topics. To overcome this, using simple messages (but with links to more information) and using multiple methods of communication, can help to reach different sectors of society. Public perceptions of trustworthiness should be considered when choosing agencies and individuals to communicate about flooding, and a tailored approach is particularly important to reach those groups who are oblivious to flood risk. Our recommendations are summarised in eight guidelines (Figure 2).

We tested these guidelines with both members of the public and members of public agencies involved in flood communication and responses. In addition to confirming support for the guidelines, and ideas for useful tools for their implementation, the testing suggested an order of importance for the guidelines (as indicated by the numbering of each guideline in Figure 2).

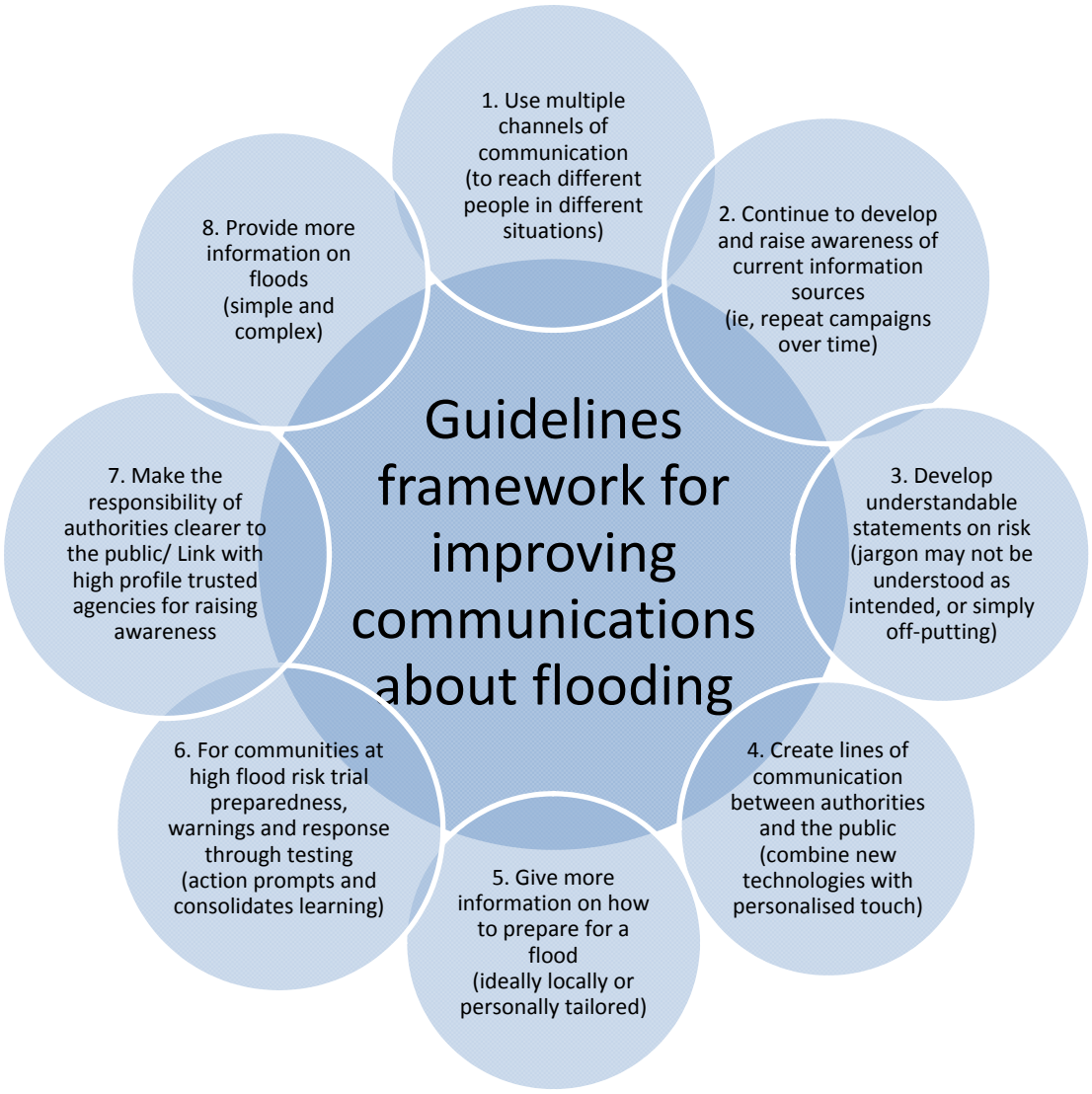

Figure 2 The framework of 8 guidelines proposed by this project, to aid the design of effective flood communication systems in any European country

The guidelines framework has implications for practitioners responsible for designing of new communication methods and modification of existing approaches, across the EU. Applying the guidelines requires knowledge of local context obtained from community engagement, to avoid erroneous assumptions. Policy-makers therefore are mandated to resource and encourage community engagement, as part of a carefully thought through process of communications design.

There are no 'one size fits all solutions' to designing effective flood communications, since these must always be based in an understanding of local society and cultural context, and any pre-existing systems. However, based on our experiences in case study sites, we suggest that community engagement and personalised approaches are particularly helpful for communicating about flood preparedness, and reaching out to those who consider flood communications irrelevant. Using new technologies should also be considered, and even to create 'opt out' flood warning systems (where, for example, telephone messages are automatically delivered to every household in at risk postal code areas) though existing legislation and data protection principles may make this challenging.

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1 Introduction to URFlood and review of relevant literature and practice

This chapter 'sets the scene' for the URFlood project and the research outlined in this report. It begins with a brief background to the development of the URFlood project (section 1.1). It then reviews the literature relevant to both the design and delivery of the project (1.2). It goes on to summarise and compare current practice in four European countries (section 1.3), and existing guidance that has been issued on flood communication (section1.4). The chapter finishes by summarising conclusions for research into flood communications, which were used to inform work presented in the following chapters.

1.1 Background to the URFlood project

The project came out of an understanding of the current flood risk research and more specifically work carried out on flood warnings and flood awareness, largely from research carried out in the UK due to the specific expertise of partner 5 (e.g. Twigger-Ross & Colbourne, 2009) but also drawing on the substantial European work carried out in the FP6 FLOODsite project (specifically, Task 10 and Task 11 of that project)[1].

It was clear from this work that whilst flood risk communication is context specific, there are a number of key factors that characterise successful communications. In this project we have used that knowledge to shape the instruments used in the data collection for the case studies.

Specifically, the eleven case studies across the four countries (Scotland, Ireland, Italy and Finland) sought to gather information around local flood risk communication systems. Having collected that local information the findings were compared to draw out common features that could be developed into guidelines for practical advice on designing flood risk communications. The guidelines were then tested with a range of stakeholders, including professional partners and members of affected communities.

1.1.1 Project structure

The activities of the project were divided into a set of six related work packages (WPs). These approximately corresponded with activity over time (excepting WP1 which spanned the project): so, for example the literature reviewed in WP2 and WP3 (combined WPs) informed the later activities in WP4, 5 and 6. The WPs also have some correspondence with order of sections presented in this report.

WP1 Project management and knowledge exchange
WP2&3 Understanding the role of uncertainty in flood risk communication: see section 1.2 to 1.3.
WP4 Investigating knowledge systems: see section 1.4, and 5.1.
WP5 Developing new flood communication processes: see section 5.2.
WP6 Testing new flood communication processes: see section 5.3
WP7 Synthesising results to improve understanding & actions: sections 6, 7 and 8.

[1] Within FLOODsite, Task 10 focused on with socio-economic evaluation and modelling methods, whereas Task 11 focused on risk perception, community behaviour and social resilience. More information is available from the FLOODsite website (http://www.floodsite.net/).

1.1.2 Rationale and assumptions

In this section we discuss the overall assumptions underlying the project, based in previous research and literature. (Subsequent parts of section 1 focus in more detail on review the existing literature and experiences on key issues of relevance to the project.)

Although we define risk as per the EU Floods Directive (2007) (see box), we expect that different actors (in particular many members of the general public) may not understand or process this terminology as per this definition.

Definitions used in this project that relate to other CRUE-ERA-NET projects

1) Community:
All the people living in a particular area of place. However, it cannot be assumed that all these people share the same backgrounds, norms or understandings.

2) Resilience:
This is a dynamic process of behavioural adaptation to an event with adverse impacts, and is underpinned by the resources available (e.g. economic, human and social capitals).

3) Risk:
The product of hazard (e.g. flood return period, depth and extent of flooding) and vulnerability (e.g. exposure and susceptibility of people and assets).

For a complete list of definitions see the list of Terms and Definitions at the end of this report.

Our starting assumptions were the following:

1) The flood risk communications system is best conceptualised as an interactive dynamic knowledge system between the different actors involved in an affected area. Knowledge systems view information as a resource that flows around a network of different actors, is converted to knowledge and may influence practices (Roling and Engels, 1990).
2) Information is made sense of by recipients of flood awareness and flood warnings in their own social context and is considered as only one input into decisions to act in a flood situation. Members of the public draw on their own forms of judgement to assess risk information based on how it fits in with their everyday experiences and experience of risk information (Pidgeon et al, 2003; Horlick-Jones, 2007) and with their own subjective ways of viewing risk (Slovic, 2000; Vahabi, 2007).
3) Understanding responses to flood communication requires both understanding the situational factors (physical characteristics, location) of the risk and social, cultural and cognitive attributes (personal and psychological) of individuals for whom the communication is intended (Tobin and Montz, 1997, Werrity et al, 2007; Twigger-Ross et al, 2009).
4) Information is evaluated in terms of who it comes from as well as what it says. Trust in the source of the information is as important as providing accurate information and influences how people assess the risk (Renn and Levine, 1991) and how they interpret the risk (Fischer and Glenck, in progress).
5) The research challenges the “information deficit model” (Hilgartner, 1990) of risk communication, which assumes that the public are lacking in their knowledge of science and risk and that more information will produce more rational responses in risk situations (Quine et al, 2011).
6) The “public” are conceptualised as heterogenous and understandings of the heterogeneity are crucial in formulating effective flood warnings. They are not considered to be “a homogeneous mass to be ‘managed’ or ‘led’” (Involve, 2008, p 23). Further as Frewer (2004 p.392) suggests “It is no longer assumed that the public will passively react to risk information without active involvement in the risk management process (Rowe and Frewer, 2000; Wynne, 2001)”.

Therefore, rather than assuming an information deficit model (i.e. that providing more or better information will ensure more ‘rational’ responses to flood events or risk) we consider that how someone will process and react to a message will depend on how their background, situation and pre-existing assumptions affects perceptions and understanding about the message’s topic and source. We expect that

communication methods which take these points into account are more likely to be accepted and effective, by producing desired reactions in community members. We argue that providing effective communications about flooding, both for preparedness and for warning, will therefore contribute to community resilience by reducing the economic and human cost of damages caused by flood events. Furthermore, any actions that build community capacity to prepare for floods and react to warnings, is itself likely to promote community cohesion and hence indirectly promote community resilience.

1.2 Review and synthesis of literature relevant to flood risk communication

In this section we provide a short overview of the conclusions from the main body of risk communication literature together with findings from the flood warning work in order to provide some key points that need consideration in the communication of flood risks. (This chapter corresponds to project activities under WP2 & WP3.)

This section is divided into four sections: (1) we elicit insights from the general risk communication literature; (2) we discuss important aspects of uncertainty; (3) we explore specific characteristics that could be taken into account specific to flood risk communication; and (4) we discuss the concept of knowledge systems, which affect how concepts of risk and uncertainty are understood and processed be message recipients.

1.2.1 Risk communication

There are general insights in the risk communication literature which provide a substantial basis for developing more specific flood risk communications.

Firstly, how is risk communication defined? Covello (1992; pg. 359) defined risk communication as “the exchange of information among interested parties about the nature, magnitude, significance, or control of a risk”. The National Research Council (1989; pg. 2) defined risk communication as “an interactive process of exchange of information and opinion among individuals, groups, and institutions”. More recently, Quine et al (2011) provide a useful risk communication framework in the context of Lyme disease, which has five dimensions and focuses on influencing responses rather than on providing information. Those five dimensions are:

- “Who? Do actions need to be tailored to particular audiences and their activities?
- Where? Is the risk or the underlying hazards place/site specific?
- When? Is the risk specific to time of day or season, and should actions be taken before, during and after a visit?
- What? Are there behaviours that can minimise the risk of acquiring the disease?
- How? Can behaviours be influenced by measures that encourage, exemplify and/or engage?”

These different definitions reflect the evolution of risk communication since the mid-1980s, from concern about how best to inform the public about the technical aspects of risk assessment to a process of communication that includes an understanding of how various groups in the society perceive and respond to risk information. Fischhoff (1995; pg. 137) suggests that risk communication over the previous two decades has moved through different “focal communication strategies which practitioners hope will do the trick”. His stages move from content-oriented risk communication intended to persuade, to process-oriented risk communication involving partnership. Since 1995 further changes can be detected towards an emphasis on response based risk communication that brings together different knowledges and expertise to support appropriate responses in risk situations (Twigger-Ross et al, 2009; Quine et al, 2011), thereby moving away from “top down communication processes to more consultative, transparent and inclusive decision-making processes” Frewer, (2004) p. 392

This change in focus for risk communication has been driven by a number of strands including changing concepts of science and increased knowledge of risk perception, and understanding of the issues of trust and credibility. Seminal work in the 1990s by Functowitcz and Ravetz (1990, 1992) on post-normal science, analyses how the presence of uncertainty and complexity in science-relevant policy issues points to the development of alternative problem-solving approaches. These alternative approaches embrace uncertainty and open up the technical processes to a wider stakeholder community (or extended peer community). Consistent with this perspective, Covello, Menkes and Nehnevajsa (1982, p. 53) stated that "the full dimension of risk cannot be captured solely by the probability of an adverse consequence, because this misses the human element."

This human element is in part described in work on risk perception, specifically, the concept of perceived risk which became prominent in the mid 1970s (Slovic, Fischhoff, Lichtenstein, Corrigan & Combs, 1977). The importance of analysing and considering risk perception is connected to the assumption that the way individuals perceive their vulnerability to natural hazards shapes their reactions and ways of coping with these risks (Schumm, 1994). Therefore, getting information on how people perceive risk is valuable in understanding people's behaviour (Armaş, 2006; Sjöberg, 2000; Slovic, 2000). Risk perception research has drawn out the fact that communities and groups are not homogeneous in the way they understand, respond and perceive risk and uncertainty (Shaw, Cudmore, Collier, Reed, Antonelli, Genna & Berman, 2005; Tapsell, Burton, Oakes, & Parker, 2006; Thrush, Burningham & Fielding, 2005).

Finally risk communication research has explored the role of trust in institutions and credibility of source of messages, showing the importance of those aspects to whether or not people respond to messages. Walker et al (2009; p.25) summarise clearly the findings around trust and credibility:

"Communication without trust and credibility is likely to have very little impact (Renn and Levine 1991, Fischhoff 1998; William and Noyes 2007) particularly where people are being asked to, for example, evacuate an area at risk or pay for expensive hazard protection measures. Lofstedt (2003) argues that trust is the 'most important component of risk communication' with the existence of trust/distrust relating to three core criteria of fairness, competence and efficiency."

Having trust in institutions has been shown to be related to lower levels of perceived risk and higher levels of perceived safety (Fitchen et al, 1987). A fourth aspect of trust has also been added and that is caring, it is important for people to feel that the institutions involved in risk management care about them. This unpacking of the concept of trust is very useful for guiding practically how risk communicators operate, the focus needs to be spread across those four aspects for trust to be successfully engendered.

While the risk is certainly a socio-cultural construct, it cannot be defined as a product of perceptions and social constructions, rather, also technical risk analyses are an integral part of the social processing of risk (Hannigan, 2006; Renn, 1992). Having this as a key foundation for risk communication ensures that the socio-cultural aspects are not neglected. In this research carrying out the case studies provides an opportunity to gather those aspects.

1.2.2 Exploring uncertainty

Uncertainty is a crucial concept within risk communication and this section provides an overview of some of the issues around uncertainty that were raised in the wider literature review. Uncertainty is inevitably linked with flood risk management. Building no Brugnach et al (2007), we consider it relevant to distinguish three types of uncertainty relating to predicting flood hazard and flood risk management:

- Probabilistic uncertainty (limitations in the accuracy in calculating probability due to incomplete knowledge or data).
- Non-probablistic uncertainty (inability to calculate probability due to unpredictability, variability and/or complexity of the system).
- Interpretative uncertainty (differences in how people interpret information creating ambiguity)

In the context of flood risk, it is important to understand all three forms of uncertainty. To identify the different aspects of uncertainty relating to flood risk Brugnach et al.,(2007) created the following matrix (Table 1) by comparing the three aspects of uncertainty with the three systems relating to flood risk; the natural, technical and social systems.

Table 1 Brugnach et al.,(2007) uncertainty matrix adapted to consider flood warning and responses

System	Probabilistic uncertainty (Incomplete knowledge) - lack of information - unreliable information - lack of theoretical understanding -ignorance	Non-probabilistic uncertainty (unpredictable system behaviour)	Multiple knowledge frames -different and/or conflicting ways of understanding the system - different values and beliefs
Natural systems -climate impacts -water quantity -water quality -ecosystem	Incomplete knowledge about the natural system e.g. unreliable measurements of water levels	Unpredictable behaviour of the natural system e.g. what will be the highest water level next year?	Multiple knowledge frames about the natural system e.g. is the main problem fluvial or pluvial flood risk?
Technical systems -Infrastructure -Technologies -Innovations	Incomplete knowledge about the technical system e.g. what water level will the flood defence resist?	Unpredictable behaviour of the technical system e.g. will the flood defence remain operational?	Multiple knowledge frames about the technical system e.g. should we raise dykes or create flood plains?
Social systems -organisational context -stakeholders -economical aspects -political aspects -legal aspects	Incomplete knowledge about the social system e.g. what are the economic impacts of a flood for the different stakeholders?	Unpredictable behaviour of the social system e.g. how strong will the reaction of stakeholders be at the next flood?	Multiple knowledge frames about the natural system e.g. do we need to impose insurance against floods or adapt legal regulations about spatial planning?
Strategies for dealing with uncertainty	- Control - Adaptation: unpredictability accepted and no prediction is attempted	- Increase understanding e.g. range estimation uncertainty propagation models, more data gathering and research, use expert opinions.	- Communication - Understanding and sharing knowledge systems - Engagement with stakeholders

In keeping with post-normal science (discussed above) which embraces uncertainty, this project recognises these issues of uncertainty within the flood warning system. Its focus is on investigating the final column, multiple knowledge frames in order to develop successful strategies for reducing those uncertainties.

1.2.3 Flood risk communication

The general insights from the risk communication literature can be complemented from flood-specific insights from works focused on flood warning and flood awareness-raising.

Quite a bit of research has examined characteristics that will need consideration when designing both awareness raising and flood warnings and the idea that “one size will fit all” has largely given way to the consideration of more flexible approaches. These characteristics have been summarised into three categories: flood characteristics, area characteristics, and social characteristics (after Ramsbottom et al, 2003).

Flood Characteristics
Flood characteristics include the type of flood (fluvial, pluvial or coastal), the type of catchment (small and steep, or large and flat), the depth and velocity, and the time of day or year (Ferrnadez-Bilbao and Twigger-Ross, 2009). The predictability of the flood is another flood characteristic (Jonkman, 2003). Different types of floods have significant differences in predictability and impact (Jonkman, 2003). Flood warnings should vary according to the flood type.

Area Characteristics
This includes aspects of the local geography e.g. urban/rural areas, types of buildings and vulnerable locations. Flash floods are particularly harmful in urban areas, where intense rainfall can rapidly overload urban drainage capacities (Parker, 2003). However, issuing warnings in urban areas can be difficult: as flooding can come from different sources, floods are often difficult to predict, and the density and diversity of urban population make it hard to contact all at risk. Warnings may need to be tailored to property to type, as appropriate access and escape routes may vary, whilst ground floor flats, bungalows, caravans are all likely to be more vulnerable in a flood and may require different warnings. Finally, vulnerable locations include schools or hospitals which may need more tailored warnings and longer lead times in order to evacuate patients or school children.

Social Characteristics
Finally, Tapsell et al. (2005) suggested that, within the population, certain groups, on the basis of social characteristics, are more vulnerable and exposed to disasters. These characteristics include age, gender, language, socio-economic level, health. More specifically, based on research in the UK, Shaw et al. (2005) identified a list of factors to identify those types of groups:

- special needs/health groups (e.g., disabilities);
- people living in poverty;
- groups with no or insufficient local language skills;
- groups with a lack of appreciation of environmental cues owing to different backgrounds or unfamiliarity with area and customs;
- untested response and recovery capability of services or individuals;
- fragile social structure;
- individuals and communities not involved in or aware of planning processes.

The research insights on responses from the research hazard warning literatures have generated a range of recommendations as to how hazard warning messages should be designed and carried out to become more effective. Drabek (2000) suggests seven factors which need to be considered when delivering a warning message. These, in a more practical way, pick up on various aspects of the points reviewed above:

1) Credibility: if there are doubts about the credibility of source then the message will be ignored;
2) An official source: people are less likely to respond if the source is perceived as unofficial or if the source is regarded as untrustworthy (Fordham & Ketteridge, 1995). In order to enhance the trustworthiness of messages it is suggested that agreement between multiple official agencies over the severity of the situation should be conveyed to the public;
3) Clarity: warnings must be worded in clear understandable language without the use of jargon;
4) Consistency: the message, or messages, should be consistent; inconsistencies, such as different message sources giving different estimates of the response time available, produce confusion and could encourage people to ignore the message;
5) Precision: the message should be specific in detail, e.g., a road name spelt wrongly can neutralise the warning effect;
6) Repetition: multiple messages will evoke more timely responses;
7) Confirmation: research over the past decades has found that the first thing a person does upon receipt of a message, wherever it comes from, is not to respond to it but to seek to confirm the message‘s authenticity and the appropriateness of the actions for which it calls.

1.2.4 Knowledge systems

To frame the research in this project we used the concept of "knowledge systems" (Roling and Engels, 1990). Knowledge systems are important as they affect how concepts of risk and uncertainty are understood and processed be message recipients.

The perspective of a knowledge system2 implies that differences in how people understand a situation can derive from entirely different mindsets, not just data held. Knowledge systems can be defined as ways of understanding, and are derived from information from a variety of sources. Knowledge systems will vary between individuals according to their background: it is not simply a case that some peope lack information, and others have information; rather different groups form different knowledge systems, based on their different experiences. Therefore, it is often thought of experts in a subject (where the system is largely derived from formal education) are often thought to contrast with those of people who have no formal education on the subject (formed by learning from experience, observation and often dependent on social and cultural context).

Information can be viewed as resource that flows around a network of different actors, is converted to knowledge and may influence practices (Roling and Engels, 1990). However, although knowledge transfers within one type of knowledge system are relatively easy, transfers from one type of system to another (or vice versa) can be difficult, because the transferred messages do not make much sense within the other. The idea of knowledge systems challenges the information deficit model by suggesting that it is important to understand how the knowledge is used in decision making. They can be influenced by a range of different factors, including socio-political factors, institutional and cultural conditions. The process of interpreting information is highly varied, context specific, influenced by the fit with existing values and beliefs; individual and collective identities; and prior experiences (Roling and Engels, 1990). The systemic approach emphasises the collective aspect that is important for understanding community resilience (see Howgate and Kenyon, 2009; Lähteenmäki and Rotko, 2005), and the concept of multiple knowledge systems highlights the variability between stakeholders' perspectives. This can be illustrated by expert and lay perceptions of flood warning systems and is nicely illustrated by Handmer (2001), reproduced in Figure 3:

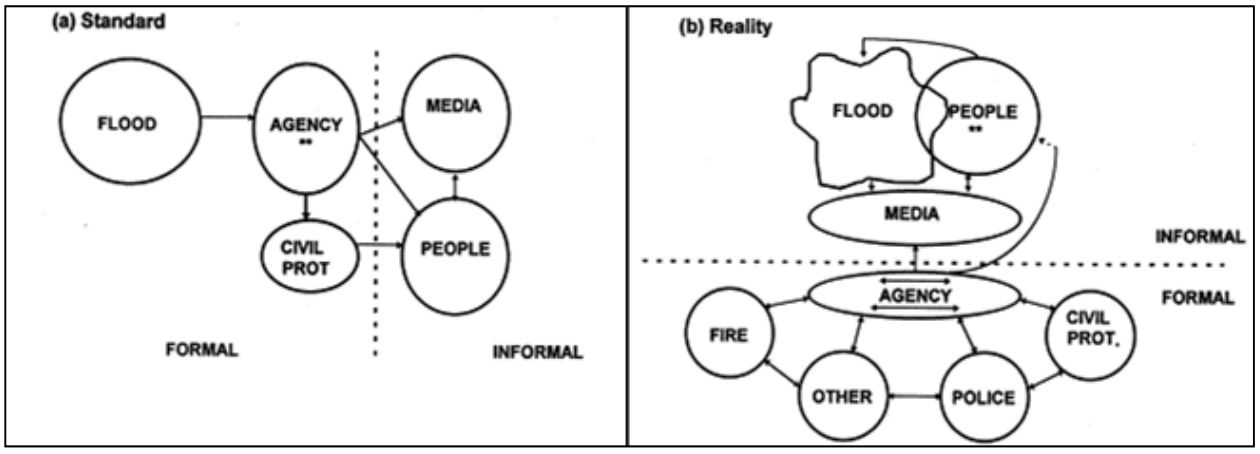


Figure 3 Alternative ways of conceptualizing flood-warning systems, taken from Handmer (2001). (a) represents a view typically held by those responsible for deploying warnings; (b) represents the actual conceptualisation typically held by people at risk

[2] URFlood's understanding of knowledge systems stems from the human development school of rural development rather than from the computing science or artificial intelligence communities. Both share an interest in how information is used but diverge in eliciting and representing these systems.

Handmer's conceptual model (Figure 3) suggests that those responsible for deploying warnings typically expect the public at risk to have a simple view of the actors involved, whereas those at risk actually hold more messy conceptual models, with a larger role for interaction within society and influence from the media, and correspondingly less prominence for the responsible agencies. Understanding the nature of these different knowledge systems, and possible mismatches is vital for good flood risk communication, and the research has investigated this as appropriate.

1.3 Evaluating existing guidelines on good practice

This section is a review of existing best practice guidelines on delivering flood related information to both the general public and the stakeholders involved in the flood management practice.

Given the changes in the practice of risk communication it is not surprising that there is, at least rhetorically, greater emphasis on a "people-centred approach" to flood warning systems where communities have input into the design and operation of the system (Sene, 2008). The United Nations Global Survey of Early Warning Systems (2006) states the objectives of people-centred early warning systems are "to empower individuals and communities threatened by hazards to act in sufficient time and in an appropriate manner so as to reduce the possibility of personal injury, loss of life, damage to property and the environment and loss of livelihoods". To be effective, early warning systems must be both technically systematic and people-centred (Basher, 2006). Uncertainty must be taken into account in forecasting, warning and emergency management practices in order to achieve effective response (Georgakakos & Jubach, 2007).

In summary, existing guidelines suggest that good practice in flood warning needs to combine institutional and procedural co-ordination with response-based messages tailored as appropriate to flood, area and social characteristics disseminated via multiple channels and embedded within wider processes of flood risk management and emergency planning. These aspects are explored further below.

1.3.1 Institutional and procedural co-ordination

Developing and implementing an effective early warning system requires the contribution and coordination of a wide range of individuals and institutions, as is evidenced by the complexity of the project organograms presented in the previous section. In order for flood warnings to be effective there needs to be clear understandings of roles and responsibilities of forecasters and decision-makers (Lumbroso, 2008; Stanganelli, 2008)., together with effective communication among weather forecasters, flood forecasters, disaster management and media agents (Du Plessis, 2002). Without clearly defined responsibilities for agencies involved decision uncertainty can be created (Penning-Rowsell et al, 2000) which can affect decision-making in times of emergency.

As well as clarity in terms of roles and responsibilities good practice guidance recommends that the dissemination of flood warning information be based on clear protocols and procedures and supported by an adequate telecommunications infrastructure (United Nations, 2006). Moreover, clearly defined procedures of warning dissemination should be established before a flood event (Sene, 2008), as during a major flood event there may be little time to discuss warning procedures. Staff therefore need clear guidelines on how to act in an emergency situation and if possible to have run simulated events. Such an exercise was carried out in March 2011, Exercise Watermark, by DEFRA (Department for Environment, Food and Rural Affairs), with the Welsh Assembly Government (WAG). They conducted a national emergency flooding exercise which tested the arrangements across England and Wales to respond to severe, wide-area flooding. It was one of the biggest exercises to take place nationally. The Environment Agency, England and Wales planned and delivered a central core exercise taking place nationally involving government departments which was supported by regional exercises and locally based community activities (http://www.exercisewatermark.co.uk).

1.3.2 Tailored response-based messages

In terms of what information to include in flood warnings, Sene (2008) provides a recommendation from Emergency Management Australia, which includes information on the nature of the flood, who will be affected, what information people need to respond appropriately and how they can get the information they require. Du Plessis (2002) agrees that the extent of a flood along with a specific time of occurrence should be included in a flood warning, although in practice that may not be possible to provide. Actions should be specified to deal with the risk (Shaw et al., 2005) and crucially local information should be provided (Twigger-Ross et al, 2009). For an effective response to be achievable, communities must receive precise and specific flood warnings coupled with advice on what effective action they need to take. (Ardalan, 2009; United Nations, 2006). A key issue is to ensure that the flood warning system is response focused, that is, all effort is aimed at ensuring that people take effective action in the event of a flood. Flood warning systems can become focused on the dissemination of the warning (how many warnings are sent, how long does it take etc) when what is of vital importance is that the warnings contain actionable information (Twigger-Ross and Colbourne, 2009).

Considering the issues of risk perception, and social characteristics discussed earlier it is important that the information is understandable and relevant to the audience (Shaw et al., 2005) which involves identifying key characteristics and knowledge systems of the audience (Basher, 2006). Recognition that there is an understanding of the target population at risk is considered to increase confidence in the flood warning system (Chowdhury, 2005). In terms of language, definitions and formats for flood warnings need to be trialled and tested (Faulkner, 2007), as indeed they have been recently in Scotland and England prior to the introduction of the new flood warning codes. There is also a case for warnings to be in multiple languages in order that they can reach all affected communities (Twigger-Ross et al., 2009).

1.3.3 Multiple channels of dissemination

It is clear from the brief summary of flood warning dissemination in the case study countries that multiple channels are currently in use in many places. Research suggests that it is important to have a range of channels through which warnings are disseminated. More than one communication method should be used when disseminating a flood warning in case one method fails (Sene, 2008; Penning-Rowsell et al, 2000). Multiple communication channels are also necessary to ensure everyone is reached (United Nations, 2006). Using multiple sources also reinforce the message (Shaw et al., 2005) and people are more likely to respond to a warning if it comes from several sources (Sene, 2008). However it is important that the message is consistent across all sources (Shaw et al., 2005).

Two-way communication paths between the lead agency and the hazard site are important for effective, tailored response (Penning-Rowsell et al., 2000), and indeed a key finding from research in the UK on the social performance of flood warning technologies (Tapsell et al, 2005) was that face to face interaction was the method that would be most effective with the majority of people with a range of vulnerability characteristics whereas methods relying on telecommunications and technology would be most effective with those who are already connected to services and resources and not those with vulnerability characteristics.

In term of dissemination methods typically local media (TV, radio), local helplines etc are put in place. In some cases flood wardens or community wardens are also available to help, and warnings could be successfully disseminated through direct links with local agencies such as residents associations, community centres, schools, health centres, faith groups etc, which would reach a large and diverse range of people (Lumbroso, 2008).

1.3.4 Embedding within wider contexts of flood risk management and emergency planning

A final key aspect of good practice in flood warning is that it be embedded in wider contexts of flood risk management and emergency planning. In order to manage long-term flood management, working relationships should be developed between the agencies involved (Faulkner, 2007). Further, awareness raising about flood risk should be carried out along with engagement around what actions to take during a flood emergency (White, 2001). Community emergency planning around flooding in areas that are at high risk enable flood risk to become "normalised" with people knowing what to do in an emergency. In areas where flood risk is much lower, linking flood risk into wider processes of emergency planning should ensure that there are routines and procedures in place should there be a flood. Finally, linking flood risk management up with wider water management issues is another way to embed it into communities and contexts.

1.3.5 Conclusions about good practice guidelines

Appropriately designed and implemented early warning systems, combined with community participation, can be very effective in reducing damage caused by flooding (Ardalan, 2009). Clear roles and responsibilities for agencies involved in flood management should be established along with relationships between these agencies (Stanganelli, 2008). Flood warnings should be specific (Ardalan, 2009) and include actions that should be taken by the recipient (Shaw et al., 2005). They should be tailored to specific population groups, especially those that are vulnerable (Twigger-Ross et al, 2009). There are many ways to disseminate a warning with the most advanced method being through direct means such as personal phone, fax, email or pagers (Du Plessis, 2002). However, warnings should be disseminated using multiple channels to reinforce the warning (Shaw et al., 2005) and reach every individual affected (United Nations, 2006). Feedback is important in order to improve the flood warning system and to learn from previous experience (United Nations, 2006). In the long-term, emphasis should be put on raising flood risk awareness and preparedness in communities on the local level.

1.4 Comparing current practice

As part of the review and improving a better understanding of how current roles and responsibilities in relation to flood risk communication differs between the case studies, each country developed flow diagrams or "organograms" of who and how responsibility is shared between the relevant authorities. By understanding the roles and responsibilities of relevant organisations in flood management, it is hoped that pathways to improved coordination between these organisations can be identified. These can be seen in Figure 4, Figure 7, Figure 5 and Figure 6 (the figures are located following the text description for each country). The different appearances of the organograms reflect both different situations described, and different stakeholder preferences in each country.

1.4.1 Finland

Finland has multiple organisations involved at different stages of flood preparation, warnings and responses (Figure 4). Except during rescue operations, the regional environmental authority has more general responsibility for a variety flood risk management activities, and flood defence strategies.

In situations where floods seem likely, as the flood probability increases, hydrological monitoring is enhanced by environmental authorities, the Finnish Environment Institute and the Finnish Meteorological Institute. This may include flood warnings. In this phase there may be preventative actions like ice sawing, ice removal and actions made by the property owners: in addition the regional environmental authority may give orders about watershed regulation. At this time regional rescue authorities and other parties will raise the state of their readiness on the basis of this information. For regular events, like the spring snowmelt floods, co-operation between the different authorities is planned well in advance, with special planning meetings. During these meetings, they check communication, responsibilities and procedures between key individuals.

The situation in the watershed (with respect of the amount of snow, water and reservoirs) and the flood risk, is presented in writing via bulletins from the environmental authority, the hydropower company, the rescue authority and the municipal authority. Flood predictions are given to different areas, together with details of where to find more information and the date of next bulletins. These bulletins are targeted at inhabitants, the owners of the properties and the other authorities. In addition to these bulletins, the transport authority informs the predicted effects of the flood on the roads. In addition to these bulletins, other means of communication used are local newspapers, local radio and TV and internet. During the flood situation house-to-house visits may be used. The responsible flood authorities use mainly mobile phones, emails, internet and the national radio network of authorities (called VIRVE) to communicate between themselves. As the floods are caused mainly by snow melting in the spring, the communication and information is planned beforehand according to the flood predictions.

In the middle of April every year a management group of different authorities meets and reviews communication on the ground is planned. Just before and during the flood event the bulletins are given every week or even more often if necessary. In addition the local radio and TV also provide up-to-date flood reports including expert interviews about the flood situation.
Finland's environmental administration has a hydrological forecast website (www.environment.fi/waterforecast) as well as a flood mapping page (www.ymparisto.fi/tulvakartat). At the moment, there is no interactive flood warning system such as Floodline in the UK.

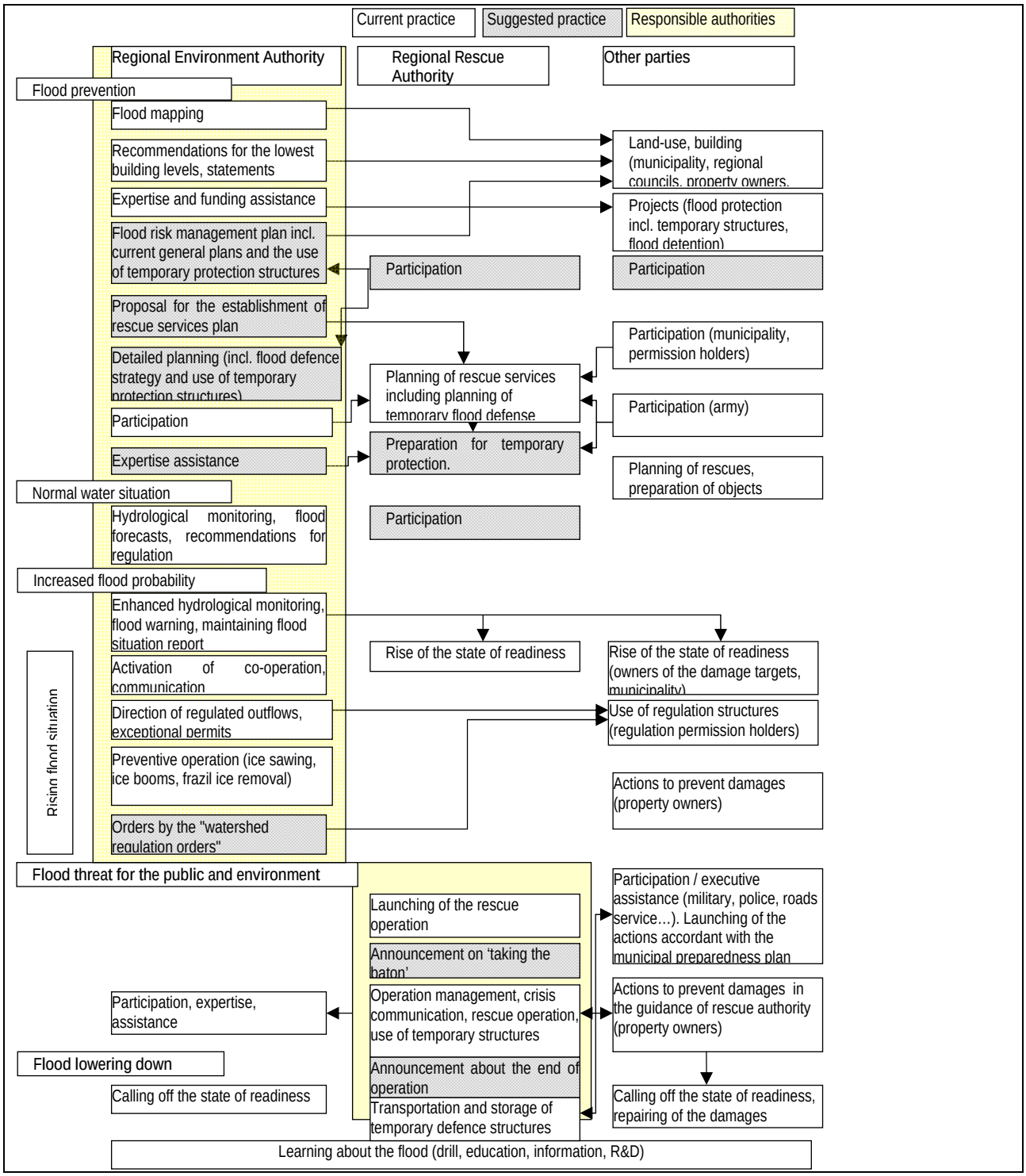


Figure 4 Distribution of flood communication and other responsibilities in Finland for fluvial floods. Yellow shading indicates respondible authorities, grey shadig indicates suggested procedures.

1.4.2 Ireland

In April 2008 the Government's Public Information and Awareness Campaign on emergency planning was launched. The central focus of the campaign was a handbook "Preparing for Major Emergencies" which was prepared by the Office of Emergency Planning and was distributed to every household in the country (Office of Emergency Planning, 2009). The Government Information Service (GIS) plays a key role in preparing and projecting the Government's message on emergency management and response issues. An Emergency Planning Media Unit, chaired by the GIS, promotes and coordinates this work. This group, comprising Press and Information Officers of Government Departments and other key public authorities, continues to update and coordinate arrangements for handling queries on emergency planning and emergency management from the media as well as information and advice to the public (Office of Emergency Planning, 2009). Met Eireann also provide direct severe weather alerts to local authorities. Local authorities use these alerts to inform their judgement of possible flooding in their areas. Met Éireann is the leading provider of weather information and related services for Ireland (Met Éireann, 2009). Met Éireann aims to ensure the protection and safety of life and property by issuing public weather forecasts and warnings. They are responsible for the provision of forecast services and warnings to the media, industrial and commercial customers, Government and semi-state bodies, local authorities, and the general public. (Met Éireann, 2009). The responsibilities and roles in relation to responding to flooding situations are defined in the 2006 Report of the Flood Policy Review Group, and the Department of the Environment, Heritage, and Local Government (DoEHLG) publication, "A Framework for Major Emergency Management". It includes arrangements for the principal response agencies (An Garda Síochána, the Health Service Executive and Local Authorities) to work together. It also links the principal response agencies to the relevant Government departments. It forms the basis for major emergency management in Ireland (Framework for Major Emergency Management, 2006). Some Local Authority Emergency Response Plans include details of disseminating warnings to the public. Methods of communicating with the public include help-lines, websites, Aertel teletext, automatic text-messaging, community volunteers and using the media (Wicklow Local Authorities Major Emergency Plan, 2009). Overall, however, there is no standardised flood forecasting and warning system in Ireland. Each local authority is responsible for disseminating flood warnings in their respective area. Many local authorities therefore have no specific flood communication plan in place, but as part of the major emergency framework, a document "A guide to flood emergencies", and an accompanying protocol details a suggested approach to flood emergency response and gives details of commuincation of flood warnings.

In terms of information available to the public at risk, the Office of Public Works (the lead agency responsible for flood risk management in Ireland) has two websites relating to flood information. The first, www.flooding.ie is intended to enhance public access to information about flooding and contains information about preparation, protection, what to do in the event of a flood, what to do after a flood, who can help in a flood, as well as specific information for farmers and business owners. It can be accessed in three languages: English, Irish and Polish. The second website, www.floodmaps.ie is a Flood Hazard Mapping website. Members of the public can search for flood information in any locality and view reports, photographs, newspaper articles and other information about reported floods. In addition to the websites, an awareness campaign entitled "Plan, Prepare, Protect" was launched by the OPW in December 2005 across Ireland. 70,000 copies of an information booklet were distributed to local public libraries, citizens' information centres and local authority offices. 150,000 information leaflets were distributed to properties in areas most prone to flooding. There was subsequently a booster media campaign in October 2006.

Key to Irish organogram (Figure 5):

Lead Government Agencies	ESB – Electricity Supply Board
Committee set up during times of emergency	GIS – Government Information Service
Framework	HSE – Health Service Executive
Media Unit	IFA – Irish Farmers Association
Other agencies and groups	LA – Local Authority
Brought together viaEmergency Response Co-ordination Committee	NECC: National Emergency Coordination Centre
Framework for Major Emergency Management includes these groups	NRA – National Roads Authority
Emergency Planning Media Unit involves these groups	OEP – Office of Emergency Planning
	OPW – Office of Public Works

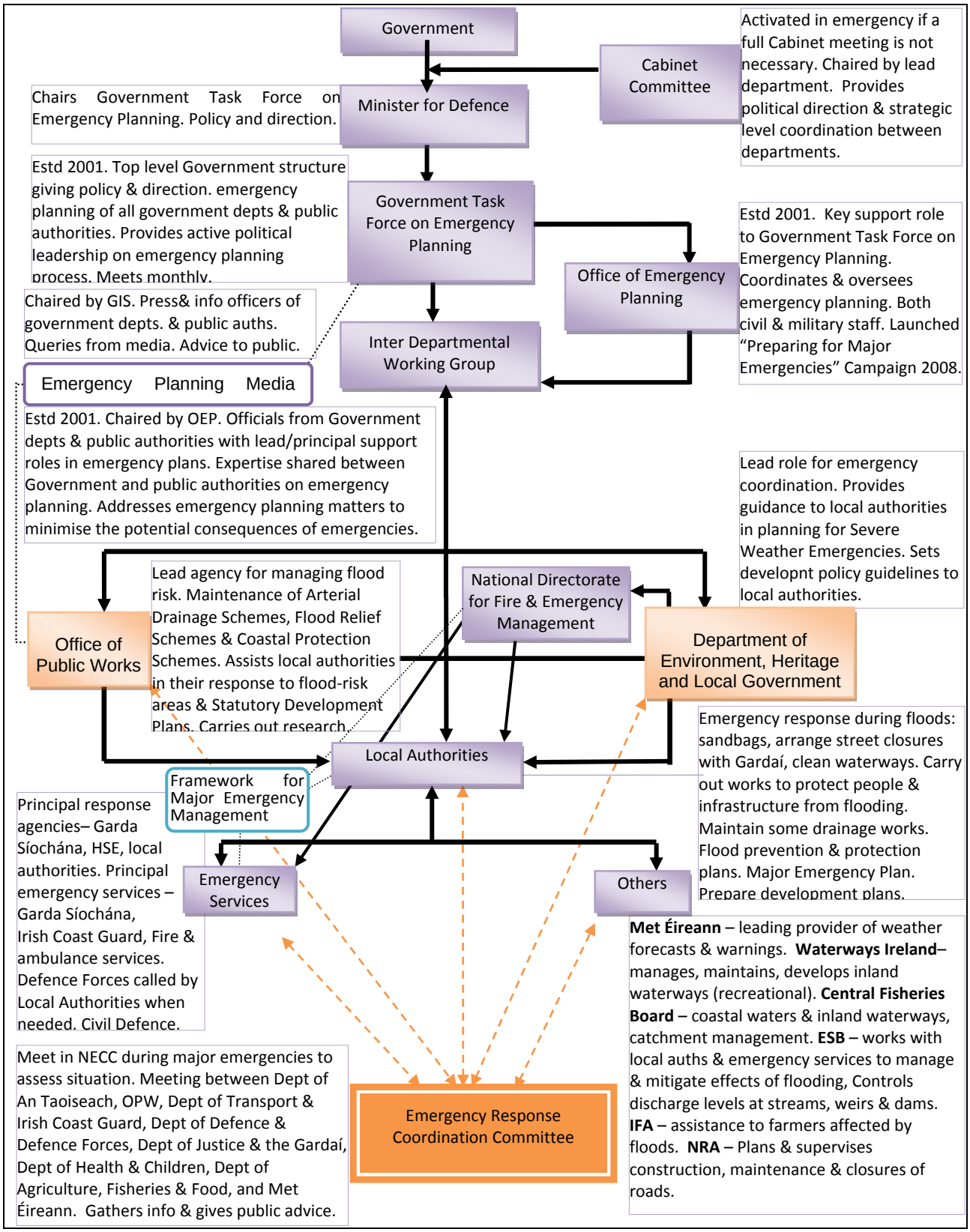


Figure 5 Organogram for flood communications in Ireland. Colours & acronyms key is on previous page.

1.4.3 Italy

In Italy, River Basin Authorities are important organisation for managing and communicating flood risk. They span regions, and carry out a variety of planning and programming activities on land protection and water resources management. Communicating and managing information on these topics is one of their main activities; this includes collecting, processing, storing and disseminating data. In agreement with the latest laws, data produced by the Basin Authority are available for free from their website.

The most common flood-relevant plans developed are:

1. hydraulic hazard plans, defining specific structural and non structural actions to be carried out for flood risk reduction in the river basin;
2. land protection plans, planning and programming frame which, in line with the present state and the future economic and social development of the territory will tend to minimize the damage involved with hydraulic and geological hazards;
3. water quality plans, defining the actions to be carried out to reach and maintain water quality levels and to protect and manage surface waters;
4. dredging activity plans, managing the extraction of materials such as sand and gravel from the river bed, from flood plain and natural flooding areas.

In addition, some of the most common research activities conducted are:

1. collecting the more detailed and updated hydro-geological data on the river basin;
2. reporting data dealing with areas interested by slope instability. The data base is built and upgraded through traditional methods integrated with advanced technologies as radar remote sensing;
3. hydrologic and hydraulic modeling is being used to identify the areas with high hydraulic hazard and to evaluate the effects of structural and non-structural actions programmed by the Plan on hydraulic hazard on the basin. The model uses mono and bi-dimensional unsteady flow patterns;
4. morphological and morphodynamic analysis of erosion, aiming to improve knowledge of sediment production, transport and accumulation.

The Civil Protection System (Figure 6) comprises one National Functional Centre (corresponding to the National Civil Protection Department) and a number of Regional Functional Centres spread over the Italian territory. In addition, within the Civil Protection System, several Competence Centres have been set up to provide services, information, data, processed data and technical-scientific contributions useful for predicting, monitoring and supervising the various types of risk.
The National Civil Protection Department finances, promotes and organizes and coordinates technical and scientific actions that are aimed to gain an understanding of environmental risks and to implement mitigation to reduce the impact of extreme events (landslides, flood, etc.). It makes use of a network of Regional Functional Centres that aim to collect and integrate the following types of data:

1. quantitative and qualitative data for earth systems monitoring;
2. hydro-geological and geo-morphological data obtained from territorial and landslide monitoring;
3. meteorological, hydrological and hydraulic data;

The Regional Functional Centres provide a real time service available throughtout the whole year, as support for central and local authorities' actions in state of alert or for emergencies management.
Details of the Civil Protection System are available on the website of the National Civil Protection Department (http://www.protezionecivile.gov.it/jcms/en/funzionale_idro.wp?request_locale=en) For case studies in this project, specific information is respectively provided by Civil Protection agency of Rome Municipality (Protezione Civile del Comune di Roma): (www.protezionecivilecomuneroma.it), and the Civial protection agency of the Province of Calabria (Protazione Civile Calabria): (http://www.protezionecivilecalabria.it/).

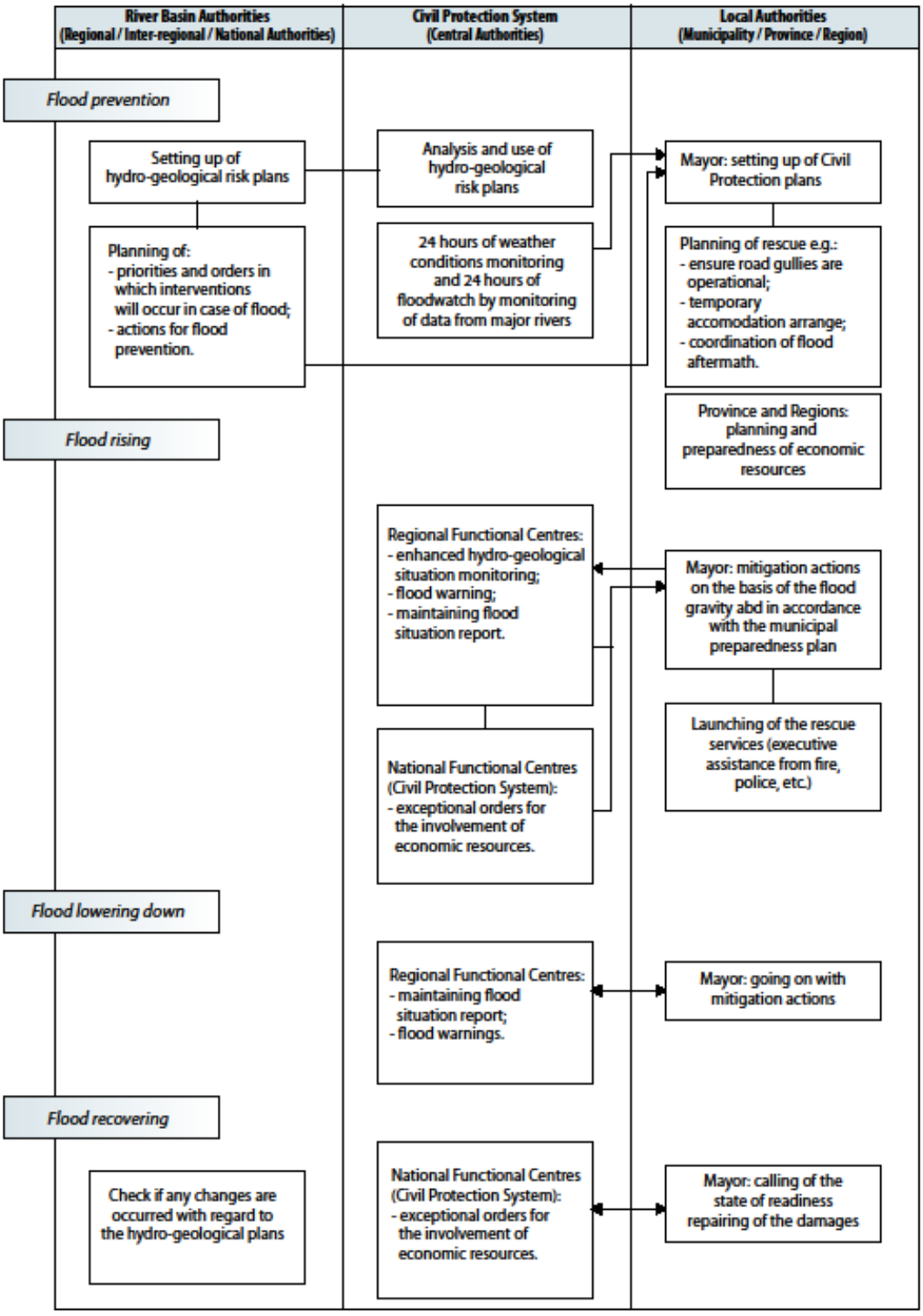


Figure 6 Organogram of flood responsibilities in Italy.

1.4.4 Scotland

The Scottish Environment Protection Agency (SEPA) uses the same warning messages via Floodline on their website, as in England and Wales (Flood Watch, Flood Warning, Severe Flood Warning and All Clear). They provide flood alerts and warnings to flood management partners and members of the public (SEPA, 2009). SEPA makes use of flood warning duty officers, based at SEPA offices across the country. These duty officers use weather forecasts, rainfall data, river level data and tidal forecasts to make a daily assessment of the likelihood of flooding. The flood warning levels are set by looking at the historical record of flooding on a river and agreeing flood warning thresholds with local flood management partners. SEPA aims to give a three-hour advance warning of flooding (SEPA, 2009). Their flood warning schemes have largely been developed in response to flood events and have been tailored to meet local requirements. For example, the flood warnings they provide to Perth and Kinross Council provide adequate time to close the flood gates on the River Tay at Perth (SEPA, 2009). SEPA also has a coastal flood watch service, which covers nine broad coastal areas (SEPA, 2009). Flood warning duty officers receive information from the Meterological Office and Storm Tide Forecasting Service. This uses a model to forecast sea levels around the coast based on predicted tides and weather conditions. When the predicted sea levels suggest a risk of flooding, flood watches are issued (Kaya, 2005).

SEPA started providing direct flood warning messages to members of the public comparable to Floodline Warnings Direct in England and Wales in March 2011. It issues warnings on the Floodline recorded information system and on their website. It does however, issue direct warnings to emergency services and local authorities to enable them to take action. SEPA provides flooding publications such as “Preparing for flooding - a guide for small and medium sized businesses in Scotland”, “Flood alleviation products” and “Protecting your property from flooding“.

SEPA is obliged to provide advice to local authorities on flood risk for planning purposes, and advice on flood prevention. However, although local authorities should be involved in preparation (both building flood defences and liaising with community to build preparedness) and responses to floods, they are not directly involved with delivering the actual warnings. In areas where there is no formal flood monitoring scheme operated by SEPA, SEPA and the Meteorological Office examine weather forecasts and SEPA will issue a "Flood Alert" which is for a geographical area usually corresponding to local authority boundaries. Where there is formal flood monitoring, "Flood Warnings" tailored to these specific areas are issued by SEPA about 3-6 hours in advance of potential flooding. In terms of the case studies, this scheme covers three of the four case studies (Huntly, Cathart and Newburgh). The fourth case study is covered by a less geographically-specific Flood Alert scheme. It is relevant to note ‘the Scottish Flood Forum’ (SFF), although it has no statuatory role and so is not shown in the diagram. The SFF is a community-based independent organisation that works in partnership with SEPA and other relevant organisations to support and represent those affected by or at risk of flooding. Therefore, where it works (including our case study sites of Huntly, Newburgh and Moffat), it assists in supporting responses and recovery from flooding.

The text below is the key to the organogram (Figure 7), on the following page.

Key to colours	**Abbreviations continued**
Green – Policy	CMPs – Catchment Management Plans
Blue - Body/individual with responsibility for flood risk preparation and warning	COSLA - Convention of Scottish Local Authorities
	EC – European Commission
Red – Advisory Group	FLAGS – Flood Liaison and Appraisal Groups
Purple – Responder Group	LA – Local Authority
Orange – Provide related service	NHS – National Health Service
Abbreviations	SEPA – Scottish Environment Protection Agency
ACPOS - Association of Chief Police Officers in Scotland	SG – Scottish Government
	SNH – Scottish Natural Heritage
CFOAS – Chief Fire Officers Association Scotland	SOLACE – Society of Local Authority Chief Executives
	SuDS – Sustainable Urban Drainage System

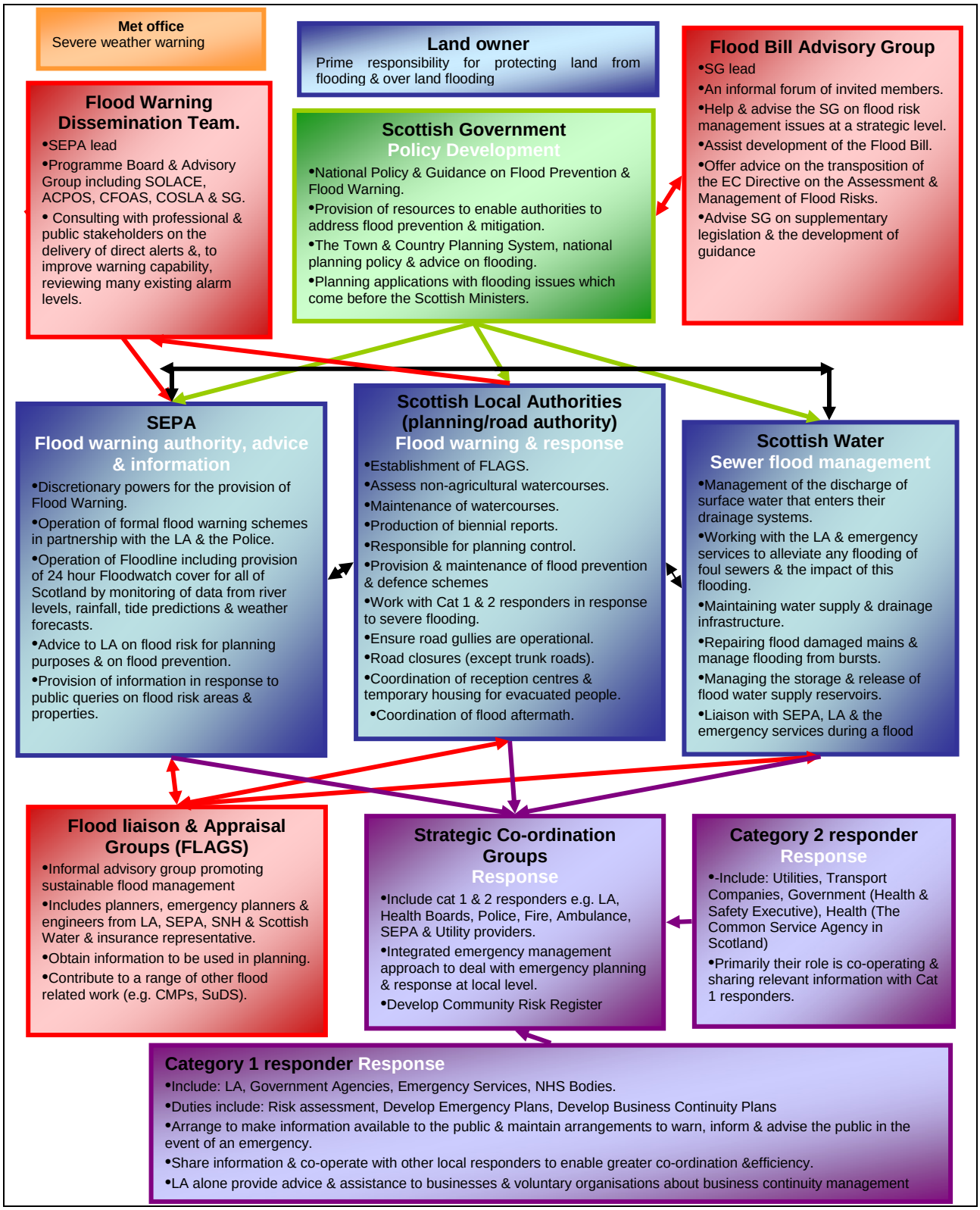


Figure 7 Organogram for flood communications in Scotland. Colours & acronyms key is on previous page.

1.4.5 Conclusions on existing practices

The four organograms for each country are presented in slightly different formats because of the contrasting arrangements existing in each country. However, they each tend to follow a "top-down" approach; government at the top of the chain, public at risk at the bottom. From the earlier literature review, a top-down approach is known to be linear and often expert driven, with little engagement of end-users. There is usually a focus on the role of government rather than the individual at risk and there is little room for feedback loops needed to improve the system. A "people-centred" approach (1.3) is now recognised as an important part of flood risk management and involves communities having input into the design and operation of the system. The public at risk do not feature in any of the four figures above. The Finnish organogram includes "participation" as a suggested practice, but is not yet in current practice.

Methods of national flood warnings vary considerably between and within the case study countries.. The majority of flood warnings are issued on the internet, teletext, or via radio and television announcements. In Scotland there are also recorded messaging services that the public can call to listen to further information regarding a potential flood. Other methods of warning include sirens, flood wardens, and self-warning. In Scotland, Ireland and Finland, emergency services and other core responders are warned directly of the potential flooding.

The majority of warning systems studied use warning codes based on levels of risk. These are generally low risk, medium risk and high risk of flooding. They are based on hydrological and meteorological data and forecasting methods.

A further issue is how the public perceive these systems, which are quite complex and are not necessarily written down anywhere for people to digest. Given that the public are expected to respond in a flood situation, find information etc, their perceptions of these structures are important to understand. If they see things as overly complex then it will not help their understanding of from whom to seek and expect information, or what to do in the event of an emergency. Furthermore, these diagrams exclude the potential role of other sources of information that can influence ideas e.g. media, friends, community. We will therefore check this in our work (see work described in section 5.1.2).

1.5 Conclusions for research into flood communications

The preceding review of existing literature and experiences contains two main sets of implications for URFlood's research into flood communications.

Firstly, the literature on risk, uncertainty, and responses to flooding and other hazards identifies many potential factors which may affect any individuals' understanding of and response to flood warning systems. These include aspects of individual experience, social context as well as attributes of the warning received and flood itself. These factors all affect how information is processed and used to create knowledge and understanding, and so they should be used to inform the design of any research into communications about flooding. Particular topics of interest which may be important but warrant more information, are the role of credibility of a source and clarity of messages. These ideas therefore informed the survey work described in section 5.1.

Secondly, the literature on flooding and communication contains many lessons on good and bad practices in communication. This directly informs the guidelines presented in section 5.2. Furthermore, these lessons are also picked up on in section 5.3 as when we discussed testing of our framework we noted tools/methods that could help in its implementation.

2 Objectives

The aim of the research was to improve flood risk planning and responses to flood warnings by investigating and illustrating how flood risk communications are incorporated into the knowledge systems of different actors. The rationale is based on putting the communication of uncertainty and risk in the broader context of social, institutional, cultural and psychological behaviour. The objectives were to:

- Describe the knowledge systems which emergency responders, responsible authorities and members of the public use to make sense of flood risk information, defining factors that effect responses.
- Provide evidence of the way different actors respond to uncertainties in flood risk information and explore how and under what circumstances information on flood risk uncertainty is made sense of and related to effective responses.
- Develop and test alternative tools for communicating flood risk that take account of knowledge systems and needs.
- Illustrate where any mismatches between different knowledge systems are likely to have an impact on responses and community resilience.
- Trial alternative communication methods that take account of different knowledge systems.

The elicitation of perceptions of uncertainties and risk (as part of knowledge systems), modifications to communications and testing of guidelines took place using case studies in Finland, Ireland, Italy and Scotland.

The research design sought to ensure trans-national relevance through synthesis at every stage, and local relevance via ongoing stakeholder engagement. The project was designed to result in guidelines for use throughout the EU, as to how to implement good practice flood communications and how to respond to differences in how information is interpreted and utilised. These guidelines should support the move towards Flood Risk Assessment and Management (FRAM) under the EU Floods Directive, improving resilience to the social, economic and environmental consequences of flood risk.

As such the project contributes to the first theme of the CRUE-ERA-NET call (improving risk awareness and increasing public participation), and seeks to contribute to the overarching goals of CRUE ERA-NET.

3 Methodology

This chapter describes the approaches to collecting and analysing data for URFlood. The project uses a mixed methods approach to combine multiple sources of existing data and multiple modes of data collection, to understand perceptions of people at risk of flooding. The order of sections in this chapter follows the chronological order of work within the project.

3.1 Review of literature and existing practices relevant to flood risk communication

A literature review and synthesis allowed URFlood to establish and build on existing knowledge and insights relevant to flood risk communication. URFlood also went beyond this to collate existing experiences and responsibilities with regard to flood communication in each of the case study countries.

3.1.1 Context and Aim of Method

The aim of this phase of the research was to ensure that URFlood and incorporated existing insights from previous practical and academic work, to avoid duplication and to maximise the utility and value of its contribution.

Field of Application

A literature review can be carried out on nearly any topic. For URFlood, the main bodies of academic literature reviewed were: a) risk communication (non-specific to floods); b) uncertainty; c) specific flood risk communication, and d) knowledge systems (see section 1.2). Furthermore, URFlood, sought and collated any existing guidance and best practice guidelines as to how to design effective flood communications (section 1.3).
Keywords: Risk communication

URFlood also reviewed existing practices in flood communication within each of four countries in which case-studies were located: Ireland, Italy, Finland and Scotland. This was carried out by studying existing policy documents and guidelines and by checking and discussing practices with those agencies involved.
Keywords: Forecasting & Warning, Emergency planning, Crisis management

3.1.2 How to apply the method

Input and Resources

A successful and useful literature review relies on an exhaustive search of academic databases for literature (and good access to original sources), and the synthesis of the research relies on researchers with good prior understanding of the concepts discussed.

Expected results

The reviews were expected to provide useful insights into the key aspects of perceptions of risk and flood risk communications that would be relevant to further explore in URFlood. The results of the review of

literature are described in section 1.2, the review of existing best practice guidelines in section 1.3, and the review of existing practices in our case studies in 1.4. The overall implications of our reviewing for the rest of the project are presented in section 1.5.

Assessment of Results

We believe the review successfully covered all main topics relevant to the URFlood's research aims. For a full understanding of the review and its coverage, it is important to refer back to the original data we used – therefore the literature review provides citations to the original sources we reviewed.

Scale of Application

Reviews can be applied to scope understanding of issues of any scale. However, on very specific topics there may not be much pre-existing literature or experience to collect.

Degree of implementation

Performing a review is a good way to develop understanding by those new to a topic area. However they are best carried out by scientists with prior understanding of the general topics to be covered.

3.1.3 Example of review and results

When we sought documents or any existing guidelines about flood communication, we found many of the documents were relatively recent (i.e. within the last 10 years). However, even within that time, there had a been a shift in emphasis towards a people-centric approach. This favoured tailoring communication systems to communities at risk, and encouraging their input into response systems and their design. (See section 1.3). We therefore decided that understanding perceptions and knowledge systems of communities at risk should be the key focus on our later data collection for URFlood.

3.2 Collaborating to plan research at case study sites

3.2.1 Context and Aim of Method

The aim of this method was to make a coherent trans-national plan for research, through complementary case study site selection and co-ordinated survey design.

Field of Application

URFlood partners aimed to create a research design that permitted the collection of findings with cross-national relevance. Cross-national relevance was achieved through coordinated selection of case study sites and through a guiding set of research questions or topics that formed the starting point of tailored research design in each of the case study sites. Space and time constraints constrain the number of questions that can be asked (long questionnaires will not be answered), so partners took care to choose complementary questions, so a full range of relevant questions was asked between them (but not necessarily every question was asked by every partner). This was linked to the process of tailoring the questionnaire for local needs at each case study site, to determine what questions would be 'workable'.
Keywords: Risk Assessment, Risk communication, Participation

3.2.2 How to apply the method

Input and Resources

The partners reviewed potential case study sites within their countries with input from national-level steering groups and/or individuals linked with existing flood responses and communications. Then, the partners together discussed their potential sites, to select a set that encompassed a range of risk-types, flood experiences, and community-engagement, in both rural and urban settings. The literature review results, combined with an understanding of existing flood-communication practices was the main input required to make the set of common topics that formed a trans-national research plan.

Expected results

The expected outcome of partner collaboration in selecting research sites and topics, was trans-national relevance to the data collection.

Assessment of Results

A successful trans-national research plan should balance the desire for coherence in research topics with the need for locally-relevant and sensible data collection.

Scale of Application

It is possible to prepare research topics with trans-national relevance, but the details of research in each question must always be shaped by socio-cultural context and existing practices.

Degree of implementation

Collaboration to identify case study sites requires input from those with knowledge of at-risk communities, plus knowledge of the research topics. Trans-national research plans require input from scientists with experience not only in the research topics and social science research design, but also experience in cross-national collaboration.

3.2.3 Example of collaboration in planning

The selected case studies together represent a range of flood-risk types (the case study in Finland provides an examples of flood risk are due to ice and flood melt) and also flood risk-type combinations (for example, some of the case studies in Ireland are subject to both fluvial, pluvial, coastal and residual risks). At the same time, case studies were chosen to make useful contrasts within country (for example, there was both an urban case study and rural case study where there was fluvial risks). See section 4 for more details.

3.3 Implementing the survey of perceptions and experiences in communities at risk of flooding

3.3.1 Context and Aim of Method

Questionnaires can produce representative quantitative information on the public's understandings and experiences in relation to flooding, and relate these to attributes such as age or education.

Field of Application

Structured questionnaire surveys are suitable for collecting quantitative data about distribution of experiences, perceptions and socio-demographic attributes within populations.
Keywords: Risk communication, Participation, Risk governance.

3.3.2 How to apply the method

Input and Resources

Questionnaire surveys require time to craft and test a questionnaire which probes relevant issues, is unbiased and understood as intended, and yet not too long. Questionnaire design relies on input from scientists and representatives of communities at risk via an iterative process of testing and piloting.

Expected results

Data collected via the questionnaire survey was expected to yield new insights into experiences, processing and perceptions of flood risk communication. Analysis of the data is described in section 3.4.

Assessment of Results

The sample of those returning questionnaires must be representative of the general population, in order to allow generalisation of findings. A randomised sample strategy can achieve this (for example postcode database can be used to randomly select households within a flood risk envelope), or every household known within an area can be targeted (as in Rovaniemi, Huntly and White Cart). The final sample size must be sufficiently large to allow confidence in generalising traits to the general population. Therefore hundreds of questionnaires were distributed by the project, since when administered by post, a typical response rates can be 10%.

Scale of Application

Questionnaire surveys can be applied over quite large scales, according to the resources available and the population of interest. However, questionnaires must be tested and tailored to local context, so, for example, it is not possible to design one questionnaire that (when translated) could be reliably used in every country in Europe. It is hard to make reliable generalisations from small sample sizes, although the minimum sample size required will depend on the complexity of the analysis and the distribution of traits in a population.

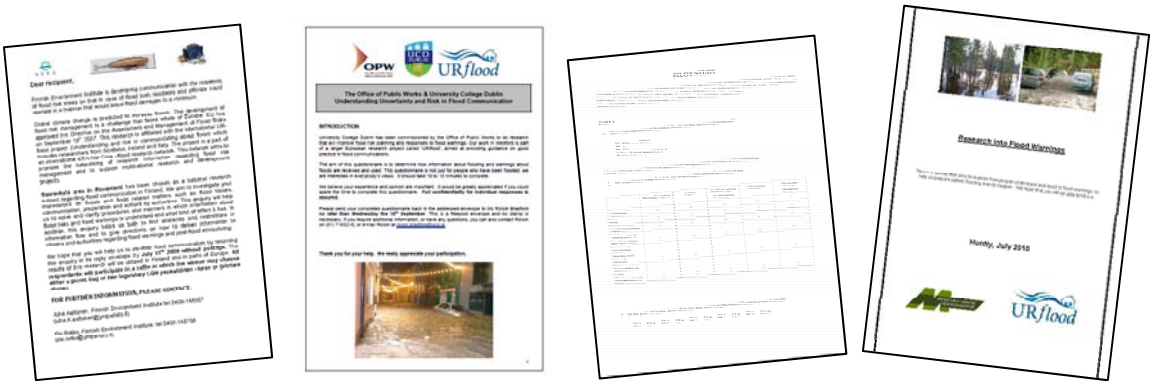
Degree of implementation

Social scientists should be involved in the design of a questionnaire, the sampling procedure, and data analysis. The distribution of the questionnaires and entry of data can be performed by non-scientists with relevant training. Ethical standards require informed consent of participants and anonymity of responses.

3.3.3 Example

Each country developed a questionnaire to cover common issues, yet take into account local differences. For example, the Scottish questionnaire checked awareness of the existing flood warning systems in place in Scotland, with reference to the newly developed 'Floodline'.

These questionnaires developed for use in each country are all available from http://www.macaulay.ac.uk/urflood/case_studies.php



3.4 Statistical analysis of questionnaire survey data

3.4.1 Context and Aim of Method

The use of statistics for the description and analysis of data aimed to provide a objective description and summary of the data collected by the survey into risk communication experiences and perceptions by communities at risk (section 3.3).

Field of Application

Statistical description and analysis can be applied to numeric, ordinal (ie ranked) or categorical data. However, they cannot be used on qualitative or textual data, so are less useful for describing written responses to 'open' format questions. For the analyses performed in URFlood, all statistical tests were two-tailed and we use a critical significance value (p-value) of 0.05 (i.e., we follow the usual convention that if there is less than a 5% probability that an observed pattern occurred due only to chance variation in the data, we accept that the observed pattern is not due to chance).
Keywords: Risk communication, Risk Assessment, Participation

3.4.2 How to apply the method

Input and Resources

The data collected in surveys can be stored in excel spreadsheets. However, it is best to use specialised statistical software to store and analyse data: URFlood used software called 'SPSS' (originally, Statistical Package for the Social Sciences).

Expected results

Statistics are expected to allow objective clear description of key findings of the surveys distributed for URFlood.

Assessment of Results

The results are presented in section 5.1. Successful application of statistics depends on correct selection and use of statistics, and reporting of appropriate details. Knowledge of statistics will also aid a reader to interpret the results, although headline messages should remain accessible without this.

Scale of Application

Statistical analysis can be applied to any size of dataset, although certain analyses are not meaningful or useful on very small datasets.

Degree of implementation

Social scientists with statistical training must perform the analysis and supervise data recording.

3.4.3 Example

Most of the descriptive statistics presented in this report are summarised in barcharts and tables so should be understandable to non-specialists. However, analysing and detecting significant patterns and trends depends on the use of various tests, and understanding these requires specialist training (Healey, 1999). However "Chi-squared tests" and "t-tests" are commonly used within URFlood so are briefly described here: Chi-squared can test if sample distributions are significantly different from that expected at random (e.g. if people's preferences are equally distributed over different communication methods, or not); and t-tests are used to compare the distributions over an attribute, (e.g. to see if men have significantly greater rating of their preparedness, versus women).

3.5 Collaborating to develop the guidelines

3.5.1 Context and Aim of Method

The aim was to develop a trans-nationally framework of guidelines for effective communications about flood risks.

Field of Application

The guidelines were developed by an informal process of discussion and reflection by all project partners in discussion, based on the basis of the results of the questionnaire survey, and building on the earlier insights and recommendations from the review of existing literature relevant to flood risk communications.
Keywords: Risk communication, Participation

3.5.2 How to apply the method

Input and Resources

The input of various national-level stakeholders was sought informally by project partners, as the partners discussed ideas for potential guidelines.

Expected results

The expected results were a framework that would be trans-nationally relevant and useful for allowing European countries to develop effective flood communications.

Assessment of Results

The guidelines will be successful if they resonated with stakeholders (see testing section below) and ultimately allow for and promote development of effective flood communications. Their interpretation should be informed by an understanding of the underlying research and literature that led to their conception.

Scale of Application

The guidelines were developed to be relevant and make sense both at a trans-national scale and at local scales. The guidelines should be applicable in any European country.

Degree of implementation

The development of the guidelines depended on expert reflection and input from all project partners combined with informal consultation with local and national level stakeholders.

3.5.3 Example of guideline development

Members of communities at risk receive information from many sources, differently from the formal sources of information specified by policies and legislation. However they often wish for more information, but may not know where to look, or look to agencies that are not those specified by formal structures and plans. Therefore, project partners proposed creating a guideline for creating new lines of communication between authorities and the communities at risk.

3.6 Testing the guidelines

The aim of testing guidelines was to check the guidelines suggest by the project partners resonated with communities at risk and were considered appropriate by national-level stakeholders.

Field of Application

In each country we used a mixture of different methods to test the guidelines, shaped by stakeholder input. Between all the partners a mixture of data was collected, from structured surveys, semi-structured interviews, and focus groups. Focus groups and interviews were used to produces rich qualitative data, since these are particularly suitable for eliciting hard to articulate ideas, to probe and explore complex or poorly known topics, and to capture the range of ideas held by and between individuals.
Keywords: Risk communication, Participation

3.6.1 How to apply the method

Because of space constraints, this section focuses on principals of data collection via interviews and focus groups since principles applying to surveys have already been covered in section 3.3.

Input and Resources

Input in focus groups and interviews came from two different groups: firstly, a sample of the community at the risk in each country, and secondly, staff in organisations responsible for or relevant to flood responses and communications. Focus groups and interviews also require input from trained facilitators who can guide discussion whilst remaining neutral and non-prompting.

Expected results

It was expected that a group discussion or interview will produce rich textual data capturing links between topics and issues as understood by respondents, and this would contain reflection, judgement, observations for each guideline, together with specific ideas for improvement or implementation.

Assessment of Results

Qualitative analysis does not require software for analysis (although it can help with larger datasets). For URFlood the discussion from every country was compiled and collated by guideline.

Scale of Application

In segregated communities or for controversial topics, several discussions may be necessary to ensure a range of views are captured. However, for URFlood we considered one to two discussion groups to be sufficient to capture relevant ideas, although further discussions and other groups would have been sought had the guidelines proved controversial (they did not).

Degree of implementation

Social scientists experienced in facilitation and qualitative analysis should be involved in the preparation of topic list of discussion, the facilitation of discussion, and analysis of the results. Ethical standards require informed consent of participants and anonymity of responses.

3.6.2 Examples of a testing group discussion

In Scotland, there was much discussion of stories relating to personal visits – those who had received a personal visit in connection with flood warnings and flood preparedness, generally described their experiences very favourably, and they thought that similar visits would be a good idea in future. Their views accorded with testing results from other countries, fit well with the trans-national survey findings, and were noted down as a potential activity to consider for those wishing to implement the guidelines framework.

4 Case studies

There were 11 study sites, in 4 countries, selected to cover a range of cultural settings and flood risks. In this section we present the case studies alphabetically by country: Finland (one site), Ireland (four sites), Italy (two sites), Scotland (four sites).

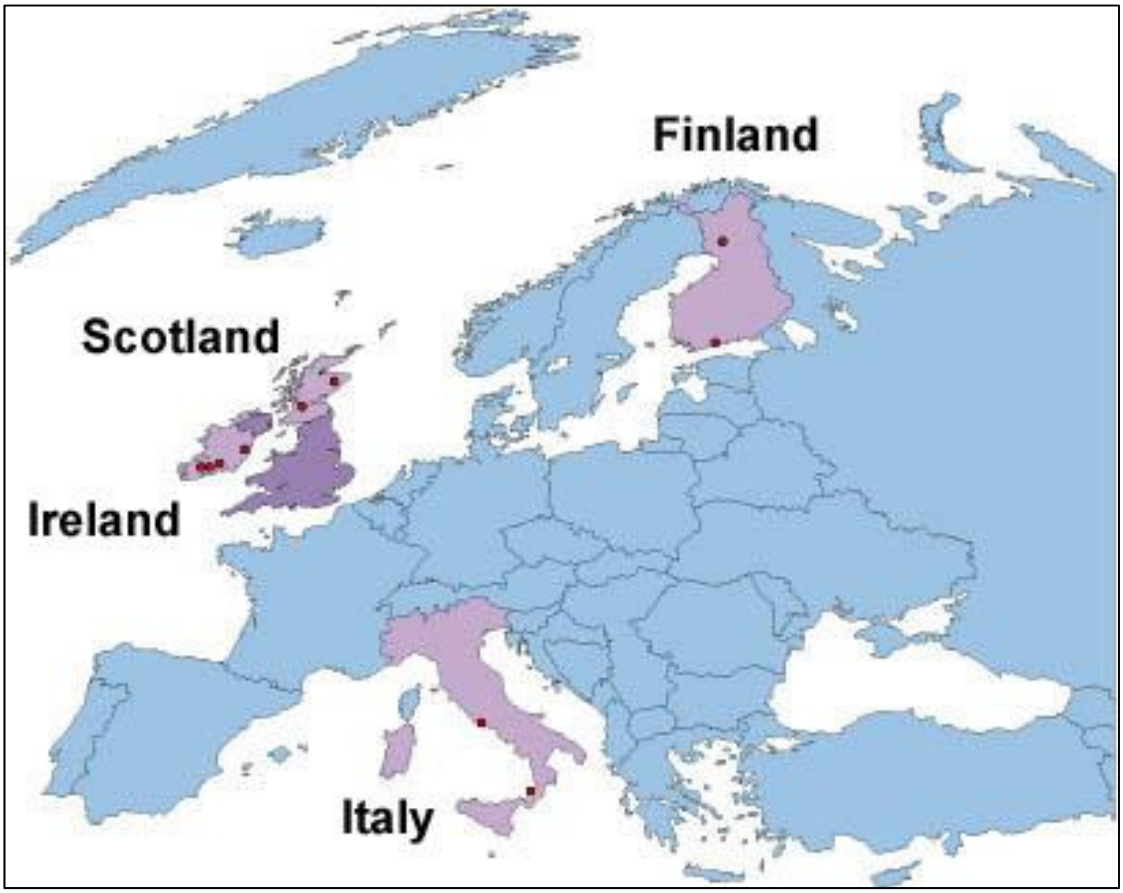


Figure 8 A map showing the distribution of study sites in this project (red dots represent study sites).

4.1 Rovaniemi, Lapland Province, Finland

4.1.1 Main Characteristics

Major Type of Flood: Fluvial and from ice breakup
Size of Catchment: 51,127 km²
Past Flood Events: Last big event in 1993, minor damage yearly.
Environmental Settings: Located on the Arctic Circle where Kemijoki and Ounasjoki rivers join. River ice break up jams may cause high water levels in the area.
Socio-economic Settings: Rovaniemi is the 15th largest city (pop 59,353+~5000 students), Saarenkylä (pop 1,985; "island's village") is particularly at risk.

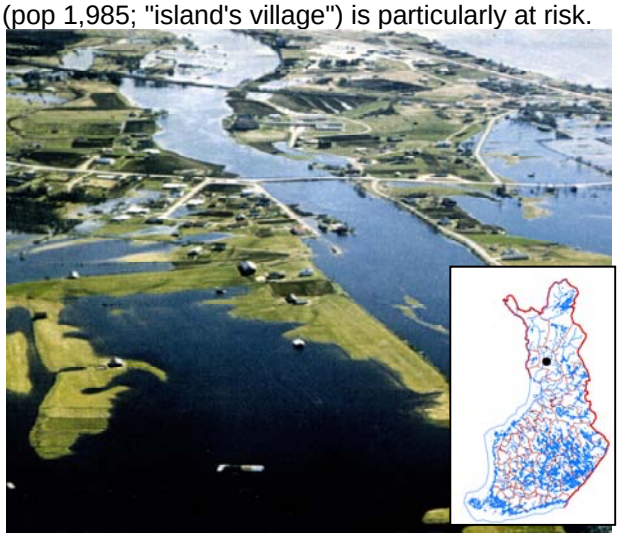


Figure 9 Flooded, yet agro-intensive Saarenkylä in 1973, and its location within Finland.

4.1.2 Level of stakeholder Involvement

In Steering group: Centre of Economic development, traffic and environment of Lapland (ELY) (Main partnership), Ministry of Agriculture and Forestry, City of Rovaniemi, Rescue Department of Lapland, Kemijoki Oy (regulation operator).
Stakeholders in delivering material: City of Rovaniemi, ELY Centre of Lapland.
Stakeholders in testing: Residents' association.

4.1.3 CRUE Activities

Rovaniemi had previously gathered addresses of local people, to whom 1678 questionnaires were sent and 375 returned (22.3% response rate). A separate questionnaire went to residents and authorities. Questions were shaped by discussion with local authorities, especially with the Regional Environment Centre of Lapland.

4.2 Ballinasloe, County Galway, Ireland

4.2.1 Main Characteristics

Major Type of Flood: New fluvial risk
Size of Catchment: 1,590 km²
Past Flood Events: Little until November 2009
Environmental Settings: Situated on the banks of the River Suck (tributary of Shannon). In 2009 the riverbanks burst following weeks of persistent and often heavy rain.

Socio-economic Settings: The town of Ballinasloe has a population of over 6,000 (2006 census).

Figure 10 Aerial view of Ballinasloe when flooded in November 2009.

4.2.2 Level of stakeholder Involvement

Principal engagement was with the public at risk via self-completion postal questionnaires. Ballinasloe Town Council, the relevant local authority, was consulted before carrying out the work. The Office of Public Works was involved in study endorsement, questionnaire development, site selection and the issuing of press releases.

4.2.3 CRUE Activities

Ballinasloe was chosen as it is an area of 'new' fluvial risk, with no experience of severe flooding until November 2009. A total of 353 residential and business addresses within a previous flood extent envelope were targeted. From these, 84 questionnaires were returned, a response rate of 24%.

4.3 Clonmel, County Tipperary, Ireland

4.3.1 Main Characteristics

Major Type of Flood: Fluvial, residual risk
Size of Catchment: 2,173 km²
Past Flood Events: Six severe floods since 1995, plus more minor floods.
Environmental Settings: Located in a valley on the banks of the River Suir. Extreme weather conditions causes overflow onto the floodplain, valley and Clonmel.
Socio-economic Settings: Clonmel's population is over 16,000. Approximately 1300 business and residential properties lie within the 100-year flood envelope

Figure 11 Aerial view of Clonmel in flood.

4.3.2 Level of stakeholder Involvement

Principal stakeholder involvement was with the public at risk via self-completion postal questionnaires. Clonmel Borough Council was consulted before carrying out the work. The Office of Public Works was involved in study endorsement, questionnaire development, site selection and the issuing of press releases.

4.3.3 CRUE Activities

Clonmel was chosen as it experiences regular fluvial floods and has areas exposed to residual risk following a recent defence scheme that includes demountable barriers. 649 residential and business addresses in the 100-year flood contour were targeted, and 126 questionnaires returned; a 20% response rate.

4.4 River Dodder, Dublin, Ireland

4.4.1 Main Characteristics

Major Type of Flood: Fluvial, pluvial, coastal and residual risk
Size of Catchment: 125 km²
Past Flood Events: Severe tidal floods in Feb 2002. Many other events.
Environmental Settings: The River Dodder is one of Dublin's most important rivers. The mouth of the river is tidal, while the catchment is largely urban in nature.
Socio-economic Settings: Dublin has a population of 1.2 million (2006 census).

Figure 12 Hurricane Charlie caused damage along the River Dodder in 1986

4.4.2 Level of stakeholder Involvement

Principal stakeholder involvement was with the public at risk via self-completion postal questionnaires. Dublin City Council, South Dublin County Council and Dun Laoghaire-Rathdown County Council were consulted beforehand. The Office of Public Works was involved in study endorsement, questionnaire development, site selection and the issuing of press releases.

4.4.3 CRUE Activities

The area within the flood contour of the River Dodder in Dublin was chosen as it experiences fluvial floods; coastal floods from the tidal river mouth; pluvial floods due to the urban nature of the catchment and residual risk due to structural flood defences. 676 addresses were targeted and 148 questionnaires were returned (22% response rate).

4.5 Wexford Town, County Wexford, Ireland

4.5.1 Main Characteristics

Major Type of Flood: coastal
Size of Catchment: 6.39 km²
Past Flood Events: Last major flood in 2004
Environmental Settings: Situated where the River Slaney meets the Irish Sea. Coastal floods have been caused by high tides and strong south-easterly winds.
Socio-economic Settings: Wexford Borough's population is ~8,850 (2006 census). About 550 business and residential properties are in the 200 year flood envelope.

Figure 13 Flooding of business and residential property in Wexford Town, 2004.

4.5.2 Level of stakeholder Involvement

Principal stakeholder involvement was with the public at risk via self-completion postal questionnaires. Wexford Borough Council was consulted before carrying out the work. The Office of Public Works was involved in study endorsement, questionnaire development, site selection and the issuing of press releases.

4.5.3 CRUE Activities

Wexford Town was chosen for study as it experiences coastal floods from the Irish Sea. A total of 494 residential and business addresses within the 200-year flood contour were sent the questionnaire. From these, 78 questionnaires were returned, equating to a 16% response rate.

4.6 Rome, Lazio, Italy

4.6.1 Main Characteristics

Major Type of Flood: pluvial and fluvial
Size of Catchment: 445 km²
Past Flood Events: Multiple floods from the Tiber (last 2008)
Environmental Settings: The Tiber River enters northeast Rome and leaves in the southeast.
Socio-economic Settings: The capital of Italy (pop ~2.7 million). Prima Porta area population is ~155,000. Fast urban development and quick deforestation has increased flood damages.

Figure 14 A past flood event in the Prima Porta area, red dot marks its location within Italy.

4.6.2 Level of stakeholder Involvement

The Rome case study was chosen after several discussions and interviews with important institutional stakeholders such as the “Land Defense Regional Association” (A.R.Di.S. - Associazione Regionale per la Difesa del Suolo), “Civil Protection” (Protezione Civile Comune di Roma), “Regional Functional Centre of the Lazio Region” (C.F.R. - Centro Funzionale Regionale della Regione Lazio).

4.6.3 CRUE Activities

This site was chosen to include an example of primary risks from pluvial and fluvial flooding. A total of 150 questionnaires were sent to at risk properties throughout the Prima Porta area, and 134 were returned (a response rate of 90%).

4.7 Vibo Valentia, Calabria, Italy

4.7.1 Main Characteristics

Major Type of Flood: pluvial and coastal
Size of Catchment: 46.34 km²
Past Flood Events: 3rd July 2006 pluvial flood. Other floods nearby.
Environmental Settings: Situated in the central-West part of Calabria along the Tirreno coast.
Socio-economic Settings: Bivona area has population ~2000 and Vibo Valentia area has ~8000. In the 2006 flood 12 were heavily injured and 4 died.

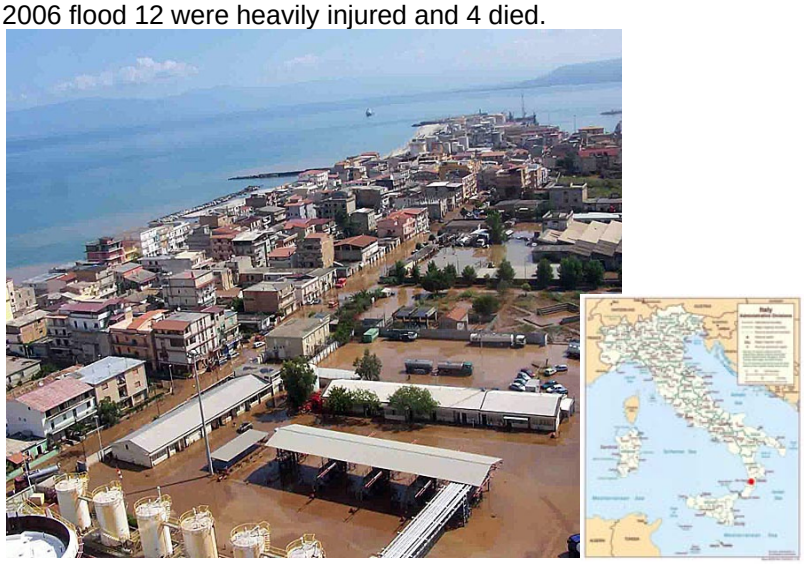


Figure 15 Aerial view of Vibo Valentia when flooded, red dot marks its location within Italy.

4.7.2 Level of stakeholder Involvement

In addition to community involvement via questionnaires, the site was chosen in consultation with: "Regional Environment Protection Agency - Calabria" (A.R.P.A.-CAL. – Agenzia Regionale per la Protezione Ambiente Calabria), "Regional Functional Centre for the Calabria Region" (C.F.R. - Centro Funzionale Regionale della Regione Calabria), Flood Operative Centre" (C.O.A. - Centro Operativo Alluvione), Vibo Valentia Municipality (Comune di Vibo Valentia) and Civil Protection (Calabria).

4.7.3 CRUE Activities

This site was chosen to include an example of primary risks from pluvial and coastal flooding. A total of 120 questionnaires were sent to at risk properties in the Vibo Valentia area, and 112 were returned (a 93% response rate).

4.8 Cathcart, Glasgow, Scotland

4.8.1 Main Characteristics

Major Type of Flood: fluvial
Size of Catchment: 250 km²
Past Flood Events: more than 20 significant floods in 80 years
Environmental Settings: The White Cart Water flows through Cathcart (55.818, -4.261). It is a shallow and fast flowing river: 12 hrs of rain can raise water by up to 6 m.
Socio-economic Settings: Residential area with railway station, used for commuters to the city. Over 1750 homes and businesses in Glasgow have a history of flooding from the White Cart.

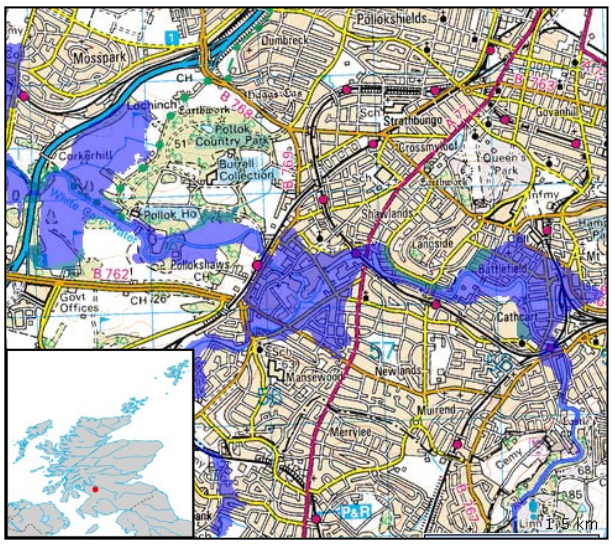


Figure 16 Flood risk map for Cathcart. Blue areas indicate flood risk.

4.8.2 Level of stakeholder Involvement

A cross-section of the community have been involved by responding to questionnaires. We co-operated and worked with the local authority to develop our work plan here.

4.8.3 CRUE Activities

Glasgow City Council is carrying out high profile construction of 3 floodwater storage sites, 9 ha of permanent wetlands and 8 km of low walls along river banks, to reduce the present risk of flooding. We chose this site because we wished to sample an urban location, and because of past experience with flooding. We sent out 180 questionnaires and 37 were returned (a response rate of 21%).

4.9 Huntly, Aberdeenshire, Scotland

4.9.1 Main Characteristics

Major Type of Flood: fluvial
Size of Catchment: 1,266 km²
Past Flood Events: last flooded 1-2 Nov 2009 'worst in living memory'.
Environmental Settings: (57.442, -2.787) Flooding can be caused if the River Deveron overtops its banks e.g. after heavy rain.
Socio-economic Settings: Vulnerable groups of society are particularly at risk: the low lying 'meadows' area includes a care home for the elderly, and social housing.

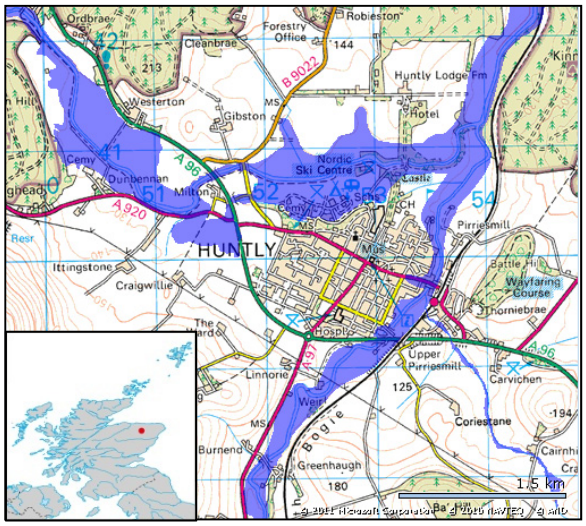


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Figure 17 Flood risk map for Huntly. Blue areas indicate flood risk.

4.9.2 Level of stakeholder Involvement

There was strong community concern (they have collected donations for flood victims) and motivation to discuss floods with this project. URFlood liaised with the Scottish Flood Forum (SFF), which has been visiting to assist in recovery from flooding. In June 2011, in response to demand, the local authority announced funding for a flood alleviation scheme.

4.9.3 CRUE Activities

After the November 2009 floods, there was some information provided about flood risk and preparation by local authorities, and this allowed us to probe recall of recent efforts. We ran a focus group discussion here, followed by a questionnaire survey. We sent out 86 questionnaires, of which 47 were returned (a response rate of 55%). Finally discussion and interviews here contributed to guideline-testing.

4.10 Moffat, Dumfries & Galloway, Scotland

4.10.1 Main Characteristics

Major Type of Flood: pluvial & fluvial.
Size of Catchment: 960km² (the Annan catchment)
Past Flood Events: multiple events, e.g. pluvial floods 20th July 2011
Environmental Settings: Moffat (55.333, -3.444) is flood prone after severe rainfall, and runoff from the Gallowhill area collects in inadequate culverts flowing through urbanised areas.
Socio-economic Settings: Moffat has been increasingly urbanised in recent years (population now about 2200), increasing potential damages from flooding.

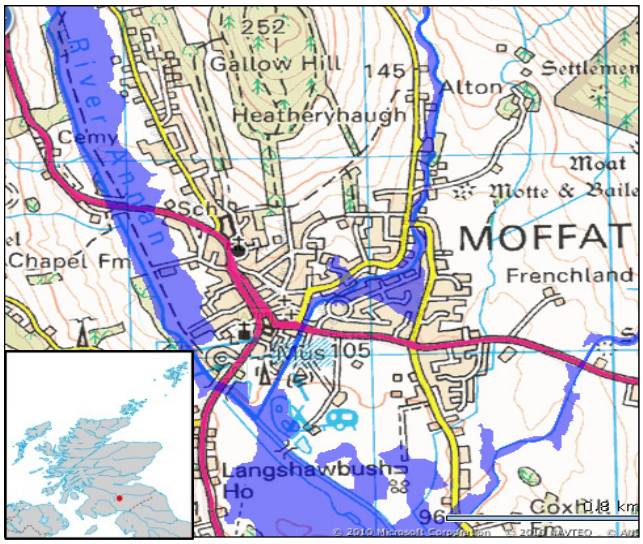

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Figure 18 Flood risk map for Moffat. Blue areas indicate flood risk.

4.10.2 Level of stakeholder Involvement

Residents here feel vulnerable to flooding and fear its effects because of past experience. At this site we have worked closely with the Scottish Flood Forum who have been working with the community to establish a self-help group (www.scottishfloodforum.org/tag/moffat-community-flood-group/).

4.10.3 CRUE Activities

Properties randomly selected throughout the village were asked to return the Scottish questionnaire. After we analysed the questionnaire data and compiled our guidelines, We sent out 60 questionnaires of which 22 were returned (a response rate of 37%). Moffat was also visited to discuss and test our draft guidelines.

4.11 Newburgh, Aberdeenshire, Scotland

4.11.1 Main Characteristics

Major Type of Flood: coastal and fluvial
Size of Catchment: 550 km²
Past flood events: None but classified as vulnerable by SEPA
Environmental Setting: Coastal rural community (57.317, -2.003) on the Northeast coastline, above Aberdeen.
Socio-economic Setting: The community is typical of many rural areas in North-east Scotland. Fewer than 100 properties are at risk from flooding.

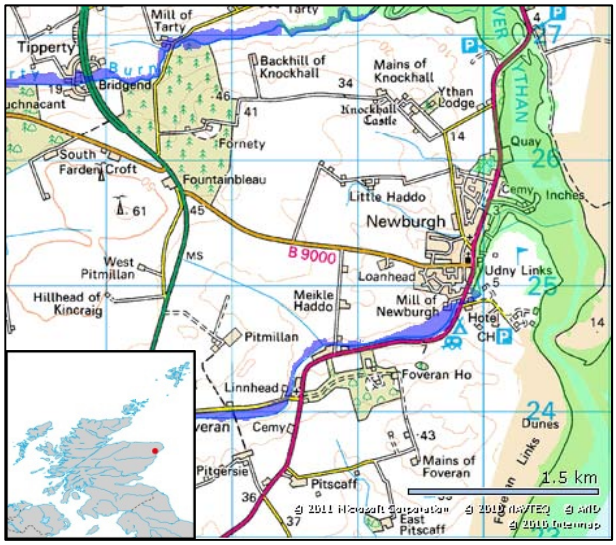

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Figure 19 Flood risk map for Newburgh. Blue areas indicate flood risk.

4.11.2 Level of stakeholder Involvement

The community have been involved in the work through responding to questionnaires. We have also worked with the local authority as they are interested in the results from the study. These together with the national government, The Scottish Flood Forum and the Scottish Environment Protection Agency are our principal stakeholders.

4.11.3 CRUE Activities

The community is at risk from both coastal and fluvial flooding, but has little actual experience of flooding. We sent out 100 questionnaires, of which 36 were returned (a response rate of 36%).

5 Results and discussion

This chapter is divided into three sections. First we present the results of data collection to elicit key aspects of knowledge systems that affect how communications about flood warnings and preparedness are processed (this corresponds with WP4, 'Investigating knowledge systems'). We then present our framework guidelines derived from this analysis (this corresponds with WP5 'Developing new flood communication processes'). Finally, we present points raised in the testing and discussion of these guidelines, as to how new approaches to flood communication might be implemented (this corresponds with WP6, 'Testing new flood communication processes').

5.1 Investigating knowledge systems

In all countries our discussions with agencies involved in flooding or flood communications prefaced the design of a questionnaire to probe key aspects of public knowledge systems. In addition, focus group discussions with the public were held in some locations. In addition to informing questionnaire design, these discussions were also helpful for informing and checking our understanding of how knowledge systems may differ between different groups.

5.1.1 Factors taken into account in interpreting and using flood risk and flood warning information by the public at risk

In preparatory work with agencies, and in focus group with the public, our discussions encompassed the role of various agencies in how flood communications were thought to be communicated. Our organograms of public roles and responsibilities (section 1) were developed for each country to make clear the actual role of organisations in deploying flood warnings.

However, in our discussions we noted that agencies and the public could see issues differently. As such, we support the use of the second conceptual model developed by Handmer et al. (2001). Handmer suggested that agencies responsible for communication tend to see communication systems as simpler, and agency-focused, whereas from the public's point of view the situation is rather more 'messy' (i.e. many complicated and sometimes vague associations). Handmer's conceptual model (Figure 20) suggests that those responsible for deploying warnings typically expect the public at risk to have a simple view of the actors involved, whereas those at risk actually hold more messy conceptual models, with a larger role for interaction within society and influence from the media, and correspondingly less prominence for the responsible agencies.

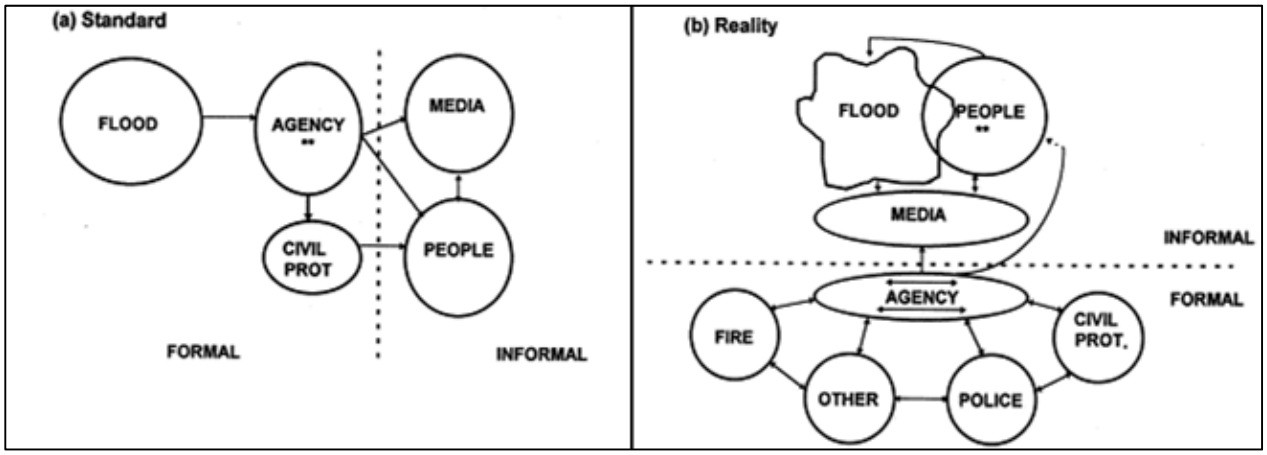

Figure 20 Alternative ways of conceptualising flood-warning systems, taken from Handmer (2001). (a) represents a view typically held by those responsible for deploying warnings; (b) represents the actual conceptualisation typically held by people at risk

As a result of our discussions, we agree that there is this mismatch. In fact, on the basis of our discussions with focus groups, we suggest that the reality of how flood warnings are understood can be even more 'messy'. For example, Figure 21 shows typical perceptions of agency roles and responsibilities as held b members of the public in Scottish focus groups.

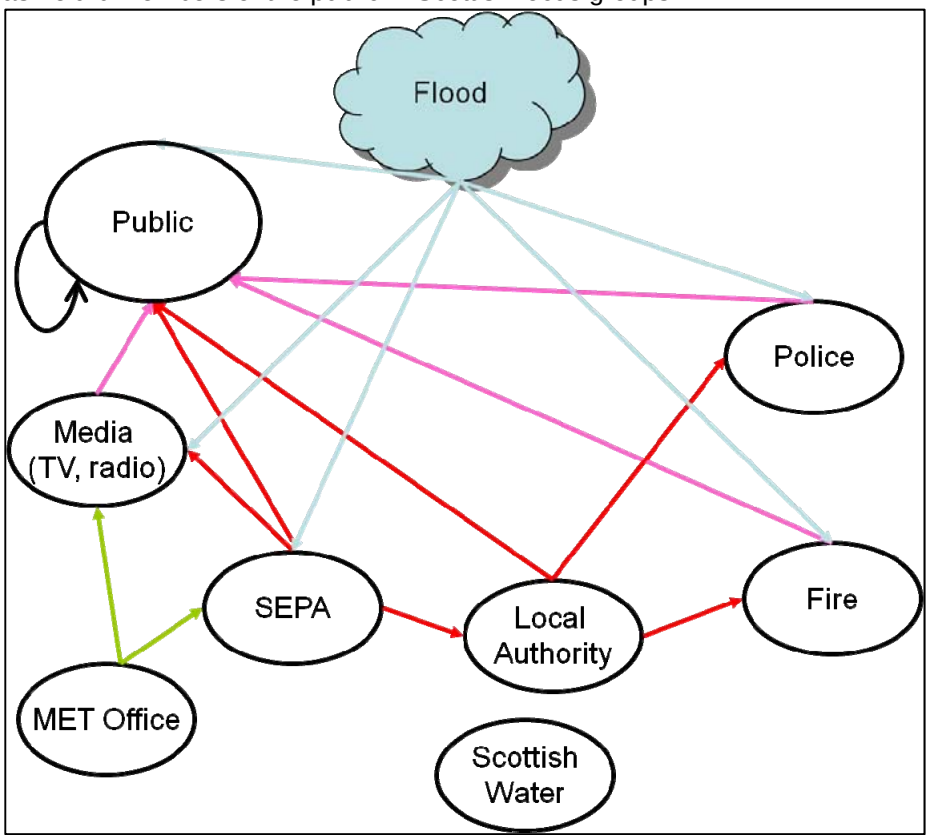

Figure 21 Model of how flood warnings communicated, as perceived by the public, and derived from Scottish focus group discussion. Red = direct flood warning; Pink= relaying of flood warning; Green= severe weather warning; Pale Blue= observation of flood and weather. Scottish Water is the agency responsible for provision of drinking water and sewerage, and vaguely associated with floods by public.

(We do not present diagrams like Figure 21 for other partner countries but discussions there confirmed that understandings and processing are similarly complicated or messy in every location.) We therefore support the use of the model developed by Handmer and recommend this is recognised by agencies responsible for flooding. When designing communications, agencies must remember the public point of view, and the multiple link sources of information that may be used.

The wide range of information sources that members of the public may use and be influenced by means that there are potentially many factors which can influence how people process and make sense of flood messages. Not all of these may be recognised by agencies (see section 1.4 for the organograms of the formally designated roles), or controllable by agencies during any particular flooding event. This suggests the importance of agencies investing in promoting preparedness, so that regardless of from whom information is heard during a flood, a person will then react in ways that are helpful - seeking information from established sources and preparing for flooding – as seen as appropriate by the responsible agencies.

Of course, 'the public' is not a homogenous category. Our focus groups discussions were potentially biased to those people who were already interested in talking about flooding, so the data from our widely disseminated questionnaires was used to get a better idea of the range of ideas in the population.

5.1.2 Surveying key factors shaping public perceptions and relationships with flood communications

Based on the literature review, our discussions with focus groups, and our understanding that flood communications were widely perceived as a 'messy' issue by members of the public; we identified a set of common key questions to be incorporated into a survey using a structured questionnaire.

5.1.2.1 Questionnaire development

In every country, questionnaires covered a common set of core issues which included: perceptions of flood risk; personal experiences of flooding; awareness of flood warnings; terminology and concepts associated with uncertainty and risk; information sources and availability; perceptions of trust and reliability; experiences of flooding; knowledge of actions to take. In addition, every questionnaire collected information on a variety of socio-demographic attributes, including age, language ability, employment, and education status, influenced by the seven factors found predictive of more vulnerable groups in times of disasters by Shaw et al. (2005) (for more details see section 1.2.3).

Each country partner developed a separate questionnaire that covered these common issues, tailored according to local language and understandings, and refined by piloting. Where possible questions were asked in the same way, and with the same answer format. This allowed the answers to be added into a trans-national database of survey results.

During testing and piloting, it was clear that the total list of potential questions was so long that it would not be feasible to include them all in one questionnaire (very long questionnaires are very unlikely to be returned). Furthermore, it was clear that not every question could be directly translated nor every answer format directly transferable to every country or community at risk. To ensure that all important questions would be covered by URFlood, partners worked together to select questions that were complementary, so all relevant questions were covered in the same form in two or more countries (Table 2).

As a result of the coordinated development of the questionnaires, there were 61 questions whose question and answer format was shared between two or more partners (Table 2). Of these, 10 were shared in all four countries, 15 were shared in three countries, and 36 in two countries. These totals exclude sub-questions (for example, each questions on a websites would be two questions in a questionnaire). The trans-national coordination therefore enabled more questions to be covered, than could be achieved by any single questionnaire.

Table 2 The common questions shared by two or more country's questionnaires where question and answer formats permit direct comparison and combination of data. Questions covered by only one country's questionnaire are not presented here. F=Finland, IR=Ireland, IT=Italy, S=Scotland.

Topic	Common question between 2+ countries	F	IR	IT	S
Awareness, recall and perception of information on flood preparedness and flood warnings	Did you receive any warning before the last flood?	-	Y	-	Y
	Where did you hear these warnings from?	-	Y	-	Y
	Have you visited the website on flooding? If so, how helpful was this?	Y	Y	Y	Y
	Have you visited the flood maps website? If so, how helpful was this?	Y	Y	-	Y
	How important do you think "flood warnings" are?	Y	-	Y	-
	How important do you think "Floodbanks and other protective measures" are?	Y	-	Y	-
	How important do you think "pre-flood communications" are?	Y	-	Y	-
	How would you rate the amount of information available on actions to take?	-	Y	-	Y
	How would you rate the amount of information available on flood warnings?	Y	Y	-	Y
	What is the most preferred source of information on actions to take?	Y	Y	-	Y
	What is the most preferred source of information on flood warnings?	-	Y	Y	Y
	What sources of information do you get about flood preparedness?	Y	Y	Y	Y
	What sources of information do you get about flood warnings?	-	Y	Y	Y
Confidence & understanding of terminology	Agreement with statement "I do not understand talk about probabilities"	-	Y	-	Y
	Agreement with statement "I understand how risk is assessed"	-	Y	-	Y
	Agreement with statement "It would be good to have more information about uncertainty in warnings"	-	Y	-	Y
	Agreement with statement "Messages from authorities use too much technical jargon"	Y	Y	-	Y
	Agreement with statement "We get enough information already"	-	Y	-	Y
	Do people actually understand what a 1% floods is?	Y	Y	-	-
	Do people actually understand what a 100 year flood is?	Y	Y	-	Y
	Do you think you understand what a 1 in 100 flood is?	-	Y	Y	-
	Do you think you understand what a 1% flood is?	-	Y	Y	-
	Do you think you understand what a 100 year flood is?	-	Y	Y	Y
	Do you think you understand what a flood with a 1 in 100 chance of being equalled/exceeded every year is?	-	Y	Y	-
Perceptions of potential sources communicating about floods	Do you think agencies are accessible/ listen to the public?	Y	Y	-	Y
	How did the Emergency Services listen to you?	-	Y	-	Y
	How did the Local Authority listen to you?	-	Y	-	Y
	How did the National body (OPW,SEPA) listen to you?	-	Y	-	Y
	How reliable are the Emergency Services?	-	Y	-	Y
	How reliable are the friends and family?	-	Y	-	Y
	How reliable is the Local Authority?	-	Y	-	Y
	How reliable is the National body (e.g. OPW, SEPA)?	-	Y	-	Y
	How trustworthy is the Emergency Services?	-	Y	-	Y
	How trustworthy is the Local Authority?	-	Y	-	Y
	How trustworthy is the National body (e.g. OPW, SEPA)?	-	Y	-	Y
	How important do you think "my own precautionary measures" are?	Y	-	Y	-

Topic	Common question between 2+ countries	F	IR	IT	S
Preparedness or knowledge of actions to take	If you heard of a flood, who would you tell?	-	Y	-	Y
	What actions did you take to prepare for the last flood?	-	Y	-	Y
	What actions might you do to prepare for a flood?	-	Y	Y	Y
	What is your current level of preparedness?	Y	Y	Y	-
Prior experience of flooding and perceptions of flood risk	Do you think you currently live in a flood risk area?	Y	Y	Y	Y
	Have you been affected by flooding in your current residence?	Y	Y	Y	Y
	How many times have floods occurred in your current residence?	Y	Y	Y	Y
	How worried are you about flood risk to your area?	Y	-	Y	-
	How worried are you about flood risk to your city?	Y	-	Y	-
	How worried are you about flood risk to your home?	Y	-	Y	-
	If you experienced flooding, what have you undergone?	Y	Y	-	-
	What concerns you the most regarding floods?	Y	-	Y	-
	What do you think caused these floods?	Y	Y	Y	Y
Socio-demographic attributes of respondent and household	Are you a small business owner?	-	Y	-	Y
	How long have you lived in this area?	Y	-	-	Y
	How long have you lived in your current residence?	Y	Y	-	-
	How many people live in your household in total?	Y	-	-	Y
	Is English/Italian/Finnish your first language?	Y	Y	Y	Y
	If not, how fluent are you?	-	Y	Y	Y
	What best describes your employment status?	-	Y	Y	Y
	What is the ownership of your residence?	Y	Y	Y	Y
	What is your gender?	Y	Y	Y	Y
	What is your highest level of education?	-	Y	Y	Y
	What type of building do you live in?	Y	Y	-	Y
	Which age group are you in?	Y	Y	Y	Y
	/Total shared questions in each country's questionnaire	32	51	29	46

In addition to the questions shown in Table 2, many questionnaires contained similar questions that could not be phrased or structured identically to other countries. These are not shown in the table above, since their data cannot be combined with other countries' into a single statistical analysis, but their results are still useful and relevant to interpreting and comparing how concepts are understood.

It is important to note that the country-specific analyses generally support the trans-national analyses reported here. Therefore, in this report we do not directly report this data (that covering a shared topic or question but using a different question phrasing or answer format) though we do note any particular exceptions from country-specific data analysis. Instead, results reported here focus on the substantial body of data from reviewing the directly shared questions.

Data collected from the 'common questions' in each country were added to a cross-national database of responses, for statistical analysis and reporting. Each country partner also separately analysed the data collected in its questionnaires, to provide country-level insights. Each questionnaire also covered extra questions specific to the locality. For example, in Scotland the questionnaire explored awareness of the Floodline Direct service and probed awareness and judgements of the 4-level symbol system used in flood warning communications. In Ireland a national campaign in relation to preparing for flooding entitled

"Plan, Prepare, Protect" was evaluated in terms of awareness and helpfulness of information provided. In Finland the area of compensation for flood losses was investigated along with respondents thoughts on the usefulness of flood drills. The Italian questionnaire on the other hand investigated the relative concern that the public hold for floods by comparing this to other concerns such as unemployment and road accidents.

5.1.2.2 Trans-national questionnaire results

This chapter focuses mainly on the findings of analysis from the cross-national database. However, those with interest in particular countries can receive country-specific reports from the respective country partners (these reports contain information from all the questions asked within the country, not just those common to other countries.) In addition, a more detailed version of the cross-national report is available on request from the project coordinator.

The results are ordered in a narrative structure that begins with a description of the respondents sampled, and then their flood experiences. This section then goes on to link these with aspects of knowledge systems and other perceptions, with the topic order approximately following the course of a flood (from flood preparation, to hearing warnings, interpreting messages, and taking action).

Where statistical tests[3] have been performed to check for trends or patterns in the data, only those tests where a significant difference has been found are reported. All statistical tests were two-tailed and we use a critical significance value (p-value) of 0.05.

Description of sample respondents
In total, 1142 questionnaires were entered into the common database. These included 144 from the Scottish case studies, 436 from Ireland, 325 from Finland and 237 from Italy. Common questions were asked either between two to four countries. A typical response rate (questionnaire sent versus returned) is 10%, so the overall response rate of 26% was excellent (Table 3), and may well reflect strong public concern and interest in this topic.

Table 3 The distribution of questionnaires by case study site.

Country	Case study site	Number issued	Number returned	Percent returned (response rate)
Finland	Rovaniemi	1678	375	22.3%
Ireland	Ballinasloe	353	84	23.8%
	Clonmel	649	126	19.4%
	River Dodder (Dublin)	676	148	21.9%
	Wexford Town	494	78	15.8%
Italy	Rome	150	134	89.3%
	Vibo Valentia	120	112	93.3%
Scotland	Cathcart (Glasgow)	180	37	20.6%
	Huntly	86	47	54.7%
	Moffat	60	22	36.7%
	Newburgh	100	36	36.0%
/Total		/4546	/1199	/26.4%

[3] The report has been written with a wide readership in mind, but assumes some familiarity with basic statistics (percentages, chi-squared, t-tests etc) and notation (e.g. n=sample size, df=degrees of freedom, p=significance level). The principles of statistical analysis are described in section 3.4, which also provides a suggestion for further reading on this subject.

The sample was made up of 78% who owned their residence and 18% who rented; with the remainder being classified as "other". There was a very even gender balance with 51% men and 49% women. Almost 90% of the sample spoke the country's first language (English, Finnish or Italian) as their mother tongue. Of those who did not, 77% felt they spoke that language either somewhat or very fluently. (As 98% of people in Rovaniemi had Finnish as their mother tongue, the second part of the question -about other languages- was not asked in Finland.) The majority of respondents (64%) were 45 years and over, while just 16% were under the age of 35, which when compared to census data suggests a slight bias to older groups (Figure 22).

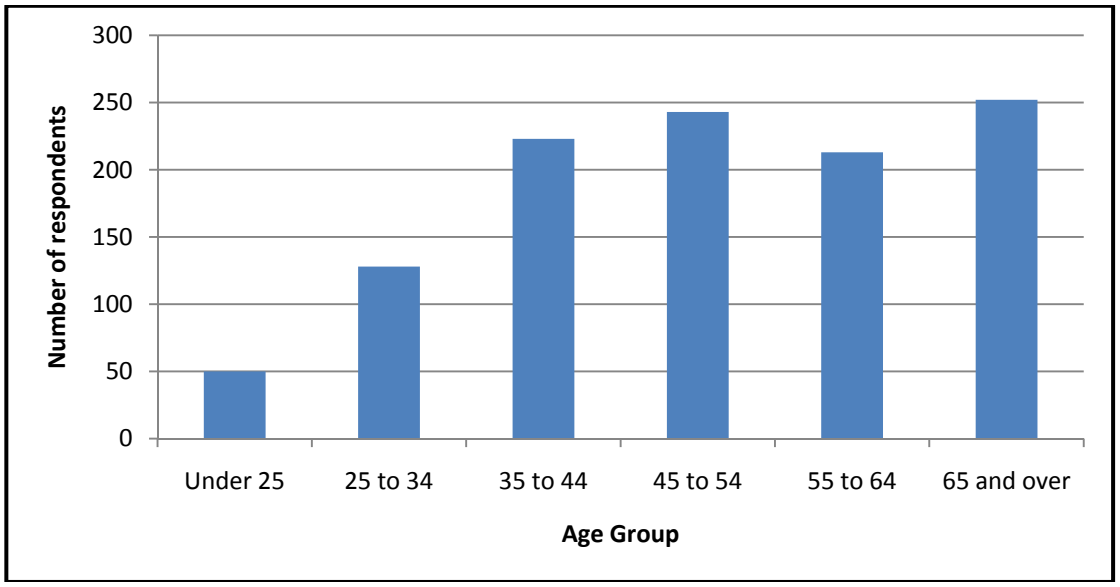

Figure 22 Age distribution of cross-national sample (n=1142).

Between Scotland and Ireland, 84% of respondents were residents while the remaining 16% were small business owners. In Ireland and Finland, the mean length of time respondents lived in their current residence was 20 years, with a standard deviation of 18 years. The majority of respondents in Ireland and Finland had lived in their current residence for over 13 years. The average number of years respondents in Scotland and Finland had been living in the specific case study area was 33 years with a standard deviation of 20 years. The majority had lived in the area for more than 32 years.

Respondents in Ireland, Scotland and Finland were asked the type of building lived in. Bungalows and terraced houses were the most common with almost one quarter of the sample in each of these. However, the type of building varied with country and indeed, case study area. The proportion of bungalows is highest in Finland (50% of building types) and lowest in Ireland (7%). However, within the Irish sample for example, building types varied with 27% of the Ballinasloe sample living in bungalows.

In Ireland, Scotland and Italy, the employment status of respondents was assessed and the majority were found to be employed in some form, either full-time, part-time or through self-employment. Over 20% of respondents were retired, (reflecting a high number of respondents in the 65 and over age category). Respondents also had a wide range of educational backgrounds, with secondary-level education (to age 16) the most common category.

Summary

The sample of this survey is generally socio-demographically diverse, and so represents individuals from a range of educational, employment backgrounds, and is gender-balanced. There are few respondents whose local language is not their first language, which limits ability to detect effects, but accurately reflects sample populations. There may be a slight bias to older groups, but a wide range of ages are represented.

Respondents' flood experiences and awareness

Awareness levels and perception of risk, along with factors affecting awareness and perception of the public at risk were explored in each country.

Perceptions of flood risk

Within the sample, almost 70% of respondents felt that they were living in a flood risk area. 61% of respondents had been flooded in the past (more information on particular experiences and extent of damage are explored in more detail in the cross-national and country-specific reports). There are therefore a large number of respondents who although they have not experienced flooding, feel they are at risk. Many of these worry more about the size of a flood, rather than their frequency although this varies between countries (Figure 23). This may have implications for how often they expect to be flooded.

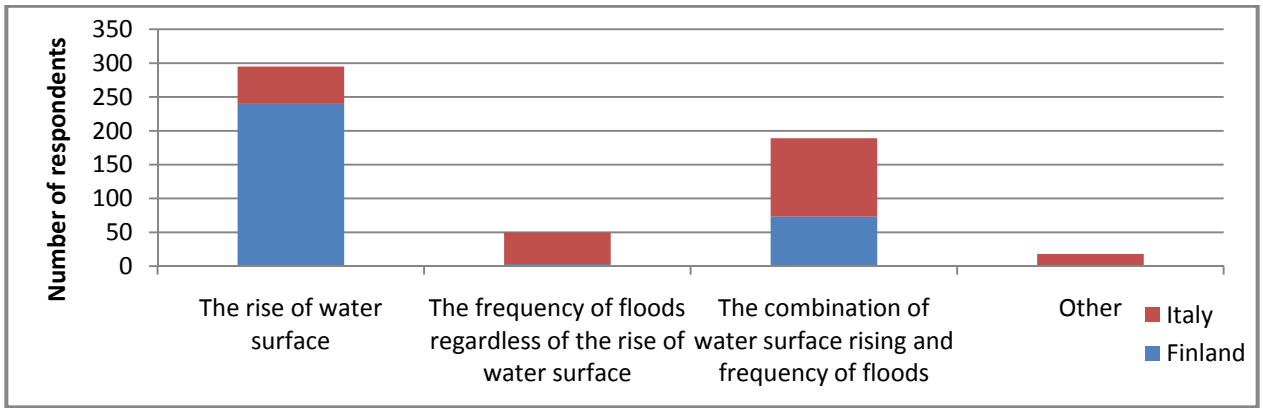

Figure 23 What concerns respondents the most about a flood, question asked to respondents in Finland and Italy.

Concern of the public at risk was further explored in both Italy and Finland by investigating the degree of worry felt for the risk of flooding to respondents' home, local area and regional area (Figure 24). Results indicate that the public at risk within this sample are more worried about flood risk in their local area than they are to both flood risk in the regional area and flood risk concerning their own homes. Worry concerning respondents' own homes was lower than worry towards both the local and regional areas. The greatest amount of uncertainty (those in the "don't know" category) was regarding concern for the regional area. The results are affected by previous flood experience: unsurprisingly, those who have been flooded more are more likely to express worry, particularly for their own home (Chi-square test, df=1, $p<0.001$).

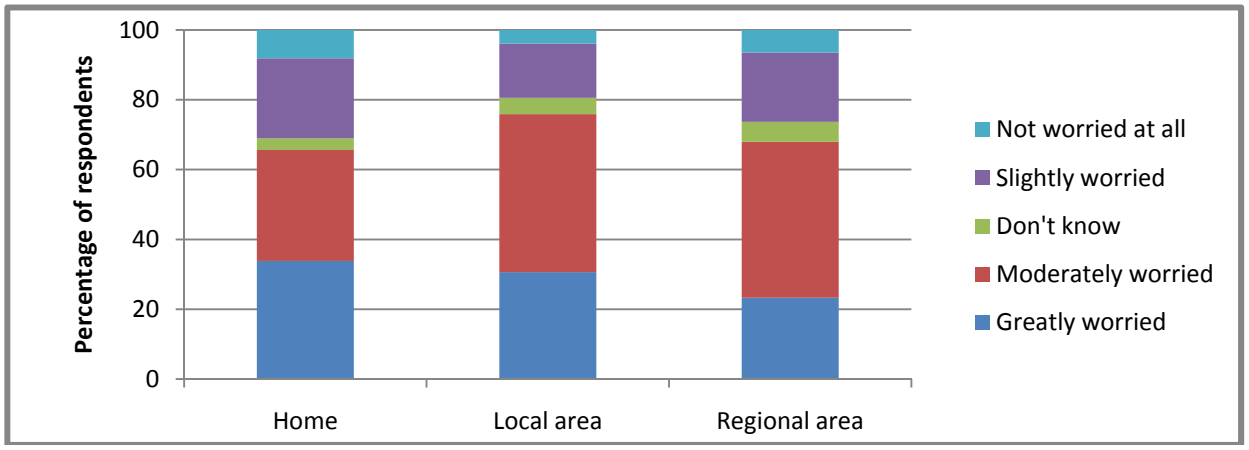

Figure 24 Degree of worry regarding risk of flooding to the home, local area, regional area (n=618), question asked to respondents in Finland and Italy.

Perception of causes of flooding
Knowledge of the flooding process and perception of the causes of flooding was explored by asking respondents what they thought the causes or sources of the last major flood were. A variety of responses were given in every case study site. Flooding from intense rainfall was perceived to be the biggest problem in Ireland, Scotland and Italy, followed by flooding from rivers. A flood defence breach was not seen to be as important in these three countries. 30% of the total respondents in Ireland and Scotland judged overflow of drains to be a main source of flooding, whilst in Finland respondents chose floods caused by a large discharge more often than floods caused by an ice jam. Results indicate that certain flooding processes such as flood defence breaches or groundwater flooding were not seen as major problems by the public at risk.

Factors affecting concern about flooding
Unsurprisingly, experience of flooding has a direct effect on whether respondents feel they are living in a flood risk area: a higher percentage of those who have been flooded previously fall into the category of feeling at risk to flooding, whilst those who have no flood experience are less likely to think they are at risk (Chi-square test, df=1, $p<0.001$). However, there are respondents who have been flooded in the past who do not feel at risk to flooding (n=82). This indicates a level of residual risk in communities. Ownership of residence, gender, language spoken and age did not affect these responses.

Those who do not speak the local language as their first language were also more likely to worry more about their homes flooding ($t=5.75$, df=155, $p<0.001$) and of the local and regional areas. Interestingly, those who owned their properties were found to have a lower degree of worry regarding risk to their homes than renters ($t=2$, df=80, $p<0.05$). Those who felt they were living in a flood risk area had a significantly higher degree of worry than those who felt they were not at risk ($t=-9.01$, df=440, $p<0.001$).

Summary
The public at risk may not perceive that they are at risk of flooding, particularly if they have not been flooded before. This is potentially a barrier to communicating about flooding and building capacity to cope with flooding. However, even if they are not personally worried for their own property, they may still worry about flooding in their local area. They may also not perceive all potential sources of flooding, such as groundwater flooding, especially those who may not have experienced flooding in the past.

Before a flood: Respondents' views of preparedness and available information
A total of 966 respondents in Ireland, Italy and Finland answered a question relating to their current levels of preparedness for floods (this question was rejected during piloting in Scotland). The results in Figure 25 show that the majority of respondents felt that they were not prepared (n=528). Only a small minority of respondents felt very well prepared (n=80).

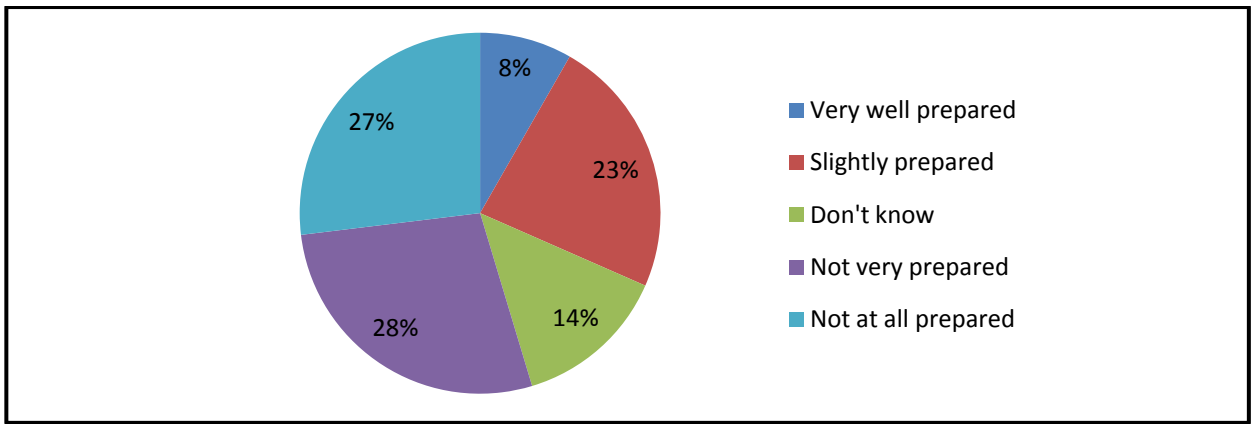

Figure 25 Self-evaluation of current levels of personal preparedness for floods (n=966), question asked to respondents in Finland, Italy and Ireland.

Previous flood experience was found to be related to current preparedness levels: those previously flooded had a higher level of preparedness than those who had not (t=-7.96, df=922, p<0.001). Interestingly, perception of living in a flood risk area was found to have no influence on preparedness. There was also no effect of ownership of residence, age or speaking the local language fluently. Men felt a slightly higher level of preparedness than women (t=-4.3, df=942, p<0.001) but it is not clear if and why this translates into actual preparedness, or reflects a greater general confidence in ability to take action.

General views on information available to support preparedness

Overall, there was a strong desire for more information. In Ireland, Scotland and Finland respondents were asked to rate the amount of information that is available on floods. (In Scotland and Ireland this was subdivided into warnings about floods and actions to take or preparedness.) 43% of the 865 respondents who answered this question thought that the amount of information available about floods was "too little", while over 30% did not know. 26% rated the availability of information as "fine" while just two respondents (0.2%) felt there was "too much". The Irish were most likely to say there was not enough information.
Those who had visited either of the websites were found to rate the availability of information more positively than those who had not. This again suggests the helpfulness and the quality of information available on the websites.

Those who felt there was not enough information available were more likely to have been flooded before. However, perceiving flood risk, had little effect on this rating, suggesting that many of those of who perceive risk but have not yet been flooded do not realise that they will need more information or will not be prepared should a flood come. Men were more likely than women to say there was "too little" information (Chi-square test, df=2, p=0.02). No relationship was found for ownership of residence, type of building lived in, language spoken, or age group.

Using websites to prepare

Within each country, it was investigated whether the public at risk knew where to get information about flooding from. In every country, an agency has a website about flooding[4], and respondents were asked whether they had visited these sites. There was widespread lack of awareness of these sites. Of the 1,117 people who answered this question, 87% had not visited these sites. Scotland, Ireland and Finland answered a similar question relating to particular web pages about flood mapping websites, and there was a similar lack of visits to these. Italy had the highest proportion of respondents visiting the flood information site (28%), while Scotland had the most visiting its mapping site (33%). Those who had been flooded before were not found to have visited the websites any more than those with no flood experience. Furthermore, there was no significant relationship between feeling at risk and visiting the websites.

However, those who had visited sites (n=233) were likely to judge them as helpful (as rated on a five-point scale ranging from not at all helpful to very helpful; Figure 26). Only a small minority of respondents found the websites to be not at all helpful (n=5). Four out of these five respondents were from Ireland, with the other from Italy. Those who owned their own property were more likely to have visited the websites than those who rent (Chi-square test p=0.008). Older respondents were found to be less likely to visit the website, not only those in the over 65 age category (Chi-square test p<0.001), but even in the over 45 age category in Italy. Gender and language fluency had no influence on visiting the websites.

[4] In Scotland, SEPA have information about flooding on their website as well as flood risk maps (www.sepa.org.uk/flooding.aspx). In Ireland, the OPW have a website with information about flooding (www.flooding.ie) and another website showing previous flood history (www.floodmaps.ie). In Italy, Several websites are available at municipality, river basin or regional level such as that by the Protezione Civile del Comune di Roma (www.protezionecivilecomuneroma.it). Finland's environmental administration has a hydrological forecast website (www.environment.fi/waterforecast) as well as a flood mapping page (www.ymparisto.fi/tulvakartat).

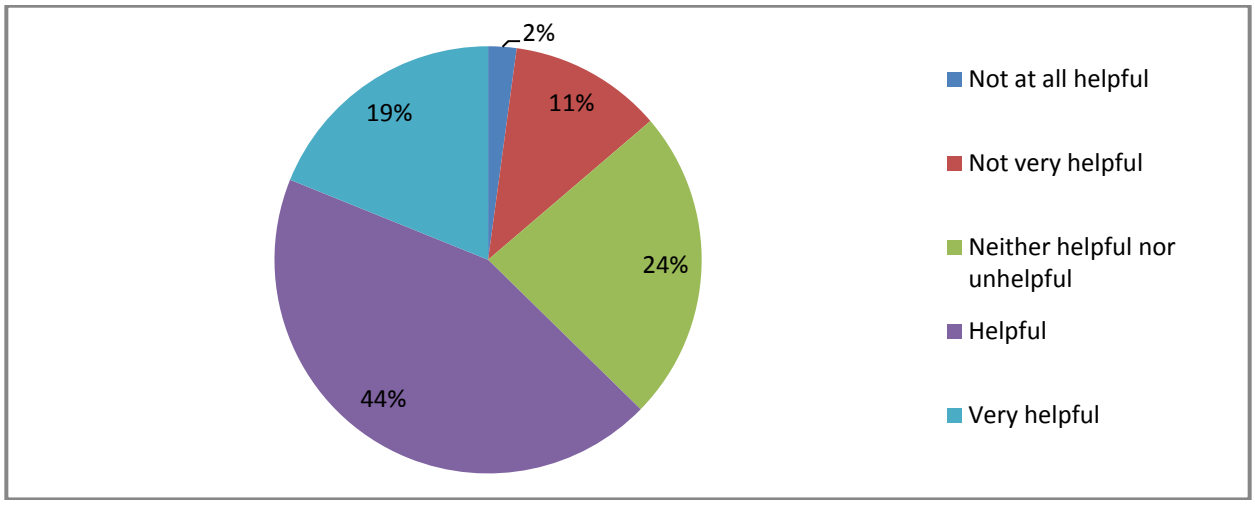

Figure 26 Helpfulness rating of websites on flooding (n=215), question asked to respondents who had viewed websites in Finland, Ireland, Italy and Scotland.

Perceptions of different types of precautionary measures

To further investigate the views of the public at risk regarding pre-flood preparedness, the importance of various precautionary measures was explored in both Finland and Italy. Flood warnings and flood communication were rated as extremely important by the public at risk within both these countries, and over 90% of respondents felt these precautions were either important or very important (Figure 27). Flood-banks and other protective measures were also thought important. However, respondents rated their own precautionary measures as less important than the other measures.

There was also the highest amount of uncertainty in this category with almost 10% (n=52) choosing “don’t know” when asked to rate the importance of this option. These results indicate that the public at risk may place more responsibility on the authorities to warn, communicate and protect their properties, than they place on themselves. Respondents who own their own property were found to rate the importance of flood-banks and flood warnings higher than those who rent ($t=-2.4$, $df=506$, $p=0.016$ and $t=-3.05$, $df=511$, $p=0.002$ respectively).

Respondents who felt they were more prepared for flooding rated their own precautionary measures more important, than those who felt less prepared (1-way Anova, $F=5.944$, $p<0.001$). This suggests that increasing respondent’s perception of their own responsibility for flood protection will increase preparedness levels. No difference was found between those who have and have not been flooded and their idea of the importance of the above measures. The same is true for those who feel they are living in a flood risk area. However, in the Italian sample, the amount of the importance of “people own precautionary measure„ decreased where they had past experience of flooding or where flood risk perceptions had increased: this could suggest a decreasing sense of self-efficacy to cope with a flood in case of bigger flood events, at least in some countries. There was no significant effect found of ownership of residence on the perceived importance of pre-flood communications or their own precautionary measures, whilst gender and age also had no influence.

Summary

There is a strong desire for more information related to flooding. Existing sources such as websites may not be known, but the websites are popular when visited. Individuals were less likely to rate their own precautionary measures as important, versus other precautionary measures such as flood warnings, or floodbanks. Furthermore, these individuals were also less likely to feel prepared. This suggests that it may be useful to raise awareness of the importance of self-preparedness and empowerment, when promoting resilience with communities in at risk areas.

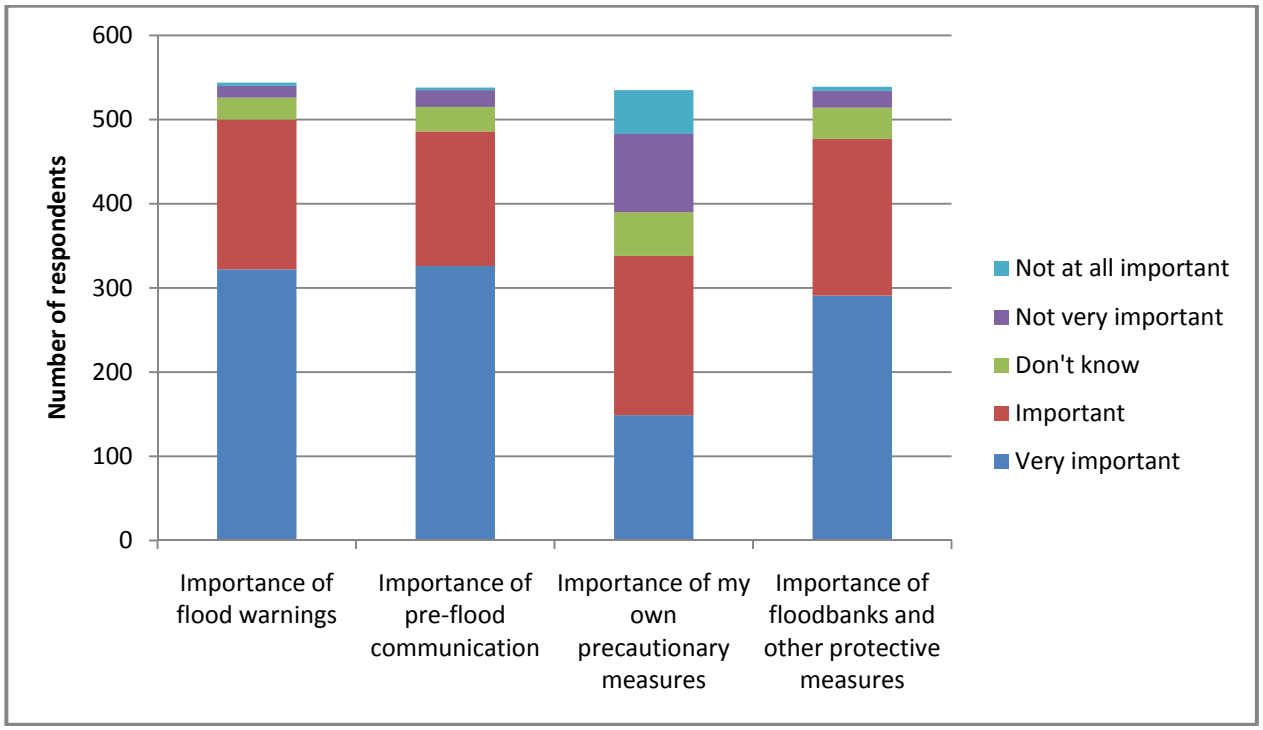

Figure 27 Importance rating of various precautionary measures (n=607), question asked to respondents in Finland and Italy.

Preferences for communications about floods

Preferences for methods of communications were investigated across the case study areas. Communications about floods are not always given through methods that the public at risk might prefer.

Preferred sources of information

In every country, messages about floods might be heard in a variety of ways: for example television is commonly cited as source of information. However, respondents in Ireland, Scotland and Italy were asked from what sources they would *prefer* to receive information on floods. Common options asked in all three countries included TV, radio, internet, phone call, SMS, email, in-person visit and other. The option of a loudhailer was given in both Ireland and Scotland, while brochures and leaflets were given as an option in both Ireland and Italy. Respondents could choose as many options as they felt appropriate. Figure 28 shows that radio is preferred by the largest number of respondents (n=529), followed by an in-person visit (n=506). Phone calls and information on TV were more popular than SMS messages and emails. The internet was the least popular source of flood information (n=200). In Finland the respondents were asked about their sources of information. and their primary source. The questions were separated in a slightly different way, for general information about floods and operational directions during the flood. In both cases the radio was listed the most preferable and TV and newspapers as the second preferred. The differences between different options were small. When asked to evaluate the utility of different sources, all of the sources were considered useful, but the radio was rated the most useful (rather than newer technologies such as SMS and Internet). In-person visits were not rated as particularly useful. This supports that flood communication must rely on many different means.

To further investigate communication methods, respondents in both Ireland and Scotland were asked to choose their most preferred communication method from the same list of options. Figure 29 illustrate that an in-person visit was the most popular method both for hearing about flood warnings and for receiving information on what actions to take. Phone calls and SMS messages were also popular, with phone calls being more suitable for information on preparation and SMS messages suitable for flood warnings. Again,

the internet was the least popular option. TV was particularly popular in Italy, where not only did 58% of respondents view TV as the primary source of information, but 78% selected it as the preferred source.

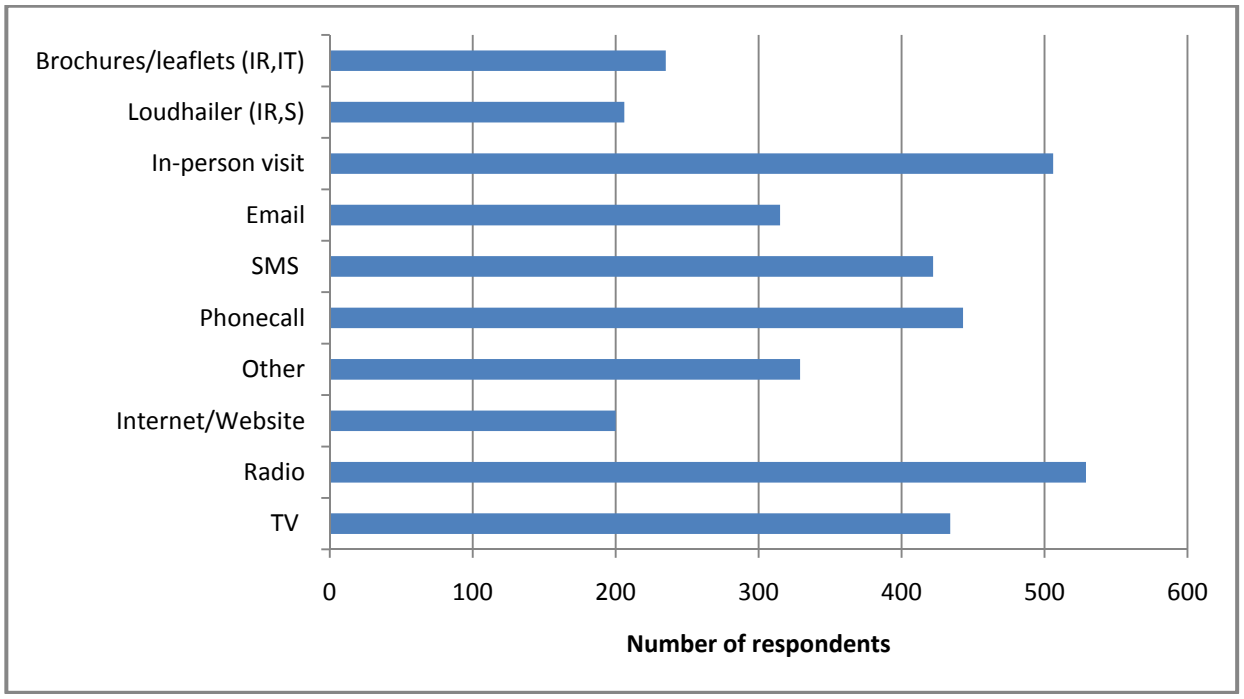

Figure 28 Preferred communication methods for hearing about a flood warning (n=817). Question asked in Italy, Ireland and Scotland.

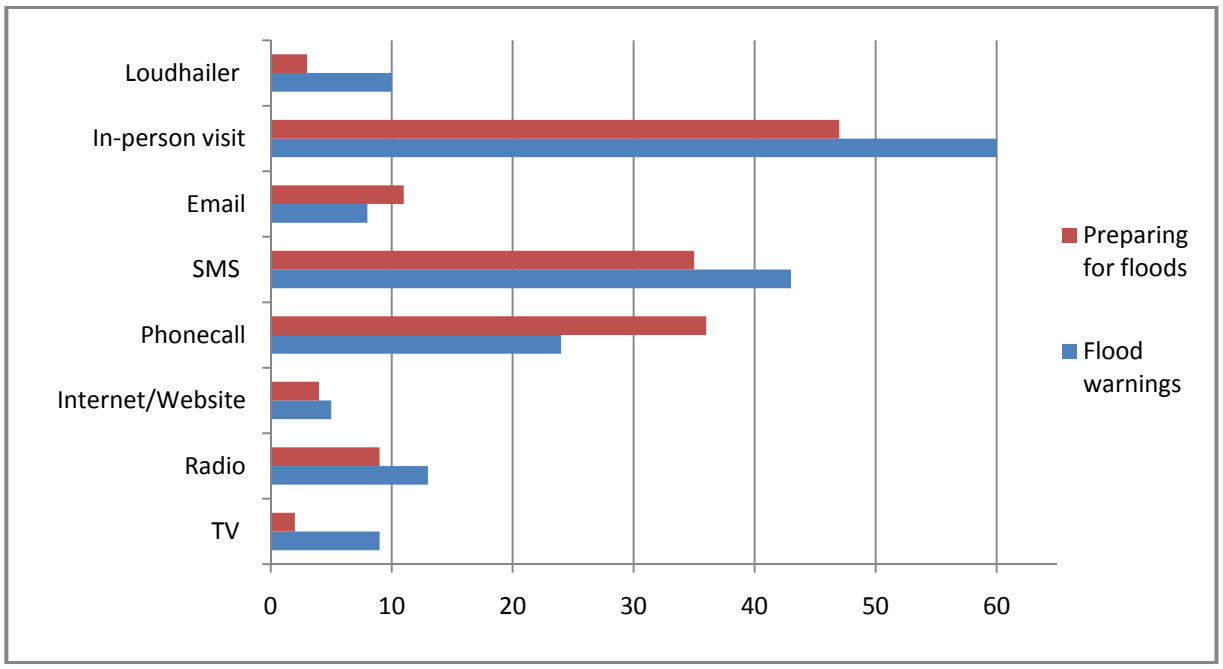

Figure 29 The single most preferred communication source (n=180), question asked in Ireland and Scotland.

Factors affecting preferences

Multiple socio-demographic factors influenced choice of preferred methods for the Italian, Scottish and Irish sample. For example, those who preferred TV tended to be women (Chi-square=9.6, df=1, p=0.002), and with less language fluency (Chi-square=18.3, df=1, p<0.001), younger (t=-4.2, df=782, p<0.001), and less educated (t=-3.5, df=777, p<0.001). Those who preferred internet tended to be younger (t=-5.3, df=785, p<0.001), and employed full-time or part-time (Chi-square=17.6, df=7, p=0.014). Those who would prefer a phone call tended not to speak English/Italian as a first language (Chi-square=4.9, df=1, p=0.027) and to have a lower education level (t=-3.5, df=777, p=0.001). Those who preferred SMS tended to be younger (t=-4.6, df=762, p<0.001), and employed full-time or part-time (Chi-square=21.4, df=7, p=0.003). An in-person visit was more likely to be preferred by women (Chi-square=7.2, df=1, p=0.005). Brochures and leaflets were also more popular with women (Chi-square=8, df=1, p=0.004), as well as those who were younger (t=-2.6, df=785, p=0.01) and more educated (t=2.5, df=777, p=0.012). Those who are older are more likely to prefer loudhailers. Having received a previous warning had no significant effect on any of the methods above. In general, younger people preferred new technologies. For example, in Italy, people aged 18-35 were more likely to prefer technologies as sources of information (such as internet or e-mail), although other sources were still popular for this group.

Summary

Taken altogether, this sample of the multiple demographic links with preferences shows that no one method can reach 'all the people all the time'. There is no one method of communication that is preferred across or within countries. This may suggest that multiple methods should be employed in order to target a greater range of people and maximise uptake of messages. These methods should include radio, in-person visits, phone calls and SMS messages. Methods such as the internet, emails and loudhailers should not be depended upon as these methods were not found to be as preferable to the public at risk.

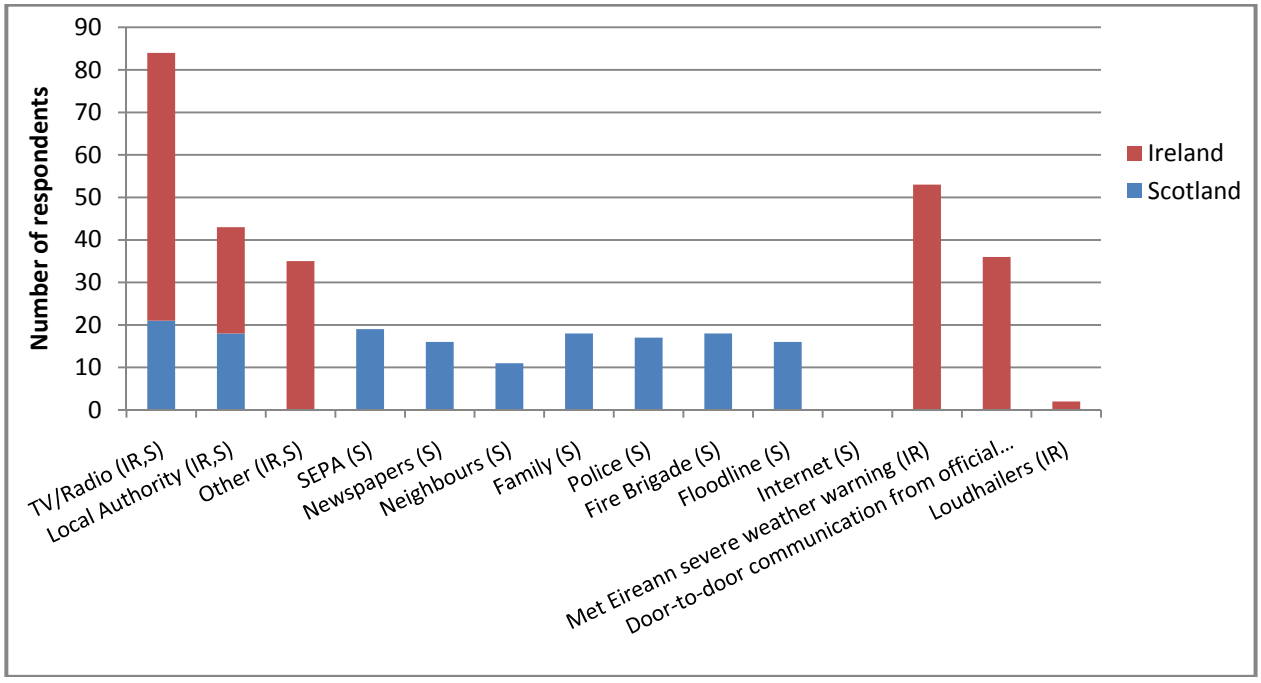

Figure 30 Sources of flood warnings recalled (n=187) question asked to respondents with experience of flooding in Scotland and Ireland. Options presented to respondents varied between countries: 'S;' identifies those options given in Scotland, and 'IR' those options given in Ireland.

Recall of past flood warnings

450 respondents in Scotland and Ireland answered a question about if they recalled receiving a flood warning before the last major flood event (this question was not asked in Finland or Italy). Of these, 133

respondents had received a warning (30%) while almost 50% (n=220) had not (the Scottish questionnaire also gave the option of "don't know" of which 97 respondents chose). Those respondents who recalled receiving a warning, were asked from which sources they had heard warning information. Respondents were given several options to tick. The largest category ticked was TV and radio (Figure 30) whilst in Ireland Met Eireann was particularly often identified as a source.

Various factors were compared with those who received a warning to investigate whether there were more vulnerable groups being excluded from receiving warnings. It was found that those living in bungalows and flats or apartments were more likely to receive a warning than other building types. Detached and semi-detached houses were the least likely to receive a warning (Chi-square test $p<0.05$). There was no effect of residence-ownership, age, language fluency, employment status, level of education or gender. Those who received flood warnings did not rate the amount of information that is available regarding flood warnings any higher than those who did not receive any warning.

Summary
Multiple sources of information, both formal and informal, are remembered by those who recall hearing flood warnings. However, it is important to identify if these correspond with those sources which people perceive to be reliable and/or trustworthy.

Processing flood warnings
In order for the public at risk to process a warning effectively, they must trust the source of warning, find the source to be reliable and also comprehend the warning message. These aspects of processing flood warning by the public at risk were investigated across the case study areas.

Evaluating trust and reliability
For the public to heed a message it is important that they trust the source and believe the message to be important and relevant. In Ireland and Scotland, respondents were asked to rate the trustworthiness of the national body (OPW in Ireland, SEPA in Scotland), the local authority and the emergency services. Respondent often had moderate to high levels of trust in all of the agencies, but in all countries they placed a greater amount of trust in emergency services over local and national bodies (Figure 31). Even if trust is high, reliability is also needed in order for the public to respond to the warning (for example, perhaps an individual may trust their neighbour but not necessarily believe them to be a very reliable source of information on flood risk). We therefore used a separate question to probe perceived reliability of different sources, but found these ratings followed a similar pattern to those for trust. As the public must perceive a source of flood warnings as both trustworthy and reliable, in order to respond appropriately, these results suggest that a warning coming from the emergency services could produce a better response from the public.

Factors affecting evaluations of trust and reliability
Previous flood experience was found to have an effect on the trust and reliability rating of the national and local agencies. Those who had been previously flooded, tended to have a lower level of trust and reliability in both the national and local bodies ($t=-3.3$, $df=245$, $p=0.001$). Previous flood experience was found to have no effect on trust in the emergency services but it did lessen perceived reliability ($t=-2.1$, $df=516$, $p=0.036$), perhaps because those who have been flooded realise no agency can make perfect predictions or perfect responses in emergency situations.

Respondents who recalled receiving a warning had a bit more trust in the local authority ($t=3$, $df=303$, $p=0.003$) and felt they were more reliable ($t=3.4$, $df=319$, $p=0.001$). They also felt the national body was more reliable ($t=2.4$, $df=300$, $p=0.016$). Whether respondents had received a warning or not had no significant effect on trust in the national body or trust or reliability of the emergency services. Respondents with a third level of education or higher (18+) placed more trust and reliability in all three agencies than those with lower levels of education. Perception of living in a flood risk area had no effect on trust and reliability of these agencies within this sample. Other factors that had no effect include ownership of residence, being a small business owner, speaking English as a first language, having visited either of the flood information websites, type of building lived in, age and employment status.

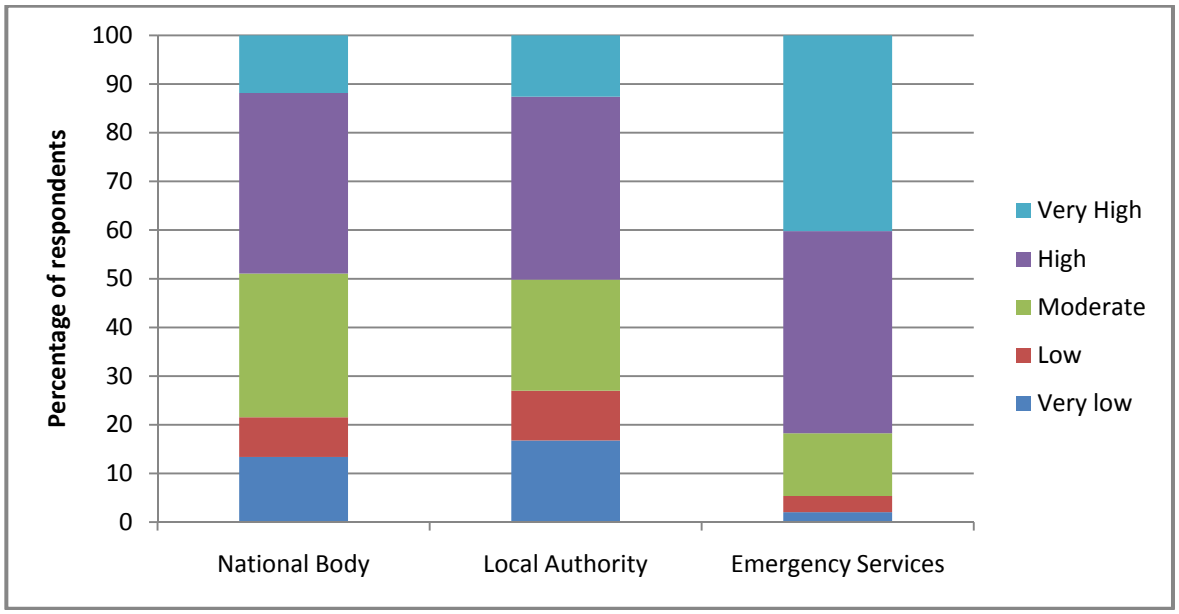

Figure 31 Rating of trust in public agencies (n=548), question asked to respondents in Ireland and Scotland. National body =OPW in Ireland and SEPA in Scotland.

These results suggest that if warnings are to be disseminated by the national and local authorities (as is currently often the case in Ireland and Scotland) the perceived idea of trust and reliability in both the national and local bodies needs to be strengthened. This should be focused on those who have been flooded (especially those who did not receive any warning), males and those with lower levels of education.

Interactions with agencies related to flooding

In addition to the public trusting the source and believing the message to be relevant and reliable, it is also important that agencies involved in flood management listen to the concerns and needs of the local people during a flood event.

Overall, there was frustration with the perceived accessibility of agencies: when respondents in Ireland, Scotland and Finland were asked whether in general, they felt that authorities listened or were accessible, a larger proportion did not agree (30% compared to 26%). 44% did not know. In Finland the respondents were asked how they feel different local parties (the city of Rovaniemi, rescue workers, voluntary organizations, hydropower company, environment authority) had handled flood related matters before, during and after floods and also flood related communication. The answers most often favoured the rescue authority together with the environment authority for both general flood related-issues as well more as specifically for flood communications.

Following on from assessing trust and reliability of the national body, local authority and emergency services in Ireland and Scotland, these respondents were asked if they had tried to speak with any of these bodies, and if so, to evaluate how well the agencies had listened to them (with answer options being “ignored me”, “listened a little” and “listened well”). The local authority (n=193) was the agency most contacted by respondents, followed by the emergency services (n=161). Only 73 respondents tried to contact the national body. Although the local authorities were contacted more often than the emergency services, respondents gave a better rating to the emergency services, who were judged to have “listened well” by 65%, and “listened a little” by 30%. The national bodies were found to have the least amount of positive communication with the public at risk in this sample. Not only did far less respondents attempt to contact them, almost a third of those who did try and contact them felt ignored. The national bodies also had the smallest percentage of those who felt they listened well (20%).

Summary
Respondents' feelings on how they felt they were listened to, were directly related to trust and reliability. Those who felt listened to by the national bodies and local authorities were far more likely to give higher trust and reliability ratings for the same organisations (1-way Anova, $F=20.3$, $p<0.001$). Interestingly this had no effect on trust and reliability of the emergency services. These results indicate that improving communication between the public at risk and the authorities involved may improve trust and reliability and therefore improve responses to flood warnings. Associating flood messages with agencies that are already perceived as trustworthy and reliable may also be useful. No demographic factors were found to have an effect on feeling listened to by these authorities.

Processing and understanding terminology
For the public to process a flood warning, they must understand the terminology used in the message. There is also a certain amount of uncertainty involved which must be conveyed clearly. The terms in existing use: Terms such as "a 100 year flood", a "flood with a 1% annual exceedance probability", a "1 in 100 flood" and "a flood with a 1 in 100 chance of being equalled or exceeded every year" are often used in flood communications.

Respondents evaluation of their own understanding of terms
The public at risk's comprehension of these terms was therefore investigated. For example, respondents in Ireland, Scotland and Italy were asked if they knew what a 100 year flood was. In addition to this, respondents in Ireland and Italy were asked whether they thought they understood the other three terms mentioned above. Figure 32 indicates that the public at risk feel that they understand the term "100 year flood" better than the other three terms, whilst 65% of respondents did not understand "flood with a 1% annual exceedance probability". This term should therefore not be used in flood communications to the general public.

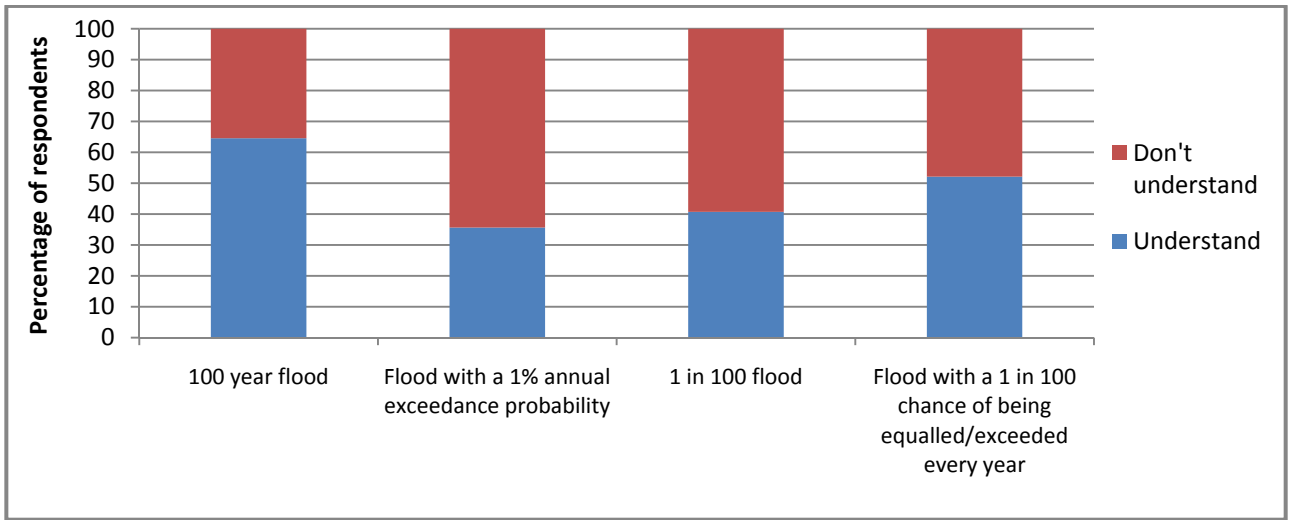

Figure 32 Respondents rating of their understanding of terms associated with flood risk communications. All terms presented to respondents in Italy and Ireland (n=589). First term also presented in Scotland (n=683).

Confidence and understanding
To further investigate understanding of these terms, respondents in the four case studies across Ireland were presented with a test. They were asked "if the following floods were to happen today, when do you think they would happen again", with the options being "will happen in 100 years time" and "could happen any time". If respondents chose the first option, it was deduced that the term was not understood properly. In Finland this test was done by presenting the statement "a 100 year flood will not occur in my lifetime". If respondents agreed with this statement, it was deduced that they did not fully understand the

term. These "tests" were carried out in Ireland for all four terms and in Finland for the more commonly used terms, the "100 year flood" and a "flood with a 1% annual exceedance probability". They showed that although over 60% of respondents in Finland and Ireland claimed to understand the term "flood with a 1% annual exceedance probability", less than 40% actually understood it (Figure 33). These results further support the earlier recommendation that this term should not be used in flood communications to the general public. More educated groups, and men, may have more confidence in using both terms, but no actual difference in their actual understanding.

In Scotland, respondents were asked to self-rate their own confidence in understanding of the term, and a large proportion were not fully confident. These findings suggest some terms are better understood than others. The term "100 year flood", for example, is probably better understood than the "flood with a 1% annual exceedance probability". However, the public's interpretation of "a 100 year flood" cannot be taken for granted and it is best that the meaning is spelt out, wherever possible.

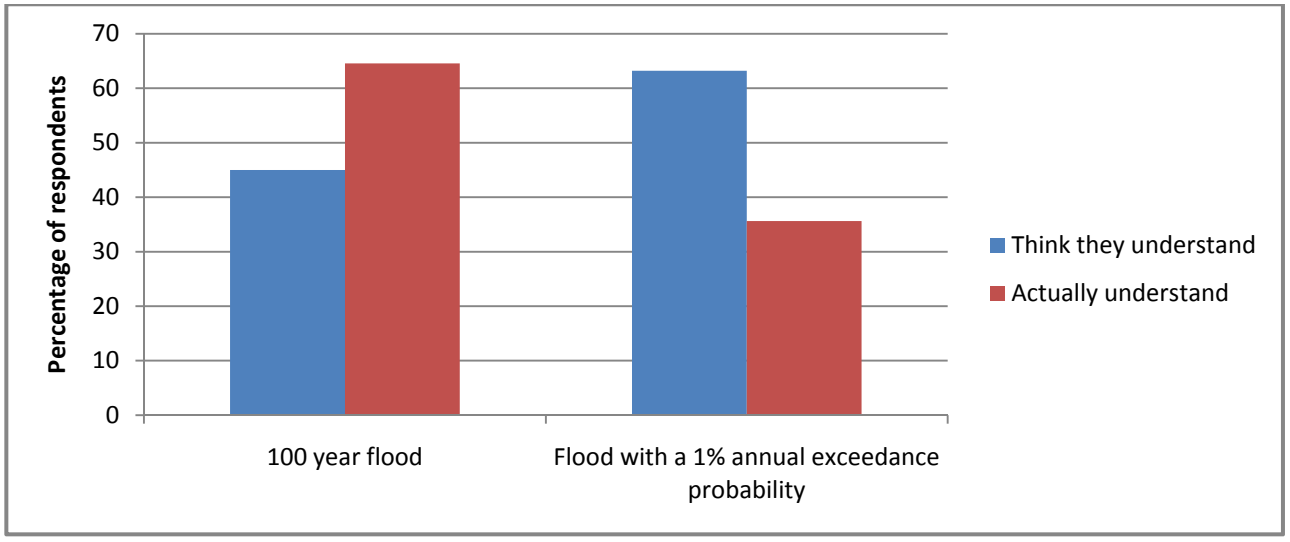

Figure 33 URFlood team's rating of whether respondents in Finland and Ireland actually understood two phrases associated with communicating flood risk (n=572).

Effect of previous experience of flooding

Previous flood experience was found to have no effect on whether respondents thought they understood the terms "100 year flood", "flood with a 1% annual exceedance probability" or a "1 in 100 flood". However, it did have an effect on actually understanding the terms, i.e. passing the test described above. Those who had been flooded in the past were found to be more likely to pass the test for both the "100 year flood" term (Chi-square=8.7, df=1, p=0.03) and the "1% annual exceedance probability" term (Chi-square=5.2, df=1, p<0.001). They were also found to be more likely to think they understood the term "a flood with a 1 in 100 chance of being equalled or exceeded every year" (Chi-square=5.9, df=1, p=0.015). Similar results were found for those who felt they lived in a flood risk area. This suggests that people without flooding experience – even if living in a flood risk area – are particularly unlikely to understand these terms as intended if they are used in warnings.

Further to questions about specific terms, several questions understanding of the concepts used in flood communications such as probability and assessment of risks was investigated. Respondents in Ireland and Scotland were asked to agree or disagree with several statements such as "I do not understand talk about probabilities" and "I understand how risk is assessed". There was also a statement regarding technical jargon used by authorities in the Irish, Scottish and Finnish questionnaires. The majority of respondents felt that they understand talk about probabilities (60%, n=296) and how risk is assessed (51%, n=253). In relation to the question about technical jargon used by authorities, the results were more

evenly spread. 38% of respondents felt that authorities do not use too much technical jargon, but 29% felt they did (the remaining 33% did not agree or disagree with the statement).

Factors affecting understanding
Women were less likely to declare understanding of terms relating to probabilities ($t=-2.7$, $df=477$, $p=0.008$) and how risk is assessed ($t=2.5$, $df=475$, $p=0.012$). They were also more likely to feel that authorities use too much technical jargon ($t=-2$, $df=786$, $p<0.05$). Given the previously observed lack of gender difference in understanding, this probably may reflect gender differences in confidence expressed.

Those with lower levels of education were less likely to declare understanding of probabilities (1-way Anova, $F=11$, $p<0.001$) and how risk is assessed (1-way Anova, $F=3.1$, $p<0.05$). Employment status was found to have an effect on understanding of probabilities; unemployed, retired or homemakers were less likely to declare an understanding of these concepts (1-way Anova, $F=2.7$, $p=0.01$). A similar trend was found for understanding how risk is assessed.

Summary
For the public to process a flood warning, they must understand the terminology used in the message. The results of this survey indicate that the term 100 year flood should be used above the term a 1% annual exceedance probability. More information should be given on explaining these terms as over 35% of this sample did not understand the former term, increasing to almost 60% for the latter. This information should be focused on: those who have no experience of being flooded, those with lower levels of education, those that are unemployed or retired, those with lower levels of the country's first language and perhaps also women.

Reacting to flood warnings
Theory suggests that individuals receiving new information may seek to share, discuss and add to it, as well as taking action. We therefore explored responses that had been taken by those flooded previously.
Who talks to who?
On first receiving a flood warning, often the first reaction is to talk to someone about this. This concept was investigated in both the Irish and Scottish case studies where respondents were asked to choose from a list (which included both agencies linked to flooding and members of their community) and asked who they would tell if they heard a warning about a flood in their area. The largest group selected were neighbours (42%) followed by family and friends (33%). Far fewer selected their local authority (16%) relevant national body (5%). Only 1% said they would not discuss the information with anyone.
This relates to the natural way in which information is shared by members of communities at risk, but may also relate results in the previous section where national-level bodies were thought slightly less reliable, trustworthy and open to communication than local authorities.

Actions taken
Respondents in Ireland and Scotland who had been previously flooded were asked to choose from a list, the actions they took during the last major flood. Common options given in both questionnaires and the corresponding number of respondents who chose these options are shown in Figure 34. Putting sandbags, flood-boards or flood-gates in place was the action most taken by respondents (n=128), followed closely by watching the water levels (n=122). Items of sentimental value were moved or protected more often than costly items such as fridges and furniture. Blocking toilets was the action least carried out by respondents (n=21). A large number of respondents (n=144) sought further information by listening to the TV or radio or by contacting friends and family for advice, suggesting a strong desire for more information. Helping neighbours was the third most common action to be taken during the last major flood (n=82), suggesting how community capacity can be important during flood crises.

In a related question. Finnish respondents were asked if they had taken any measures in a past flood risk situation. Approximately 65% of the respondents had taken no actions, and 35% of those who had experienced the last major flood event in 1993 had been bad. Only 24% judged that they had been well prepared and 41% did not know or could not estimate their preparedness.

Comparing past actions to hypothetical actions
Questions relating to what the public at risk think they might do if they received a flood warning were asked in order to compare this to what the public at risk actually did during the last flood. In Ireland and Italy these questions could be answered by all respondents, while the Scottish questionnaire aimed these questions at those who had not been flooded previously. These answers about hypothetical responses revealed more options tended to be selected than had actually happened during the last real flood.

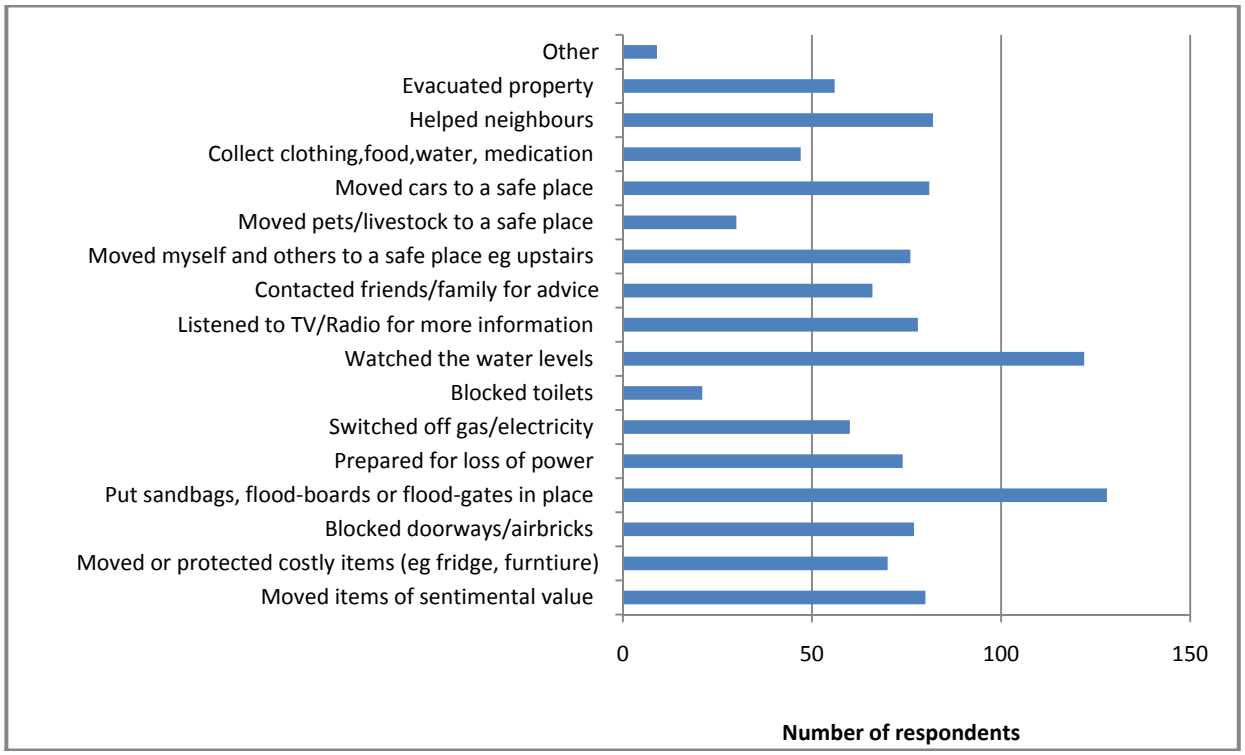

Figure 34 Actions taken during the last major flood, question asked in Ireland and Scotland (n=187).

Summary
At risk communities are generally not well prepared for flooding, but despite this individuals may over-estimate their preparedness, or their ability to remember and implement all options during the panic of a flood event. This lack of awareness of preparedness could act as a barrier to attending to flood communications. Reminders and even practice runs /drills might be of assistance in closing the gap between theory and reality.

5.1.2.3 Summary of findings and conclusions

The majority of respondents within this sample had been previously flooded and therefore thought they were living in a flood risk area. There were however, a large number of respondents who felt they were at risk even though they have not experienced flooding. There were also respondents who have been flooded in the past who do not feel at risk to flooding indicating a level of residual risk in communities. Knowledge of the flooding process and perception of the causes of flooding was explored by asking respondents what they thought the causes or sources of the last major flood were. Flooding from intense rainfall was found to be the biggest problem, followed by flooding from rivers and overflow of drains. A flood defence breach was not seen to be as important. The public at risk therefore require more information regarding other types of flooding such as groundwater flooding and flood defence breaches, especially those who may not have experienced flooding in the past.

Issues of concern felt by the public at risk were explored. The public at risk within this sample are more worried about flood risk in their local area than they are to both flood risk in the regional area and flood risk concerning their own homes. Worry concerning respondents' own homes was lower than worry towards both the local and regional areas. The results are however, dependent on previous flood experience; those with a greater amount of worry tend to have been flooded before.

The majority of respondents felt that they were not prepared for flooding. Current preparedness levels were found to be related to previous flood experience. Those who have been flooded previously often have a higher level of preparedness than those without flood experience. Interestingly, perception of living in a flood risk area was found to have no influence on preparedness levels within this sample. This indicates that increasing awareness about flood risk may not have an effect on the public being prepared. The vast majority of respondents had not visited the flood information or flood mapping website in their respective country. However, the majority of respondents who had visited either of the sites in any of the four countries found the information to be helpful. Those who had visited either of the websites were found to rate the availability of information about flooding in the respective country higher than those who had not which again, again suggesting the helpfulness and the quality of information available on the websites. However, those who had visited the websites did not feel significantly more prepared for flooding, than those who had not visited.

Flood warnings and flood communication were found to be extremely important by the public at risk. Flood-banks and other protective measures were also found to have high importance. Respondents' own precautionary measures however, were found to be less important than the others, indicating that the public at risk may place more responsibility on the authorities to warn, communicate and protect their properties, than they place on themselves.

Specific Outcomes

There are some common patterns in what affects perception and reaction to flood communication, across countries. Perceptions of trust and reliability in agencies affect how messages are judged. Many want more information, but information that employs technical terms may be understood differently than intended. Multiple sources are needed to communicate with all sectors of society.

Lessons Learned

A single questionnaire will not be suitable for use in multiple countries (due to multiple socio-cultural differences and sensitivities). However, with careful preparation it is possible and useful to cover common topics for joint cross-national statistical analysis.

The public at risk place a greater amount of trust and reliability in emergency services over local and national bodies. As the public must trust the source of flood warnings in order to respond appropriately, these results indicate that a warning coming from the emergency services would produce a better response from the public, during times of flood. Previous flood experience was found to have an effect on trust and reliability. Those who had been previously flooded tended to rate a lower level of trust and reliability in the national and local bodies, but not the emergency services. Respondents who had received a warning had more trust in the local authority and felt they were more reliable. The results suggest that if warnings are to be disseminated by the national and local authorities (as is currently often the case) the perceived idea of trust and reliability in both the national and local bodies needs to be strengthened. This should be focused on those who have been flooded (especially those who did not receive any warning), males and those with lower levels of education. In addition to the public trusting the source and believing the message to be relevant and reliable, it is also important that agencies involved in flood management listen to the concerns and needs of the local people during a flood event. Local authorities were contacted

regarding flooding more often than the emergency services; however, respondents gave a better rating to the emergency services. The national bodies were found to have the least amount of positive communication with the public at risk in this sample. Respondents' feelings on how they felt they were listened to were found to be directly related to trust and reliability.

For the public to process a flood warning, they must understand the terminology used in the message. The results of this survey indicate that the term 100 year flood should be used above the term a 1% annual exceedance probability. More information should be given on explaining these terms as over 35% of this sample did not understand the former term, increasing to almost 60% for the latter. This information should be focused on those who have no experience being flooded, those with lower levels of education, those that are unemployed or retired, those with lower levels of the country's first language and perhaps also women.

Actions that the public at risk in this sample thought they might do more often than was actually done in the last major flood include moving items of sentimental value as well as costly items, preparing for loss of power, listening to the TV or radio for more information and collecting clothing, food, water and medication. Actions that were taken more often in practice than respondents thought they might take include blocking doorways or airbricks, putting sandbags, flood-boards or flood-gates in place and watching the water levels.

The majority of respondents felt that they do not get enough information about floods. Respondents also felt that it would be good to have more information about uncertainty in flood warnings. Current methods of receiving information often include mainly TV and radio. Respondents in this sample would like to receive information through radio and in-person visits. The internet was the least preferred method, although those who had visited agency websites about flooding generally found them useful. Preferences can vary by country: for example, in Ireland the most preferred method for both a flood warning and for information on what actions to take was an in-person visit, but it was not a popular option in Finland.

Several demographic factors were found to have an effect on the choice of methods preferred by respondents. Therefore, numerous methods should therefore be used in order to target a greater range of people. These methods should include radio, in-person visits, phone calls and SMS messages. Methods such as the internet, emails and loudhailers should not be depended upon, or not used solely, as these were not often preferred by communities at risk. Preferences will always vary between groups within communities, as well as between cultures and countries, so it is not possible generalise a single 'best' method for communicating about floods, or flood warnings.

5.2 Developing new communication processes: guidelines framework

Following the survey research, the URFlood project team aimed to identify and develop a framework to be used as an aid for agencies responsible for flood risk communication. This framework is presented here. (this corresponds to the work for Work Packages 5). It builds on results from desk top reviews of best practice and the current state of flood communication in the partner countries (from WP2 and WP3; section 1). Further to this, the framework is based on extensive case study research of the public at risk to various types of flood events in the partner countries (WP4; section 5.1). This method follows a "people-centred" and "knowledge systems" approach as it takes into consideration the public at risk and how they understand flood risk information. The framework is presented as a series of 8 guidelines developed from an identification of barriers and facilitators to effective flood communication processes.

In the course of analysing and summarising the trans-national findings, the URFlood project team noted a number of factors and observations that seemed to promote effective communications, together with a number of potential problems for communication. We begin here by summarising these 'facilitators' and 'barriers'. These provide the basis and rationale for the guidelines which follow (5.2.3).

5.2.1 Facilitators of effective communication

Perception of risk: A large number of respondents within the sample felt they were at risk even though they have not experienced flooding.

Flood experience: Those who have been flooded previously often have a higher level of preparedness than those without flood experience.

Quality of information available: The majority of respondents who had visited agency websites found this quality of information helpful.

Flood communication: Flood warnings and flood communication were found to be extremely important by the public at risk.

Trust and reliability: The public at risk place a greater amount of trust and reliability in emergency services over local and national bodies. As the public must trust the source of flood warnings in order to respond appropriately (e.g. Fordham & Ketteridge, 1995), these results indicate that a warning coming from the emergency services would produce a better response from the public, during times of flood.

Receiving previous warnings: Respondents who had received a warning had more trust in the local authority and felt they were more reliable.

Using preferred terminology: The results of this survey indicate that the term 100 year flood should be used above the term a 1% annual exceedance probability.

Information on uncertainty: Respondents felt that it would be good to have more information about uncertainty in flood warnings.

Using preferred communication methods: These methods should include radio, in-person visits, phone calls, TV and SMS messages.

Using numerous communication methods: Several demographic factors were found to have an effect on the choice of methods preferred by respondents. Numerous methods should therefore be used in order to target a greater range of people.

5.2.2 Potential barriers to effective communication

Residual risk: There were respondents who have been flooded in the past who do not feel at risk to flooding indicating a level of residual risk in communities.

Lack of concern: Worry concerning respondents' own homes was lower than worry towards both the local and regional areas.

Lack of preparedness: The majority of respondents felt that they were not prepared for flooding.

No knowledge of information sources: The vast majority of respondents had not visited the flood information or flood mapping website in their respective country.

Perception of responsibility: Respondents' own precautionary measures were found to be less important than flood warnings, communication, flood-banks and other protective measures indicating that the public at risk may place more responsibility on the authorities to warn, communicate and protect their properties, than they place on themselves.

Previous flood experience: Those who had been previously flooded tended to have a lower level of trust and reliability in the national and local bodies.

Lack of positive communication: The national bodies were found to have the least amount of positive communication with the public at risk in this sample. Respondents' feelings on how they felt they were listened to were found to be directly related to trust and reliability.

Not understanding terminology: More information should be given on explaining terminology as over 35% of this sample did not understand the term 100 year flood increasing to almost 60% for the term a 1% annual exceedance probability. This information should be focused on those who have no experience of flooding, those with lower levels of education, those that are unemployed or retired, those with lower levels of the country's first language and perhaps also women.

Information availability: The majority of respondents felt that they do not get enough information about floods

Using unwanted communication methods: Methods such as the internet, emails and loudhailers should not be depended upon, as these methods were not found to be as preferable to the public at risk.

Based on these, a framework of guidelines was developed to encapsulate the main implications for flood communications. The guidelines were based on common patterns across all 4 countries, and so should be widely applicable in these countries and beyond.

5.2.3 Framework of guidelines developed for testing

We identified eight interrelated guidelines, based on the barriers and facilitators to communication identified from the questionnaire analysis. Since these guidelines were created based on cross-national findings, we therefore expected these should be applicable to all case studies in our report and beyond throughout Europe.

The proposed guidelines were presented as being equally significant, i.e. with no particular order:

- Give more information on how to prepare for a flood (ideally locally or personally tailored)
- Provide more information on floods (simple and complex)
- Develop understandable statements on risk (jargon may not be understood as intended, or simply off-putting)
- Use multiple channels of communication (to reach different people in different situations)
- Make the responsibility of authorities clearer to the public/ Link with high profile trusted agencies •for raising awareness
- Create lines of communication between authorities and the public (combine new technologies with personalised touch)
- Continue to develop and raise awareness of current information source (i.e. repeat campaigns over time)
- For communities at high flood risk, trial preparedness, warnings and response through testing (action prompts and consolidates learning)

Below we reflect on the original survey findings that support each guideline. All guidelines were developed by identifying a barrier and corresponding opportunity for flood communication from case study research (see section 5.1).

Guideline: Continue to develop and raise awareness of current information sources
Underlying barrier: Lack of knowledge on current information sources.
Underlying opportunity: The information that is available is of good quality.

Case study analysis showed that the vast majority of respondents had not visited the flood information or flood mapping websites in the partner countries. However, the majority of respondents who had visited the sites in any of the four countries found the information to be helpful. These information sources need to be promoted in order to educate and inform the public, which will lead to heightened awareness and preparedness of the public at risk. A higher percentage of those who had visited the websites showed higher levels of preparedness. The same can be said for awareness campaigns. Only 18% of respondents in Ireland were aware of the 2005 “Plan, Prepare, Protect” campaign, although the campaign was deemed helpful by a large majority of those that did remember it. Awareness campaigns should be repeated over time. In addition to this, improving the competence of the media representatives about floods would increase the distributing of correct information. This is important as the media can give a wide coverage, influencing many people.

Guideline: Use multiple channels of communication
Underlying barrier: An over-reliance on websites and single types of communication does not meet the needs of all people.
Underlying opportunity: Use preferred and multiple communication methods.

From an analysis of case study data, several demographic factors were found to have an effect on the choice of methods of flood communication preferred by respondents. Numerous methods should therefore be used in order to target a greater range of people. Preferred communication methods across countries include radio, in-person visits, phone calls and SMS (mobile phone text) messaging. These methods did however, vary from country to country. For example, in Ireland, respondents preferred brochures or leaflets being delivered over radio announcements; whereas in Italy the opposite effect was found, although TV was the most preferred option for Italians. Similarly, TV, radio and newspapers were found to

be the most important sources of information in Finland, while Scottish respondents outstandingly preferred phone calls and SMS messaging. There seemed a marked preference for oral forms of communication in Italy, with SMS being the only written form with a degree of preference similar to TV and radio. In general, the least preferred communication methods across countries include the internet, emails and loudhailers. Within the Irish sample, less than 9% of respondents had visited the national flood information site (www.flooding.ie), while less than 7% had visited the Flood Hazard Mapping site (www.floodmaps.ie). Other forms least preferred by Irish respondents include a scrolling message at the bottom of a TV screen and information on teletext. The use of oral communication over written communication was found to be a facilitator to flood communications in Italy.

Guideline: Give more information on how to prepare for a flood
Underlying barrier: Lack of preparedness and perception of responsibility.
Underlying opportunity: Importance of proactive flood communication and being aware of what actions to take

The majority of respondents studied felt that they were not prepared for flooding. In addition to this, many did not act appropriately during the last flood. Case study analysis showed that those who have been flooded previously often have higher preparedness levels than those without flood experience. Information on how to prepare for a flood should therefore be particularly targeted at residents who may be at risk but have not yet been flooded. In Finland, for example, actual preparatory actions such as personal preparatory actions and town planning were not considered as useful by the public at risk. This indicates that the benefits of the preparatory flood risk assessment and planning may not have been properly outlined to them. Furthermore, flood communication seems to appear as mostly crisis communication to both authorities and residents in Finland, with proactive flood communication is perhaps not felt as important; resulting in less effort being given. Relating to this, when considering what proactive measures are useful, individuals at risk often ranked their personal preparedness lower than other measures, such as the construction of floodbanks. Therefore, providing information about how to prepare for a flood may be necessarily prefaced and accompanied by messages emphasising the need for personal action and responsibility in preparedness.

Guideline: Provide more information on floods
Underlying barrier: Poor knowledge of or access to available information, not understanding flooding processes.
Underlying opportunity: Requests for more flood communication and information on uncertainty.

The majority of respondents in the Scottish and Irish case studies felt that they do not get enough information about floods. Furthermore, flood warnings and flood communication were found to be extremely important by the public at risk in Finland and Italy. Respondents in the various countries felt it would be good to have more information on uncertainty in flood warnings and had a high level of confidence in their ability to understand probability and the assessment of risk. Information on floods should therefore include details of uncertainty, probabilities and risk. In addition to this, flood defence breaches and groundwater flooding were not seen as major causes of flooding by the public at risk. More information should therefore be given to the public at risk regarding other types of flooding such as groundwater flooding, focussing on those who may not have experienced flooding in the past. The importance of preparation for floods may be strongly made by telling people about successful experiences, to encourage empowerment rather than denial. Individuals should feel they can do something by themselves and that they have the support of their community.

Guideline: Develop understandable statements on risk
Underlying barrier: The public at risk not understanding commonly used flood terminology.
Underlying opportunity: Use of preferred terminology.

More information should be given on explaining terminology or changing terminology used altogether. For example the term “100 year flood” was more understandable than “1% annual exceedance probability”:

that over 35% did not understand the former term “100 year flood” and almost 60% did not understand the latter.

This information should be focused on those who have no flood experience, those with lower levels of education, those that are unemployed or retired, those with lower levels of the country’s first language and perhaps also women. Terms with more understandable and simpler language should be used. It may be relevant to consider and borrow terms with a common usage in other fields or sectors: or example, how probabilities are described in gambling.

Guideline: Make the responsibility of authorities clearer to the public/ Use emergency services in raising flood awareness
Underlying barrier: Some existing sources of information are not as clear and as trusted as for example the emergency services or community groups where they exist.
Underlying opportunity: High trust and reliability of emergency services.

The public at risk of flooding in the case studies placed a greater amount of trust and reliability in emergency services over local and national bodies. As the public must trust the source of flood warnings in order to respond appropriately, these results indicate that a warning coming from the emergency services would produce a better response from the public during times of flood. The reason emergency services are so trusted may be that they are present ‘on the ground’ in flood situations, carrying out concrete tasks such as helping people. Making the responsibilities of each authority clearer to the public would increase the overall trust in authorities.
Originally the guideline was developed as “Make the responsibility of authorities clearer to the public”. This guideline was tested in Italy and Finland and revised to include the addition of “Use emergency services in raising flood awareness”. The revised guideline was tested in Finland, Ireland and Scotland.

Guideline: Create lines of communication between authorities and the public
Underlying barrier: Lack of positive communication and co-operation between authorities and the public.
Underlying opportunity: Feeling of being listened to increases trust.

Upon receiving a flood warning, the majority of respondents within the Scottish and Irish case studies said they would tell their neighbours, family and friends. Few would tell the emergency services, local authorities or national bodies. National bodies were found to have the least amount of positive communication with the public at risk across the Irish and Scottish samples. Respondents’ feelings on how they felt they were listened to were found to be directly related to trust and reliability. In Finland, respondents did not have positive experiences of co-operation with authorities during a flood. They felt that increasing interaction between themselves and the authorities would improve the situation.

Guideline: For communities at high flood risk, trial preparedness, warnings and response through testing
Underlying barrier: No perception of personal responsibility in addition to a lack of preparedness by the public at risk.
Underlying opportunity: Proactive flood communication leads to an awareness of what actions to take.

A big barrier to communicating information about flooding and flood warnings is that many in at risk communities may not appreciate that they are personally at risk, or that they can personally play a role in preparedness. Furthermore, past experience in actions taken (or not taken) implies that many of those who think they are prepared may not sufficiently prepared to react during a flood situation. The literature also encourages a focus on when and how to take action. Therefore, a flood drill or simulation may be necessary to build resilience, to make such individuals aware that they need to be better prepared for a flood. A drill could help those who are interested to know more. but unsure what to do. And, as indicated under previous guidelines, there is some lack of understanding as to the roles and responsibilities of the various agencies involved as well as a lack of access to information on flooding. A trial of preparing and responding to flood warnings (i.e. a flood drill) in vulnerable areas would help to identify how communications are being translated into actions.

5.3 Testing new communication processes: reflections on guidelines and specific actions

After the guidelines were created, they and specific ideas for their implementation were discussed and tested with various stakeholders in each of the partner countries. (This work corresponds with WP6.) Stakeholders' responses to each of the guidelines are summarised below, per guideline: hence, there may be repetition with earlier material from the survey (section 5.1), or overlap between guidelines, according to what stakeholders reported.

5.3.1 Summary of testing methods

The guidelines were tested on various stakeholders involved in flood risk management as well as the public at risk. Mixed methods were used to do this.

In Scotland, two discussion groups were held. The first included 14 members of the Scottish Flood Forum which consists of a range of representatives including local authorities, national agencies, emergency services, government, researchers and people from flood impacted communities. The second discussion included 12 members of the local flood action group in Moffat, consisting of the public with either a direct experience of flooding or an interest in helping reduce the risk to the community in the future. A further interview was carried out with a national representative of First Responders. In Italy, the public at risk were interviewed in both Rome and Vibo Valentia, with 50 people in total studied. In addition to this, 24 'experts' were also interviewed, chosen from the authorities involved in the flood risk area, such as Civil Protection, Fire-Fighters, Municipality of Rome, Municipality of Vibo Valentia and the Department of Geological Services. Finland held two discussion groups or workshops with regional environment authorities working with floods as well as flood experts from Ministry of Agriculture and Forestry, Ministry of Transport and Communications, Ministry of Social Affairs and Health, Finnish Regional Councils, Finnish Meteorological Institute, Association of Towns and Municipalities, Finnish Environment Institute, and Centre for Economic Development, Transport and the Environment. In addition to this, 10 questionnaires were sent to the public at risk in Rovaniemi. The Irish testing focused on the public at risk, with 13 in-depth interviews being carried out with those living in flood risk areas in Dublin. In total, the testing consisted of 4 focus groups, 74 interviews and 10 questionnaires. It involved all stakeholders including authorities, emergency services and the public at risk.

5.3.2 Summary of testing results, by guideline

This section summarises the key discussion and survey results from testing. The results are structured by guideline, although there is of course overlap between the topics. Since the original justification for the guidelines was generally agreed with, and to some extent reiterated by testing responses, there may appear to be some duplication of the text in section 5.2.3. However, the text is based on the testing and also contains details of suggested actions and ideas that arose during testing (although there can be no single solution for implementing any part of guidelines framework).

Full details of the testing results are contained in a dedicated testing report. This will be available from the URFlood website from autumn 2011, or available on request from the project coordinator.

Guideline: Continue to develop and raise awareness of current information sources
It was identified during testing in Ireland, Italy and Scotland that promoting current information would not be useful to those who are not aware of or are indifferent to flood risk. In addition to this, local people may feel that they know the river and local environment well and so don't need further information. Without any awareness of flood risk, people will be unlikely to seek out, process or register information regarding flooding and flood preparation. Despite past efforts, case study results indicated it was likely that in every

country there would be some people in this category of "blissful ignorance". Special efforts must therefore be made to target this group of people to create an initial awareness of the possibility of flooding. These people are likely to be those with no flood experience or those flooded a long time ago. In terms of the current information that is available, respondents in the various partner countries felt that it was often too generic and not local enough, could be "too official" and not "practical", is not always up-to-date and is not useful during a crisis. It was generally felt that there is not enough information provided and that current mass notifications are not effective.

Suggestions for implementation
Respondents suggested that in order to improve current information in terms of quality, quantity and efficacy, relatively simple measures can be carried out. These include tailoring information to local needs and using more current or "up-to-the-minute" information. Respondents felt that available information should include more crisis information in a more attention grabbing format as well as including supplementary information such as cleaning and maintenance of the river. Routes to finding the information also need to be clear. For example, it was identified in Finland and Ireland that sources of information are behind a complex path or cryptic URL that is difficult to remember. Providing simple URLs can usually be easily achieved. Respondents in the partner countries suggested a variety of approaches to promote current information sources. In Ireland and Scotland it was suggested that promotion could be done through local people such as community flood groups, community consultations or residents associations. Buying and selling houses in flood risk areas was also seen as an opportunity to promote current information through "Home Reports" or insurance companies. Respondents throughout the partner countries felt that mass media communication could be utilised further such as TV, radio, newspapers, leaflets and links from other relevant websites such as traffic information, bus services and weather forecasts that people often use during times of extreme weather.

The timing of promotional initiatives was considered important in Ireland and Scotland. For example promoting information during wet weather, when large scale floods are reported in the news, or on anniversaries of previous floods. Emergency services and coast guards were identified as being useful for promotion of current information in Scotland and Ireland respectively. It was identified through testing that there are problems with the effectiveness of current information due to the public not trusting authorities and therefore the source of information. This may be due to the perception that there is a lack of co-operation and cohesive approaches between authorities, a lack of interaction between authorities and the public and the public feeling neglected by the authorities. In addition to this, the public are not aware of which authorities to contact. In order for the public to utilise current information sources they must first trust the authorities and be aware of their respective roles and responsibilities.

Guideline: Use multiple channels of communication
There was recognition in the testing phase that with the rapidly developing world of communications, there is a new methods can be used in addition to more traditional communication channels. However, problems identified included resource and cost restraints. Respondents also felt that even with multiple channels of communication, individuals have prejudices and misunderstandings and may still interpret information incorrectly. Further perceived problems were identified with some past experience with authorities. The public at risk in Ireland especially, thought that authorities don't care enough, are not prioritising the public and use websites for dissemination only in order to "cover themselves". More direct communication was also considered important.

Suggestions for implementation
Respondents in the partner countries also felt that co-operation between the authorities and the media needs to be improved in order to use the media more efficiently in disseminating flood warnings and information. This could include educating the media regarding floods. Suggestions for useful methods of communication included mass media, printed brochures, articles in local newspapers, through flood officers, information lines and daily points of access such as car park spaces screens. An emphasis was put on more trusted communication methods such as using people from the community (sometimes called 'gatekeepers'), residents associations, meteorological institutes or through local councillors. Such ongoing activities might also link to the media, enhancing their messages.

Guideline: Give more information on how to prepare for a flood
It was recognised in testing in the various countries that a lack of risk perception and awareness can lead to the public at risk ignoring information provided on how to prepare for flooding. It was argued that people do not live in expectation of flooding, even if they are aware that the risk exists. This may be due to the perception of flooding as a "rare" event. The existence of residual risk was also identified as an issue, with those living near structural flood defences feeling protected from all future floods. Increasing awareness of risk and the public's perception of individual responsibility in terms of protecting themselves is therefore essential. In addition to this, respondents felt that citizens do not always understand the basics of flood protection, while the authorities perceive it to be common sense and that people should know what to do.

Again, there were perceived problems with the authorities relevant to flood communications. Respondents felt that authorities deal with flooding in a reactive way and do not consider proactive methods such as education and preparing for flooding a priority. Lack of resources in delivering this information was also identified as an issue.

Suggestions for implementation
However, it is felt that proactive initiatives will save money in the future by reducing future damage. In order for the public to prepare for future floods, the benefits of doing so must be stressed. This could be done by working with insurance companies and emergency services to give personal advice on the benefits of preparatory measures. Financial benefits in terms of insurance prices and effects on property prices as well as the importance of protecting sentimental items should be made clear.

Local groups such as flood groups, community centres, residents associations or local councillors would be useful in this approach. Information on how to prepare for flooding should be tailored for different people such as the elderly, people living in one story accommodation, those with children etc. and should be provided through different media. Suggestions from respondents regarding the appropriate media to provide information on preparing for flooding include educational programmes in schools and communities, information leaflets, easily accessible websites, local libraries, personal connections with local media representatives, social networking sites such as Facebook as well as through TV, radio and newspaper advertisements. Twitter messages were not mentioned by respondents, but may become more important in future. The high cost of personal flood protection products such as floodgates was identified as a further problem. Authorities or local groups could work with these companies to get special rates on bulk orders for communities at risk.

Guideline: Provide more information on floods
Respondents in the testing phase agreed that there is not enough information provided about floods. It was felt that information should include the effects of climate change, the effect on property prices, descriptions of local flood history, stories of personal flood experiences, marks showing previous flood heights, details on current schemes as well as explanations of what current flood warnings are based on. This information should also be better targeted. However, problems were discussed in terms of resources, poor flood maps, problems with authorities and indifference. Respondents thought that flood maps should be visualised better, have more user friendly interfaces and be household specific. They felt that authorities did not listen to the public or consider their needs: considerint that they may think that the public already know everything about flooding, or if not, that the responsibility is on the individual to find out.

Suggestions for implementation
It was suggested that all public authorities with local responsiblities –such as regional planning authorities– should be given more information about floods and that emergency training should be developed. Indifference of the public at risk was identified as a potential problem. This is especially so in areas where flooding is not frequent, as people can have "short-term memories" when it comes to flooding.

Indifference may also arise as the public will not be interested in the processes of flooding or will "switch off" when they hear technical terms and descriptions. Too many flood warnings can also lead to complacency and a reduction in trust of the issuing authority. The information therefore needs to be prioritised and not all provided at once so that people do not feel overloaded with information.

To avoid overload, it was suggested that only information relevant to a particular stage of flooding could be provided at any one time. Also, flood information could also be provided frequently through different means. Examples of how to provide this information include articles in newspapers, by utilising the emergency services, through demonstration videos, interactive web-based games, brochures or leaflets delivered to at-risk areas, through local groups and residents associations, programmes on TV and other easily accessible sources. Potential approaches may even include educational programmes in schools.

Guideline: Develop understandable statements on risk
The difficulty of communicating risk to the public was recognised in the testing phase. A balance needs to be achieved between using simple enough language to be understood by all and using over-simplified terms that may reduce topic salience. As the concepts of probability and scientific expressions of uncertainties are difficult, people still may not understand, even when explained. Gauging people's understanding was also identified as a problem.

Respondents often felt that authorities are to blame for using terms that the public do not understand. It was felt that authorities are accustomed to technical language; utilising terms that have always been used due to a lack of consideration and understanding of the public's needs. It was also thought that authorities only use these terms to "cover themselves" and because they "sound good".

Suggestions for implementation
It was suggested that multiple statements should be developed and tested with different target groups from at risk communities, before using such phrasing in flood risk communications. A "layman" or non-technical person should look at any planned information for public use, and simplify it to suit the needs of the public. Statements need to be clear, direct, brief, focussed and contain simple language. Audio, video and imaging should be used and terms should be related back to previous floods. There also needs to be a balance between a sufficient explanation and providing too much detail. Risk terminology could be explained to people when buying a house in a risk area. Further contacts should be made available such as a contact centre, website or local group where additional information can be sought. The consistency of statements was also recognised as important.

Guideline: Make the responsibility of authorities clearer to the public/ Use emergency services in raising flood awareness
It was agreed during testing that the public are often not aware of the roles and responsibilities of the various authorities. The public at risk do not trust authorities and feel there is no collaboration or organisation between the various authorities involved. Lack of communication between authorities may exist due to administrative borders, especially in large watersheds. It was identified that the public are not interested enough in the authorities for the promotion of their roles and responsibilities to be worthwhile.

Problems in using emergency services to raise awareness were identified as the associated high cost, lack of resources and difficult logistics. Some respondents also felt that it was not the responsibility of the emergency services to raise awareness of flooding and that it was a waste of their time and resources.

Suggestions for implementation
It was suggested that authorities could discuss their work in the media and plan communication in order to improve collaboration. Respondents suggested that the concept of using emergency services to raise awareness could also be discussed between agencies and if the emergency services agree, trialled in some risk areas. Further suggestions were to utilise local groups and to focus attention on specific groups such as the elderly, people with disabilities and new residents. The use of more personalised information was also seen as important.

Guideline: Create lines of communication between authorities and the public
Past interactions have left the public at risk feeling ignored by authorities, leading to a lack of trust and further breakdowns in communication. Respondents in the testing phase often blamed authorities for their lack of collaboration, lack of initiative, for not taking the public into account and just doing the "bare minimum". Respondents felt that communication is not seen as a priority by authorities due to their reactive approaches to flood risk, with some respondents quoting "there is no attention until a disaster happens". Cost, resources and lack of labour were identified as further reasons for the lack of communication. In Finland, legislation was sometimes thought to also act as a barrier.

Suggestions for implementation
A clear gap was perceived between citizens and authorities responsible for communicating about floods. Trust and two-way communication can however, be built up through simple means, putting communities in a better position to further help themselves. Self-help groups could be built in at-risk communities or existing local groups could be used. Public events could be held and an information line could be set up. Existing channels such as social media, radio, TV, weather forecasts as well as contact through local councillors and on-the-ground services should be utilised. Lines of communication should be made visible to the public at risk.

Guideline: For communities at high flood risk, trial preparedness, warnings and response through testing
(The wording of this guideline was simplified to "Carry out a flood drill for high flood risk areas" for the Irish testing.) The resource intensive nature of such a recommendation was identified in the testing phase. Flood drills can be a huge undertaking with complicated logistics involved. Specifically, co-operation and organisation between authorities could prove difficult. Motivating the public at risk may also be difficult as they may not be interested or find it inconvenient. Some may not take it seriously while it may cause fear and worry in others.

Suggestions for implementation
If the previous guidelines discussed were successful, a flood drill might not be absolutely necessary. However, many respondents felt that a flood drill would be good to build up trust and communication between authorities and communities at risk as well as co-operation between the authorities themselves. It would illustrate where existing strengths and weaknesses occur by testing the entire process of preparedness, warning and action. Suggestions for implementation of this guideline included reviewing drills carried out elsewhere such as Exercise Watermark held in England and Wales in March 2011 and a 2006 dam-break drill held in Lake Kemijärvi and Rovaniemi, Finland. Pilots could also be carried out to test the concept in certain flood risk areas. Involving trained volunteers and local groups such as residents associations and community centres would engage the community. Evacuation drills and accessibility drills for sandbags were identified as useful aspects. A tailored approach to the local area focussing on more vulnerable members of the community was acknowledged as being important.

Specific Outcomes

It is possible to develop a general framework of guidelines which is applicable across sites and countries. However, implementation of the framework in any situation will depend on the pre-existing local context. Therefore, localised knowledge will be needed – not only of the systems and structures already in place, but of the experiences and perceptions of the public at risk.

Lessons Learned

When seeking to understand the views of the public at risk, it is challenging but important to seek out those who may not already have an interest in the topic, e.g. because they do not perceive themselves at risk.

5.3.3 Conclusions from testing and final guidelines framework

All eight guidelines were considered useful by respondents in each of the partner countries, further supporting the valuable and transferable nature of the findings. No guidelines were considered dispensable. As a result of the testing phase, which included discussion of which guidelines, if any, were most important in each country, the guidelines were given the following order of priority:

1) Use multiple channels of communication
(Important in Finland, Ireland and Scotland)
2 Continue to develop and raise awareness of current information sources
(Important in Finland, Ireland and Scotland)
3) Develop understandable statements on risk
(Important in Italy and Scotland)
4) Create lines of communication between authorities and the public
(Important in Ireland and Scotland)
5) Give more information on how to prepare for a flood
(Important in Finland)
6) For communities at high flood risk, trial preparedness, warnings and response through testing e.g. use drills
(Important in Italy and Scotland but least important in Ireland)
7) Make the responsibility of authorities clearer to the public/ Link with high profile trusted agencies
(Important in Scotland but least important in Finland and Italy)
8) Provide more information on floods
(Not most important in any country).

Although we have ranked the guidelines, we suggest that since they are all interrelated, they be presented as in Figure 35 on the following page, and all used by those developing effective communication plans.

In the text of this section (5.3) we note multiple actions or potential tools by which these guidelines might be implemented, according to suggestions discussed and offered during testing with respondents. For example, these ideas include flood drills, self-help groups, text messages, involving “lay people” consultants for agencies, building a presence on social media, offering personalised guidance, and creating links with existing key contacts (or ‘gatekeepers’) and organisations to build trust with agencies and capacity within communities.

We pick up on these suggestions for implementation, and the general implications of the guidelines for practitioners in the following sections (particularly section 7).

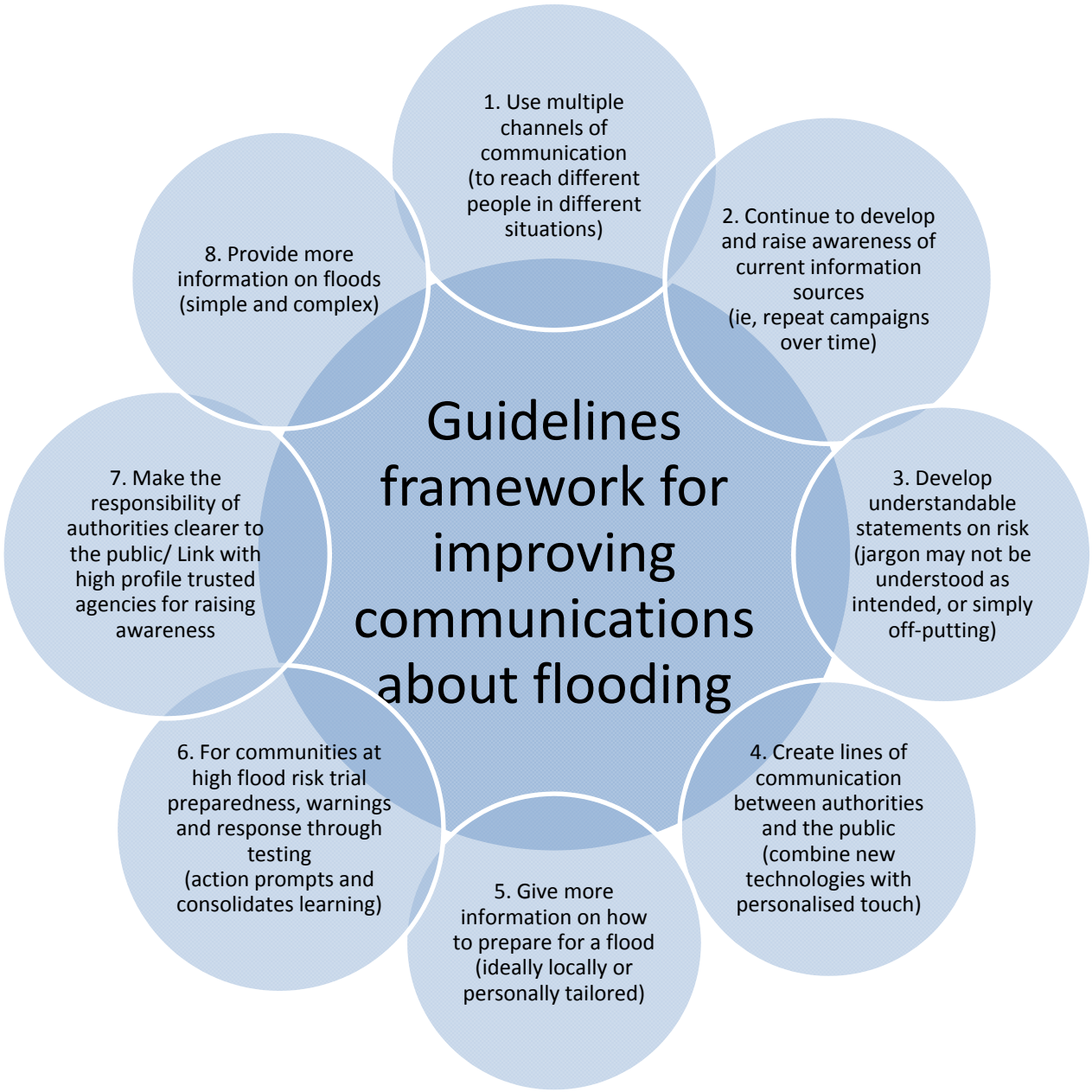

Figure 35 The final framework of eight guidelines for effective flood risk communication. The guidelines are numbered according to priority, but all interrelated.

The final guidelines make up a framework that can be used by agencies involved in flood risk management, in any European country, as a decision aid in developing or improving flood communication plans.

5.4 Summarising results by objectives

Our literature review, data collection and discussions are presented in an order intended to have narrative sense for the reader, highlight key findings, and facilitate comparability with other CRUE final reports. Therefore, the resulting report structure does not exactly match with the objectives as originally laid our in our plan of work (section 2), so here we briefly summarise our results by the objectives that were laid in our plan of work, and "signpost" where further information can be found.

Objective 1. Describe the knowledge systems which emergency responders, responsible authorities and members of the public use to make sense of flood risk information
On the basis of the literature review (section 1), we consider the key system to describe was that of the public, so in this report we mainly focus on key aspects of knowledge systems of the public.

In section 1.4 we present organograms created by this project, showing the designated links and responsibilities as understood by agencies. In section 5.1 we show a 'typical' public perception of these systems to confirm the literature's suggestion that public perceptions of the responsibilities, and where they get information from, is different, and considerable more 'messy' than the situation perceived by agencies.

Objective 2. Provide evidence of the way different actors respond to uncertainties in flood risk information and explore how and under what circumstances information on flood risk uncertainty is made sense of and related to responses
We confirm that the public understand uncertainty and risk differently to agencies or scientists: their understanding of roles and responsibilities, of terminologies and what are appropriate responses may not match with the expectations of agencies. Terms like "annual exceedance" are especially confusing, and though the public may have confidence with some other terms like "1 in 100 year flood" they may not always understand these terms as intended by the original sources. Care must be taken with all terms used associated with describing risk, or derived from the technical literature.

Different sectors of the public have different perceptions and experience: some vulnerable groups (e.g. some older or less educated people) and those not flooded before may be less likely to process communication and respond as intended.

Please see sections 5.1 and 5.2 for more information

Objective 3. Develop and test alternative tools for communicating flood risk that take account of knowledge systems and needs
We suggest a framework of eight guidelines for those developing flood communications (section 5.2)
We tested the guidelines in a mix of questionnaires and group discussions and interviews. These supported our suggestions and proposed guidelines (section 5.2-5.3).

We suggest specific ideas for practically applying the guidelines (see the end of section 5.2, and section 5.3). For example, combining new technology (automated phone warning-messages) with personalised approaches and flood drills may satisfy many of the recommendations (section 7).

See section 5.2- 5.3, and 7 for more information.

Objective 4. Illustrate where any mismatches between different knowledge systems are likely to have an impact on responses and community resilience. (This relates to objective 2.)
The public at risk give more prominence to messages they hear from within their community and the media than messages from agencies (section 5.1), versus the formal designated systems of agencies (section 1.4).

We note that differences within communities can cause different responses by different groups. Those who are not aware of the primary lines of communication set up by agencies (e.g. Floodline) will be less likely to receive information or know where to look for additional information. Those who have not been flooded may attend less to any messages about flood risk, preparedness or warnings.

We observe that neighbours and community contacts can play a key role in alerting/discussing flood warnings, assisting with flood responses, and hence contributing to community resilience.

Objective 5. Trial alternative communication methods that take account of different knowledge systems. (This relates to objective 3)
We tested some suggestions for communication methods in our survey of flood experiences and perceptions (section 5.2) and in testing of our guidelines (section 5.3).

Personalised approaches and contact (e.g. in-person visits) were a popular method in all countries, especially for advising about preparedness/actions to take. Phone calls and SMS text messages were also often popular.

Related to this, we note that agency liaison with community contacts and action groups can be an effective way of building community capacity for preparedness and effective reaction to flood events.

We observed that personalised warning messages to phone lines were popular where suggested or installed, but 'opt in' will not reach everyone at risk.

However, different people in different situations are likely to be sensitive to different sources, so a variety of sources of communication should always be used.

6 Contribution of the project to the overarching topics of the call

6.1 Connection to the Floods Directive

This project mainly contributes to the flood risk management plans that must be prepared under the EU Floods Directive (2007/60/EC). The Directive specifies the importance of flood risk management plans over flood defence measures. Our guidelines framework can be used across Europe, as should assist member states in preparing communication plans as part of their flood risk management plans.

The Floods Directive also stresses the importance of public participation and the need for a "people-centred" approach to flood risk management. A major part of this research has involved the public at risk, to assess their attitudes to flood risk and uncertainty.

6.2 Participation

Participation played a central role in the URFlood project.

6.2.1 Participation of communities at risk of flooding

Extensive quantitative research was carried out on stakeholders in the 11 case study areas across four countries. These stakeholders included residents and small business owners at risk to various types of floods (the 'public at risk'), including fluvial, pluvial and coastal floods. It also included those with residual risk. A guidelines framework was developed based on analysis of their views on various themes, including awareness of flood risk, their awareness of flood related communications and availability of information, the role of uncertainty in these communications, responses to flood warnings and how these responses could be improved. Our guidelines framework was also tested through engagement with the public at risk. Public engagement followed ethical standards: with all respondents anonymised and participation dependent on informed consent.

In this way, the URFlood project contributes to strengthening public participation in future flood risk management. The URFlood project followed a "people-centred" approach to flood risk management, by basing a communication framework on information received from communities at risk. The literature suggests that for a flood communication strategy to be effective, the public must be involved in the planning stages. The URFlood project work contributes to this. By producing guidelines that emphasise, amongst other things, the importance of community engagement and understanding, we also support future further engagement by the public at risk in Europe.

6.2.2 Participation of parties linked to flood risk communication

URFlood has also taken into account the interests of other potentially affected parties. There has been ongoing consultation with the relevant national bodies in each partner country, including the Scottish Environmental Protection Agency, the Irish Office of Public Works, the Finnish Government and the

Institute for Environmental Protection and Research in Italy. From the outset of the project liaison with these stakeholders was developed as they deemed appropriate: for example, in Finland and Scotland formal steering groups were established to discuss and comment on plans for research, meeting about twice per year in both locations. By contrast, in Italy there was a more informal relationship with the relevant parties, but a final meeting in Venice is partially a response to their needs.

It is hoped that the project can contribute valuable lessons to public authorities and institutions involved in flood communication. The project contributes to good governance by including the input of stakeholders in producing and improving flood risk management plans. There were no trans-boundary issues.

6.3 Harmonisation

Case studies across four countries within the URFlood project ensure a trans-national aspect. A common methodology with core questions was the approach taken in each case study, to ensure straightforward comparison of data collected. A database of all core questions from each of the case studies was be used in order to develop a trans-national flood risk management strategy. This cross-national database on experiences of floods and perceptions of issues related to flood communications is unique, and so the guidelines derived by it are cross-nationally relevant. Coordinating research across four countries allowed the total list of questions covered by the research project to be longer, versus the number of questions that could be feasibly tackled in any one country or case study.

In addition to the trans-national In addition to this, each of the individual countries has the option to analyse data to provide a national strategy; thus providing a balance regarding the drive for consistent, trans-national flood risk management strategies and the need for local tailor-made solutions. At a regional scale, implementation of the guidelines should always depend on knowledge of local society and existing flood communication processes.

6.3.1 Links with IMRA and FREEMAN projects

The topics of URFlood's research are particularly relevant to two other CRUE ERA-NET projects: IMRA (Integrative flood risk governance approach for improvement of risk awareness and increased public participation) and FREEMAN (Flood resilience enhancement and management). URFlood's programme of work was influenced by early findings and reviews presented at early CRUE ERA-NET meetings.

The objective of FREEMAN is to find ways to increase flood resilience, based on flood experience in the past. It particularly focuses on a) Risk perception and communication, b) Flood risk management tools and c) Analysis of flood institutions. The principal collaboration has been with FREEMAN as regards to its first area of work, and in the shared country of Italy. (There are no case studies from Ireland, Scotland and Finland shared with in any other CRUE ERA-NET projects.) In the early stages of the project the Italian partners selected as their second case study Vibo Valentia in conjunction with FREEMAN. (They have also worked on the Tiber, and that river is also a case study in the IMRA project). On 12th September 2011 the Italian URFlood partner will hold a joint meeting with FREEMAN and IMRA and agencies in Venice to present together and discuss links between work done in similar sites for the different projects.

The objective of IMRA is "to improve risk perception and the actual decision-making through active participation of responsible actors and the population three study areas of three European river basins". It aims to produce a Practical Handbook to promote effective risk management and communication strategies. We have had less formal links with this project, except for shared discussions at CRUE ERA-NET meetings, which informed the topics we explored in our case study work. However, we expect that the URFlood guidelines framework for effective communication of flood warnings could be a useful adjunct to IMRA's handbook or other outputs.

The principal academic output linking URFlood and FREEMAN is a joint research paper with FREEMAN project entitled "The Role of Flood Awareness and Risk Perception in Flood Management across Europe" to be submitted to a Special Edition of Natural Hazards Earth Systems Sciences Journal, September 2011. Moreover, a second joint research paper with both FREEMAN and IMRA entitled "Flood risk management in Italy: challenges and opportunities for the implementation of the EU Flood Risk Management Directive" will be prepared for the same journal special edition.

Finally, a book chapter has been produced jointly with the CRUE ERA-NET project RISKMAP, as a result of the literature review carried out at the beginning of the project and after an IMRA meeting where representative of the other projects where invited and met: Kuhlicke, C., Cini, F., Pugliese, E., Carrus, G. (in press). Risk perception and flooding. In Bernhofer, C., Schanze, J., Seegert, J. (Eds.), Textbook on Integrated Flood Risk Management. Springer, Berlin.

Reflection on links between the findings of these projects will be further discussed at the final symposium of CRUE ERA-NET in Graz, Austria, in September 2011.

6.4 Restrictions

The case studies chosen include a large range of social, socio-cultural-historical, legal, institutional, political and economic characteristics, both within each partner country and also on a trans-national level. The case studies were also chosen to include different types of flooding including fluvial, pluvial and coastal flooding, along with residual risk. The guidelines framework developed depended on general results found from the shared questions asked in each case study area, and we are therefore confident therefore that it applies cross-nationally, and for different types of floods. We expect there should be few significant restrictions from socio-political circumstances, or flood type.

However, we tailored methods in each country and case study according to local history, sensitivity and experiences. This means that not all questions were asked in exactly the same way, and different issues received different emphases in every country. This reflects that there will always be unique aspects of socio-cultural context that should be taken into account when researching these issues, as well as when deciding how to apply the guidelines.

6.5 Enhancement of Resilience

We define community resilience as a dynamic process of behavioural adaptation to an event with adverse impacts and is underpinned by the resources available (e.g. economic, human and social capitals). (We did not directly attempt to measure community resilience.) We argue that providing effective communications about flooding, both for preparedness and for warning, will contribute to community resilience by reducing the economic and human cost of damages caused by flood events (resistance to floods), and hence reduce the magnitude of recovery needed after flood events. Furthermore, any actions that build community capacity to prepare for floods and react to warnings, is itself likely to promote community cohesion and hence indirectly promote community resilience.

7 Implications for stakeholders

Our proposed framework of eight guidelines has implications for practitioners in the field of flood warning and flood preparedness, and for the policy-makers who support their work.

1) Use multiple channels of communication
2 Continue to develop and raise awareness of current information sources
3) Develop understandable statements on risk
4) Create lines of communication between authorities and the public
5) Give more information on how to prepare for a flood
6) For communities at high flood risk, trial preparedness, warnings and response through testing e.g. use drills
7) Make the responsibility of authorities clearer to the public/ Link with high profile trusted agencies
8) Provide more information on floods

In this chapter we discuss how the guidelines can be used by practitioners, the main stakeholders targeted by our work. (This section corresponds with WP7 on "Synthesising results".) By "practitioner" we refer to those agencies and their staff responsible for delivering communications about flood preparedness, and communications about flood warnings. Each of the points below is relevant to implementing the whole guidelines framework, not any particular guideline.

Combine new technologies with personalised approaches to reach a wide audience
There is a desire for the delivery of tailored messages (i.e. those specific to location, time and individual) yet messages must also be clear and preferably unambiguous. Many people also want more information. These goals and desires may easily contradict! However, we suggest that they can be best reconciled by two contrasting approaches. Firstly, new technologies (e.g. automated voice messages; AVMs) can offer warnings specific to location quickly, once set up. This is backed up by the popularity of the new 'Floodline' service in Scotland, which will deliver automated telephone messages direct to mobile phones and landlines, in the event of flood warnings being issued in their postcode area. However, these systems are typically 'opt in', these cannot be entirely relied upon. Furthermore, not everyone likes or uses the same technology.

The second approach is personalised visits, particularly for promoting flood preparedness. This can allow the most tailored advice. Although this can be staff-resource intensive, such visits can be tightly targeted at risk areas, and our research suggests that they are far more likely to be effective than less costly messages that are generic and ignored. Experience with the Scottish Flood Forum suggests that liaising with members of at risk communities can also provide a way for the community to build its own capacity to build preparedness, and particular community members can have a key role to play in spreading messages, particularly to vulnerable groups and those who might otherwise ignore messages about floods or from agencies.

Start with a people-centric approach when designing communications
Practitioners should recognise that public perceptions of the message content and sources are key to understanding how messages will be processed and reacted to. Messages may be received but will not be processed as intended if the language and terminology they use is not understood, or understood differently than intended by the senders. Therefore, wherever possible jargon and technical terminology should be avoided, instead using everyday terms and language. Any specialist terms that are used should be carefully picked based on public understandings, and brought to the attention of communities at risk before a flood event. It may be useful to do this as part of a conversation about the whole topic of uncertainty and risk in flooding, and when to take action, rather simply publicising definitions of terms.

An individual's evaluation of a sources (particularly its reliability and trustworthiness), will, rightly or wrongly, also influence how messages are understood and processed. In our study the emergency services were often perceived as the most trustworthy and reliable. Community and third sector organisations are also often trusted. If other agencies have responsibility for delivering messages, making new links to deliver messages via or in association with these agencies may be a worthwhile investment to help to improve uptake of those messages. Since the fire services in particular often already play a role in responding to flooding events, they may welcome the opportunity to play a role in promoting preparedness. Support for this comes from an analogous experience involving the fire service in the UK, where the fire services became involved in promoting the installation of fire alarms and fire escapes, successfully reducing the loss of life and severity of fire emergencies.

Establish and promote 'gateways' to information that are easy to recall

Many members of the public wish for clearer lines of communication and a clearer understanding of where to find more information. In this case, a single memorable telephone number or website (with a short url) may be most useful, being easy to recall in an emergency situation and/or also acting as a 'gateway' to other sources of information.

Promoting understanding of the roles of different agencies is useful but in a crisis (and even at other times) a member of the public often wants one 'port of call' to find out the information they need, or provide a link to other sources of information. Therefore, we suggest that any agency perceived by the public as having a role in flood responses, should be prepared to expect enquiries when information about flooding is issued, and field these enquires and/or transfer them to agencies best equipped to handle the enquiry or request for information.

Tailor communication approaches according to local context

Although our guidelines about flood communication are based on cross-national experience and so should be relevant across the EU, interpreting how to apply them will always depend on an understanding of the local situation, not only any existing measures for communicating about floods, but also the local perceptions and knowledge systems of communities at risk of flooding. For this reason, we anticipate that for some readers, some of our recommendations may seem unsatisfactorily conditional or vague, since we can not say that any single method or tool is the 'best' way of communicating flood warning messages. However, an essential point of our work is that there are no 'magic bullets' nor 'one size fits all solutions'.

Adopting the guidelines framework should promote effective flood communications but this must be combined with an understanding of a particular situation, and engagement with communities at risk, in order to identify the most effective approach to communication in a particular context. This will require collection of data about local communities (see section 8). The methods deployed in this project suggest that either qualitative or quantitative methods, or ideally a mixture of both, can be useful for collecting this data from communities.

Implications for policy-makers

The effective communication of information about floods is encouraged by and consistent with the requirements of the EU Floods Directive. National-level policy-makers should therefore support the above suggestions, to enable practitioners to achieve effective communications. To do this, they may be required to invest not only in creating new communication systems where none presently exist, but in adapting existing systems to improve clarity for the public. Policy-makers should consider how to encourage and resource data collection via community engagement, to ensure new systems are best tailored to their all sectors of society within their country.

In the next chapter (8) we discuss further implications for policy-makers, as well as discussing other potential issues for researchers, data collection and practitioners.

8 Policy recommendations (National/European level) and further research needs

Below we build on the previous chapter to suggest some areas that may be worthy of further consideration by practitioners, policy-makers, for data collection, and science.

8.1 Practitioner issues

There are three areas where practitioners may wish to check and reconsider existing skill sets and systems, to promote effective flood risk communications:

Build community engagement skills
The public often appreciate personalised guidance on how to prepare for floods. Therefore, practitioners should consider training in community engagement skills and principles of communication, to ensure that this guidance is appropriately delivered.

Consider and coordinate agencies involved in flood communication
Where there are multiple organisations and agencies involved in flood communications, these could consider if existing roles and responsibilities could be shared and/or reconfigured so that various forms of communications are perceived by the public to come from the most appropriate sources. Alternatively /in addition, a single outward-facing point of contact which links to further sources may assist.

Learn from experiences in other countries
Practitioners in countries without flood warning systems should learn from those that do have flood warning systems. For example, existing AVM systems (e.g. “Floodline” service in Scotland and Floodline Warnings Direct in England and Wales) offer useful lessons on how to best design and deploy similar systems elsewhere. Potentially, a database or portal to list and link experiences, could facilitate this cross-national learning.

8.2 Policy-maker issues

For national-level policy-makers, the main requirements are to enable and resource practitioners to effectively communicate flood warnings and information about flood preparedness:

Resource data collection need to design effective communication systems
National-level policy-makers must expect and resource data collection, as this is needed to ensure flood communications will be received and understood by all sectors of a community (see sub-section on data-related issues). However, although communication strategies should be evidence-based, the form of that evidence may be qualitative or quantitative, formal or informal: the key point is that views are sought via community engagement. To do this, policy makers may wish to encourage recruitment of practitioners with experience in community engagement.

Beyond the need for country-level tailoring, the particular experiences of communities in high-risk locations should be taken into account, since these will shape their evaluations of agencies involved and ultimately their responses to communications. Policy-makers may wish to consider if mandating an 'additional layer' of community engagement would be useful in these communities, perhaps involving support for responsible agencies or their partners to build and maintain personal contacts, deliver personalised advice and build capacity with community groups.

Formally encourage and support community engagement
For this reason it may be particularly useful to support responsible agencies to build and maintain personal contacts in at risk communities (e.g. to build capacity with community groups and/or to deliver personalised advice to households). At present, based on experience with the case studies in this report, we observe that personal contacts are often maintained informally, without official resourcing.

Promoting and enabling communications between agencies, authorities and support groups involved may help the effective delivery of messages and support smooth consistent communications with members of the public. It will be useful and may assist efficient allocation of resources to ensure policy is written to allow agencies, authorities and/or support groups the flexibility to link together to deliver communications as seems most appropriate for a particular situation.

Consider 'opt out' not 'opt in' flood warning systems
One of the limitations of automated voice messages (AVMs) to deliver flood warnings is that these systems are 'opt in'. This means those who are at risk but unaware of it, or unaware of the communication system, are particularly unlikely to be covered by an AVM. Enabling an 'opt out' system would greatly increase coverage of flood warning delivery, with particular benefit to hard to reach groups that may be uninterested or unaware of flood risk and/or warnings delivered by other methods. An opt out system could pose challenges for national and EU requirements for protection and use of personal data, and therefore this may require attention by national and European policy-makers. Opt out systems for organ donations exist in 24 EU countries: this is obviously quite a different topic, but does illustrate that opt-out systems are possible.

8.3 Data related issues

From what we have said, it is obvious that we consider some form of data collection essential for the creation of effective communication systems in every country:

Data on communities and their perceptions are needed in every country
Although our guidelines framework for flood communication are based on cross-national experience and so are relevant across the EU, interpreting how to apply them will always depend on an understanding of the local situation, of existing measures and of perceptions and knowledge systems held by members of the public. To get an understanding of local perceptions, research and engagement with communities is required, to ensure communication strategies are not based on erroneous assumptions. This suggests a certain amount of new data on community perceptions will need to be collected by every country seeking to design effective flood communications.

Understanding experiences in local areas may also be necessary
In our experience of working with communities, sometimes locally-specific issues could also be relevant: if an agency was perceived to have failed in some previous flood emergency (or unrelated event) this can badly prejudice how that agency and its messages will be perceived (or vice versa). A poor reputation can be hard to repair or overcome. For communities known to be at significant risk of flooding, it may be useful to check local perceptions of agencies that will be involved in flood communication and flood responses, and adapt.

Mixed methods can support the collection of these data
The topics covered in the questionnaires used in this study can provide useful guidance on topics to cover and questions to ask (available from www.macaulay.ac.uk/urflood). For example in any location it will be particularly useful to know what agencies and organisations are trusted, whose messages are perceived as reliable, if people in at risk areas are already worried about flood risk. These data can be elicited by formal surveys, or via careful engagement and exploration of these issues through discussions with community leaders and groups.

8.4 Scientific issues

As part of the Floods Directive, many countries will be initiating or amending efforts to build resilience with at risk communities, and this will inevitably entail communication about flooding. The current implementation of the Floods Directive therefore presents a unique opportunity for the social sciences and psychology of understanding and perceptions relating to risks and communication. For example, our experience suggest that a focus on the effect of past experiences on perceptions may be a fruitful new topic, and understanding how these effects might be remediated or tackled would be of practical relevance to informing future efforts by practitioners.

Long after a flooding event, the aftermath of flooding and its effects can cause tremendous stress, mental and physical health impacts (for example, in Scottish flooded communities, the Scottish Flood Forum has collected data which detail a wide range of damages and impacts to individuals and communities). However, effective flood communications should (together with other measures) promote preparedness and community resilience. It could therefore be important for future research efforts to track not only their impacts in the short term (i.e. actions taken during a flood event) but also in the long term (i.e. to explore if and how they reduce stress and health impacts and improve community resilience).

Tracking these efforts can improve our understanding of how communications are processed and risks are perceived, and hence inform future efforts to build resilience, as well our understanding of the concepts and theory relating to knowledge systems and communication.

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Summary of websites referred to in this report.

Information about related projects on flooding
Information about the Second CRUE Funding Initiative on Flood Resilience: http://www.crue-eranet.net
Information about URFlood: http://www.macaulay.ac.uk/urflood/
Information about FREEMAN: http://www.feem-project.net/FREEMAN/
Information about IMRA: http://www.imra.cnr.it/

Website of the FP6 project FLOODsite: http://www.floodsite.net/

Websites communicating flood information to the public
Finland
A hydrological forecast website www.environment.fi/waterforecast and a flood mapping page www.ymparisto.fi/tulvakartat are run by Finland's environmental administration.

Ireland
The site www.flooding.ie aims to enhance public access to information about flooding and contains information about preparation, protection, what to do in the event of a flood, what to do after a flood, who can help in a flood, as well as specific information for farmers and business owners. It can be accessed in three languages: English, Irish and Polish. The website www.floodmaps.ie contains Flood Hazard Mapping information.

Italy
Details of the Civil Protection System are available on the website of the National Civil Protection Department:
http://www.protezionecivile.gov.it/jcms/en/funzionale_idro.wp?request_locale=en
For the areas of Rome Municipality and the Province of Calabria, information is respectively provided by the Protezione Civile del Comune di Roma: www.protezionecivilecomuneroma.it, and Protazione Civile Calabria: http://www.protezionecivilecalabria.it/.

Scotland
Information about flooding is provided by SEPA: http://www.sepa.org.uk/flooding.aspx and includes an interactive flood risk map.
Their website also describes their automated 'Floodline' warnings system: http://www.sepa.org.uk/flooding/sepas_floodline_service.aspx .
The Scottish Flood Forum is a community-based Scottish organisation with experience in supporting and representing those affected by or 'at risk' of flooding: http://www.scottishfloodforum.org/

England and Wales
Information about flooding is provided by the Environment Agency: http://www.environment-agency.gov.uk/homeandleisure/floods/, This includes links to a flood risk map, and information about their automated system 'Floodline warnings direct: http://fwd.environment-agency.gov.uk/
DEFRA, with the Welsh Assembly Government (WAG), conducted a national emergency flooding exercise called 'Exercise Watermark' in March 2011. It tested the preparedness of England and Wales to respond to severe, wide-area flooding. Information about this major flood simulation exercise is at: http://www.exercisewatermark.co.uk

Acknowledgements

The researchers are grateful to the numerous residents of the 11 case study sites who agreed to take part in focus group discussions or to fill in questionnaires. As outlined in the case study fact sheets, in each country our work involved collaboration with numerous agencies, in addition to our funders. In Scotland we are particularly grateful to the Scottish Government, SEPA, Paul Hendy and the Scottish Flood Forum, and Fiona Watson of Huntly. In Ireland, we would like to thank the Office of Public Works, particularly Tom Bolger, Oliver Nicholson, Tony Smyth, Jim Casey, Vincent Hussey and Cyril Mc Carthy. We would also like to thank Jonathan Cooney of Clonmel Borough Council and Gerard O'Connell of Dublin City Council.
In Finland we thank the Ministry of Agriculture and Forestry; Centre of Economic Development, Transport and the Environment of Lapland; City of Rovaniemi; Kemijoki Oy; the Regional Rescue Service of Lapland; Thomas Banafa; Sonja Ignatius and Mikko Sane from the Finnish Environment Institute. In Italy,we are particularly grateful to ISPRA (and specifically in the persons of Stefano Mariani, Elena Giusta and Annelise Sambati). Moreover we are grateful also to ARDIS (Associazione Regionale per la Difesa del Suolo, in the person of Carlo De Santis); Protezione Civile (specifically the Department of Geological Service, Extra-department Office, Calabria Department, Municipality of Rome Department); Centro Funzionale Regionale of Lazio and Calabria regions and the Municipality of Vibo Valentia; the Fondazione Eni Enrico Mattei (in the person of Jaroslav Mysiak).

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Terms and Definitions

This section provides definitions of terms used by URFlood.

Term	Definition
Community	We define this all the people living in a particular area of place. However, it cannot be assumed that all these people share the same backgrounds, norms or understandings.
Community resilience	A dynamic process of behavioural adaptation to an event with adverse impacts and is underpinned by the resources available (e.g. economic, human and social capitals).
Flood risk	We define this as per the EU Floods Directive (2007) as the product of hazard (e.g. flood return period, depth and extent of flooding) and vulnerability (e.g. exposure and susceptibility of people and assets).
Knowledge system	We define a knowledge systems as a way of understanding the world and processing information to form knowledge. Knowledge systems are created from and based in information from a variety of sources (from culture, to observation, or formal learning). The perspective of a knowledge system implies that differences in how people understand a situation can derive from entirely different mindsets, not just differences in data held.
Risk	The product of hazard (e.g. flood return period, depth and extent of flooding) and vulnerability (e.g. exposure and susceptibility of people and assets).
Risk communication	This can be defined in many ways, but we follow the definition of Covello (1992): "The exchange of information among interested parties about the nature, magnitude, significance, or control of a risk". We also note that risk communication can be interactive and has dimensions focused on influencing behaviour rather than just providing information (for more detail see section 1.2).

Glossary of Acronyms and Abbreviations

ARDIS	Associazione Regionale per la Difesa del Suolo (Italy)
AVM	Automated Voice Messaging
CFR	Centro Funzionale Regionale della Regione Lazio (Italy)
CIRPA	Centro Interuniversitario di Ricerca in Psicologia Ambientale (Italy)
CRUE	Coordination of the research financed in the European Union on flood management
DEFRA	Department of Environment, Food and Rural Affairs (UK)
df	Degrees of Freedom (statistics terminology)
EA	The Environment Agency, England (UK)
ELY	Center of Economic development, traffic and environment of Lapland, Finland
FRAM	Flood Risk Assessment and Management under the EU Floods Directive
FREEMAN	Flood REsilience Enhancement and MANagement –a sister CRUE-ERA-NET project
FWD	Floodline Warnings Direct – a flood warning system in use in England)
IMRA	Integrative flood risk governance approach for IMprovement of Risk Awareness and increased public participation - a sister CRUE-ERA-NET project
ISPRA	Institute for Environmental Protection and Research (Italy)
JHI	The James Hutton Institute, Scotland (UK)
MLURI	Macaulay Land Use Research Institute (now JHI)
MMS	Ministry of Agriculture and Forestry (Finland)
N	Symbol meaning sample size (used when reporting statistics)
NFM	Natural Flood Management
OPW	Office of Public Works (Ireland)
p	p-values are used to indicate the likelihood that a test result could be generated by chance: a p-value below 0.05 is generally accepted as significant
SEPA	Scottish Environment Protection Agency (UK)
SFF	The Scottish Flood Forum, supports communities at risk of flooding
SMS	Short Message Service (mobile phone text message)
SPSS	SPSS is a software package used for statistical analysis of data, usually social science data. (SPSS was originally an acronym for 'Statistical Package for the Social Sciences' but is now a name in its own right.)
UCD	University College Dublin (Ireland)
VIRVE	A telephone network used by authorities and agencies in Finland
WAG	Welsh Assembly Government (UK)
WP	Work Package (part of a project)

Table of project information

Joint project title	◄	**URFlood – Understanding Uncertainty and Risk in communicating about floods**
CRUE Project No.:	◄	ERAC-CT-2004-515742
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Project website:	◄	http://www.macaulay.ac.uk/urflood/
Objectives	◄	•Describe the knowledge systems which emergency responders, responsible authorities and members of the public use to make sense of flood risk information, defining factors that effect responses. •Provide evidence of the way different actors respond to uncertainties in flood risk information and explore how and under what circumstances information on flood risk uncertainty is made sense of and related to effective responses. •Develop and test alternative tools for communicating flood risk that take account of knowledge systems and needs. •Illustrate where any mismatches between different knowledge systems are likely to have an impact on responses and community resilience. •Trial alternative communication methods that take account of different knowledge systems
Background	◄	Rather than assuming an information deficit model (ie that providing more or better information will ensure more 'rational' responses to flood events or risk) this project uses the idea of 'knowledge systems'. We consider that how someone will process and react to a message will depend on how their background, situation and pre-existing assumptions affects perceptions and understanding about the message's topic and source. Therefore, improving individual and collective capacity to respond to flood risk communications and flood warnings depends on adapting communications to the perceptions of target audiences (social groups at risk of flooding).
Research	◄	Community understandings and experiences of flooding, flood risk and

	flood preparedness were probed in 11 case study sites, primarily through the use of a questionnaire survey, but also focus groups. On the basis of questionnaire a framework of cross-national guidelines for effective communication were prepared, and then the ideas in these tested via revisiting the communities (using a mixture of focus groups and questionnaires).
Findings ◄	Flood warnings and communication were found to be extremely important by the public at risk. However, messages from authorities are often misunderstood or not trusted, not helped by misunderstanding or confusion about some terms associated with risk and uncertainty. Although there have been past efforts at communication in case study areas, results showed low preparedness levels and uncertainty about how to react to warnings. Current web-information sources were not widely known in any of the partner countries although popular when visited. However, there is a general wish for more information and consistency for all agencies involved in responding to flood risk.
Implications (Outcome) ◄	Those charged with communicating about floods cannot assume that their terminology, messages and role are well understood by the public, even if there have been previous efforts to communicate about these topics. To overcome this, using simple messages (but with links to more information) and using multiple methods of communication, can help to reach different sectors of society. Public perceptions of trustworthiness should be considered when choosing agencies and individuals to communicate about flooding, and a tailored approach is particularly important to reach those groups who are oblivious to flood risk. Our recommendations are summarised in 8 guidelines.
Publications related to the project ◄	**Academic outputs (journal and conference papers)** • Paper to be submitted for the IWA World Congress on Water, Climate and Energy to be held in Dublin in May 2012 (September 2011). • Research poster "Understanding Uncertainty in Flood Communications" presented at National Hydrology Conference, Athlone, Ireland (November 2010). • Research poster "Understanding Uncertainty in Flood Communications" presented at Climate and River Basin Management Symposium, Oulu, Finland (January 2011). • Oral presentation at the European Conference of Social Psychology (2011). • Submitted paper entitled "Addressing Interpretive Uncertainty in Flood Risk Management" to the Climate 2011 Conference, to be held online in November 2011 (May 2011). • Submitted three papers to the UFRIM Conference to be held in Graz, Sept 2011, for oral and poster presentation entitled "Organisational Structures for Effective Flood Risk Management", "Influences on Flood Awareness and Preparedness in Improving Flood Risk Management" and "Improving Flood Communications in Europe: Results from Vulnerable and Impacted Communities" (June 2011). • Submitted paper for the UFRIM Conference Plenary Session to be held in Graz, Sept 2011, entitled "Uncertainty and Risk in Flood Communications (URFlood) in Europe" (July 2011). • Writing state–of-the-art review on flood risk communication to be submitted for journal publication (Ongoing). • Writing research paper "A Knowledge Systems Approach for Effective Flood Risk Management" to be submitted for journal publication (Ongoing).

- Writing joint research paper with FREEMAN project entitled "The Role of Flood Awareness and Risk Perception in Flood Management across Europe" to be submitted to the Special Edition Natural Hazards Earth Systems Sciences Journal, September 2011 (Ongoing).
- Writing a second joint research paper with both FREEMAN and IMRA projects entitled "Flood risk management in Italy: challenges and opportunities for the implementation of the EU Flood Risk Management Directive" for the same special edition as above.
- Writing research paper "Improving Flood Communications in Europe: Results from Vulnerable and Impacted Communities" to be submitted to the Special Edition Natural Hazards Earth Systems Sciences, September 2011 (Ongoing).
- Abstract submitted for the 2011 Irish National Hydrology Conference that will take place in Athlone, Co. Westmeath in November 2011 (July 2011).
- A book chapter jointly prepared with RISKMAP project: Kuhlicke, C., Cini, F., Pugliese, E., Carrus, G. (in press). Risk perception and flooding. In Bernhofer, C., Schanze, J., Seegert, J. (Eds.), Textbook on Integrated Flood Risk Management. Springer, Berlin.

Activities linked to Funding Bodies and Agencies linked to flood responses and flood management

- Presentations and progress reports given to Irish national funder (e.g. April, August 2010).
- Letters to local authorities regarding questionnaire dissemination and presentations to local authorities e.g. Nov 2009 to representative of Dublin City Council involved in Flood Resilient City Project.
- Discussion of work and guidelines with Scottish Flood Forum and presentation of work to relevant agencies in Steering Group within Scotland (2010, 2011).
- Similarly the Finnish partner has met with a steering group twice a year: local authorities, relevant environmental authorities attend this, and the Ministry of Agriculture and Forestry has also been invited.
- A policy brief based on the guidelines is planned for Scotland (September 2011)
- The Italian partner plans to hold a joint meeting with FREEMAN and IMRA and agencies in Venice to present together and discuss links between work done in similar sites for the different projects (September 2011).

Activities involving the general public

- Web site www.macaulay.ac.uk/urflood
- There have been meetings and emails with local community groups in various locations (e.g. Scotland, autumn 2010).
- In Ireland, press releases were issued to promote the questionnaire dissemination (e.g. Ireland, September 2010).
- Residents of residential and business properties within case study areas were asked to fill in a questionnaire, and invited to contact the project teams for more information.
- Each partner will undertake community feedback reports and/or meetings, in Finland, Ireland, Italy and Scotland, after the final report is submitted.