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European Flood Risk Management Research

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Flood resilient communities – managing the consequences of flooding

CRUE Research Report No 2: Flood Incident Management – A FRAMEwork for improvement – FIM FRAME
Comparison of currently available tools and enabling technologies for the emergency planning of floods

Prepared by the Joint Project Consortium consisting of

Project partner #1, HR Wallingford, UK

Project partner #2, Deltares, The Netherlands

Project partner #3, Laboratoire Central Des Pont Et Chaussées, France

Project partner #4, University Montpellier III, France

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DISCLAIMER

Flood Incident Management – A FRAMEwork for improvement

Flood Incident Management – A FRAMEwork for improvement – FIM FRAME
The Effectiveness and Robustness of Emergency Plans for Floods

This report was prepared with the support of the CRUE Funding Initiative on Flood Risk Management Research. While reasonable care has been taken in preparing this publication to ensure that information is appropriate and valid it have to be considered that the views, conclusions and recommendations expressed herein are those of the authors and most not necessarily endorse the views of the CRUE ERA-NET or the respective Funding bodies involved.

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Flood resilient communities – managing the consequences of flooding

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Comparison of currently available tools and enabling technologies for the emergency planning of floods

CRUE Research Report No I-2

Prepared by

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CRUE Funding Initiative on FRM

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Summary

This report has been produced as part of Work Package 2 (WP2) of the ERA NET CRUE research project entitled Flood Incident Management – A FRAMEwork for improvement (FIM FRAME). The report provides an overview of tools that are available to assist with providing information for emergency plans for floods. As part of WP2 research flood managers were consulted to assess what tools they currently use and also to assess which tools they perceive to be useful.

From the research carried out many flood managers are often not aware of the tools that are available to assist them in providing information to emergency plans for floods. Based response of flood managers in the three countries, the two main obstacles to tools not being used appear to be:

1. Lack of awareness of the methods that are available
2. Availability of data

In formulating emergency plans for floods it would appear that "expert judgement" is often used rather than specific tools. Many responders to the survey mentioned that they used a combination of information rather than specific methods or tools. For example in the survey in England and Wales around half to a third of the responders stated that they were aware of or used the following methods to inform Multi-Agency Flood Plans (MAFPs):

- Accessibility of inundated roads
- Optimisation of the location of shelters
- Damage to critical infrastructure
- Optimal evacuation routes
- Effects of improvements in flood warning on the risk to people
- Methods to assess potential injuries and loss of life

However, none of the 44 responders who are involved in providing information to assist with the formulation of MAFPs explicitly mentioned any methods or tools that provide such information.

In France the awareness level of the tools and methods available would appear to be lower than that in England and Wales and the Netherlands. The lack of awareness in general may be as a result of a need to improve the dissemination of the tools and the relevant research. The lack of awareness of tools to assess the consequences of flooding or to assess potential damage has already been pointed out in many articles and reports in France.

In all three countries there would appear to be a requirement for some form of guidance on what tools are available, what data they require and how they can be implemented to give information that can be used to improve emergency plans for floods.

Contents

1 Introduction

1.1 Background to the research

This report has been produced as part of Work Package 2 (WP2) of the ERA NET CRUE research project entitled Flood Incident Management – A FRAMEwork for improvement (FIM FRAME).

FIM FRAME is a 24 month project research project. The project is funded by

- The joint Department for Environment, Food and Rural Affairs (Defra)/Environment Agency Flood And Coastal Erosion Risk Management (FCERM) Research and Development Programme and
- The Ministère de l'Ecologie, de l'Energie, du Développement Durable et de la Mer, en charge des Technologies Vertes et des Négociations sur le Climat (MEEDDM).

The research is being undertaken in the UK, France and the Netherlands. The project partners are:

- HR Wallingford, UK – Project coordinators
- Deltares, The Netherlands
- Gestion des Sociétés, des Territoires et des Risques (GESTER), University of Montpellier III, France
- Laboratoire Central des Ponts et Chaussées (LCPC), Nantes, France.

The objectives of the research can be summarised as follows:

- To assess the "effectiveness" of a sample of current flood emergency plans in the UK, The Netherlands and France and to assess methods by which the plans can be improved;
- To evaluate the current tools and technical systems that are used to inform flood emergency plans and the ability of these tools to support future flood event emergency planning with the main aim of reducing residual risk (i.e. primarily loss of life);
- To establish how currently available tools (e.g. guidelines, models) can be used to improve emergency management plans for floods and whether there are any gaps in the tools that are available;
- To provide a framework by which flood incident management can be improved that will be tested in a number of case studies.

The research has been carried out in six Work Packages (WPs) as follows:

- WP1 - Effectiveness and robustness of flood event management plans
- WP2 - Comparison of currently available tools for the emergency planning of floods
- WP3 - Development of framework to improve flood event management
- WP4 - Case studies utilising the developed framework to improve emergency plans working together with emergency responders, emergency planners and other stakeholders
- WP5 - Dissemination of the results
- WP6 - Management and coordination.

The relationship between the six Work Packages is shown in Figure 1.1.

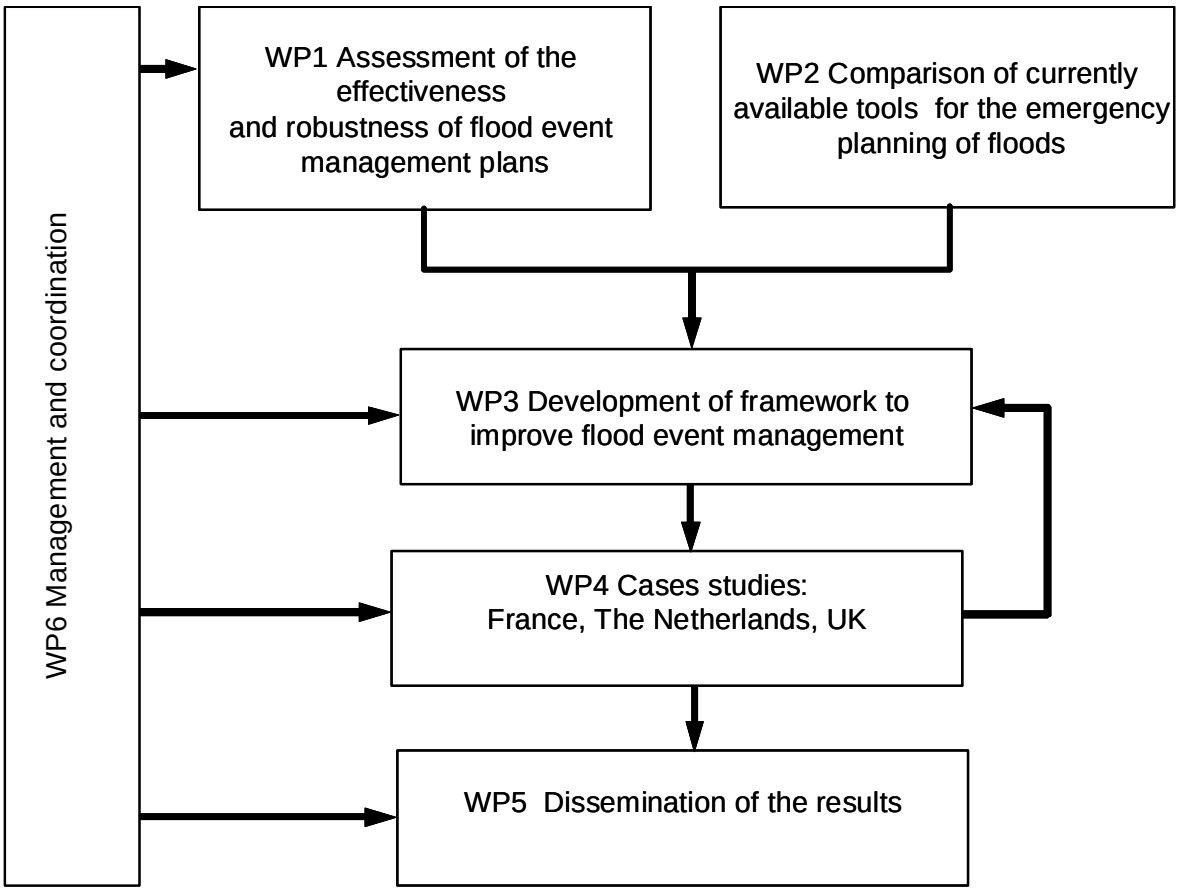


Figure 1.1 Relationship between the FIM FRAME Work Packages

1.2 Structure of the report

This report has been structured as follows:

- Chapter 1 provides background to the objectives of the research and this report;
- Chapter 2 gives a review of tools and methods that could be used to improve the emergency planning for floods that are available in England and Wales, France and the Netherlands;
- Chapter 3 summaries the output from a survey of flood managers in the three countries;
- Chapter 4 brings out the conclusions of the report;
- Chapter 5 details the references used to compile the report.

1.3 Background to Work Package 2 (WP2) of FIM FRAME

The principal emphasis in the development of any flood emergency plan should be on the response to the flood incident and not the cause of the incident. In many locations there are an infinite number of possible flood scenarios and it is impossible to plan for them all. By concentrating on planning to deal with outcomes, it is possible to respond to a very large range of flood events within the framework of a limited number of plans. Such plans need to be flexible: to allow for all weathers and times of day/night, to work when key people are on holiday and to be usable even when the outcomes of an incident have unexpected complications.

Any flood emergency plan must be tested to ensure that it encompasses the outcomes of all known or reasonably foreseeable risks and that it would be effective in providing a sufficient and timely response. At present, this is normally done through table top exercises or in some cases full-scale live exercises of a response. Both these approaches, although useful have their limitations in terms of cost, time and the number of scenarios that can be undertaken. At present, tools such as emergency planning software are rarely used in either flood event planning exercises or to improve the effectiveness of these plans.

The output of this Work Package (WP), together with the results of WP1 and the research undertaken with the stakeholders in each country, will provide the research team with a sound basis to answer the following questions:

- Are the tools being used and if so are the effective in improving the response to flood events?
- How do these tools address the problems emergency planners face and can the tools be improved?
- How can these tools be used in practice to reduce the residual risk from floods especially the loss of life?
- Can the output from these tools be used to improve the coordination between different emergency responders?

As part of WP3, the metrics developed in WP1 to assess flood emergency plans will be mapped to the available tools. The purpose of this mapping process is to highlight the following:

- Where tools that are not currently being used can improve flood event management plans;
- Where there are no appropriate tools available;
- Where tools need to be improved.

The objective of this mapping process will inform the development of a framework to improve the emergency planning for floods that will be developed as part of WP3.

2 Review and assessment of tools

2.1 Introduction

This section provides a brief review of tools that are available in the three project areas and that are also used in other parts of the world. The tools reviewed fall into the following categories:

- Guidelines and checklists;
- Flood hazard mapping tools;
- Tools related to assessing the risk to people, vehicles, evacuations times and safe havens.

2.2 Guidelines and checklists

2.2.1 Preliminary guidance for developing a Multi-Agency Flood Plan, England and Wales

The objective of the guidance is to assist Local Development Forums in England and Wales to develop Multi-Agency Flood Plans (MAFP). The 43 page guidance provides examples of the information that should be included in a MAFP and also how the MAFP should be structured. The guidance covers:

- Aim and objectives of the plan;
- Ownership and audience;
- The risk of flooding;
- Related and interdependent plans;
- Communication plan;
- Plan activation – Thresholds and triggers;
- Actions, roles and responsibilities;
- Vulnerable people;
- Key infrastructure;
- Evacuation and sheltering of people;
- Recovery;
- Training and exercising.

2.2.2 Checklist for a Multi-Agency Flood Plan, England and Wales

The checklist was developed so that a consistent method for assessment can be applied. It can be used as a discussion tool with LRFs and to provide an audit trail to show how an assessment status of “satisfactory” or otherwise of a Multi-Agency Flood Plan was derived. The checklist includes a suggested scoring system. The MAFPs are scored out of a possible 565 points and are rated as follows:

- 81% to 100% Very satisfactory

- 61% to 80% Satisfactory
- 41% to 60% Average
- 21% to 40% Unsatisfactory
- 0% to 20% Very unsatisfactory

2.2.3 *Guide ORSEC Départemental - Méthode générale, France*

The Guide Orsec Départemental - Méthode générale was produced to assist in producing emergency plans in France. ORSEC plans are aimed at the Départmental level in France. This guidance comprises a 73 page document to help planners put these plans together.

2.2.4 *Plan Communal de Sauvegarde - Guide pratique d'élaboration, France*

The "Plan Communal de Sauvegarde - Guide pratique d'élaboration" is 200 page guidance document put together to help prepare community level emergency plans that cover all natural hazards. The document contains checklists, flowcharts, details of technical tools as well as examples to help community leaders put together plans. The document is freely available via the internet. The document appears to be widely used in France to assist emergency planners in putting local level emergency plans together.

2.2.5 *Plan Communal de Sauvegarde (PCS) "S'organiser pour être prêt" La Démarche, France*

This 42 page document details the process for putting together a PCS. The document is freely available on the internet. The document outlines the following:

- The main principles for putting together a PCS;
- Guidance on the level of detail that is required in a PCS;
- Information on which actors should be involved and the level of support;
- The legal background and documents relevant to PCSs.

2.2.6 *Plan Communal de Sauvegarde PCS "S'entraîner pour être prêt" Les Exercices, France*

This 88 page document, freely available from the internet, provides information on how to conduct training exercises for PCS. It covers:

- The principles of the exercises including: the possible types; stages; how to prepare for the exercise and what the objectives should be;
- How to prepare for the training exercise;
- What can be learnt from the experience;
- A numbers of cases studies and examples including ones that are related to flooding.

2.2.7 *Prévenir et gérer les risques naturels au niveau local pour le développement durable des territoires - Guide à l'usage du maire et des élus - Rhône-Alpes, France*

This document is specifically aimed at the Rhône-Alpes region of France; it is a 42 page document that is freely downloadable from the internet. Its focus is related to how local communes in the Rhône-Alpes region can identify natural hazards although it does link to the Plan Communal de Sauvegarde that are often based on these assessments.

2.2.8 *Inventory of the resource requirements for emergency management, The Netherlands*

The inventory of resources requirements for emergency management – 'Leidraad Maatramp' (LMR) was produced by the Dutch Ministry of Inland Affairs. It provides a method to assist emergency responders in determining the required resources to deal with a particular type of emergency or hazard. Eighteen types of hazards are identified including flooding. For each hazard, five scenarios are defined of which one is selected as the standard scenario. For this scenario the required resources are determined. This gives an indication as to which type of emergency requires the most resources. The tool focus is to help produce plans and in the training and education of managers of the different organisations involved in emergency management. Figure 2.1 gives a typical output from the tool. There are also spreadsheets available as part of the tool to help assess the resource capacity.

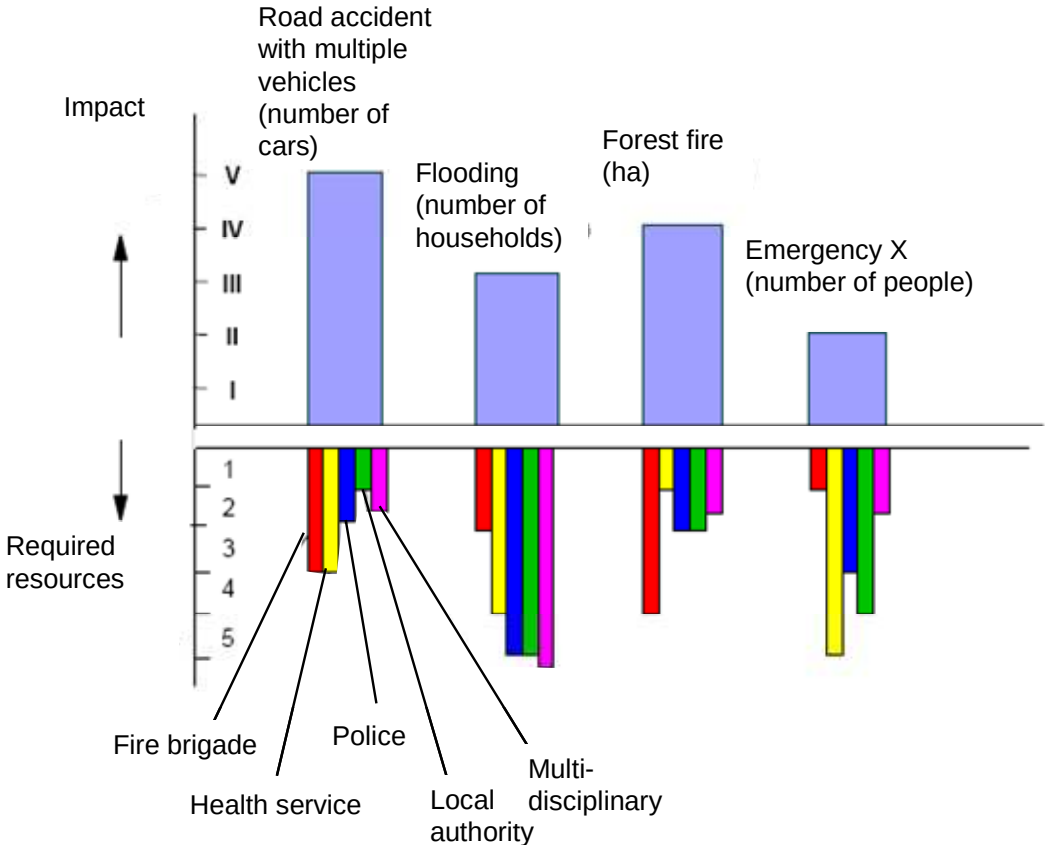


Figure 2.1 Inventory of resource requirements for emergency management – 'Leidraad Maatramp' (LMR)

2.2.9 Regional model for disaster planning, The Netherlands

This guidance provides a format for regional disaster planning. The format was produced by the Haaglanden Safety Region. The format was developed to provide a model for event planning. It focuses on all types of disaster that can occur on a regional scale. It provides predefined chapters and contains definitions, background information and explanation and descriptions of aspects which are generally agreed upon e.g. processes, responsibilities at certain emergency levels. Region specific information needs to be filled in. However, it is not obligatory to follow this format in the Netherlands.

2.2.10 Framework for evaluation of task execution of Safety region (RADAR), The Netherlands

The framework for the evaluation of Safety Region event management (RADAR, RAmpenbestrijding Doorlichtings ARrangement) is an instrument for evaluating the state of event management implementation in The Netherlands. It defines the criteria that event management should comply with. The criteria are divided into subjects such as: organisation, alerting, upgrading and information management.

2.2.11 Quality criteria for the production of municipal event plans (Besluit kwaliteitscriteria planvorming rampenbestrijding), The Netherlands

The objective of this tool is to establish criteria for event planning. The statutory regulations describe the criteria which a municipal event plan should comply with. These plans are of a general nature and do not specifically deal with flood risk.

2.3 Flood hazard mapping tools

2.3.1 Introduction

There are numerous flood hazard mapping tools and models available. The results of the surveys of flood managers have indicated that there is a high degree of awareness amongst flood managers regarding the tools that are available for mapping the flood hazard. It is not the intention of this report to repeat the large volume of information that already exists on flood hazard mapping tools. In the past decade the use of two dimensional hydraulic models has become increasingly prevalent meaning that it is now easier than ever to produce flood hazard maps that show not only flood extent but depth, velocity or a combination of these two parameters. Two dimensional hydraulic models include Flo-2D, InfoWorks RS 2D; Mike 21; Sobek; Telemac 2D and TuFLOW. Typical outputs in terms of maximum flood depth and velocity maps are shown in Figures 2.2, 2.3 and 2.4.

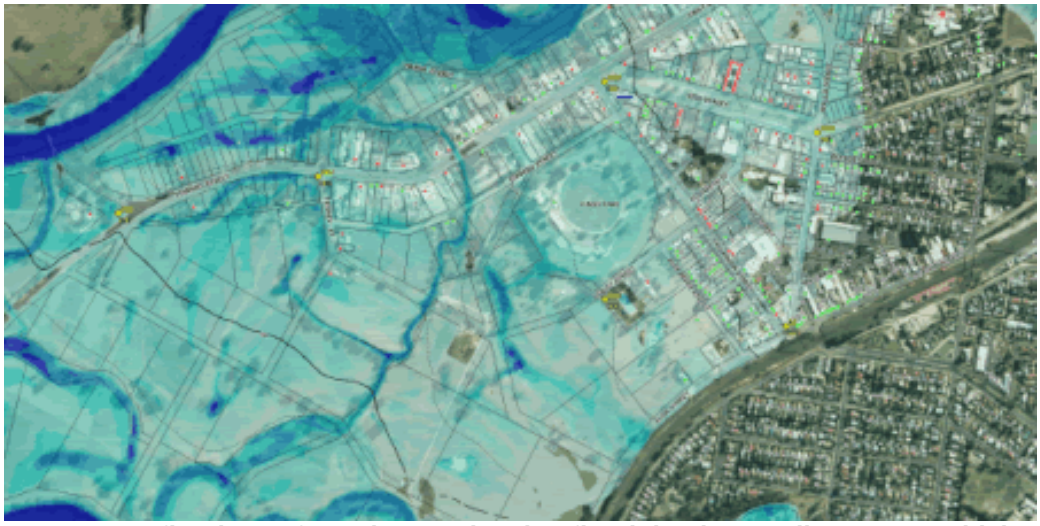


Figure 2.2 **A flood map from the UK showing flood depth as well as extent which represents a typical output from a piece of two dimensional hydraulic model**

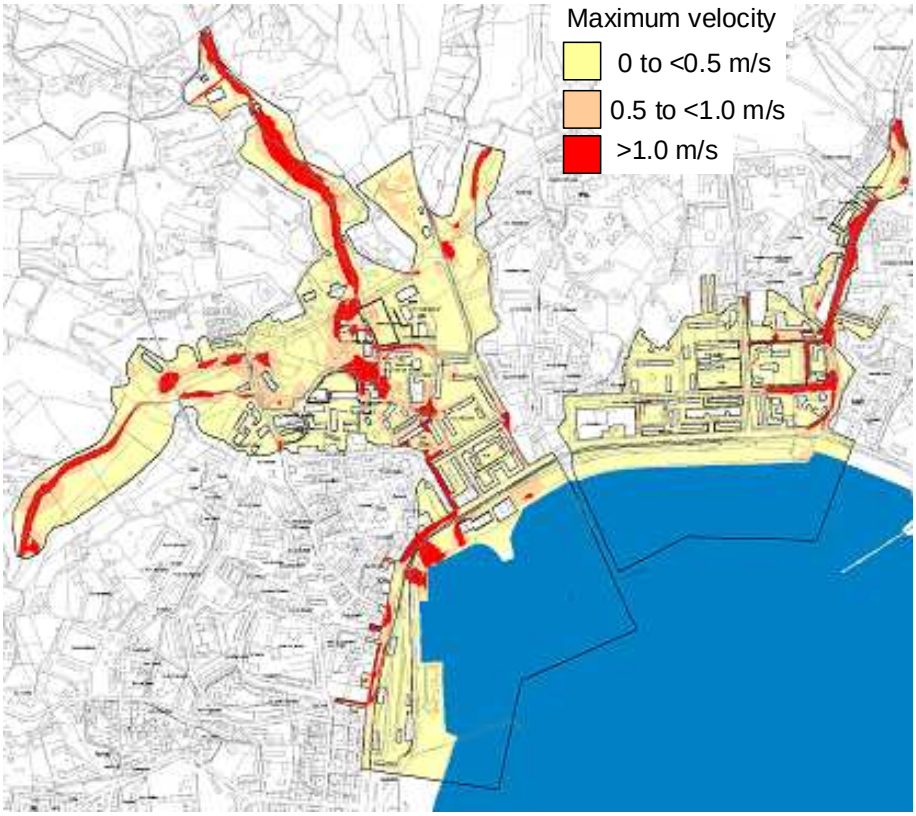
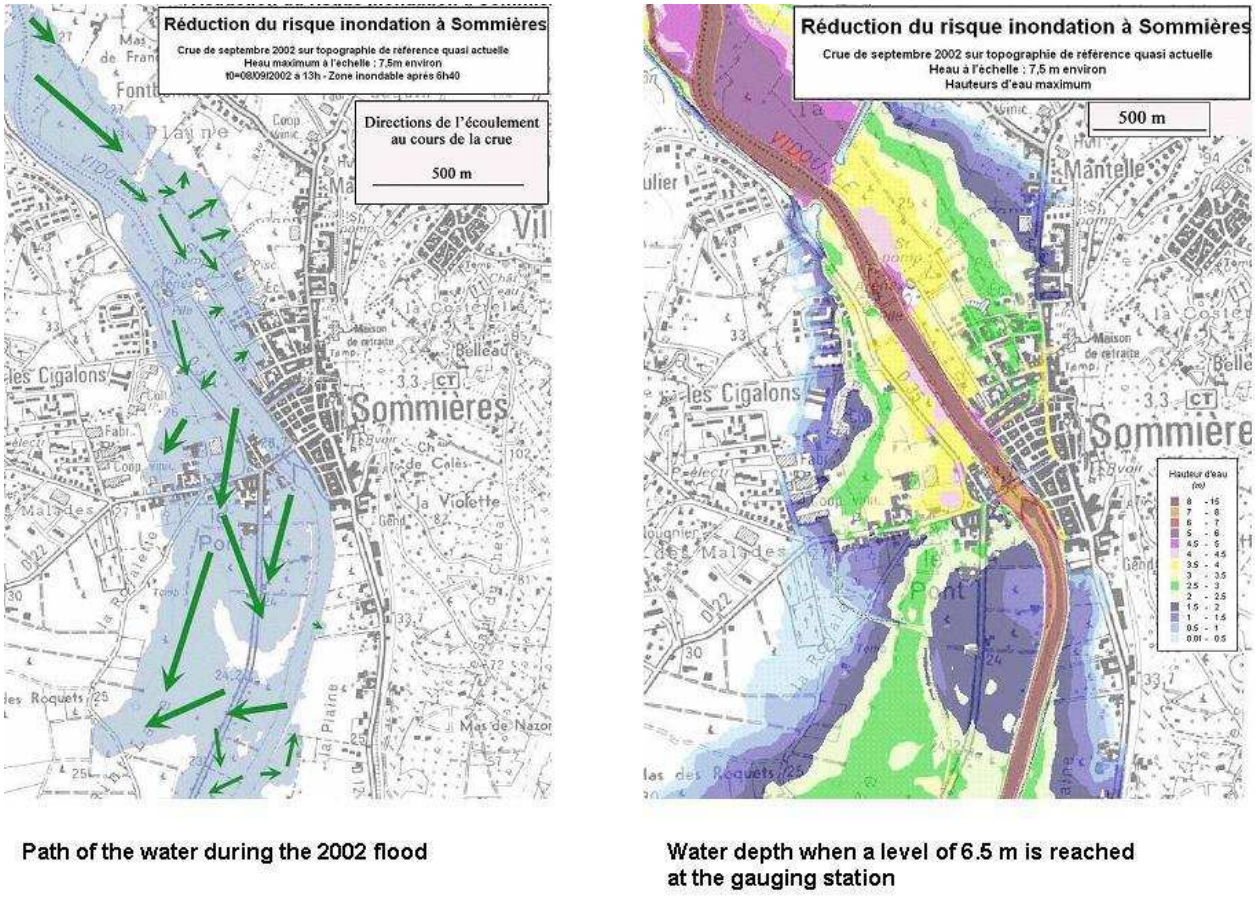


Figure 2.3 **A map for an urban area in France showing maximum flood velocities for the 1 in 100 year flood produced using a two dimensional hydraulic model used in emergency planning**



Path of the water during the 2002 flood

Water depth when a level of 6.5 m is reached at the gauging station

Figure 2.4 Examples of flood maps showing flow paths and flood depths used in emergency plans for Sommières in France

2.3.2 *Environment Agency Flood Map, England and Wales*

The Environment Agency in England has developed flood extent maps. These maps show the flood extent for the "undefended scenario" (i.e. assuming that there are no flood defences in place). There is a process whereby these maps are continually updated. For fluvial floods the maps show the maximum undefended flood extent for the 1 in 100 and 1 in 1,000 year return period. For coastal flooding the undefended flood extents for the 1 in 200 and 1 in 1,000 year return periods are shown. These maps also show Flood Zones as follow:

- **Flood Zone 1** - This zone has a less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1%) – classified by the Environment Agency as a "low probability zone";
- **Flood Zone 2** - This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% to 0.1%) or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% to 0.1%) in any year. – classified by the Environment Agency as a "medium probability zone";
- **Flood Zone 3a** - This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year – classified by the Environment Agency as a "high probability zone";
- **Flood Zone 3b** - This zone comprises land where water has to flow or be stored in times of flood, this is often defined as land which would flood with an annual probability of 1 in 20 (5%)

or greater in any year– classified by the Environment Agency as a “high probability zone – functional floodplain”.

An example of the Environment Agency’s flood map is shown in Figure 2.5.

Figure 2.5 Example of the Environment Agency Flood Map in the vicinity of Oxford

2.3.3 *Environment Agency Surface Water Flood Map, England and Wales*

The surface water flood maps were produced to provide an initial indication of areas that may be susceptible to surface water flooding, for use in their functions which relate to emergencies as defined and as required by the Civil Contingencies Act 2004 in England and Wales. The maps show susceptibility to surface water flooding where this is defined as “*flood event that results from rainfall generated overland flow before the runoff enters any watercourse or sewer*”. It is usually associated with high intensity rainfall (typically >30mm/hour) resulting in overland flow and ponding in depressions in the topography, but can also occur with lower intensity rainfall or melting snow where the ground is saturated, frozen, developed or otherwise has low permeability. Urban underground sewerage/drainage systems and surface watercourses may be completely overwhelmed, preventing drainage. Surface water flooding does not include sewer surcharge in isolation. A typical example of the surface water flood map is shown in Figure 2.6.

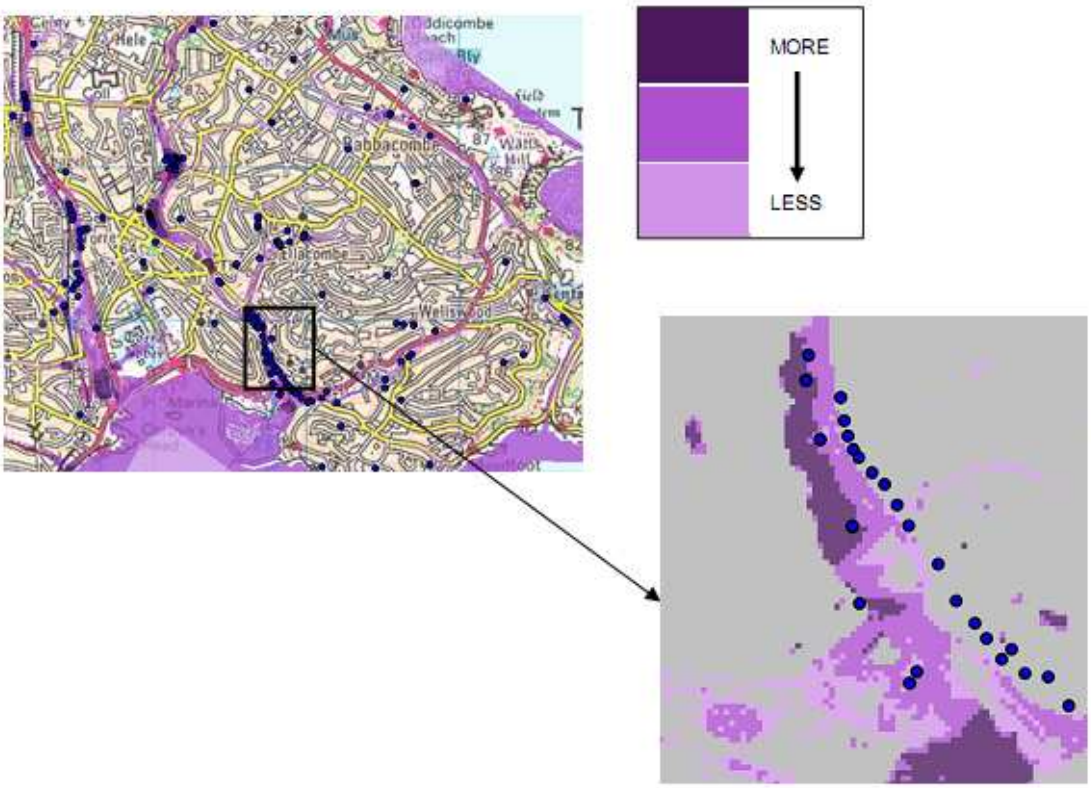


Figure 2.6 **Example of the Environment Agency Surface Water Flood Map in the town of Torquay in the south-west of England**

2.3.4 *Environment Agency Reservoir Inundation Maps (RIM), England and Wales*

The Environment Agency has produced inundation maps for all of the 2,092 large raised reservoirs that they regulate under the Reservoirs Act 1975. These inundation maps show the effects on the downstream catchment of a dam breach. Top-tier local authorities will use these maps to manage the development of emergency flood plans with their Local Resilience Forum (LRF). These plans will be followed in the event of a dam breach.

2.3.5 *OSIRIS Inondation, France*

The software called “OSIRIS Inondation” is a tool that has been developed to help Communes and the emergency managers in France to prepare their flood protection plans (Plan de Sauvegarde Inondation). It provides details of inundation levels, as shown in Figure 2.7; however, it also acts as an emergency management tool. The use of this software helps to simplify the production and updating of these plans. The software was developed by the Loire Département, in partnership with the Centre of Maritime and River Technical studies (CETMEF). The main objectives of the tool are:

- To provide a framework and a tool support to help decision makers and local stakeholders to prepare their local emergency management plans (PCSs)

- To disseminate flood forecasts and to establish a link with emergency management
- To help involve all the relevant actors in the process of prevention and management of the floods
- To facilitate the communication between the various levels of management and responsibility of the actors involved in emergency planning
- To provide a freely available tool to help emergency planners assess floods.

The tool also provides details of the action required for a particular level of hazard. This is shown in Figure 2.8. This tool does not seem to be particularly widely used in France.

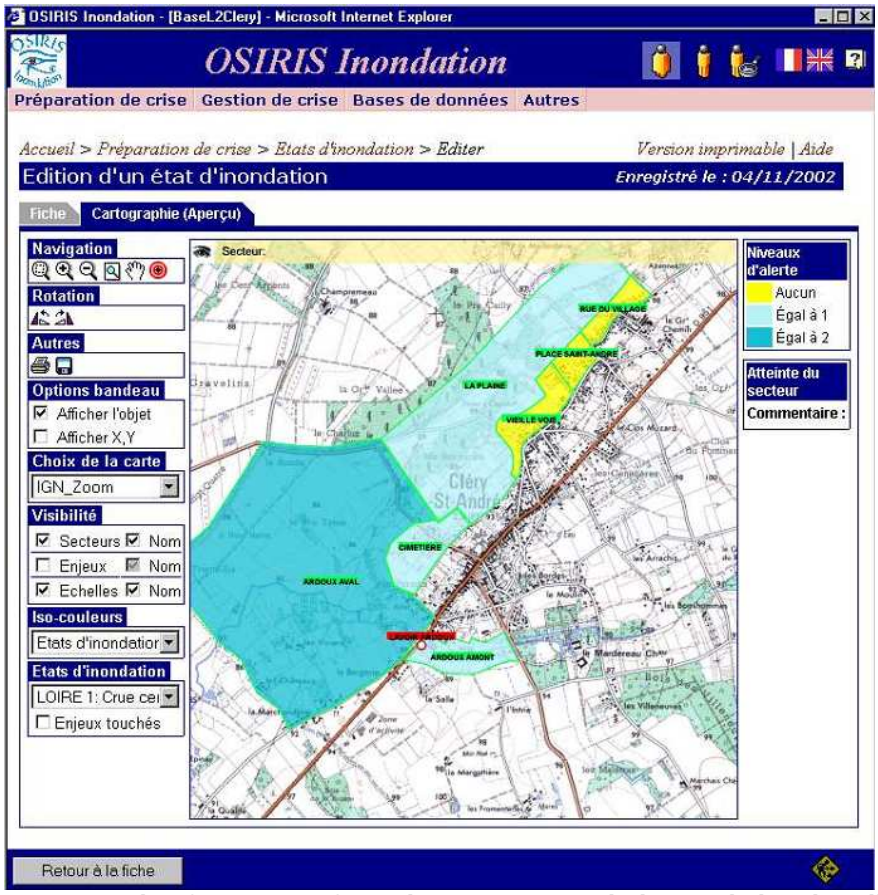


Figure 2.7 Example of an output from the OSIRIS Inondation tool showing different levels of flood inundation

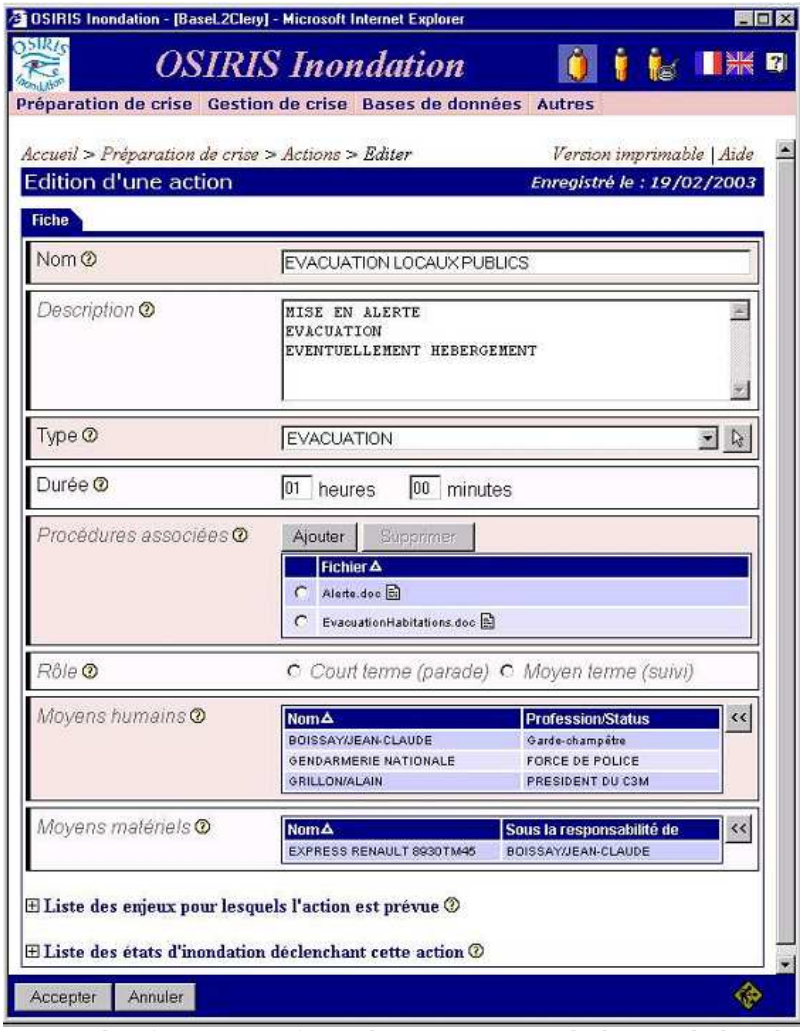


Figure 2.8 **Example of an output from the OSIRIS Inondation tool showing the action required for a particular level of flood hazard**

2.3.6 *LIZARD-flooding, The Netherlands*

The LIZARD-flooding system is based on the Flood Early Warning System (Delft-FEWS) software that provides base operations for water management in The Netherlands. The internet based system, which can be used by municipalities, regional water boards and the national water board contains over 5,000 nation-wide flood scenarios, and over 200 flood models.

The software has a module for the management, viewing and comparison of flood model scenarios and results. It is a web based information system with a central database containing many flood simulation scenarios including flood extents, water depths, water velocities, land use, damage, accessibility or roads and numbers of causalities. The tool can be used to gain an insight in the effects of different flood scenarios for the Netherlands and provide the basis for strategic and operational choices. Figure 2.9 shows an example of Lizard-flooding showing flood water depths.

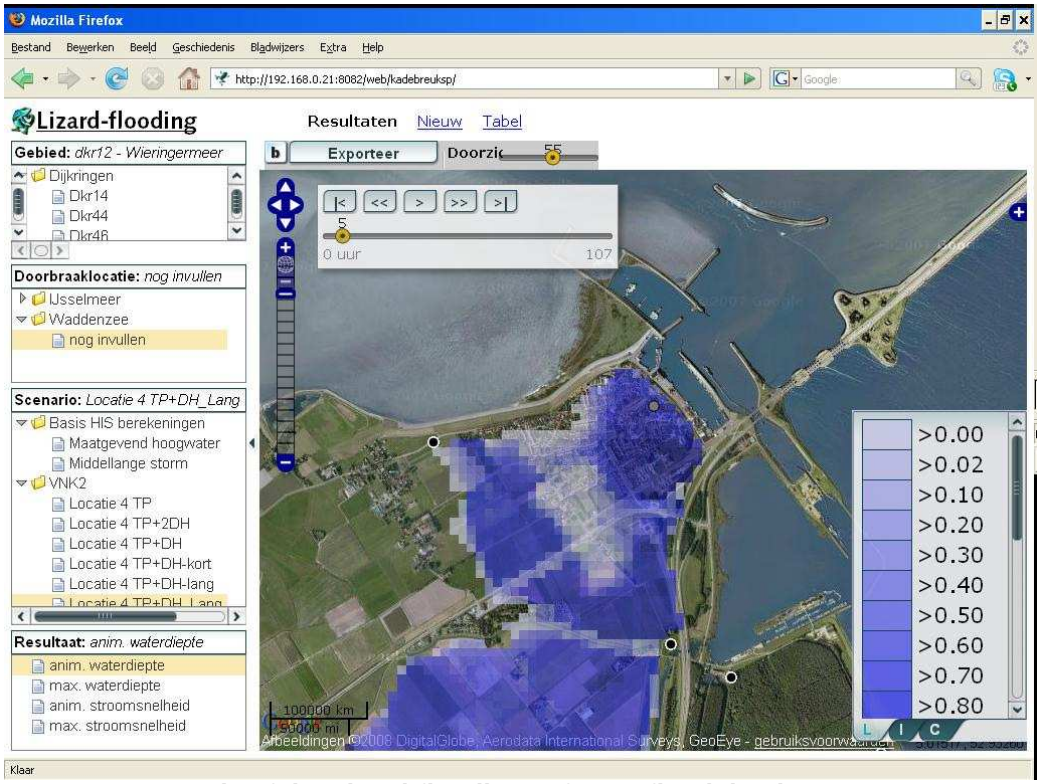


Figure 2.9 Example of the Lizard-flooding software flood depth map

2.4 Tools related to assessing the risk to people and vehicles, evacuation times and safe havens

2.4.1 Risk to people method, England and Wales

The objective of the Risks to People method is to provide a simple method for assessing and mapping the risk of death or serious harm to people caused by flooding. Two of the stakeholder requirements that were identified as part of the project were to:

- Provide guidance on identifying areas of high flood risk to people at a local scale which is needed for Local Authority emergency plans. Guidance should be based on local data where possible.
- As long as detailed information on flood velocity and depth are available, provide a method via which maps could be produced highlighting the most “at risk” people, areas of danger for people and vehicles and safe access and exit routes.

The method requires the following:

- The flood hazard defined by the flow depth and velocity
- The area vulnerability which depends on the nature of the area (including types of buildings), availability of flood warnings and speed of onset of a flood

- The people vulnerability which depends on the age and physical condition of the people exposed to a flood.

Figures 2.10 and 2.11 provide details of the outputs from these methods.

d x (v + 0.5)	Degree of flood hazard	Description
<0.75	Low	Caution *"Flood zone with shallow flowing water or deep standing water"*
0.75 - 1.25	Moderate	Dangerous for some (i.e. children) *"Danger: Flood zone with deep or fast flowing water"*
1.25 - 2.5	Significant	Dangerous for most people *"Danger: flood zone with deep fast flowing water"*
>2.5	Extreme	Dangerous for all *"Extreme danger: flood zone with deep fast flowing water"*

Where d = depth of the floodwater and v = velocity of the floodwater

Figure 2.10 Output of the Risk to People project showing the degree of flood hazard

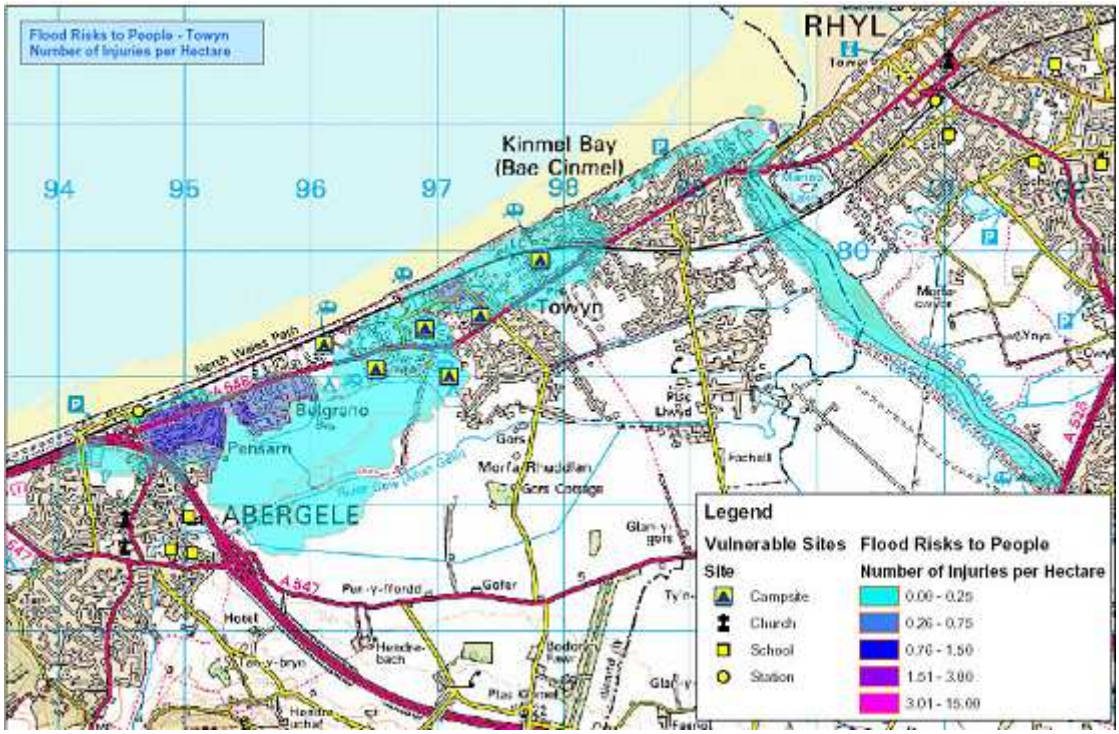


Figure 2.11 Output of the Risk to People project map showing the expected number of injuries per hectare for a breach of the flood defences in north Wales

2.4.2 LIFESim, USA

LIFESim is a spatially-distributed simulation modelling system for estimating potential life loss developed by the University of Utah in the USA. It allows potential loss of life during a flood event to be estimated based on the loss of shelter; building collapse and evacuation time.

LIFESim can be used for dam safety risk assessment and by dam owners and local authority emergency managers to explore options for improving the effectiveness of emergency planning and response. Development of LIFESim has been sponsored by the US Army Corps of Engineers and the Australian National Committee on Large Dams (ANCOLD). A typical output for LIFESim is given Figure 2.12, which shows the projected loss of life for an embayment in New Orleans with an increase in water level in the embayment.

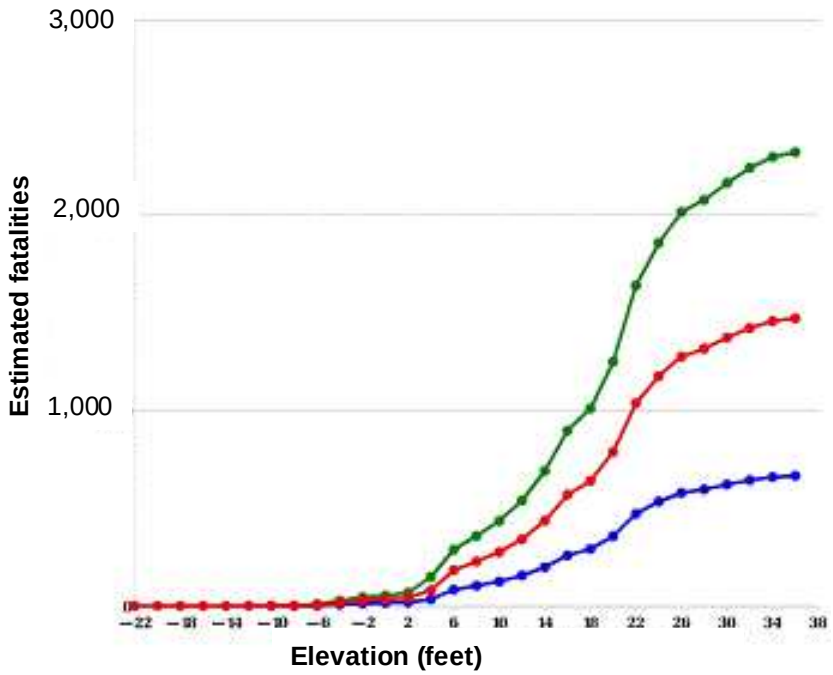


Figure 2.12 Output from LIFESim showing the increase in estimated fatalities in New Orleans with an increase in water level

2.4.3 Outil d'aide à la gestion des risques et des crises (OGERIC), France

The Outils d'aide à la gestion des risques et des crises (OGERIC) is a French tool to assist with the management of risk and emergencies. The tool was developed in 2009by the Centre d'Etudes Techniques de l'Equipement Mediterranée to help emergency management services to handle their GIS data during emergencies. OGERIC allows emergency managers:

- To display all the events in a GIS
- To locate and follow the outcome of the events
- To cross reference other databases
- To display geographical layers such as road network and floodplains
- To have an overview of elements useful for decision making

The OGERIC allows post emergency evaluation to be carried out more easily and links to key databases. During an emergency the operator of the system can map events and this information is available to emergency responders as events unfold. Various actors can contribute information to the system. The tool acts as an interface to display more easily GIS information. However, it does not bring any response on specific items such as the assessment of the accessibility of inundated roads or other risks. A typical screen from the tool is shown in Figure 2.13.

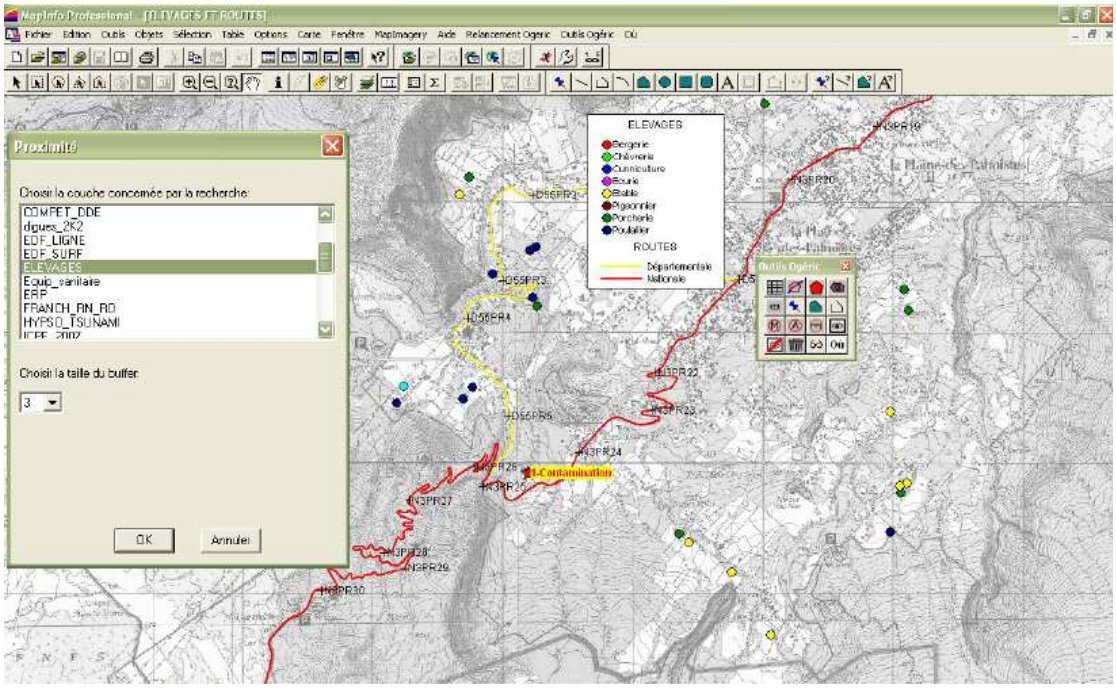


Figure 2.13 Example of work process of the OGERIC tool

2.4.4 *National evacuation Module (LEM), The Netherlands*

The objective of the Tool is to support the planning, exercise, evaluation and monitoring for a large scale evacuation event. The tool was produced by the Dutch National Water Board. It comprises three modules; planning, training and monitoring. The planning module focuses on preparing for an evacuation event. The training module is used for multi actor training purposes and the monitoring module is applied to monitor the actual event in comparison to the scenario on which the plan is based. By monitoring one can adjust the planned operations to the actual event using the original plan as a basis. The underlying software is OmniTrans for calculation of traffic, and Spoel for evacuation simulation process in time. Different scenarios can be evaluated. The module takes account of the behavior of people, shelter areas, location of vulnerable groups of people and road capacity during the event. A vulnerability assessment of the scenarios can be performed as well. Figure 2.14 gives an example of the work process in the LEM software.

Figure 2.14 Example of work process of the LEM software

2.4.5 *Life Safety Model, UK/Canada*

The Life Safety Model is a detailed micro-modelling tool that can aid in assessing risk to people and evacuation times from a range of flood events including: fluvial floods, flash floods; dam breaks and breaches of flood defences. It uses a physics-based approach to simulate the physical interactions of people, vehicles and buildings in a major flood event.

For a given population at risk, LSM will:

- Estimate the potential loss of life due to an extreme flood event;
- Estimate evacuation times;
- Provide an estimate of the potential number of buildings that will collapse;
- Produce a spectrum of virtual representations of how a flood emergency could evolve;
- Support emergency analysis activities which aim to support the development of mitigation strategies that could reduce the potential loss of life.

LSM can also provide insight into the damage to structures, determine areas of greatest flood risk, and provide insight into the needs for timing and location of evacuation as the flood progresses.

Unlike other loss estimation techniques, LSM has been designed to look at specific areas, and utilise detailed local data. To date, the model has been tested on a few case studies to confirm the suitability and validity of the techniques. The model is currently being used in Humberside in England to assess evacuation times and risk to people. The LSM provides a more transparent and defensible set of predictions, which incorporate a wider range of variables influencing loss of life than traditional “black box” approaches. Figure 2.15 show an example output from the LSM showing the number of people at risk for different scenarios. Figure 2.16 shows a screen shot of an animation of an evacuation.

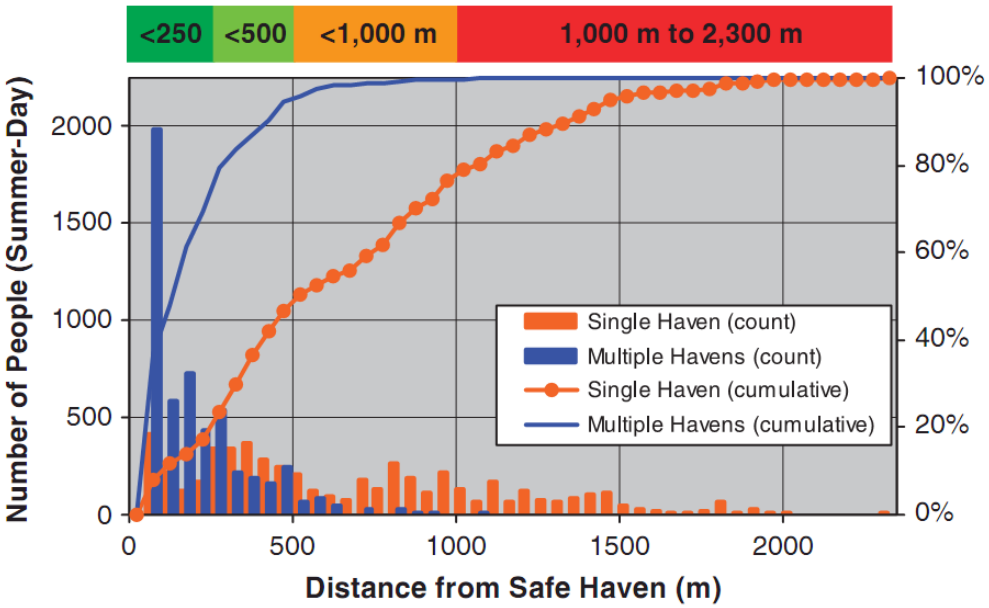


Figure 2.15 **Results from the Life Safety Model Evacuation showing the population at risk in a costal zone as a function of distance from safe haven(s) for summer daytime**

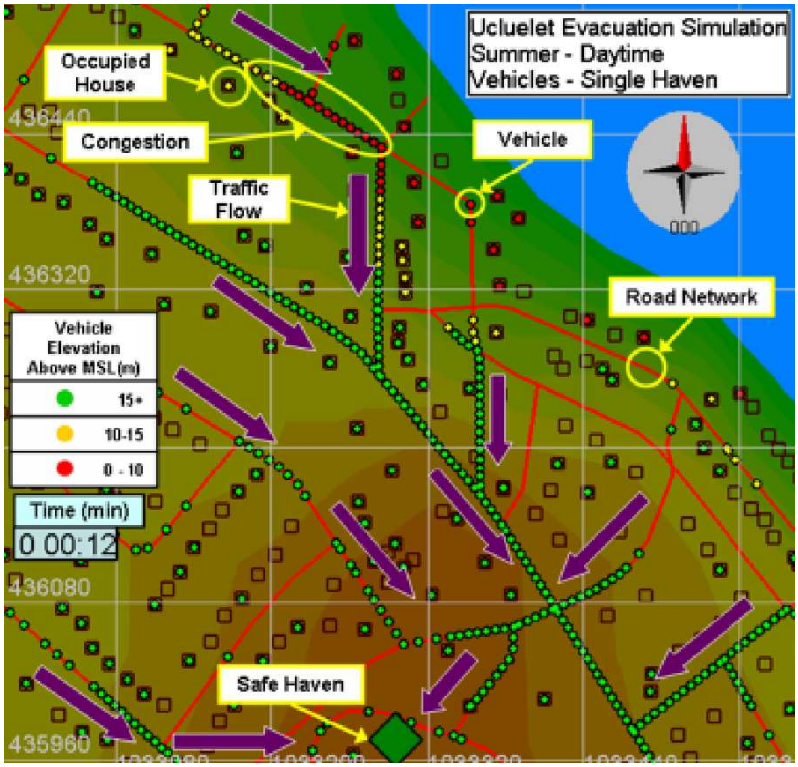


Figure 2.16 **Screenshot of summer daytime, single haven, vehicular evacuation simulation for people at risk of flooding in a coastal zone**

2.4.6 *Flood Information and Warning system (FLIWAS), The Netherlands*

FLIWAS is a web-based system and consists of different independently usable modules. FLIWAS is primarily intended for water management professionals and for decision makers on different levels. The water manager can access information that can be used to take appropriate practical actions during flood events. FLIWAS can be linked to an evacuation module. Information on current and predicted water levels or weak spots in embankments can be supplied. Decisions can then be taken about protecting flood defences.

In terms of emergency planning FLIWAS can be used to help decision makers assess how to respond to a flood event, and used to help formulate flood emergency plans, as well as being used in exercises. FLIWAS has cost some €10 million to develop. To a certain extent it acts as a repository for a whole range of information that could be useful to emergency planners including:

- A library of pre-calculated flood depth maps as shown in Figure 2.17;
- Provision of evacuation times using a separate module;
- Information relating to the places where the dike ring is weak or is likely to collapse;
- Provision of situation reports for emergency plans.

A diagrammatic overview of FLIWAS is shown in Figure 2.18.

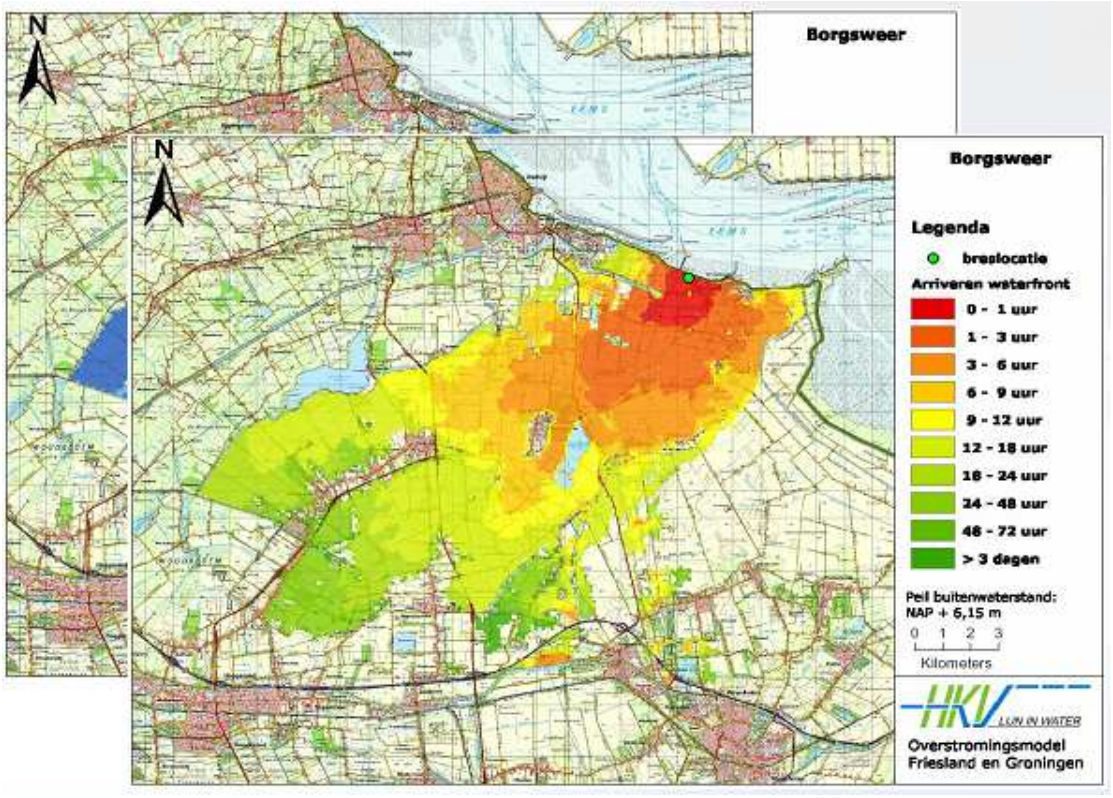


Figure 2.17 Example of pre-calculated flood maps used in FLIWAS

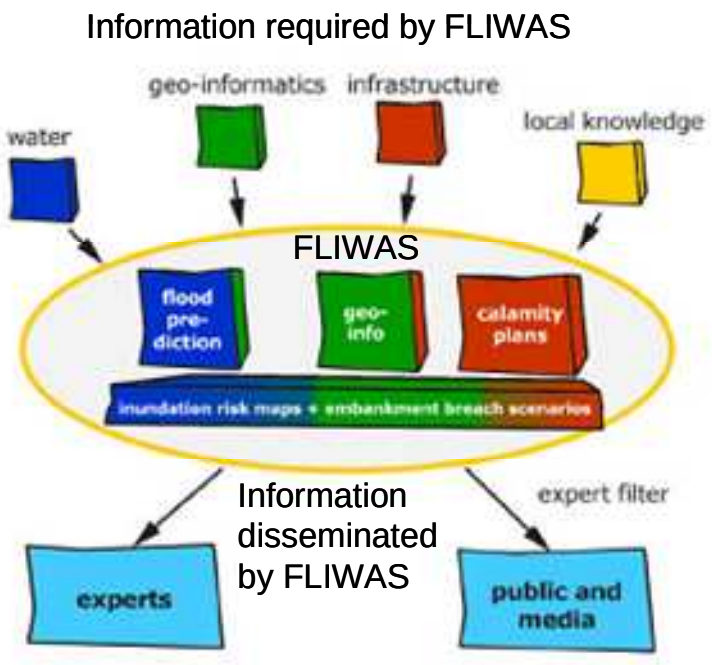


Figure 2.18 Diagrammatic overview of FLIWAS

2.4.7 *Stability of vehicles in floodwater, Australia/UK*

Keller and Mitsch (1993) carried out research on the stability of both cars and people in flood conditions to inform the design of urban streets as floodways for floods with a return period of greater than 1 in 5 years. The research took an entirely theoretical approach and considered the physics of vehicle and person stability in flood conditions. The analysis of vehicle stability involved calculations for three types of common cars. The vehicle stability calculations were based on the distribution of the buoyancy force between the two axles. The axle load for the front and rear axle was estimated from car manufacturer' specifications. A simple spreadsheet was set up using the research carried out by Keller and Mitsch. This could be used to inform the accessibility of roads during flood events. A typical example of stability curves for fours types of vehicles, related to the velocity and depth of the flood water is shown in Figure 2.19.

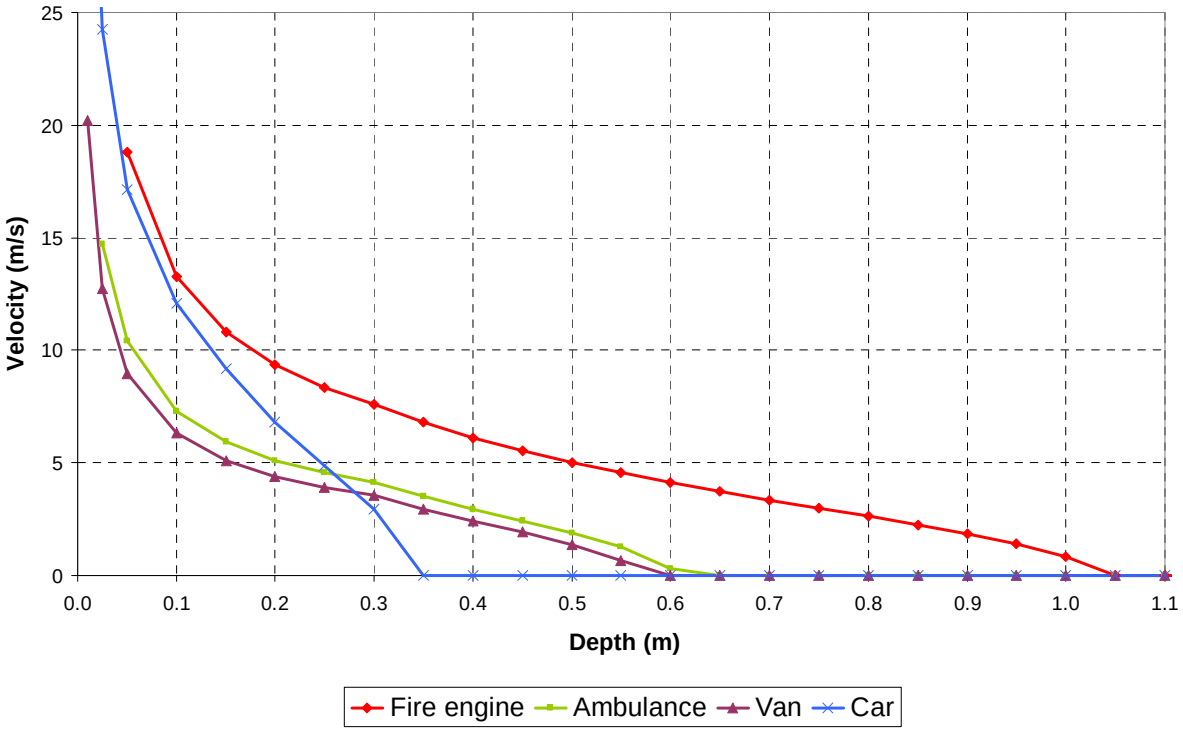


Figure 2.19 **Stability of different vehicles in flood water as a product of the depth and velocity**

2.4.8 *Evacuation Calculator, The Netherlands*

The Evacuation Calculator (EC) was developed in order to calculate how much time is required for evacuation and to determine the effect of traffic management during the evacuation process on the required evacuation time. The EC is used for the generation and distribution of trips, one might say the traffic load distribution to the traffic network. The traffic model has the function of managing the network and allocating the available transport capacity to the load generated by the EC.

A summary of the way in which the EC works is given below:

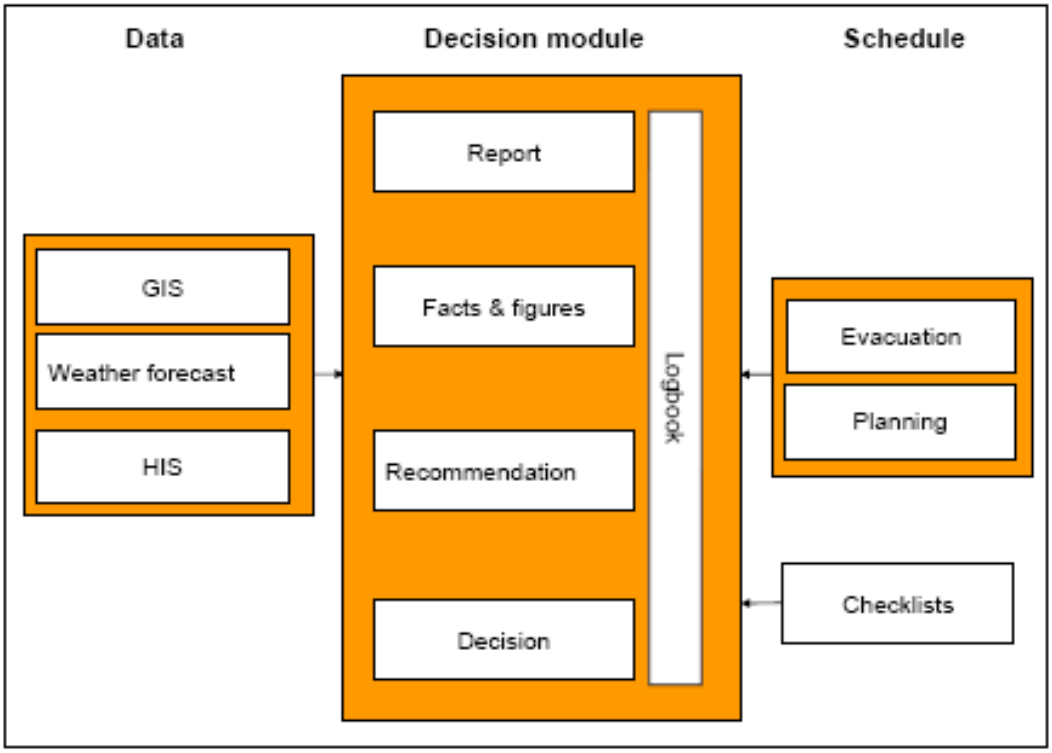
i. The EC first calculates the number of trips needed to evacuate each postal code area which is marked as a 'source zone'. The number of trips depends on the number of people and cattle present and the distribution of the people over different evacuation categories.
ii. The EC distributes the number of trips from all source zones over the different exits available. For this distribution there are four options:
    - Reference: The evacuees from each source area are equally distributed over each exit. Each exit thus receives the same number of people;
    - Nearest exit: People go to the exit nearest to them;
    - Traffic management: The vehicle distance will be minimised given a use of the exits proportional to the projected capacity;
    - Outflow areas: the user is free in assigning origin zones to a set of one of more exits. Within each combination of origins and destination(s) the traffic management method will be applied (minimising the vehicle distance given the use of the exits proportional to the projected capacity).

iii. The EC calculates the time needed for all people to organise themselves for departure and to drive from the source zone to the exit zone
iv. The EC determines the time needed at the exit

The EC calculates one situation assuming a best case regarding behaviour of people and traffic flow.

2.4.9 *ESCAPE, The Netherlands*

ESCAPE stands for European Solutions by Co-operation And Planning in Emergencies. As part of the ESCAPE project a Decision Support System (DSS) was developed. The Escape DSS consists of a module for the calculation of potential damage and casualties as a result of inundation, and a module that permits the calculation of the time required for the evacuation of a certain area as a function of the location and number of people to evacuate, the capacity of evacuation roads and the available exits of the area. To determine the evacuation, this system uses the different input data: demography; road inventory; weather conditions. Furthermore, for every area the number of inhabitants, their location, and the number of disabled and elderly people has to be known. Figure 2.20 shows the modular setup of Escape.



(Source: Lumbroso et al)
Figure 2.20 Modular setup of Escape

2.4.10 *INDY, The Netherlands*

INDY provides a method to assess mass evacuation times for floods using a dynamic model. It was produced by Netherlands Organisation for Applied Scientific Research Building and Construction (TNO) and Delft University of Technology. For the evacuation model the dynamic

traffic assignment (DTA) model called INDY was used. The model allows the analysis of traffic scenarios on transportation networks. Its flexible modelling of the interactions between travel demand and infrastructure supply allow it to predict the traffic conditions of a road network over time, identify the locations where congestion occurs and estimate the corresponding delays. INDY is able to simulate traffic over the network in a realistic way such that the results serve as a good indication of the expected traffic outcome resulting from an evacuation. After the simulation is completed, the results can be visualised using the specialist software.

2.4.11 *Probability of building collapse, UK/USA/Others*

This is not a tool as such; however, there has been some limited research into the combinations of velocity and depth of floodwater that are required for the collapse of buildings during a flood. Some typical curves are shown in Figure 2.21. These could be used to define zones where probabilities of the collapse of buildings following a dam or flood defence failure can be mapped. An example of how this can be done is shown in Figure 2.22.

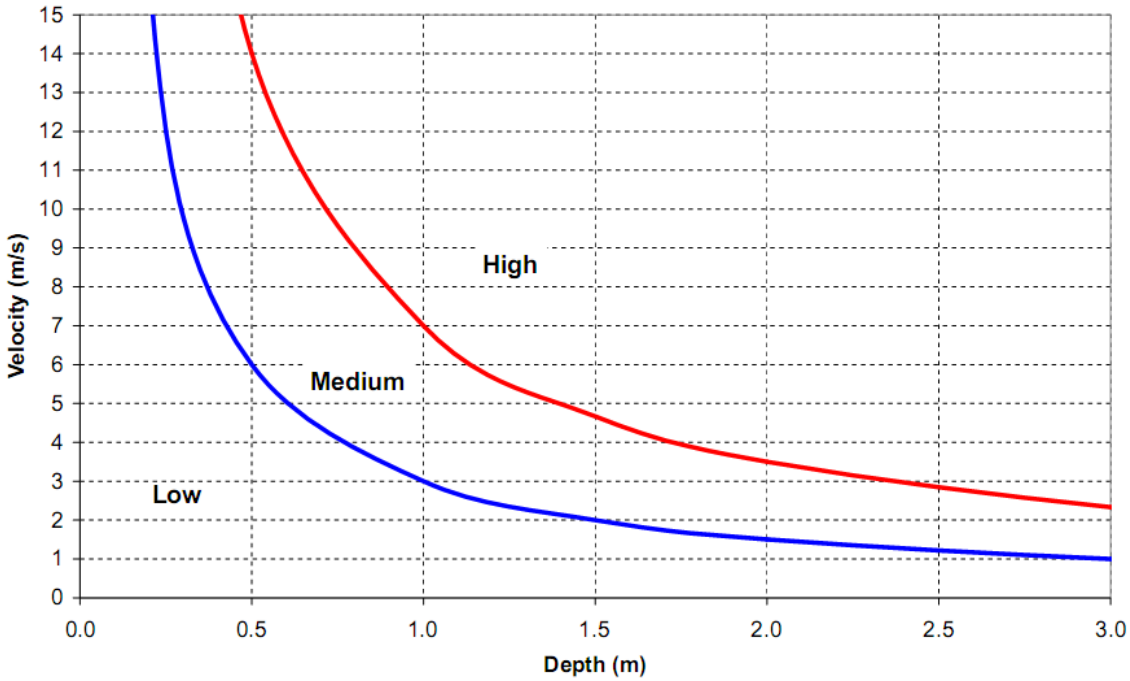


Figure 2.21 **Graphs of floodwater velocity vs. depth that can be used to estimate the probability of building collapse**

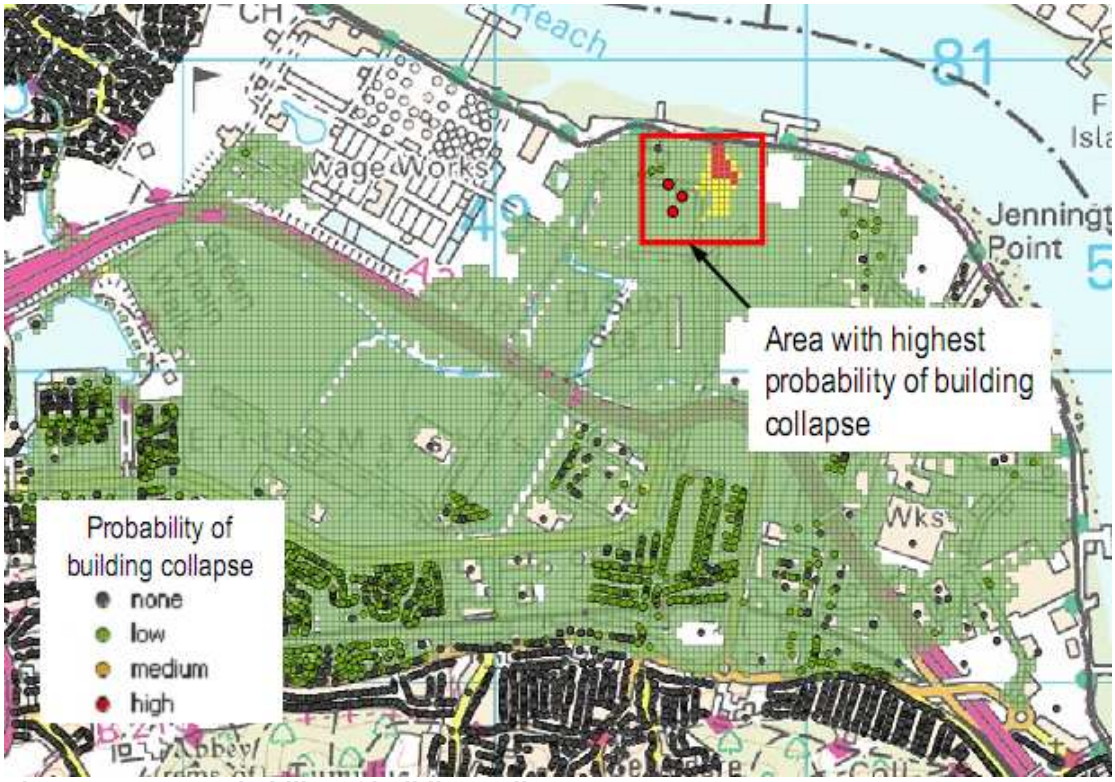
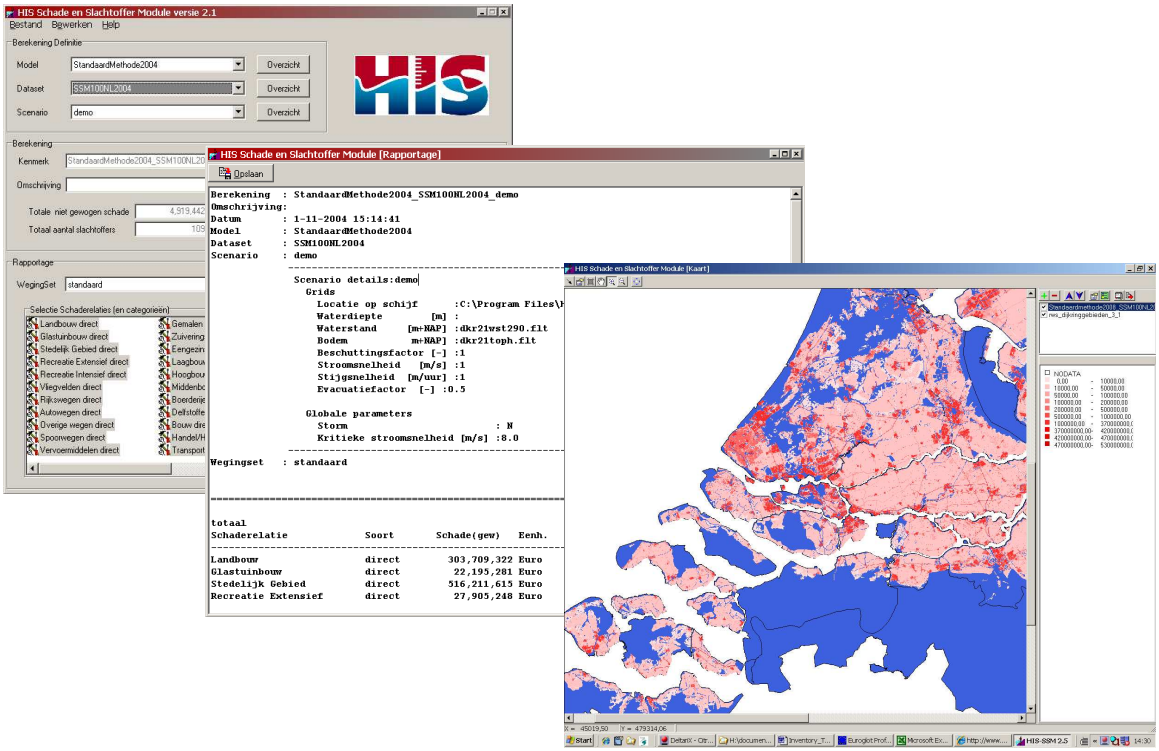


Figure 2.22 Probability of building collapse

2.4.12 *HIS SSM, damage and casualties module, The Netherlands*

The tool was developed by the Dutch Ministry of Traffic, Public Works and Water Management to determine damages and casualties for different flooding scenarios. The tool provides a standardized method for the Netherlands to ensure that the calculation of damages and casualties are being performed in a uniform manner. The tool is part of the Flood Information System (HIS) but can be used stand-alone. The tool requires water depth maps as an input. Figure 2.23 shows the user interface, report and map results from the HIS SSM.

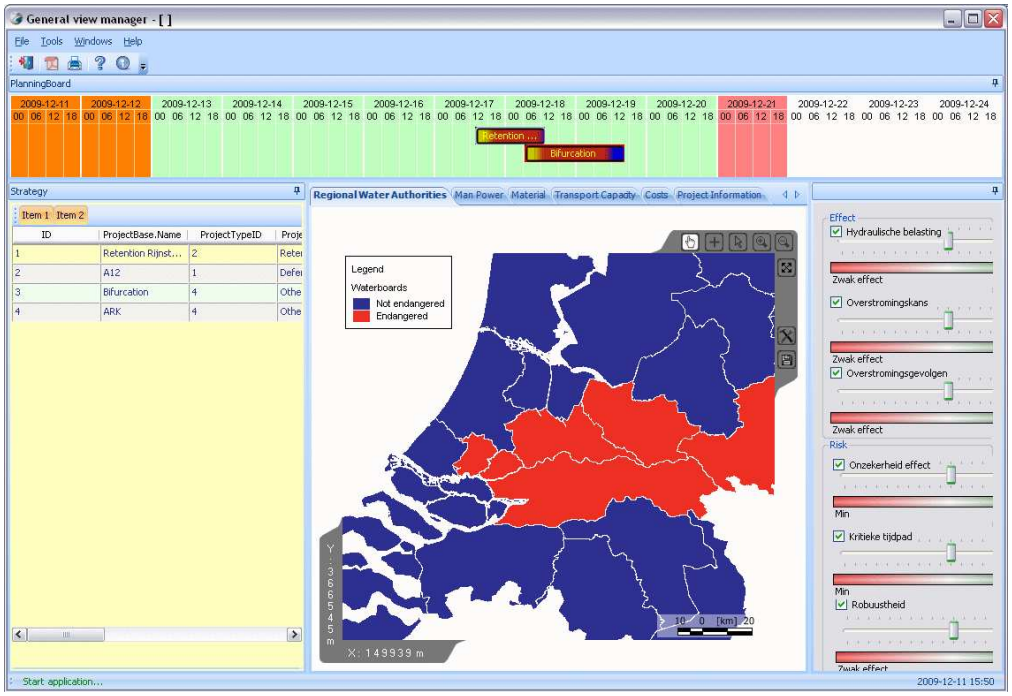


(Source: Groot Zwaaftink and Dijkman)

Figure 2.23 User interface, report and map results from the HIS SSM

2.4.13 *Planning kit for flood event measures, The Netherlands*

The planning kit was developed by Deltares, and provides insight into measures which can be taken to manage a flood event or to reduce the impact of flooding. The kit is an assembly of all possible measures and their effects. The effects have been pre-calculated to avoid extensive calculations to be made during an actual event. The kit includes measures which are thought to be applicable but are not adequate as a result of for example side-effects. The planning kit includes information on required resources and costs. It is currently at a prototype stage but may be used in the future by emergency planners. Figure 2.24 shows an example screen from the prototype planning kit for flood event measures.

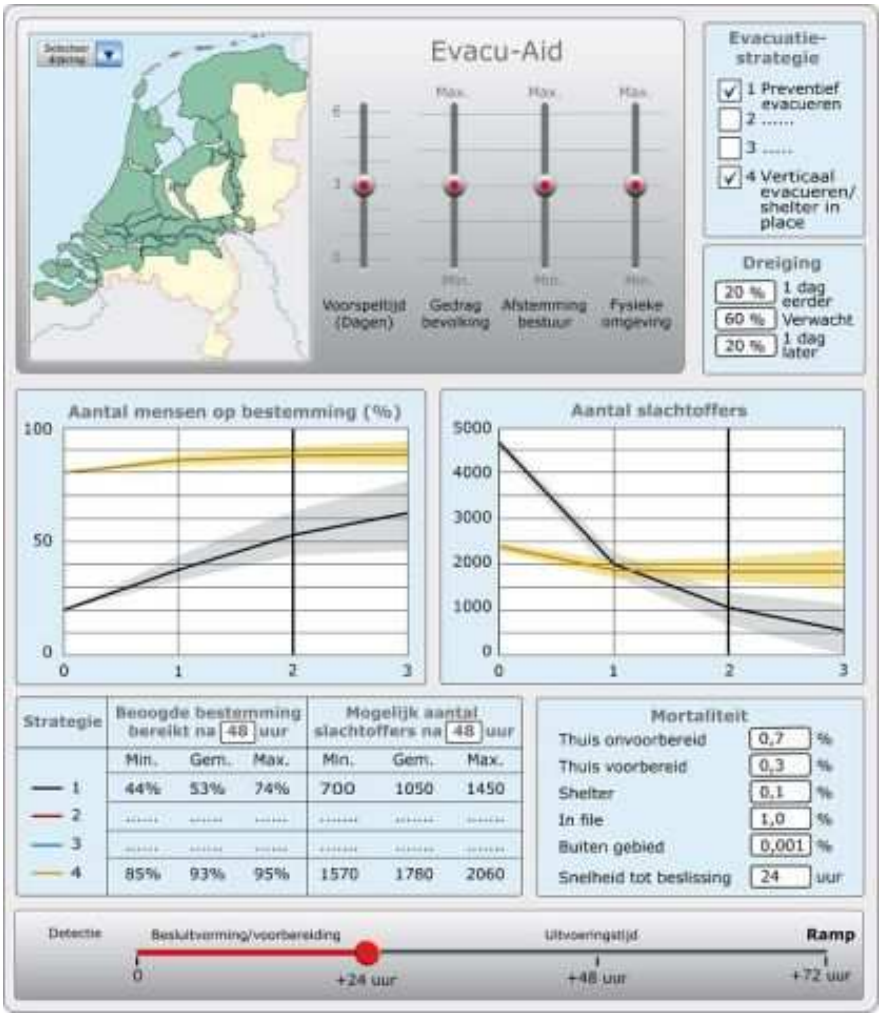


(Source: van Ruiten and Hendriks)

Figure 2.24 Example screen from the prototype planning kit for flood event measures

2.4.14 *EvacuAid*

EvacuAid was developed to evaluate different evacuation strategies. EvacuAid can be used during an event for decision support and for event planning to evaluate different evacuation strategies. EvacuAid consists of a database with simulation results from the National Evacuation Module. To gain insight in the outcome of an evacuation strategy, assumptions are made on the threat, the behaviour of people, decisions made by the government and the physical aspects and the interaction between these aspects. Several evacuation scenarios can be defined with different sets of assumptions. It is currently at a prototype stage. Figure 2.25 shows example Evacu-Aid screens.



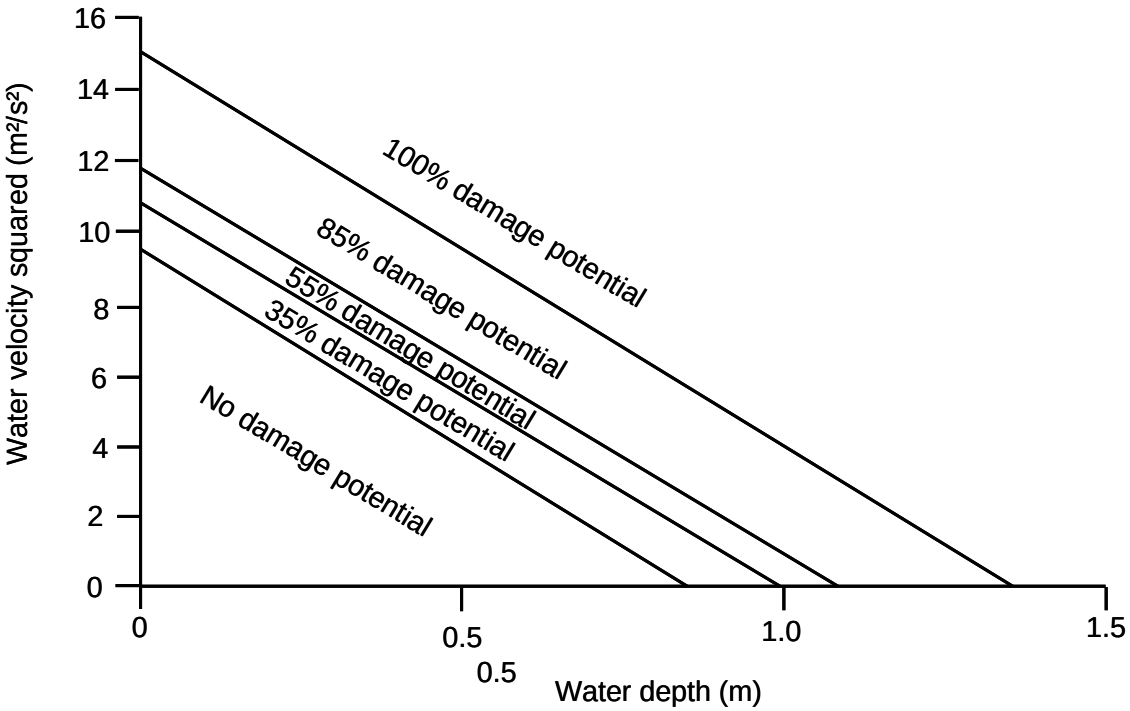
(Source: Kolen)

Figure 2.25 Example of EvacuAid screen

2.4.15 *NaTECH hazards*

Industrial accidents triggered by natural events (NaTech accidents) are a significant category of industrial accidents and important for emergency plans. Several specific elements that characterize NaTech events still need to be investigated. In particular, the damage mode of equipment and the specific final scenarios that may take place in NaTech accidents are key elements for the assessment of hazard and risk due to these events.

In the case of floods no simplified equipment damage models are available in the literature. There is only very limited data available to analyze in detail the damage caused by floods to industrial equipment. The information about past accidents recorded in industrial accident databases is usually not sufficiently detailed, in particular with respect to the description of the structural damage of equipment caused by the floods. There have been some limited tools available to assess NaTech hazards using simple damage functions such as those shown in Figure 2.26.



(Source: Bonvicini et al, 2009)

Figure 2.26 Example of simple damage function for use in assessing NaTech damage by flood water

3 Review of the results of the research undertaken with flood managers

3.1 Introduction

The research undertaken with flood managers in WP2 was to gain an idea of the level of awareness that flood managers had of the tools that have been developed and that could be potentially used to improve flood emergency plans. This chapter summarises the details of the research undertaken with stakeholders. Stakeholders were engaged through two main methods:

- Face-to-face discussions and meetings;
- An online survey in English, Dutch and French that was disseminated to flood managers within the three partner countries.

The objectives of the research undertaken with the stakeholders were to assess the awareness amongst flood managers of the tools that they currently use and also to attempt to ascertain the level of awareness of the tools that are available. The results of this research are summarised below. Details of the surveys and full results are given in Appendices A, B, C and D.

3.2 Introduction to the surveys

For each of the countries the flood managers were asked about the tools, methods and guidelines that they currently use or knew of that could be of assistance in formulating emergency plans for floods. The following choices were given in the survey:

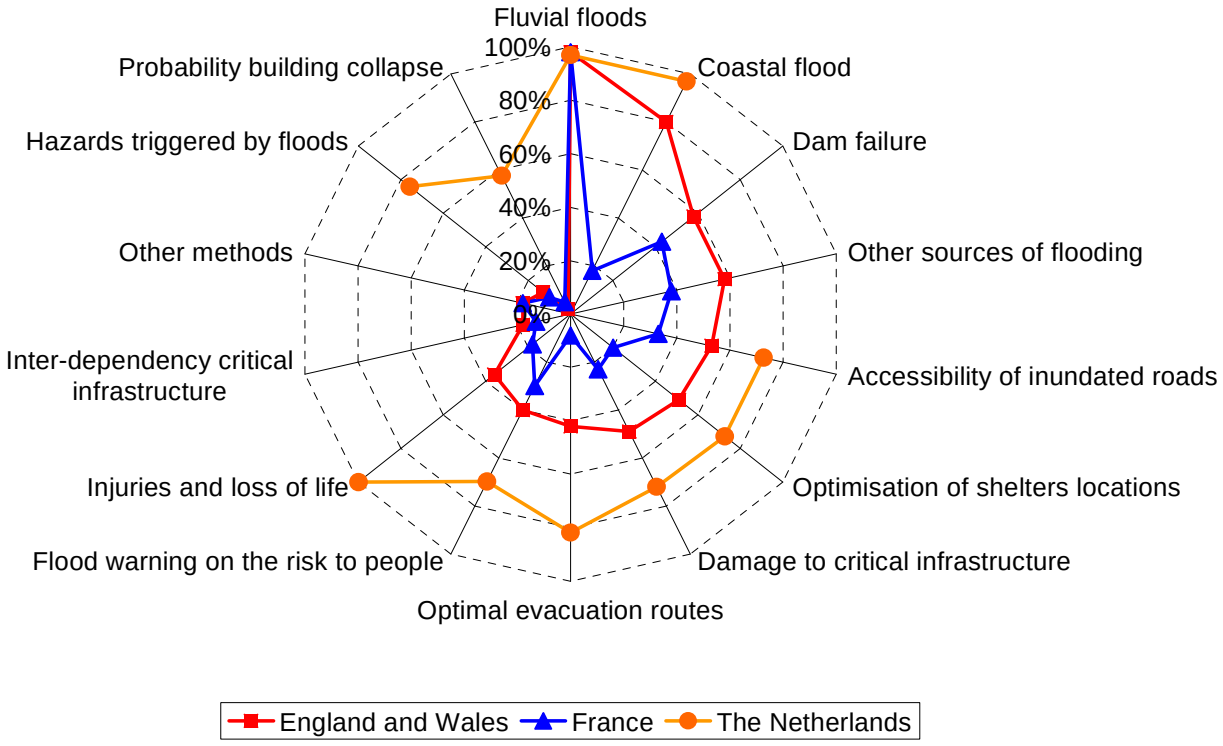
- Methods to assess the flood hazard from fluvial floods;
- Methods to assess the flood hazard from coastal floods;
- Methods to assess the flood hazard from dam failures;
- Methods to assess the flood hazard from other sources;
- Methods to assess potential injuries and loss of life during floods;
- Tools to assess the “accessibility” of inundated roads to emergency services and other vehicles;
- Methods to assess the optimal evacuation route(s) from inundated areas;
- Tools to assess the effects of improvements in the dissemination of flood warnings on the risk to people;
- Tools to assess the potential damage to critical infrastructure (e.g. gas, water and electricity supplies);
- Methods to assess the inter-dependency between critical infrastructure;
- Tools to optimise the location of shelters with respect to the flood hazard;
- Methods to assess other hazards triggered as the result of flooding;
- Methods to assess the probability of buildings collapsing during floods.

The research also investigated what tools are actually being used by flood managers to help them inform emergency plans, and also the reasons why tools were not being used. Finally flood managers were asked to provide comments on tools, methods or guidance that could usefully contribute to improving emergency plans for floods. The results of the surveys are summarised below.

In England and Wales there was 53 Environment Agency staff who responded to the survey of which 39 completed all the questions. In France 77 flood managers commenced the survey with 31 people completing all the questions. It is important to note that in the Netherlands the response rate to the survey was low. There were eight responses of which five people worked for a Dutch research institute who produce tools for flood risk management.

3.3 Awareness of tools available

As part of the survey flood managers in the three countries were asked which tools, methods and guidelines they used or knew of that were of use in formulating emergency plans for floods. The list of options that was provided in the survey is detailed in Section 3.2. Figure 3.1 shows the percentage of responders in the three countries who use or are aware of the different tools.



Note: Questions relating to dam failure; other sources of flooding; inter-dependency of critical infrastructure; and other methods were not included in the Dutch survey as they were not seen as relevant to the situation in the Netherlands
Netherlands results based on a sample of eight people five of whom work at a Dutch institute that carried out research into flood risk and flood emergency management

Figure 3.1 Percentage of responders who use or aware of a method that contribute to flood emergency plans

Figure 3.1 shows that the level of awareness of tools was highest in the Netherlands followed by England and Wales, and then France. However, the results need to be interpreted with care. The response rate in the Netherlands was low with only eight people answering all the questions and five of these people work for a Dutch institute that carries out research into flood risk and flood emergency management tools and hence where awareness levels of the methods available could be argued to be higher than in a flood management organisation. Generally, a higher awareness was seen in England and Wales compared to France across all of the flooding aspects raised.

The awareness of methods to assess fluvial flood hazards (>90%) was very high in all three countries and high in England and Wales and the Netherlands relating to methods to assess coastal hazards. It is interesting to note that in France the level of awareness of tools to assess coastal hazards was low, around 20%.

Floodplain mapping and hydraulic modelling are both “mature sciences” in the Europe with hundreds of millions of Euros worth of mapping studies and modelling exercises being undertaken in Europe in the past decade. As a consequence it is understandable that most of the responders are familiar with the flood mapping outputs, tools and models. The level of awareness of the responders regarding tools that would cover the following was low:

- Accessibility of inundated roads
- Optimisation of the location of shelters
- Damage to critical infrastructure
- Optimal evacuation routes
- Effects of improvements in flood warning on the risk to people
- Methods to assess potential injuries and loss of life

When asked what tools they actually use very few responders from the three countries explicitly named tools that can carry out the above, even though they mentioned that they used them to inform their emergency management plans.

3.4 Obstacles to the use of tools

As part of the survey the responders were asked about the current usage of certain tools to inform flood emergency plans. The stakeholders were asked if they currently used the tools and if not to classify the reason into one of the following categories:

- Not relevant to emergency plans for floods;
- Unaware of the method;
- Cost
- User friendliness issues;
- Availability of data;
- Other reasons.

The responses to these questions are discussed below.

3.4.1 Obstacles to the use of tools to assess flood hazard

Figure 3.2 shows the responses for tools to assess the following sources of flood hazard:

- Rivers (fluvial);

- Coastal;
- Dams;
- Other sources.

The use of tools to assess fluvial and coastal flood hazards in England and Wales and the Netherlands was high, although some responders did state that methods to assess coastal flood hazards were not relevant to their plans; however, these were responders who lived in landlocked" areas unaffected by coastal flooding. The level of awareness of tools to assess the coastal flood hazard was low in France (only approximately 45% of responders). It is interesting to note that the level of awareness of the tools is higher than the percentage of responders (around 20%) in France who stated that these tools were actually used to inform emergency plans. With respect to assessing flood hazard from dams the major obstacle for these methods not being employed more frequently was "availability of data". Some 25% of responders in England and Wales and France indicated that this was an issue. Regarding assessing flood hazards from other sources (e.g. pluvial flooding) in France almost 20% of responders were unaware of methods to assess this hazard.

3.4.2 *Obstacles to the use of tools to assess flood risk to receptors*

Figures 3.3 and 3.4 show the survey responses for tools to assess the following that are mainly related to receptors (i.e. people, buildings or infrastructure) located in the floodplain:

- Potential injuries and loss of life
- Accessibility of inundated roads to vehicles
- Optimal evacuation route(s) from inundated areas
- Effects of improvements in the dissemination of flood warnings on the risk to people
- Potential damage to critical infrastructure
- Optimising the locations of shelters with respect to floods
- Assessment of other hazards triggered by flooding
- Probability of buildings collapsing during floods

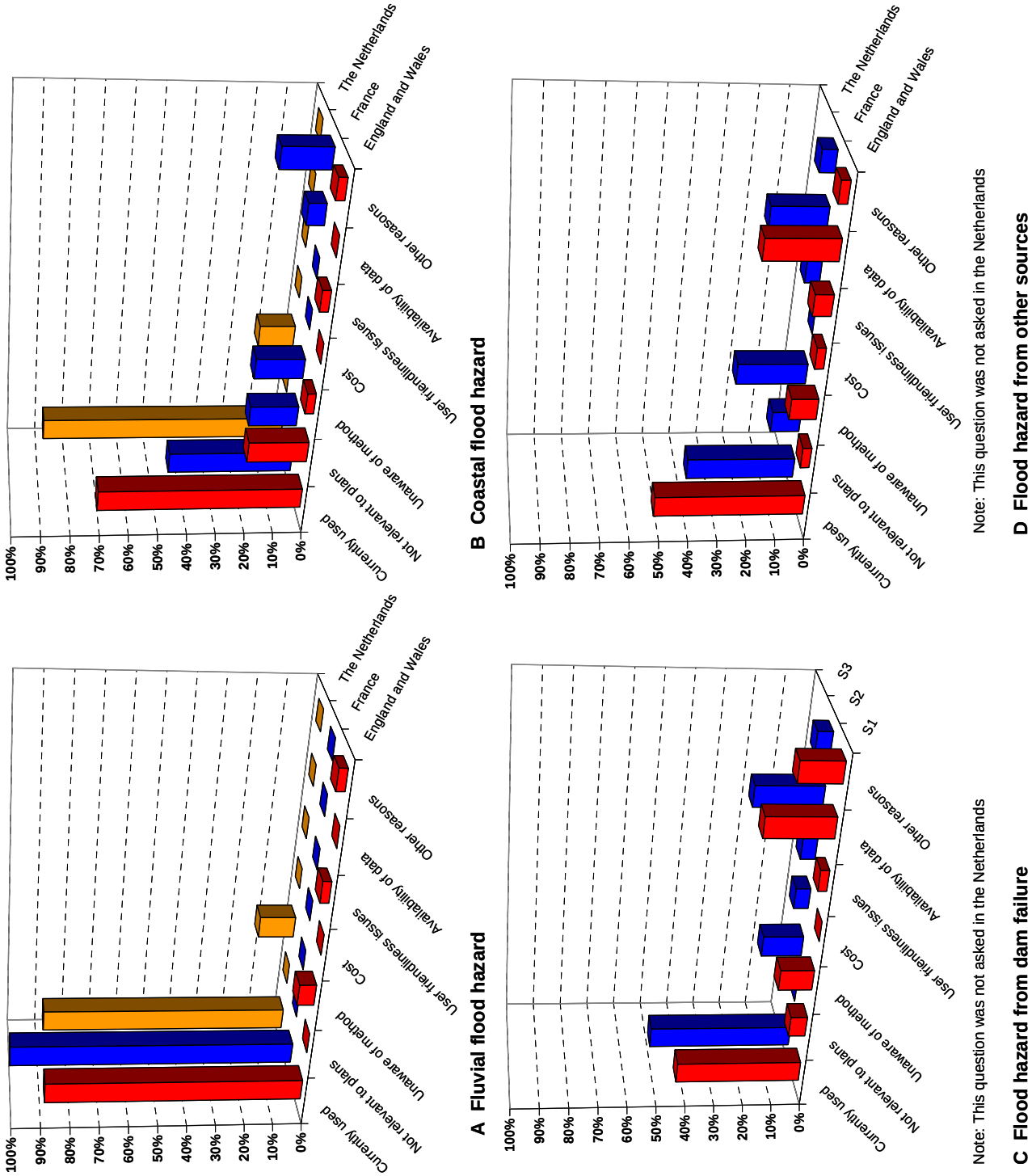
Figures 3.3 and 3.4 show that the main reason for the lack of use of tools for the type of tools listed above was "unawareness of the method". A typical reply that indicates that there is a lack of awareness of exactly what tools are available was as follows.

"*I'm not sure what you meant by any of this really. Where we have ways and means locally of determining the information you refer to I have considered that to be a tool we use but the wording of this survey implies there are specific nationally developed tools and models out there to deliver the information. If this is the case most of my answers would be that I am not aware of the tool!*"

User friendliness was not seen by the responders to be an obstacle to the use of tools but this may be linked to that fact that there was a high level of unawareness concerning these types of tools meaning that responders were unable to comment knowledgably on these issues. It is interesting to note that cost was not seen as a major constraint for the implementation of the methods. Very few users (<3%) indicated that the methods listed in the survey were not relevant to formulation of emergency plans for floods.

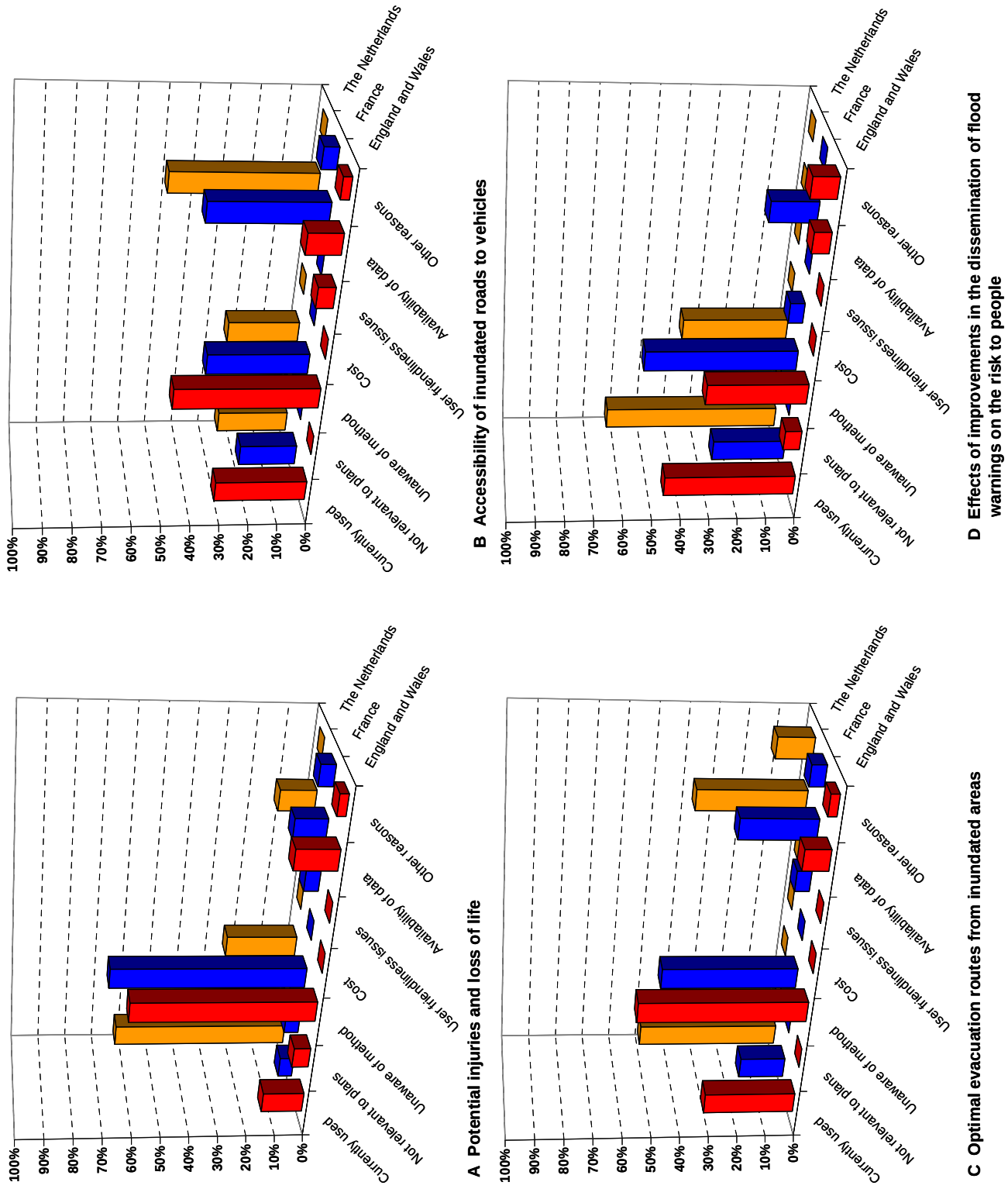
Very few of the responders to the survey (<3%) who are involved in providing information to assist with the formulation of emergency plans explicitly mentioned any methods or tools that provide information on the above subjects. For example discussions with one responder indicated that in the case of accessibility of roads to emergency vehicles often "rule of thumb" methods

were used (i.e. emergency services would be told that roads were inaccessible if there was 200 mm or more of water covering the road) rather than a more “scientifically” based method.



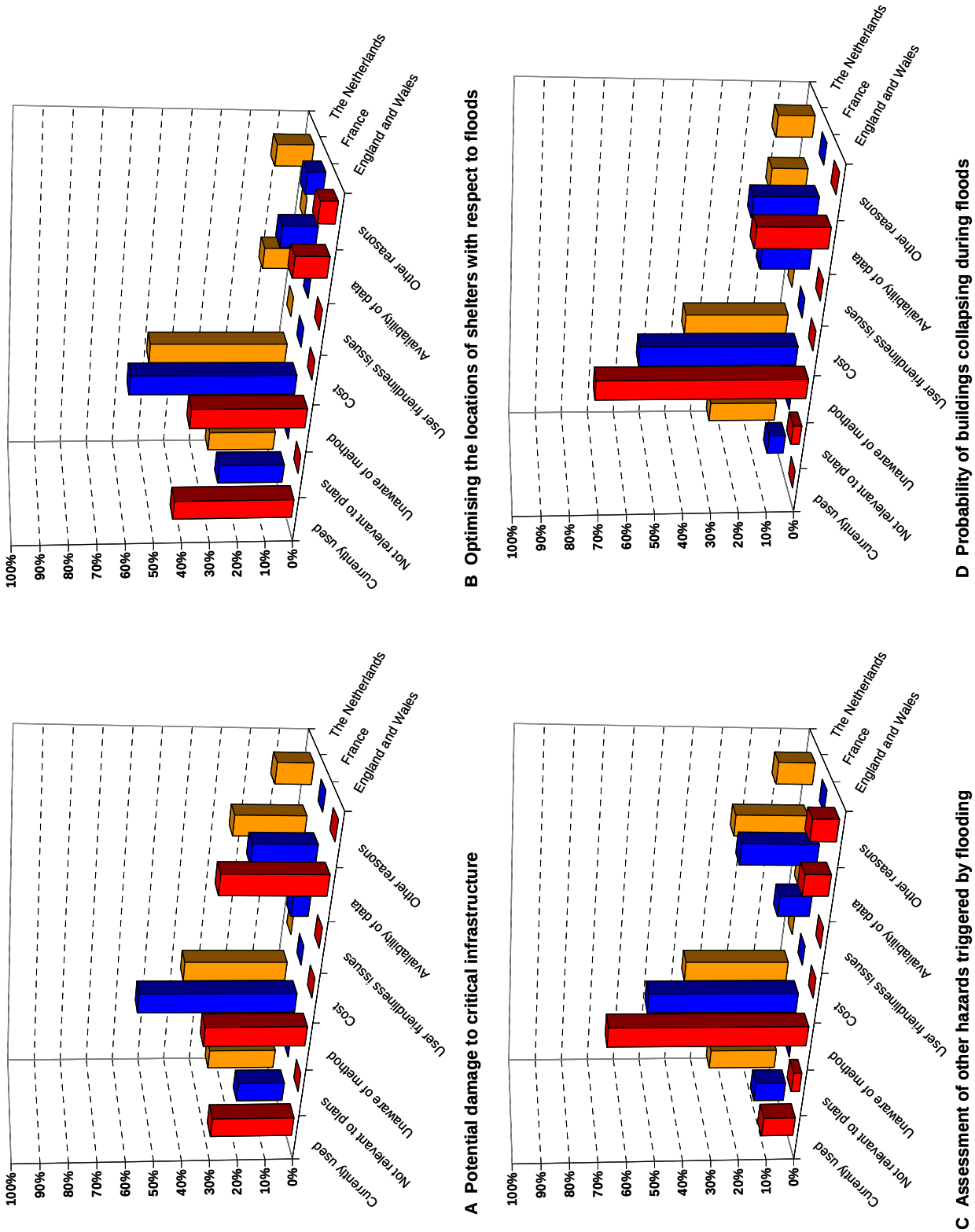
Note: Netherlands results based on a sample of eight people five of whom work at a Dutch research institute

Figure 3.2 Comparison of obstacles to using tools to assess flood hazard from different sources



Note: Netherlands results based on a sample of eight people five of whom work at a Dutch research institute

Figure 3.3 Comparison of obstacles to using tools to assess flood risk to receptors – Part 1



Note: Netherlands results based on a sample of eight people five of whom work at a Dutch research institute

Figure 3.4 Comparison of obstacles to using tools to assess flood risk to receptors – Part 2

4 Conclusions

From the research carried out many flood managers are often not aware of the tools that are available to assist them in providing information to emergency plans for floods. Based on the online survey of flood managers in the three countries, the two main obstacles to tools not being used appear to be:

1. Lack of awareness of the methods that are available
2. Availability of data

In formulating emergency plans for floods it would appear that "expert judgement" is often used rather than specific tools. Many responders to the survey mentioned that they used a combination of information rather than specific methods or tools. For example in the survey in England and Wales around half to a third of the responders stated that they were aware of or used the following methods to inform Multi-Agency Flood Plans (MAFPs):

- Accessibility of inundated roads
- Optimisation of the location of shelters
- Damage to critical infrastructure
- Optimal evacuation routes
- Effects of improvements in flood warning on the risk to people
- Methods to assess potential injuries and loss of life

However, none of the 44 responders who are involved in providing information to assist with the formulation of MAFPs explicitly mentioned any methods or tools that provide such information.

In France the awareness level of the tools and methods available would appear to be lower than that in England and Wales and the Netherlands. The lack of awareness in general may be as a result of a need to improve the dissemination of the tools and the relevant research. The lack of awareness of tools to assess the consequences of flooding or to assess potential damage has already been pointed out in many articles and reports in France (Hubert & Ledoux, 1999).

In all three countries there would appear to be a requirement for some form of guidance on what tools are available, what data they require and how they can be implemented to give information that can be used to improve emergency plans for floods.

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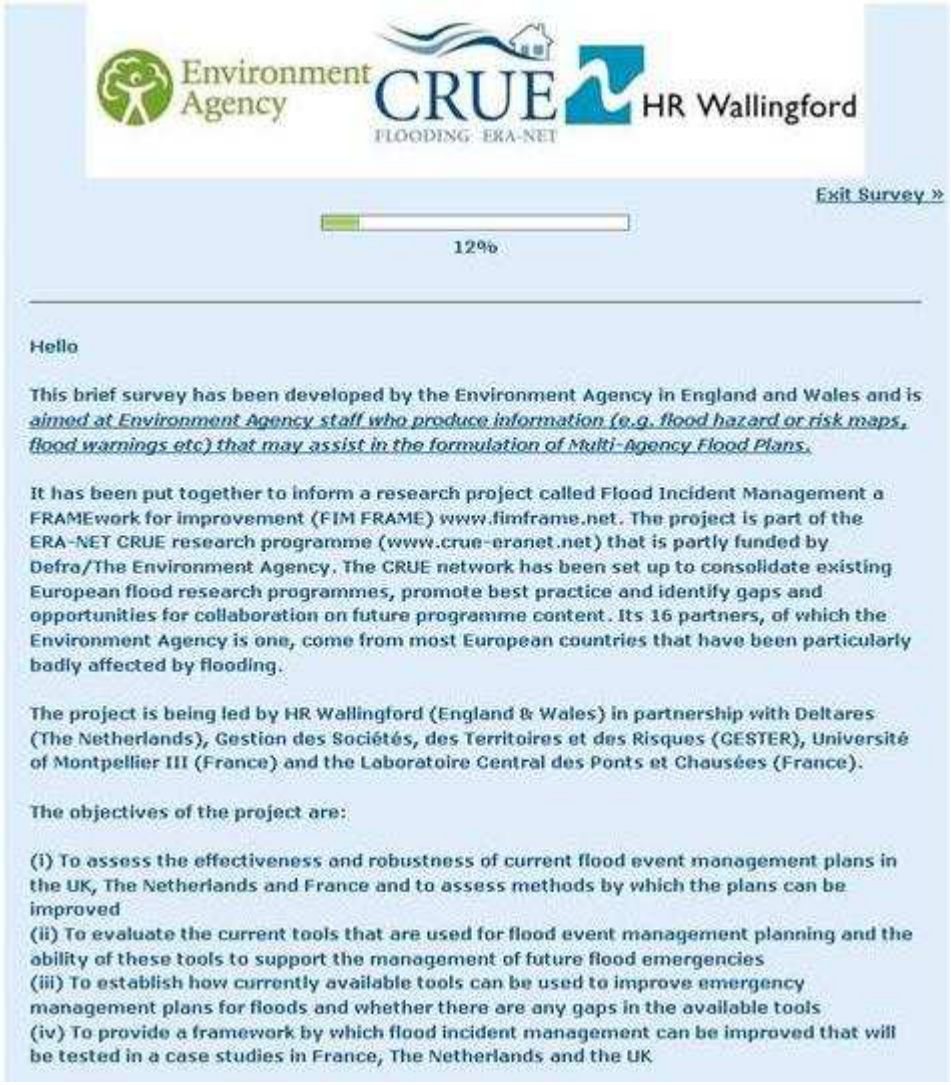
Acknowledgments

The FIM FRAME team members would like to thank all the stakeholders across England and Wales, France and the Netherlands who contributed to the work package by filling in the survey or by making time for the face-to-face consultation.

Appendix A Details of the online surveys

A1 England and Wales survey



Environment Agency CRUE FLOODING ERA-NET HR Wallingford

Exit Survey »

12%

Hello

This brief survey has been developed by the Environment Agency in England and Wales and is *aimed at Environment Agency staff who produce information (e.g. flood hazard or risk maps, flood warnings etc) that may assist in the formulation of Multi-Agency Flood Plans.*

It has been put together to inform a research project called Flood Incident Management a FRAMEwork for improvement (FIM FRAME) www.fimframe.net. The project is part of the ERA-NET CRUE research programme (www.crue-eranet.net) that is partly funded by Defra/The Environment Agency. The CRUE network has been set up to consolidate existing European flood research programmes, promote best practice and identify gaps and opportunities for collaboration on future programme content. Its 16 partners, of which the Environment Agency is one, come from most European countries that have been particularly badly affected by flooding.

The project is being led by HR Wallingford (England & Wales) in partnership with Deltares (The Netherlands), Gestion des Sociétés, des Territoires et des Risques (GESTER), Université of Montpellier III (France) and the Laboratoire Central des Ponts et Chausées (France).

The objectives of the project are:

(i) To assess the effectiveness and robustness of current flood event management plans in the UK, The Netherlands and France and to assess methods by which the plans can be improved
(ii) To evaluate the current tools that are used for flood event management planning and the ability of these tools to support the management of future flood emergencies
(iii) To establish how currently available tools can be used to improve emergency management plans for floods and whether there are any gaps in the available tools
(iv) To provide a framework by which flood incident management can be improved that will be tested in a case studies in France, The Netherlands and the UK

opportunities for collaboration on future programme content. Its 16 partners, of which the Environment Agency is one, come from most European countries that have been particularly badly affected by flooding.

The project is being led by HR Wallingford (England & Wales) in partnership with Deltares (The Netherlands), Gestion des Sociétés, des Territoires et des Risques (GESTER), Université of Montpellier III (France) and the Laboratoire Central des Ponts et Chausées (France).

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(iii) To establish how currently available tools can be used to improve emergency management plans for floods and whether there are any gaps in the available tools
(iv) To provide a framework by which flood incident management can be improved that will be tested in a case studies in France, The Netherlands and the UK

The main objectives of the survey are:

(i) To understand what tools, method, software and guidelines are currently used by the Environment Agency that could be of assistance to emergency planners in formulating Multi Agency Flood Plans
(ii) To understand what tools (e.g. methods, guidelines, checklists, software etc) if any, could be developed to assist with the development of Multi Agency Flood Plans

Your participation in this study is completely voluntary. There are no foreseeable risks associated with this project. However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any point. It is very important for us to learn your opinions.

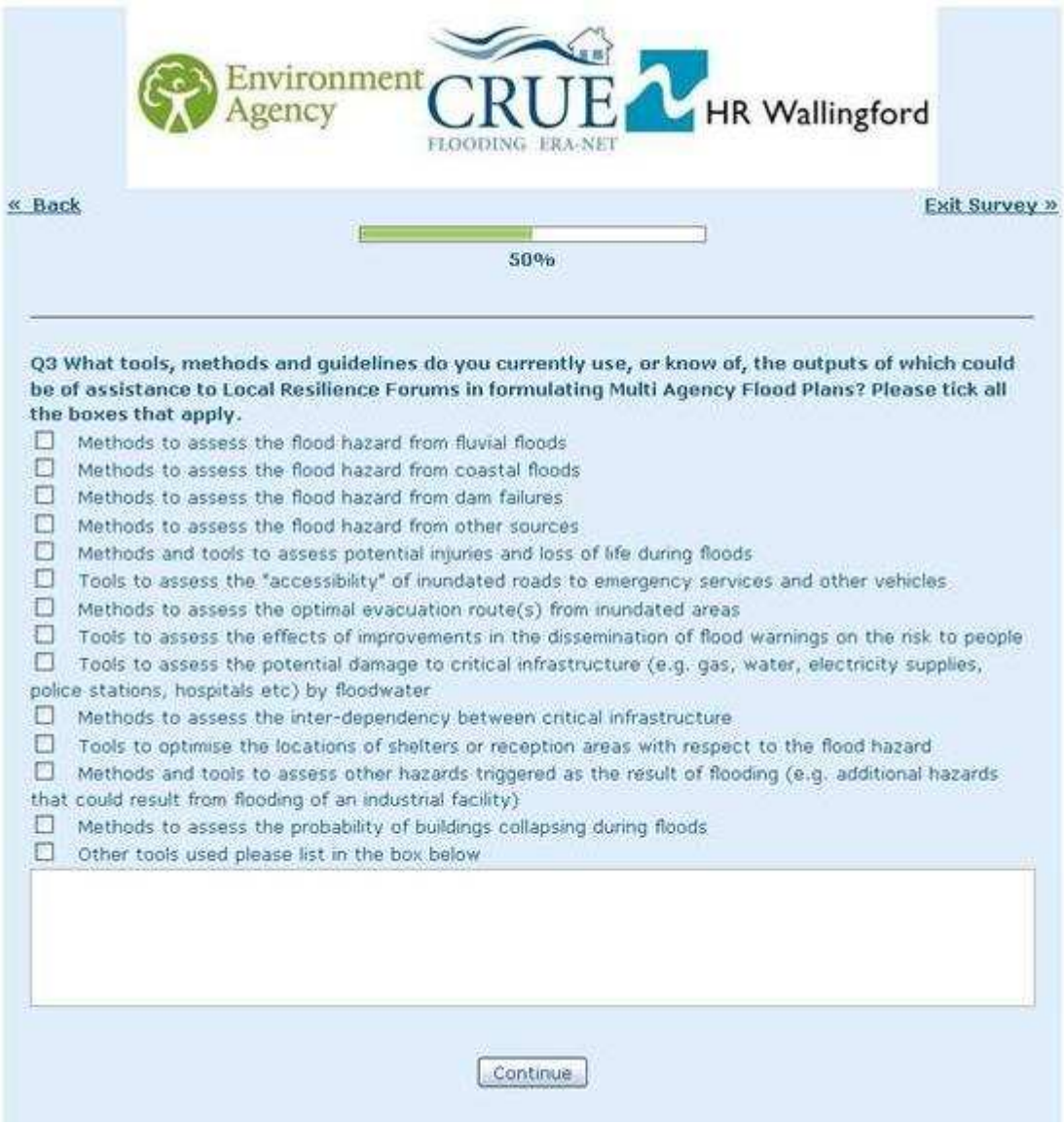
Your survey responses will be strictly confidential and data from this research will be reported only in the aggregate. Your information will be coded and will remain confidential. If you have questions at any time about the survey or the procedures, you may contact Darren Lumbroso by email at d.lumbroso@hrwallingford.co.uk.

It should take no more than 10 minutes to complete the questionnaire.

Thank you very much for your time and support. Please start with the survey now by clicking on the Continue button below.

Continue


Environment Agency
CRUE
FLOODING ERA-NET
HR Wallingford
« Back
Exit Survey »
37%
Q1 Which Environment Agency Area do you work in?
-- Select --
Q2 Are you currently involved in producing information that may be used by Local Resilience Forums in formulating Multi Agency Flood Plans?
Yes
No
Don't know
Continue



« Back Exit Survey »

50%

Q3 What tools, methods and guidelines do you currently use, or know of, the outputs of which could be of assistance to Local Resilience Forums in formulating Multi Agency Flood Plans? Please tick all the boxes that apply.

- ☐ Methods to assess the flood hazard from fluvial floods
- ☐ Methods to assess the flood hazard from coastal floods
- ☐ Methods to assess the flood hazard from dam failures
- ☐ Methods to assess the flood hazard from other sources
- ☐ Methods and tools to assess potential injuries and loss of life during floods
- ☐ Tools to assess the "accessibility" of inundated roads to emergency services and other vehicles
- ☐ Methods to assess the optimal evacuation route(s) from inundated areas
- ☐ Tools to assess the effects of improvements in the dissemination of flood warnings on the risk to people
- ☐ Tools to assess the potential damage to critical infrastructure (e.g. gas, water, electricity supplies, police stations, hospitals etc) by floodwater
- ☐ Methods to assess the inter-dependency between critical infrastructure
- ☐ Tools to optimise the locations of shelters or reception areas with respect to the flood hazard
- ☐ Methods and tools to assess other hazards triggered as the result of flooding (e.g. additional hazards that could result from flooding of an industrial facility)
- ☐ Methods to assess the probability of buildings collapsing during floods
- ☐ Other tools used please list in the box below

Continue


Environment Agency
CRUE
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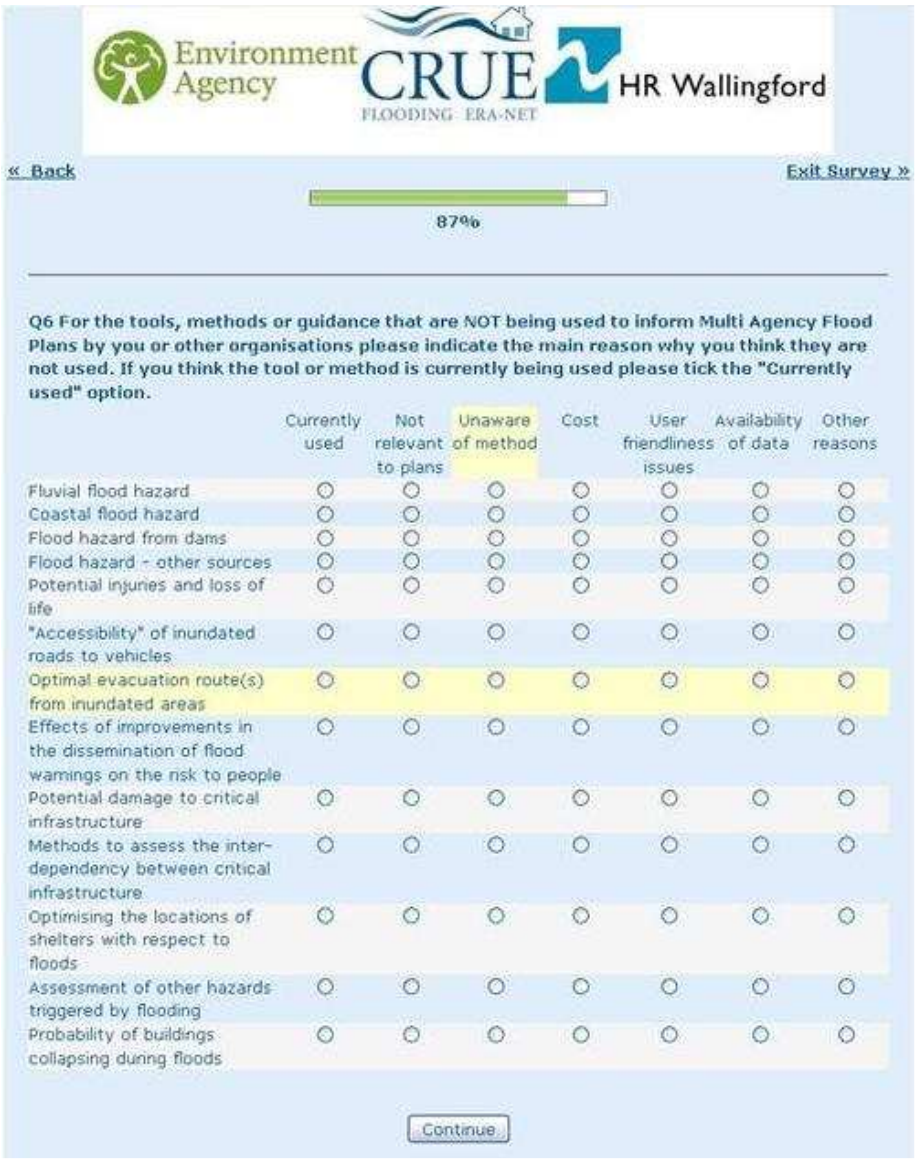
HR Wallingford
« Back
Exit Survey »
62%
Q4 Please list the names of the tools, methods or guidance that you currently use that are of assistance to Local Resilience Forums in producing Multi Agency Flood Plans?
Continue


Environment Agency
CRUE
FLOODING ERA-NET
HR Wallingford
« Back
Exit Survey »
75%
Q5 Are there any other tools, methods or guidance that you would like to see developed that could be used by Local Resilience Forums to develop Multi Agency Flood Plans?
No
Yes - Please provide a brief description in the box below
Continue



Environment Agency CRUE FLOODING ERA-NET HR Wallingford

« Back Exit Survey »

87%

Q6 For the tools, methods or guidance that are NOT being used to inform Multi Agency Flood Plans by you or other organisations please indicate the main reason why you think they are not used. If you think the tool or method is currently being used please tick the "Currently used" option.

	Currently used	Not relevant to plans	Unaware of method	Cost	User friendliness issues	Availability of data	Other reasons
Fluvial flood hazard	○	○	○	○	○	○	○
Coastal flood hazard	○	○	○	○	○	○	○
Flood hazard from dams	○	○	○	○	○	○	○
Flood hazard - other sources	○	○	○	○	○	○	○
Potential injuries and loss of life	○	○	○	○	○	○	○
"Accessibility" of inundated roads to vehicles	○	○	○	○	○	○	○
Optimal evacuation route(s) from inundated areas	○	○	○	○	○	○	○
Effects of improvements in the dissemination of flood warnings on the risk to people	○	○	○	○	○	○	○
Potential damage to critical infrastructure	○	○	○	○	○	○	○
Methods to assess the inter-dependency between critical infrastructure	○	○	○	○	○	○	○
Optimising the locations of shelters with respect to floods	○	○	○	○	○	○	○
Assessment of other hazards triggered by flooding	○	○	○	○	○	○	○
Probability of buildings collapsing during floods	○	○	○	○	○	○	○

Continue


Environment Agency
CRUE
FLOODING ERA-NET
HR Wallingford
« Back
Exit Survey »
100%
Q7 If you have any further comments that you wish to make about tools, methods or guidance that you believe could contribute to improving Multi Agency Flood Plans please add them to the box below.
Continue
The final project reports will be available from the project web site www.fimframe.net. If you would like any further information please contact the project coordinator Darren Lumbroso by email at d.lumbroso@hrwallingford.co.uk.
Thank you for completing this survey

A2 French survey

LCPC Laboratoire Central des Ponts et Chaussées — CRUE FLOODING ERA-NET — Université Paul-Valéry Montpellier III

Exit Survey »

11%

Bonjour,

Ce questionnaire a été réalisé afin de renseigner un projet de recherche européen appelé «*Flood Incident Management, a FRAMEwork for improvement (FIM FRAME)*» www.fimframe.net. Ce projet fait partie du programme de recherche ERA-NET CRUE (www.crue-eranet.net), en collaboration avec le MEEDDM et des partenaires étrangers (Angleterre et Pays-Bas)

Le réseau CRUE a été mis en place pour renforcer les différents programmes de recherche européens sur les inondations, promouvoir les meilleures pratiques et identifier les lacunes et atouts dans la gestion du risque inondation. Ses 16 partenaires, dont le Ministère de l'Ecologie et du Développement Durable, viennent des pays européens qui ont été particulièrement touchés par le risque inondation.

Le projet est piloté par le laboratoire *HR Wallingford* (Angleterre et Pays de Galles), en partenariat avec *Deltares* (Pays-Bas), le laboratoire Gester (*Gestion des Sociétés, des Territoires et des Risques*) de Université de Montpellier III (France) et le Laboratoire Central des Ponts et Chaussées (France).

Objectifs de la recherche:

- Les objectifs du projet sont:

1. Evaluer l'efficience et la robustesse des plans de gestion du risque inondation actuels en Angleterre, aux Pays-Bas et en France, et évaluer les méthodes qui pourraient permettre d'améliorer ces plans.
2. Evaluer les outils actuels utilisés en matière de planification de la gestion de crise inondation et la capacité de ces outils à perfectionner la gestion des futures crises liées aux inondations.
3. Envisager la façon dont les outils actuellement disponibles peuvent être utilisés pour améliorer les plans de gestion de crise « inondations » et identifier les éventuels manques au niveau de ces outils.
4. Fournir un cadre d'étude pour l'amélioration de la gestion du risque inondation à travers des études de cas en France, au Pays-Bas et en Angleterre.

- Les principaux objectifs du questionnaire sont:

1. Comprendre quelles sont les informations qui peuvent aider les gestionnaires de crise lors de la réalisation de « plans de gestion de crise inondations ».
2. Connaitre les outils (méthodes, guide méthodologique, directive, logiciels d'aide à la décision etc) qui pourraient être développés afin d'aider à l'amélioration et à la diffusion des «plans de gestion de crise inondations».

Il est très important pour nous de connaître vos opinions.

Votre participation à cette étude est libre. Vous pouvez vous retirer de l'enquête à n'importe quel moment. Vos réponses au questionnaire seront strictement confidentielles et seuls les résultats généraux figureront dans le rapport. Vos informations seront codées et resteront confidentielles. Si vous aviez des questions concernant le questionnaire ou la procédure, veuillez contacter Freddy Vinet par e-mail à freddy.vinet@univ-montp3.fr ou le coordonnateur Darren Lumbroso (d.lumbrosos@hrwallingford.co.uk).

La réponse au questionnaire ne devrait pas prendre plus de dix minutes.

Nous vous remercions pour l'intérêt et le temps que vous avez porté à cette étude. Merci de commencer le questionnaire en cliquant sur le bouton suivant «continue».

Continue

« Back Exit Survey »

44%

Q1 Dans quelle DREAL/DDT travaillez-vous?

-- Select --

Q2 Dans quel service travaillez-vous?

Q3 Êtes-vous actuellement impliqué dans la production d'informations susceptibles d'être utilisés dans l'élaboration de plans de gestion de crise inondation (PCS, ORSEC, PPI)?

- Oui
- Non
- Ne sait pas

Continue

« Back Exit Survey »

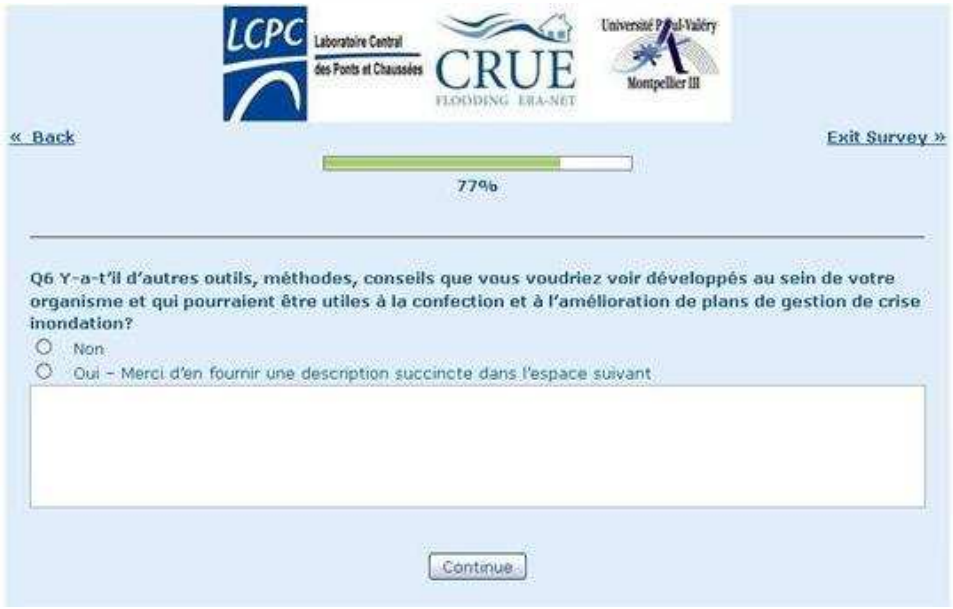
55%

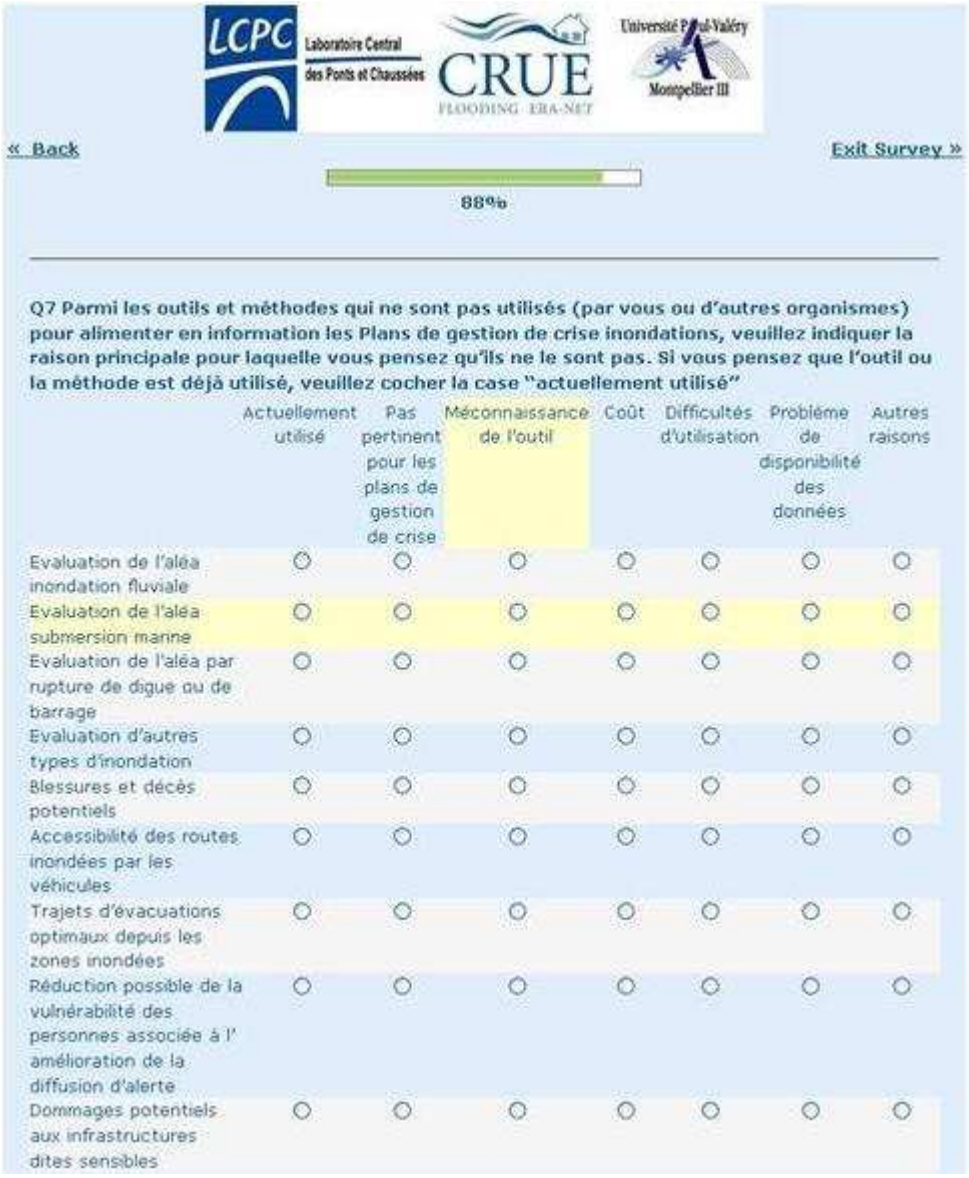
Q4 Quels sont les outils et méthodes que vous utilisez habituellement, ou dont vous connaissez l'existence, et dont les résultats pourraient aider à la réalisation de Plans de gestion de crise inondation? Veuillez cocher toutes les cases qui répondent à la question

- ☐ Méthodes pour évaluer l'aléa « inondations fluviales »
- ☐ Méthodes pour évaluer l'aléa « submersion marine »
- ☐ Méthodes pour évaluer l'aléa « ruptures de digues »
- ☐ Méthodes pour évaluer d'autres types d'inondations
- ☐ Méthodes et outils pour évaluer les pertes de vies humaines et les dommages aux personnes (santé..) en cas d'inondation
- ☐ Outils permettant d'évaluer l'accessibilité du réseau routier pour les services d'urgence et la circulation générale en cas d'inondation
- ☐ Méthodes pour évaluer les trajets optimaux d'évacuation des zones inondées
- ☐ Outils pour évaluer les effets de l'amélioration de la diffusion des alertes inondations à la population
- ☐ Outils pour évaluer les dommages potentiels aux infrastructures sensibles (par ex : gaz, eau, centrales électriques, commissariats de police, hôpitaux)
- ☐ Méthodes pour évaluer les interactions possibles entre infrastructures sensibles
- ☐ Outils pour optimiser la localisation des zones d'accueil et d'hébergement en cas d'inondation
- ☐ Méthodes et outils pour évaluer les autres risques déclenchés par les inondations (effets domino, risques NaTech par ex. les risques qui pourraient résulter d'une inondation d'un complexe industriel)
- ☐ Méthodes pour évaluer la probabilité d'effondrement des bâtiments durant les inondations
- ☐ Autres outils utilisés – lister dans l'espace suivant

Continue


« Back
Exit Survey »
66%
Q5 Veuillez lister le nom des outils (guide, logiciel d'aide à la décision, méthodologie...) que vous utilisez ou dont vous disposez actuellement et qui sont utiles à l'élaboration des plans de gestion de crise inondation?
Continue


« Back
Exit Survey »
77%
Q6 Y-a-t'il d'autres outils, méthodes, conseils que vous voudriez voir développés au sein de votre organisme et qui pourraient être utiles à la confection et à l'amélioration de plans de gestion de crise inondation?
Non
Oui - Merci d'en fournir une description succincte dans l'espace suivant
Continue



« Back Exit Survey »

88%

Q7 Parmi les outils et méthodes qui ne sont pas utilisés (par vous ou d'autres organismes) pour alimenter en information les Plans de gestion de crise inondations, veuillez indiquer la raison principale pour laquelle vous pensez qu'ils ne le sont pas. Si vous pensez que l'outil ou la méthode est déjà utilisé, veuillez cocher la case "actuellement utilisé"

	Actuellement utilisé	Pas pertinent pour les plans de gestion de crise	Méconnaissance de l'outil	Coût	Difficultés d'utilisation	Problème de disponibilité des données	Autres raisons
Evaluation de l'aléa inondation fluviale	○	○	○	○	○	○	○
Evaluation de l'aléa submersion marine	○	○	○	○	○	○	○
Evaluation de l'aléa par rupture de digue ou de barrage	○	○	○	○	○	○	○
Evaluation d'autres types d'inondation	○	○	○	○	○	○	○
Blessures et décès potentiels	○	○	○	○	○	○	○
Accessibilité des routes inondées par les véhicules	○	○	○	○	○	○	○
Trajets d'évacuations optimaux depuis les zones inondées	○	○	○	○	○	○	○
Réduction possible de la vulnérabilité des personnes associée à l'amélioration de la diffusion d'alerte	○	○	○	○	○	○	○
Dommages potentiels aux infrastructures dites sensibles	○	○	○	○	○	○	○

Méthodes pour évaluer les interactions possibles entre les infrastructures sensibles	○	○	○	○	○	○	○
Optimiser la localisation des abris en respect avec le risque inondation	○	○	○	○	○	○	○
Evaluation des autres risques déclenchés par les inondations (effet domino)	○	○	○	○	○	○	○
Probabilité de destruction des bâtiments par les inondations	○	○	○	○	○	○	○

Continue

« Back Exit Survey »

100%

Q8 Si vous avez d'autres commentaires que vous souhaiteriez faire à propos d'outils et méthodes qui pourraient améliorer les plans de gestion de crise inondation, veuillez les ajouter ci-dessous.

Continue

Merci pour le temps que vous avez accordé à cette enquête. Le rapport final du projet sera disponible sur le site web du projet www.fimframe.net en 2011. Cependant, des résultats intermédiaires au niveau du questionnaire devraient être disponibles au téléchargement sur le site web FIM FRAME en mai 2010. Pour de plus amples informations ou si vous souhaitez faire d'autres suggestions (votre avis détaillé nous intéresse), vous pouvez contacter Freddy Vinet par e-mail à l'adresse suivante : freddy.vinet@univ-montp3.fr ou Olivier Payrastre par e-mail à l'adresse suivante : olivier.payrastre@lcpc.fr.

Thank you for completing this survey

A3 The Netherlands survey

CRUE FLOODING ERA-NET

Deltares Enabling Delta Life

Exit Survey »

10%

Geachte mevrouw, mijnheer,

Deze korte enquête (minder dan 10 minuten) vindt plaats in het kader van het Europese onderzoeksproject Flood Incident Management a FRAMEwork for improvement (FIM Frame, www.fimframe.net).
- Het FIM Frame project is onderdeel van het Europese onderzoeksprogramma ERA-NET CRUE (www.crue-eranet.net).
- Doel van het CRUE programma is het versterken van bestaande Europese onderzoeken m.b.t. overstromingsrisico, het promoten van 'best practices' en het identificeren van behoeftes en kansen voor toekomstige samenwerking tussen Europese landen.
- Het FIM Frame project wordt geleid door het Engelse onderzoeksinstituut HR Wallingford. Verder werken aan het project mee: Deltares (Nederland), Universiteit van Montpellier (Frankrijk) en Laboratoire Central des Ponts et Chausées (Frankrijk).

De doelen van het FIM Frame project zijn:
- Het evalueren van de effectiviteit en robuustheid van huidige rampenplannen voor overstromingen in Groot-Brittannië, Nederland en Frankrijk en het evalueren van methoden waarmee de plannen verbeterd kunnen worden.
- Het verkrijgen van overzicht van (potentiële) instrumenten (methoden, richtlijnen, handleidingen, software etc) die gebruikt worden bij het maken van rampenplannen en inzicht in en de meerwaarde van deze instrumenten bij het opstellen van de rampenplannen.
- Het bepalen hoe de beschikbare instrumenten gebruikt kunnen worden om rampenplannen te verbeteren en het identificeren van lacunes m.b.t. instrumenten.
- Het ontwikkelen van een kader (framework) te gebruiken om rampenplannen te verbeteren. Het kader zal getoetst worden binnen verschillende pilot gebieden in Nederland, Groot-Brittannië en Frankrijk.

Deze enquête wordt gehouden in het kader van het eerste en tweede projectdoel en moet inzicht geven in de informatie en instrumenten die kunnen bijdragen bij het opzetten van rampenplannen.

Wij waarderen het zeer indien u bereid bent deel te nemen aan deze enquête omdat uw inbreng erg waardevol voor ons zal zijn. Uw deelname aan deze enquête is geheel vrijwillig.

Uw antwoorden op de enquête vragen zijn anoniem. In aanvulling worden de resultaten gecodeerd. Met uw reacties zal vertrouwelijk worden omgegaan en resultaten van de enquête worden alleen gebruikt voor het FIM Frame project en door het FIM Frame projectteam. Indien u vragen hebt over de enquête of de procedure, dan kunt u contact opnemen met Karin Stone (karin.stone@deltares.nl) of Darren Lumbroso (d.lumbroso@hrwallingford.co.uk.).

Het invullen van deze enquête kost niet meer dan 10 minuten. Namens het projectteam dank ik u voor uw tijd. U kunt de enquête opstarten door op de 'Continue' knop te klikken.

Continue

« Back

Exit Survey »

30%

In de enquête wordt de term 'rampenplan' gebruikt. Onder rampenplan wordt rampen- of crisisplannen en de onderliggende rampen- of crisisbestrijdingsplannen verstaan.

Q1. Bij welk type instituut bent u werkzaam?

- Onderzoeksinstituut
- Adviesbureau
- Waterschap
- Rijkswaterstaat
- Anders namelijk:

Q2 Produceert u (of collega's) vanuit uw werk informatie die ter ondersteuning *zou kunnen* dienen bij het maken van rampenplannen voor overstromingen?

- Ja
- Nee
- Onduidelijk

Continue

« Back

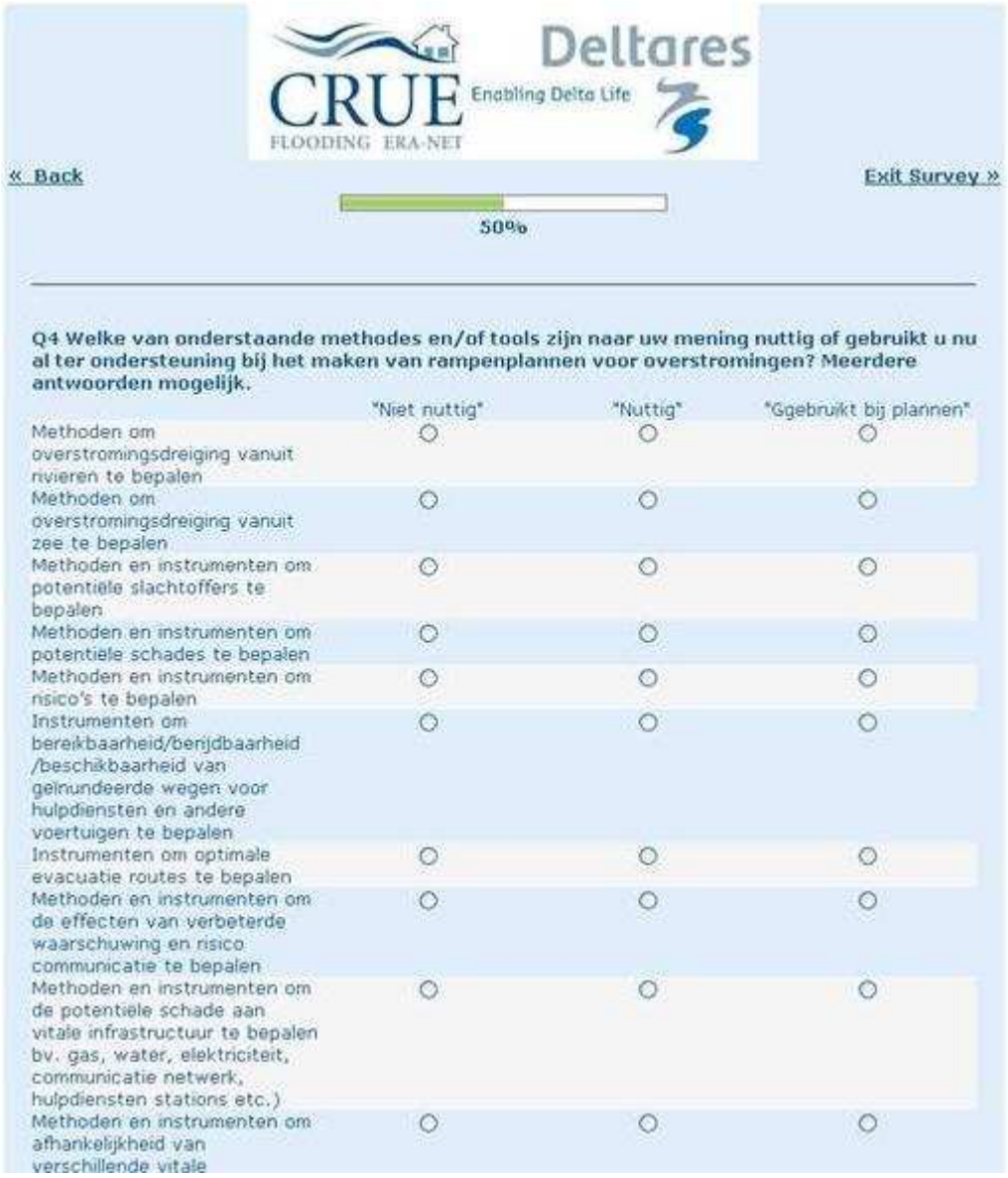
Exit Survey »

40%

Q3 Produceert u (of collega's) vanuit uw werk *momenteel al* informatie die ter ondersteuning dient bij het maken van rampenplannen voor overstromingen?

- Ja
- Nee
- Onduidelijk

Continue



« Back

Exit Survey »

50%

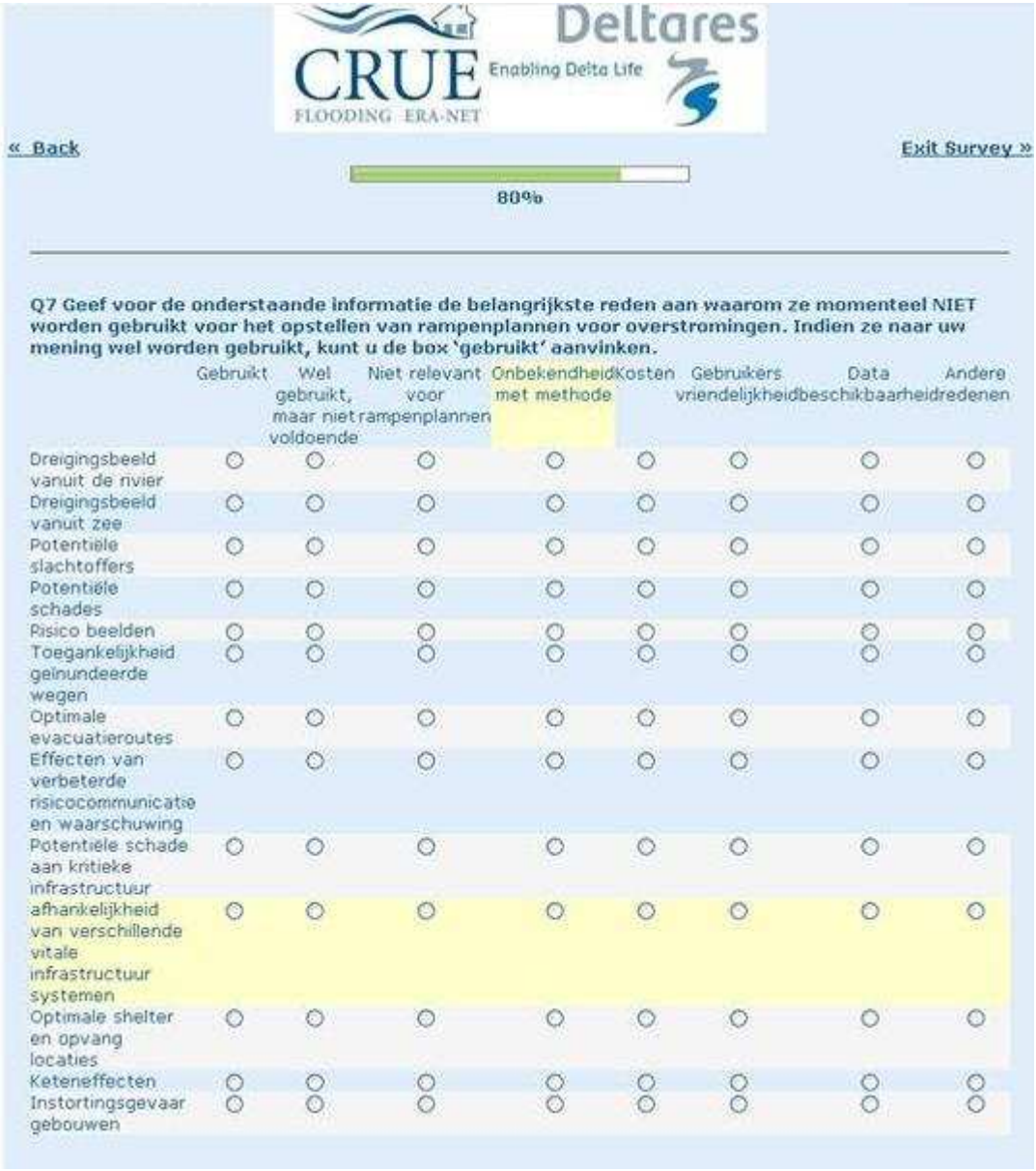
Q4 Welke van onderstaande methodes en/of tools zijn naar uw mening nuttig of gebruikt u nu al ter ondersteuning bij het maken van rampenplannen voor overstromingen? Meerdere antwoorden mogelijk.

	"Niet nuttig"	"Nuttig"	"Ggebruikt bij plannen"
Methoden om overstromingsdreiging vanuit rivieren te bepalen	○	○	○
Methoden om overstromingsdreiging vanuit zee te bepalen	○	○	○
Methoden en instrumenten om potentiële slachtoffers te bepalen	○	○	○
Methoden en instrumenten om potentiële schades te bepalen	○	○	○
Methoden en instrumenten om risico's te bepalen	○	○	○
Instrumenten om bereikbaarheid/berijdbaarheid /beschikbaarheid van geïnundeerde wegen voor hulpdiensten en andere voertuigen te bepalen	○	○	○
Instrumenten om optimale evacuatie routes te bepalen	○	○	○
Methoden en instrumenten om de effecten van verbeterde waarschuwing en risico communicatie te bepalen	○	○	○
Methoden en instrumenten om de potentiële schade aan vitale infrastructuur te bepalen bv. gas, water, elektriciteit, communicatie netwerk, hulpdiensten stations etc.)	○	○	○
Methoden en instrumenten om afhankelijkheid van verschillende vitale	○	○	○

Methoden om overstromingsdreiging vanuit zee te bepalen	○	○	○
Methoden en instrumenten om potentiële slachtoffers te bepalen	○	○	○
Methoden en instrumenten om potentiële schades te bepalen	○	○	○
Methoden en instrumenten om risico's te bepalen	○	○	○
Instrumenten om bereikbaarheid/berijdbaarheid /beschikbaarheid van geïnundeerde wegen voor hulpdiensten en andere voertuigen te bepalen	○	○	○
Instrumenten om optimale evacuatie routes te bepalen	○	○	○
Methoden en instrumenten om de effecten van verbeterde waarschuwing en risico communicatie te bepalen	○	○	○
Methoden en instrumenten om de potentiële schade aan vitale infrastructuur te bepalen bv. gas, water, elektriciteit, communicatie netwerk, hulpdiensten stations etc.)	○	○	○
Methoden en instrumenten om afhankelijkheid van verschillende vitale infrastructuur systemen te beoordelen	○	○	○
Instrumenten om shelter of opvang locaties te optimaliseren	○	○	○
Methoden en instrumenten om keten effecten van overstromingen te bepalen (Bv. chemische ramp a.g.v. overstroming)	○	○	○
Methoden om instortingsgevaar van gebouwen bij een overstroming te evalueren	○	○	○

Continue


CRUE
FLOODING ERA-NET
Deltares
Enabling Delta Life
« Back
Exit Survey »
70%
Q5 Kent u andere methodes en instrumenten die nog niet in bovengenoemde lijst staan waarvan u denkt dat zij nuttig kunnen zijn of die u nu al gebruikt ter ondersteuning voor het opstellen van rampenplannen.
Nee
Ja, namelijk:
Q6 Zijn er methodes, instrumenten en/of informatie die u graag ontwikkeld zou willen zien ter ondersteuning bij het opstellen van rampenplannen voor overstromingen?
Nee
Ja, namelijk:
Continue



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Exit Survey »

80%

Q7 Geef voor de onderstaande informatie de belangrijkste reden aan waarom ze momenteel NIET worden gebruikt voor het opstellen van rampenplannen voor overstromingen. Indien ze naar uw mening wel worden gebruikt, kunt u de box 'gebruikt' aanvinken.

	Gebruikt	Wel gebruikt, maar niet voldoende	Niet relevant voor rampenplannen	Onbekendheid met methode	Kosten	Gebruikers vriendelijkheid	Data beschikbaarheid	Andere redenen
Dreigingsbeeld vanuit de rivier	○	○	○	○	○	○	○	○
Dreigingsbeeld vanuit zee	○	○	○	○	○	○	○	○
Potentiële slachtoffers	○	○	○	○	○	○	○	○
Potentiële schades	○	○	○	○	○	○	○	○
Risico beelden	○	○	○	○	○	○	○	○
Toegankelijkheid geïnundeerde wegen	○	○	○	○	○	○	○	○
Optimale evacuatieroutes	○	○	○	○	○	○	○	○
Effecten van verbeterde risicocommunicatie en waarschuwing	○	○	○	○	○	○	○	○
Potentiële schade aan kritieke infrastructuur	○	○	○	○	○	○	○	○
afhankelijkheid van verschillende vitale infrastructuur systemen	○	○	○	○	○	○	○	○
Optimale shelter en opvang locaties	○	○	○	○	○	○	○	○
Keteneffecten	○	○	○	○	○	○	○	○
Instortingsgevaar gebouwen	○	○	○	○	○	○	○	○

Hartelijk dank voor uw tijd. De definitieve project resultaten zullen in 2011 beschikbaar komen op de project website (www.fimframe.net). Resultaten van deze enquête zullen vanaf mei 2010 via de project website beschikbaar gesteld worden. Voor vragen en informatie kunt u ook contact opnemen met Karin Stone (karin.stone@deltares.nl) of de project coördinator Darren Lumbroso (d.lumbroso@hrwallingford.co.uk).

Thank you for completing this survey

Appendix B Details of the survey of flood managers in England and Wales

B1 Review of the England and Wales flood managers survey

B1.1 Introduction

The survey was sent solely to staff in the Environment Agency who were believed to be involved in contributing towards MAFPs. There were 53 responses to the Environment Agency survey of which 39 completed all of the survey. Table B1 provides the responses by Environment Agency Region.

B1 Environment Agency responses

Environment Agency Region	Percentage of responses received
Anglian	15.1%
Midlands	13.2%
North East	11.3%
North West	5.7%
Southern	13.2%
South West	9.4%
Thames	20.8%
Welsh	11.3%
Head Office	0.0%

Of the 53 responses that were received 44 of the responders stated that they were currently involved in producing information that may be used by Local Resilience Forums in formulating Multi Agency Flood Plans. With eight stating they were not involved in producing information that could assist with MAFPs and the rest stating that they “didn’t know”.

B1.2 Tools, methods and guidelines currently used in England and Wales

The flood incident management teams at the Environment Agency were asked about what tools, methods or guidelines that they were aware of or currently used that could contribute to the formulation of Multi Agency Flood Plans (MAFPs). The results are summarised in Table B2.

Table B2 Percentage of responders in England and Wales who use or are aware of methods that contribute to Multi Agency Flood Plans

Tool, method or guidelines	Percentage of responders who use or are aware of method
Fluvial floods hazard	98%
Coastal floods hazard	80%
Flood hazard from dam failures	58%
Hazard from other sources of flooding	58%
Accessibility of inundated roads	53%
Optimisation of the location of shelters	51%
Damage to critical infrastructure	49%
Optimal evacuation routes	42%
Effects of improvements in flood warning on the risk to people	40%
Methods to assess potential injuries and loss of life	36%
Inter-dependency of critical infrastructure	18%
Other methods	18%
Tools to assess other hazards triggered by floods	13%
Methods to assess the probability of building collapse	2%

Table B2 clearly shows that there is a good awareness of methods to assess the flood hazard from rivers and to a slightly lesser degree from the coast. When asked to list the names of the tools, methods or guidance that the flood managers used the response could be group under the following headings:

i. Flood maps and hydraulic models – 41 responses
ii. Multi-Agency Flood Plan guidance and checklist – 27 responses
iii. Flood warnings – 20 responses
iv. Receptors vulnerable to flooding – 8 responses
v. Flood Risk Assessment Guidance for New Development FD2320 and Planning Policy Statement related documents – 6 responses
vi. Flood defences – 5 responses
vii. Previously written plans – 5 responses
viii. Critical infrastructure – 2 responses
ix. Others

There were 41 responders who mentioned the use of specific mapping products or hydraulic models such as ISIS, Tuflow, JFLOW and THEMIS. A number of responders mentioned the use of they used the new Surface Water Flood Map as well as reservoir inundation maps and plans. One responder stated the following:

"*Within the Development and Flood Risk Section which deals primarily with Planning Applications and Flood Defence Consent Applications we have access to a number of Agency hydraulic models of rivers providing various return period flood levels together with the associated mapping. Reservoir inundation maps. Strategic Flood Risk Assessments (SFRAs) produced by all of the District Councils that should consider all forms of flooding, these will incorporate the Ageny's web based flood plain detail Flood Zones 1,2 and 3, these are classed as Level 1 SFRAs, in addition to these there will be a small number of Level 2 SFRAs that will provide individual models of specific flooding areas, for example where regeneration areas are highlighted through Local Development Frameworks.*"

Flood plain mapping and hydraulic modelling are both "mature sciences" in the UK with the Environment Agency undertaking tens of millions of pounds worth of mapping studies and modelling exercises since it was formed in 1996. As a consequence it is understandable that most of the responders are familiar with the flood mapping outputs, tools and models

It was interesting to note that although relative new documents there were 27 responders who stated that they used the Multi Agency Flood Plan guidance and checklist to help them

What is interesting from the response is that very few and in some cases no responders to the survey explicitly mentioned tools that would cover the following:

- Accessibility of inundated roads
- Optimisation of the location of shelters
- Damage to critical infrastructure
- Optimal evacuation routes
- Effects of improvements in flood warning on the risk to people
- Methods to assess potential injuries and loss of life

However, in their many responders stated that they used these methods to inform Multi-Agency Flood Plans in England and Wales.

B1.3 Obstacles to the use of tools, methods and guidelines relevant to emergency planning in England and Wales

As part of the survey the flood incident managers were about the current usage of certain tools to inform Multi Agency Flood Plans. The stakeholders were asked if they current used the tools and if not to classify the reason why not into one of the following:

- Not relevant to Multi-Agency Flood Plans;
- Unaware of the method;
- Cost
- User friendliness issues;
- Availability of data;
- Other reasons.

The results of the survey are given in Tables B3 and B4. Of the methods the methods currently stared to be used by responders to the survey ranked as follows:

Fluvial floods hazard	88.6%
Coastal floods hazard	70.6%
Hazard from other sources of flooding	51.5%
Optimal evacuation routes	45.7%
Improvements in flood warning on the risk to people	45.7%
Flood hazard from dam failures	42.9%
Optimisation of the location of shelters	42.9%
Accessibility of inundated roads	31.4%
Damage to critical infrastructure	29.4%
Methods to assess potential injuries and loss of life	14.3%
Assessment of other hazards triggered by floods	11.4
Methods to assess the probability of building collapse	0.0%

Table B3 Response to the usage of tools to inform Multi-Agency Flood Plans by the Environment Agency – Part 1

Current usage of tools to inform Multi-Agency Flood Plans (% of responders)	Methods to assess flood hazard from				Potential injuries and loss of life	Accessibility of inundated roads to vehicles
	Fluvial	Coastal	Dams	Other sources		
Currently used	88.6%	70.6%	42.9%	51.5%	14.3%	31.4%
Reasons given if not currently used						
Not relevant to plans	0.0%	20.6%	5.7%	3.0%	5.7%	0.0%
Unaware of method	5.7%	2.9%	11.4%	9.1%	62.9%	48.6%
Cost	0.0%	0.0%	0.0%	3.0%	0.0%	0.0%
User friendliness issues	2.9%	2.9%	2.9%	6.1%	0.0%	5.7%
Availability of data	0.0%	0.0%	22.9%	24.2%	14.3%	11.4%
Other reasons	2.9%	2.9%	14.3%	3.0%	2.9%	2.9%

Table B4 Response to the usage of tools to inform Multi-Agency Flood Plans by the Environment Agency – Part 2

Current usage of tools to inform Multi-Agency Flood Plans (% of responders)	Optimal evacuation route(s) from inundated areas	Effects of improvements in the dissemination of flood warnings on the risk to people	Potential damage to critical infrastructure	Optimising the locations of shelters with respect to floods	Assessment of other hazards triggered by flooding	Probability of buildings collapsing during floods
Currently used	31.4%	45.7%	29.4%	42.9%	11.4%	0.0%
Reasons given if not currently used						
Not relevant to plans	0.0%	5.7%	0.0%	0.0%	2.9%	3.0%
Unaware of method	57.1%	34.3%	35.3%	40.0%	68.6%	72.7%
Cost	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
User friendliness issues	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Availability of data	8.6%	5.7%	35.4%	11.4%	8.6%	24.2%
Other reasons	2.9%	8.6%	0.0%	5.7%	8.6%	0.0%

B1.3.1 Unaware of method

The main reason for the lack of use of tools such as: methods to assess loss of life; optimisation of evacuation routes and shelters; assessment of other hazards triggered by floods; and the probability of building collapse were stated to be "unawareness of the method".

Typical replies indicating that there is a lack of awareness of exactly what tools are available.

"I'm not sure what you meant by any of this really. Where we have ways and means locally of determining the information you refer to I have considered that to be a tool we use but the wording of this survey implies there are specific nationally developed tools and models out there to delver the information. If this is the case most my answers would be that I am not aware of the tool!"

"*There are no dedicated tools or methods employed beyond standard Environment Agency datasets such as Flood Map*."

"*Educate all Environment Agency staff involved with MAFPs about what tools are available to us to help us with the plans and share best practice between areas*".

"*There may be guidance, methods, or tools in existence that I am unaware of. If so it might be good to give training on these tools, have best practice sessions with colleagues or at least produce a comprehensive internal brief on the help that is available to assist in producing MAFPs*."

"*Many of the issues raised are complex. In an ideal world, with unlimited resource we would do "a bells and whistle's job on MAFPs, we do not live in that world, we use the tools we have, and we make inferences and judgments. Many of the 'tools' referred to [in the survey] do not exist, which makes deciding if we use them difficult, as we do make reasoned decisions based on data sets, but is this a tool? We also load our time to the highest risk communities, so some get more time put to them than others, and all MAFPs are live documents and will develop with time, we use the tools we have at each iteration*."

B1.3.2 Availability of data

Availability of data was seen to be an issue mainly with regards to assessing potential damage to critical infrastructure; flooding from other sources; dam failure and the probability of building collapse. One responder noted that:

"*Focus needs to be on particular sections within flood plans which are proving difficult to write, in particular the inclusion of information on critical local infrastructure. We desperately need some form of guidance on how to include this information and what level of detail to include. At the moment these sections are being omitted due to lack of information from infrastructure owners and poor understanding of how to include the information when it has been supplied*."

B1.3.3 Friendliness

User friendliness was not seen by the responders.

B1.3.4 Cost as an obstacle

It is interesting to note that cost was not seen as a major constraint for the implementation of the methods. There was just one method where cost was quoted as an issue

B1.3.5 Not relevant to plan

Very few users indicated that the methods listed in the survey were not relevant to MAFPs. For the assessment of coastal flooding some 20% of responders stated that the method was not relevant;

however, this likely to be because the flood mangers who responded to this question are based in an area where there is no coastal flooding.

B2. Are there any other tools, methods or guidance that you would like to see developed that could be used by Local Resilience Forums to develop Multi Agency Flood Plans?

Identification of critical /essential local infrastructure
Guidance on safe evacuation - what is safe - what is acceptable and for who - also clarification of who's responsibility it is to comment/object to new development proposals that are dependent on evacuation by third parties etc.
Joint probability of flooding form differing sources - fluvial/pluvial/tidal
Joint probability - pluvial/fluvial/tidal in areas at risk of each
More definite guidance on how the MAFP is structures. For example my two LRFs write their MAFPs based on EA flood warning areas, but I know this is not the case in other LRFs. I would appreciate a definite decision on how the MAFP should be structured to minimise confusion and double handling with EA LFWPs.
Guidance to differentiate depending on the size of the authority I;e. Greater Manchester produced a strategic level plan and the individual boroughs produced tactical/operation response plans. So there needs to be guidance for strategic plans and guidance for Operational Plans
Guidance on Plan Activation and the escalation routes to activate the plan
Guidance on Mutual and Military Aid
Guidance on how areas should conduct the risk assessment section on the Community Flood Risk Summary sheet
Guidance on differentiation between strategic MAFPs for County level plans and tactical/response plans at a more local level
Further guidance on carrying out the risk assessments
Guidance on plan activation and escalation (who does it and what is the mechanism)
Guidance on Mutual Aid procedures (how are they implemented and how are they overseen at a strategic level)
Guidance on MACA (implementation and management)
Tools to assess damage (and financial cost) caused by inundation (may already exist but I am not aware of it)
A tool to guide developers, applicants on suitable flood warning and evacuation plans for different types of development and occupants vulnerability, i.e. caravans, affordable housing, care homes etc.
Reservoir inundation information when released.
Revised information on critical infrastructure especial along the lines of what is critical as it varies depending on the situation and the opinion of the owner. An agreement to share information as some companies are still unwilling to share information and inform as to which parts of their structure are critical as for example not every substation is critical.
Better guidance as to what is a satisfactory plan with possible mandatory sections because currently it is down the LRF to put in what they see fit. The structure etc in the guidance are suggestion and so it can be hard to get LRF to include all the relevant information."
Flood visualisation
some professional partners have lists of vulnerable people that are data protected i.e. those that require regular medical treatment this would help during major flood events for evacuation etc.
Assessment of risk of injury during evacuation against risk of injury due to flooding if not evacuated.
Assessment of lead time needed to enable safe evacuation of communities."
Flood visualisation - this would be useful for responders to see the areas that could be affected and plan their response appropriately.
Tools, methods or guidance on how to include in flood plans the vulnerability of local critical infrastructure, including identifying key points of failure. There needs to be an agreement on how this information can be published in the flood plan with permission of the infrastructure owners.
Very hard to acquire but more information on critical infrastructure and their likelihood of flooding would be very beneficial to emergency responders. This data at the moment is very sparse.

I found the guidance which was produced to be used in the preparation of the Multi Agency Flood Plan to be very vague. I would have liked to see some sort of template to follow.
Templates/more detailed examples of maps, what needs to be shown on them.
LRFs have requested clearer guidance on MAFPs
We deal with Local Resilience Forums on applications for new development and my experience is they look at new development in isolation rather then taking a position we have enough problems we don't want to put any additional burden on the emergency services
Some kind of online forum, website - possibly the NRE to share best practice between LRFs demonstrating examples of "satisfactory" plans.
Methods of sharing confidential data at short notice
Flood depth estimation system could be developed into a really good visualisation tool
More guidance on what agencies/ organisations should be producing/ contributing to each section - this will help us with asking the LRF's to produce these.
Clearer guidance from the Government over the production, implementation and practicing of Flood Plans.
Details of issues to consider and how plans are formulated would be useful. At present the local authority Emergency Planners appear to struggle to interpret the outputs SFRAs and implement the findings.
Greater consideration of flooding in the field of Emergency Planning would be beneficial.
It would be good to see tools and methodologies developed for the areas of interest listed as a checklist in a previous question.
Improved flood visualisation tools
Secure website for data sharing within LRF and live reporting between Bronze Silver and Gold Command

Please list the names of the tools, methods or guidance that you currently use that are of assistance to Local Resilience Forums in producing Multi Agency Flood Plans?

The responders were asked the above question. Their responses could be broadly grouped under the following headings:

- Flood maps, mapping products and hydraulic models
- Flood Risk Assessment Guidance for New Development FD2320 and PPS related documents
- Flood Warning related tools
- Multi-Agency Flood Plan Guidance
- Flood defences
- Critical infrastructure
- Receptors vulnerable to flooding
- Historical information
- Previously written plans
- Others

The full list of replies grouped under these headings is given below.

Flood maps, mapping products and hydraulic models
Environment Agency (EA) Flood Maps (ISIS, Tuflow, JFLOW mathematical models)
Surface water flooding maps
Reservoir inundation maps
Flood map
ISIS
TUFLOW
THEMIS - local flooding inundation modelling software"
No dedicated tools or methods employed beyond standard EA datasets such as Flood Map.
THEMIS, ISIS
Flood mapping/GIS: flood modelling (including hazard mapping), reservoir flood maps, areas susceptible to surface water flooding maps
EA flood maps

Mapping products (Flood depth, flow velocity, flood hazard, blockage scenario, over-topping, Areas Benefitting from defences, Standards of protection, Address Point data, Digital Terrain modelling)
EA Flood Map and other associated risk maps etc.
LFWP, Flood Outlines, depths and velocity models, Dorset Explorer,
Outputs from Area Strategic Mapping & Modelling projects. Flood Map, Surface Water Flood Map, Reservoir Inundation Map and historic information"
Flood Map
The Flood Map
EasiMap
Properties at risk in the 1 in 100 and 1000 year outline
River modelling, tidal modelling, surface water maps, dam breach flood flows
GIS - flood zones, lidar, other topographic data, SFRAs, CFMPs, mapping studies
Flood Maps
Reservoir inundation maps, reservoir off site plan guidance
We already have a Multi Agency Flood Plan and the LRF have commented that the most useful thing is the maps which contain the flood warning areas and other critical and vulnerable infrastructure.
Surface Water Flooding Map
EA flood zones
Surface Water Flooding Map
Reservoir Inundation Maps
Reservoir Plans
Environment Agency's flood zone maps and detailed modelling
Surface Water Flooding Maps
Outputs from Area Strategic Mapping and Modelling projects. Flood Map, Surface Water Flood Map, Reservoir Inundation Mapping
Flood maps, Surface Water Flooding Maps.
OS master map data
Flood spreading animations
Within the Development and Flood Risk Section which deals primarily with Planning Applications and Flood Defence Consent Applications we have access to a number of Agency hydraulic models of rivers providing various return period flood levels together with the associated mapping. Reservoir inundation maps. Strategic Flood Risk Assessments (SFRA's) produced by all of the District Councils that should consider all forms of flooding, these will incorporate the Agony's web based flood plain detail Flood Zones 1,2 and 3, these are classed as Level 1 SFRA's, in addition to these there will be a small number of Level 2 SFRA's that will provide individual models of specific flooding areas, for example where regeneration areas are highlighted through Local Development Frameworks.
GIS (Map Info, ArcView)
Flood Survey, Maps and experience of previous events
ARC Map - flood warning areas
Areas susceptible to surface water flooding,
Lidar

Flood Risk Assessment Guidance for New Development FD2320 and PPS related documents
Flood Risk Assessment Guidance for New Development FD2320
Defra guidance FD2320 and FD2321 which gives guidance on assessing flood hazard, a
Defra/EA report FD2320
FD2320/TR2 from the PPS25 Practice guide
PPS25 companion guide
PPS25 and supporting practice guide

Flood Warning related tools
Flood Warning Direct (FWD)
Flood Warning Areas
EA Local Flood Warning Plan
Local flood warning plans, FWD

Floodline Warnings Direct
Environment Agency Local Flood Warning Plans
EA Flood Warning Areas
local flood warning plans
EA Flood Warning Areas
Local Flood Warning Plan
Local flood warning plans.
EA Local Flood Warning Plans
Flood warnings direct
EA Local Flood Warning Plans
Flood Warning Area Shapefiles
Propserties at risk in the Flood Warning Areas
Local Flood Warning Plans (LFWP)
LFWPs
LFWPs
EA Flood Warning procedures and operational procedures

Multi-Agency Flood Plan Guidance
Defra guidance and checklist produced in 2009
Multi-Agency Flood Plan Guidance, checklist
MAFP guidance from DEFRA
MAFP guidance and templates
LMAFP template produced locally
DEFRA multi agency flood plan check list
Defra checklist guidance
Defra MAFP guidance
Preliminary guidance - Developing a Multi-agency flood plan produced by the Civil Contingencies Secretariat and use of the templates contained within
Emergency Prepardness (Civil Contingencies Act) including plan templates & guides.
Flood Warning & Operational Manuals
Defra MAFP guidance
Preliminary DEFRA guidance was followed.
Guidance documents include DEFRA flood guidance
Defra/EA Multi Agency Flood Plan Guidance and Checklist for Multi Agency Flood Plans
Developing a Multi Agency Flood Plan Guidance for Local Resilience Forums and Emergency Planners, Checklist for Multi Agency Flood Plans, Templates, Figures and Tables for Developing a Multi Agency Flood Plan
Developing a Multi-Agency Flood Plan (MAFP) - Guidance for Local Resilience Forums and Emergency Planners
Defra Guidance on MAFPs
Civil Contingencies preliminary guidance for MAFP's
Checklist for Multi-Agency Flood Plans (MAFP)
Multi-Agency Flood Plan Guidance Templates, Figures and Tables
Defra guidance
Auditing the MAFP in our are using the new multi agency flood plan checklist.
Civil Contingencies Secretariat (CCS) Guidance
CCS Guidance
Emergency Response and Recovery Guidance
Generic LRF and County level emergency Planning guidance

Flood defences
Defences - National Flood and Coastal Defence Database (NFCDD)
NFCDD
Areas benefiting from defences map - NFCDD
EA Defences

Defences in place

Receptors vulnerable to flooding
Receptors Vulnerable to Flooding Data
Receptors Vulnerable to Flooding
Receptors Vulnerable to Flooding
Vulnerable locations/people data (EPU)
Receptors vulnerable to flooding database
Receptors vulnerable to flooding information (key infrastructure in GIS format)
Receptors vulnerable to flooding
Community Risk Register

Critical infrastructure
Critical infrastructure
Critical infrastructure location maps - lists from utility companies

Historical information
Historic information and local knowledge held by all multi-agency partners
EA flood history - where known
History of flooding for each flood warning area
Historic flood info
Historic flooding

Previously written plans
Existing County/District/Borough Emergency Plans
Flood Plans from other LRFs demonstrating best practice
Previous written plans
LRF floods action plans
Existing LA operational and tactical plans etc

Others
Gauge board sheets for triggers
Through the planning process a number of Flood Risk Assessments(FRA's) are submitted in support of planning applications, some of these are undertaken to the Agency's standard which enables the web base information to be uprated,
Strategic Flood Risk Assessments
Site specific Flood Risk Assessments
Reservoir register
Rapid Response Catchment Plans
Outputs from FFC & Met Office (weather statements & heavy rainfall warnings etc.)
Time to peak information - from forecasting information
EA Operational procedures
Data and information held by all Cat1 & Cat 2 Responders
Properties signed up to the Floodline Warnings Direct Service for each Borough/District area.
Strategic Flood Risk Assessments, Site specific flood risk assessments, Local Drainage Groups
Strategic and site specific Flood Consequence Assessments
Civil Contingencies Act
LRF risk assessments for flooding
Local EA Area staff knowledge
Pitt Report,
Flood Exercises, - lessons learnt etc.
Sharing info between partners in MA sessions to produce the plans.

Other comments

Educate all EA staff involved with MAFPs about what tools are available to us to help us with the plans

Share best practice between areas

There may be guidance, methods, or tools in existence that I am unaware of (I have only been in EA for a year). If so it might be good to give training on these tools, have best practice sessions with colleagues or at least produce a comprehensive internal brief on the help that is available to assist in producing MAFPs.

The tools need to be simple and generic so they can be applied throughout the country in a consistent manner. Information gaps also need to be identified and a process highlighted how they can be filled and by what organisation, i.e. hazard mapping by the EA.

One of the key challenges on the east coast (or in any defended tidal areas) is to establish a proportionate and appropriate emergency response for breach scenarios. Determining the probability of breach is a key issue as is the time to call for evacuation. It would be helpful if consideration can be given to the dilemma of either evacuating too early, and early signs of a potential breach occurring don't materialise, as opposed to waiting until there are more definite signs that a breach will actually occur and this being too late to enable safe evacuation of communities immediately behind the defences, and before dangerous flooding happens. Guidance on the different parameters at play, the thought process needed, decision elements and a suitable process would be very helpful. (How do we try to avoid 'crying wolf' too often?) Happy to discuss further/assist with this consideration/process work if required.

There is good generic guidance on requirements for a flood plans. Focus needs to be on particular sections within flood plans which are proving difficult to write, in particular the inclusion of information on critical local infrastructure. We desperately need some form of guidance on how to include this information and what level of detail to include. At the moment these sections are being omitted due to lack of information from infrastructure owners and poor understanding of how to include the information when it has been supplied.

I'm not sure what you meant by any of this really. Where we have ways and means locally of determining the information you refer to I have considered that to be a tool we use but the wording of this survey implies there are specific nationally developed tools and models out there to delver the information. If this is the case most my answers would be that I am not aware of the tool!

Multi Agency Flood Plans suit LRFs that are composed of one county but are not very well suited to the Thames Valley LRF which is made up of three counties and Milton Keynes. The MAFP was written at strategic gold level and linked closely to the Local Flood Warning plans which anup-to-date and well liked by both Cat 1 and 2 responders.

Often the information held by local authorities is not used to inform Flood Plans or to assist the Local Resilience Forum in making decisions. The information contained in Strategic Flood Risk Assessments appears to often just be used by the Spatial Planners and not Emergency Planners.

An understanding of the sequence of events during a flood, what the impacts on people and buildings will be and the longer term implications will be essential."

This is a terrible survey; I would not use the outputs from this to make decisions.

Many of the issues raised are complex. In an ideal world, with unlimited resource we would do “a bells and whistles” job on MAFPs, we do not live in that world, we use the tools we have, we make inferences and judgments. Many of the 'tools' referred to do not exist, which makes deciding if we use them difficult, as we do make reasoned decisions based on data sets, but is this a tool? We also load our time to the highest risk communities, so some get more time put to them than others, and all MAFPs are live documents and will develop with time, we use the tools we have at each iteration.

Appendix C Details of the survey of flood managers in France

C1 Review of the French flood managers' survey

There were a total of 77 people who commenced the survey and a total of 31 fully completed responses. The survey was distributed to various organisations responsible for flood management including the Direction régionale de l'environnement, de l'aménagement et du logement (DREAL) and Direction départemental des territoires (DDT). Details of the location of the responses are displayed in Table C1. Around 75% of responders are involved in producing information that may be used in emergency plans. Table C2 gives the percentage of responders in France who use or are aware of methods that contribute to emergency plans.

Table C1 Geographical origin of responders to the flood manager survey

Region	Number of responses
Alsace	2
Aquitaine	5
Auvergne	2
Basse-Normandie	1
Bourgogne	1
Bretagne	0
Centre	6
Champagne-Ardenne	2
Collectivités et territoires d'Outre-Mer	0
Corse	0
Départements d'Outre-Mer	0
Franche-Comté	0
Haute-Normandie	4
Ile-de-France	4
Languedoc-Roussillon	1
Limousin	1
Lorraine	2
Midi-Pyrénées	3
Nord-Pas-de-Calais	1
Pays de la Loire	4
Picardie	1
Poitou-Charentes	2
Provence-Alpes-Côte-d'Azur	2
Rhône-Alpes	7

Table C2 Percentage of responders in France who use or are aware of methods that contribute to emergency plans

Tool, method or guidelines	Percentage of responders who use or are aware of method
Fluvial floods hazard	98%
Flood hazard from dam failures	43%
Hazard from other sources of flooding	38%
Accessibility of inundated roads	33%
Effects of improvements in flood warning on the risk to people	30%
Damage to critical infrastructure	23%
Optimisation of the location of shelters	20%
Coastal floods hazard	18%
Methods to assess potential injuries and loss of life	18%
Others	18%
Inter-dependency of critical infrastructure	13%
Tools to assess other hazards triggered by floods	10%
Optimal evacuation routes	8%
Methods to assess the probability of building collapse	5%

Table C2 shows the percentage of responders who are aware or who use tools to assess different items in flood management plans. Most of the people who filled in the survey were aware of methods used to assess fluvial flood hazard. This is the most widespread type of flood in France and all the French regions are prone to this kind of flood. Flood hazards from dam failure ranked second. This may be due to the recent reinforcement of legal requirements relating to dam security in France. Tools concerning the assessment of flood hazard are clearly dominant except for coastal flooding. Unlike in the Netherlands and in England and Wales, coastal floods had never been considered as a relevant problem in France. However, the recent sea surge in western France that killed about 50 people on 28 February 2010 ought to change the point of view of authorities on this problem. Only one responder out of 5 was aware or used tools to assess damage or potential impacts of flood events (i.e. methods to assess potential injuries and loss of life; damage to critical infrastructure). The lack of dissemination of tools to assess the impacts on flood or to assess potential damages has already been pointed out in many articles and reports in France. (Hubert & Ledoux, 1999) Only 10 % of flood managers mentioned “Tools to assess other hazards triggered by floods”. Natechs are not really addressed in France. Technological and natural hazards still are dealt separately. However some services in charge with flood management use *methods to evaluate the cost of the damage at large scales (departmental, regional)* and *tools to evaluate the potential damage in farms.*

Tables C3 and C4 confirmed this trend. These Tables display the results of question 6 : “For the tools and methods that are NOT being used to inform flood emergency management plans by you or other organisations please indicate the main reason why you think they are not used. If you think the tool or method is currently being used please tick the "Currently used" option.”. Except for tools used in the assessment of coastal floods (which is linked to the geographical context of the regions as all the regions have not got seaside), the irrelevancy of proposed methods is not pointed out. The two main reasons why tools or methods are not used are first unawareness of the tools and the second is the lack of data.

Unaware of tool
Tools to evaluate flood hazards are the most disseminated ones. It is linked to the competencies of services. There has been a single minded focus on the knowledge of hazard. International organisations admit now that one must shift from a pure knowledge of hazards to an integrated assessment and management of the risk (Hutter, 2006).

The awareness of the existence of tools is low for tools that help to evaluate the impacts: potential injuries and loss of life, probability of buildings collapsing during floods and for tools or methods that can help organizing the emergency (e.g. optimising the locations of shelters) (more than half of responders don't know any tools linked to the item)**.** Scores are high for tools assessing the potential triggering of risk after a flooding (NaTech). However, for tools related to the evaluation of road networks availability during an emergency, the awareness is better: only about 30% to 40% of responders state that they do not know any tools.

Availability of data
For the methods to inform dam failure plans, the lack of data clearly appears. This problem is being addressed by the French Ministry of Ecology. For tools helping in assessing potential disruptions caused by floods e.g. *Potential damage to critical infrastructure, Accessibility of inundated roads to vehicles flood,* the number of response "availability of data" is high. That means the tools are known by a part of the responders but the lack of data to inform those tools is a constraint. So for the management of networks (road), or for Natech risks, responders know that tools exist. There is a room for improvement in the use of such tools providing accurate data.

Cost
Thus, as a paradox, the cost is not selected as an obstacle for the use of tools. We should have asked whether the cost of data (instead the cost of the tools) is a real bottleneck. Most of the time, data to inform the tool is more expensive than the tool itself. We also can wonder how the lack of available data is a consequence of the cost of the building of databases.

General comments
The tools that are researched are between the knowledge of Risk and the real time forecast. A responder describes this "missing link" as "*the tools making it possible to work on the forecast of the floods, intermediate link between knowledge of the risk for the PPR (land use planning) and the forecast of the flood! It is about a step engaged by the ministry and we will compel the departments to develop this function!* Some responders contact us by email and told that they were expecting for the results of the survey because the question were very "concrete".

Table C3 Response to the usage of tools to inform emergency plans in France – Part 1

Current usage of tools to inform emergency plans (% of responders)	Methods to assess flood hazard from				Potential injuries and loss of life	Accessibility of inundated roads to vehicles
	Fluvial	Coastal	Dams	Other sources		
Currently used	100%	44%	50%	38%	5%	20%
Reasons given if not currently used						
Not relevant to plans	0%	17%	0%	10%	5%	0%
Unaware of method	0%	17%	14%	24%	68%	35%
Cost	0%	0%	5%	0%	0%	0%
User friendliness issues	0%	0%	5%	5%	5%	0%
Availability of data	0%	6%	23%	19%	11%	40%
Other reasons	0%	17%	5%	5%	5%	5%

Table C4 Response to the usage of tools to inform emergency plans in France – Part 2

Current usage of tools to inform emergency plans (% of responders)	Optimal evacuation route(s) from inundated areas	Effects of improvements in the dissemination of flood warnings on the risk to people	Potential damage to critical infrastructure	Optimising the locations of shelters with respect to floods	Assessment of other hazards triggered by flooding	Probability of buildings collapsing during floods
Currently used	16%	26%	17%	24%	11%	6%
Reasons given if not currently used						
Not relevant to plans	0%	0%	0%	0%	0%	0%
Unaware of method	47%	53%	56%	59%	53%	56%
Cost	0%	5%	0%	0%	0%	0%
User friendliness issues	5%	0%	6%	0%	11%	17%
Availability of data	26%	16%	22%	12%	26%	22%
Other reasons	5%	0%	0%	6%	0%	0%

Appendix D Review of the Dutch flood managers' survey

D1 Introduction

A total of eight people completed the survey aimed at flood managers in the Netherlands. These people are all involved in the development of tools and instruments, information and knowledge which could be used or already is used for the development of flood emergency management plans. They all answered "yes" to the question "Do you currently produce information actually used for flood event management planning?" Five responders are employed at a research institute, and three work for the Dutch Ministry of Traffic and Water Management.

In addition, two questions were added to the survey aimed at people involved in the development of flood emergency management plans. These additional questions are related to the current use of tools and instruments for plan development. This survey was send out to people involved in the Dutch Safety regions and included people working for the Water Boards. As well as being a partner within the Safety Regions, the Water Boards are partly responsible for the provision of information used for flood emergency management planning. Forty-five responders participated in this survey.

D2 Tools, methods and guidelines currently used the Netherlands

The responders involved in the development of tools and instruments were asked which methods and instruments they currently use or thought to be (potentially) useful for the development of flood event management plans. The results are shown in Table D1.

The responders involved in the development of tools and instruments were asked which methods and instruments they currently use or thought to be potentially useful for the development of flood event management plans. The results are shown in Table D2.

Table D1 Awareness and use of information for event planning in the Netherlands

Tools, methods or guidelines	Not aware (%)	Aware of tool (%)	Tool used to assist with plans (%)
Potential injuries and loss of life	0.0%	57.6%	42.4%
Flood extent	3.0%	24.2%	72.7%
Evacuation time	6.1%	48.5%	45.5%
Flood warning lead times	9.1%	24.2%	66.7%
Flood depths, velocities and flow routes	15.2%	33.3%	51.5%
Optimal evacuation routes	18.2%	51.5%	30.3%
Effect of implementation of measures (temporal levees, sand bags)	18.2%	42.4%	39.4%
Damage to critical infrastructure	21.2%	48.5%	30.3%
Available of resources	21.2%	48.5%	30.3%
Hazards triggered by floods	24.2%	57.6%	18.2%
Optimisation of the location of shelters	27.3%	57.6%	15.2%
Accessibility of inundated roads	27.3%	42.4%	30.3%
Effects of improvements in flood warning on the risk to people	30.3%	36.4%	33.3%
Potential damage maps	33.3%	48.5%	18.2%
Probability of buildings collapsing	42.4%	48.5%	9.1%

Methods for the assessment of loss of life and damage are thought to be used by the developers of the methods in the planning stage. When compared to the information actually used by the planners, shown in TableD1 it is seen that this is true for information on loss of life, but that information on potential damage are actually not being used extensively. Most of the methods are thought to be useful for the development of plans.

The following (type of) tools were mentioned by developers as potentially useful (existing or to be developed) although not listed in the Table D1

- Overview of flood simulations, including animation of flooding
- Data and GIS tools: (on land use, schools, hospitals, day-care for children, aid services, heights of the area)
- Instruments to determine the sensitivity of levees and their resilience to different scenarios. On-line determination of the damage to coastal defences using expected water heights and wave data
- Decision support tool for evaluation of different evacuation strategies

The flood event planners were asked which information they are aware of or actually use for the development of their plans. Thirty-three people responded to the question. The results are presented in Table D2. It should be noted that the question differs from the question stated in the English and French survey where the responders were asked which methods they are aware of.

It can be seen that information resulting from flood simulation models, such as flood extent, water depth and velocities are applied for the development of the plans. Recently more attention is given to research on casualties and evacuation. This information is used for the plans, but to a lesser extent then the flood simulation results.

In addition the responders were asked which tools, methods or guidelines they currently use for the development of their plans. The majority of the respondents (92.3%) declared that their organizations makes use of instruments (methods, guidelines, advice, software) for making Flood event plans. The types of tools used are:

- Guidelines and format; Inspection frameworks, Legal frameworks, scripts, national communication strategy;
- Flood simulation software;
- Traffic and evacuation simulation software;
- Action plans.

The responders mentioning some kind of format or guideline were numerous, although no consistency was seen in the named formats. Several responders mentioned a personal format or a format developed within the region. For example responders to the survey stated that:

"*We use a compilation of several methods and guidelines*"
"*We use a format developed in cooperation*"

Table D2 Awareness and use of information for event planning in the Netherlands

	Not aware	Aware of	Used in plans	Aware of and used in plans
Potential injuries and loss of life	0.0	57.6	42.4	100.0
Flood extent	3.0	24.2	72.7	97.0
Evacuation time	6.1	48.5	45.5	93.9
Flood warning lead times	9.1	24.2	66.7	90.9
Flood depths, velocities and flow routes	15.2	33.3	51.5	84.8
Optimal evacuation routes	18.2	51.5	30.3	81.8
Effect of implementation of measures (temporal levees, sand bags)	18.2	42.4	39.4	81.8
Damage to critical infrastructure	21.2	48.5	30.3	78.8
Available of resources	21.2	48.5	30.3	78.8
Hazards triggered by floods	24.2	57.6	18.2	75.8
Optimisation of the location of shelters	27.3	57.6	15.2	72.7
Accessibility of inundated roads	27.3	42.4	30.3	72.7
Effects of improvements in flood warning on the risk to people	30.3	36.4	33.3	69.7
Potential damage maps	33.3	48.5	18.2	66.7
Probability of buildings collapsing	42.4	48.5	9.1	57.6

It is seen that information resulting from flood simulation models, such as flood extent, water depth and velocities are applied for the development of the plans. Recently more attention is given to research on casualties and evacuation. This information is used for the plans, but to a lesser extent then the flood simulation results.

In addition the responders were asked which tools, methods or guidelines they currently use for the development of their plans. The majority of the respondents (92.3%) declared that their organizations makes use of instruments (methods, guidelines, advice, software) for making Flood event plans. The types of tools used are:

- Guidelines and format; Inspection frameworks, Legal frameworks, scripts, national communication strategy
- Flood simulation software
- Traffic and evacuation simulation software
- Action plans

The responders mentioning some kind of format or guideline were numerous, although no consistency was seen in the named formats. Several responders mentioned a personal format or a format developed within the region.

We use a compilation of several methods and guidelines
We use a format developed in cooperation

Required development of tools

The developers were asked if there were any tools or methods they would like to see developed for the assistance of flood event planning.

- Evaluation and improvement of event plans
- A tool providing an overview of measures and their effectiveness
- Flood defences

An equal question was given to the event planners. Of the responders, 61.5% would like some other instrument (existing or to be developed) to be available for Flood event planning. Types of instruments mentioned are:

- *Guidelines and standardization*. There is a need for more standardization of the Dutch flood event plans. This should result in making the plan uniform and simplifying them. This need corresponds to the observed diversity in formats and guidelines which are currently used.

  'In the TMO period, several regions have been active with plan construction. I missed a framework for setting up this plan, the do's and don'ts and more tips and tricks (region Noord-Holland-Noord). This results in many beautiful plans that cost a lot of time to construct, but that probably miss a solid general basis.'

- *Flood simulation and prediction*. Although the flood simulation and prediction methods are quite advanced, there is still a need for further development. This is especially seen for coastal flooding where there is a need to increase the accuracy of prediction time.
- *Evacuation simulation*
- *Training through serious gaming*
- *Information exchange.* Generally improving presentation. Specifically for different types of data; database development for resources, maps for Decision support.
- *General improvement of the user-friendliness of systems*

One person mentioned that: *there is enough room for improvement of the existing tools*

Obstacles to the use of tools, methods and guidelines relevant to emergency planning in the Netherlands

When looking into the reasons why information and methods are not being used (as assumed by the developers of the tools and methods), the main reasons given are: unaware of method and availability of data. The results are summarized in Table D3.

Table D3 Response to the usage of tools used for flood event planning

Current usage of tools to inform emergency flood plans (% of responders)	Methods to assess flood hazard from				Potential injuries and loss of life	Accessibility of inundated roads to vehicles
	Fluvial	Coastal	Dams	Other sources		
Currently used	62.5%	62.5%	-	-	50.0%	0.0%
Reasons given if not currently used						
Used, but not enough	25.0%	25.0%	-	-	12.5%	25.0%
Not relevant to plans	0.0%	0.0%	-	-	0.0%	0.0%
Unaware of method	12.5%	12.5%	-	-	25.0%	25.0%
Cost	0.0%	0.0%	-	-	0.0%	0.0%
User friendliness issues	0.0%	0.0%	-	-	0.0%	0.0%
Availability of data	0.0%	0.0%	-	-	12.5%	50.0%
Other reasons	0.0%	0.0%	-	-	0.0%	0.0%

Current usage of tools to inform emergency flood plans (% of responders)	Optimal evacuation route(s) from inundated areas	Effects of improvements in the dissemination of flood warnings on the risk to people	Potential damage to critical infrastructure	Optimising the locations of shelters with respect to floods	Assessment of other hazards triggered by flooding	Probability of buildings collapsing during floods
Currently used	25.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Reasons given if not currently used						
Used, but not enough	25.0%	62.5%	25.0%	25.0%	25.0%	25.0%
Not relevant to plans	0.0%	0.0%	0.0%	0.0%	0.0%	12.5%
Unaware of method	0.0%	37.5%	37.5%	50%	37.5%	37.5%
Cost	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
User friendliness issues	0.0%	0.0%	0.0%	12.5%	0.0%	0.0%
Availability of data	37.5%	0.0%	25.0%	0.0%	25.0%	12.5%
Other reasons	12.5%	0.0%	12.5%	12.5%	12.5%	12.5%

Developer's survey

Are their other methods and instruments not mentioned in the previous list of which you think they could be of use for the development of flood event plans?

GIS tools
- "Data en GIS tools, e.g. land use data, data with locations of schools, day-care centres, hospitals, emergency services, ground levels

Flood patterns
- LIZARD, a tool which shows all flooding patterns for the Netherlands
- The velocity with which the water rises and spreads

Evacuation
- Decision support tool in relation to evacuation strategy based on threatened area, behaviour people, number of people threatened, e.g. EvacuAid

Flood defences
- Instruments which determine the sensitivity (strength) for different water scenarios. The current national evaluation of flood defences only assesses one scenario, while in reality a number of scenarios are likely to occur.

Are there any other tools, methods or guidance that you would like to see developed that could be used by to develop flood emergency plans?

Measures
- Tools which provide an overview of measures and their effectiveness

Evaluation and improvement of event plans
- Tools which give insight into the effectiveness of flood event plans on casualty risk
- Evaluation instrument for training and exercise of event plans. Objective appraisal along a learning curve

Flood defences
- On-line determination of damage to coastal defences using expected sea water levels and wave information

Other comments
- Their is still enough which can be done on the mentioned instruments

- I think that for most of these methods not enough is known for them to be really useful for event planning e.g. chain effects, we know little of the release of toxic substance

- I also think that a good estimation is needed of rescue possibilities. Is there enough resources available to rescue everyone within a certain time, or are additional measures necessary

Planners survey

Please list the names of the tools, methods or guidance that you currently use that are of assistance to emergency plans

Guidelines and formats
- Guidelines
- Inspection requirements

- Several laws and acts (2x)
- Evaluation frameworks
- Guideline for preparation of event plan (general plan)
- National communication strategy
- For the development of a municipality event plan formats exist
- Personal format (2x)
- Model 'calamity care' from the water board union
- Format developed in cooperation
- Inter provincial evaluation framework for water board calamity plans
- TMO documentation and earlier instruments such as the LMR (leidraad maatramp operationele prestatie)
- We use for so far available, standard formats and available documents such as the national coordination plan
- A compilation of several methods and guidelines
- Format for evacuation

Flood simulation model (results)
- Flood simulations
- DSS for calculating flood scenarios
- Software of flood scenarios which shows the flood patterns in time
- Flooding atlas

Evacuation and traffic modelling
- Information on evacuation possibilities resulting form traffic modelling
- Evacuation calculator (2x)
- The HIS (High water Information System containing evacuation calculator and damage and casualties module)

Action plans
- Action plan

What needs do you have for (existing) instruments which can contribute to the flood event planning?

Guidelines e.g.:
- Automated action plan
- Format which encompasses earlier mentioned criteria and tips resulting in uniform event plans.
- Revision of existing formats resulting in simpler plans
- Uniformity of plans within the Netherlands. Even if there are standards available (for the general event plans), plans still differ considerably. This is due to the fact that we all think that our region is unique which justifies for deviation of the known procedures and phasing.

Flood simulation and prediction
- Instruments which contribute to improved flood scenario information
- For a coastal flooding it is of great importance to gain information on probability of failure of defences earlier in the event. Therefore more accurate predictions need to be performed

Training
- Improved training methods, e.g. serious gaming,

Information sharing
- In general: improved presentation and communication of information

- Resources: database containing both the organisations which are involved as well as the people and means (available capacity) which are available for evacuation and rescue and the location of the resources
- Informing: Maps to inform decision makers maps (for DSS) on e.g. people, traffic, businesses, infrastructure

User friendliness

- User-friendly information systems

Evacuation

- Dynamic model for evacuation with which different options can be evaluated fast
- Need for an instrument to be used during an actual event to be able to choose the correct measures for the situation

General comments

- More need for regional instruments
- In due time yes, but now the emphasis is on the fundamental planning