

*Integrate, Consolidate
and Disseminate
European Flood Risk
Management Research*

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

**IMPROVING AND ASSESSING EMERGENCY
PLANS FOR FLOODS -
THE FIM FRAME METHOD
GUIDANCE DOCUMENT
DRAFT FOR CONSULTATION**

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Second Era-Net CRUE Funding Initiative: Flood resilient communities – managing the consequences of flooding

CRUE Research Report

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

Flood Incident Management – A FRAMEwork for improvement – FIM FRAME

CRUE Research Final Report

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2ND CRUE FUNDING INITIATIVE ON FLOOD RESILIENCE

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1 Introduction

Recent decades have seen significant increases in the number, scope and complexity of incidents and disasters. It is now generally agreed that places that are significantly at risk of hazards should be required to construct emergency plans. Recent research has found that there is an “enormous variety and lack of homogeneity” amongst emergency planning documents in many parts of the world. There is a shortage of adequate methods for creating, evaluating and approving emergency plans. Many emergency planners have expressed a need for guidance as they are often uncertain about the quality and appropriateness of their plans, and on how to develop new plans.

This document provides guidance on a method for developing or improving an emergency plan for floods. The method was developed within the ERA-Net CRUE FIM FRAME project and is known as the FIM FRAME method. The method is designed to be:

- **Simple**, so that it can be applied by anyone without any specific training
- **Transportable**, so that it can be used anywhere
- **Generic**, to allow it to be adapted by users for their specific purpose and not limited to a specific spatial scale (i.e. the method can be used at a local, regional and national level)

In conjunction with the FIM FRAME method suggestions are made of tools that can be used by emergency planners, flood risk managers and emergency responders to develop and improve emergency plans. In the context of the FIM FRAME method the term “tool” is used to refer guidance documents, checklist, a specific method or software.

The five principles of information management were used to develop the method. The five principles of information management take the form of a set of statements or objectives for information management. These are:

- **Data and information** - Recognise and understand all types of information, incoming and outgoing;
- **Roles and responsibilities** - Understand the legal issues and execute “duty of care” responsibilities, including stakeholder engagement;
- **Processes and procedures** - Identify and specify processes and procedures undertaken, whether technical or organisation orientated;
- **Tools and technologies** - Identify tools (e.g. databases, modelling software, checklists, decision trees, flow diagrams) and enabling technologies (e.g. the internet, video, publishing) to support the processes and procedures;
- **Audit and control** - Monitor and audit the processes and procedures and carry out remedial actions as required, i.e. do the actual activities undertaken match with the desired activities, if not what needs changing – the actual activities or the desired activities?

These principles can be applied to all information flow systems, such as that involved in managing a flooding response, and bring together all possible elements everything from high-level policy issues to detailed analysis. This type of framework enables all of the actors and actions involved in a system to be mapped, and thereby to develop comprehensive and optimal procedures. The five principles are shown in Figure 1.1.

Information management

The five principles

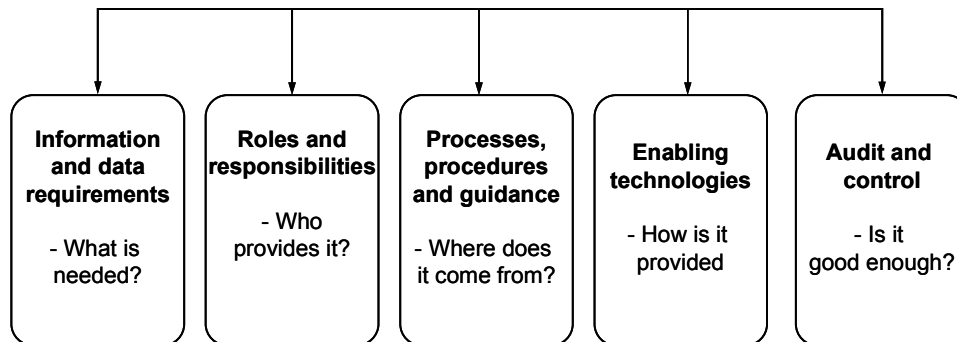


Figure 1.1 The five principles of information management

(i) Information and data requirements

Fundamentally, any organisation involved with the emergency planning for floods must review their information and data requirements to ensure they match their needs. It is not sufficient to assume that because certain information or data are collected or generated they will always be needed. Information demands need to be expressed explicitly to all the stakeholders involved. The movement of information through the emergency response system, between responders and with the public, needs to be understood.

(ii) Roles and responsibilities

It is important to define the roles and responsibilities of stakeholders involved in the emergency planning for floods. This can then be mapped to their data requirements, and how they change and transmit information.

(iii) Processes, procedures and guidance

The processes, procedures and guidance for emergency planning for floods within each organisation will be described at this stage. This means that if an organisation is a collector of information used in emergency planning, it needs to be stated what techniques are used. Similarly, if an organisation generates data using modelling (e.g. flood forecasts) such procedures also need to be documented.

(iv) Enabling technologies

In order for organisations to improve their emergency planning for flood events it is important that they apply appropriate enabling technologies. This does not mean the organisation has to constantly keep up with the latest technological developments, but it should recognise that technology does become obsolete and thus it is important to make informed decisions about upgrade programmes.

(v) Audit and control

The audit and control stage is an essential part of any practices for maximising the value of information. It enables the benefits of the process to be quantified and areas of improvement identified. If the organisation already has a formal audit procedure, then procedures to improve information exchange should be incorporated within it.

Information provision is an essential component of emergency management and therefore effective information management is an important component of effective emergency planning. Whether data is used in a commercial or non-commercial environment it is essential that the costs of providing the data are less than the benefits obtained. However, the value of data can easily be misunderstood if there is no

agreed basis for discussing and organising an organisation's ideas about it. This subject has to be dealt with in a practical and effective way which will allow possible solutions to be implemented in those cases where there is any advantage to be gained.

This guidance document has been structured as follows:

- Section 2 provides a theoretical overview of the FIM FRAME method
- Section 3 provides some practical examples of implementing the method in England, France and the Netherlands
- Section 4 provides brief details of some of the tools that are available that are applicable to helping develop and improving emergency plans for floods

2 Use of the FIM FRAME method to develop and improve emergency plans

2.1 How to apply the method

The method is structured in three steps:

1. **Appraise** - Applying metrics to assess plans in order to 'flag up' general issues
2. **Tackle** - structuring\de-structuring the process and identifying specific issues
3. **Implement** - taking actions to address the issues and updating the plan

These steps are shown in Figure 2.1 These steps do not need to be applied sequentially and the method can be used starting at any point. For example, if no plan is in place the method can be applied starting from step 2. If some issues have already been identified e.g. as result of a post-event appraisal or an exercise, then the starting point could be step 3. The FIM FRAME can also be used as a process of continually improvement e.g. to re-appraise a plan after it last been updated.

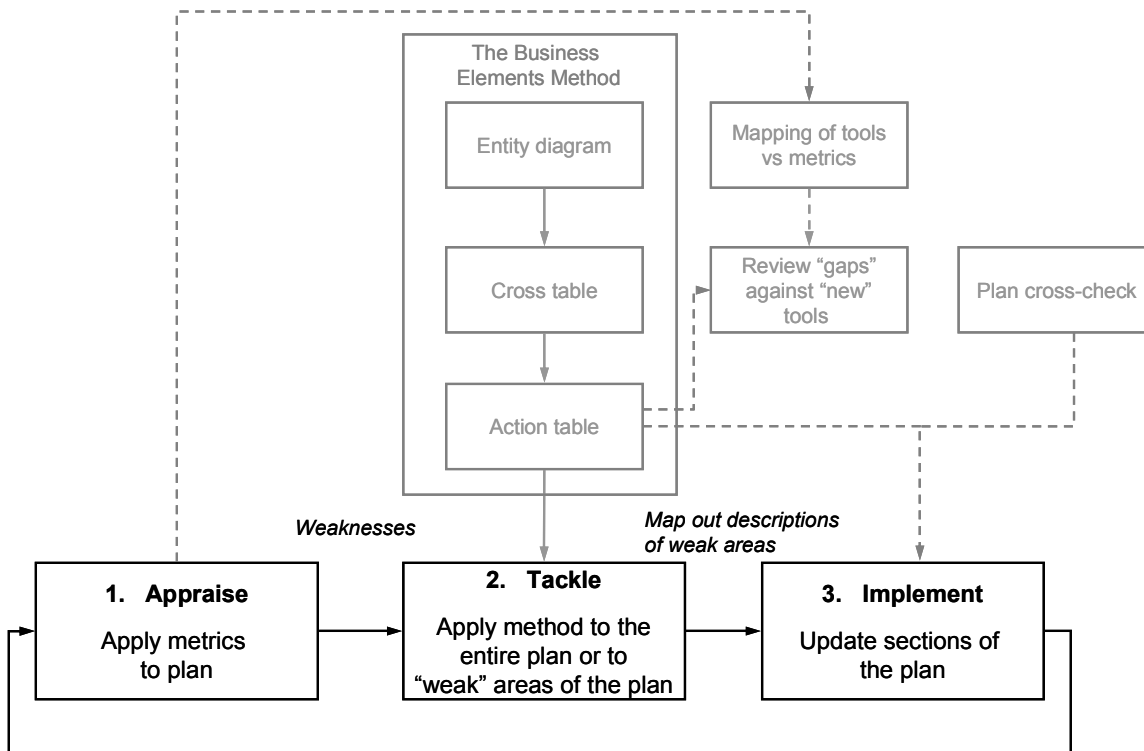


Figure 2.1 Diagram of the FIM FRAME method

In setting out the above method, there is one element that requires further explanation. Step 2 requires the application of the Business Elements Method, which is an approach for analysing any business process.

The Business Elements Method is a tried and tested approach for analysing any process (or event); in this case the flood emergency plan. This method consists in examining the process in terms of five factors:

- Processes
- Roles and responsibilities
- Data and information
- Tools
- Audit

Considering these elements can help to produce a clearer picture of the process and provide an understanding of the interdependencies within the different parts that constitute the process. This can help to identify, possible issues or “weaknesses”, and to gain a clear understanding of how to address these and how these can affect the process.

2.2 Step 1 -“Appraise” - Apply metrics to identify general issues or weaknesses

In order to appraise an emergency plan for floods 22 metrics were developed. The set of metrics developed can be:

- Applied to emergency plans for floods at a range of geographical scales ranging from a regional to local level
- Generic but at the same time be clear and focused to avoid misinterpretation
- Measurable

The metrics used to appraise a plan are given in Table 2.1. The metrics allow for the plans to be “scored” in a quantitative manner. For example a score of “1” would be given for a metric where the level of detail is low; “2” where the level of detail is medium and “3” where the metric is treated in a high level of detail. By averaging the metric scores, an overall score of a plan can be obtained. In addition the average score per metric for the evaluated plans gives an insight into which metrics are addressed within the plans and to what level of detail. The average scoring range for the developed metrics was divided into five equally distributed bands between a score of 1 and 3. These scoring bands are given in Table 2.2.

It is important to note that if a metric is not covered in an emergency plan for a flood but is included and covered in sufficient detail in a clearly referenced, complementary plan then the metric should score a “3” (i.e. a high level of detail). For example in the case of the metric for “evacuation routes” if these are clearly shown in a generic evacuation plan that covers a wide range of hazards and this evacuation plan is clearly referenced in the emergency plan for floods then the “Evacuation routes” metric should score a “3”.

The appraisal of the plan consists of assessing the plan against the metrics developed. This appraisal achieves an initial understanding on how the plan is likely to perform and what are the main weaknesses.

Table 2.1 Metrics for the appraisal of emergency plans for floods – Part 1

Metric	Level of detail		
	Low	Medium	High
Objectives, assumptions and target audience			
Aims and objectives of plan	Not detailed	Aims and objectives included but could be clarified further	Clearly stated aims and objectives including the area covered, types and sources of flooding
Target audience and updating of the plan	Not detailed	Audience defined and plan dated	Audience defined and how they will be notified of updates and modifications to the plan included
Assumptions made by the plan	Not detailed	Covers some aspects	Covers all aspects including: flood warning lead time; method by which rescue will be undertaken; implications of the failure of critical infrastructure
Organisation and responsibilities			
Actions, roles and responsibilities	Not detailed	Brief details of the roles and responsibilities related to the activation of the plan provided	Details of the roles and responsibilities related to the activation of the plan provided including health and safety and environmental considerations
Recovery	Not detailed	Brief details of how the recovery is managed	Details of how the recovery is managed including clean up, waste disposal, repairs to public assets, humanitarian assistance
Training and exercises	Not detailed	Brief details of training and exercise requirements	Internal and external (with other organisations) training and exercises outlined
Plan activation	Not detailed	Brief description of the thresholds or levels used to activate plan	Description of the thresholds or levels used to activate plan together with flow chart
Communication			
Communication with other agencies	Not detailed	Outlined in words	Detailed and the links shown diagrammatically
Communication with the public	Not detailed	Outlined in words	Detailed and shown the links shown diagrammatically
Management of the media	Not detailed	Outline media management strategy in place	Well defined media management strategy in place
Flood warning (if available)	Undefined	Levels of flood warning with details of the areas flooded at each level	Levels of flood warning with details of the areas flooded at each level and shown on a map
Relationship with complementary emergency plans detailed	Not detailed	Outlined in words	Detailed and the links shown diagrammatically

Table 2.1 Metrics for the assessment of emergency plans for floods – Part 2

Metric	Level of detail		
	Low	Medium	High
Evacuation			
Evacuation routes	Not detailed	Evacuation routes shown on a map	Evacuation routes detailed together with roads likely to be closed and their accessibility for emergency vehicles and other vehicles
Shelters/Safe havens	Not detailed	Safe havens/shelters shown on a map	Safe havens/shelters shown on a map with their capacity and facilities
Flood hazard			
Flood hazard map	Not detailed	Flood hazard map(s) showing extent	Flood hazard map(s) showing water depth and velocity
Details of previous floods (if available)	Not detailed	Brief description of historical flood	Description of historical floods with the cause and a brief description of the risk in terms of people and properties affected
Flood risk to receptors			
Flood risk to people	Not detailed	Number of people potentially affected included	Potential injuries and loss of life included and mapped for a range of scenarios
Flood risk to vulnerable people (e.g. elderly or disabled)	Not detailed	Areas where elderly/sick people live mapped	Numbers of vulnerable people defined with a response strategy
Flood risk to residential property	Not detailed	Number of properties defined	Number of properties defined together with those at risk of collapsing during an extreme flood
Flood risk to businesses	Not detailed	Number of businesses defined	Number and type of businesses defined together with potential losses
Flood risk to critical infrastructure (e.g. water supply, gas, electricity, police, fire brigade)	Not detailed	Number of pieces of critical infrastructure shown on the flood map(s)	Number of pieces critical infrastructure shown on the flood map(s) and an assessment of their likelihood of failure during a flood
Potential for NaTech hazards at industrial facilities (if present)*	Not detailed	Potential NaTech sites shown on map	Potential NaTech sites shown on map and brief details of the response

*Note: A NaTech is defined as technological hazard that is triggered by a natural hazard. For example the flooding of an industrial plant may lead to the release of a toxic chemical that poses a threat to humans, as well as flora and fauna

Table 2.2 Scores for the emergency plan

Average score	Average quality	Description to determine the quality of the flood emergency management plan
2.6 to 3.0	Good	There is little or no further information that could have been included in the plan. This can be considered as a 'Good' score with little room for improvement.
2.2 to <2.6	Above average	There is some further information that could have been included in the plan. This could be considered an "Above average" score.
1.8 to <2.2	Average	Considerably more information could have been included in the plan. This could be considered an "Average" score.
1.4 to <1.8	Room for improvement	There is information missing from the plan. There is "Room for improvement".
1.0 to <1.4	Considerable room for improvement	There is a large amount of additional information that could be included in the plan. There is "Considerable room for improvement".

2.3 Step 2 - "Tackle" - structuring\de-structuring the process and identifying specific issues

This step can be performed for the whole plan or just for particular aspects, (e.g. for metrics that obtained a low score in the "Appraise" step). The "Tackle" step aims to go through specific processes (or components of the plan) and expand them into their constituent "items or entities", each of these being analysed both individually and in combination with the other items they are linked to. This analysis is based on the application of the five principles of the Business Elements Method (i.e. processes, roles and responsibilities, data and information, tools and audit) that have been adapted to comprise three subsequent steps:

- (i) Describe the process - the **Entity diagram**
- (ii) Process\Responsibilities\Tools\Information - the **Cross-table**
- (iii) Identify and tackle the issues – the **Action table**

For each of these steps there corresponds a specific outcome: the Entity diagram, the Cross-table and the Action table; the latter will be used as the basis for the implementation and the updating of the plan as part of Step 3 – "Implement".

2.3.1 Part (i) - Entity diagram

The first part consists of developing an entity diagram for the entire plan or for just a particular aspect of the plan (e.g. the identification of vulnerable people). The aim of the entity diagram is to include all the elements that constitute the particular process. This diagram also aims to describe the relationship between such elements. An 'Entity diagram' comprises boxes and arrows.

The boxes contain specific "entities". The entities are the components that constitute the aspect being analysed. The arrows describe the relationship between the entities. For each of the boxes, the following questions should be addressed:

- What does this entity do? (e.g. what is the process and who is responsible for the process)
- What does this entity provide? (e.g. what information is produced)
- Who does it inform? (e.g. who receives the information and who is responsible for passing this information)
- Who makes sure that this is done? (e.g. who audits the process)

- How this is done? (e.g. which tools are used/needed to produce the information or perform the process)

The answers to these questions might already be in a box in the diagram, and therefore an arrow can be drawn to connect the two boxes. Alternatively, another box should be added to identify the missing entity and then connect the existing box with the new one. Figure 2.2 provides a generic example of an entity diagram.

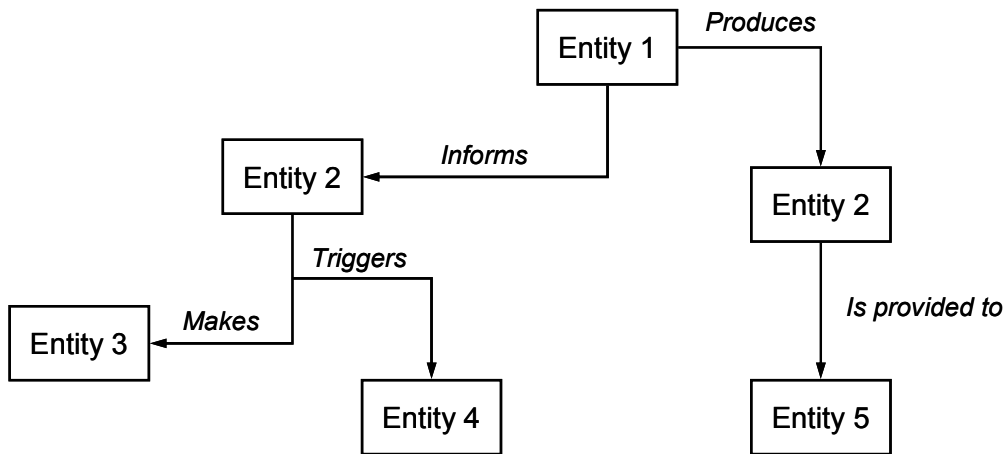


Figure 2.2 Example of a generic entity diagram

2.3.2 Part (ii) - Cross-table - Process\Responsibilities\Tools\Information

The part of the method considers each entity in the diagram. The outcome from part (ii) is a simple table containing all the entities in the first quadrant, the related roles and responsibilities in the second, the Information in the third and the Tools in the fourth quadrant. This is shown in Figure 2.3.

<p>1. Processes and procedures (What ?)</p>	<p>2. Roles\Responsibilities (Who?)</p>
<p>4. Tools (How?)</p>	<p>3. Information (Which data?)</p>

Figure 2.3 Example of a generic cross table

Starting from one 'quadrant' of the cross table (e.g. Processes and procedures), the first question to ask will be:

Processes and procedures What does the entity do?

Once the process is described, the other part of the tables and the relative links should be completed by exploring:

FROM Processes and procedures TO Roles and responsibilities Who is responsible for doing this? Who checks that this has been done?

FROM Processes and procedures TO Information Which data or information are needed for doing this?

FROM Processes and procedures TO Tools What tools are needed\used for doing this?

Once the links between Processes and procedures have been explored, the other quadrant of the tables should be analysed, starting from e.g. the Information quadrant:

FROM Information TO Roles and responsibilities Who uses this data? Who is responsible for providing this information? Who audits that this information is provided\disseminated?

FROM Information TO Tools How is this information produced? How is it communicated? Where\how is it stored?

FROM Tools TO Roles and responsibilities Who owns the tools? Who has access to the tools?

Figure 2.4 gives an example of a generic cross table that has been completed. Completing the cross table helps to provide a better understanding of the elements of the process as well as of the links within the various elements. While constructing the cross-table, certain issues can arise. These issues should be highlighted and should be discussed in detail in the next part.

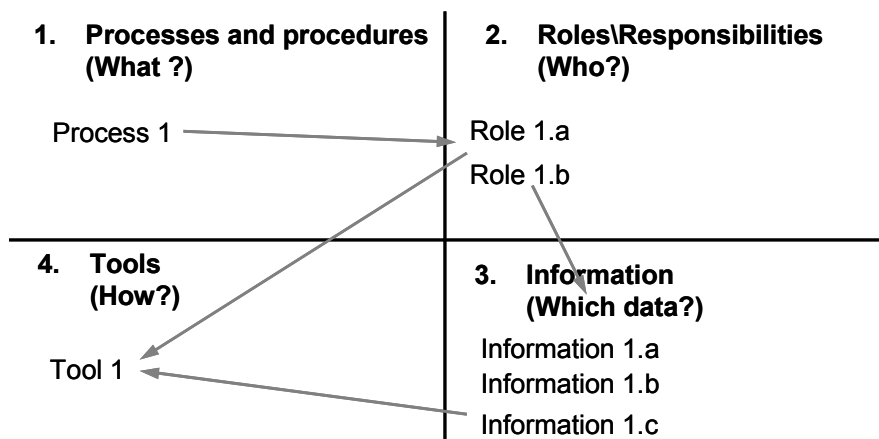


Figure 2.4 Example of a filled in generic cross table

2.3.3 Part (iii) – Action table

When identifying the links in the cross table, certain issues can arise, for example:

- Identifying the links may not be straightforward;
- Some links that should theoretically be in place do not exist in practice;
- Some information is not provided by any entity (e.g. neither by a tool nor a person)
- Information is provided but not fed back to anyone

Once such an issue arises, this should be reported and described in the first column of the Action table. The blank action table is shown in Table 2.3.

Table 2.3 Action table – identifying ‘Tackling actions’

Issues	Tackling actions					Implementation			
	How to address it? Actions	Who should bring it forward? Responsibility	What information is needed?	Is any tool needed ?	Who checks this is done? Audit	Priority	Resources	Time-line	Plan to be updated?

For each of the identified issues, the user can analyse how to address them by going through the questions proposed by the table, and filling the columns in accordingly:

How to address it?	Defining a specific Action(s) that is (are) needed to tackle the issue.
Who should bring it forward?	Identifying who should be responsible for taking forward each of the specified actions.
What information is needed?	Listing possible information and sources of information
Is any tool needed?	Discuss if any particular tool is needed to create the required information, who owns the tool and how this can be used. A table providing some guidance on some of the tools that are currently available is given in Appendix A
Who checks this is done?	Assigning a physical person who should be responsible to audit and check whether the action is brought forward as well as whether this is done correctly

Once the issue has been analysed, part (iii) should be repeated for other identified issues. The outcome of this process is the Action Table containing tangible actions that should be undertaken and audits that should be introduced into the process, as well as identifying responsibilities for these actions.

This simple analysis can provide a guide for exploring the process and spot possible issues, especially due to the links within different aspects that might not have been fully covered in emergency plans, and that might cause possible “bottlenecks” to the process.

Listing these items in a table might help to keep track of them, and this can be of help to check whether these have been addressed in the next review of the plan. Table 2.4 provides an example of the analysis of an issue through the Action table

2.4 Step 3 “Implement” - taking actions forward

This step should start from the issues and relative actions identified by the Action table. It can also start from specific issues identified elsewhere, e.g. directly through the appraisal of the metrics or by other means e.g. a post-event assessment. This step should include:

- a. Plan cross-check, to identify specific parts of the plans that cover (or should cover) the issue.
- b. Update the section of the plans, identifying detailed measures that should be taken to include the specific issue in the plan or to modify the plan so that the specific issue is covered.
- c. Reviewing the action list and push forward the implementation plan.

Once the issue is described and the Tackling Actions identified in the Action Table, the Implementation part of the table needs to be filled in. For each of the identified Actions, the following need to should be specified:

Priority	What is the degree of importance of the particular actions (in terms of High, Medium, and Low) and/or what is the sequential order in the list of actions (whether this action needs to be done in 1st place, 2nd, 3rd...)
Resources	What are the resources needed (in terms of time, people and/or money) for fulfilling this action and where/how these resources are secured
Timeline	List of specific sub-actions with relative timelines
Plan to be updated?	The answer can simply be YES/NO. This column simply aims to capture any actions that should result in an update of the plan

This step will translate the actions identified in the Action table into specific measures of implementation into the plans, including identifying a timeline for the implementation of the measures and resources that are needed for the implementations. The whole table, supported by the Entity Diagram and the Cross-Table, will also provide strong and documented evidence of the reason for which the actions, and relative resources, are needed.

This can provide:

- A strong business case that will help to put the actions into practice by demonstrating the importance of securing resources
- A ‘to do’ list that can help prioritise the actions, if resources are limited, and tackle the most important issues first
- Evidence for demonstrating the importance of the identified actions to those involved in the planning process, helping to engage with them and gaining a collaborative attitude

An example of a completed table is shown in Table 2.5.

Issue	Tackling actions						Implementation			
	How to address it? Actions	Who should bring it forward? Responsibility	What information is needed?	Is any new tool needed?	Who checks this is done? Audit	Priority	Resources	Timeline	Plan to be updated?	
Description of the first issue e.g. police warning households only by mobile phone – Issues related to network coverage	1. Analyse the network coverage for each area. This should be collected and stored in GIS maps for the police to analyse.	The telephone company should have this information. The police should seek and collect this information. Policeman X is the individual responsible.	Mobile telephone network coverage by area.	Information in GIS layers would be ideal. make sure this is compatible with the police system.	Policeman X is the individual responsible. Police officer Y is responsible for checking this is done and reporting back.					
	2. Decide how to use this information and how to introduce this into the emergency plan.	Policeman X to present the information to other people responsible for emergency planning. Meeting scheduled on how to use the information and to introduce it into the plan.			Relevant emergency planners ensure that a meeting is held and the actions are followed up.					

Table 2.4 Action table – Example 1

Issue	Tackling actions						Implementation			
	How to address it? Actions	Who should bring it forward? Responsibility	What information is needed?	Is any new tool needed?	Who checks this is done? Audit	Priority	Resources	Timeline	Plan to be updated?	
Description of the first issue e.g. police warning households only by mobile phone – issues related to network coverage	1. Analyse the network coverage for each area. This should be collected and stored in GIS maps for the police to analyse.	The telephone company should have this information. The police should seek and collect this information. Policeman X is the individual responsible.	Mobile telephone network coverage by area.	Information in GIS layers would be ideal. make sure this is compatible with the police system.	Policeman X is the individual responsible. Police officer Y is responsible for checking this is done and reporting back.	High – To be done first	€€€€€€ needed to be obtained From the Local Authority and central government	Police GIS facilities to be checked by Policeman X by 15 Dec 2010 Policeman X to Contact telephone company by 15 Dec 2010 to agree data sharing Seek update on data sharing by 15 Mar 2011 Set up shared database by 30 April 2011	No	
	2. Decide how to use this information and how to introduce this into the emergency plan.	Policeman X to present the information to other people responsible for emergency planning. Meeting scheduled on how to use the information and to introduce it into the plan.			Relevant emergency planners ensure that a meeting is held and the actions are followed up.	High – To be done second	One day for relevant staff to attend meeting. Three days to update plan and check it	Police officer Y to set up emergency planning meeting by 15 May 2011 By 30 June 2011 Policeman X to present GIS layers and their use to emergency planners Update the emergency plan by 30 July 2011 Updated plan checked by emergency planners by 15 August 2011	Yes	

Table 2.5 Action table – Example 2

3 Application of the FIM FRAME method in the city of Sheffield, UK

This chapter provides an example of a practical application of the FIM FRAME method to a Multi-Agency Flood Plan (MAFP) for the city of Sheffield in the UK. The first step was to appraise the plan using the developed metrics. The appraisal is shown in Table 3.1.

The majority of the scores fell in the average or high category, with the plan overall obtaining an 'average' rating. The main weak areas were:

- Evacuation routes – no detail is provided, either on a map or in the text
- Detail is not provided on vulnerable people – there was a strong view that this information changes on a daily basis, and whilst the responders do receive updated information on a regular basis, it is not sensible to include this in the 'static' plan
- Critical infrastructure – although this is provided in a table, it is not included on a map
- NaTech hazards – in common with the majority of plans analysed to date, this information is not provided (or even known).

From this initial analysis it is clear that certain improvements could be made relatively easily, without the need for any new information or use of tools. Three possibilities are:

- Further explanation provided in the 'Scope' section on the assumptions made by the plan, such as what type of flood risks are considered
- A flowchart provided that summarises how the plan is activated and what roles the various responders take
- A diagram or flowchart is provided to show how the MAFP links in with other complementary plans, and what actions or events may require the use of each one.

With these simple changes, the average score would rise to 2.27, and the plan would then be assessed as 'above average'.

Table 3.1 Metric scores for the Sheffield MAFP

Metric	Level of detail			Score	Comments / Potential improvements
	Low	Medium	High		
Objectives, assumptions and target audience					
Aims and objectives of plan			●	3	
Target audience and updating of the plan			●	3	
Assumptions made by the plan		●		2	Provide more detail in the 'Scope' section
Organisation and responsibilities					
Actions, roles and responsibilities			●	3	
Recovery		●		2	
Training and exercises			●	3	
Plan activation		●		2	Include flow chart of activation actions
Communication					
Communication with other agencies		●		2	
Communication with the public		●		2	
Management of the media			●	3	Media management well signposted
Flood warning (if available)			●	3	Clear signposting to location of other maps
Relationship with complementary emergency plans detailed		●		2	
Evacuation					
Evacuation routes	●			1	Consider how to determine 'optimum' evacuation routes, and impact of flood on access
Shelters/Safe havens			●	3	Scored High because policy is not to include this information in MAFP
Flood hazard					
Flood hazard map		●		2	
Details of previous floods (if available)		●		2	
Flood risk to receptors					
Flood risk to people	●			1	
Flood risk to vulnerable people (e.g. elderly or disabled)		●		1.5	Not realistic to provide up-to-date information as it changes daily
Flood risk to residential property		●		2	Residential and business properties need splitting out

Metric	Level of detail			Score	Comments / Potential improvements
	Low	Medium	High		
					in the plan
Flood risk to businesses		●		2	“
Flood risk to critical infrastructure (e.g. water supply, gas, electricity, police, fire brigade)	●			1.5	
Potential for NaTech hazards at industrial facilities (if present)*	●			1	
	Average score			2.14	An 'Average' plan

Based on this assessment, the stakeholders agreed to look at 'Evacuation routes' during the as part of the Tackle step. The first part of the 'Tackle' step was to build an Entity Diagram, as shown in Figure 3.1.

Part 2 of the 'Tackle' phase was to fill in the Cross Table, which breaks the entities down into:

- Processes and procedures
- Roles and responsibilities
- Information
- Tools

From the entity diagram, the various processes and procedures were identified, and inserted in the first quadrant. These were then assessed on the basis of who was responsible for them, what information was required, and whether any tools or other technology was used or needed. The resultant table is presented in Figure 3.2.

During this analysis, the participants were asked to note possible difficulties in identifying the links between the various items in the table. Lack of clarity or missing links are dealt with as 'red lights' in the tackle process. Such items are to be noted in the first column of the Action Table. From the group discussions two key issues were identified: how were the public informed of the need to evacuate, and where should they be told to go (if at all). These points are summarised in Figure 3.3.

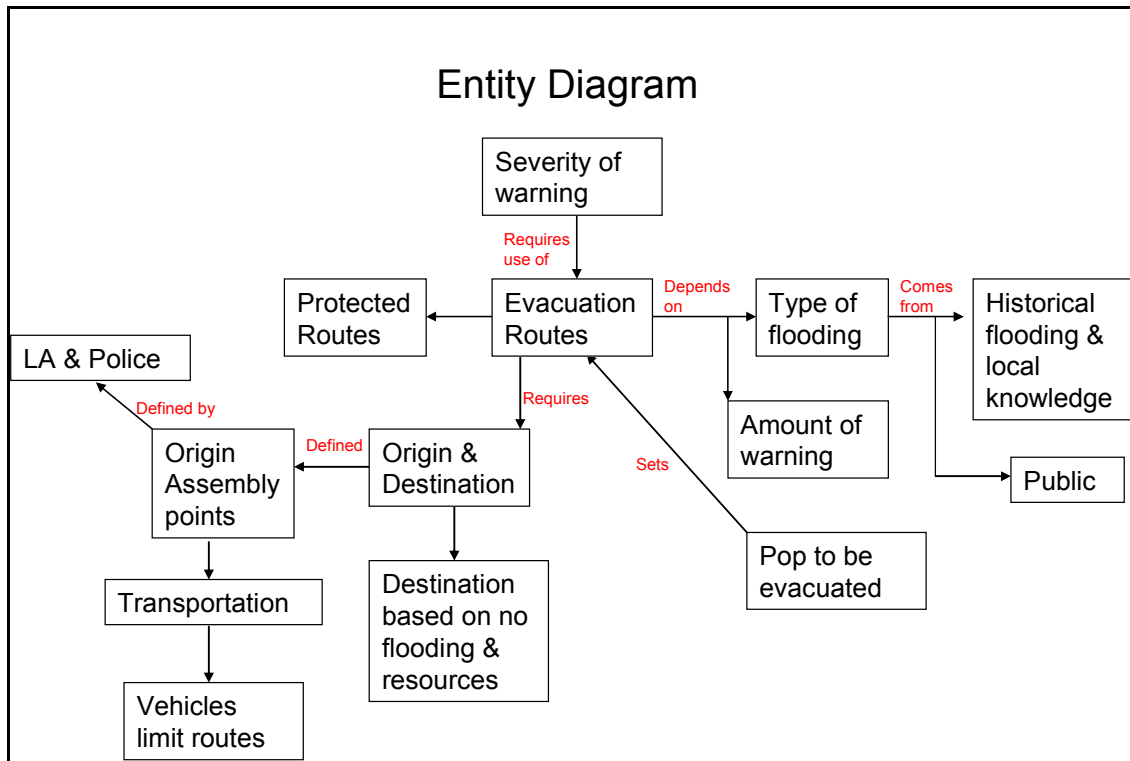
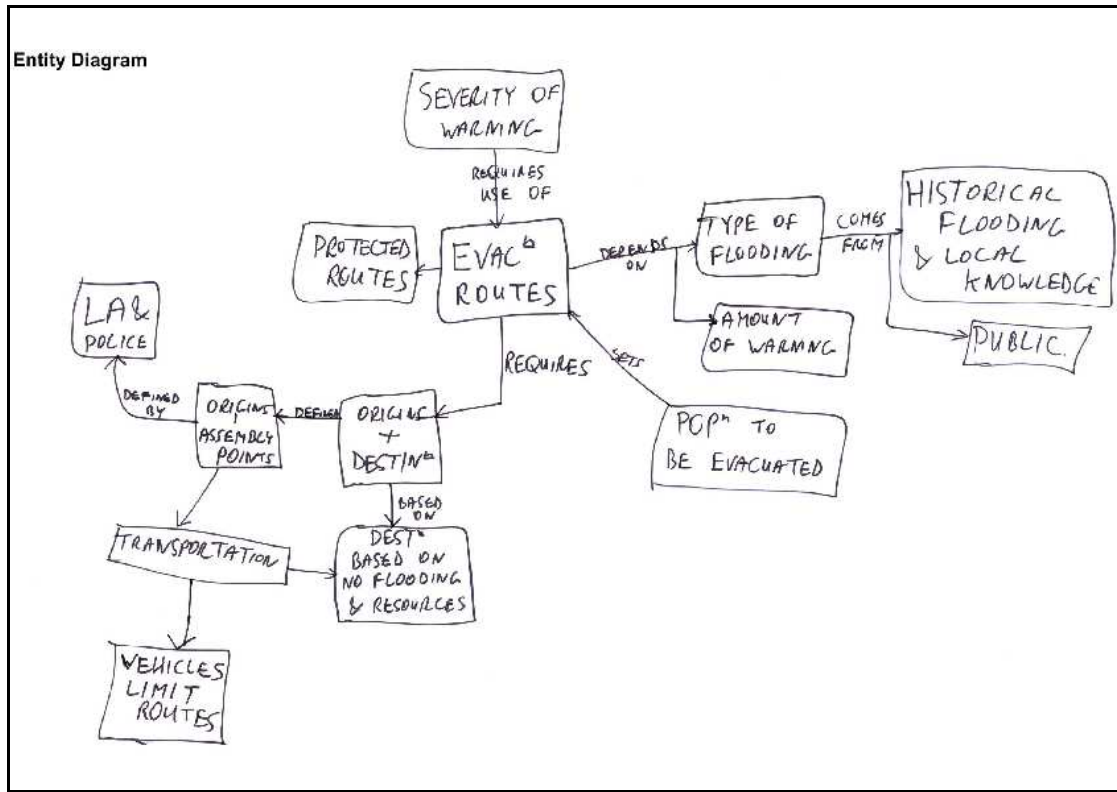


Figure 3.1 Entity diagram for 'Evacuation Routes'

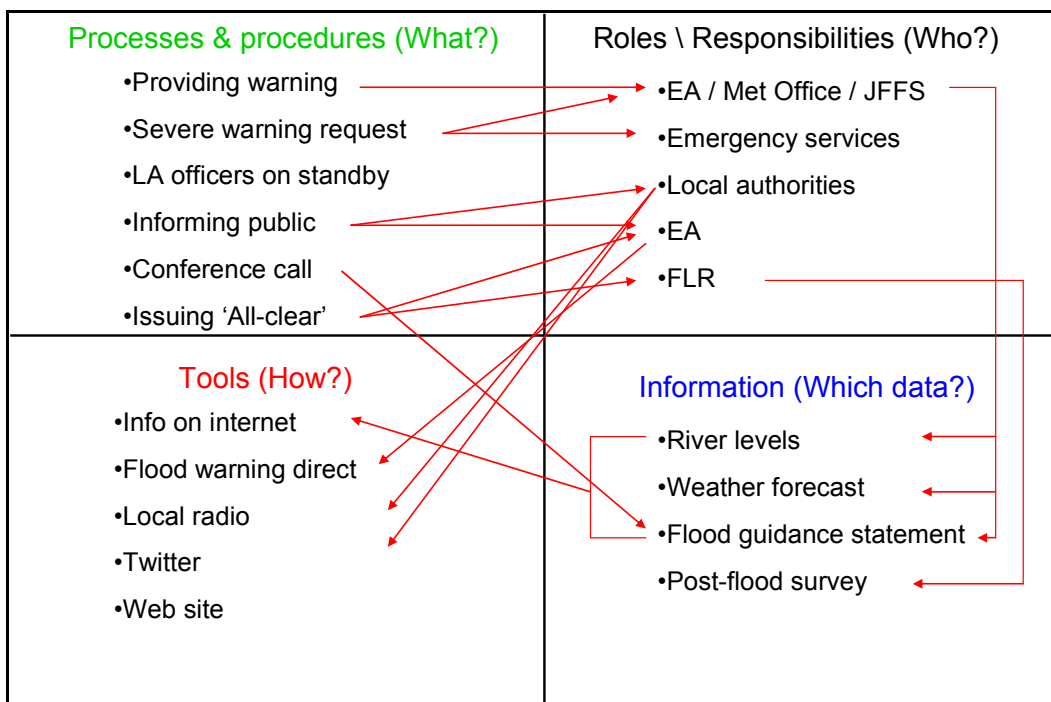
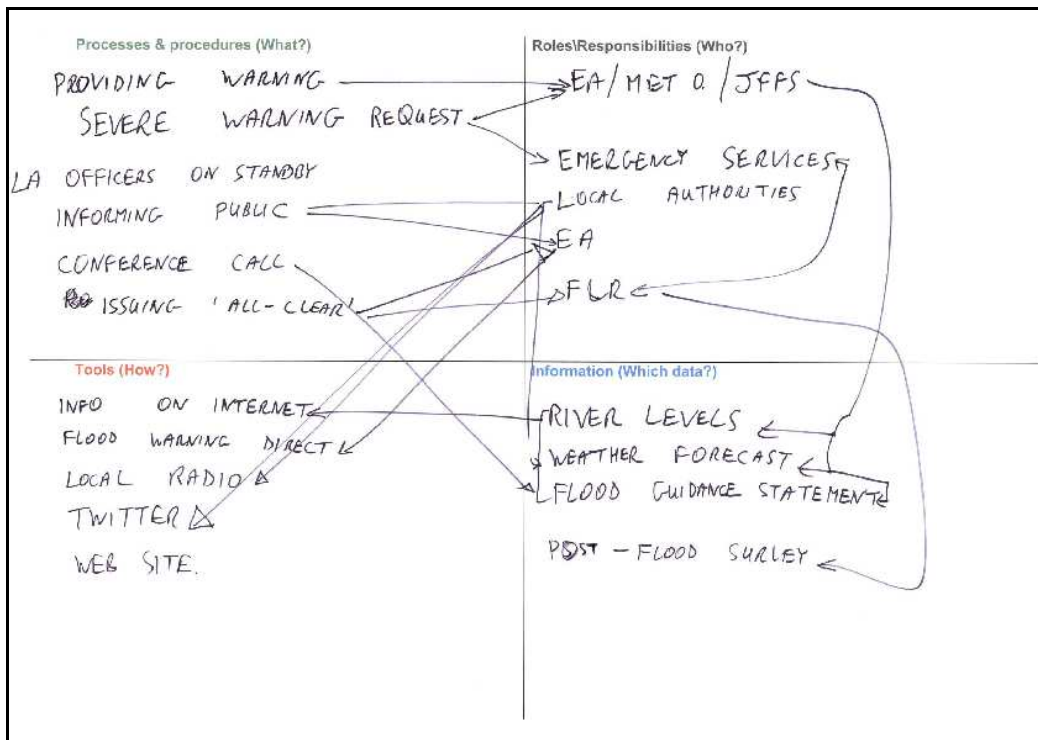


Figure 3.2 Cross Table for 'Evacuation Routes'

EVACUATION

Issues	Tackling actions				
	How to address it? Actions	Who should bring it forward? Responsibility	What information is needed?	Is any tool needed?	Who checks this is done? Audit
INFORMING PUBLIC	MEDIA MESSAGE	① EA ② M.Ag.	RIVER LEVELS FLUVIAL FORECAST	RIVER MODEL LOOK TO PROVIDE TO THEMSELVES	TCG
	FWD	EA → M.Ag.	" REQUEST FROM M.Ag PARTNERS		EA
	DOOR - KNOCKING	LA / E.S.	" PREFERRED DESTINATIONS	GIS SYSTEM	TCG
	WEB.	M. Ag	" "		TCG
	SIGNAGE.	LA	PREFERRED ROUTES.		TCG
WHERE DO THEY GO?	REST CENTRES	LA	PLUVIAL FORECAST	Y	
	GET ADDRESS DETAILS	LA / E.S. POLICE	SUITABLE LOCATIONS	GIS / LOCAL K.	TCG.
			—	CO-OPERATION	LA.

Evacuation

Issues	Tackling actions				
	How to address it? Actions	Who should bring it forward? Responsibility	What information is needed?	Is any tool needed?	Who checks this is done? Audit
Informing public	Media Message	EA M.Ag.	River levels Fluvial forecast	River model	TCG
	FWD	EA to M.Ag	Request from M.Ag partners		EA
	Door-knocking	LA / E.S.	Preferred Destinations	GIS System	TCG
	WEB	M.Ag	Preferred Destinations		TCG
	Signage	LA	Preferred Routes		TCG
Where do they go?	Rest centres	LA	Pluvial forecast	Y	
	Get address details	LA / Police	Suitable locations	GIS / Local knowledge	TCG
				Co-operation	LA

Figure 3.3 Action Table for 'evacuation routes'

Following the application of the FIM FRAME method tools were applied to assess evacuation routes and how these could affect the loss of life during an extreme flood event.

4 Use of tools in the city of Sheffield, UK

In this case of the Sheffield MAFP the impact of a dam failure on the town upstream of Sheffield was considered. Two tools were applied:

- A Life Safety Model (LSM)
- Risk to People method

The results from the application of LSM were presented at a workshop, and the animation of the flood wave and the movement of the population provided a very clear representation of where fatalities occurred and where the population needed to move to escape the floodwaters. Two key conclusions were reached:

1. The provision of an adequate warning of a breach at the dam was vital, and means to transmit this warning to the rest of the town should be considered
2. The narrow form of the valley means that fatalities only occur in the riparian zone, so if people move uphill, perpendicular to the river, this will afford the greatest safety.

The stakeholders responsible for emergency planning need to consider whether dedicated uphill escape need defining, or whether general advice can be given for people to simply move away from the river once the warning siren is heard. This also needs to consider whether specific shelter locations need to be defined. Some form of permanent signage could be used to remind people that a flood risk exists and where they should move.

Beyond this simple analysis, the LSM could be used to further investigate different warning rates and locations, plus the designation of shelters. This last option is probably not realistic as the linear nature of the town means that a large number of shelters would be needed if people were to get to high ground as quickly as possible. It is probably better to define the major roads to be used to get right away from the area, where people can be advised on where to proceed to. The results from the analysis can be used to improve the mapping of flood hazard and the location of any businesses or infrastructure that would be affected by the dam failure. To summarise the tools applied helped with the following:

- Planning evacuation routes
- Determining shelter and safe haven locations
- Defining warning arrangements

Table 4.1 overleaf provides a general overview of the tools that are available to “improve” or further develop each of the 22 metrics. It is not the aim of Table 4.1 to recommend bespoke tools as these are often country specific. However, it does provide an overview on the type of tools that are available.

Table 4.1 Overview of the tools available that can be used to meet the requirements of the metrics – Part 1

Metric	Brief description of tools
Objectives, assumptions and target audience	
Aims and objectives of plan	Various checklists and guidelines that have been produced locally
Target audience and updating of the plan	
Assumptions made by the plan	
Organisation and responsibilities	
Actions, roles and responsibilities	Tools that assist with detailed roles and the links shown diagrammatically
Recovery	Manuals and checklists detailing requirements for recovery
Training and exercises	Manuals detailing the training and exercises
Plan activation	Guidelines to assist with the definition of “trigger levels” and how these can be improved
Communication	
Communication with other agencies	Checklists and guidelines to assist with communication with various key actors in the emergency management process
Communication with the public	
Management of the media	
Flood warning (if available)	Methods to map the levels of flood warning (e.g. high, medium, low vigilance) with details of the areas flooded at each warning level and with these shown on a map
Relationship with complementary emergency plans detailed	Methods to assist with mapping of relationships between plans
Evacuation	
Evacuation routes	Suitability of evacuation routes and their accessibility can be assessed by: <ul style="list-style-type: none"> • Methods to access the accessibility of flooded routes for emergency services including guidance documents and simple spreadsheet analysis to assess vehicle stability • Evacuation models to assess viable evacuation routes, use of shelters and evacuation times
Shelters/Safe havens	Mapping of safe havens and shelters with their capacity and facilities on a map in relation to a variety of flood hazard scenarios
Flood hazard	
Flood hazard map	Two dimensional hydraulic models that produce water depths and water velocities. Modelling tools that can produce these results include: <ul style="list-style-type: none"> • FLOW-2D • InfoWorks RS • MIKE 21 • SOBEK • TuFLOW
Details of previous floods (if available)	Methods to obtain details of previous floods including: <ul style="list-style-type: none"> • Historical archives including libraries and newspapers • Research with local stakeholders that have experience or knowledge of historical floods • Historical flood maps showing previous events

Table 4.1 Overview of the tools available that can be used to meet the requirements of the metrics – Part 2

Metric	Brief description of tools
Flood risk to receptors	
Flood risk to people	Tools and software that can estimate the potential number of injuries and loss of life for a range of scenarios. These include methods such as: <ul style="list-style-type: none"> • DEFRA Risk to People method • Life Safety Model • LifeSim • TU Delft method • HAZUS method • United States Bureau of Reclamation (USBR) Procedure for estimating loss of life
Flood risk to vulnerable people (e.g. elderly or disabled)	Methods and tools that can be used: <ul style="list-style-type: none"> • Demographic data to map the location of elderly people and other vulnerable people • Mapping of schools, old-age peoples' homes, hospitals and nurseries
Flood risk to residential property	Methods and tools that can be used: <ul style="list-style-type: none"> • List the number and location of properties that are likely to be affected by a range of flood scenarios • Mapping of residential properties in relation to the flood hazard • Identification of the means by which people can be evacuated from residential properties
Flood risk to businesses	Methods and tools that can be used: <ul style="list-style-type: none"> • List the number, location and type of businesses that are likely to be affected by a range of flood scenarios • Mapping of businesses in relation to the flood hazard
Flood risk to critical infrastructure (e.g. water supply, gas, electricity, police, fire brigade)	Methods and tools that can be used: <ul style="list-style-type: none"> • Mapping of critical infrastructure in relation to the flood hazard • Methods to establish the consequences of failure (e.g. the number of people who could lose their potable water following the flooding of a water supply plant and the duration and implications of the closure)
Potential for NaTech hazards at industrial facilities (if present)*	Methods and tools that can be used: <ul style="list-style-type: none"> • Mapping of infrastructure and locations that could result in a NaTech hazard (e.g. industrial plants, chemical plants) in relation to the flood hazard • Methods to establish the consequences of failure (e.g. the number of people who could lose their potable water following the flooding of a water supply plant and the effect of this)

*Note: A NaTech is defined as technological hazard that is triggered by a natural hazard. For example the flooding of an industrial plant may lead to the release of a toxic chemical that poses a threat to humans, as well as flora and fauna

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