Background to the PFRA European Overview – UC10508

The individual Member State Reports reflect the situation as reported by the Member States to the European Commission in 2014
The situation in the MSs may have altered since then

Assessment of Flood Hazard and Flood Risk Maps

Member State Report: UK - United Kingdom

Date that the assessment was completed: 12 December 2014

Information reported and assessed

The schemas for electronically reporting/making information available to the Commission were filled in with a wealth of information. The UK made available links to its national flood risk and flood hazard maps for 15 of its 16 units of management: one unit of management did not have any identified flood risk areas. Detailed summaries were provided on the methods used to prepare the maps and specific details of national maps for visualisation at the European level were also reported. No links to other relevant information on the preparation of the maps were provided.

This report is structured according to a questionnaire that was completed for all Member States that reported on their flood hazard and risk maps. Questions 2 and 3 of the questionnaire were answered on the basis of a qualitative check of a subset of the Member State's flood hazard and flood risk maps located on national servers and/or web pages. All other questions (question 1 and questions 4 to 11) were answered on the basis of an assessment of numeric and summary information reported by the Member State on the methods used in the preparation of their maps. The report does not include in-depth assessment of national background methodological reports which may have been referenced in the Member State's reports and/or provided with their electronic reports.

This report includes information on what the Member State has included/considered or not included/considered in its flood risk and hazard maps and their development. This is a presentation of the facts on the electronic information reported to WISE by Member States and does not discuss which elements are mandatory according to the Directive and which are optional.

Main outcomes of the assessment

a) Good practices adopted:

The UK has three authorities that were responsible for the production of Flood Hazard and Flood Risk Maps for the first cycle of implementation of the Floods Directive. These are the Environment Agency, which was responsible for the production of maps for England and Wales, the Scottish Environment Protection Agency in Scotland and the Rivers Agency in Northern Ireland. The majority of online map viewers produced by these authorities are informative and easy to use, particularly the one for Scotland which has multiple layers that can be turned on and off and a detailed search facility. In a number of cases, linked PDF maps are also available to the public. Northern Ireland provides a user guide which is helpful in understanding all the functionality that is available and photos are available to view from historic flood events.

b) Weaknesses:

For England and Wales it can be difficult to see the difference between low, medium and high probability events because the base map cannot be turned off. The same problem is seen on the PDF maps.

Subsequent to the assessment, the UK authority for England and Wales (Environment Agency) commented that, for the online system, those colours were chosen through user testing, by members of the public who were asked to test the mapping system to input to its design. The shades of blue were felt by the testers to be the most intuitive option, most likely to instil an understanding of the flood risk. The England and Wales authority also mentioned they had received strong feedback from their testers that any extra functionality (like being able to turn layers on and off) overcomplicated the system and should be avoided. Finally, the Environment Agency commented that the option to interrogate the maps at the click of a mouse to ascertain the level of flood risk would overcome any residual uncertainty.

Generally, more information has been reported to WISE than is available to view on the maps. For England and Wales, WISE data indicates that infrastructure and installations which might cause accidental pollution in a flood situation have been reported, but these are not identifiable in the map viewer. With Northern Ireland, types and sectors of economic activity affected and installations which might cause accidental pollution in case of flooding are not shown on the map.

c) Lessons to be learnt:

The UK electronic reports to WISE illustrate that it is possible for Member States to provide timely, comprehensive and detailed information that is very useful for the European Commission in checking and assessing flood hazard and flood risk maps.

The easy-to-use and very informative map viewer for Scotland provides an example of good practice in visualising flood hazard and flood risk maps.

Flood maps from coastal waters and the main rivers in England and Wales are combined. As coastal and river flooding may not necessarily occur at the same time in areas potentially affected by both, it might be of benefit to the user if the sources are presented separately on maps as well as combined in areas subject to both sources of floods.

Groundwater flooding is often considered as not being significant in many Member States. Scotland provides a possible good practice example of where groundwater mapping is used to identify areas where it could contribute to flooding (from other sources) by prolonging a flood event or by increasing its adverse consequences.

Flooding from sewerage systems can be assessed so that its potential consequences can be explicitly incorporated and taken into account in the mapping of pluvial floods (in Scotland).

There are around 7000 large dams in Europe and thousands more smaller dams. However, relatively few Member States seem to map the hazard and risk of flooding from the failure of artificial water bearing infrastructure such as the breaching of dams associated with reservoirs. The UK (England, Wales and Northern Ireland) has demonstrated that potential floods from this source can be successfully and effectively mapped.

Mapping of areas of potential significant flood risk

Question 1: What are the reasons reported in the FHRM schema for the non-inclusion of some APSFRs, elements or aspects in the flood hazard and flood risk maps?

For Scotland maps only show information where it is available or appropriate. Flooding from reservoirs is excluded because it will be part of separate work under the Reservoirs (Scotland) Act 2011. Groundwater flooding is only included where it may prolong a flood event or exacerbate its impacts. The map showing the impacts of flooding does not include ground water because accurate information is not available. On the economic activity maps, only roads located within flood waters above a depth of 0.15m were displayed as this is the depth at which driving becomes dangerous. The impact of pluvial flooding on agricultural land was not assessed as the impact of shallow and brief flooding on agricultural production/ loss of crops is difficult to ascertain.

In England and Wales reservoir flooding is only mapped where the capacity is over 25,000m^3.

In Northern Ireland, coastal flood hazard maps do not provide flow velocity as this is optional under Article 6(4)(c), this is the same for flood depth. No mapping has been produced for groundwater because no areas are at significant risk. Reservoir flooding is only mapped where the capacity is over 10,000m^3; these maps are available on request to operators/managers.

Areas of Potential Significant Flood Risk (APSFR) and other risk areas identified by the assessment of flood risk and those for which maps were prepared

Unit of Management	Number of Areas of Potential Significant Flood Risk (1)			FHRM information reported at Unit of Management scale (2)		Number of other areas with available national FHRM (3)
	a) Identified according to Article 5	b) with links to national maps	c) with details of maps provided to WISE	b) with links to national maps	c) with details of maps provided to WISE	b) with links to national maps
UK01	206	206	206	0	Yes	0
UK02	37	37	37	0	Yes	1
UK03	No significant risk areas identified from pluvial, groundwater and minor watercourse flooding			Yes	Yes	0
UK04	3	3	3	Yes	Yes	0
UK05	1	1	1	Yes	Yes	0
UK06	2	2	2	Yes	Yes	0
UK07	1	1	1	Yes	Yes	0
UK08	No significant risk areas identified from pluvial, groundwater and minor watercourse flooding			Yes	Yes	0
UK09	7	7	7	Yes	Yes	0
UK10	2	2	2	Yes	Yes	0
UK11	No significant risk areas identified from pluvial, groundwater and minor watercourse flooding			Yes	Yes	0

Unit of Management	Number of Areas of Potential Significant Flood Risk (1)			FHRM information reported at Unit of Management scale (2)		Number of other areas with available national FHRM (3)
	a) Identified according to Article 5	b) with links to national maps	c) with details of maps provided to WISE	b) with links to national maps	c) with details of maps provided to WISE	b) with links to national maps
UK12	2	2	2	Yes	Yes	0
UKNI_NB	9	9	9	No	Yes	0
UKNI_NE	8	8	8	Yes	Yes	0
UKNI_NW	3	3	3	Yes	Yes	0
UKGI17	No significant flood risk areas identified			No significant flood risk areas identified		

Key:

a) Article 5 requires the identification of areas of potential significant flood risk (APSFR) based on a new Preliminary Flood Risk Assessment or an existing one.

b) Member States were asked to provide links to national web pages or viewers where maps of the flood hazard and flood risk associated with APSFRs could be viewed (column 1). Alternatively or additionally maps could be made available and reported at the level of the Unit of Management (column 2) or at other geographical scales (column 3),

c) Member States were asked to provide numeric details (such as source of flooding, numbers of potentially affected inhabitants and types of potential adverse consequences) of the maps associated with the APSFR so that they could be depicted on a European map of flooding. The maps could be reported with the relevant APSFR code (column 1) and/or at the level of the Unit of Management (column 2).
In some circumstances, (c) may be greater than (a), for example if additional APSFRs were identified after 2012.

Note: Article 13.1.b was applied to floods from sea water, the main rivers and large raised reservoirs in England and Wales (UK02-EN, UK03 to UK12) and did not identify APSFR as required by Article 5. Links to the maps for these specific sources of flooding were provided at the UoM level for the UoMs in England and wales.

Content of flood hazard and flood risk maps

Note: Not all of the maps prepared by Member States have been examined. Instead a subset was selected and reviewed by designated assessors.

The maps for checking were selected on the basis of information provided by Member States with their Preliminary Flood Risk Assessments (PFRAs) in 2012 (where available) and the screening of the maps made available in the "LinkToMS" schema.

The aim was to select a sufficient number of maps to reflect:

- Potential differences in methodologies, presentation and visualisation of maps between the Units of Management (UoM) within a Member State. Some Member States have a strong national approach, in others there are differences between administrative regions;
- Differences in sources of floods included in hazard and risk maps. Some APSFRs and UoM are associated with more than one source of flooding whereas others are not. The aim was to check maps associated with all possible types of flood associated with a Member State. For those Member States applying Article 4 and Article 13.1.a the selection of relevant flood types can be informed from the reporting of APSFR in March 2012;
- Differences in the Articles applied across a Member State and within UoMs. Whilst some Member States have applied only one Article across their whole territory and for all flood types, others have applied different Articles within a UoM and also according to flood types.
- The application of Article 13.1.b and Article 13.2 by some Member States in at least some of their UoMs. In these cases Member States may have provided UoM codes, other area codes or both: in these cases it was the flood maps associated with the areas that were checked. The objective was to check examples of maps within the linked areas in relation to all potential and relevant sources of flooding and that may have been mapped."

Links to national web pages where examples of national maps can be viewed are given below.

Question 2 Which types of flood, scenarios, hazard elements and potential adverse consequences have been mapped and visualised?

Table 1: First seven maps assessed

Unit of management	**UK01**	**UK02_England**	**UK02_England**	**UK02_Scotland**	**UK03**	**UK03**	**UK04**
APSFR code	**UKSCAP100**	**Not applicable**	**Not applicable**	**UKSCAP145**	**Not applicable**	**Not applicable**	**Not applicable**
The provided link went straight to the APSFR	Yes			Yes			
Map located by searching for name of APSFR							
Source(s) of flooding mapped	Fluvial, Coastal, Pluvial (Groundwater - 1)	Fluvial and Coastal grouped together. Pluvial shown on different map	Artificial (reservoirs)	Fluvial, Pluvial, (Groundwater, coastal – 2)	Fluvial and Coastal grouped together. Pluvial shown on different map	Artificial (reservoirs)	Fluvial and Coastal grouped together. Pluvial shown on different map
Mechanism(s) of flooding mapped	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Characteristic(s) of flooding mapped	No Data	No Data	No Data	No Data	No Data	No Data	No Data

Unit of management	UK01	UK02_England	UK02_England	UK02_Scotland	UK03	UK03	UK04
APSFR code	**UKSCAP100**	**Not applicable**	**Not applicable**	**UKSCAP145**	**Not applicable**	**Not applicable**	**Not applicable**
Linked map available to public	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mapped scenarios:							
Floods with a low probability mapped	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Floods with a medium probability mapped	Yes	Yes	No	Yes	Yes	No	Yes
Floods with a high probability mapped	Yes	Yes	No	Yes	Yes	No	Yes
Separate maps or layers for each probability scenario	Yes	No	No	Yes	No	No	No
Separate maps or layers for each flood type	Yes	Yes	No	Yes	Yes	Yes	Yes
More than one scenario shown on the same Map	Yes	Yes	No	Yes	Yes	No	Yes
More than one source of flooding shown on the same Map	Yes	Yes	No	Yes	Yes	No	Yes
Hazard Elements shown on map:							
Flood extents	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Water depth	Yes	Yes	No	Yes	Yes	Yes	Yes
Water levels	No	No	No	No	No	No	No
Flow velocities	Yes	Yes	No	Yes	Yes	Yes	Yes
Relevant water flow	No	No	No	No	No	No	No
Flood Hazard and Flood Risk on the same map	Yes	No	Yes	Yes	No	No	No
Separate maps of Flood Hazard and Flood Risk	Yes	No	No	Yes	No	No	No
Potential adverse consequences shown on:							
Number of Inhabitants potentially affected	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Human health	Yes	No	No	Yes	No	No	No
The community	Yes	No	Yes	Yes	No	No	No
Type and sectors of economic activity	Yes	No	No	Yes	No	No	No
Land use	Yes	Yes	Yes	Yes	Yes	No	Yes
Point locations for storage of chemicals, vital networks and services	Yes	No	No	Yes	No	No	No
Property	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Infrastructure	Yes	No	Yes	Yes	No	No	No

Unit of management	UK01	UK02_England	UK02_England	UK02_Scotland	UK03	UK03	UK04
APSFR code	**UKSCAP100**	**Not applicable**	**Not applicable**	**UKSCAP145**	**Not applicable**	**Not applicable**	**Not applicable**
Location of Industrial Emissions Directive installations	Yes	No	No	No	No	No	No
WFD Protected Areas	No	No	Yes	No	No	No	No
Status of water bodies	No	No	No	No	No	No	No
Areas vulnerable to floods with high content of transported sediment and debris flow	No	No	No	No	No	No	No
Other significant sources of pollution	No	No	No	No	No	No	No
Cultural Heritage	No	No	Yes	No	No	No	No
Other useful information	Yes	No	No	Yes	No	No	No
Impacts of Climate Change	No	No	No	No	No	No	No
Coastal protection defences in place	No	No	No	No	No	No	No

(1) Although groundwater flooding is an option to be selected on the map, there are no actual areas at risk of groundwater flooding within this APSFR.

(2) Although groundwater and coastal flooding are options to be selected on the map, there are no actual areas at risk of groundwater or coastal flooding within this APSFR.

Table 2: Last seven maps assessed

Unit of management	UK04	UK06	UK06	UK07	UK12	UKGBNIIENB	UKGBNIIENE
APSFR code	**UK04A0002**	**Not applicable**	**UK06A0002**	**Not applicable**	**Not applicable**		**UKNI_NE_APSFR_01**
The provided link went straight to the APSFR			Yes				Yes
Map located by searching for name of APSFR							
Source(s) of flooding mapped	Pluvial	Artificial water bearing infrastructure (reservoirs)	Pluvial	Fluvial and Coastal grouped together.	Artificial water bearing infrastructure (reservoirs)	Fluvial Pluvial Coastal	Fluvial Coastal Pluvial
Mechanism(s) of flooding mapped	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Characteristic(s) of flooding mapped	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Linked map available to public	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mapped scenarios:							
Floods with a low probability	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Unit of management	UK04	UK06	UK06	UK07	UK12	UKGBNIIENB	UKGBNIIENE
APSFR code	**UK04A0002**	**Not applicable**	**UK06A0002**	**Not applicable**	**Not applicable**		**UKNI_NE_APSFR_01**
mapped							
Floods with a medium probability mapped	Yes	No	Yes	Yes	No	Yes	Yes
Floods with a high probability mapped	Yes	No	Yes	Yes	No	No	Yes
Separate maps or layers for each probability scenario	No	No	No	No	No	No	No
Separate maps or layers for each flood type	Yes	Yes	Yes	Yes	Yes	No	No
More than one scenario shown on the same Map	Yes	No	Yes	Yes	No	Yes	Yes
More than one source of flooding shown on the same Map	No	No	No	Yes	No	Yes	Yes
Hazard Elements shown on map:							
Flood extents	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Water depth	No	No	No	No	No	Yes	Yes
Water levels	No	No	No	No	No	Yes	Yes
Flow velocities	No	No	No	No	No	Yes	Yes
Relevant water flow	No	No	No	No	No	Yes	No
Flood Hazard and Flood Risk on the same map	No	Yes	Yes	Yes	Yes	No	Yes
Separate maps of Flood Hazard and Flood Risk	Yes	No	No	No	No	Yes	No
Potential adverse consequences shown on:							
Number of Inhabitants potentially affected	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Human health	No	No	No	No	No	No	No
The community	No	Yes	Yes	Yes	Yes	No	No
Type and sectors of economic activity	No	No	No	No	No	No	No
Land use	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Point locations for storage of chemicals, vital networks and services	Yes	No	No	No	No	No	No
Property	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Infrastructure	No	Yes	Yes	Yes	Yes	Yes	Yes
Location of Industrial Emissions Directive installations	No	No	No	No	No	No	No
WFD Protected Areas	Yes	Yes	Yes	Yes	Yes	No	No

Unit of management	UK04	UK06	UK06	UK07	UK12	UKGBNIIENB	UKGBNIIENE
APSFR code	**UK04A0002**	**Not applicable**	**UK06A0002**	**Not applicable**	**Not applicable**		**UKNI_NE_APSFR_01**
Status of water bodies	No	No	No	No	No	No	No
Areas vulnerable to floods with high content of transported sediment and debris flow	No	No	No	No	No	No	No
Other significant sources of pollution	No	No	No	No	No	No	No
Cultural Heritage	No	Yes	Yes	Yes	Yes	No	No
Other useful information	No	No	No	No	No	No	No
Impacts of Climate Change	No	No	No	No	No	Yes	Yes
Coastal protection defences in place	No	No	No	No	No	Yes	Yes

Links to national maps:

http://watermaps.environment-agency.gov.uk/wiyby/wiyby.aspx?topic=floodmap#x=234034&y=276407&scale=3

The following link was used for the assessment of the maps: http://map.sepa.org.uk/floodmap/map.htm. Subsequent to the assessment, the UK authorities (Scotland) explained that recent changes to the SEPA web site have altered the address of the online maps. The new address is as follows: http://www.sepa.org.uk/environment/water/flooding.

https://mapping.dardni.gov.uk/FloodMapsNI/index.aspx

Contextual information provided with maps

Question 3 What contextual information was generally provided with the maps?

Table 1: First seven maps assessed

Unit of Management	UK01	UK02_England	UK02_England	UK02_Scotland	UK03	UK03	UK04
APSFR code	**UKSCAP100**	**Not applicable**	**Not applicable**	**UKSCAP145**	**Not applicable**	**Not applicable**	**Not applicable**
Title: brief description of the map	No	Yes	Yes	No	Yes	Yes	Yes
Explanation to the public on how to understand and interpret the flood maps	No	Yes	Yes	No	Yes	Yes	Yes
Responsible authority (organisation responsible for the development and publishing of the maps, with contact details)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Date of preparation / publication	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Legend (textual description of symbols, colours, line features, etc.)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Purpose of development and intended use	No	No	Yes	No	No	No	No
Method of development	No	No	No	No	No	No	No
Limitations of map and / or assessment of uncertainty (1)	No	No	No	No	No	No	No
Disclaimer (to enforce explanatory information and limitations, and provide legal protection to the responsible authority against adverse consequences of misuse)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
North and scale: preferably using scale bar as this allows for changes in page size	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Scope and detail of the explanatory information: should be appropriate to the intended audience (2)	No	Yes	No	No	Yes	Yes	Yes
Intended audience & complexity: Maps intended for public use should be simple and self-explanatory and include a clear legend, such that as little supporting or explanatory information as possible is required for correct interpretation.	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(1) in the maps of England and Wales, uncertainty is presented in terms of how the information could be used, based on user testing and talking with members of the public. For example: You can use the information in this area to see the approximate areas that would flood, and which parts would be shallower or deeper. This information is in the text when you click on a flooded area in the map for rivers/sea, or surface water, and changes based on the quality of the modelled information.

(2) subsequent to the assessment, the authorities for England and Wales stated that the level of detail contained within their maps is based on user testing, thus they believe that it is appropriate to the intended audience. Separate detailed technical documents are shared between Risk Management Authorities, and with the public on request, but are not proactively shared with the public.

Table 2: Last seven maps assessed

Unit of Management	UK04	UK06	UK06	UK07	UK12	UKGBNIIENB	UKGBNIIENE
APSFR code	**UK04A0002**	**Not applicable**	**UK06A0002**	**Not applicable**	**Not applicable**		**UKNI_NE_APSFR_01**
Title: brief description of the map	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Unit of Management	UK04	UK06	UK06	UK07	UK12	UKGBNIIENB	UKGBNIIENE
APSFR code	UK04A0002	Not applicable	UK06A0002	Not applicable	Not applicable		UKNI_NE_APSFR_01
Explanation to the public on how to understand and interpret the flood maps	No	Yes	Yes	Yes	Yes	Yes	Yes
Responsible authority (organisation responsible for the development and publishing of the maps, with contact details)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Date of preparation / publication	No	Yes	Yes	Yes	Yes	Yes	Yes
Legend (textual description of symbols, colours, line features, etc.)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Purpose of development and intended use	No	Yes	Yes	Yes	Yes	No	No
Method of development	No	No	No	No	No	No	No
Limitations of map and / or assessment of uncertainty (1)	No	No	No	No	No	Yes	Yes
Disclaimer (to enforce explanatory information and limitations, and provide legal protection to the responsible authority against adverse consequences of misuse)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
North and scale: preferably using scale bar as this allows for changes in page size	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Scope and detail of the explanatory information: should be appropriate to the intended audience (2)	No	No	No	No	No	No	No
Intended audience & complexity: Maps intended for public use should be simple and self-explanatory and include a clear legend, such that as little supporting or explanatory information as possible is required for correct interpretation.	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(1) in the maps of England and Wales, uncertainty is presented in terms of how the information could be used, based on user testing and talking with members of the public. For example: You can use the information in this area to see the approximate areas that would flood, and which parts would be shallower or deeper. This information is in the text when you click on a flooded area in the map for rivers/sea, or surface water, and changes based on the quality of the modelled information.

(2) subsequent to the assessment, the authorities for England and Wales stated that the level of detail contained within their maps is based on user testing, thus they believe that it is appropriate to the intended audience. Separate detailed technical documents are shared between Risk Management Authorities, and with the public on request, but are not proactively shared with the public.

Summary of findings from questions 2 and 3.

For Scotland the web viewer is very user friendly and easy to navigate. Contextual information provided for the maps includes the logo of the responsible authority and a link to their flooding homepage. A scale bar, the date of publication, a legend and disclaimer are visible and the maps are simple and self-explanatory.

For England and Wales it can be difficult to see the difference between low, medium and high probability events because the base map cannot be turned off. Not much information is provided in the map from the initial link, but more can be found by clicking through subsequent web pages and links. The PDF maps show the same difficulty in distinguishing between low, medium and high probability and the maps cover quite a large area so some detail is lost. Subsequent to the assessment, the UK authority for England and Wales (Environment Agency) commented that the colours used to represent the different scenarios were chosen by members of the public through user testing. They tested a range of options from purples through to green, amber and red and blue was the preferred option as it intuitively 'looked' like water and so encouraged an appropriate interpretation. The Environment Agency also commented that during their testing, the users preferred to be presented with less information to start with, so that they weren't overwhelmed with tick boxes and options. They preferred to then be able to click through if they were interested in learning more.

In a few cases, WISE data indicates that infrastructure and installations which might cause accidental pollution in flood events have been reported, but these are not easy to identify in the map viewer. The maps in the online viewer have a general title and a brief explanation to the public on how to understand the maps; flood probabilities are not mentioned, but the user can also click on an area to get more information. Subsequent to the assessment, the UK authority for England and Wales (Environment Agency) commented that the social research they conducted found that members of the public generally do not like probabilities, and often misinterpreted them (for example some people either thought that a 1 in 100 year flood meant it wouldn't flood in their life time whilst others thought that meant that only 1 in 100 of the people or properties would flood). The groupings of high, medium and low made more sense. The probabilities are nevertheless provided in the click through text so that people who are interested in this information can still access it.

An email link to the responsible authority is available, as is the date the map was last updated, a legend, disclaimer and a scale bar. PDF maps provide slightly more contextual information as they have a detailed title describing the map and explain how to interpret the map and its purpose (although this is in the surrounding text, rather than on the map itself).

For Northern Ireland the map viewer is user friendly and provides quite a lot of information, either on the map or on the linked PDF documents. Types and sectors of economic activity affected and installations which might cause accidental pollution in flood situations are not shown on the map. The user guide provided is very helpful in understanding all the functionality that is available. Titles are provided for the PDF maps, as well as contact details for the responsible authority, a north arrow and the date of preparation. Information on how to understand the maps is given in the user guide; a legend, scale bar and disclaimer/limitations are also available.

Methodologies used to prepare flood hazard maps

Question 4 What methods and relevant information have been used to identify, assess or calculate flooding hazards for the relevant scenarios, and are these compliant with the requirements of the Floods Directive?

The sources of flood for which flood hazard maps have been published, or which have been assessed but flood hazard maps have not been published, were:

Source of flooding	Published	Hazard assessed but not published	Neither published nor assessed	Not relevant
Fluvial	(S,EW,NI) UK01, UKGBNINE, UKGBNIIENB, UKGBNIIENW, UK02, UK03, UK04, UK05, UK06, UK07, UK08, UK09, UK10, UK11, UK12			
Pluvial	(S,EW,NI) UK01, UKGBNINE, UKGBNIIENB, UKGBNIIENW, UK02, UK03, UK04, UK05, UK06, UK07, UK08, UK09, UK10, UK11, UK12			
Coastal	(S,EW,NI) UK01, UKGBNINE, UKGBNIIENB, UKGBNIIENW, UK02, UK03, UK04, UK05, UK06, UK07, UK08, UK09, UK10, UK11, UK12			
Groundwater	(S) UK01, UK02	UKGBNINE, UKGBNIIENB, UKGBNIIENW		(EW) UK02, UK03, UK04, UK05, UK06, UK07, UK08, UK09, UK10, UK11, UK12
Artificial water bearing infrastructure	(EW,NI) UKGBNINE, UKGBNIIENB, UKGBNIIENW, UK02, UK03, UK04, UK05, UK06, UK07, UK08, UK09, UK10, UK11, UK12*			
Sewerage systems	(S) UK01, UK02 – combined with pluvial flooding			
Other (described below if applicable)				(S,EW,NI) UK01, UKGBNINE, UKGBNIIENB, UKGBNIIENW, UK02, UK03, UK04, UK05,

				UK06, UK07, UK08, UK09, UK10, UK11, UK12

* Maps showing floods from artificial water bearing infrastructure are available to reservoir owner, operators and managers on request.

Other: No other types of floods have been identified as relevant in the UK.

Comments

Key: S represents Scotland, EW - England and Wales and NI - Northern Ireland.

In England and Wales, fluvial and coastal flooding is combined. Artificial water bearing infrastructure refers to reservoirs.

In Northern Ireland, artificial water bearing infrastructure also refers to reservoirs. No areas are at a significant risk of flooding from groundwater so no mapping was produced for this type of flooding.

A) Fluvial floods

Scenarios mapped or assessed

Scenario	Return period e.g. 100 years	Percentage e.g. 1%	Decimal e.g. 0.01	Other expression
Low probability	S = 1000 years, EW = 1 in 1000 years, NI = 1000 years	EW = 0.1%, NI = 0.1%		
Medium probability	S = 200 years, EW = 1 in 100 years, NI = 100 years	EW = 1%, NI = 1%		
High probability	S = 10 years, EW = 1 in 30 years, NI = 10 years	EW = 3.3%, NI = 10%		

Summary of the information found and in particular any differences between the UoMs in the Member State.

S represents Scotland, EW - England and Wales and NI - Northern Ireland.

In Scotland, for fluvial and coastal sources, High probability floods have a 10 year return period, Medium a 200 year return period and Low a 1000 year return period. For pluvial sources, Low probability floods have a 200 year return period plus climate change.

England and Wales: Probabilities are expressed as both percentages and return periods. Fluvial and coastal flooding are grouped together. Probabilities of 3.3% (1 in 30), 1% (1 in 100) and 0.1% (1 in 1000) chance of flooding in any year are used to communicate chance of flooding. In addition, a “very low” probability scenario is included to show a probability of flooding of less than 1 in 1000.

Northern Ireland: Probabilities are expressed as both percentages and return periods: High probability floods have a 10 year return period (10% AEP) for fluvial and coastal flooding and a 30 year return period (3.33% AEP) for pluvial flooding. Medium probability events have a 100 year return period (1% AEP) for fluvial flooding and a 200 year return period (0.5% AEP) for coastal and pluvial flooding. Low probability floods have a 1000 year return period (0.1% AEP) for fluvial, pluvial and coastal flooding.

Elements mapped or assessed

Scenario	Flood extent	Water depth/level	Water/flow velocities	Other
Low probability	Yes	Yes	Yes	
Medium probability	Yes	Yes	Yes	
High probability	Yes	Yes	Yes	

Summary of the information found and in particular any differences between the UoMs in the Member State.

Scotland: The hazard maps show flood extent, flood depth and flood velocities (where appropriate).

England and Wales: Fluvial and coastal flooding are grouped together (where relevant). The assessment for both is included here. Flow and level records at gauging stations provide the information for water depth and velocity. Water depth and flow velocity were not consistently

shown in all English and Welsh maps checked in the qualitative assessment (see Tables 1 and 2 under Question 2).

Northern Ireland: both water depth and water level are shown on maps. Flow velocities are visible on the linked PDF maps.

Methods used

What scenarios were considered and tested in the development of the published maps?	Scotland: Fluvial flood hazard maps were prepared for eight probabilities (10, 30, 30 plus climate change, 50, 100, 200, 200 plus climate change and 1,000 year return periods). England and Wales: Many thousands of simulations were run but it is not specified which scenarios these were for. Subsequent to the assessment, the UK authority for England and Wales (Environment Agency) explained that the simulations looked at a range of flood probabilities and a range of failure probabilities, all combined to give an overall chance of flooding. This method allowed any chance of flooding to be displayed; however the selected published options gave consistency with surface water and with the needs of the flood risk management community and users of the data. Northern Ireland: Mention reasons for inclusion (see box below), no other scenarios described. The scenarios tested are not described, it is only mentioned that maps were produced for 20 Significant Flood Risk Areas.
What were the reasons for the exclusion or inclusion of certain scenarios for the final published maps?	Scotland: Medium and low probability flood events were selected for consistency with return periods used in Scottish Planning Policy. High probability floods were chosen for inclusion as they reflect observed events experienced over the last few decades. England and Wales: The scenarios were combined and then mapped. Subsequent to the assessment, the UK authority for England and Wales (Environment Agency) explained that the selected published options gave consistency with surface water and with the needs of the flood risk management community and users of the data. Northern Ireland: Medium probability floods were selected to be consistent with return periods used in current land use planning policy, high and low probabilities were selected after consultation with the Competent Authority in Ireland as these needed to be consistent across the international RBDs.
How were return periods and/or probabilities of flooding calculated, for example what was the length of measurement series used in the calculations?	Scotland: Not described. Subsequent to the assessment, the UK authority for Scotland (SEPA) commented that the Flow Grid referenced in the submission is a UK dataset that is based on appropriate hydrological

	assessment techniques used to define return period. This is developed from gauged records supplied by the various UK agencies and stored in the HiFlows database. England and Wales: Not described. Subsequent to the assessment, the UK authority for England and Wales (Environment Agency) explained that this varies from long data records of hundreds of years, to statistical analyses where no/little measurement exists. Northern Ireland: Not described.
How was the most appropriate scale of the map determined? For example, flood maps intended to raise public awareness should enable anyone to find out where there are risks of flooding. Maps for this purpose may have a relatively larger scale e.g. 1: 10,000 to 1: 25,000 compared to those used for national or regional planning purposes (1:100,000 to 1: 500,000). Also the mapping of some hazard features such as flow velocity may require a more detailed scale such as 1:1,000 or 1:5,000.	Scotland: Not described, closest scale the user can zoom to is 1:25,000. This applies to all flood sources except groundwater, for which the closest scale is 1:94,000. England and Wales: Not described, closest scale the user can zoom to is 1:10,000. Northern Ireland: Not described, closest scale the user can zoom to is 1:10,000.
What was the resolution of digital terrain models used to calculate flood hazards?	Scotland: 5m. England and Wales: 5m. Northern Ireland: 2 points per metre density.
How were existing flood defences taken into account?	Scotland: Taken from the Scottish Flood Defence Asset Database (SFDAD) and added to the digital terrain model. England and Wales: Using the Environment Agency's National Flood Risk Assessment (NaFRA), information on flood defences and their condition and failure probability was combined to produce a probabilistic assessment. Northern Ireland: Maps show the Standard of Protection of the flood defences in bands of: less than 50 years, between 50 and 75 years, between 75 and 100 years and greater than 100 years. Flood defences were captured and built into each of the models.
How were existing infrastructure or buildings taken into account?	Scotland: Using surface roughness data from the Ordinance Survey. England and Wales: Not described. Northern Ireland: Buildings from LiDAR data were emphasised to give accurate flow paths. Some flow is allowed to penetrate buildings.
What other data sets were used?	Scotland: Fluvial model inflows taken from the CEH Flow Grid. England and Wales: 2D JFlow software was used for rivers, and a combination of direct projection and 2D HYDROF software for coastal areas. ISIS 1D, TUFLOW or other 1D/2D modelling where appropriate. EA's asset management system (AIMS). Northern Ireland: Infoworks ICM, Infoworks RS, 1D/2D modelling, Floods Estimation Handbook (FEH) methodology.
What are the key assumptions of the method?	Scotland: The updated CEH Flow Grid is broadly representative of river flows across

	Scotland, there is no allowance for artificial modifications to flow due to reservoir operation, the channel capacity for all watercourses approximates to the Median Annual Maximum Flow and in-channel hydraulics and channel morphology are not a key factor. England and Wales: Not described. Northern Ireland: Not described
What were the identified uncertainties in the methods and resultant maps and assessments?	Scotland: Uncertainties are around the data used to create the maps such as hydrological and topographical information and from modelling techniques. England and Wales: Not described. Subsequent to the assessment the UK authorities explained that uncertainties in the maps vary from place to place depending on the input data (DTM, model type, etc.). Based on user testing and talking with members of the public they present uncertainty in terms of how the information could be used. For example: you can use the information in this area to see the approximate areas that would flood, and which parts would be shallower or deeper. This information is in the text when you click on a flooded area in the map for rivers/sea, or surface water, and changes based on the quality of the modelled information. Northern Ireland: DTM has a vertical accuracy of +/- 15cm.
What were the shortcomings of the method?	Scotland: Not described. England and Wales: Not described. Northern Ireland: Not described
What were the advantages of the method?	Scotland: Not described. England and Wales: Not described. Northern Ireland: Models were validated against known historical data. Models made use of the extensive data available on the hydrometric network in Northern Ireland. Subsequent to the assessment, the UK authority for Scotland (SEPA) commented that outputs were referenced against historic flood records and involved additional validation by local authority partners. Further details can be supplied.

B) Pluvial floods

Scenarios mapped or assessed

Scenario	Return period e.g. 100 years	Percentage e.g. 1%	Decimal e.g. 0.01	Other expression
Low probability	S = 200 years, NI = 1000 years	EW = 0.1%, NI = 0.1%		
Medium probability	S = 200 years, NI = 200 years	EW = 1%, NI =0.5%		
High probability	S = 10 years, NI = 30 years	EW = 3.3%, NI = 3.33%		

Summary of the information found and in particular any differences between the UoMs in the Member State.

S represents Scotland, EW - England and Wales and NI - Northern Ireland.

Scotland: for fluvial and coastal sources, High probability floods have a 10 year return period, Medium a 200 year return period and Low a 1000 year return period. For pluvial sources, Low probability floods have a 200 year return period plus climate change.

England and Wales: Probabilities are expressed as percentages. Fluvial and coastal flooding are grouped together. Probabilities of 3.3%, 1% and 0.1% chance of flooding in any year were used to communicate chance of flooding.

Northern Ireland: Probabilities are expressed as percentages and return periods: High probability floods have a 10 year return period (10% AEP) for fluvial and coastal flooding and a 30 year return period (3.33% AEP) for pluvial flooding. Medium probability events have a 100 year return period (1% AEP) for fluvial flooding and a 200 year return period (0.5% AEP) for coastal and pluvial flooding. Low probability floods have a 1000 year return period (0.1% AEP) for fluvial, pluvial and coastal flooding.

Elements mapped or assessed

Scenario	Flood extent	Water depth/level	Water/flow velocities	Other
Low probability	Yes	Yes	Yes	
Medium probability	Yes	Yes	Yes	
High probability	Yes	Yes	Yes	

Summary of the information found and in particular any differences between the UoMs in the Member State.

Scotland: The hazard maps show flood extent, flood depth and flood velocities (where appropriate).

England and Wales: depth is published in three bands and velocity in two bands. Water depth and flow velocity were not consistently shown in all English and Welsh maps checked in the qualitative assessment (see Tables 1 and 2 under Question 2).

Northern Ireland: Maps do not include flow velocity information as this is optional under Article 6(4)(c) and included 'where appropriate'.

Methods used

What scenarios were considered and tested in the development of the published maps?	Scotland: 7 probabilities were tested. England and Wales: 3 different storm durations were tested for each of 3 flood

	probabilities, and the worst case taken for each cell for any given flood probability. Northern Ireland: see next answer. Information on any other unpublished maps which were considered is not provided.
What were the reasons for the exclusion or inclusion of certain scenarios for the final published maps?	Scotland: Medium and low probability flood events were selected for consistency with return periods used in Scottish Planning Policy. High probability floods were chosen for inclusion as they reflect observed events experienced over the last few decades. England and Wales: 3 different storm durations were tested for each of 3 flood probabilities, and the worst case taken for each cell for any given flood probability. Northern Ireland: The high probability event was chosen as flooding at the exceedance limit is consistent with the design of storm drains. The medium probability was chosen to demonstrate the impact when the all storm drainage systems would be overwhelmed. The low probability event was selected to be consistent with the other sources of flooding.
How were return periods and/or probabilities of flooding calculated, for example what was the length of measurement series used in the calculations?	Scotland: 7 probabilities at a 1 hour and 3 hour rainfall duration. England and Wales:3 different storm durations were tested for each of 3 flood probabilities, and the worst case taken for each cell for any given flood probability. Rainfall was based on best practice statistical methods set out in the Flood Estimation Handbook. Northern Ireland: Not described
How was the most appropriate scale of the map determined? For example, flood maps intended to raise public awareness should enable anyone to find out where there are risks of flooding. Maps for this purpose may have a relatively larger scale e.g. 1: 10,000 to 1: 25,000 compared to those used for national or regional planning purposes (1:100,000 to 1: 500,000). Also the mapping of some hazard features such as flow velocity may require a more detailed scale such as 1:1,000 or 1:5,000.	Scotland: Not described, closest scale the user can zoom to is 1:25,000. England and Wales: Not described, closest scale the user can zoom to is 1:10,000. Subsequent to the assessment, the UK authority for England and Wales (Environment Agency) explained that the scale was chosen as an appropriate balance between allowing the user to find a location on the map; and giving a false sense of confidence in the map data ('my living room will flood but the kitchen won't'). Northern Ireland: Not described, closest scale the user can zoom to is 1:10,000.
What was the resolution of digital terrain models used to calculate flood hazards?	Scotland: 1, 2 or 5m. England and Wales: 2m. Northern Ireland: 5m.
How were existing flood defences taken into account?	Scotland: Not described. Subsequent to the assessment, the UK authority for Scotland (SEPA) commented that they are not aware of formal pluvial defences but other structures are included in the DTM. England and Wales: Not described. Northern Ireland: Not described.
How were existing infrastructure or buildings taken into account?	Scotland: Data was post processed to introduce 0.3m 'stubby' buildings. England and Wales: Data was post processed to introduce 0.3m 'stubby' buildings from detailed OS MasterMap. Buildings are modelled so that water flows through them

	easily only once a certain depth has been reached. Northern Ireland: The DTM was modified to incorporate the buildings and road layers from BaseMap-NI.
What other data sets were used?	Scotland: OS MasterMap and VectorMap, Urban/Rural classification dataset, Land Cover map 2007 and CEH rainfall data. England and Wales: Total rainfall depths, local authority data where this was more appropriate. Subsequent to the assessment, the UK authority for England and Wales (Environment Agency) explained that many other additional data sets were used, including: soil data, CEH rainfall data, OS MasterMap, drainage data where available. Local authority mapping was used to replace the national mapping where it better represented local flood risk. Northern Ireland: SAR data (in order to assess cross border implications of flooding), rainfall inputs.
What are the key assumptions of the method?	Scotland: 20% uplift for climate change, 50% summer profile from the rainfall dataset. England and Wales: main assumption is around capacity of sub-surface drainage system as detailed local data was generally not available in a useable format. Northern Ireland: A 'blanket rainfall approach' has been used and a percentage runoff coefficient applied to represent water soaking into the ground surface.
What were the identified uncertainties in the methods and resultant maps and assessments?	Scotland: Uncertainties are around the data used to create the maps such as hydrological and topographical information and from modelling techniques. England and Wales: Uncertainties are around input data and models. Northern Ireland: Not described.
What were the shortcomings of the method?	Scotland: Not described. England and Wales: Not described. Northern Ireland: Not described.
What were the advantages of the method?	Scotland: Regional outputs are based on high resolution LiDAR data as reported. England and Wales: The results from the computer model were validated using historical observations and local modelling data in three pilot areas. Northern Ireland: outputs were validated with an urban flood event from 2007.

C) Coastal floods

Scenarios mapped or assessed

Scenario	Return period e.g. 100 years	Percentage e.g. 1%	Decimal e.g. 0.01	Other expression
Low probability	S = 1000 years, NI = 1000 years	NI = 0.1%		
Medium probability	S = 200 years, NI = 200 years	NI = 0.5%		

High probability	S = 10 years, NI = 10 years	NI = 10%		

Summary of the information found and in particular any differences between the UoMs in the Member State.

S represents Scotland, EW - England and Wales and NI - Northern Ireland.

Scotland: High probability floods have a 10 year return period, Medium a 200 year return period and Low a 1000 year return period for fluvial and coastal sources. For pluvial sources, low probability floods have a 200 year return period plus climate change.

England and Wales: Probabilities are expressed as both percentages and return periods. Fluvial and coastal flooding are grouped together. Probabilities of 3.3% (1 in 30), 1% (1 in 100) and 0.1% (1 in 1000) chance of flooding in any year are used to communicate chance of flooding. In addition, a "very low" probability scenario is included to show a probability of flooding of less than 1 in 1000.

Northern Ireland: Probabilities are expressed as percentages and return periods: High probability floods have a 10 year return period (10% AEP) for fluvial and coastal flooding and a 30 year return period (3.33% AEP) for pluvial flooding. Medium probability events have a 100 year return period (1% AEP) for fluvial flooding and a 200 year return period (0.5% AEP) for coastal and pluvial flooding. Low probability floods have a 1000 year return period (0.1% AEP) for fluvial, pluvial and coastal flooding.

Elements mapped or assessed

Scenario	Flood extent	Water depth/level	Water/flow velocities	Other
Low probability	Yes	Yes	Yes	
Medium probability	Yes	Yes	Yes	
High probability	Yes	Yes	Yes	

Summary of the information found and in particular any differences between the UoMs in the Member State.

Scotland: The hazard maps show (where available) flood extent, flood depth and flood velocities (where appropriate).

England and Wales: see Q4a, included with fluvial assessment.

Northern Ireland: Maps do not include flow velocity information as this is optional in Article 6(4)(c) and included 'where appropriate'.

Methods used

What scenarios were considered and tested in the development of the published maps?	Scotland: 8 probabilities were tested (10, 25, 50, 100, 200, 200 plus climate change, 1,000 and 10,000 year return periods) Northern Ireland: see next answer. Information on any unpublished maps considered is not provided.
What were the reasons for the exclusion or inclusion of certain scenarios for the final published maps?	Scotland: Medium and low probability flood events were selected for consistency with return periods used in Scottish Planning Policy. High probability floods were chosen for inclusion as they reflect observed events experienced over the last few decades. Northern Ireland: Medium probability was selected to be consistent with return periods

	used in current land use planning policy, high and low probabilities were selected after consultation with the Competent Authority in Ireland as these needed to be consistent across the international RBDs.
How were return periods and/or probabilities of flooding calculated, for example what was the length of measurement series used in the calculations?	Scotland: the UK Coastal Flood Boundary (DFB) dataset is based on appropriate assessment techniques for estimating water level. Northern Ireland: Not described
How was the most appropriate scale of the map determined? For example, flood maps intended to raise public awareness should enable anyone to find out where there are risks of flooding. Maps for this purpose may have a relatively larger scale e.g. 1: 10,000 to 1: 25,000 compared to those used for national or regional planning purposes (1:100,000 to 1: 500,000). Also the mapping of some hazard features such as flow velocity may require a more detailed scale such as 1:1,000 or 1:5,000.	Scotland: Not described. Northern Ireland: Not described. Subsequent to the assessment the UK authority for Northern Ireland (Rivers Agency) explained that scales were determined through discussion and consultation with stakeholders.
What was the resolution of digital terrain models used to calculate flood hazards?	Scotland: 5m. Northern Ireland: Not described
How were existing flood defences taken into account?	Scotland: information was taken from SFDAD Northern Ireland: Not described
How were existing infrastructure or buildings taken into account?	Scotland: Not described. Northern Ireland: Not described
What other data sets were used?	Scotland: UK Coastal Flood Boundary (CFB) Dataset, tide gauge data and local authority modelling, climate change predictions, OS 1:50,000 background raster mapping and 1:250,000 OS Strategic Coastal Dataset. Northern Ireland: LiDAR, the joint Irish bathymetric Survey, Admiralty tide gauge data, Irish Surge and Tidal model (ISTM), MIKE21 HD, sea defence data, climate change predictions from UKCP09 outputs, OS 1:50,000 background raster mapping and1:250,000 OS Strategic Coastal Dataset.
What are the key assumptions of the method?	Scotland: the method assumes that all land below the projected level is potentially at risk of flooding and that the DTM is an appropriate representation of ground surface. Northern Ireland: Certain models were developed using the tidal boundary with base fluvial flow
What were the identified uncertainties in the methods and resultant maps and assessments?	Scotland: Tracked in 2 ways - confidence intervals in metres and qualitative assessment (e.g. accuracy of the DTM). Northern Ireland: Not described.
What were the shortcomings of the method?	Scotland: The method does not provide velocities associated with coastal flooding. Northern Ireland: Not described
What were the advantages of the method?	Scotland: Not described. Northern Ireland: Not described

D) Groundwater floods

In England and Wales groundwater was found not to be a source of significant flood risk during the PFRA and so was not mapped.

Scotland applied article 6.7 to the 2 relevant UoMs, UK01 and UK02-SCO, meaning that groundwater flooding for high and medium probabilities can be omitted in the preparation of flood hazard maps

Groundwater flood maps have been produced in Scotland for a low probability to highlight areas where groundwater may contribute to flooding. The groundwater flood map is not considered (by the Scottish Authorities) to be a flood hazard or extent map: it provides a proxy for a low probability flood map. The map is a high-level generalised assessment identifying catchments within which there are areas where there is a significant predicted contribution to flood risk or where there are historic records of flooding. The predicted contribution of groundwater has only been included where there is confidence that it could contribute to flooding by prolonging a flood event or exacerbating its impacts. Due to a lack of appropriate monitoring data to indicate groundwater flooding events, a return period has not been attributed to this dataset. Depth and velocity information is not presented and a climate change scenario has not been included.

E) Floods from Artificial Water Bearing Infrastructure

Summary of the information found and in particular any differences between the UoMs in the Member State.

Elements mapped or assessed

Scenario	Flood extent	Water depth/level	Water/flow velocities	Other
Failure of infrastructure e.g. reservoir dam failure	Yes	Yes	Yes	(NI) UKGBNINE, UKGBNIIENB, UKGBNIIENW

Summary of the information found and in particular any differences between the UoMs in the Member State.

EW - England and Wales and NI - Northern Ireland.

England and Wales: Areas at risk of flooding from large raised reservoirs (reservoirs with a capacity over 25,000m^3) were mapped (and made publicly available) for a 'worst credible breach' scenario but no probabilities assigned. Flood modelling was undertaken to predict the arrival, depth, velocity, hazard and extent of flooding resulting from a dam breach flood wave.

Northern Ireland: The elements included in the maps are not described. Maps have been produced for 156 reservoirs which are capable of holding in excess of 10,000m^3 of water above the natural level of the surrounding ground. They are available to reservoir owner, operators and managers, on request.

Methods used

What scenarios were considered and tested in the development of the published maps?	England and Wales: only the effects of a sudden breach when the reservoir is full are modelled. Northern Ireland: low probability
What were the reasons for the exclusion or inclusion of certain scenarios for the final published maps?	England and Wales: Not applicable. Northern Ireland: Dam breach is not considered to occur under medium or high probability events.
How were the probabilities of flooding calculated, for example, were they based on historic events?	England and Wales: Not applicable - reservoirs are unlikely to cause flooding so no probability is associated with it. Northern

	Ireland: Not described
If probability scenarios were not assessed, please describe the assessment methods used.	England and Wales: a 'credible worst case scenario' was studied using the effects of a sudden breach. Northern Ireland: Not applicable
How was the most appropriate scale of the map determined? For example, flood maps intended to raise public awareness should enable anyone to find out where there are risks of flooding. Maps for this purpose may have a relatively larger scale e.g. 1: 10,000 to 1: 25,000 compared to those used for national or regional planning purposes (1:100,000 to 1: 500,000). Also the mapping of some hazard features such as flow velocity may require a more detailed scale such as 1:1,000 or 1:5,000.	England and Wales: Not described. Subsequent to the assessment, the UK authority for England and Wales (Environment Agency) explained that the scale was chosen as an appropriate balance between allowing the user to find a location on the map; and giving a false sense of confidence in the map data ('my living room will flood but the kitchen won't'). Northern Ireland: Not described
What was the resolution of digital terrain models used to calculate flood hazards?	England and Wales: DTM resolution not mentioned. Northern Ireland: DTM resolution not mentioned.
What other data sets were used?	England and Wales: InfoWorks-RS-2D, TUFLOW or equivalent 2D software. Northern Ireland: Not described
What are the key assumptions of the method?	England and Wales: not described. Reservoirs are assumed to be full and overtopping at the time of modelled breach and breach is assumed to occur over the full height of the dam/embankment. Northern Ireland: Reservoirs only mapped if they hold more than 10,000m^3 of water above natural ground level.
What were the identified uncertainties in the methods and resultant maps and assessments?	England and Wales: Not described. Northern Ireland: Not described

F) Floods from sewerage systems

In Scotland a series of surface water maps were created for pluvial and sewerage flooding: the maps were not presented separately. The pluvial extent, depth and, where appropriate, velocity flood hazard maps were prepared considering certain rainfall events and durations and various sewer capacities. A sewer flooding assessment was also undertaken by Scottish Water. Key outputs were points where floods were likely to originate from sewerage systems, flood depth representation, flood extents, time series information indicating cumulative flood volumes lost from individual manholes and false blockage locations to allow overland flow representation.

G). Other types of floods

Note: No information was found on whether the hazard and risk of flooding from other sources have been mapped.

Methodologies used to prepare flood risk maps

Question 5 What methods and relevant information have been used to prepare flood risk maps? Which potential adverse consequences are reported and how have they been identified and presented in flood risk maps?

a) Risk to human health

Scotland: The indicative number of inhabitants potentially affected by flooding was determined by counting properties located within the flood extent and multiplying by the average occupancy rate per household (2.2). The data set used is described, including the source layers, and a 1km^2 grid was used to determine areas/hotspots of population at risk of flooding. The number of inhabitants at risk is shown on the maps through coloured grids with the number of inhabitants affected banded together (e.g. 1 – 50 and 501 – 1000).

England and Wales: The number of people at risk of flooding was calculated using guidance from the Office for National Statistics General Lifestyle Survey, using an average household size of 2.35 persons. The source layers used are given and a point polygon analysis was done between hazard maps and residential properties. The process was slightly different for surface water flooding, which used only one of the source layers. This is displayed on the maps as colour coded and size proportionate circles, for example, 0 – 1000 people at risk is shown as a small yellow circle, 5000 + is a larger red circle.

Northern Ireland: The number of properties in the flood area was determined from 2 datasets, one of which is more up to date. For each probability the residential property affected was multiplied by 2.5 (average occupancy). The numbers of inhabitants affected is not clearly shown on the maps, however, indicative numbers could be derived from detailed street maps.

b) Risk to economic activity

Scotland: For property, a direct economic assessment of flood risk using a standardised depth/damage methodology was conducted. The types of community service or utility assessed are not displayed on the maps, only their location is identified. Length and type of roads impacted by flooding was calculated. Only roads located within flood waters above 0.15m were displayed as this is the depth at which driving becomes dangerous. Bridges were removed as including them would overestimate the impacted road lengths. The number and length of railway lines impacted was assessed. The Integrated Transport Network (ITN) dataset informed the roads and railway lines affected by flooding. Airport terminals were identified using the OS MasterMap Airports and OS MasterMap Runways datasets and displayed on risk maps. Direct damages to agricultural land were assessed using one-off cost values. The impact to agricultural land from pluvial flooding was not assessed as it is difficult to ascertain the impact of shallow and brief flooding on production/ loss of crops. In addition to these activities, commercial properties and airports can be viewed on the maps.

England and Wales: Airports were identified using a point in polygon analysis, railways by intersecting recorded railways with hazard maps and roads by intersecting the Environment Agency's roads layer with the hazard maps. Non-residential properties (rivers, sea and reservoirs) were identified using a point in polygon analysis and source layers for maps are given in the summary report. Those properties affected by surface water flooding were identified using only one source layer. Agricultural land was classified using Natural England's classification (Grade 1,

best to Grade 5, poorest) Grades 1-3 were included in the analysis. All of these activities can be viewed on the PDF maps.

Northern Ireland: A direct economic assessment of flood risk was undertaken using depth/damage methodology which gave a count of properties affected as well as damage figures for each of the probability flood events, this does not appear on the map viewer. The summary information provided by NI states that community services and utilities were identified and are displayed on the flood risk maps but this is not obvious. The summary report states where information was sourced from for other economic activities but does not describe how the maps were prepared. It is assumed that the risk to economic activity is determined using detailed street maps that give information on the function of certain buildings.

c) Risk to Installations covered by the requirements of the Industrial Emissions Directive (IED) or previously under the IPPC Directive

Scotland: Scottish regulations segregate activities with a high pollution potential into Part A (release of pollutants into air, water or land) and Part B (release of pollutants into the air). The production of flood risk maps concentrates on authorised Part A sites only. The PPC installation dataset is displayed as a series of point features and were identified where they are located within a flood extent.

England and Wales: The Environment Agency (EA) identified active IPPC installations within the EA's Pollution Inventory which fell within 50m of flood risk.

Northern Ireland: The production of flood risk maps considered Part A sites only. Northern Ireland Environment Agency provided the IPPC data which was then added to the flood maps. Each IPPC site is displayed as a polygon indicating the boundary of the installation. The occupant of the site is also recorded.

d) Risk to WFD protected areas

Scotland: A risk-based approach of identifying protected areas and bodies of water potentially affected by pollution from floodwater inundated IPPC installations was undertaken. This involved the implementation of active boundaries which consider travel and pollutant dispersal patterns where protected areas and bodies of water within these boundaries were highlighted as being potentially at risk. Fluvial - IPPC installations were considered to have an impact on protected areas and bodies of water downstream until pollutants reach the coastline. Coastal – not considered are: the type and quantity of pollutant, nor soluble and/or liquid borne pollutants and therefore the method only gives a general indication of pollutant travel and dispersal. Environmental sites at risk are viewed on the map as shaded areas or as points for IPCC installations.

England and Wales: Point in polygon analysis was undertaken for abstractions, Bathing Waters were identified if they were within 50m of flood risk and other protected areas were identified by intersecting records with the hazard maps. These can be viewed on the map as circles with Special Areas of Conservation etc. visible as shaded areas.

Northern Ireland: Data was provided by NIEA, flood extent and depth maps for all scenarios are available. Protected areas are not shown on the maps for NI.

e) Other consequences considered

Scotland: No additional information mapped.

England and Wales: Additional areas considered relevant were World Heritage Sites, Parks and Gardens of Special Historic Interest, Scheduled Ancient Monuments

(SAMs) and Listed Buildings which were identified by intersecting records with the hazard maps or by point in polygon analysis.

Northern Ireland: No additional information mapped.

Justification for applying Article 6.6

Question 6 What are the justifications for applying Article 6.6 (coastal areas), if applied, and how has it been determined that an adequate level of protection is in place against coastal floods?

Article 6(6) has not been applied in any UoM in Scotland, England and Wales or Northern Ireland (source: WISE Flood report: FD.9.0 FHRM B - Application of Article 6.6).

Justification for applying Article 6.7

Question 7 What are the justifications for applying Article 6.7 (groundwater floods), if applied?

Groundwater is considered as a contributing source rather than as a main source of flooding	Yes
It is difficult to distinguish the impact of groundwater flooding from other sources of flooding	Yes
There is limited information or historical records on groundwater flooding	Yes
Only low probability groundwater flooding is assessed to be hazardous or a risk	No
Other (described below)	No

Summary of the information reported and in particular any differences in UoMs in the Member State.

Article 6.7 is applied in Scotland only.

In England and Wales goundwater was not mapped at all as it was not considered to be a source of significant flood risk.

Application of Article 13.1.b in accordance with requirements of the Floods Directive

Question 8 Have the flood hazard maps and flood risk maps been prepared in accordance with the relevant provisions of the Floods Directive where Article 13.1.b has been applied?

a) Have the flood hazard and flood risk maps been produced at the level of the river basin district or unit of management?

Yes for all UoMs	No
Yes for all significant sources of flood	No
For some but not all UoMs	Yes
For some but not all significant sources of flood	No
No	No
No information	No

Explanation

Article 13.1.b is applied in England and Wales only. Links to the hazard maps go to a web viewer with an area slightly larger than the UoM displayed. No UoM boundaries are defined or visible on the maps. Flood risk maps are produced at the UoM level and are available as PDF documents.

b) Have the flood hazard and flood risk maps been produced at the most appropriate scale for the areas identified?

Yes for all UoMs	Yes
Yes for all significant sources of flood	No
For some but not all UoMs	No
For some but not all significant sources of flood	No
No	No
No information	No

Explanation

The scale of maps is generally consistent for UoMs. The flood hazard maps are zoomed out too far at their initial use for flood extent to be seen. However, this is easily rectified by the user zooming in to areas of interest. The flood risk maps are produced at a larger scale which is more appropriate to show the detail present.

c) Has there been a prior exchange of information on the preparation of flood hazard and flood risk maps with Member States sharing areas of potential significant flood risk?

Yes for all international UoMs	No
Yes for all shared areas with a significant flood risk	No
For some but not all international UoMs	No
For some but not all shared areas with a significant flood risk	No
No	No
No information	Yes

Explanation

This question is not relevant to England and Wales; there is no sharing of areas of potential flood risk with other member states.

d) Have flood hazard maps been prepared for all the required flooding scenarios for all sources of floods that represent a significant risk?

Yes for all required scenarios	Yes
Yes for all significant sources of flooding	Yes
For some but not all required scenarios	No
For some but not all significant sources of flooding	No
No	No
No information	No

Explanation

Pluvial and fluvial and coastal flooding maps have been prepared at low, medium and high probabilities (very low is also available for pluvial flooding). No scenarios are presented for artificial flooding as reservoirs are unlikely to cause flooding so no probability is associated with it.

e) Have the required elements - extent, water depth or level, flow velocity (where appropriate) - been shown in the flood hazard maps for each of the required flooding scenarios?

Yes for all required elements	Yes
Yes for all significant sources of flooding and required scenarios	Yes
For some but not all required elements	No
For some but not all significant sources of flooding and required scenarios	No
No	No
No information	No

Explanation

Flood extent, water depth and flow velocities are assessed for fluvial, pluvial, coastal and reservoir flooding at the various scenarios.

f) Do the flood risk maps for each flooding scenario for all sources of floods, that represent a significant risk, show the required adverse consequences (affected inhabitants, areas of affected economic activity, installations, WFD protected areas)?

Yes for all required adverse consequences	Yes
Yes for all significant sources of flooding and required scenarios	Yes
For some but not all required adverse consequences	No
For some but not all significant sources of flooding or required scenarios	No
No	No
No information	No

Explanation

PDFs of flood risk contain three sets of maps – one each for risk to people, economic activity and the natural and historic environment. Risk maps have been created for reservoir flooding, surface water flooding and fluvial and coastal flooding (the latter two also including the various probabilities of flooding).

g) Has Article 6.6 been applied and maps produced for an extreme flooding event scenario in coastal waters where there is an adequate level of protection in place?

No

Explanation

Not applicable, Article 6.6 has not been applied.

h) Has Article 6.7 been applied and maps produced for an extreme flooding event scenario for groundwater?

No

Explanation

Not applicable, Article 6.7 has not been applied.

i) Have the flood hazard and flood risk maps been made available to the public

Yes for all flood hazard and flood risk maps in all UoMs.

Explanation

The Environment Agency website is available to the public for use. All of England and Wales is available in the map viewer (for example: http://watermaps.environment-agency.gov.uk/wiyby/wiyby.aspx?topic=floodmap#x=344696andy=443948andscale=1). The PDF risk maps are available to the public from www.gov.uk.

Compliance of the use of Article 13.2 with the requirements of Article 6

Article 13(2) has not been applied in any UoM in the UK (Source: WISE Floods summary reports: FD.9.0 FHRM G - Use of Article 13.2).

Information exchanged between Member States and the preparation of coherent maps in international RBDs or UoMs

Question 10 How has it been ensured that there was prior information exchange on the production of maps between Member States sharing international RBDs or UoMs, and how was it ensured that coherent maps were produced between the relevant Member States?

The number of cross border Units of Management with shared flood risk areas in this Member State

There are 3 international river basin districts (IRBDs) shared with the Republic of Ireland, only 2 of which have shared flood risk areas.

Summary of the information reported and in particular any differences between UoMs in the Member State.

England and Scotland have reported in FD.9.0 FHRM E, but this has not been assessed here as UK02 is not an international UoM.

Northern Ireland: Information is coordinated using the Floods Directive Cross Border Implementation Group and the Floods Directive Cross Border Technical Working Group. Data is shared and the mapping output reviewed to ensure it is consistent.

Consideration of climate change impacts in the preparation of the maps

Question 11 How has climate change been taken into account when the flood hazard scenarios were identified?

Climate change has been taken into account	Yes
For which sources of flooding	Scotland: Pluvial, fluvial, coastal. England and Wales: Not specified explicitly – any rainfall or flow data uses recorded data and therefore incorporates climate change that has occurred. Northern Ireland: Fluvial and coastal.
For low probability scenario	Scotland: Coastal (10,000 year return period). England and Wales: Not mentioned explicitly. Northern Ireland: Not mentioned explicitly.
For medium probability scenario	Scotland: Pluvial, coastal and fluvial (200 year return period). England and Wales: Not mentioned explicitly. Northern Ireland: nNot mentioned explicitly.
For high probability scenario	Scotland: Pluvial and fluvial (30 year return period). England and Wales: Not mentioned explicitly. Northern Ireland: Not mentioned explicitly.
Climate change trend scenarios have been obtained from the IPCC or other international sources	No
Climate change trend scenarios have been obtained from the national research programmes	Yes
Flood hazard scenarios are based on modelling of changes in flood hazard in relation to climate change	No
Flood hazard scenarios included trend analysis of historical data of hydrological and meteorological observations	Yes
Flood hazard scenarios included a statistical assessment of historical climate data	No

Summary of how climate change has been taken into account in the production of flood hazard maps, and highlight any differences between UoMs in the Member State

It is not clear if flood hazard scenarios are based on modelling of changes in flood hazard in relation to climate change of if they include a statistical assessment of historical climate data.

Scotland: Fluvial - climate change scenarios are based on an assessment of the vulnerability of Scotland's rivers to a conservative 2080s high emissions scenario, 67%ile. Coastal - climate change scenario has been defined by United Kingdom Climate Projection 2009 (UKCP09) predictions for 2080 high emissions 95%ile predictions. Pluvial - Rainfall depth figures were multiplied by 1.2 to reflect a 20% uplift for climate change. It should be noted that, although this information is being compiled and developed in Scotland, the published maps do not take account of future climate change.

England and Wales: The published maps do not take account of future climate change.

Northern Ireland: Fluvial hazard extent was produced for 2030, based on Q100 hydrology plus 20%. A climate change coastal hazard extent was also produced for 2030, based on United Kingdom Climate Projection 2009 (UKCP09) predictions for sea level rise.