

# Impact of flooding (risk maps)

## summary: Methodology and mapping

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### 1. Introduction

The Flood Risk Management (Scotland) Act 2009 (FRM Act) introduced a co-ordinated and partnership approach to how we sustainably tackle flood risk in Scotland. To fulfil this we are considering all sources of flooding and whole river catchments when making flood risk management decisions.

A key milestone of the FRM Act is the production of flood hazard and flood risk maps for Scotland. These maps provide the most comprehensive national source of data on flood hazard and risk and include information on different likelihoods of flooding:

Time Horizon	Likelihood of flooding	River and Coastal	Surface Water
Present Day	High	10 year	10 year
Present Day	Medium	200 year	200 year
Present Day	Low	1000 year	200 year plus climate change

In order to understand the impact of flooding we must first represent the source. To produce flood risk maps for each source of flooding SEPA has developed datasets and methodologies for river, coastal and surface water sources of flooding. These flood maps show extents, depths and (where appropriate) velocities and can therefore be used to understand the risk posed by these flood sources. These datasets have been used to create Scotland's flood risk maps.

This summary provides information on how we developed our flood risk maps and how to interpret this data. Its primary purpose is to support Scottish Government, local authorities, Scottish Water and other responsible authorities in their understanding of how the maps were developed and support internal/external briefings and enquiries. This in turn will help to increase public awareness and understanding of flood risk. Previous knowledge of the flood maps and their development is assumed.

## 2. Development and review

The mapping of flooding is a dynamic process and the flood maps will be subject to review and change as we develop our input data, methodologies and techniques. SEPA will continue to work with responsible authorities and partner organisations to improve our confidence in representing flood risk across Scotland.

Ongoing developments that SEPA is working towards include improvements in both flood hazard and the flood risk maps produced from these datasets:

### Flood Hazard Maps:

- Improved input data. For example, the use of Light Detection And Ranging (LiDAR) information that extends our coverage of higher resolution ground models;
- Investigate how to effectively apply hydrological and hydraulic modelling methods;
- Incorporation of outputs from detailed local studies where appropriate;
- Considering where and how wave impact studies might improve confidence in outputs.

### Risk Maps:

- Improving resolution of property and population datasets
- Improving the way risk is shown in the maps by grading receptors from low to high risk for each return period being mapped.

## 3. Methodology and data

### 3.1 Approach

A nationally-applied methodology has been used to produce the flood risk maps for Scotland. The map provides information on the indicative impacts of flooding at the community level.

There is an inherent uncertainty in flood modelling as a result of assumptions and simplifications that are required to enable complex natural processes to be reflected through hydraulic modelling software. Please refer to section 5 for guidance on interpretation.

### 3.2 Data

The data used to produce the flood risk maps is listed in Table 1 (Appendix). With the exception of the river, coastal and surface water hazard map outputs the datasets used are published by other organisations and therefore information about quality checks on these datasets has not been included as in other summary documents. Information on how the datasets have been used is detailed in section 3.3.

### 3.3 Methodology

Flood risk maps are produced using the river, coastal and surface water flood hazard maps and have been created for the three reportable return periods (high, medium and low likelihood).

Flood risk maps have been created for each of the Potentially Vulnerable Areas (PVA) across Scotland. The flood risk maps are based on the following receptors:

- Number of people;
- Type of economic activity;
- Businesses;
- Transport (Roads);
- Transport (Railways);
- Transport (Airports);
- Protected areas or bodies of water impacted by flooding;
- Protected areas or bodies of water affected by pollution from Integrated Pollution Prevention and Control installation (IPPC) sites

#### 3.3.1 Number of people

The flood risk maps show for each source of flooding and likelihood the indicative number of inhabitants who potentially could be affected by impacts of flooding. This was calculated from a count of properties located within the flood extent, using property point data, multiplied by the average number of occupants in each property<sup>1</sup>.

#### 3.3.2 Type of economic activity

The receptors which have been used to show the type of economic activity potentially impacted by flooding is consistent with those used in the National Flood Risk Assessment (NFRA):

- Property: Residential and commercial properties;
- Infrastructure: Utilities (including power generation and communication) and transport (including road, rail and airports);
- Rural land use: Agricultural activity;
- Economic activity: commercial (including manufacturing, retail services and community services).

Receptors were counted if located within a flood extent.

Economic damage figures were derived using industry standard pre-defined values for residential and commercial properties and agricultural activity. This data is held separately.

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<sup>1</sup> The population of Scotland in 2010 was 5,222,100 with 2,360,000 households (Census and GROS, Feb 2012). The Occupancy rate obtained from census 2011 (Estimates of Households and Dwellings in Scotland, 2010) <http://www.gro-scotland.gov.uk/files2/stats/household-estimates/he-10/households-dwellings-est-2010.pdf>

### 3.3.3 Integrated Pollution Prevention and Control sites

The FRM Act requires that SEPA identifies, and shows on the flood risk maps, *“installations....concerning integrated pollution prevention and control, which might cause accidental pollution if any type of flood...occurred”*.

The Integrated Pollution Prevention and Control (IPPC) data relates to new or existing industrial and agricultural activities with a high pollution potential, e.g. energy industries, production and processing of metals, mineral industry, livestock farming and waste management. Regulations segregate activities with high pollution potential into Part A (release of pollutants into air, water or land) and Part B (release of pollutants into the air). The flood risk maps concentrate on Part A sites only.

The sites were identified where they are located within a flood extent.

### 3.3.4 Protected area or bodies of water impacted by flooding

The FRM Act requires that SEPA identifies, and show on the flood risk maps, specific *“protected areas or bodies of water which potentially could be affected if any type of flood...occurred”*.

The protected areas/bodies of water which were identified included areas used for water abstraction, areas designated for economically significant aquatic species, areas designated for recreational waters, nutrient-sensitive areas, conservation areas for wild birds, special areas of conservation and sites of special scientific interest.

The protected areas and bodies of water that intersect with a flood extent were identified and included within the flood risk maps.

### 3.3.5 Protected area or bodies of water affected by pollution from IPPC sites

This receptor combines the outputs from sections 3.3.3 and 3.3.4. The sites identified in section 3.3.3 were cross referenced with the identified protected areas and water bodies at risk of flooding from section 3.3.4. This determined the amount of protected areas and bodies of water potentially affected by pollution from IPPC sites during a flood.

## 4. Validation and quality review

A robust validation and review process was undertaken for the river flood map data:

- **Peer contribution** - The Scottish Advisory and Implementation Forum for Flooding (SAIFF) Modelling Appraisal Strategy Group provided peer contribution in developing the approach for flood mapping. This group includes industry representatives, academia, representation from the Society of Chief Officers of Transportation in Scotland (SCOTS), Scottish Water and Scottish Government.
- **Internal review** - Risk map presentation was discussed at SEPA's business steering group, and at internal workshops. This included presenting examples of outputs, collating comments and testing different options.
- **Local authority review** - Local authorities received presentations on the purpose, presentation and limitations of the risk maps through Local Advisory Group (LAG) meetings. There was also representation from local authorities at SEPA-led workshops on the presentation of the risk maps

## 5. Interpretation

The flood risk maps has been developed using a nationally-applied methodology. They are a tool to help raise public awareness and understanding of flood risk, support flood risk management and land use planning decisions.

The maps are of a strategic nature to support flood risk management planning at a community level. It is not appropriate for property level assessment. This is due to the application of a nationally consistent methodology being applied to provide Scotland wide mapping and with this approach there are assumptions and inherent uncertainty. The visual zoom on the map, published on the SEPA website, is set to support the intended use of the maps at a community level. Similarly, we would advise that when data is hosted on your internal servers that going beyond the recommended level of zoom will lead to increased uncertainty in the application of the map.

The map is not licensed for commercial use and all users must agree to terms and conditions before viewing the map.

### 5.1 Assumptions

The methodology was implemented based on a number of key assumptions:

#### 5.1.1 Flood hazard maps

The flood risk maps have been developed based on data outputs from the flood hazard maps for river, coastal and surface water. Any assumptions that have been made during their development will also apply to the flood risk maps.

#### 5.1.2 Flood risk maps

The flood risk maps have been developed using the best available national data. The data reflects counts of population, property, protected water bodies & IPPC sites as they stood when the relevant datasets were created. It is therefore assumed that the picture of flood risk that these datasets paint is the best national representation. As the maps are improved any updates to these datasets, for example updated property counts, will be taken into account.

### 5.2 Confidence

Flood hazard mapping and the assessment of the sources and impacts of flooding is a complex process. Due to assumptions that are necessary to allow us to reflect complex natural processes, there are uncertainties associated with developing any assessment or modelling methodology.

Assumptions may be applied at each stage of the process and from a range of sources. For example, sources of uncertainty in flood hazard mapping include:

- The data going into the assessment such as hydrological or topographic information;
- The method or model used;
- Future changes e.g. climate change and land use changes;
- Economic and social uncertainties associated with receptor data such as population and property information.

The consideration of model/map confidence enables us to make informed decisions by providing understanding the confidence in the data and the final mapped outputs. It also identifies where resources can be focused for further development.

### **5.3 Limitations**

The flood risk maps have been produced at the national scale using national datasets and a consistent methodology. This map is a strategic product intended for use at a community scale and should not be used at the individual property level without further guidance.

Due to the strategic nature of the output and the methodology used, there are limitations associated with the river flood map. Such modelling at the national scale and limitations of the methodology leads to difficulties representing:

- As the flood risk maps are based on outputs from the flood hazard maps for river, coastal and surface water flooding, consideration must be taken of the limitations of the those maps;
- Population demographics change more frequently than the maps are likely to be updated;
- The flood risk maps do not account for any potential changes in flood risk as a result of climate change.

Every effort has been made to create a flood risk maps that reflects the knowledge and information available. Where this included information for a specific return period this was merged with our modelled flood outline. As we develop and improve our data, methodologies and techniques the maps will be reviewed and updated. SEPA will continue to work with responsible authorities and partner organisations to improve our knowledge, understanding and the representation of flooding across Scotland.

### **5.4 Caveats**

- The map is not licensed for commercial use and all users must agree to terms and conditions before viewing the map.
- The flood maps are indicative and of a strategic nature. It is inappropriate for these flood maps to be used to assess flood risk to an individual property.

## Appendix

**Table 1: Data used as an input to the flood risk maps**

Data	Description
<b>River, coastal and surface water flood maps</b>	The key input to the production of flood risk maps is the outputs produced by the flood hazard maps for river, coastal and surface water flooding. The flood extent, depth and velocities were used to make assessments of flooding on a range of receptors.
<b>Ordnance Survey MasterMap</b>	This is a nationally maintained dataset that provides details of addressing, height and imagery, backdrop, detailed networks and addresses and locations. Within the scope of this project, Ordnance Survey MasterMap was used for various reasons including identifying locations of airports and runways.
<b>Ordnance Survey Integrated Transport Network (ITN)</b>	<p>Taken from the Ordnance Survey MasterMap, this dataset details all motorways, A roads, B roads, minor roads, local streets and private roads which in total display roads at a total length of 550,000km.</p> <p>This was used to determine how much of the transport network is at risk from flooding.</p>
<b>Land Cover Map 2007</b>	<p>This dataset provides land cover information for the full of the UK and is a dataset produced and provided by Centre for Ecology &amp; Hydrology. The methodology classifies land cover into 23 land cover classes based on information about the broad habitat.</p> <p>This dataset was used to derive counts of agricultural activity affected by flooding.</p>
<b>Integrated Pollution Prevention and Control sites (IPPC)</b>	<p>Integrated Pollution Prevention and Control (IPPC) relates to new or existing industrial and agricultural activities with a high pollution potential, e.g. energy industries, production and processing of metals, mineral industry, livestock farming and waste management.</p> <p>The IPPC dataset was created as part of the Pollution Prevention and Control (Scotland) Regulations 2000.</p>
<b>Environmental Sites</b>	<p>This dataset is inclusive of:</p> <ul style="list-style-type: none"> <li>• Sites of Scientific Interest (SSSIs)</li> <li>• Special Areas of Conservation (SACs)</li> <li>• Special Protection Areas (SPAs)</li> <li>• Drinking water protection areas are identified under the Water Framework Directive (WFD) where water is abstracted from waterbodies for 'raw' consumption. The classification includes groundwater, loch and river waterbodies.</li> <li>• Cyprinid waters</li> <li>• Salmonid water</li> <li>• Shellfish growing waters</li> <li>• Recreational waters</li> <li>• Nutrient sensitive areas including Nitrate Vulnerable Zones (NVZs) and catchments of estuaries, rivers and lochs which are designated under the Urban Waste Water Treatment Directive (UWWTD)</li> </ul>