Indicators and trends

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Indicator name			Version
CRS20 Number of flood events attended by Scottish Fire & Rescue Service (SFRS) each year			**31/03/16**
Indicator type:	**Risk/opportunity**	**Impact**	**Action**
		X	

SCCAP Theme	SCCAP Objective	CCRA risk/opportunity
Climate Ready Society	S1, S2, S3 B2	FL1: Number of people at significant risk of flooding FL7/FL24/FL27: Flooding of non-residential property BE10/BE11/BE12/BE15/BE18/FL6/FL24: Property at risk of flooding GNr1: Emergency response to events (floods)

At a glance

- Across Scotland, 3308 flooding events attended by SFRS (and likely to be attributable to extreme weather) occurred in the six years to March 2015.
- The majority of these events affected residential dwellings, though community services, emergency services and utilities were also impacted, particularly health and education facilities.
- Climate change is likely to result in increased precipitation and heavy rainfall events in all regions for all emissions scenarios progressively across the three reference periods this century, which will increase the risk of flood events.
- Scottish Fire and Rescue Service as well as other Category 1 responders will need to take account of this in their next round of strategic planning.

Latest Figure	Trend
2014-15: SFRS attended 606 flooding events that are considered 'relevant' to a weather related event	No significant trend (2009-15)

(of which 42 were almost certainly weather related)[1]	

Why is this indicator important?

Different types of flooding – pluvial, fluvial and coastal – have different impacts at different scales on society. The flooding of dwellings has physical and psychological impacts on the people who live there; the flooding of schools has a wider impact on communities and the local economy due to secondary effects such as parents' unplanned absence from work to look after their children. The flooding of emergency services facilities – fire, police and ambulance stations – and critical national infrastructure (CNI) – water treatment works, electricity generating facilities – has the potential to disrupt entire regions.

Climate Change projections indicate an increase in precipitation and heavy rainfall events across all regions of Scotland over the course of this century. Recognising that the strategic planning cycle for Category 1 Responders is typically 10 years in advance, a better understanding of the patterns of actual flooding enables more accurate flood modelling and investment in adaptive capacity to be targeted appropriately.

Statistics are presented for the three operating regions: North, West and East. The Local Authorities in each of these regions are catalogued in the Methodology section.

Related Indicators:
BB1: Property at risk of flooding (residential)
BB3: Property at risk of flooding (non-residential)
CRS12: Number of community services at significant risk of flooding

What is happening now?

Scottish Fire and Rescue Service recorded 1,367 flooding related events[2] in 2014-15 (Table 1). However, attribution of flooding due to weather events is problematic as a result of the way that the data are captured - see Methodology. As a consequence, of these 1,367 flooding events only 606 (44%) are considered to be 'relevant' to a weather related event, using the criteria outlined in the methodology for *widespread flooding*, and of these only 42 events (7%) are almost certainly so (Table 2).

The Scottish Fire & Rescue Service (SFRS) is a unitary force. It operates across 3 *Service Delivery Areas*: North, East and West. The majority (53%) of all flooding events during this period occurred in the West; a quarter (25%) in the North and just over a fifth (22%) in the East (Table 1). However, weather related flooding events had a more significant impact in the North (Table 2).

[1] Currently the incident recording system does not clearly attribute flooding to weather events as opposed to other sources, and assistance at a flood event may be recorded under another category (Rescue or Evacuation from Water)

[2] This includes rescue/evacuation from water events which may have been as a consequence of the weather

Table 1: Distribution of flooding events 2014-15

	Total Events	per 1,000 population	per 1,000 households
North	340	0.26	0.59
West	719	0.30	0.66
East	308	0.19	0.42
Scotland	1367	0.26	0.57

Source: SFRS & National Records of Scotland

Table 2: Distributional impact of weather related flooding events 2014-15

	Total Events	per 1,000 population	per 1,000 households
North	257	0.20	0.44
West	133	0.06	0.12
East	216	0.13	0.30
Scotland	606	0.11	0.25

Source: SFRS & National Records of Scotland

The majority (64%) of these events resulted in household flooding which affected just over 7 people in every 100,000 of the population (Table 3). Critical National Infrastructure (CNI)[3] (Scottish Government, 2011) and Emergency Services were relatively unaffected with 2 utilities (sewage and water works) and 2 fire stations flooded in 2014-15. Flooding events in health facilities were primarily on individual hospital wards.

Table 3: Flood receptors (weather related flooding events) 2014-15

	North	West	East	Scotland
Households	148	76	163	387
Other residential	13	3	11	27
Education	7	3	2	12
Health	6	7	6	19
Emergency Services	2	0	0	2
Public Institutions	0	0	0	0
Utilities (CNI)	2	0	0	2
Vehicle	9	8	3	20
Other	70	36	31	137
Total events	257	133	216	606

Source: SFRS

Of the 3 fatalities recorded in flooding/water events in 2014-15 (2 in the East and 1 in the West), none are likely to have been due to weather related flooding events. Of the 15 injuries sustained during the year (10 in the North and 5 in the West) probably only 1 was weather related. Of the 95 rescues (8 in the East, 44 in the North, 43 in the West) 39 were probably as a result of weather related events (1 in the East, 10 in the North and 28 in the West).

What has happened in the past?

Since 2009 there have been 10,436 flooding events in Scotland. Of these, 3,308 are likely to have been as a result of weather events (Table 4), while 13% (445) almost certainly have.

[3] Water, road transport, health and social care, regional and local government and food (production, processing, import, distribution and retail) are devolved powers. Fuel, finance, central government, aviation, maritime and rail are reserved.

Table 4: Weather related flooding events Scotland 2009 – (March) 2015

Scotland	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015 to date	Total
Households	268	189	171	345	281	387	99	1,740
Other residential	20	12	10	21	20	27	2	112
Education	21	6	8	10	8	12	0	65
Health	12	15	13	32	17	19	5	113
Emergency Services	2	4	3	3	7	2	0	21
Public Institutions	1	0	0	0	2	0	0	3
Utilities (CNI)	0	3	2	2	3	2	1	13
Vehicle	68	29	51	53	26	20	0	247
Other	208	163	147	183	130	137	26	994
Total events	**600**	**421**	**405**	**649**	**494**	**606**	**133**	**3,308**

Of the 3,308 events that can be said to be 'weather relevant', 3 affected public institutions and 13 affected Utilities (CNI) in Scotland in the period 2009 - 15. There was a significant impact on facilities associated with education (65 events), health (108 events) and emergency services (21 events).

The majority (39%) of weather related flood events were in the North area (1,283 events) with the West and East showing similar numbers of events (938 and 954 respectively). In each of the three regions over half of all events resulted in flooding to dwellings (Table 5).

Table 5: Distributional impact of weather related flooding events 2009-2015

North	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	Total		
Households	144	72	74	135	94	148	667		52%
Other residential	13	6	5	10	6	13	53		4%
Education	9	2	5	3	2	7	28		2%
Health	6	6	3	12	6	6	39		3%
Emergency Services	1	1	0	2	1	2	7		1%
Public Institutions	1	0	0	0	0	0	1		0%
Utilities (CNI)	0	2	1	0	2	2	7		1%
Vehicle	34	3	5	14	1	9	66		5%
Other	104	68	65	63	45	70	415		32%
Total events	**312**	**160**	**158**	**239**	**157**	**257**	**1283**	**39%**	
East									
	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	Total		
Households	52	38	28	137	119	163	537		56%
Other residential	5	2	3	8	6	11	35		4%
Education	5	1	1	4	1	2	14		1%
Health	2	0	2	12	5	6	27		3%
Emergency Services	0	2	1	1	5	0	9		1%
Public Institutions	0	0	0	0	1	0	1		0%
Utilities (CNI)	0	1	0	2	1	0	4		0%
Vehicle	11	11	15	21	2	3	63		7%
Other	49	41	36	76	31	31	264		28%
Total events	**124**	**96**	**86**	**261**	**171**	**216**	**954**	**29%**	
West									
	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	Total		
Households	72	79	69	73	68	76	437		47%
Other residential	2	4	2	3	8	3	22		2%
Education	7	3	2	3	5	3	23		2%
Health	4	9	8	8	6	7	42		4%
Emergency Services	1	1	2	0	1	0	5		1%
Public Institutions	0	0	0	0	1	0	1		0%
Utilities (CNI)	0	0	1	0	0	0	1		0%
Vehicle	23	15	31	18	23	8	118		13%
Other	55	54	46	44	54	36	289		31%
Total events	**164**	**165**	**161**	**149**	**166**	**133**	**938**	**28%**	

Over this period, of the events with a clear attribution to the weather, there were two fatalities, both in 2009-10 (1 in the North and 1 in the West), a very small number of injuries (6 in the North, 6 in the West and 1 in the East) and 334 rescues (108 in the North, 166 in the West and 60 in the East)- around 6 each year for every 100,000 of the population (Table 6).

Table 6: Fatalities, injuries and rescues (resulting from flood events clearly attributable to the weather) 2009-15

	Events			Fatalities			Injuries			Rescues			Total			
	North	East	West	North	East	West	North	East	West	North	East	West	Events	Fatalities	Injuries	Rescues
2009-10	52	19	40	1	0	1	2	0	0	60	5	20	110	2	2	85
2010-11	13	15	35	0	0	0	0	0	1	1	6	13	63	0	1	20
2011-12	20	24	44	0	0	0	1	0	2	12	22	32	88	0	3	66
2012-13	19	27	43	0	0	0	2	0	0	12	23	36	89	0	2	71
2013-14	10	4	39	0	0	0	1	1	2	13	3	37	53	0	4	53
2014-15	12	4	26	0	0	0	0	0	1	10	1	28	42	0	1	39
Total	126	93	227	1	0	1	6	1	6	108	60	166	445	2	13	334

What is projected to happen in the future?

An increase in winter precipitation is projected across all regions for all emissions scenarios. It is very unlikely that winter precipitation would increase by more than 55%, but very likely it will be greater than 12%, under the High emissions scenario (A1F1) in the West in the third reference period centered around 2080. A 6% to 30% range is projected even under the Low emissions scenario (B1) (UKCP09, 2009). Each of these scenarios will increase the incidence of flood events in the future and will need to be considered by SFRS in their next round of strategic planning, given the 10 year lead time to implementation.

Patterns of change

Interpretation of indicator trends

No trends are apparent from current data.

Limitations

i. The indicator is populated from the Scottish Fire and Rescue Services Incident Reporting System. Under the Civil Contingencies Act (2004) the SFRS (and other Category 1 Responders) have a statutory duty to respond to emergencies defined as: *"[…] an event or situation which threatens serious damage to human welfare […] which threatens serious damage to the environment of a place […] war or terrorism, which threatens serious damage to the security of the United Kingdom"* (UK Government, 2004). They respond also to (flooding) events as a duty of care where other commitments allow them to do so. Consequently, the data presented here may underestimate the number of actual events.

ii. Prior to 2012, flooding due to extreme weather events was not distinguished from other types of flooding in the SFRS IRS. Since the initial release of the DCLG system in April of that year, the ability to capture widespread flooding where casualties occur has been available in all areas except

Strathclyde[4]. Where no casualties have occurred (or in Strathclyde) the methodology provided in Table 4 below has been used to estimate flooding events caused by extreme weather. The DCLG system is due to be replaced in the near future at which time Strathclyde will migrate to a single UK-wide system. This will make reporting more consistent. However, specific enhancements to the system would need to be requested in order to clearly attribute flooding to weather events as opposed to other sources.

iii. Data related to other extreme weather events – extreme heat, extreme cold, storms and high winds - are unavailable. This makes any consideration of capability and capacity

References

UK Government (2004) Civil Contingencies Act 2004, available at: http://www.legislation.gov.uk/ukpga/2004/36/pdfs/ukpga_20040036_en.pdf

UK Government (2012) *Incident Reporting System – Questions and Lists (Version 1.6 XML Schemas v1-0n)*, Department of Communities and Local Government, London 2012.

Scottish Government (2011) Secure and Resilient. A Strategic Framework for Critical National Infrastructure in Scotland, available at: http://www.gov.scot/Resource/Doc/346469/0115308.pdf

UKCP09 (2009) Jenkins, G., Perry, M. & Prior J. *The Climate of the United Kingdom and Recent Trends*. Hadley Centre, Met Office, Exeter. Available at: http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87933&filetype=pdf . (Accessed 23 Jan 2015). See also: Climate Projections for Scotland, available at: http://www.environment.scotland.gov.uk/get-interactive/data/scottish-climate-projections/

Further information

Scottish Government (2012) Police & Fire Reform (Scotland) Act, available at: http://www.legislation.gov.uk/asp/2012/8/pdfs/asp_20120008_en.pdf

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[4] Although legacy Scottish fire services were replaced by SFRS in April 2013 the manner in which each legacy service still complete IRS reports remains the same therefore there are inconsistencies in the way incidents are recorded in the old 'Strathclyde' area as opposed to the rest of Scotland.

Appendix One: Indicator metadata and methodology

Table 1: Indicator metadata

	Metadata
Title of the indicator	CRS20 - Number of flood events attended by Scottish Fire & Rescue Service (SFRS) each year
Indicator contact: Organisation or individual/s responsible for the indicator	ClimateXChange
Indicator data source	Scottish Government, Justice Analytical Services. Scottish Fire & Rescue Service, Performance Data team.
Data link: URL for retrieving the indicator primary indicator data.	Aggregated data available at SG Climate Justice Analytics http://www.gov.scot/Topics/Statistics/Browse/Crime-Justice/Datasets/DatasetsFire Incident data provided as a custom data extract by SFRS Performance Data team.

Table 2: Indicator data

	Indicator data
Temporal coverage: Start and end dates, identifying any significant data gaps.	April 2009 – March 2015.
Frequency of updates: Planned or potential updates	Incident commanders update SFRS Performance Data in near real-time. Scottish Government Justice Analytics statistics are updated annually.
Spatial coverage: Maximum area for which data is available	Scotland
Uncertainties: Uncertainty issues arising from e.g. data collection, aggregation of data, data gaps	Data consolidation issues in the transition from the 8 regional fire authorities to a single unitary force in 2013. Strathclyde will continue to use its own Incident Reporting System until the UK-wide system being developed for the Department of Communities & Local Government is commissioned.
Spatial resolution: Scale/unit for which data is collected	Property level

Categorical resolution: Potential for disaggregation of data into categories	Local Authorities 8 antecedent fire authorities (probably time limited)
Data accessibility: Restrictions on usage, relevant terms & conditions	Scottish Government data is publicly available, free of charge. SFRS Performance Data is a confidential, custom data extract for the use of ClimateXChange in the SCCAP assessment.

Table 3 Contributing data sources

Contributing data sources Data sets used to create the indicator data, the organisation responsible for them and any URLs which provide access to the data.
Scottish Government Justice Analytics http://www.gov.scot/Topics/Statistics/Browse/Crime-Justice/Datasets/DatasetsFire SFRS Performance Data custom data extract covering all 10,436 flooding events that the SFRS attended between April 2009 and March 2015.

Table 4 Indicator methodology

Indicator methodology The methodology used to create the indicator data
Data from April 2009 through March 2015 was extracted from SFRS Incident Reporting System – both the DCLG and Strathclyde Fire and Rescue Service system - filtered by Special Services (Flooding) and Special Services (Rescue or Evacuation from Water): Special Service types 20-25, 30-38, 40-43 and 50-52 (UK Government, 2012). These are indicated in the table below and identify whether they were deemed 'relevant' in trying to identify incidents where 'widespread flooding' is considered to have been caused by extreme weather events.

Main category	Sub category 1	Sub category 2	Relevant to search
Flooding	Advice Only		No
	Evacuation		Yes
	Make Safe		No
	Other		Yes
	Pumping Out		Yes
	Stand by - no action		No
Rescue or Evacuation from water	Person in water or at immediate risk of entering the water	Bank side, partly in or out of water	Yes
		From widespread flooding	Yes

		Other	Yes
		Person fallen through ice or at risk of doing so	No
		Person in indoor pool or outdoor pool	No
		Person in industrial or other manmade water feature e.g. sewage plant	No
		Person in or top of building that is surrounded by moving water that will exceed head height or cause structural collapse	Yes
		Person in or top of vehicle that is surrounded by moving water greater than (2) foot deep	Yes
		Person in pond, lake, loch, sea or estuary or other waterway	Yes
		Person in sinking or otherwise unsound vessel	Yes
		Person stranded on beach or cliff with rising or full tide, river side/ravine or other waterway embankment where could fall into water	Yes
		River structure; bridge or island, stranded on an island, tree in water	Yes
	Person not in water or at imminent risk of entering water	Other	Yes
		Person assisted from dwelling surrounded by water	Yes
		Person assisted through or across public highway covered by water	Yes

The incident categories marked *No* under *Relevant to search* were excluded from all data searches on the grounds that no widespread flooding incidents would be recorded under these headings.

A total of 3,312 'relevant' incidents were identified between April 1st 2009 and March 31st 2015. This dataset formed the basis for the analysis here.

The three operating regions North, West and East include the following Local Authorities:

Region	**District**	**Local Authorities**
North	Grampian	Aberdeen City Aberdeenshire Moray
	Highlands & Islands	Highland Shetland Islands Orkney Islands Eilean Siar (Western Isles)
	Tayside	Angus Dundee City Perth & Kinross
West	Argyll & Bute	Argyll & Bute

	Ayrshire	North Ayrshire East Ayrshire South Ayrshire
	Dumfries & Galloway	Dumfries & Galloway
	Dunbartonshire	West Dunbartonshire East Dunbartonshire
	Glasgow City	Glasgow City
	Lanarkshire	North Lanarkshire South Lanarkshire
	Renfrewshire	East Renfrewshire Renfrewshire
	Inverclyde	
East	Fife	Fife
	Forth Valley	Falkirk Stirling Clackmannanshire
	Lothian & Borders	East Lothian West Lothian Midlothian City of Edinburgh Scottish Borders