

How are climate change risks affecting Scottish society and how well prepared are we?	Version August 2016
<p>A changing climate will affect all sectors of society, with the potential to cause significant economic and social disruption.</p> <p>Our indicators for the Society theme of the Scottish Climate Change Adaptation Programme (SCCAP) collectively provide an overview of the current state of resilience of Scottish society, covering both social and economic measures. They establish a baseline of vulnerability and exposure (<i>risk</i>), actual <i>impacts</i> (where these exist and are being measured), and any adaptation <i>actions</i> that are being taken forward under the SCCAP.</p> <p>Society's exposure and vulnerability to climate change can be difficult to quantify. Quantitative measurement, such as the number of households at risk of a significant flood event, provides only part of the picture. It is difficult to assess the non-material risks to society as a whole – in particular the risks to health and wellbeing. There are significant gaps in data and knowledge, especially in relation to the risks and impacts of climate change on wellbeing and mental health.</p> <p>Climate change is very likely to increase precipitation and the number of heavy rainfall events ($\geq 25\text{mm}$ in any 24 hour period). Inevitably, the number of flooding incidents will increase unless infrastructure and buildings are adapted to cope.</p> <p>Flooding is relatively rare in Scotland but can have a devastating impact on those whose homes or businesses are flooded. Flooding of community services like health centres or schools can have wide ranging consequences. Flooding of emergency services premises – fire, police and ambulance – has the potential to disrupt entire regions.</p> <p>There is currently little data to assess communities' exposure and vulnerability to the impact of extreme weather-related flooding on community services. This is an important aspect of resilience as communities are dependent on the services provided by GP and dental surgeries, hospitals, schools and emergency services. Scotland's 14 Local Flood Risk Management Plans should provide a clearer picture in future.</p> <p>For Scotland, distributional differences should not be under-estimated, noting in particular the challenges of remote rural <i>islands</i>. Sparse and/or aggregated (national scale) data make accurate assessment of localised impacts difficult.</p> <p>We also have a limited understanding of the extent to which adaptive capacity is being built through social capital.¹ To meaningfully monitor change in adaptive capacity, assessment requires monitoring and evaluation metrics to be identified, agreed and designed into adaptation policies from the outset. In order to determine whether policies to build adaptive capacity are successful, need modification or should be replaced, we need quantitative assessments of their effectiveness and efficiency. Currently, this is not possible.</p>	

¹ Networks together with shared norms, values and understandings that facilitate co-operation within or among groups (OECD).

Adaptation options

Preparing Scotland is the Scottish Government's guidance on improving societal resilience. It considers risk, impacts and actions under three broad headings: *Prepare; Respond; Recover*

1. Prepare: assess the risks by understanding vulnerabilities

Climate related risks frequently manifest as extreme weather events: extreme temperatures, flood, storms and high winds. These events impact directly on the material fabric of society for example by putting residential and non-residential properties at risk of flooding. The distribution of risks across different socio-economic groups is uneven, and depends on many factors including physical health, mental wellbeing, age, employment, financial health, mobility, and social inclusion and isolation.

Scotland's Flood Risk Management Strategies (FRM Strategies) coordinate efforts to tackle flooding. They set the national direction of future flood risk management, helping to target investment and coordinate action across public bodies. Each of Scotland's 14 Local Plan Districts has an FRM Strategy, which is used as a basis for better decision-making across flood risk management organisations.

Local Flood Risk Management Plans provide local detail about flood management actions for 2016-2021. Both Local Flood Risk Management Plans and Flood Risk Management Strategies will be updated every six years.

Climate-related information is already included in **Preparing Scotland: Warning and Informing**. Warnings and alerts are made available to the public through SEPA's **Floodline** service. SEPA also collaborates with the Met Office to provide a more detailed **Scottish Flood Forecasting Service** integrating hydrological and metrological data, specifically for Category 1 and Category 2 Responders as defined in the Civil Contingencies Act (Scotland) 2004.

The SCCAP uses recommendations from **Good Places Better Health** to evaluate risks associated with societal preparedness, including, for example, an assessment of climate resilient housing stock against benchmarks provided by the Scottish Housing Quality Standard (SHQS).

The corresponding risk reduction measures are important components of preparation. Innovation in demand-side efficiency and accelerating the development of new energy efficient technologies contribute to building adaptive capacity. Government support for energy efficiency has sought, through socio-economic targeting, to establish co-benefits in addressing economic disadvantage.

More generally, policies designed to build the capabilities necessary to improve societal resilience involve disseminating information, advice, guidance, education and support, and developing knowledge and skills. The Scottish Government published a public engagement strategy in 2010 to raise awareness of adaptive actions that can be taken in response to the impacts of a changing climate and maximise the impact of the above policies. Wider communication and engagement on climate change issues is ongoing, including a number of 'Climate Ready' action plans for the public and private sectors and communities – see for example Adaptation Scotland's visualisation tool, *Climate Ready Places*.

2. Respond: to threats and realised impacts

Responding to climate change requires developing appropriate knowledge and skills (capabilities)

but its distributive and differentiated nature requires different capacity across communities and geographical areas.

Capability refers to developing and disseminating the knowledge and skills needed to adapt. Much of the responsibility for this knowledge transfer lies with Scotland's Public Bodies. **Preparing Scotland** is referenced frequently in the development of their delivery plans, indicating that they should be consistent with the framework and therefore able to deliver a coherent set of procedures for action.

Capacity refers to the resources – human, financial and equipment - required to actually deliver the adaptation action plans. The success of any adaptation strategy will depend in part on broader economic considerations, particularly adequate capital funding. Any assessment of capacity must consider the availability of suitably trained personnel with access to the specialist equipment required for any given situation and the funds necessary to keep the training up to date and the equipment maintained.

Response can also be proactive where appropriately targeted interventions result in systemic improvements to overall resilience.

Risks associated with fuel poverty, for example, can exacerbate climate disadvantage and, consequently, lead to increased social vulnerability. Demand management through more efficient use of energy can contribute to reducing fuel poverty rates leading to a reduction in vulnerability and thereby an improvement in overall resilience.

Since 2009, Scottish Government has spent over £500m on fuel poverty and energy efficiency Programmes. HEEPS, the most recent of these, provided £65m of grant funding in financial year 2015 for eligible householders. This scheme will be developed further in the **Scotland's Energy Efficiency Programme (SEEP)**, which will see energy efficiency in both residential and non-residential building stock designated a National Infrastructure Priority from 2017.

3. Recover: by developing and applying coping strategies

Recovery is the primary goal of resilience.

Local and Regional Resilience Partnerships co-ordinate the multi-agency response necessary to support recovery from a range of events including but not limited to extreme weather. The responsibilities for response and recovery are separate, although in practice this line is frequently blurred. Based on the principles of integrated emergency management (IEM), the emergency services work with other Category 1 and Category 2 Responders in Local or Regional Resilience Partnerships (LRP/RRP), depending on the scale of the event. In 2013, the eight Strategic Coordinating Groups (SCGs), corresponding to the eight regional police forces, were replaced by three RRP (North, East and West), which in turn are broken down into 13 LRPs (3 in the North and East, 7 in the West). The RRP benefit from many years of knowledge accumulated during the operation of the SCGs. However, the transition to unitary police and fire services continues to require organisational change; and the climate related elements of the new National Risk Register for Scotland would require regional and local interpretation in the Community Risk Registers being developed by LRPs.

While it is the consensus view that vulnerable groups are less able to recover from events, our understanding of how different elements of vulnerability – employment, income, health, access to services, etc. – affect resilience is not very well developed. Indeed, the different methods adopted frequently prevent definitive conclusions being drawn: SEPA's use of the Social Flood Vulnerability

Index (SFVI), for example, considers 2 dimensions of vulnerability – social characteristics and financial indices – while Scottish Government studies frequently use the 7 domain Index of Multiple Deprivation (SIMD).

Economic resilience is another important element of the recovery process. For most of those affected, extreme weather events will undoubtedly have a financial impact, which can only be offset by insurance cover. Unfortunately, data disaggregated for Scotland is currently unavailable from the sources that would be expected to hold it – Association of British Insurers (ABI), the Institute and Faculty of Actuaries, Scottish Flood Forum – and so little can be said about the actual financial impacts of extreme weather events at the present time.

Policies like UK-wide **Flood Re** have been proposed for reinsurance protection. These are designed to keep the flood insurance element of insurance available and affordable to homeowners at risk of repeat flooding.

Where businesses are affected, broader economic issues can be at stake as they typically involve the livelihoods of more people than the business owner alone. The business itself may well provide services to the broader community. Pharmacies and post offices, for example, are recognised as Community Services in the SEPA **National Flood Risk Management Strategies**. Other types of business, particularly food retailers and their supply chains, part of the Critical National Infrastructure², may become increasingly important for community cohesion, especially if recovery is protracted.

In situations where events occur in succession, there is anecdotal evidence that the capacity of both those affected and those supporting the recovery process can be overwhelmed relatively quickly.

What do the indicators tell us?

For society, the risks presented by climate change and the impacts that are already identifiable frequently have multiple costs (and, occasionally, benefits). This introduces an additional level of complexity when trying to produce an overall assessment of risk, impact and action. The inter-connection between different risks, impacts and actions is one, perhaps *the*, defining characteristic of Climate Ready Society.

The RISK of flooding to households and community services

Progress towards a society that is resilient to climate change in Scotland is broadly positive with much more work required in some areas of policy to build adaptive capacity; distributional (geographical) and differential (socio-economic) spreads are apparent.

When considered only at national scale, current and projected effects of climate change on Scottish society as a whole could be considered to be relatively slight. However, this would fail to recognise the *distributed* nature of risks and impacts.

Using SEPA modelled data, just over 3% (79,200 properties) of residential properties are at risk from a 1 in 200 year flood event. Only 5.6% (350 assets) of Community Services – hospitals and care homes, GP and dental surgeries, education facilities, emergency services – are at risk in a similar return period. The risk to Infrastructure assets – electricity sub-stations; wastewater and water

² Critical National Infrastructure (CNI): see <http://www.scotland.gov.uk/Publications/2011/03/21095856/3>, for example

treatment works; and the transport networks – is similarly low. There is no comprehensive source of information on the uptake of property level protection at national scale.

Distributional differences are apparent, for example, for the 9% of properties supplied by private water supplies at risk of flooding, those in Highland & Argyll and Tayside are significantly more exposed than other regions.

In terms of differentiated risk, despite concerted efforts, some of the underlying causes of vulnerability continue to show year-on-year increases with economic disadvantage being a critical factor.

- BB1/BB3: Property (residential and non-residential) at risk of flooding.
- CRS12: Number of community services at significant risk of flooding
- CRS54: Off-grid private water supplies at risk of flooding
- CRS58: Number of households/people falling below the SHQS & Tolerable Standard
- CRS61: Number of household in fuel poverty
- CRS62: Domestic debt held with energy companies for the supply of electricity and gas
- BE5: Electricity substations located in areas at flood risk
- BE6: Customers reliant on electricity substations located in areas at flood risk
- BT9: Disruption risk to railway services as a result of flooding
- BW4: Wastewater treatment works in areas at flood risk
- BW5: Water treatment works in areas at flood risk

The IMPACT of extreme weather events

Excess deaths due to cold in winter have been falling steadily and significantly over the last 60 years. Improvements in housing, improved health care, higher incomes and greater awareness of the risks of cold suggest that the link between winter temperatures and increased winter mortality may be weakening.

While mean winter temperatures are expected to rise, the impact of short-term exposure to very low temperature extremes (cold snaps) – hypothermia, cardiac and pulmonary diseases – is unlikely to change. However, short-term exposure to high temperature extremes (heat-waves) – heatstroke, syncope and fatigue – is likely to increase. Premature deaths due to extreme heat are not considered to be a significant climate-related health risk in Scotland until at least the 2050s.

The number of hospital admissions directly attributable to flooding and other extreme weather events is low, currently fewer than 1,000 cases per year from all causes.

Across Scotland, between 2009 and 2015 the Scottish Fire and Rescue Service attended 3,308 flooding/water events which can be identified as potentially weather-related. The majority of these events affected residential dwellings, though community services were also impacted, particularly health and education facilities. Flooding events in Scotland rarely directly result in physical injury.

Modelled data from SEPA estimates the economic impact of flooding on residential and non-residential properties based on annual average damages (AAD)³ at some £252m, primarily as a result of fluvial flooding (£141m) with roughly equal impacts from coastal (£53m) and pluvial (£58m). In terms of absolute numbers, distributional differences between Local Plan Districts are very

³ Economic damages incorporates: direct damages to non-residential and residential properties, indirect damages (drying out, temporary accommodation) to residential properties, additional emergency services costs, vehicle damages associated with residential properties, damages to arable agriculture, damages to roads surface caused by floodwater

apparent: AAD from all sources of flooding of £66.6m in Clyde and Loch Lomond, two orders of magnitude less (£436,000) on Shetland for example. The actual cost of annual flood damages in Scotland ranges from around £210m for property damage to £780m for all property plus agriculture).

- CRS8: Excess deaths due to extreme temperatures
- CRS9: Number of hospital admissions as a result of extreme weather events
- CRS20: Number of flood incidents attended by SFRS each year
- BT4: Flood events affecting the trunk road network
- BT12: Flood events affecting the rail network
- BE4/14: Electricity supply disruption due to flooding

ACTIONS taken to reduce the risk and impact of flooding on households, community services and emergency services

Even though the actual risk is small (see above), the perceived risk as measured by the number of registrations for flood warnings and alerts has shown a steady increase year-on-year since the **Floodline** service was introduced in 2011.

During Storm Desmond in December 2015, the Floodline website received over 100,000 user sessions (250,000 page views) in the space of 6 days, exceeding the previous record of 95,000 in August 2014. 550 new people registered for the service. The water level web page alone was viewed over 100,000 times and 64 notifications of flooding were notified through 'Report a Flood', a feature added recently. At the height of the event, 15 Alerts and 75 Warnings had been issued (including 2 Severe, the first time since the launch of the system that this level of risk had been identified). Over 70,000 messages were sent via a variety of channels (email, fax, pager, SMS and voice messages).

Floodline is an example of a suite of policies aimed at building capability through the provision of information, advice, guidance, education and support (collectively 'Knowledge Transfer'). 65% of the policies and proposals in the Climate Ready Society theme of the SCCAP are concerned with knowledge transfer to build resilience at different scale - individual, household, community and (responder) organisational - each with distributed (regional and national) characteristics and differences.

Of the 20 potential indicators identified to track progress in this area, only 2 can be developed currently as a result of the gaps in data identified during this study.

- CRS34: Number of registrations for flood warnings/alerts
- CRS64: Uptake of energy efficiency measures

Constraints

The datasets that have been identified to date cannot yet support a comprehensive, quantitative assessment of Scottish society's capacity to prepare for, respond to and recover from climate related events. This observation is as important as what the indicators can tell us. It reflects a lack of systematic analysis work on societal resilience.

While there are research groups working on aspects of the issue, we have found no systematic study of societal resilience.

Some 33 indicators overall could not be developed due to data availability/quality issues:

- i. Number of (vulnerable) people at significant risk of heat stress

- ii. Number of households/(vulnerable) people at significant risk of flooding
- iii. Number of households (within most deprived communities) flooded each year
- iv. Uptake of SQHS Guidance on reducing damp and condensation
- v. Uptake of flood defensive measures – property level prevention and protection
- vi. Cost benefit of defensive measures for all assets: residential, non-residential, critical infrastructure
- vii. Coverage of flood insurance
- viii. Insurance claims for residential properties resulting from flooding and other extreme weather events
- ix. Insurance claims for non-residential properties resulting from flooding and other extreme weather events
- x. Insurance claims for consequential loss resulting from flooding and other extreme weather events
- xi. Number of school days lost each year due to flooding and other extreme weather events
- xii. Uptake of public awareness measures on heat waves
- xiii. Heatwave action plans in place
- xiv. Incidence of new [water/food borne] diseases, including changes in disease vectors and [water/food borne] pathogens as a result of climate change
- xv. Mortality and morbidity attributable to [food/water/vector] borne diseases
- xvi. Number of psychiatric hospital admissions episodes attributable to flooding events each year
- xvii. Hospital admissions due to respiratory disease attributable to algal or fungal/mould growth
- xviii. Uptake of VTEC/E.coli Action Plan
- xix. Category 1 Responders risk assessment plans in place
- xx. Category 2 Responders risk assessment plans in place
- xxi. Category 1 responder expenditure on emergency planning and response
- xxii. Category 2 responder expenditure on emergency planning and response
- xxiii. Number of SCCAP Delivery Agencies programmes in place (covers 10 programmes)
- xxiv. SCCAP Delivery Agencies programmes expenditure
- xxv. Uptake of awareness raising programmes (covers 6 programmes)
- xxvi. Uptake of public awareness measures on psychological effects of EWE [flood/storm]
- xxvii. Knowledge transfer of EWE [flood] risk areas
- xxviii. Knowledge Transfer of assets at risk of EWE [flood]: Households; Community Services; Critical National Infrastructure (CNI) assets
- xxix. Operational capacity of Category 1 Responders
- xxx. Uptake of measures to improve the effectiveness of Category 1 Responders
- xxxi. Operational capacity of Local/Regional Resilience Partnerships
- xxxii. Uptake of measures to improve the effectiveness of Local/Regional Resilience Partnerships
- xxxiii. Number of deaths and injuries from flooding & storm events each year due to Category 1 Responder availability

Some *qualitative* comments can be made regarding the status of knowledge transfer programmes, where plans have been widely established and implementations are now following; the reporting obligations for Public Bodies, which will provide an important data source for tracking the progress of the Adaptation Programme, which are at different stages of maturity for those bodies with delivery responsibilities, the Category 1 Responders; the development of Community Risk Registers, which are now in place for all three RRP and 3 have been published by SFRS for the 13 LRPs. The Community Risk Registers will need to be reviewed in the light of the National Risk Register for Scotland, due to be published in 2017.

However, there are a number of areas where data are simply unavailable. The lack of disaggregated insurance data for Scotland, for example, means that it is not possible to calibrate the modelled data

used by SEPA to assess flood risk with empirical event data. Similarly, long-term assessment of mental health and wellbeing is required, going beyond the anxiety scores of post-event questionnaires, and taking account of different impacts of acute, sub-acute and long-term events.

An estimate of the efficiency of defensive flood measures may be informed once the Local Authority asset inventory, required by the Flood Risk Management Act 2009, has been developed, using the methods described in the Flood Hazard Research Centre's 'Multi-Coloured Handbook' to assess economic impact.

Policies and proposals focused on the adaptive capacity of business, industry & services were absent from the SCCAP - in part as a result of a lack of engagement by the private sector in the consultation process.

No assessment of food poverty and food security risks are possible, reflecting, to some extent, the lack of policy levers addressing business impacts in the current SCCAP, particularly the adaptive capacity of supply chains. Food Standards Scotland is developing a climate change strategy, which will include an assessment of the risks and impacts of emergent food-borne pathogens.

Separating a consideration of resilience to a changing climate from the development of more general societal resilience may be unhelpful. The ability to heat/cool households cost effectively, for example, is a fundamental need, which may be affected in a variety of different ways by a changing climate. In health and social care, the ability to attribute emergent health impacts to a climate signal is probably less important than recognising the fact that pandemics undermine resilience and make communities more vulnerable. A resilient community will be inherently less vulnerable to any hazard, including climate change.

Other relevant indicators

Risks and impacts of flooding on the infrastructure network are discussed in the **Flooding** narrative in relation to a range of indicators covering energy, transport, water as well as residential and non-residential property, all of which are relevant to society as a whole. So too, estimates of risk from dilapidated building fabric, resulting in rising damp and condensation (see BB17/18 Dampness in housing stock; Condensation in housing stock).

Water quality is considered further in the **Water Quality & Availability** narrative.

Ecosystem based adaptation approaches establish value in natural flood management solutions. The value of alleviating flood by slowing water run-off through peatland restoration projects, which have the co-benefits of maintaining water quality in the face of peat degradation could be demonstrated by projects funded through the SNH Peatland Action Programme, for example (see Resilience of the Natural Environment narrative)

For more detailed analysis of climate change risks to society and Scotland's ability to adapt, see our three assessments of [societal resilience](#), [health and well-being](#) and [capability and capacity](#).