Indicators and trends

Monitoring climate change adaptation

climate change

Scotland's centre of expertise connecting climate change research and policy

Indicator name				Version
BW5 Water treatment works in areas at flood risk				**10/03/16**
Indicator type:	**Risk/opportunity**	**Impact**	**Action**	
	X			

SCCAP Theme	SCCAP Objective	CCRA risk/opportunity
Buildings and infrastructure networks	B2: Provide the knowledge, skills and tools to manage climate change impacts on buildings and infrastructure	FL7/24/27 Flooding of non-residential property

At a glance

- Clean water is a basic requirement, and security of water services is crucial to society.
- Some Scottish water treatment works (WTW) have already experienced flooding, and others may be at risk now and in the future due to climate change.
- Until 2002, water assets were managed at regional and local levels, with case-by-case management. From 2006 Scottish Water has undertaken flood risk assessments at a national level, followed by interventions where required
- The Scottish Water Asset Register includes wastewater treatment works, water treatment works and pumping stations. The methodology for assessment of asset flood risk to any of these commissioned by Scottish Water are broadly similar.

Latest Figure	Trend
2010-2012: 45 of 250 water treatment works (18%) lie within SEPA's 0.5% Annual Probability indicative coastal and fluvial flood boundaries (but have not experience historical flooding issues). Although there are additional treatment works known to have experienced flooding, the number could not be verified at the time of study.	No additional data for trend analysis.

Why is this indicator important?

The ability to provide safe drinking water is a fundamental requirement of society. Understanding the risk to water services is important for Scottish Water, in order to inform both central strategic objectives and local asset management plans. Scottish Water has responsibility for more than 250 water treatment works, as well as for around 1,380 service reservoirs and water towers and almost 600 water pumping stations.

The infrastructure supporting the treatment and delivery of water may be vulnerable to climate change impacts due to flooding (Scottish Government, 2011). Flooding of water treatment assets can arise due to inundation via fluvial, coastal or pluvial sources. Failure of the water treatment function arises principally due to the impact upon critical equipment (particularly electrical) rather than due to impact on process.

Related Indicators
BW4 Wastewater treatment works in areas at flood risk

What is happening now?

In 2012 Scottish Water undertook a Flood Risk Assessment for 45 water treatment works, identified as a priority from a total of more than 250. From this, appropriate interventions were identified and addressed through a coordinated programme of capital investment and maintenance (Scottish Water, 2012a).
Service resilience is an increasing focus for Scottish Water, covering a range of factors, of which climate change is one. The approach is set out in their 2015-21 Regulatory Business Plan (Scottish Water, 2014).

What has happened in the past?

Between 2006 and 2010, Scottish Water worked to improve their understanding of flood risk across the water asset base. Raw water storage, raw water pumping stations, water treatment works, treated water pumping stations, wastewater pumping stations and wastewater treatment works were examined in a desk based study using SEPA's 1:200 flood risk maps (coastal & fluvial) and anecdotal records of surface water flooding of assets. This information was consolidated into an asset flood risk register.

Following the introduction of the Flood Risk Management (Scotland) Act 2009 and the subsequent release of SEPA's National Flood Risk Assessment 2011, Scottish Water was able to refresh the way in which it assesses the flood resilience of its asset base. In 2012, Scottish Water commissioned the development of an asset selection methodology (Scottish Water, 2012a), with the aim of better understanding the risk exposure and intervention options for a number of water treatment works and other assets. This methodology identified 45 water treatment assets as requiring a more detailed flood risk assessment (defined on the basis of sites that lay within SEPA's 0.5% annual probability indicative coastal and fluvial flood boundaries but that had not already been flooded) (Scottish Water, 2012b). It is possible that, at the time of this study, there were additional treatment works known to have experienced flooding however, this information could not be verified.

What is projected to happen in the future?

It is widely accepted that climate change will bring an increase in sudden and intense rainfall, coastal flooding will become more frequent and more severe, and sea-level will rise (Scottish Government, 2009). More specifically, climate change will influence catchment response through an increase in peak rainfall intensity, thus also increasing peak fluvial flows. With respect to coastal flooding, climate change will bring an increase in both sea levels and in storminess, making those assets located nearer Scottish shores more susceptible to waves and breaches of defence crest levels. This overtopping of coastal defences may result in increased flood risk due to ponding (as influenced by topography) or may result in structural problems due to the ingress of seawater from coastal spray.
Scottish Water is now developing a more risk-based approach that focuses on critical assets in order to prioritise the management of flood risk.

Patterns of change

n/a

Interpretation of indicator trends

There are no additional data to allow for analysis of trends.

Limitations

The data for 2010-2012 offer a baseline to measure the number of water treatment works located in areas at risk of flooding. However, this is based *only* on risk as identified through location mapped to SEPA's 0.5% Annual Probability indicative coastal and fluvial flood boundaries. In other words, it is simply a measure of assets that lie within the flood risk area. The indicator and data do not confirm the outcome of flood risk assessments; neither do they yield detail on interventions to manage the risk. Use of this data should hence be undertaken with care.

References

Dixon and Tawn (1997). Estimates of extreme sea conditions: spatial analyses for the UK coast. POL report 112.

SEPA (2010). Technical Flood Risk Guidance for Stakeholders, 2010, Version 6.0. Ref SS-NFR-P-022. Coastal flood boundary conditions for UK mainland and islands. Environment Agency, 2011.

SEPA (2011). National Flood Risk Assessment. Available at: http://www.sepa.org.uk/flooding/flood_risk_management/national_flood_risk_assessment.aspx

Scottish Government (2009). Scotland's Climate Change Adaptation Framework (SCCAF). *Water Resource Management Action Plan.* Available at http://www.gov.scot/Resource/Doc/295166/0091322.pdf

Scottish Government (2011). Scotland's Climate Change Adaptation Framework (SCCAF). *Energy Sector Action Plan.* Available at: http://www.gov.scot/Resource/Doc/175776/0114907.pdf

Scottish Water (2012a). Asset Flood Resilience, Asset Selection Methodology, SW Ref: 401191-0000-20-GEN-0001, July 2012.

Scottish Water (2012b). Asset Flood resilience, Flood risk assessments. Hydrological and hydraulic modelling strategy to assess flood hazard at asset sites. SW report reference: 401191-0000-20-GEN-0003, 2012.

Scottish Water (2014). Strategic Projections and Business Plan 2015-2021 http://www.scottishwater.co.uk/about-us/publications/strategic-projections

Further information

Acknowledgements

This indicator was compiled by Professor Lynne Jack and colleagues at Heriot Watt University with input from Scottish Water. The data on assets at flood risk was provided by Scottish Water.

Katherine Beckmann, Heriot-Watt University / CXC contributed to this indicator.

Appendix One: Indicator metadata and methodology

Table 1: Indicator metadata

	Metadata
Title of the indicator	BW5 Water treatment works in areas at flood risk
Indicator contact: Organisation or individual/s responsible for the indicator	ClimateXChange
Indicator data source	Numbers supplied direct Scottish Water, and determined from flood risk assessment methodology reports
Data link: URL for retrieving the indicator primary indicator data.	The data is not publicly available, but was supplied via the contacts listed above.

Table 2: Indicator data

	Indicator data
Temporal coverage: Start and end dates, identifying any significant data gaps.	The data is for the 2012-2013 period.
Frequency of updates: Planned or potential updates	Scottish Water may undertake further flood risk assessments based on new SEPA data in 2015. However, this will still only show assets that in flood risk areas, rather than the 'real risk' to assets as identified through more detailed flood assessments, and those for which interventions have been implemented.
Spatial coverage: Maximum area for which data is available	Scotland
Uncertainties: Uncertainty issues arising from e.g. data collection, aggregation of data, data gaps	Please see 'Limitations'
Spatial resolution: Scale/unit for which data is collected	The data is at the scale of the individual asset.
Categorical resolution: Potential for disaggregation of data into categories	
Data accessibility: Restrictions on usage, relevant terms & conditions	None (as no assets are named)

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.
n/a

Table 4 Indicator methodology

<table>
<tr><th>Indicator methodology

The methodology used to create the indicator data</th></tr>
<tr><td>Numbers supplied direct by Scottish Water, and determined from flood risk assessment methodology reports (references noted above).

The method of determining flood hazard (defined as the extent and depth of flooding) for assets deemed to be at 0.5% annual probability flood risk was based on the SEPA Technical Guidance document (Technical Flood Risk Guidance for Stakeholders, 2010) and used design flood events for annual probabilities 3.33%, 1%, 0.5% and 0.1% (i.e.30-year, 100-year, 200-year and 1000-year return period events respectively). Furthermore, a climate change scenario was considered for the 0.5% annual probability for a time horizon of 2080. This flood hazard information was then combined with information on the 'vulnerability' of the asset, i.e. a reflection of the level of importance of a particular asset and of the damage possible from a flooding event.

Fluvial, tidal and pluvial flooding mechanisms were all addressed. Where assets were deemed to be at risk of more than one flooding mechanism, consideration of 'joint probability' was addressed also.

Fluvial flood risk was established using hydrological models to derive rates and volumes of runoff from the upstream catchment areas which were then translated into flood water levels for asset sites using hydraulic models. For tidal hazards, the risk assessment methodology included the flood hazard from extreme still water sea levels (encompassing coincident high tide and storm surge) and from wave overtopping. Extreme sea levels were assessed using either the POL112 method (Dixon and Tawn, 1997) or the later (and more accurate) SEPA extreme sea level data and information from the Environment Agency's coastal flood boundary conditions report (2011). Similarly, climate change was considered for the 0.5% annual probability, in this case by establishing an uplift to the still water level using UKCP09 estimates (medium emission scenario for 2080).

Risk from pluvial flooding due to direct runoff was assessed using the 2D model TUFLOW or, where appropriate, SEPA flood information. Rainfall hyetographs for new pluvial models were derived using the FEH software, and where appropriate for urban areas, consideration given to the storage capacity of urban drainage infrastructure. Climate change was considered again for the 0.5% annual probability, in this case by increasing peak rainfall intensity by 20% for a time horizon of 2080.</td></tr>
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