East Lothian Council

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Forth Estuary Local Plan District (LPD 10)

Consultation material on:

- Draft Flood Risk Management Strategy
- Draft Local Flood Risk Management Plan

Welcome to the consultation on the Forth Estuary draft flood risk management plans (Local Plan District 10).

This document consolidates all the consultation material for the Forth Estuary Local Plan District and is presented alongside the online consultation (https://frm-scotland.org.uk). It has been prepared by SEPA and the Local Authorities in the Local Plan District. If you would like further information please contact FloodActConsultation@sepa.org.uk

The consultation is open from 22 December 2014 until 02 June 2015. Information is available on how flooding should be managed, coordinated, funded and delivered, along with the consultation questions.

There is a large amount of information available in this consultation. We do not anticipate everyone will have an interest in all areas or will necessarily want to answer all questions. Some will want to see information only for where they live or work. Others will want to consider flood risk management at a regional or national scale.

Scotland has been arranged into 14 Local Plan Districts. Each Local Plan District has its own consultation containing the following information:

- A short overview document defining the Local Plan District, the flood risk authorities involved and a summary of the flood risk.
- River, coastal and surface water flooding impacts are summarised in a separate chapters.
- Each Potentially Vulnerable Area has a document describing the impacts of flooding, a document stating the local objectives and potential actions to manage flood risk and a delivery plan developed by the Lead Local Authority that sets out the proposed timescales and flooding arrangements for implementation.
- Objectives and potential actions to manage flooding that apply across the whole Local Plan District are set out in a separate document.

Potentially Vulnerable Areas within each Local Plan District were identified and consulted upon in 2011. These are priority areas where the risk and impacts of flooding are agreed to be nationally significant and where the focus of identifying new actions to manage risk will be greatest.

The documents for this Local Plan District have been developed in partnership with:

- Edinburgh City Council (Lead Local Authority), Clackmannanshire, East Dunbartonshire, East Lothian, Falkirk, Fife, Midlothian, North Lanarkshire, Perth and Kinross, Scottish Borders, South Lanarkshire, Stirling and West Lothian Councils.
- Scottish Water

Contents

Map acknowledgments

SEPA gratefully acknowledges the cooperation and input that various parties have provided, including *inter alia*, the following organisations:

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Local authorities
SEPA acknowledges the provision of flood models and other supporting data and information from local authorities in Scotland and their collaboration in the production of flood risk management information.

Scottish Water
SEPA acknowledges the inclusion of surface water flooding data generated by Scottish Water in preparation of flood risk information.

FORTH ESTUARY

Local Plan District overview

The Forth Estuary Local Plan District has an area of 3,256km^2 with a population of approximately 1.4 million. It includes Edinburgh, Livingston, Cumbernauld, Falkirk, Dunfermline, Kirkcaldy and Glenrothes (Figure 1).

The main river catchments include the River Leven, River Carron, River Avon, River Almond, Water of Leith, River Esk, River Tyne and the Eye Water.

The largest lochs include the Carron Valley and Loch Coulter reservoirs that are in the River Carron catchment. Other lochs include the Loch Leven in the River Leven catchment, Cobbinshaw Reservoir in the River Almond catchment and Harperrig, Threipmuir and Harlaw Reservoirs in the Water of Leith catchment.

The Local Plan District has 375km of coastline that includes the Firth of Forth and the Berwickshire coast. The Firth of Forth is the largest estuary on the east coast of Scotland. It extends 95km from Stirling in the west, where the River Forth flows into estuary, to Fife Ness in the east where it meets the North Sea.

The Forth Estuary Local Plan District includes part of the central belt and is relatively urbanised. More rural areas are located in the north of the Forth of Forth, in East Lothian and along the Berwickshire coast in the Scottish Borders. The main types of land cover are:

- 35% arable and horticulture
- 31% grassland
- 13% woodland
- 10% urban
- 6% heather and heather grassland
- 5% other.

Flood Risk in the Forth Estuary Local Plan District

The National Flood Risk Assessment carried out by SEPA in 2011 identified 27 Potentially Vulnerable Areas in the Forth Estuary Local Plan District. Subsequently, a further review of flood risk identified two candidate Potentially Vulnerable Areas. The location of all these areas is shown in Figure 1. It is estimated that 87% of residential and non-residential properties with a medium likelihood of being flooded are located within these Potentially Vulnerable Areas.

Approximately 14,000 residential properties and 3,700 non-residential properties have a medium likelihood of being flooding.

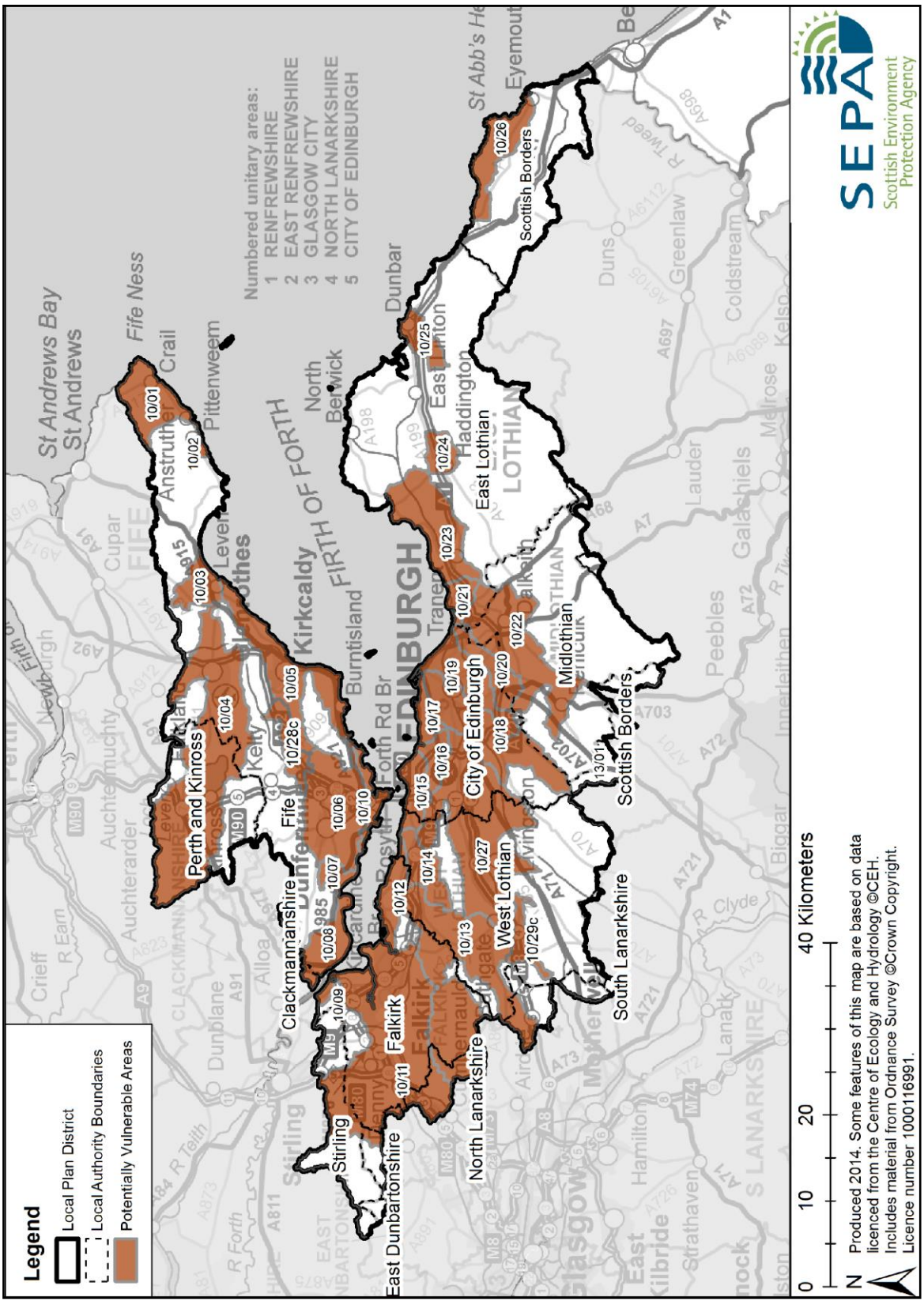


Figure 1: The Forth Estuary Local Plan District, Potentially Vulnerable Areas and local authority areas

The Annual Average Damages from flooding are approximately £34 million. This includes damages to residential properties, non-residential properties, transport and agriculture. River flooding is the main source of flooding in this Local Plan District, followed by surface water flooding (Figure 2). The damages caused by river flooding are approximately £18 million and those caused by surface water flooding are approximately £12 million. Damages caused by coastal flooding[1] are approximately £4 million.

Note that economic damages to airports and rail were not assessed as information on damages at this scale is not available.

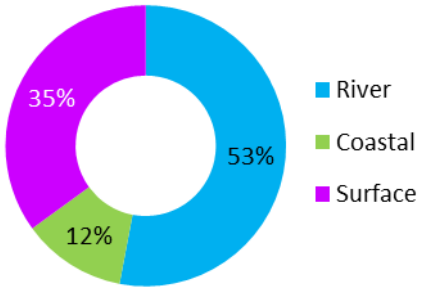


Figure 2: Sources of flooding in the Forth Estuary Local Plan District based on contribution to Annual Average Damages

The main urban areas with a medium likelihood of being flooded can be seen in Table 1. This table shows the number of residential properties at risk and the Annual Average Damages caused by flooding. This includes damages to residential properties, non-residential properties, transport and agriculture.

Locations	No of residential properties at a medium likelihood of flooding	Annual Average Damages
Edinburgh	6,500	£8,500,000
Musselburgh	1,400	£3,300,000
Dunfermline	270	£1,300,000
Buckhaven-Methil-Leven	200	£860,000
Grangemouth	720	£782,000
Linlithgow	310	£750,000
Airth	100	£670,000
Falkirk	310	£650,000
Glenrothes-Markinch-Leslie	140	£600,000
Haddington	230	£560,000

Table 1: Main urban areas with a risk of flooding[2]

Administrative arrangements within the Local Plan District

Roles and responsibilities

Under the Flood Risk Management (Scotland) Act 2009, SEPA and all responsible authorities in the Local Plan District have a duty to cooperate with the aim of reducing

[1] The term coastal flooding is used under the Flood Risk Management (Scotland) Act 2009, but in some areas it is also referred to as tidal flooding and cover areas such as estuaries and river channels that are influenced by tidal flows.
[2] Table 1 does not show properties at risk if they are protected by a flood protection scheme with a known standard of protection of 1 in 200 years.

overall flood risk. To facilitate this a Local Plan District Partnership has been established, led by Edinburgh City Council.

Membership of the partnership includes representatives from the relevant departments within local authorities together with regional representatives of both Scottish Water and SEPA. This enables the partnership to produce flood risk management strategies and local flood risk management plans which are consistent with those across Scotland and which are also informed by local knowledge and experience. The organisations involved include:

- City of Edinburgh Council
- Clackmannanshire Council
- East Lothian Council
- Falkirk Council
- Fife Council
- Midlothian Council
- North Lanarkshire Council
- Perth and Kinross Council
- Scottish Borders Council
- Stirling Council
- West Lothian Council
- SEPA
- Scottish Water

Stakeholder engagement

A National Flood Management Advisory Group has been set up by SEPA to provide advice on the preparation of the Flood Risk Management Strategies. The advisory group has a membership that represents those affected by the impact of flooding on communities, the environment, cultural heritage, the economy and human health. This group also includes representation from national transport and utilities providers.

In addition to the National Flood Management Advisory Group, there is a local advisory group run by SEPA for the Forth Estuary area to provide comments and advice on the development of flood risk management plans. Membership of the group includes organisations who have an interest in flood risk management and how it is delivered. Organisations invited to attend include Scottish Natural Heritage, Royal Society for the Protection of Birds, fisheries interests and land managers. Local authorities also participate in the local advisory group.

The local advisory group works closely with a parallel advisory group focused on the quality of the water environment and the development of river basin management plans. It is important that activities of these two groups are coordinated so that improvements in water quality can be achieved in conjunction with managing flood risk in a sustainable manner (see appendix).

A public consultation on the draft Flood Risk Management Strategy will run from late December 2014 until June 2015. Comments received will be taken into account by the Local Plan District Partnership in the preparation of the final Flood Risk Management Strategy in December 2015.

Additional consultation on how flood risk management will be delivered in the Local Plan District – providing detail on who will do what, when and how the actions are to be funded – will be available for public comment from March 2015.

Appendix

Note on confidence in data

This report uses data derived from flood maps produced by SEPA. The flood maps were developed using consistent methods for the whole of Scotland. There is uncertainty in all flood modelling due to the assumptions and simplifications required to represent complex natural processes. To improve accuracy and confidence in the information this national approach was supplemented where possible with more detailed, local assessments. The resultant maps are suitable for identifying the flood risk to communities and helping to assess the right combination of actions required to address those risks. They are not suitable for defining the flood risk to individual properties or for the detailed design of actions, such as flood defences.

The information on river flooding does not take account of the interaction with coastal, surface water or groundwater flooding. Flooding in steep catchments, in heavily culverted areas or where rivers have been heavily modified with man-made structures are represented with less confidence. Confidence is greater in locations with good topographical information and local river flow data. Confidence is also improved where models compare well with local historical data or detailed modelling. The modelling covers catchments greater than 3km^2 in size.

SEPA surface water flood modelling identifies where water ponds and collects during heavy rainfall. Assumptions have been made about the volume of rainfall lost to drainage systems or runoff. Confidence in the maps is improved where models compare well with recent flood events or more detailed local information. In certain locations regional assessment has improved our understanding of how water flows through urban areas during storms. For some areas a consideration of flooding from sewerage systems has been included. The maps do not assess flooding from culverted watercourses or groundwater.

The information on coastal flooding in this report is based on SEPA modelling using still water level predictions. The method used simplifies the coastal processes and flooding mechanisms at work during a storm. The modelling does not take into account all structures that may reduce the risk of coastal flooding, nor does it take into account the impact of wave overtopping or the interaction between river and coastal flooding. As a result they may underestimate coastal flood risk in some areas. In locations with wide and flat floodplains, the modelling may overestimate flood risk because the volumes of water able to inundate an area over a tidal cycle are not taken into account.

Links with river basin planning

The first river basin management plans were published in 2009. They are currently being reviewed and will be updated in December 2015. These plans aim to protect and improve the condition of Scotland's rivers, lochs, estuaries and coastal waters.

The status of water bodies is classified as high, good, moderate, poor or bad. High status means water bodies are close to a natural or undisturbed state. Classification takes account of water quality (the biology and chemicals present); habitat (the condition of river beds and banks, and obstacles to fish passage); and water flows (the volume of water removed and stored in reservoirs or held back behind dams).

The river basin management plans aim to prevent deterioration of rivers, coastal waters or estuaries and restore them to at least good status by 2027. If actions to

restore these areas to good status would have a significant social or economic impact (such as increase the risk of flooding), they are designated as heavily modified. For heavily modified water bodies the river basin management plans aim to achieve the best condition possible without impacting on the reason for designation. Some actions to restore rivers, coastal waters or estuaries can help manage the risk of flooding. Similarly, actions to manage the risk of flooding can help restore these areas. This is particularly relevant in water bodies affected by habitat damage or rural diffuse pollution. The storage of water in reservoirs for hydropower or water supply activities can also provide opportunities to better manage the risk of river flooding. As such, there are clear benefits from coordinating river basin management plans and flood risk management strategies.

More information on river basin management plans and the consultation on priorities to restore water bodies is available on SEPA's website (www.sepa.org.uk).

Natural flood management

SEPA have carried out a high level assessment of the potential for natural flood management across Scotland. Natural flood management refers to the restoration, enhancement or alteration of natural features and characteristics to help reduce the risk of flooding. The assessment identifies those areas where the implementation of certain types of actions might be most effective and where further investigation may be merited. The maps showing potential for natural flood management are available on the SEPA website (http://map.sepa.org.uk/floodmap/map.htm).

Three types of natural flood management measures have been considered for river flooding: runoff reduction, floodplain storage and sediment management. These are described further in the river catchment documents for this Local Plan District.

Two types of natural flood management measures have been considered for coastal flooding: estuarine surge attenuation and wave energy dissipation. Estuarine surge attenuation can reduce the impacts of coastal surges. Wave energy dissipation provides opportunities to reduce erosion through reducing wave power. These are described further in the coastal documents for this Local Plan District.

Coastal processes

Wave energy is important to understanding coastal processes and the resulting risk of coastal flooding or erosion. Waves can be influenced by winds and storms as well as the shape of the shoreline. During a storm, the wind and low atmospheric pressure can temporarily increase the height of the sea (storm surge) above predicted tidal levels. Extreme sea levels and flooding can result when a storm surge coincides with high tides.

To manage the risk of coastal flooding, it is important to understand coastal processes and how these may alter with climate change. It is expected that sea level will rise and there will be an increase in wave heights. The deposition and erosion of sediment can affect the risk of coastal flooding and the long term effectiveness of actions. Actions to manage coastal flooding in one area can also affect deposition and erosion in other areas nearby, particularly where beaches are present. The power of waves also affects the maintenance costs and lifespan of proposed or existing actions that protect against the risk of coastal flooding.

SEPA commissioned a strategic assessment to indicate where coastal erosion is an important factor when considering actions to reduce the risk of coastal flooding. This

does not include existing coastal protection or flood protection structures which may reduce the risk of coastal erosion. It also does not indicate areas that will erode or the timescales over which erosion could occur. For further information on the natural susceptibility of coastal erosion please contact SEPA.

Forth Estuary Local Plan District Objectives and potential actions

This document describes objectives and potential actions to manage flood risk in the Forth Estuary Local Plan District. They are being consulted upon alongside the objectives and potential actions for each Potentially Vulnerable Area. Objectives and potential actions relating to cultural heritage, the environment, utilities, roads and rail will be agreed with key stakeholders during 2015.

The document contains general objectives and potential actions that apply across all areas within the Local Plan District, as well as specific objectives and potential actions that relate to land use planning, surface water flooding and flood warning.

GENERAL OBJECTIVES AND POTENTIAL ACTIONS

	Indicator(s)	
Objective	**Residential properties at risk**	**Annual average damages**
Reduce overall flood risk	14,000	£34 million

Potential actions for reducing overall flood risk

Potential action	Description
Self help	Individuals have the responsibility for protecting themselves and their property from flooding. *Self-help actions can be undertaken by any individuals, businesses, organisations or communities at risk of flooding. They are applicable to all sources and probabilities of flooding. They focus on awareness and understanding of the flood risk.* *Property level protection can reduce flood impacts by restricting water entering a property, or by using construction techniques which increase the resilience of properties to flood water. It is most beneficial for flood depths less than 0.6m in areas of high probability flooding.* *Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Awareness raising	SEPA and the responsible authorities have a duty to raise public awareness of flood risk. *Heightened awareness of flood risk and actions that prepare individuals, homes and businesses for flooding can reduce the overall impact of flooding.*

Potential action	Description
Flood forecasting	The Scottish Flood Forecasting Service is a joint initiative between SEPA and the Met Office. The service provides countrywide flood guidance for emergency responders up to five days ahead and flood forecasting capabilities that underpin the flood alerts. *Flood forecasting is a key part in the delivery of a flood warning service, which allows people to take appropriate action to reduce the risk to themselves, their homes, businesses and communities.*
Emergency planning and response	Local authorities, SEPA, the police and fire and rescue services all have duties to work together and plan for emergencies and respond during emergencies. *Emergency response plans are applicable for all flood sources and likelihoods. They set out the steps to be taken during a flood event to maximise safety and minimise impacts where possible.*
Watercourse maintenance / Clearance and repair	Local authorities have a duty to carry out clearance and repair works to bodies of water where those works will substantially reduce flood risk. The local authorities must make the schedule of clearance and repair works available for public inspection. *Watercourse maintenance can prevent debris accumulating within channels, which may otherwise result in an increased flood risk. It can be undertaken as a regular planned activity or in response to a flood event.*
Maintenance / Asset management	Asset owners are responsible for the maintenance and management of their assets. *Ongoing maintenance of existing defences will ensure they continue to offer protection from flooding. This applies to all types of existing defences although appropriate maintenance activities may vary.*

LAND USE PLANNING OBJECTIVES AND POTENTIAL ACTIONS

		Indicator(s)	
Objective	**Objective ID**	**Residential properties at risk**	**Annual average damages**
Avoid an overall increase in flood risk	10001	14,000	£34 million
Reduce overall flood risk			

Potential actions for land use planning

Avoid an overall increase in flood risk	
Action	**Action ID**
Avoid development in medium to high risk areas. Local planning authorities work in partnership to undertake a catchment wide strategic flood risk assessment to inform their development plan allocations in line with SEPA's guidance on strategic flood risk assessments and land use vulnerability. Strategic flood risk assessment findings are used to inform development plan allocations.	100010300
Avoid development in medium to high risk areas. Local planning authorities and SEPA require the submission of flood risk assessments that accord with SEPA's Technical Flood Risk Guidance for Stakeholders, to support planning applications where there is a potential flood risk. The flood risk assessment should be used to demonstrate as far as possible that the development will be safe for its lifetime, without increasing flood risk elsewhere and, where possible, takes opportunities to reduce flood risk overall.	
Avoid development in medium to high risk areas. SEPA ensures that its flood risk advice to planning authorities is clear and appropriate. SEPA in consultation with local planning authorities will undertake an annual assessment of planning advice and its contribution to flood risk.	
Avoid development in medium to high risk areas. SEPA and local planning authorities engage at an early stage of the development plan process to agree appropriate forms of development to help inform the preparation and implementation of the strategic flood risk assessment.	
New development is resilient to predicted future changes in climate. Local planning authorities ensure that climate change is considered in strategic flood risk assessment and flood risk assessments based upon the best scientific evidence and the information requirements of planners to make informed decisions.	
New developments are designed to ensure that surface water drainage does not increase flood risk on or off site. SEPA prepares guidance for local planning authorities and developers on the use of pluvial hazard maps for land use planning purposes.	

Avoid an overall increase in flood risk	
Action	**Action ID**
New developments are designed to ensure that surface water drainage does not increase flood risk on or off site. Local planning authorities support the implementation of surface water management plans through development plan allocations and policies and ensure that surface water management plans take account of development opportunities that could contribute to the reduction of surface water flood risks.	100010300
New developments are designed to ensure that surface water drainage does not increase flood risk on or off site. SEPA engages at an early stage of the development plan process to progress exemplar projects that demonstrate the potential for land use planning to mitigate surface water flooding and contribute to wider environmental benefits.	

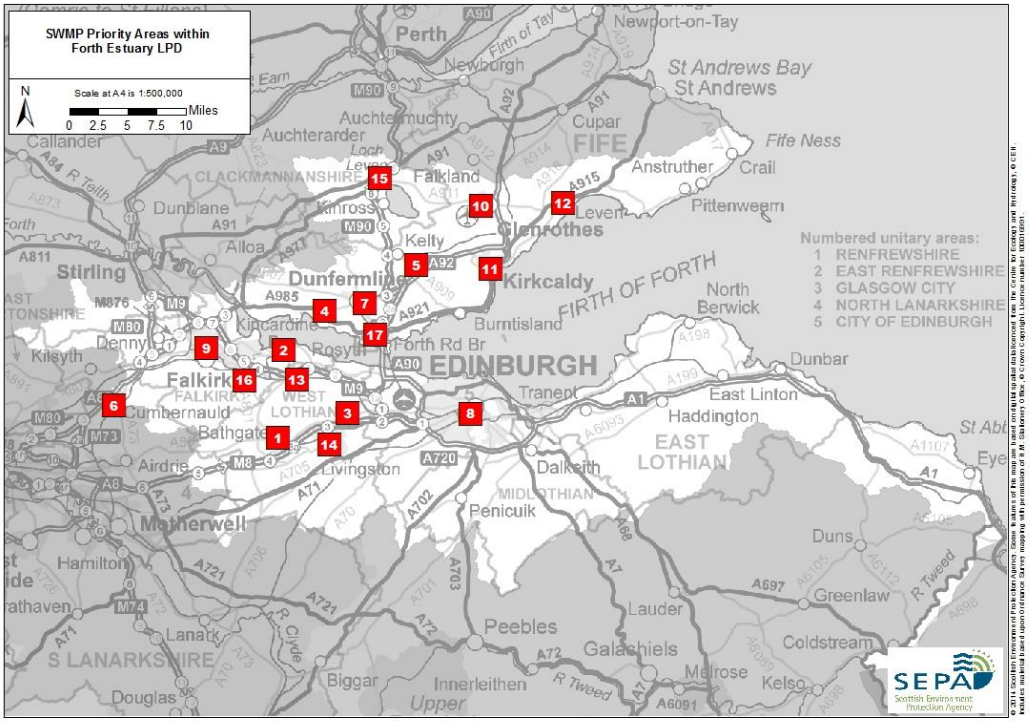
Reduce overall flood risk
Action
Reduce impacts to existing buildings. SEPA, local planning authorities and local communities engage at an early stage of the development plan process to agree the best long term land uses for areas where relocation, abandonment and/or change of use have been identified as actions in delivering sustainable flood risk management for the area. Where possible new land uses should aim to achieve multiple benefits for local communities such as the creation of blue / green infrastructure and increased resilience to climate change.
Protect and enhance natural features that have a positive impact on reducing overall flood risk. SEPA and local planning authorities will engage at an early stage of the development plan process to identify opportunities for the restoration and protection of natural features to help manage flood risk. Opportunities should be maximised to achieve multiple benefits such as the development of green and blue infrastructure and improved place making. Identify and protect areas of land that may contribute to flood management.

SURFACE WATER FLOODING OBJECTIVES AND POTENTIAL ACTIONS

Objectives for surface water flooding

The following surface water priority areas have been identified in the Forth Estuary Local Plan District. Each one has objectives set for the management of surface water flooding.

Map showing surface water priority areas



Surface water priority areas					
No.	**Surface water priority area**	**Potentially Vulnerable Area(s)**	**Local Authority**	**Objective**	**Objective ID**
1.	Bathgate	10/13 10/27	West Lothian Council	Reduce economic damages and number of residential properties at risk of surface water flooding as far as practical	10045, 10085
2.	Bo'ness, Carriden and Muirhouses	10/12	Falkirk Council	Reduce economic damages and number of residential properties at risk of surface water flooding as far as practical	10042

Surface water priority areas					
No.	**Surface water priority area**	**Potentially Vulnerable Area(s)**	**Local Authority**	**Objective**	**Objective ID**
3.	Broxburn and eastern Uphall	10/27	West Lothian Council	Reduce economic damages and number of residential properties at risk of surface water flooding as far as practical	10085
4.	Cairneyhill, Crombie and Muirside	10/06 10/07	Fife Council	Reduce economic damages and number of residential properties at risk of surface water flooding as far as practical	10017, 10023
5.	Cowdenbeath, Leuchatsbeath and Lumphinnans	10/28c	Fife Council	Reduce economic damages and number of residential properties at risk of surface water flooding as far as practical	10092
6.	Cumbernauld (east). (Cumbernauld (west) is included in the Clyde and Loch Lomond LPD)	10/11	North Lanarkshire Council	Reduce economic damages and number of residential properties at risk of surface water flooding as far as practical	10033
7.	Dunfermline, Bowershall, Crossford, Wellwood, Townhill and Halbeath	10/06	Fife Council	Reduce economic damages and number of residential properties at risk of surface water flooding as far as practical	10017
8.	Edinburgh, Musselburgh, Penicuik, Lasswade, Loanhead, Newtongrange and Dalkeith	10/16 10/17 10/18 10/19 10/20 10/21 10/22 10/27	City of Edinburgh Council, East Lothian Council, Midlothian Council	Reduce economic damages and number of residential properties at risk of surface water flooding as far as practical	10052, 10054, 10056, 10064, 10069, 10073, 10074, 10085
9.	Falkirk, Stenhousemuir and Carron	10/11	Falkirk Council	Reduce economic damages and number of residential properties at risk of surface water flooding as far as practical	10033
10.	Glenrothes and Markinch	10/04	Fife Council	Reduce economic damages and number of residential properties at risk of surface water flooding as far as practical	10008

Surface water priority areas					
No.	**Surface water priority area**	**Potentially Vulnerable Area(s)**	**Local Authority**	**Objective**	**Objective ID**
11.	Kirkcaldy and Cluny	10/05	Fife Council	Reduce economic damages and number of residential properties at risk of surface water flooding as far as practical	10100
12.	Leven and eastern Methil	10/03 10/05	Fife Council	Reduce economic damages and number of residential properties at risk of surface water flooding as far as practical	10004, 10013
13.	Linlithgow and Whitecross	10/13	West Lothian Council, Falkirk Council	Reduce economic damages and number of residential properties at risk of surface water flooding as far as practical	10045
14.	Livingston and Mid Calder	10/27	West Lothian Council	Reduce economic damages and number of residential properties at risk of surface water flooding as far as practical	10085
15.	Milnathort	10/04	Perth and Kinross Council	Reduce economic damages and number of residential properties at risk of surface water flooding as far as practical	10008
16.	Polmont and Maddiston	10/11 10/13	Falkirk Council	Reduce economic damages and number of residential properties at risk of surface water flooding as far as practical	10033, 10045
17.	Rosyth	10/10	Fife Council	Reduce economic damages and number of residential properties at risk of surface water flooding as far as practical	10024

Indicators for surface water objectives		
Potentially Vulnerable Area	**Number of residential properties at risk from surface water flooding in medium likelihood event**	**Annual average damages from surface water flooding**
10/03	160	£146,000
10/04	160	£676,000
10/05	130	£330,000
10/06	290	£882,000
10/07	60	£217,000
10/10	10	£47,900
10/11	430	£689,000
10/13	400	£1,120,000
10/16	60	£73,500
10/17	280	£154,000
10/18	1210	£1,190,000
10/19	720	£889,000
10/20	200	£391,00
10/21	50	£149,000
10/22	170	£1,080,000
10/27	450	£1,170,000

Potential actions for surface water flooding

Action	Description	Action ID
Assessment of flood risk from sewer networks	Scottish Water will carry out an assessment of flood risk from sewer networks in Potentially Vulnerable Areas where there is a risk of surface water flooding to improve knowledge and understanding of surface water flood risk. This work is ongoing and assessments are expected to be completed by 2018.	
Bathgate covered by a surface water management plan	The area must be covered by a surface water management plan or plans that set objectives for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	100452381
Bo'ness, Carriden and Muirhouses covered by a surface water management plan	The area must be covered by a surface water management plan or plans that set objectives for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	10042238
Broxburn and eastern Uphall covered by a surface water management plan	The area must be covered by a surface water management plan or plans that set objectives for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	100852381
Cairneyhill, Crombie and Muirside covered by a surface water management plan	An integrated catchment study will be carried out to improve knowledge and understanding of surface water flood risk and interactions with other sources of flooding e.g. with the sewer network, watercourses and the sea.	10023238
Cowdenbeath, Leuchatsbeath and Lumphinnans covered by a surface water management plan	The area must be covered by a surface water management plan or plans that set objectives for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	10092238
Cumbernauld (east) covered by a surface water management plan	The area must be covered by a surface water management plan or plans that set objectives for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	10033238
Dunfermline, Bowershall, Crossford, Wellwood, Townhill and Halbeath covered by a surface water management plan	The area must be covered by a surface water management plan or plans that set objectives for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	10017238
Edinburgh, Musselburgh, Penicuik, Lasswade, Loanhead, Newtongrange and Dalkeith covered by a surface water management plan	The area must be covered by a surface water management plan or plans that set objectives for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	10052238
Falkirk, Stenhousemuir and Carron covered by a surface water management plan	The area must be covered by a surface water management plan or plans that set objectives for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	100332381

Action	Description	Action ID
Glenrothes and Markinch covered by a surface water management plan	The area must be covered by a surface water management plan or plans that set objectives for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	100082381
Kirkcaldy and Cluny covered by a surface water management plan	The area must be covered by a surface water management plan or plans that set objectives for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	10100238
Leven and eastern Methil covered by a surface water management plan	The area must be covered by a surface water management plan or plans that set objectives for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	10004238
Linlithgow and Whitecross covered by a surface water management plan	The area must be covered by a surface water management plan or plans that set objectives for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	10045238
Livingston and Mid Calder covered by a surface water management plan	The area must be covered by a surface water management plan or plans that set objectives for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	10085238
Milnathort covered by a surface water management plan	The area must be covered by a surface water management plan or plans that set objectives for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	10008238
Polmont and Maddiston covered by a surface water management plan	The area must be covered by a surface water management plan or plans that set objectives for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	100452382
Rosyth covered by a surface water management plan	The area must be covered by a surface water management plan or plans that set objectives for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	10024238
Bathgate integrated catchment study	An integrated catchment study will be carried out to improve knowledge and understanding of surface water flood risk and interactions with other sources of flooding e.g. with the sewer network, watercourses and the sea.	10085239
Cumbernauld (east) integrated catchment study	An integrated catchment study will be carried out to improve knowledge and understanding of surface water flood risk and interactions with other sources of flooding e.g. with the sewer network, watercourses and the sea.	10033239
Dunfermline, Cairneyhill and Rosyth integrated catchment study	An integrated catchment study will be carried out to improve knowledge and understanding of surface water flood risk and interactions with other sources of flooding e.g. with the sewer network, watercourses and the sea.	10024239

Action	Description	Action ID
Edinburgh, Musselburgh, Lasswade, Loanhead, Newtongrange and Dalkeith integrated catchment study	An integrated catchment study will be carried out to improve knowledge and understanding of surface water flood risk and interactions with other sources of flooding e.g. with the sewer network, watercourses and the sea.	10052239
Falkirk, Stenhousemuir, Carron, Bo'ness, Carriden, Muirhouses and Polmont integrated catchment study	An integrated catchment study will be carried out to improve knowledge and understanding of surface water flood risk and interactions with other sources of flooding e.g. with the sewer network, watercourses and the sea.	100452391
Cowdenbeath, Glenrothes, Markinch, Leven and Methil integrated catchment study	An integrated catchment study will be carried out to improve knowledge and understanding of surface water flood risk and interactions with other sources of flooding e.g. with the sewer network, watercourses and the sea.	10004239
Linlithgow integrated catchment study	An integrated catchment study will be carried out to improve knowledge and understanding of surface water flood risk and interactions with other sources of flooding e.g. with the sewer network, watercourses and the sea.	10045239

FLOOD WARNING OBJECTIVES AND POTENTIAL ACTIONS

The table below shows the flood warning schemes that fall within this Local Plan District (both the existing schemes and those potential schemes under consideration). The details of the objectives and potential actions in relation to each of these are described in the pages to follow.

Existing River Flood Warning Schemes and Areas	
Almond (West Lothian)	Cramond
Braid Burn	Cameron Toll Colinton Mains Mid Liberton Portobello The Inch Park The Inch Park (Island Area)
Esk (East Lothian)	Musselburgh
Eye	Grantshouse to Eyemouth
Tyne	Haddington (Green) Haddington (Orange) Haddington (Red)
Water of Leith	Bonnington Dean Village Longstone/Stenhouse Roseburn Stockbridge Warriston
Existing Coastal Flood Warning Schemes and Areas	
Firth of Forth and Tay	Anstruther to Elie Blackness Burntisland to Aberdour Culross, Longannet and Kincardine Dunbar including West Barns Eyemouth Coastal Grangemouth Granton and Leith Kinghorn Kirkcaldy Leven and Methil Lower Largo Musselburgh Coastal North Berwick North Queensferry and Inverkeithing Bay Portobello Esplanade Prestonpans and Port Seton Rosyth, Limekilns and Charlestown Torryburn and Newmills

Potential River Flood Warning Schemes	
Areas of potential for flood warning	Broxburn and Uphall Carron and Tribs Crail Dunfermline – Lyne Burn, Tower Burn Grange Burn/Westquarter Burn Kinross Leven Niddrie Burn/Burdiehouse Burn River Ore/Kelty Burn – Bowhill u/s of Longstone – Murray Burn Whitburn – White Burn
Potential Coastal Flood Warning Schemes	
Areas of potential for flood warning	Airth coastal

Objectives for flood warning	Objective ID
Reduce overall flood risk	**10099**

Potential actions for flood warning

A strategic level assessment was undertaken to identify potential new areas for flood warning and to consider the scope for improving existing flood warning schemes. Based on this, there are five potential actions which will assess the possible development of flood warning. Once the potential actions have been assessed in each location and prioritised nationally, the most appropriate will be selected. Further details are set out below.

Develop new flood warning:
A high level assessment identified where 50 or more residential properties occurred in an area with a medium likelihood of flooding. Affected properties included those at risk of flooding as well as those impacted in other ways such as by flooded access roads. Additional areas were identified by local authorities where the knowledge of local flooding problems was more detailed. This potential action will require further local assessment.

Maintain existing flood warning:
This potential action will be assessed for all existing flood warning schemes. It will be taken forward as a preferred action if the existing scheme is the most appropriate both technically and feasibly.

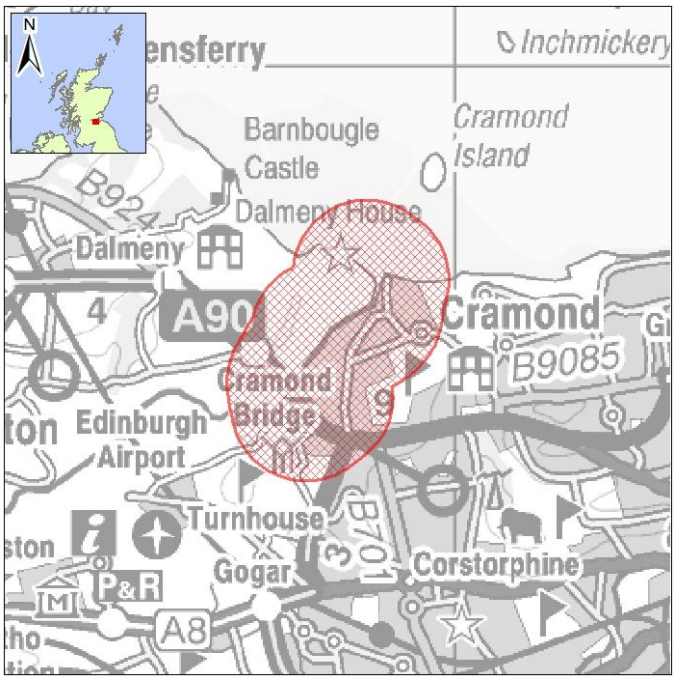
Improve existing flood warning scheme:
Existing flood warning schemes underwent a high level assessment for technical improvement. Where such improvements were deemed possible this action was included for further assessment. An improvement to a scheme could also include expansion of the scheme to include new warning areas. In order for this potential action to be accepted the costs for improvements will need to be justified based on the potential benefits.

Improve sign up of existing flood warning scheme:
SEPA aims to maximise the benefit of its flood warning service by encouraging the maximum possible sign up. Where sign up is less than 40% a targeted communications campaign may be necessary. Where any of the flood warning areas in a scheme have a sign up rate of less than 40% the action to improve sign up has been applied to the scheme. If the action is progressed, a targeted communications plan will be devised to increase sign-up rates.

Simplify existing flood warning scheme:
It may be possible, where other structural actions are being considered for an area, to simplify the process by which a flood warning is provided. The simplest type of warning scheme provides a warning when river levels exceed a pre-determined threshold. More complex warning schemes are based on interactive flood modelling. Where a flood protection scheme is built it may no longer be necessary to use interactive modelling to provide warnings; a simple warning approach may be sufficient. This action will be less appropriate where the structural actions require a warning to operate effectively.

Almond (West Lothian) River Flood Warning Scheme: potential actions

This existing flood warning scheme covers River Almond and consists of one flood warning area covering Cramond. This warning was originally established to provide the boat owners and Cramond boat club with a warning for high river levels and was originally only issued between March and October. The scheme is based on information from weather forecast from the Met Office, data from SEPA river and rain gauges and historical flood data.



Potentially Vulnerable Area

10/16, 10/17

Indicators

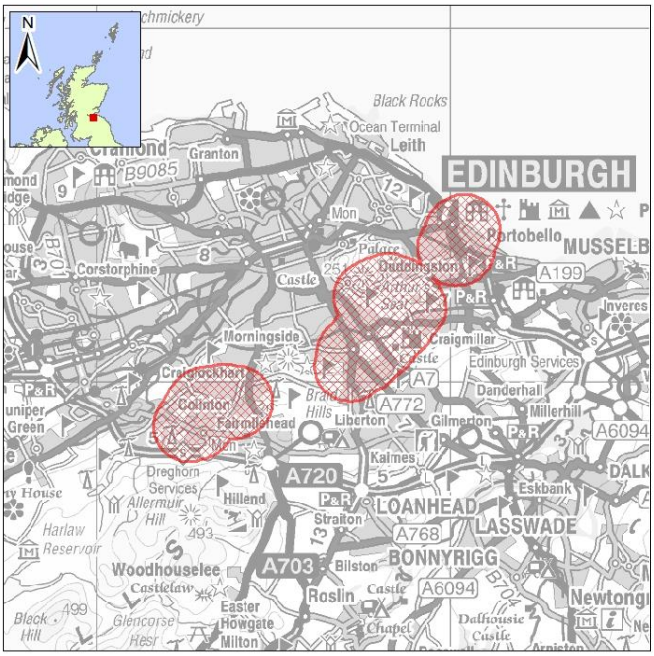
20 residential properties
£2,300 annual average damages

An initial scoping exercise was undertaken to identify the potential actions most appropriate to this flood warning scheme. The following potential actions were selected for further assessment. These will be assessed and compared and the most appropriate action selected:

Potential action	Action ID
Maintain existing flood warning	100993211810
Improve existing flood warning scheme	100993211821
Simplify existing flood warning	100993211830

Braid Burn River Flood Warning Scheme: potential actions

This existing flood warning scheme covers the Braid Burn and consists of six flood warning area covering Colinton Mains, Mid Liberton, Cameron Toll, The Inch Park, The Inch Park (Island Area) and Portobello. The scheme is based on information from the Braid Burn flood forecasting model alongside weather forecast from the Met Office, data from SEPA river and rain gauges and historical flood data. The Braid Burn flood protection scheme was completed in 2010 and there are a number of parks which are used as flood storage areas. The current flood warning messages mention that there may be water out of bank but that properties are not considered at risk. SEPA is currently undertaking a project to review and rationalise the flood warning areas in this scheme which means that they may change.



Potentially Vulnerable Area

10/19

Indicators

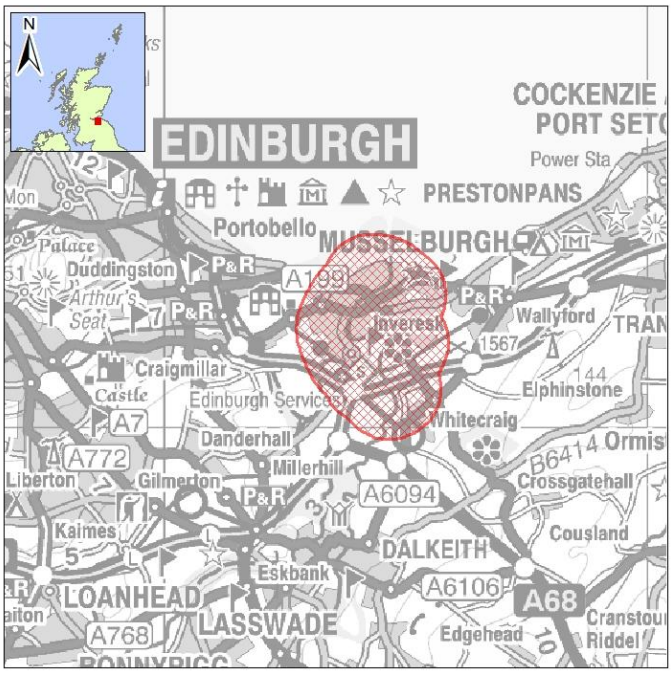
1000 residential properties
£170,000 annual average damages

An initial scoping exercise was undertaken to identify the potential actions most appropriate to this flood warning scheme. The following potential actions were selected for further assessment. These will be assessed and compared and the most appropriate action selected:

Potential action	Action ID
Maintain existing flood warning	100993231810
Improve signup of existing flood warning scheme	100993231822
Simplify existing flood warning	100993231830

Esk (East Lothian) River Flood Warning Scheme: potential actions

This existing flood warning scheme covers the River Esk in East Lothian and consists of one flood warning area covering Musselburgh.
The scheme is based on information from the SEPA river and rain gauges alongside weather forecast information from the Met Office, and historical flood data. This warning is also influenced by tide levels although there is a separate flood warning for Musselburgh Coastal.



Potentially Vulnerable Area

10/21, 10/22

Indicators

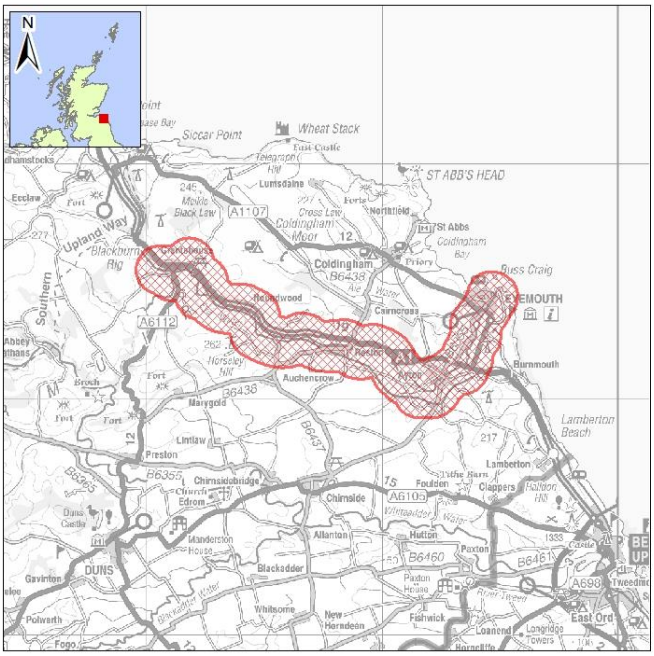
240 residential properties
£490,000 annual average damages

An initial scoping exercise was undertaken to identify the potential actions most appropriate to this flood warning scheme. The following potential actions were selected for further assessment. These will be assessed and compared and the most appropriate action selected:

Potential action	Action ID
Maintain existing flood warning	100993291810
Improve existing flood warning scheme	100993291821
Simplify existing flood warning	100993291830

Eye River Flood Warning Scheme: potential actions

This existing flood warning scheme covers the Eye Water and consists of one flood warning area covering Grantshouse to Eyemouth. The scheme is based on information from weather forecast from the Met Office, data from SEPA river and rain gauges, historical flood data and model output from the River Tweed Flood Early Warning Scheme (FEWS).



Potentially Vulnerable Area

Borders on 10/26

Indicators

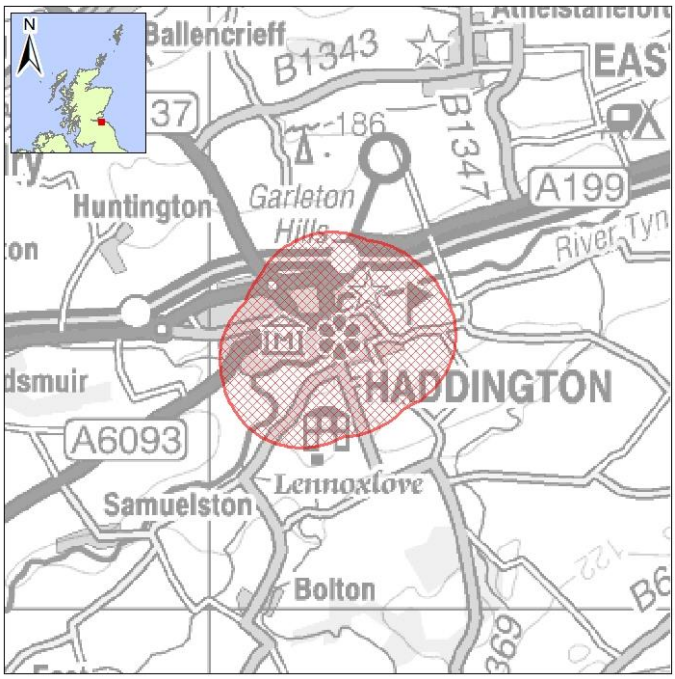
<10 residential properties
£15,000 annual average damages

An initial scoping exercise was undertaken to identify the potential actions most appropriate to this flood warning scheme. The following potential actions were selected for further assessment. These will be assessed and compared and the most appropriate action selected:

Potential action	Action ID
Maintain existing flood warning	100993311810
Improve existing flood warning scheme	100993311821
Simplify existing flood warning	100993311830

Tyne River Flood Warning Scheme: potential actions

This existing flood warning scheme covers the River Tyne and consists of three flood warning areas: Haddington (Green), Haddington (Orange) and Haddington (Red). The scheme is based on information from weather forecast from the Met Office, data from SEPA river and rain gauges and historical flood data.



Potentially Vulnerable Area

10/24

Indicators

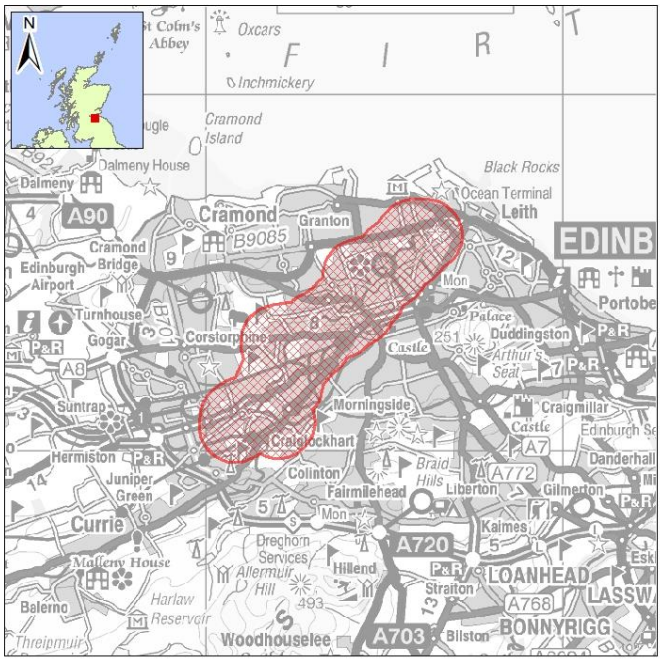
770 residential properties
£460,000 annual average damages

An initial scoping exercise was undertaken to identify the potential actions most appropriate to this flood warning scheme. The following potential actions were selected for further assessment. These will be assessed and compared and the most appropriate action selected:

Potential action	Action ID
Maintain existing flood warning	100993451810
Improve signup of existing flood warning scheme	100993451822
Simplify existing flood warning	100993451830

Water of Leith River Flood Warning Scheme: potential actions

This existing flood warning scheme covers the Water of Leith from Longstone to Bonnington and consists of six flood warning areas covering Bonnington, Dean Village, Longstone/Stenhouse, Roseburn, Stockbridge and Warriston. The scheme is based on information from weather forecast from the Met Office, data from SEPA river and rain gauges, historical flood data and model output from the Water of Leith Flood Early Warning Scheme (FEWS).



Potentially Vulnerable Area

10/18

Indicators

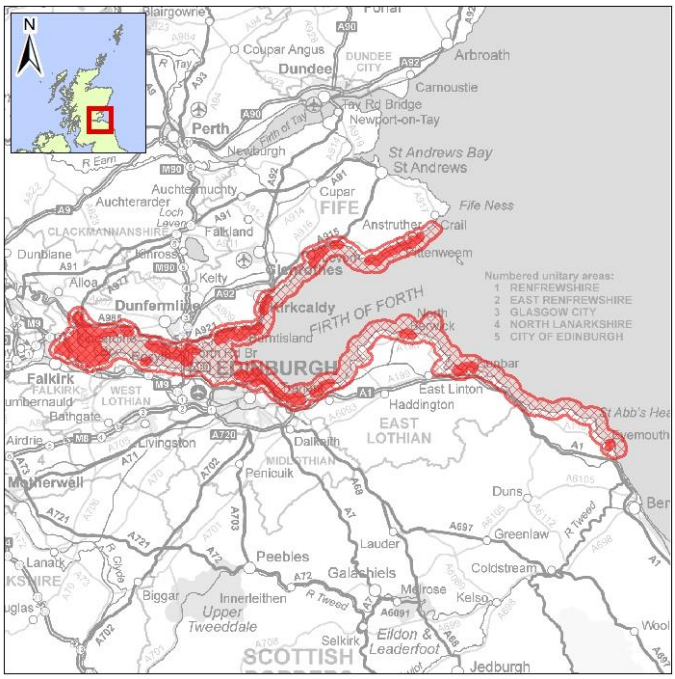
3400 residential properties
£2.4 million annual average damages

An initial scoping exercise was undertaken to identify the potential actions most appropriate to this flood warning scheme. The following potential actions were selected for further assessment. These will be assessed and compared and the most appropriate action selected:

Potential action	Action ID
Maintain existing flood warning	100993461810
Improve signup of existing flood warning scheme	100993461822
Simplify existing flood warning	100993461830

Firth of Forth and Tay Coastal Flood Warning Scheme: potential actions

This existing coastal flood warning scheme stretches from Eyemouth to Arbroath crossing more than one LPD. There are 19 flood warning areas within LPD10: Eyemouth Coastal; Dunbar including West Barns; North Berwick; Prestonpans and Port Seton; Musselburgh Coastal; Portobello Esplanade; Granton and Leith; Blackness; Grangemouth; Culross, Longannet and Kincardine; Torryburn and Newmills; Rosyth, Limekilns and Charlestown; North Queensferry and Inverkeithing Bay; Burntisland to Aberdour; Kinghorn; Kirkcaldy; Leven and Methil; Lower Largo and Anstruther to Elie. The scheme is based on information from weather forecast from the Met Office, data from SEPA coastal gauges, historical coastal flood data and model output from the Firth of Forth and Tay Flood Early Warning Scheme (FEWS).



Note: The hashed area indicates the extent of coastline covered by the flood forecasting system in this LPD. Areas where specific flood warnings are offered are shown in darker red

Potentially Vulnerable Areas

10/01, 10/02, 10/03, 10/05, 10/07, 10/08, 10/10, 10/11, 10/12, 10/17, 10/18, 10/19, 10/21, 10/23, 10/25, 10/26

Indicators

7000 residential properties (in Local Plan District 10)
£2.5 million annual average damages (in Local Plan District 10)

An initial scoping exercise was undertaken to identify the potential actions most appropriate to this flood warning scheme. The following potential actions were selected for further assessment. These will be assessed and compared and the most appropriate action selected:

Potential action	Action ID
Maintain existing flood warning	100993491810
Improve signup of existing flood warning scheme	100993491822
Simplify existing flood warning	100993491830

Potential new flood warning areas

Further information on the selection process

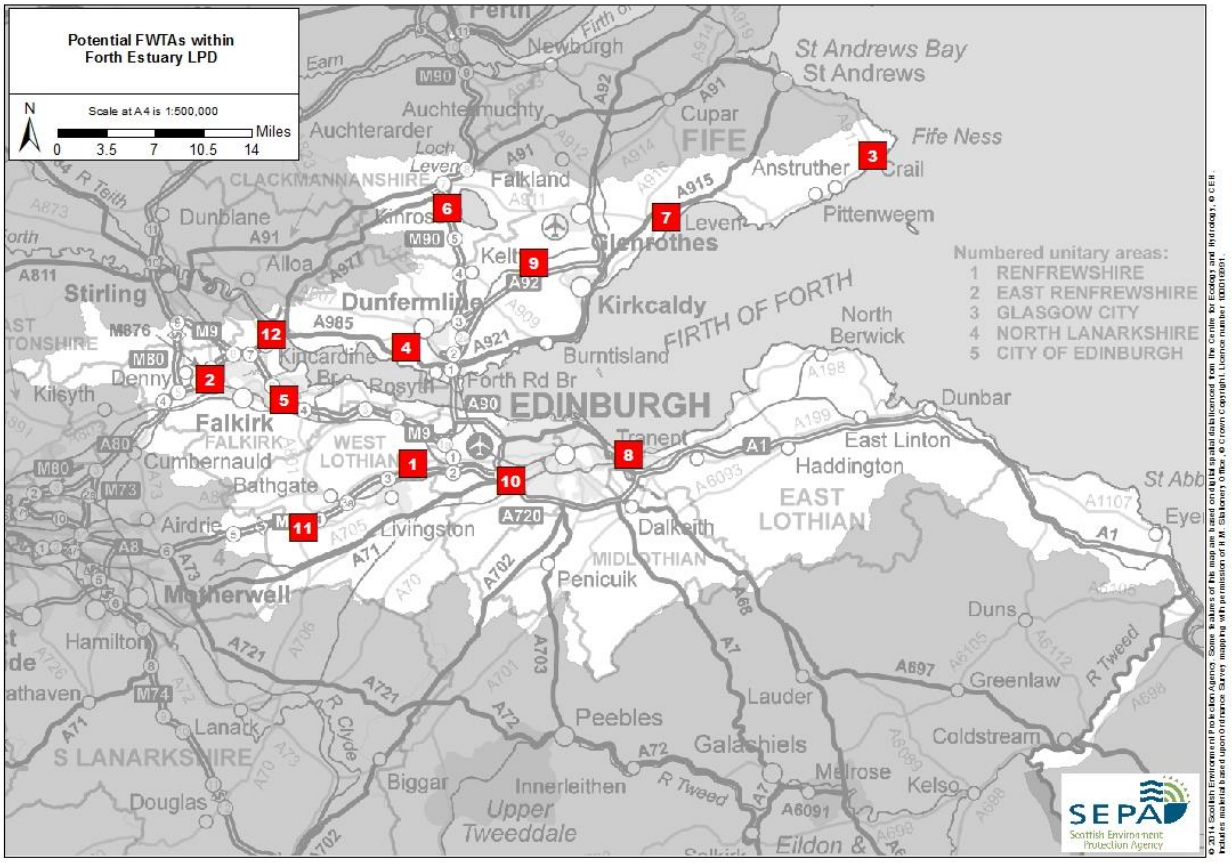
The following areas were selected using the process described under the 'Develop new flood warning' potential action. The inclusion of these areas has not taken into account where watercourses may be culverted or any overlaps in risk between river and coastal flooding. In addition the viability of offering a warning in each location has not yet been assessed so they will be subject to further screening and analysis of flooding mechanisms and technical, operational and financial feasibility. Approximate locations are shown on the map below, numbered according to the table below.

No.	Action ID	Location and Description	Indicators	Potentially Vulnerable Area
1	100994341800	Properties in Broxburn and Uphall affected by flooding from the Brox Burn.	100 residential properties £130,000 annual average damages	10/27
2	100994351800	Properties affected by flooding from the River Carron and tributaries downstream of Carron Valley Reservoir.	380 residential properties £1 million annual average damages	10/11
3	100994361800	Properties in Crail affected by flooding from the Crail Burn.	130 residential properties £240,000 annual average damages	10/01
4	100994371800	Properties in Dunfermline affected by flooding from the Lyne Burn and Tower Burn.	110 residential properties £540,000 annual average damages	10/06
5	100994381800	Properties in Falkirk affected by flooding from the Grange Burn/Westquarter Burn.	100 residential properties £150,000 annual average damages	10/11
6	100994391800	Properties in Kinross affected by flooding from the River South Queich	80 residential properties £14,000 annual average damages	10/04
7	100994401800	Properties in Leven affected by flooding from the River Leven.	20 residential properties £620,000 annual average damages	10/03

Further information on the selection process
The following areas were selected using the process described under the 'Develop new flood warning' potential action. The inclusion of these areas has not taken into account where watercourses may be culverted or any overlaps in risk between river and coastal flooding. In addition the viability of offering a warning in each location has not yet been assessed so they will be subject to further screening and analysis of flooding mechanisms and technical, operational and financial feasibility. Approximate locations are shown on the map below, numbered according to the table below.

No.	Action ID	Location and Description	Indicators	Potentially Vulnerable Area
8	100994410	Properties in Edinburgh affected by flooding from the Niddrie Burn/Burdiehouse Burn.	820 residential properties £1.1 million annual average damages	10/20
9	100994421800	Properties in Bowhill affected by flooding from the River Ore/Kelty Burn.	60 residential properties £160,000 annual average damages	10/28
10	100994431800	Properties in Edinburgh upstream of Longstone affected by flooding from the Murray Burn.	650 residential properties £690,000 annual average damages	10/18
11	100994441800	Properties in Whitburn affected by flooding from the White Burn.	140 residential properties £170,000 annual average damages	10/29
12	100994451800	Properties affected by coastal flooding at Airth	110 residential properties £580,000 annual average damages	10/09

Location of potential new flood warning areas



FORTH ESTUARY LOCAL PLAN DISTRICT

SURFACE WATER FLOODING

Surface water flooding impacts

Within the Forth Estuary Local Plan District approximately 5,400 residential properties and 2,400 non-residential properties are at risk from medium likelihood surface water floods. The Annual Average Damages caused by surface water flooding are approximately £12 million. It is estimated that 92% of properties at risk of surface water flooding are located within Potentially Vulnerable Areas.

Main urban centres and infrastructure at risk

The main urban areas at risk of surface water flooding can be seen in Table 1, which shows the number of residential properties at risk and the Annual Average Damages caused by surface water flooding. The damages include impacts to properties and roads.

Locations	Number of residential properties at risk from medium likelihood floods	Average Annual Damages
Edinburgh	2,500	£2,500,000
Linlithgow	260	£560,000
Falkirk	210	£210,000
Bo'ness	200	£440,000
Livingston	200	£380,000
Dunfermline	190	£630,000
Buckhaven-Methil-Leven	170	£170,000
Glenrothes-Markinch-Leslie	130	£340,000
Bathgate-Blackburn	110	£130,000
Broxburn	100	£130,000
Carron-Carronshore	80	£50,000
Kirkcaldy	70	£210,000
Cowdenbeath	70	£150,000
Armadale	70	£60,000
Rosyth	50	£74,000
Grangemouth	50	£62,000
Cairneyhill	50	£51,000
Musselburgh	50	£46,000
Dalkeith	40	£320,000
Newtongrange	40	£140,000
Penicuik	40	£110,000
Culross	40	£70,000
Polmont	40	£60,000
Cumbernauld	40	£60,000
Whitburn	40	£40,000
Lasswade-Bonnyrigg	30	£64,000
Burntisland	30	£40,000
Loanhead	20	£40,000
Tranent	20	£34,000
Lochore	20	£27,000
Larbert-Stenhousemuir	20	£24,000
Cardenden-Auchterderran-Bowhill	20	£24,000

Locations	Number of residential properties at risk from medium likelihood floods	Average Annual Damages
Bonnybridge-Banknock	20	£20,000
Denny-Dunipace	10	£46,000
Haddington	10	£32,000
Kinross	10	£28,000
Milnathort	10	£11,000

Table 1: Main urban areas with a medium likelihood of surface water flooding

The highest risk areas have been identified as priority areas for surface water management. These priority areas were identified using SEPA modelling, evidence from surface water floods and more detailed modelling held by the local authorities where available. The priority areas are shown in Table 2.

Priority Areas for Surface Water Management	Potentially Vulnerable Areas	Local Authorities
Bathgate	*10/13, 10/27*	*West Lothian council*
Bo'ness *including Carriden, Muirhouses,*	*10/12*	*Falkirk council*
Broxburn*, including Eastern Uphall*	*10/27*	*West Lothian council*
Cairneyhill *including Crombie and Muirside*	*10/06, 10/07*	*Fife council*
Cowdenbeath *including Leuchatsbeath and Lumphinnans*	*N/A*	*Fife council*
Cumbernauld (East) *Cumbernauld (West) is in the Clyde and Loch Lomond LPD (PVA 11/04)*	*10/11*	*North Lanarkshire council*
Dunfermline *including Bowershall, Crossford, Wellwood, Townhill and Halbeath*	*10/06*	*Fife council*
Edinburgh *including, Musselburgh, Penicuik, Lasswade, Loanhead, Newtongrange and Dalkeith*	*10/16, 10/17, 10/18, 10/19, 10/20, 10/21, 10/22, 10/27*	*City of Edinburg council, East Lothian council, Midlothian council*
Falkirk *including Stenhousemuir and Carron*	*10/11*	*Falkirk council*
Glenrothes *including Markinch*	*10/04*	*Fife council*
Kirkcaldy *including Cluny*	*10/05*	*Fife council*
Leven *including Eastern Methil*	*10/03, 10/05*	*Fife council*
Linlithgow *including Whitecross*	*10/13*	*Falkirk council, West Lothian council*
Livingston *including Mid Calder*	*10/27*	*West Lothian council*
Milnathort	*10/04*	*Perth and Kinross council*
Polmont *including Maddiston*	*10/11, 10/13*	*Falkirk council*
Rosyth	*10/10*	*Fife council*

Table 2: Priority areas for surface water management

Within the Local Plan District approximately 630 infrastructure assets and community facilities are at risk from medium likelihood surface water floods. Approximate numbers are outlined below.

Utility Assets	370 electricity substations
	30 mineral and fuel extraction sites
	<10 telecommunications sites
	<10 power stations
Community Facilities	20 schools
	<10 healthcare facilities
	<10 cultural institutes
Transport Routes	181 Roads (of which; 5 Motorways are affected at 280 locations, 68 A Roads are affected at 2,000 locations, 108 B Roads are affected at 1,200 locations)
	9 Railway routes • Berwick-upon-Tweed to Edinburgh affected at 80 locations • Carmuirs Junction to Polmont Junction affected at 15 locations • Carstairs to Edinburgh affected at 60 locations • Drumgelloch to Newbridge Junction affected at 45 locations • Dunblane to Larbert / Stirling affected at 15 locations • Edinburgh to Glasgow Queen Street affected at 90 locations • Fife Circle, Dalmeny to Winchburgh and Haymarket West Junctions affected at 110 locations • Mid Calder Junction to Holytown Junction affected at 50 locations • Perth to Ladybank (affected at 10 locations)
	Edinburgh Airport
	Fife Airport

Economic activity

The Annual Average Damages caused by surface water flooding in the Forth Estuary Local Plan District are approximately £12 million. This consists of approximately:

- 39% Roads (£4,700,000)
- 32% Residential properties (£3,830,000)
- 26% Non-residential properties (£3,200,000)
- 3% Emergency services (£400,000)
- <1% Vehicles (£120,000).

Economic damages to airports and rail were not assessed as information on damages at a strategic scale is not available. Out of the economic damages assessed, the highest damages in the Local Plan District are to roads, of which the the M9 and the Edinburgh City Bypass are significantly affected. Figure 1 shows the distribution of Annual Average Damages throughout the Local Plan District. High damages can be seen in Edinburgh due to the number of residential and non-residential properties. High damages can also be seen in Dunfermline, largely due to the number of non-residential properties affected.

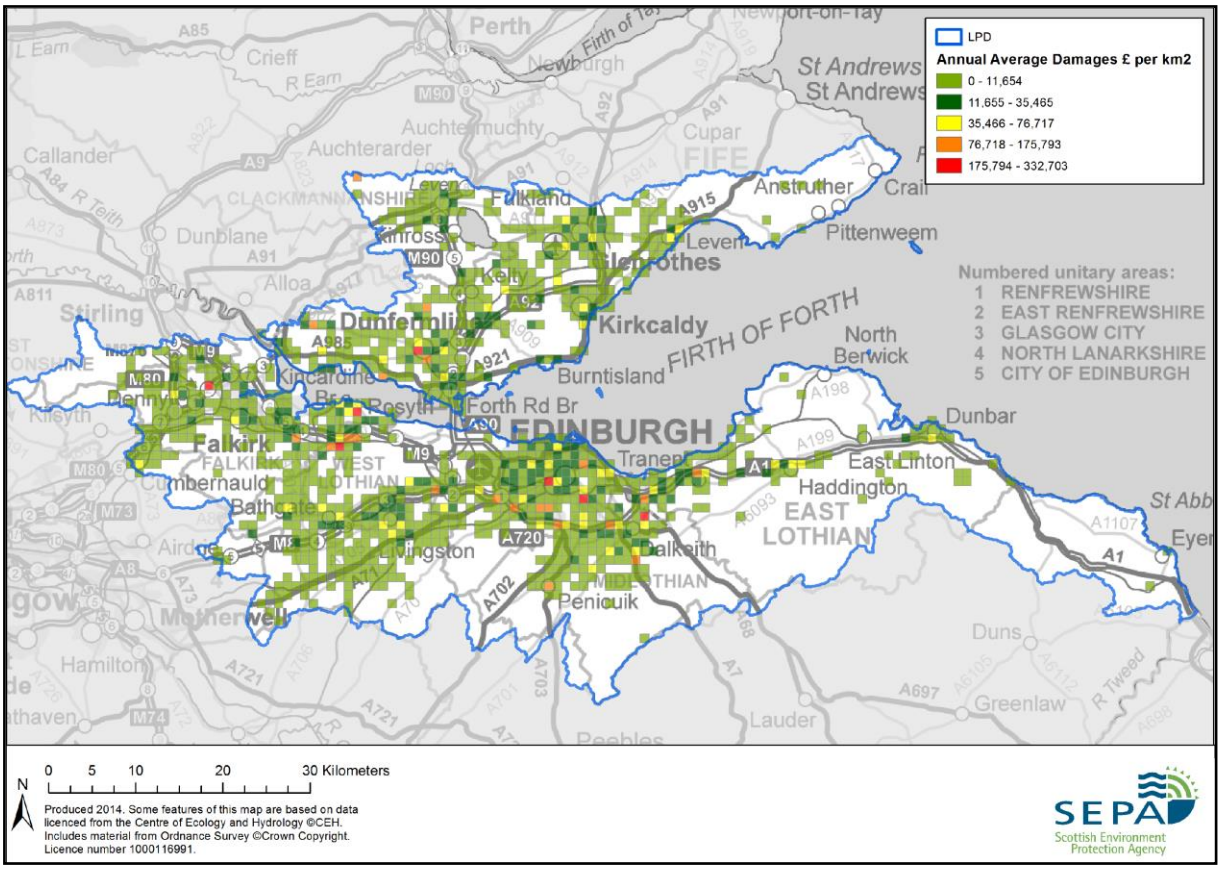


Figure 2: Annual Average Damages from surface water flooding

History of surface water flooding

The following surface water floods have been identified as significant by local authorities and SEPA. This list is not exhaustive:

- 25 July 2013, Eyemouth: Flooding in Albert Road, Church Street and Harbour Road to both residential and commercial property.
- 28 June 2012, Eyemouth: Flooding in Albert Road, Church Street and Harbour Road to both residential and commercial property.
- 8 July 2011, Edinburgh: Flooding of homes and businesses in Edinburgh. Balcarres Street in Morningside was identified as the area worst affected area with around 20 residential and 3 commercial properties flooding, (the majority of the 20 residential properties were tenement buildings and only the ground floor properties have been counted). Four properties were also affected from this flooding event at Greenbank Road.
- 6 July 2009, Milnathort: Heavy rain caused surface water flooding in areas of Fife and Perth and Kinross, including Milnathort.
- 5 December 2008, Pencaitland: Occupants were evacuated from Huntlaw Road.
- 8 to 14 August 1948, Eyemouth: Low-lying areas of Eyemouth flooded by surface water flowing down Northburn Road.

Sites of cultural importance at risk of surface water flooding

Within the Local Plan District approximately 260 cultural heritage sites are at risk from medium likelihood surface water floods. This includes approximately 160 Scheduled Monuments, 90 Gardens and Designated Landscape sites, less than 10 World Heritage Sites and 10 Battlefield sites.

Managing surface water flood risk

Many organisations work together to manage flood risk. Individuals also have a responsibility for taking action to protect themselves and their property from flooding. Further information on the roles of different organisations in flood risk management and details on what individuals or businesses can do to prepare for flooding can be found in the leaflet Prepare for flooding - a guide for residents and businesses available on the SEPA website (www.sepa.org.uk).

Actions to manage surface water flood risk in the Forth Local Plan District are described below.

Flood protection schemes

There are no formal flood protection schemes for the management of surface water flooding in the Forth Local Plan District.

Details of other structures that help to reduce the impact of surface water flooding are listed in the Appendix in Table A1.

Awareness raising campaigns & community flood action groups

SEPA and the local authorities work closely with many other organisations that have flooding related duties. These include the police, fire & rescue services, the Scottish Government, Scottish Flood Forum and the Tweed Forum. SEPA and the local authorities, often in partnership with these organisations, undertake various awareness raising campaigns that include community events, information leaflets, educational plays in schools, the use of social media and advertising.

In addition the following community groups that help with flood resilience operate within the Forth Estuary Local Plan District:

- East Lothian Tenants and Residents Panel.
- Eyemouth community resilience group.
- Friends of River Tyne.
- Musselburgh and Inveresk Community Council.
- St Abbs community resilience group.
- Various local community councils operate throughout the East Lothian Council district.
- Perth and Kinross Council are part of a wider community resilience group which works with various communities including Milnathort to develop community resilience plans.

Property level protection

Local authorities have their own policies and practice regarding property level protection. Contact your local authority or view their website for more information.

The following incentives or subsidies have been put in place to provide property owners with property level protection:

- The City of Edinburgh Council has issued properties on Balcarres Street with door and vent floor guards.
- The City of Edinburgh Council store sandbags at key Fire Stations.
- East Lothian Council strategically deploy temporary flood barriers and sand bags when properties are threatened by flooding.
- Fife Council have installed flood pods containing flood sacks and flood snakes close to areas close to flood affected properties.
- Perth and Kinross Council are currently working towards introducing a pilot project for flood protection products for properties in flood risk areas.
- Scottish Borders Council operate a subsidised flood protection products scheme for residential and non-residential property owners in flood risk areas.
- Scottish Borders Council has provided and maintains dedicated sandbag stores in areas of flood risk to ensure sandbags are available to the public in the event of a flood.
- West Lothian Council provide 'Aquasacs' which are stored at key Fire Stations through the council area.

Surface water management studies

Scottish Water, in partnership with local authorities, are undertaking two Integrated Catchment Studies to address surface water and other sources of flooding within the following areas:

- Edinburgh and Lothians Integrated Catchment Study, in partnership with the City of Edinburgh Council, East Lothian Council and Midlothian Council. The study covers a wide geographical area including; Edinburgh, Dalkeith, Musselburgh and Port Seton.
- Falkirk Integrated Catchment Study, in partnership with Falkirk Council. The study covers a wide geographical area including; Falkirk, Grangemouth and Bo'ness.

Other studies relating to surface water management include:

- Milnathort Surface Water Investigation (Atkins), Perth and Kinross Council.
- Scottish Water investigation into the mitigation of the risk of sewer flooding in Milnathort (ongoing).
- Pluvial Screening Study (Jacobs, June 2010) - screening study of Edinburgh City Council area, City of Edinburgh Council.

Climate change and future flood risk

UK Climate Projections (UKCP09) predicts future climate change may lead to warmer and drier summers, warmer and wetter winters with less snow, and more extreme temperature and rainfall. The surface water flood modelling which was undertaken considered climate change scenarios with a 20% increase in rainfall intensity.

For the medium likelihood plus climate change scenario it is estimated that the number of residential properties at risk of surface water flooding may increase from approximately 5,400 to 9,900 and the number of non-residential properties from approximately 2,400 to 4,400. With future impacts of climate change considered, new surface water flood risk may arise in Gorebridge where currently there is estimated to be a very low risk of surface water flooding.

Links with river basin planning

There are 17 urban areas identified as priorities to produce surface water management plans in the Forth Estuary Local Plan District. Links with river basin management planning and opportunities for delivering multiple benefits will be identified as part of this planning process. Fourteen of these urban areas have water bodies that are less than good status for water quality (although multiple factors could be contributing to this), and 10 due to loss or damage to habitat. There are also four bathing waters not in sufficient condition due to a combination of urban diffuse pollution and sewer or surface water overflows in high intensity rainfall events. These are Fisherrow West, Kinghorn (Harbour), Kirkcaldy (Seafield) and Portobello West. Actions to manage flooding identified through the surface water management plans might also be able to provide improvements to the status of these water bodies.

Scottish Water has identified six sewerage catchments in this Local Plan District to undertake integrated catchment studies by 2021. These studies will help inform where there may be opportunities for actions that reduce the risk of surface water flooding and improve water quality.

Appendix – Further information on existing actions

Location	Structure	Description	Owned and/or maintained by
Edinburgh	Braid Burn flood prevention scheme	Redford to Portobello - Not a measure for surface water flooding, but has implications for management	City of Edinburgh Council
Edinburgh	Water of Leith flood prevention Scheme phase 1	Stockbridge to Bonnington - Not a measure for surface water flooding, but has implications for management	City of Edinburgh Council
Gogarburn underpass	Gogarburn pumping station	Road drainage pumping station	City of Edinburgh Council
Edinburgh	Greenbank Crescent	Reprofiling of Greenbank Crescent to redirect surface water flooding into the Braid Burn	City of Edinburgh Council
Macmerry	Macmerry West Railway Walk Attenuation System	Detention Basin and Geo-cellular Storage Units	East Lothian Council
Any location	Temporary flood barrier	East Lothian council temporary flood barriers can deployed anywhere.	East Lothian Council
Grangemouth, Grange Burn	Grange Burn Flood Prevention Scheme	Raised embankments and flood relief channel constructed under the 1961 Act to contain and re-direct flows from two burns towards the River Avon	Falkirk Council
Glensburgh Road, Grangemouth	Pump installation	Pump is on a surface water drain and operated during periods of high tide, when flap valve is closed, to discharge surcharge to the River Carron	Falkirk Council
Lasswade	Temporary flood barrier	Proprietary temporary Pallet Barrier, covering School Green, Lasswade	Midlothian Council
Kinross	Bund and Wall at Myre Terrace	Prevents surface water flowing from the Myre Park and into Myre Terrace and Smith Street.	Perth & Kinross Council

Table A1: Structures that contribute to the management of surface water flooding

FORTH ESTUARY LOCAL PLAN DISTRICT

RIVER FLOODING: ALMOND AND EDINBURGH GROUP CATCHMENT

The Almond and Edinburgh Group catchment covers an area of 930km^2. The main watercourses within the catchment are Water of Leith, Braid Burn, River Esk, Niddrie Burn, River Almond, Brox Burn and Gogar Burn. There are 8 Potentially Vulnerable Areas and 1 candidate Potentially Vulnerable Area in this catchment group (Figure 1).

River flooding impacts

Within the Almond and Edinburgh catchment group approximately 5,700 residential properties and 630 non-residential properties are at a medium likelihood of river flooding. The Annual Average Damages caused by river flooding in the catchment group are estimated to be approximately £10.0 million. It is estimated that 97% of residential and non-residential properties at a medium likelihood of river flooding are located within the Potentially Vulnerable Areas.

Main urban centres and infrastructure at risk

The main urban areas with a medium likelihood of river flooding can be seen in Table 1. The table shows the number of residential properties at risk and the Annual Average Damages caused by river flooding. This includes damages to residential properties, non-residential properties, transport and agriculture.

Locations	Number of residential properties with a medium likelihood of flooding	Annual Average Damages
Edinburgh	4,000	£5,600,000
Musselburgh	1,300	£2,700,000
Whitburn	140	£180,000
Broxburn	120	£210,000
Harthill	20	£63,000
Dalkeith and Newbattle	10	£21,000
Bathgate and Blackburn	<10	£19,000
West Calder	<10	£12,000
East Calder	<10	£11,000
Lasswade and Bonnyrigg	<10	£9,000
Penicuik	<10	£2,000
Kirkliston	<10	£1,000
Livingston	<10	<£1,000

Table 1: Main urban areas with a medium likelihood of river flooding

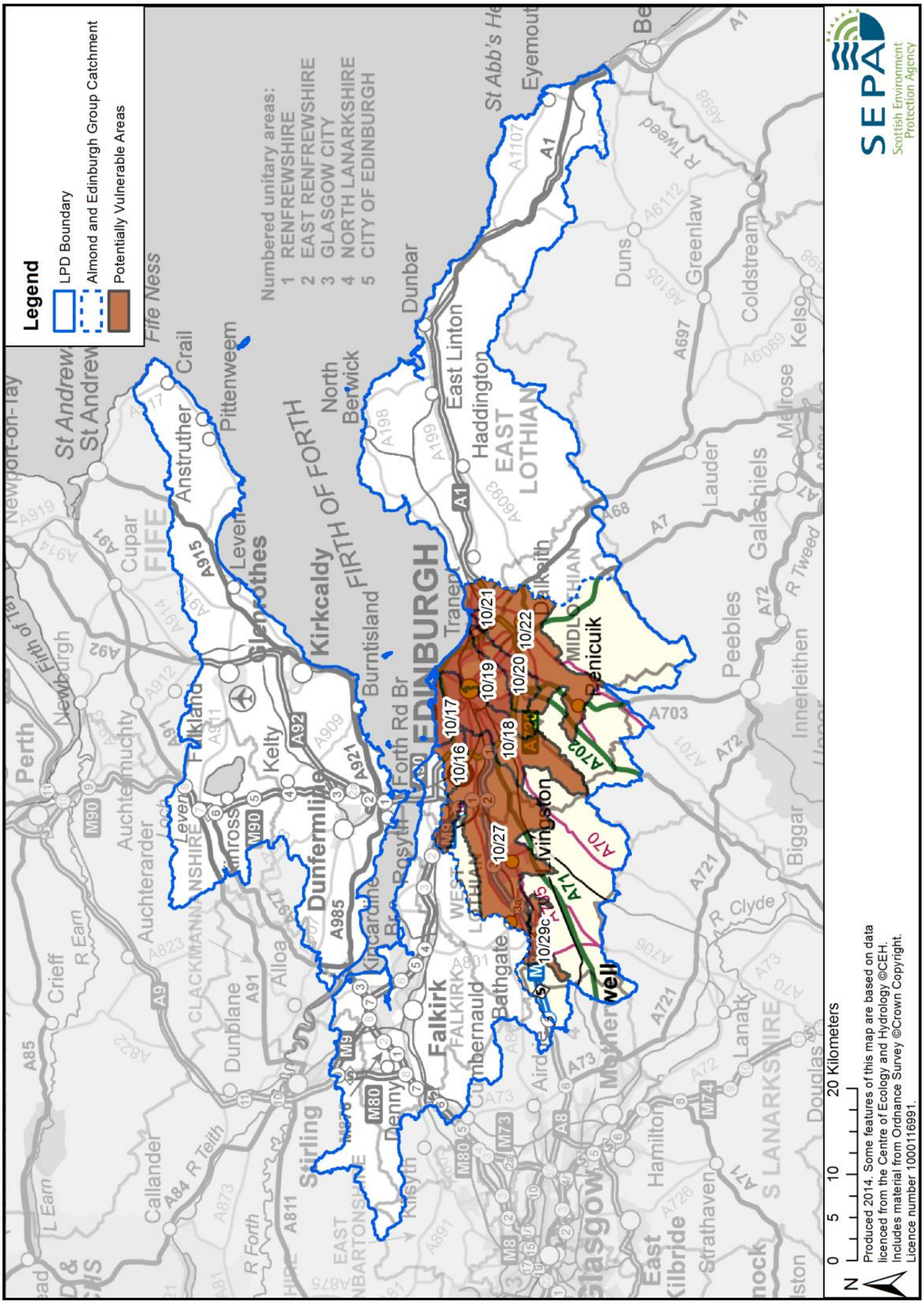


Figure 1: The Almond and Edinburgh group catchment

Within the catchment there are utility assets, community facilities and transport routes at a have a medium likelihood of river flooding. Approximate numbers are outlined below:

Utility assets:

- 40 electricity substations
- <10 mineral and fuel extraction sites

Community facilities

- <10 emergency service sites
- <10 schools and nurseries
- <10 care centres/homes

Transport routes:

- Roads
  - 2 Motorways (M8 and M9) affected at 25 locations
  - 26 A roads, affected at 186 locations
  - 25 B roads, affected at 84 locations

- Railway routes
  - Berwick-upon-Tweed to Edinburgh (4 locations at risk)
  - Carstairs to Edinburgh (10 locations at risk)
  - Drumgelloch to Newbridge Junction (2 locations at risk)
  - Edinburgh Waverly to Glasgow Queen Street (8 locations at risk)
  - Fife Circle, Dalmeny to Winchburgh and Haymarket West Junctions (7 locations at risk)
  - Midcalder Junction to Holytown Junction (8 locations at risk)

- Airports:
  - Edinburgh Airport

Economic activity

The Annual Average Damages caused by river flooding are estimated to be approximately £10.0 million. This consists of:

- 63% residential properties (£5,000,000 direct damages, £1,300,000 indirect damages)
- 26% non-residential properties (£2,600,000 direct damages)
- 5% emergency services (£500,000 indirect damages)
- 4% vehicles (£450,000 direct damages)
- 1% roads (£80,000 direct damages)
- 1% agriculture (£70,000 direct damages).

Out of the economic damages assessed, the highest damages in the catchment is to residential properties followed by damages to non-residential properties.

Figure 2 shows the Annual Average Damages throughout the catchment group. Highest damages can be seen around the Musselburgh area. This is due to combination of high density areas of non-residential and residential property which are at medium risk of flooding from the River Esk. High damage figurescan also be seen in the Murrayfield area of Edinburgh due to a combination of scattered non-residential property and high number of residential property.

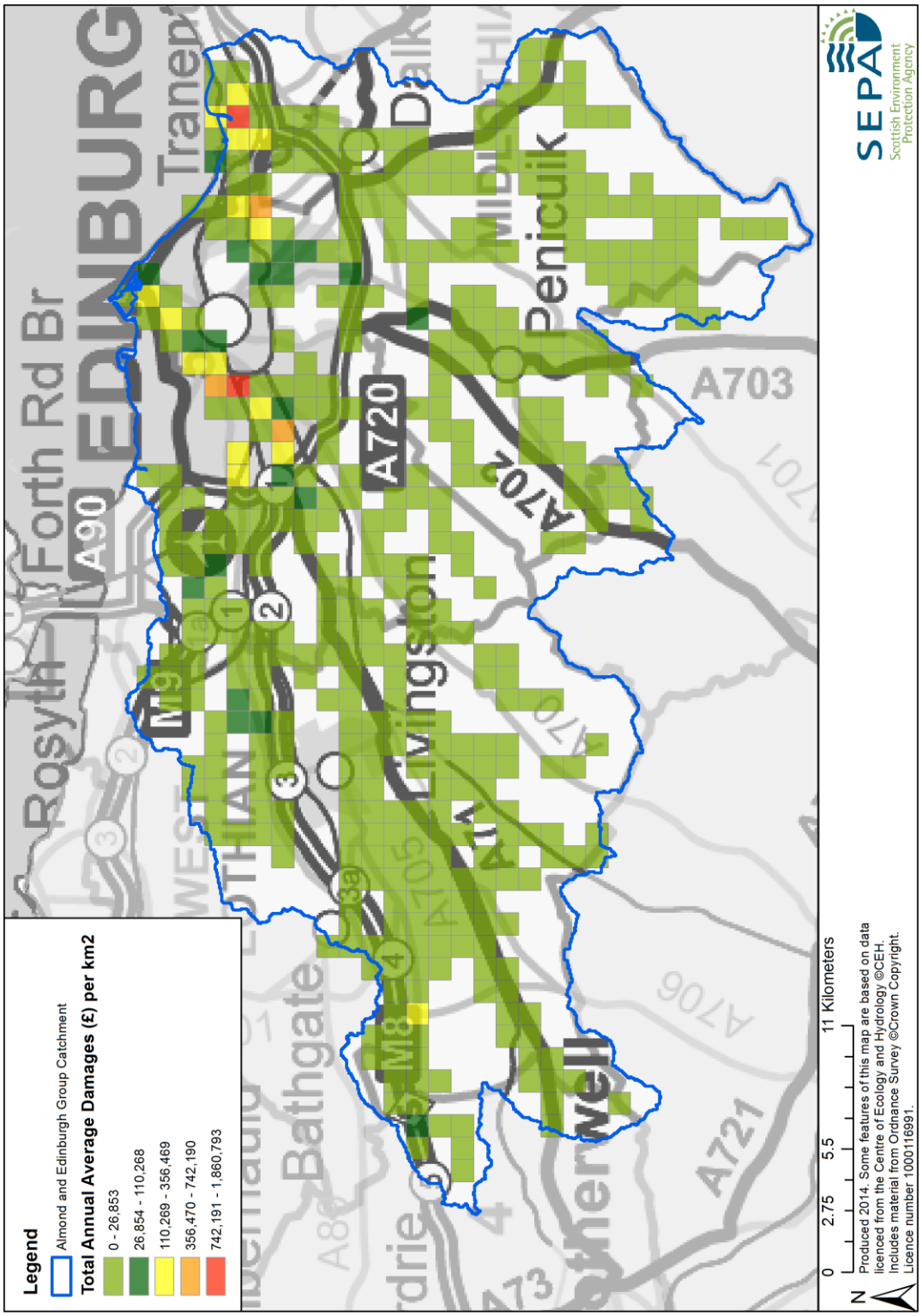


Figure 2: Annual Average Damages from river flooding

History of river flooding

The most significant river flooding event from the Water of Leith is believed to have occurred in August 1907 with water levels reported to be as deep as 6 feet in the Roseburn area of Edinburgh. The most significant river flooding event from the River Esk is believed to have occurred in August 1948 with severe flooding to Musselburgh causing evacuation of many areas of the town. The highest river level recorded at the SEPA gauging station on the River Almond at Whitburn was in December 1994, where the river levels reached 2.25m above Ordnance Datum.

Other significant historical flood events in the Almond and Edinburgh catchment include:

- 20 August 2008: Over 100 properties and at least 5 businesses flooded in Broxburn after over topping for the Brox Burn caused extensive damage in the area (specifically Webster Court, Badgers Park, West Main Street, New Holygate, Ashbank Cottages, Parkwood Gardens, Station Road/West Burnside and within Burnvale Village)
- 2004 and 2005: A series of flood events in Broxburn eventually led to the promotion of the Broxburn Flood Prevention Scheme
- 8 November 2000: Water of Leith, River Almond, Braid Burn and Gogar Burn flooded causing the collapse of boundary walls at Saughton, Balgreen, Stockbridge, Warriston and Bonnington. Over 500 properties innundated, including Murrayfield Statium, Murrayfield Ice Rink and 2 residential care homes. High water levels also caused flooding at Edinburgh Airport and Kirkliston
- 26 April 2000: Areas from Colinton to Portobello flooded from Braid Burn to an estimated depth of greater than 2m in some areas
- 6 October 1990: Flooding on the Water of Leith and River Esk resulted in a peak flow of approximately 90 m^3/s. Flooding known to have occurred in multiple locations with the Roseburn area. Musselburgh was also affected by flooding from the River Esk
- 3 November 1984: Flooding on the Water of Leith resulted in the innundation of two sheltered housing schemes. The Saughton and Roseburn areas were worst affected. Estimated 30 year return period
- 13 August 1948: Evacuation required in Musselburgh after flooding occurred from River Esk in Eskside West, Eskside East, Shorthope Street, Millhill and areas of the High Street. Water levels were recorded at 7.47m above Ordnance Datum at Inveresk Mill
- 17 August 1920: Water of Leith flooded Roseburn Park area of Edinburgh which was reported to be under six feet of water
- 18 January 1909: All the rivers in the southern and central counties of Scotland were in high flood with much of the resulting damage affecting property and livestock at Bathgate
- 15 October 1907: Water levels on the Water of Leith at Curie were1.5m above normal levels resulting in the flooding of Woodhall Paper Mill at Juniper Green. Flooding retained at Cannonmill due to retaining walls. However, it overtopped at Warriston Green causing road closures
- 1 February 1884: Overtopping on the River Almond resulted in large areas of flooding in Whitburn
- 8 October 1832: Reports of areas being inundated for three days at Slateford, Canonmills and Warriston in Edinburgh due to heavy rains and overtopping on the Water of Leith.

Areas of environmental and cultural importance at risk of flooding

Within the catchment approximately 51 cultural heritage sites a medium likelihood of river flooding, consisting of 20 Scheduled Monuments, 28 Gardens and Designated Landscapes, 2 Battlefield Sites and 1 World Heritage Site.

It is estimated that approximately 21 environmental protected sites are at a medium likelihood of river flooding. This includes 3 Special Protection Areas and 18 Sites of Special Scientific Interest.

Managing flood risk across the catchment

Many organisations work together to manage flood risk. Individuals also have a responsibility for taking action to protect themselves and their property from flooding. Further information on the roles of different organisations in flood risk management and details on what individuals or businesses can do to prepare for flooding can be found in the leaflet 'Prepare for flooding - a guide for residents and businesses' available on the SEPA website www.sepa.org.uk .

Existing actions that are in place to manage river flood risk in the Local Plan District are described below.

Flood protection schemes

There are four formal flood protection schemes including:

- Polton Road Bridge Relief Culvert Flood Prevention Scheme (Bilston Burn) – Construction of flood relief culvert crossing under C53 public road. Located immediately upstream of existing small span masonry arch bridge. Protection for up to 7 properties, boundary walls and C53 public road, when watercourse backs up from arch bridge. Design Standard of Protection is 1 in 100 years.

- Braid Burn Flood Prevention Scheme, Edinburgh (2003) – The scheme is designed to mitigate flooding of the Braid Burn and to protect residential and commercial property. Operations include the improvement and replacement of culverts and bridges, new embankments, flood walls, strengthening of existing defences, completed in 2010. Design Standard of Protection is 1 in 200 years plus 12% climate change.

- Water of Leith in Roseburn, Edinburgh (1984) – Scheme to protect Roseburn area of Murrayfield. Design Standard of Protection was originally 1 in 100 years, however the scheme is now currently providing protection of between 1 in 50 to 1 in 100 years.

- Water of Leith Flood Prevention Scheme, Edinburgh (2003) – The scheme at phase 1 involved the construction of defence walls and embankments within Stockbridge, Bonnington, Vietch's Square and Warriston. Design Standard of Protection is 1 in 200 years plus 12% climate change to 2054. Phase 2, which includes the protection of Murrayfield and Roseburn as part of the complete Water of Leith Scheme, has been confirmed by the Scottish Government and construction is due to start in 2014.

- Water of Leith (advanced works, 2010) – Reservoir works under the Water of Leith Scheme to Harperrig (July 2008) and Treipmuir/Harlow.

- Broxburn Flood Prevention Scheme (2007) - The scheme is designed to protect approximately 50 residential and 20 commercial properties in the town of Broxburn from the Brox Burn and its tributaries. Operations include the construction of flood defence walls and embankments, improved debris management system, channel conveyance improvements and replacement of vehicle and pedestrian bridges. Scheme was substantially completed in January 2014. Design Minimum Standard of Protection is 1 in 75 years plus 20% climate change allowance.

In addition to formal flood protection schemes, other actions may exist that reduce the risk of river flooding. This may include other structures and natural features. These other actions can been seen in the Appendix in Table A1.

Planned flood protection schemes

The following areas are where the local authority has undertaken a detailed study to identify preferred actions to manage flood risk. These actions are likely to be constructed as a formal flood protection scheme under the Flood Risk Management (Scotland) Act 2009.

- Water of Leith (phase 2) – Timescales for implementing the Water of Leith phase 2 flood protection scheme will be set out in the local flood risk management plan.

River flood warning schemes

SEPA's Floodline service provides flood alerts and flood warnings throughout Scotland to the public and to organisations that have flooding related duties.

Flood Alerts are issued over wide geographical areas (normally matching local authority boundaries) using information from the Met Office to determine if flooding is possible. Where SEPA has a river or coastal flood monitoring system, flood warnings can be issued for a more specific local area.

There are fourteen river flood warning target areas within this catchment as shown in Table 2 and Figure 3. Table 2 shows the total number of properties in the flood warning target area and the percentage of those properties that have signed up to receive flood alerts and flood warnings. Please note that this is not the number of properties at risk of flooding.

Flood warning target area (FWTA)	River	Number of properties within FWTA	% of properties registered – July 2013
Bonnington	Water of Leith	228	33%
Cameron Toll	Braid Burn	56	2%
Colinton Mains	Braid Burn	574	12%
Cramond	River Almond	33	42%
Dean Village	Water of Leith	150	26%
Longstone/Stenhouse	Water of Leith	402	20%
Mid Liberton	Braid Burn	49	18%
Musselburgh	River Esk	339	79%
Portobello	Braid Burn	230	13%
Roseburn	Water of Leith	871	35%

Flood warning target area (FWTA)	River	Number of properties within FWTA	% of properties registered – July 2013
Stockbridge	Water of Leith	636	41%
The Inch Park	Braid Burn	232	15%
The Inch Park (Island Area)	Braid Burn	50	8%
Warriston	Water of Leith	1,117	23%

Table 2: Flood warning target areas

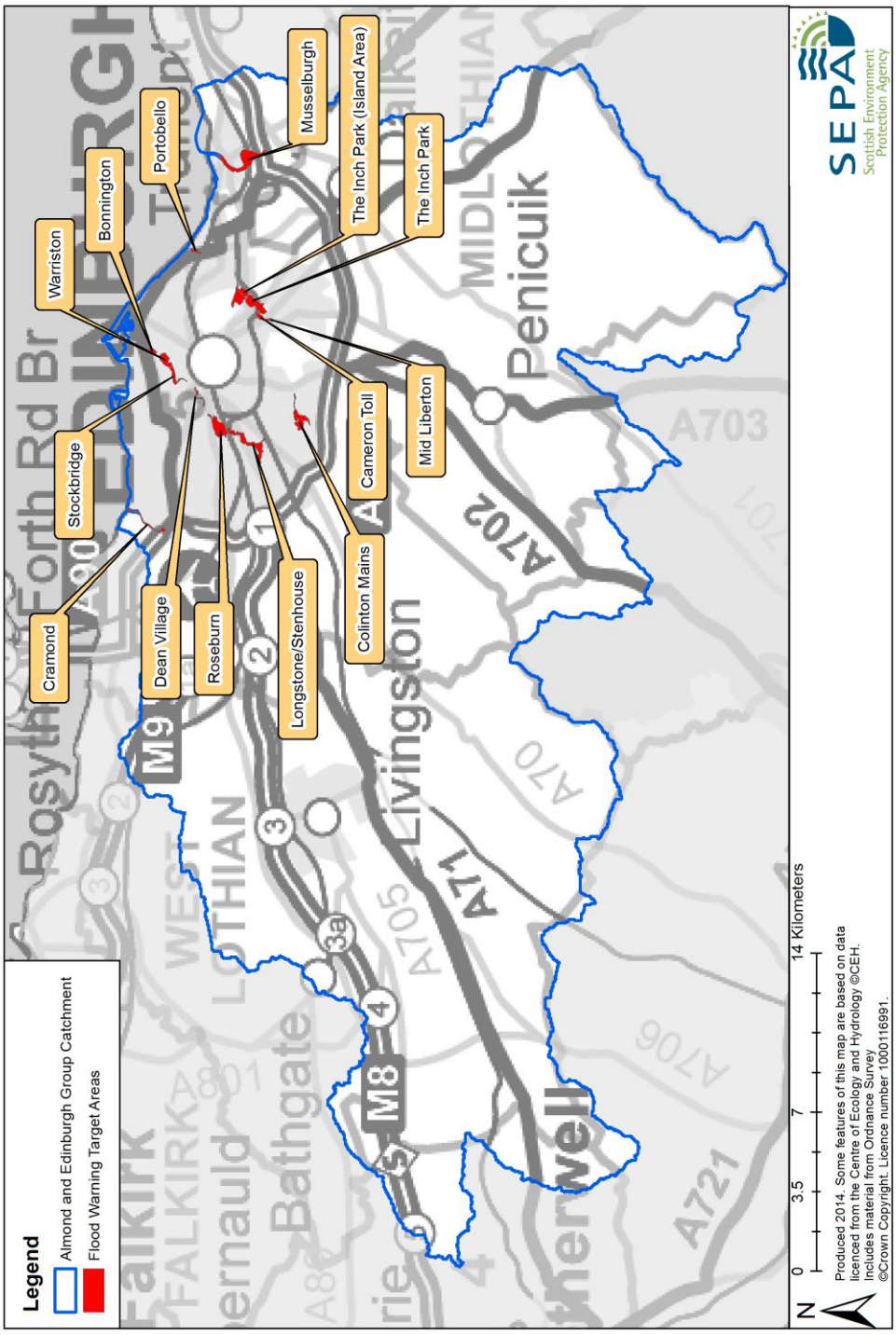


Figure 3: Flood warning target areas

Awareness raising campaigns and community groups

SEPA and the local authorities work closely with many other organisations that have flooding related duties and interests. These include the Police, Fire and Rescue services, the Scottish Government and the Scottish Flood Forum. SEPA and the local authorities, often in partnership with these organisations, undertake various awareness raising campaigns that include community events, information leaflets, educational plays in schools, the use of social media and advertising.

In addition the following community groups that help with flood resilience are known to operate within this catchment:

- Musselburgh and Inveresk Community Council
- East Lothian Tenants and Residents Panel
- East Burnside Village Community Flood Action Group, Broxburn.

In addition to the above there are also various local community councils that operate throughout the East Lothian Council area.

Property level resilience/resistance

Some local authorities have their own policies regarding property level protection. Contact your local authority or view their website for more information.

The following incentives or subsidies have been put in place to provide property owners with property level resilience/resistance:

- The City of Edinburgh Council owns 450m of temporary pallet barriers that can be utilised to protect properties from river flooding. In addition to this, the Council also owns 8,000 sandbags and there are a further 1,500 sandbags located in fire stations throughout the city which can be utilised by the public during flood events

- The City of Edinburgh Council operates emergency action packs that are used to determine where people should be deployed during flood events.

- East Lothian Council strategically deploys temporary flood barriers and sand bags when properties are threatened by flooding

- West Lothian Council provides sandbags for public use during an emergency situation. Sandbags and 'Aquasacs' are stored at key fire stations throughout the council area.

Flood risk management studies

Flood risk management studies have been identified within the Almond and Edinburgh Group catchment are provided in Table 3.

Year	Study Name
2012	Musselburgh Flood Study Final Report, *Jacobs*
2008	Niddrie Burn Catchment Study, Edinburgh, *Halcrow*
2008	Boghead and Bog Burn FAS Review, *Entec*
2007	Gogar Burn Diversion, *Black & Veatch*

Year	Study Name
2007	Braid Burn Flood Prevention Scheme Hydrological and Hydraulic Modelling Report, *Faber Maunsell*
2003	Water of Leith Flood Prevention Scheme project appraisal report, *Arup*
2002	Water of Leith Flood Prevention Scheme, Hydrological and Hydraulic Design, Engineer's Report, *Arup*
-	East Lothian Council Shoreline Management Plan Summary Report, *Babtie*

Table 3: Flood risk management studies

Climate change and future flood risk

The UK Climate Projections (UKCP09) report predicts future climate change may lead to warmer and drier summers, warmer and wetter winters with less snow, and more extreme temperature and rainfall events. The predicted increase in rainfall and consequent increases in river flows may increase the potential for river flooding. Based on the following study; *An assessment of the vulnerability of Scotland's river catchments and coasts to the impacts of climate change (CEH, 2011),* predicted increases in rainfall and river flows vary throughout Scotland based on UKCP09 2080 horizon projections.

For the UKCP09 high emissions scenario, the predicted average increase in peak river flows for the Almond and Edinburgh Group catchment may be in the order of 39% by 2080. Within the Almond and Edinburgh Group catchment it is estimated that the medium likelihood plus climate change scenario will increase the number of residential properties at risk of river flooding from approximately 5,800 to 9,000 and the number of non-residential properties from approximately 630 to 1,100.

Catchment characterisation

Hydrology

The main watercourses within the catchment are Water of Leith, Braid Burn, River Esk, Niddrie Burn, River Almond, Brox Burn and Gogar Burn. The Water of Leith and River Esk both have notable managed waterbodies that could be used to help managed flood risk. Other waterbodies in the remaining catchments are likely to be too small to be beneficial. The rate at which river levels rise within this catchment group will vary depending upon the characteristics of the individual river catchments. Steep, urbanised river catchments will respond most quickly and those with larger, rural catchment areas with shallow gradients will respond more slowly.
The average annual rainfall for this catchment is low to average for Scotland, with 600-700mm falling in the lower part of the catchment, rising to 900-1100mm in the upper catchment. This is based on rainfall data from 1961-1990.

Topography and soils

The topography of the catchments varies with those draining the Pentland Hills being relatively steep and the remainder draining gently rolling areas.

On average the soils are generally dry due to sheltered location on the east coast. The general soil type is of fine to medium textured lodgement till (formerly boulder

clay), glacial acustrine and estuarine deposits overlain by non-calcareous mineral gleys with wetness class III or IV[1].

Groundwater

This type of flooding is caused by water rising up from underlying rocks or flowing from springs. Groundwater is generally a contributing factor to flooding in Scotland rather than the primary source. Based on the SEPA groundwater flood maps there are areas surrounding Musselburgh where groundwater will significantly influence the duration and extent of flooding from other sources in this catchment.

The SEPA ground water flood map can be viewed on the SEPA website: http://map.sepa.org.uk/floodmap/map.htm

Land cover

This catchment group has a high proportion of urban and suburban areas compared to other catchments in the south east region. Across the catchment the land cover is largely arable and horticulture with the upland areas containing a mix of improved grassland, heather and coniferous woodland.

The main types of land cover present in the Almond and Edinburgh catchment are:

- 38% arable and horticulture
- 15% improved grassland
- 13% other
- 8% acid grassland
- 8% heather and heather grassland
- 8% suburban
- 7% coniferous woodland
- 3% urban.

Potential for natural flood management

Further information on natural flood management is provided in the Local Plan District overview chapter. Maps showing potential for natural flood management are available on the SEPA website (http://map.sepa.org.uk/floodmap/map.htm).

Runoff reduction

Areas with potential for runoff reduction are mainly located to the south and south east of this catchment group and limited to sites of medium potential. The largest of these areas surround Portmore Loch and Gladhouse Reservoir. Other potential sites include Crosswood Reservoir and the areas surrounding West Calder. These sites of medium runoff reduction potential mainly lie out with the Potentially Vulnerable Area boundaries.

Floodplain storage

Areas with floodplain storage are extremely limited within this catchment. The two main areas include a medium potential area surrounding the Edinburgh Airport and

[1] Based in the Hydrology of Soil Types (HOST) classification, Scottish Soils; http://preview.scottishsoils.aea.com/

an area in the far south on the Gladhouse Reservoir. This area contains both medium and high potential.

Sediment management

Channel erosion appears to be quite widespread throughout the catchment, with all water bodies experiencing moderate levels of erosion. High levels of erosion are experienced in several locations; these being the lower reach of the Niddry Burn as it joins the River Almond, the upper reach of the Lead Burn south west of Howgate, on the River South Esk downstream of both the Gladhouse Reservoir and the Roseberry Reservoir as well as Downstream of the Green Burn and continuing into the Crosswood Burn. Sediment deposition is widespread throughout the catchment. High sediment deposition occurs in the Bickerton Burn and How Burn both south and north of Whitburn, the Threipmuir and Harperig reservoirs both south and south west of Balerno. As a result Balerno may experience channel capacity reduction due to sediment build up. The River Almond also shows high deposition, particularly north and north-west of Edinburgh Airport.

Links with river basin planning

There are 47 river water bodies in the Almond and Edinburgh catchment, of which there are 5 river water bodies that are less than good status due to loss or damage to habitat. A further 10 water bodies are less than good due to water quality partially caused by rural diffuse pollution. There are also 11 water bodies designated as heavily modified. All of these need actions taken to reach good ecological potential. There are 7 water bodies designated for flood protection actions, these are the Bavelaw Burn (Threipmuir Reservoir to Water of Leith), Braid Burn (Upstream Dreghorn Barracks to Portobello), Gogar Burn (Union Canal to River Almond), River Almond (Maitland Bridge to Cramond), Water of Leith (Harperrig Reservoir to Poet's Burn confluence), Water of Leith (Murray Burn confluence to Estuary) and Water of Leith (Poet's Burn to Murray Burn confluences). Out of these water bodies, 4 are also designated for urbanisation. The Murray Burn is also designated for urbanisation and there are 3 other water bodies designated for drinking water supply.

Appendix

Further information on existing actions

As well as the formal flood protection schemes other actions exist that reduce the risk of river flooding. This can be seen in Table A1 and include other structures and natural features.

Location	Type of structure or feature	Description	Owned and/or maintained by
Niddrie Burn	Offline storage	2 stage channel through Little France, part of Niddrie Burn river restoration project	City of Edinburgh Council
Edinburgh airport	Embankments	Flood defence embankments on the Gogar Burn and River Almond to protect Edinburgh airport	Edinburgh Airport
School Green/Lasswade	Temporary pallet barrier	Temporary pallet barrier with a maximum length of 100m. Barrier protects up to 10 residential properties in School Green and Lasswade as well as other sites in the council area when appropriate (purchased 2005)	Midlothian Council
Newbridge/Kirkliston	Agricultural flood bunds	Agricultural flood bunds on the River Almond	Non local authority

Table A1: Actions and natural features that contribute to the management of river flooding

FORTH ESTUARY LOCAL PLAN DISTRICT

RIVER FLOODING: EAST LOTHIAN AND BERWICKSHIRE GROUP CATCHMENT

The East Lothian and Berwickshire group covers an area of 860km^2 and contains a number of catchments. The main river catchments in this group are the River Tyne, Eye Water, Horn Burn, Ale Water, Pease Burn, Dunglass Burn, Tower Burn, Mill Burn, Biel Water and East Peffer Water. There are four Potentially Vulnerable Areas in this catchment group (Figure 1).

River flooding impacts

Within the East Lothian and Berwickshire catchment group approximately 460 residential properties and 180 non-residential properties are at a medium likelihood of river flooding. The Annual Average Damages caused by river flooding in the catchment group are estimated to be approximately £1.7 million. It is estimated that 76% of residential and non-residential properties at a medium likelihood of river flooding are located within the Potentially Vulnerable Areas.

Main urban centres and infrastructure at risk

The main urban areas with a medium likelihood of river flooding can be seen in Table 1. The table shows the number of residential properties at risk and the Annual Average Damages caused by river flooding. This includes damages to residential properties, non-residential properties, transport and agriculture. Figure 2 shows the distribution of Annual Average Damages throughout the catchment group.

Locations	Number of residential properties with a medium likelihood of flooding	Total Annual Average Damages
Haddington	230	£560,000
Longniddry	30	£97,000
Tranent	30	£76,000
Eyemouth	20	£85,000
Dunbar and West Barns	20	£50,000
Gifford	10	£55,000
Garvald	<10	£44,000
East Linton	<10	£18,000
Ayton	<10	£12,000
North Berwick	<10	£9,000
Cockenzie and Port Seton	<10	<£1,000

Table 1: Main urban areas with a medium likelihood of river flooding

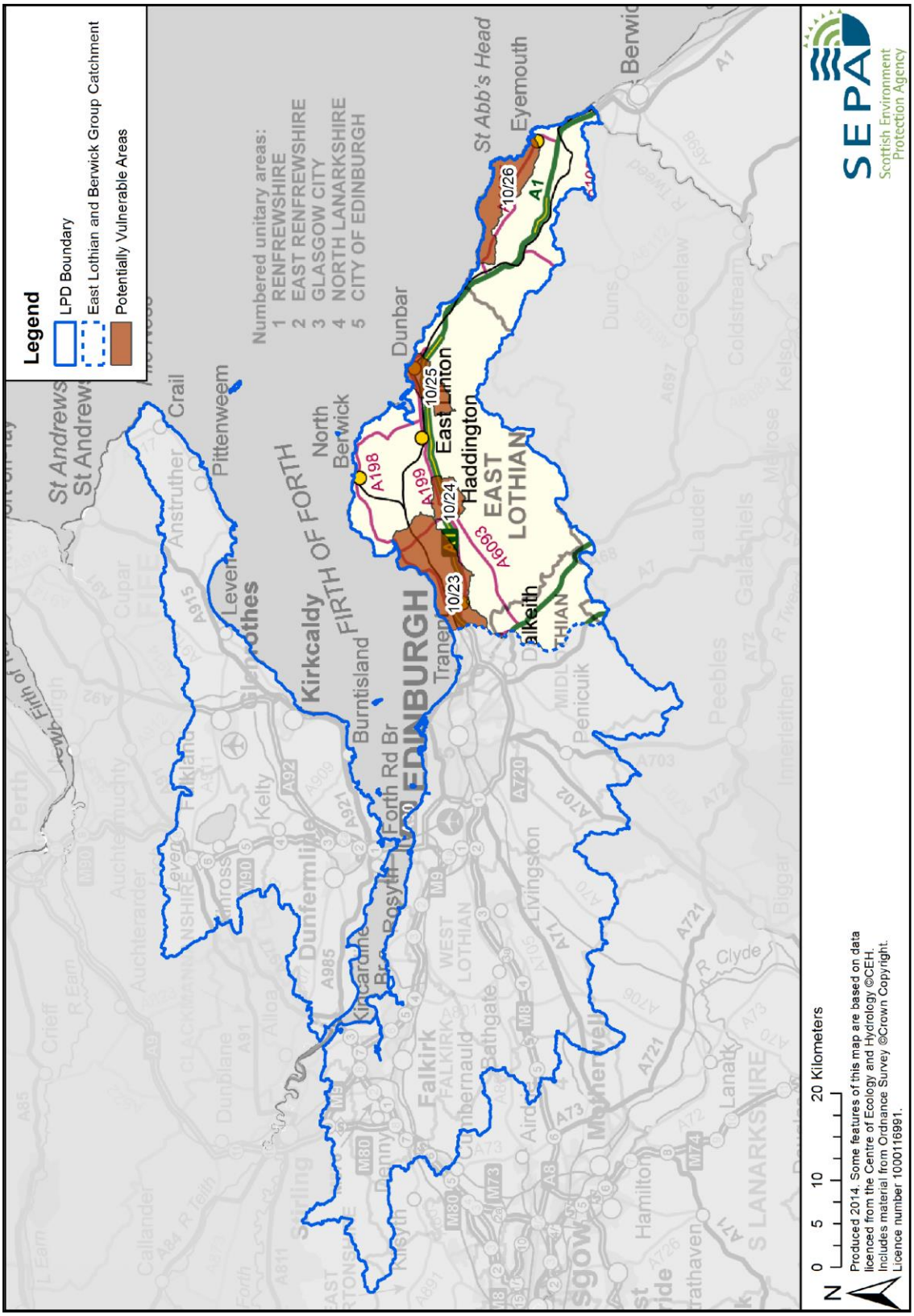


Figure 1: The East Lothian and Berwickshire catchment group

Within the catchment there are utility assets and transport routes at a medium likelihood of river flooding. Approximate numbers are outlined below:

- Utility assets:
    - 10 electricity substations

- Transport routes:

    - Roads
        - A roads: 9 roads, affected at 65 locations
        - B roads: 15 roads, affected at 58 locations.

    - Railway routes
        - Berwick-upon-Tweed to Edinburgh (33 locations at risk)
        - North Berwick to Drem Junction (at risk of flooding in 1 location)

Economic activity

The Annual Average Damages caused by river flooding in the East Lothian and Berwickshire catchment group are estimated to be around £1.7 million.

This consists of:

- 59% residential properties (£820,000 direct damages, £190,000 indirect damages)
- 18% non-residential properties (£300,000 direct damages)
- 8% agriculture (£150,000 direct damages)
- 7% emergency services (£120,000 indirect damages)
- 4% roads (£60,000 direct damages)
- 4% vehicles (£60,000 direct damages).

The highest damages can be seen around Haddington due to the high density of residential and non-residential property in the area being affected by flooding from the River Tyne. Out of the economic damages assessed for this catchment, the highest damages are attributed to non-residential properties.

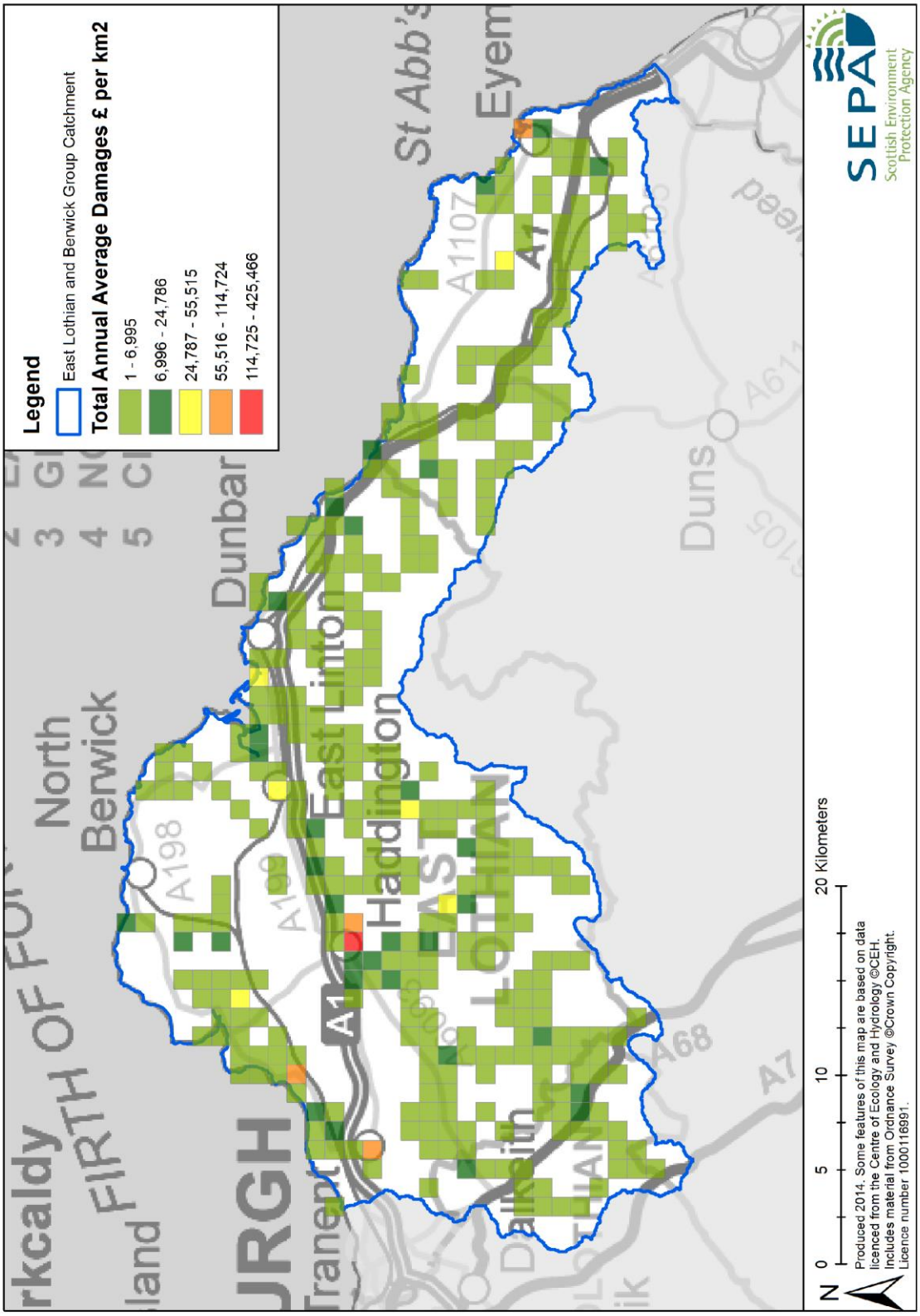


Figure 2: Annual Average Damages from river flooding

History of river flooding

The most significant river flooding event in the East Lothian and Berwick catchment is believed to have occurred in August 1948 with reports of Haddington High Street being flooded up to 57 inches from the River Tyne. The Eye Water and Whiteadder Water also caused significant flooding during this event.

Other significant historical flood events in the East Lothian and Berwick catchment include:

- 7 July and 25 Sept 2012: Property flooding in Haddington due to drains and watercourses backing up and unable to discharge into the River Tyne due to high levels. Wider property flooded avoided by actions East Lothian Council.
- 7 January 2005: Combination of river Eye Water and tidal flooding affecting properties at Harbour Road and various other premises
- 22 October 2002: Belhaven Hospital flooded, patients had to be evacuated after ward closed and the Generator room was shut down. Flooding to Duke Street and West Barns Steadings
- 12 August 1948: River Tyne, Eye Water and Whiteadder Water flooded. The waters of the River Tyne, in Haddington, rose to within 2 inches of the bottom of the plate which commemorates a previous flood of October, 1775, and flooded the High Street of the town to a depth of 57 inches. Eyemouth flooded up to the second floor of some buildings and houses evacuated at the harbour. Residents from Biel Mill Lodge, West Barns also had to be rescued. The flood event is known to have affected a large area with railway lines and road bridges damaged or destroyed and multiple buildings flooded
- 1926 and 1932: Photographic evidence of large flood events in Haddington
- 1775: Large flood event in Haddington inundating most of the town.

Areas of environmental and cultural importance at risk of flooding

Within the catchment approximately 36 cultural heritage sites have a medium likelihood of river flooding. This consists of 16 Scheduled Monuments, 18 Gardens and Designated Landscapes and 2 Battlefield Sites.

It is estimated that approximately 17 environmental sites have a medium likelihood of river flooding. This includes 2 Special Areas of Conservation, 2 Special Protection Areas and 13 Sites of Special Scientific Interest.

Managing flood risk across the catchment

Many organisations work together to manage flood risk. Individuals also have a responsibility for taking action to protect themselves and their property from flooding. Further information on the roles of different organisations in flood risk management and details on what individuals or businesses can do to prepare for flooding can be found in the leaflet ‘Prepare for flooding - a guide for residents and businesses’ available on the SEPA website www.sepa.org.uk.

Existing actions that are in place to manage river flood risk in the Local Plan District are described below.

Flood protection schemes

There are no formal flood protection schemes in this catchment group.

In addition to formal flood protection schemes, other actions exist that may reduce the risk of river flooding. This may include other structures and natural features. These other actions can been seen in the Appendix in Table A1.

River flood warning schemes

SEPA's Floodline service provides flood alerts and flood warnings throughout Scotland to the public and to organisations that have flooding related duties.

Flood alerts are issued over wide geographical areas (normally matching local authority boundaries) using information from the Met Office to determine if flooding is possible. Where SEPA has a river or coastal flood monitoring system, flood warnings can be issued for a more specific local area.

There are four river flood warning target areas within this catchment as shown in Table 2 and Figure 3. Table 2 shows the total number of properties in the flood warning target area and the percentage of those properties that have signed up to receive flood alerts and flood warnings. Please note that this is not the number of properties at risk of flooding.

Flood warning target area (FWTA)	River	Number of properties within FWTA	% of properties registered – July 2013
Grantshouse to Eyemouth	Eye Water	13	100%
Haddington (Green) [1]	River Tyne	212	70%
Haddington (Orange)	River Tyne	179	41%
Haddington (Red)	River Tyne	549	34%

Table 2: Flood warning target areas

Awareness raising campaigns and community groups

SEPA and the local authorities work closely with many other organisations that have flooding related duties and interests. These include the police, fire and rescue services, the Scottish Government and the Scottish Flood Forum. SEPA and the local authorities, often in partnership with these organisations, undertake various awareness raising campaigns that include community events, information leaflets, educational plays in schools, the use of social media and advertising.

In addition the following community groups that help with flood resilience are known to operate within this catchment:

- Friends of the River Tyne
- North Berwick Environment Group
- John Muir Trust
- East Lothian Tenants and Residential Panel.

In addition to the above there are also various local community councils that operate throughout the East Lothian Council area.

[1] These "coloured" Flood Warning Target Areas for Haddington reflect East Lothian council's emergency plan

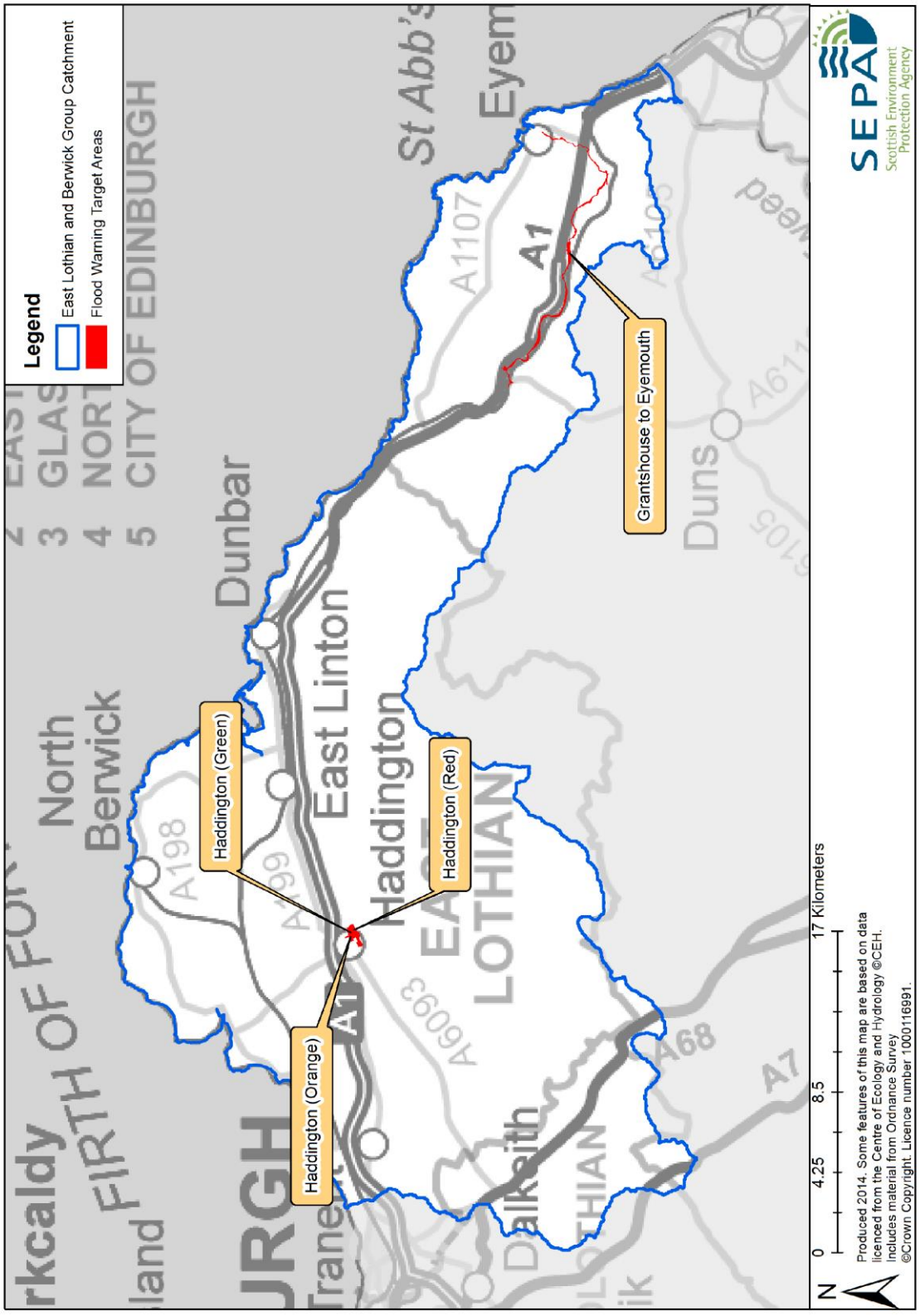


Figure 3: Flood warning target areas

Property level resilience/resistance actions

Some local authorities have their own policies regarding property level protection. Contact your local authority or view their website for more information.

The following incentives or subsidies have been put in place to provide property owners with property level resilience/resistance actions:

- East Lothian Council strategically deploys temporary flood barriers and sand bags when properties are threatened by flooding
- Scottish Borders Council offers discounted flood protection products to homes and businesses at risk in the Scottish Borders. Several properties in Eyemouth have taken up scheme and been protected from flooding as a result
- Scottish Borders Council provisions and maintains dedicated sandbag stores in areas of flood risk to ensure sandbags are readily available to the public in the event of a flood. These are mainly located at fire stations.

Flood risk management studies

Scottish Water, in partnership with City of Edinburgh Council, East Lothian Council and Midlothian Council, are undertaking an Integrated Catchment Study. The study aims to address sources of flooding within this river catchment group. This study covers the urban areas of Edinburgh, Dalkeith, Musselburgh and Port Seton.

In addition, Table 3 identifies further studies relating to flood risk management that have been identified within the East Lothian and Berwick Group catchment.

Year	Month	Study Name
2013	March	Eyemouth Overtopping and Flood Study
2009	-	Haddington Flood Study Final Report, Jacobs,
2004	February	Hydraulic Modelling of the Biel Water for Scottish Water (ABV, Black and Veatch and AMEC joint venture)

Table 3: Flood risk management studies

Climate change and future flood risk

The UK Climate Projections (UKCP09) report predicts future climate change may lead to warmer and drier summers, warmer and wetter winters with less snow, and more extreme temperature and rainfall events. The predicted increase in rainfall and consequent increases in river flows may increase the potential for river flooding. Based on the following study; *An assessment of the vulnerability of Scotland's river catchments and coasts to the impacts of climate change (CEH, 2011),* predicted increases in rainfall and river flows vary throughout Scotland based on UKCP09 2080 horizon projections.

For the UKCP09 high emissions scenario, the predicted average increase in peak river flows for the East Lothian and Berwick catchment by 2080 may be in the order of 39%. Within the East Lothian and Berwick Group catchment it is estimated that the medium likelihood plus climate change scenario will increase the number of

residential properties at risk of river flooding from approximately 580 to 950 and the number of non-residential properties from approximately 220 to 270.

Catchment characterisation

Hydrology

The East Lothian and Berwick group covers an area of 860km^2 and contains a number of catchments. The main river catchments in this group are the River Tyne, Eye Water, Horn Burn, Ale Water, Pease Burn, Dunglass Burn, Tower Burn, Mill Burn, Biel Water and East Peffer Water.

This river catchment group comprises of a number of predominately rural small catchments which have steep headwaters in the Lammermuir Hills with gently rolling topography. The Eye Water catchment is recognised as a flashy watercourse due to steep valley sides, and limited tree cover.

The average annual rainfall for this catchment is low for Scotland, with 600-700mm falling in the lower part of the catchment, rising to 700-900mm in the upper catchment. This is based on rainfall data from 1961-1990.

Topography and soils

On average the soils for this catchment group are generally dry due to a sheltered location on the east coast. The general soil type is of fine to medium textured lodgement till (formerly boulder clay), glaciolacustrine and estuarine deposits overlain by non-calcareous mineral gleys with wetness class III or IV[2].

Groundwater

This type of flooding is caused by water rising up from underlying rocks or flowing from springs. Groundwater is generally a contributing factor to flooding in Scotland rather than the primary source. Based on the SEPA groundwater flood maps there are areas in the catchment surrounding Haddington where groundwater will significantly influence the duration and extent of flooding from other sources.

The SEPA ground water flood map can be viewed on the SEPA website: http://map.sepa.org.uk/floodmap/map.htm

Land Cover

Intensive agriculture dominates in the low lying areas of the catchment. The land cover is almost exclusively arable and horticulture mixed with small areas of grassland.

The main types of land cover present in the East Lothian and Berwickshire Group catchment are:

- 71% arable and horticulture
- 9% other
- 8% improved grassland
- 6% heather and heather grassland

[2] Based in the Hydrology of Soil Types (HOST) classification, Scottish Soils; http://preview.scottishsoils.aea.com/

- 2% acid grassland
- 3% coniferous woodland
- <1% urban.

Potential for natural flood management

Further information on natural flood management is provided in the Local Plan District overview chapter. Maps showing potential for natural flood management are available on the SEPA website (http://map.sepa.org.uk/floodmap/map.htm).

Runoff reduction

In the East Lothian and Berwick catchment, potential for runoff reduction is confined mainly to areas upstream of the Biel Water/Luggate Burn. These areas are just upstream of the Dunbar and West Barns Potentially Vulnerable Area 10/25. Any actions on these potential runoff reduction sites may benefit the Potentially Vulnerable Area.

Floodplain storage

Floodplain storage potential is greatest on the River Tyne upstream of Haddington and Potentially Vulnerable Area 10/24. Elsewhere in the catchment, areas of floodplain storage potential are limited and can be considered insufficient in terms of potential benefits to at risk areas in the catchment.

Natural flood management within the River Tyne catchment has the potential to help reduce flows within the Haddington Potentially Vulnerable Area (10/24). Further local assessment would be required in order to determine the suitability of these areas and to quantify any benefits.

Sediment management

Areas of high deposition and high erosion have been identified across the East Lothian and Berwickshire catchment. This level of erosion and deposition is likely to occur for a number of reasons including natural processes or as a result of channel modification. Across the catchment, SEPA information on river modifications identifies a number of watercourses which have had some low level channel modifications which may account for some of the high erosion and deposition rates. Deposition may also be as a result of the natural processes as well as sediment transfer from land surrounding the watercourse, particularly if this is agricultural land or woodland areas.

Links with river basin planning

There are 29 river water bodies in the East Lothian and Berwickshire catchment, of which eight river water bodies are at less than good status due to loss or damage to habitat. Ten water bodies are less than good status due to water quality partially caused by rural diffuse pollution. There are no heavily modified river water bodies in this catchment.

Appendix

Further information on existing actions

As well as the formal flood protection schemes other actions exist that reduce the risk of river flooding and can be seen in Table A1. This may include other structures and natural features.

Location	Type of structure of feature	Description	Owned and/or maintained by
Eyemouth	Sluice gate	Located at west end of Eyemouth Harbour to relieve peak flows on the Eye Water	Non local authority

Table A1: Actions and natural features that contribute to the management of river flooding

FORTH ESTUARY LOCAL PLAN DISTRICT
RIVER FLOODING: FIRTH OF FORTH CATCHMENT GROUP

The Firth of Forth catchment group covers an area of 1,463km^2. The river catchments in this group include the River Leven, River Ore, Keithing Burn, Bluther Burn, River Avon, River Carron, Bonny Water and Grange Burn. There are 14 Potentially Vulnerable Areas and 1 candidate Potentially Vulnerable Area in this catchment group (figure 1).

River Flooding Impacts

Within the Firth of Forth catchment group approximately 1,700 residential properties and 450 non-residential properties are at a medium likelihood of river flooding. The Annual Average Damages caused by river flooding in the catchment group are estimated to be approximately £6.7 million. It is estimated that 87% of residential and non-residential properties at a medium likelihood of river flooding are located within the Potentially Vulnerable Areas.

Main urban centres and infrastructure at risk

The main urban areas with a medium likelihood of river flooding can be seen in table 1. The table shows the number of residential properties at risk and the Annual Average Damages caused by river flooding. This includes damages to residential properties, non-residential properties, transport and agriculture.

Locations	Number of residential properties with a medium likelihood of flooding	Annual Average Damages
Carron-Carronshore	450	£370,000
Falkirk	180	£450,000
Denny-Dunipace	160	£310,000
Crail	110	£280,000
Dunfermline	90	£630,000
Falkirk Westquarter	80	£140,000
Linlithgow	70	£190,000
Cardenden-Auchterderran-Bowhill	60	£160,000
Bonnybridge-Banknock	60	£120,000
Kirkcaldy	40	£400,000
Lochore	40	£100,000
Cowdenbeath	40	£90,000
Rosyth	40	£78,000
Buckhaven-Methil-Leven	30	£690,000
Glenrothes-Markinch-Leslie	20	£260,000
Cairneyhill	20	£80,000
Slamannan	20	£71,000
Oakley	20	£55,000
Torryburn	10	£34,000
Bathgate-Blackburn	10	£33,000

Kinross[1]	10	£20,000
Milnathort[1]	10	£19,000
Inverkeithing-North Queensferry	<10	£250,000
Larbert-Stenhousemuir	<10	£230,000
Grangemouth	<10	£200,000
Kennoway	<10	£38,000
Kelty	<10	£12,000
Anstruther-Pittenweem	<10	£5,000

Table 1: Main urban areas with a medium likelihood of river flooding

Within the catchment there are utility assets, community facilities and transport routes at a medium likelihood of river flooding. Approximate numbers are outlined below:

- Utility assets:
    - 50 electricity substations;
    - <10 telecommunication sites;
    - <10 mineral and fuel extraction sites;
    - <10 radar sites.
- Community facilities:
    - <10 emergency service sites;
    - <10 schools and nurseries.
- Transport routes:
    - Roads:
        - 4 Motorways, affected at 62 locations;
        - 29 A roads, affected at 187 locations;
        - 45 B roads, affected at 186 locations.
    - Railway routes:
        - Carmuirs Junction to Polmont Junction (1 location at risk)
        - Dunblane to Stirling/Larbert (8 locations at risk)
        - Edinburgh Waverly to Glasgow Queen Street (11 locations at risk)
        - Fife Circle, Dalmeny to Winchburgh and Haymarket West Junctions (32 locations at risk)
        - Perth to Ladybank (3 locations at risk).

[1] The numbers presented in this report are derived from SEPA data that is assessed at a strategic level. Perth and Kinross Council has identified that they believe that there are higher numbers of properties at risk from river flooding in Kinross and Milnathort.

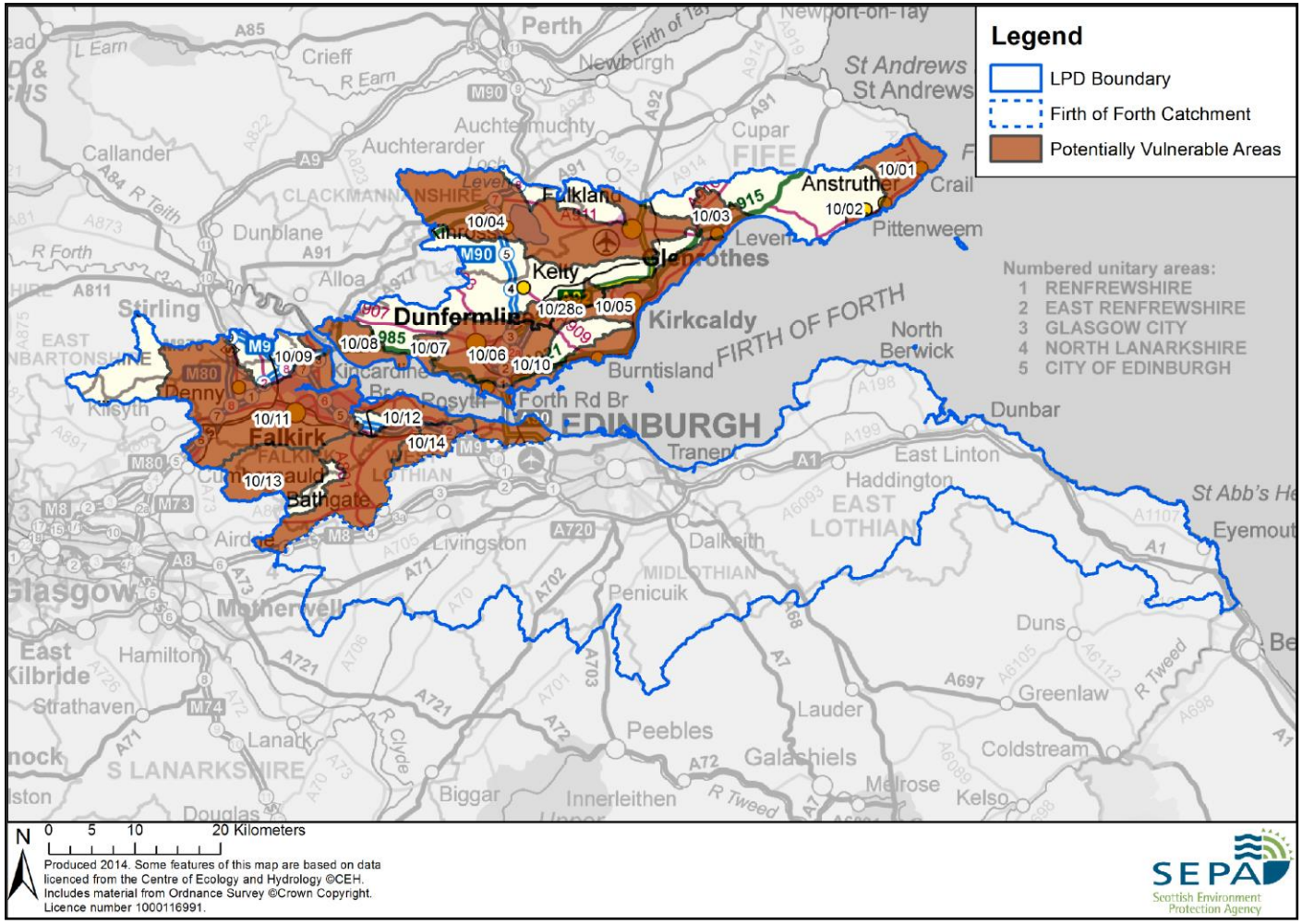


Figure 1: The Firth of Forth catchment group

Economic activity

The Annual Average Damages caused by river flooding in the Firth of Forth catchment group are estimated to be approximately £6.7 million. This consists of:

- 47 % Residential properties (£2,500,000 direct damages, £630,000 indirect damages)
- 42 % Non-residential properties (£2,800,000 direct damages)
- 6 % Emergency services (£380,000 indirect damages)
- 2 % Roads (£150,000 direct damages)
- 2 % Agriculture (£110,000 direct damages)
- 1 % Vehicles (£100,000 direct damages).

Of the economic damages assessed the highest proportion in this catchment is from residential property.

Figure 2 shows the Annual Average Damages throughout the catchment. The highest damages can be seen around the Methil/Leven area due to mainly to non-residential property at risk of flooding from the River Leven. High damages can also be seen in the Carron area of Falkirk due to dense areas of residential properties being affected by flooding from the River Carron.

Economic damages to airports and rail were not assessed as relevant information was not available.

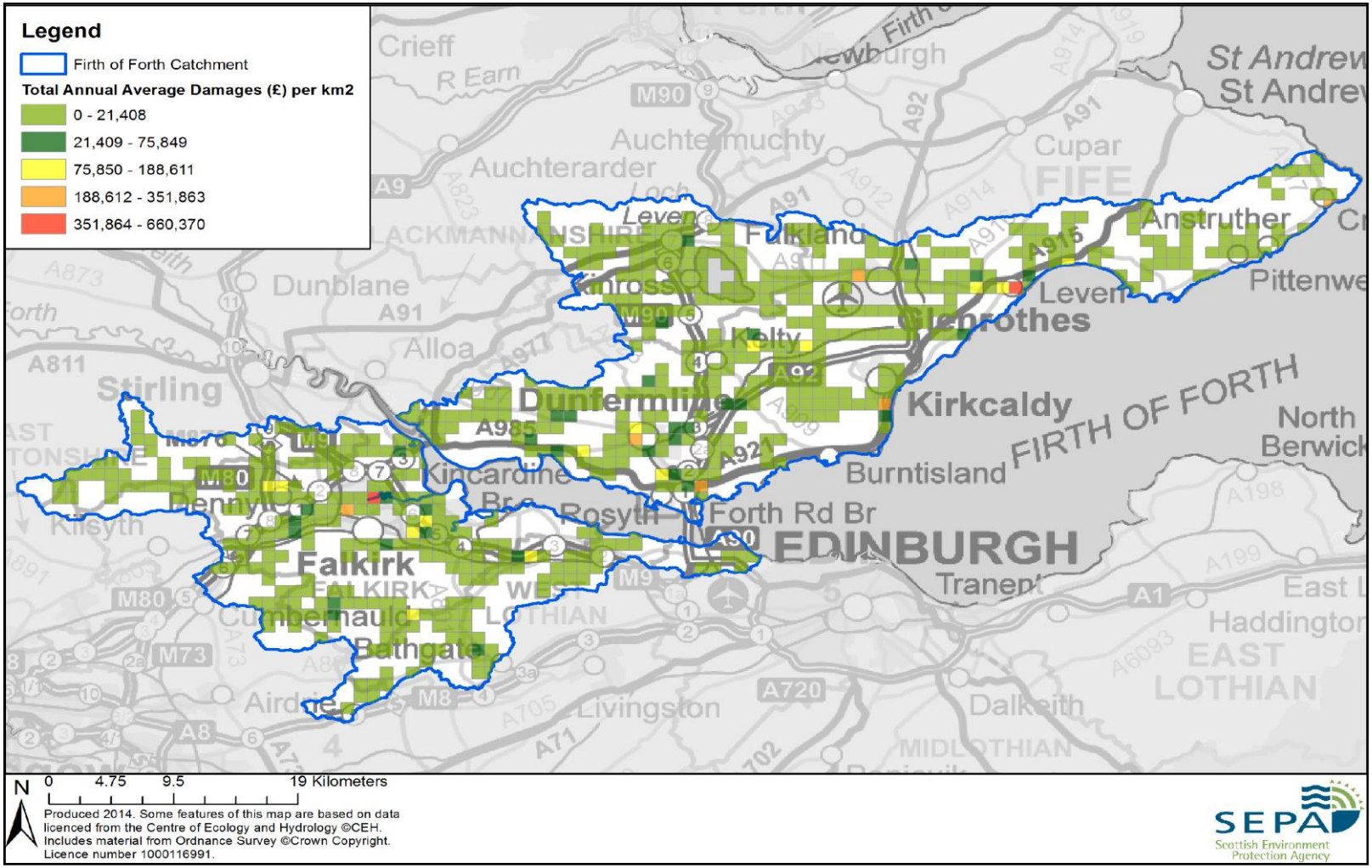


Figure 2: Annual Average Damages from river flooding

History of river flooding

The most significant river flooding event for the Firth of Forth catchment is believed to have occurred in February 1903 when many urban areas were affected by flooding from rivers and watercourses in this catchment group, including the River Leven, the River Carron, the River Lochty and the River Orr.

Other significant historical flood events in the Firth of Forth catchment include:

- 2012: A number of small burns and watercourses caused flooding events in Dunfermline, Rosyth and Oakley;
- 13 December 2006: Widespread flooding throughout the Falkirk area from River Carron. Large bus depot at Stirling Road flooded as a result. Anchor Burn Footbridge washed away and there was flooding to the living quarters of residential properties. Numerous gardens flooded and an electricity substation was threatened. Flooding resulted in the closure of the A803 at Checkbar. 3 residential and 2 non-residential properties flooded at Threepwood along the River Carron. Flooding also presented issues on Bogend Road as a result of flooding on the Tor Burn;
- 13 December 2006: Flooding from the Back Burn affected a number of commercial, industrial and domestic properties in the centre of Milnathort. In Kinross properties were affected on the north and south banks of the South Queich in the vicinity of the Industrial Estate, Queich Place, High Street and the Auction Mart;
- 2002: Flooding of the Chapel Burn affected Alloa Road in Stenhousemuir. This resulted in the flooding of 22 properties with up to 60 threatened during the flood event;
- 1998 and1999: A series of flood events over this period resulted in the promotion of the Linlithgow Flood Prevention Scheme;
- 13 and 14 January 1993: The centre of Milnathort was flooded from the Back Burn. The South Queich also affected houses and industrial properties in the South of Kinross;
- 1 April 1992: An extreme flood event generated overtopping of the Lyne Burn and tributaries, the Tower Burn and Calais Burn resulting in wide spread flooding, affecting residential, commercial and industrial properties in Dunfermline;
- April 1992: Widespread flooding throughout Fife when more than 80mm of rain fell in 24 hours. This included significant flooding in Dunfermline from the Lyne Burn, Tower Burn and Calais Burn;
- 8 February 1903: River Leven and River Carron flooded. Cameron Bridge Distillery flooded. Houses at Haugh Mill submerged to depth of 3 feet. Several acres of land flooded. Bridge at Methil Mill carried away. House flooded and bridge destroyed. River Carron overflowed its banks flooding fields. Extensive flooding at Carron and Bonny confluence. Roads flooded. Headswood Paper Works badly flooded. Lady's Bridge washed away. Miles of land under water from the Ore and Lochty rivers with the Dunfermline-Thorton Junction railway line submerged;
- 25 February 1872: River Leven burst banks flooding surrounding areas. Roads in the neighbourhood impassable as well as many houses flooded and evacuated. Furniture was seen floating down the street;
- 22 October 1864: It is recorded that there was widespread flooding throughout Fife when 49mm of rain fell in a single day.

Areas of environmental and cultural importance at risk of flooding

Within the catchment approximately 54 cultural heritage sites have a medium likelihood of river flooding, consisting of 29 Scheduled Monuments, 20 Gardens and Designated Landscapes, 4 Battlefield sites and 1 World Heritage site.

Approximately 24 environmental protected sites have a medium likelihood of river flooding. This includes 1 Special Area of Conservation, 3 Special Protection Areas and 20 Sites of Special Scientific Interest.

Managing flood Risk Across the Catchment

Many organisations work together to manage flood risk. Individuals also have a responsibility for taking action to protect themselves and their property from flooding. Further information on the roles of different organisations in flood risk management and details on what individuals or businesses can do to prepare for flooding can be found in the leaflet 'Prepare for flooding - a guide for residents and businesses' available on the SEPA website. Existing actions that are in place to manage river flood risk are described below.

Flood protection schemes

There are 6 formal flood protection schemes to reduce the risk of river flooding and 1 scheme currently under construction. The schemes are:

- Grange Burn Flood Prevention Scheme (1969) – Includes works on the Grange Burn and construction of a flood relief channel from the confluence of the Polmont and Westquarter Burns to the River Avon;
- Cairneyhill Flood Prevention Scheme (1982) - A weir at the upstream extent of the scheme incorporates an overflow structure, sluice gate and a flume. Water from the overflow structure is diverted into a culvert which directs overflow into a diversion channel around Cairneyhill. A flood water storage area and related embankments are present next to the school. Channel improvements, culverts and trash screens have been installed in the Torry Burn which runs through the town;
- Parkneuk Flood Prevention Scheme (1987) - The scheme incorporates a new culvert, associated manholes, collecting channel and silt trap between West Baldridge and Braigh Gardens, and channel improvements and pipework at Blackburn Avenue. In addition, improvements to the culvert beneath A907 were made by the roads department but these are not shown as part of the scheme;
- Kincardine-on-Forth Flood Prevention Scheme (1991) - Flood outflow diversion, construction of new culverts, improvements to existing channels. Flood water is diverted around Kincardine;
- Linlithgow Flood Prevention Scheme (2001) - The scheme was designed to mitigate the flooding of the Braehead and the Maltings areas of Linlithgow by the Mains Burn. The operations include the construction of reservoir storage, diversion channels and channel improvements;
- Milnathort Flood Prevention Scheme – A series of flood walls were constructed along the Back Burn in 2006. Following subsequent flooding later that year, a further flood wall was constructed in 2010. Design Standard of Protection is 1 in 100 years.

A further Flood Prevention Scheme is under construction in this area as outlined below:

- Dunfermline Flood Prevention Scheme – A £24 million scheme currently under construction in Dunfermline.

In addition to formal flood protection schemes, other actions exist that may reduce the risk of river flooding. This may include other structures and natural features. These other actions can been seen in the appendix in Table A1.

River flood warning schemes

SEPA's Floodline service provides flood alerts and flood warnings throughout Scotland to the public and to organisations that have flooding related duties.

Flood alerts are issued over wide geographical areas (normally matching local authority boundaries) using information from the Met Office to determine if flooding is possible. Where SEPA has a river or coastal flood monitoring system, flood warnings can be issued for a more specific local area. There are no river flood warning target areas within the Firth of Forth catchment group.

Awareness raising campaigns and community groups

SEPA and the local authorities work closely with many other organisations and interests that have flooding related duties. These include the police, fire and rescue services, the Scottish Government and the Scottish Flood Forum. SEPA and the local authorities, often in partnership with these organisations, undertake various awareness raising campaigns that include community events, information leaflets, educational plays in schools, the use of social media and advertising.

In addition, the following community groups that help with flood resilience are known to operate within this catchment:

- Carronvale Residents and Tennants Association.

Perth and Kinross Council is part of a wider community resilience group which works with various communities including Milnathort to develop community resilience plans.

Property level resilience/resistance

Some local authorities have their own policies regarding property level protection, details of which may be available on their website.

The following incentives or subsidies have been put in place to provide property owners with property level resilience/resistance:

- Perth and Kinross Council is currently working towards introducing a pilot project for flood protection products for properties in flood risk areas;
- Fife Council has installed flood pods containing flood sacks and flood snakes close to areas containing potential flood affected properties.

Flood risk management studies

Scottish Water, in partnership with Falkirk Council, is undertaking an Integrated Catchment Study. The study aims to address surface water and other sources of flooding within this river catchment group. This study covers the urban areas of Falkirk, Grangemouth and Bo'ness.

In addition to the above catchment study, other flood risk management studies have been identified within the Firth of Forth catchment relating to river flood risk management. These are listed in Table 3.

Year	Study Name
2012	Grangemouth model report, *Halcrow*
2011	Linlithgow Loch and Mill Burn Flood Study – Phase 1, *CEH*
2010	South Kinross Flood Study, *Mouchel (Draft Report)*
2010	Milnathort Flood Prevention Scheme 2009 – Technical Report, *Arup*
2010	Kirkcaldy Flood Study Phase 1 and 2, *Scott Wilson*
2010	Chapel Burn Statement of Flood Risk, *Halcrow*
2008	Boghead and Bog Burn Flood Attenuation Structures review, Entec
2007	Review Of Flooding Issues In Milnathort and Identification Of Additional Measures To Reduce Future Flood Risk, *Streamwise Ltd.*
2007	Milnathort Flood Prevention Scheme – December 2006 Flood Event Assessment, *Atkins*
2007	Milnathort Flood Prevention Scheme – December 2006 Flood Event Assessment Interim Report, *Arup*
2007	Scottish Flood Defence Asset Database, Kincardine Flood Prevention Scheme, 1992, *JBA Consulting*
2006	Chapel Burn, Larbert Flood Alleviation Updated Study, *Sir Frederick Snow and Partners Ltd (Scotland)*
2006	Milnathort Flood Prevention Scheme – Status Report, *Arup*
2005	Condition Assessment and Database of Flood and Coastal Defences, Baldridge Burn, Parkneuk, Dunfermline FPS 1987
2005	Condition Assessment and Database of Flood and Coastal Defences, Cairneyhill Flood Prevention Scheme 1982, *JBA Consulting*
2005	Scoonie Burn Flood assessment Report, *Halcrow*
2004	Brankhome and Keithing Burns Flood Studies, Final Report, *Fairhurst*
2003	Hydraulic Study of the Bathgate Water Catchment, *Entec*
2003	Bathgate Water culvert study, *Entec*
2002	Milnathort Flood Prevention Scheme 2002 – Engineering Report, *Arup*
1997	Sea defence survey, *HR Wallingford*
1993	Milnathort Flood Study, *Ove Arup & Partners*

Table 3: Flood risk management studies

Climate change and future flood risk

The UK Climate Projections (UKCP09) report predicts future climate change may lead to warmer and drier summers, warmer and wetter winters with less snow, and more extreme temperature and rainfall events. The predicted increase in rainfall and consequent increases in river flows may increase the potential for river flooding. Based on the following study; *An assessment of the vulnerability of Scotland's river catchments and coasts to the impacts of climate change (CEH, 2011),* predicted increases in rainfall and river flows vary throughout Scotland based on UKCP09 2080 horizon projections.

For the UKCP09 high emissions scenario, the predicted average increase in peak river flows for the Firth of Forth catchment by 2080 may be in the order of 39%. Within the Firth of Forth catchment it is estimated that the medium likelihood plus climate change scenario will increase the number of residential properties at risk of river flooding from approximately 1,700 to 5,000 and the number of non-residential properties from approximately 450 to 660.

Catchment characterisation

Hydrology

This river catchment group comprises a number of smaller catchments many of which are urbanised. The Firth of Forth catchment group covers an area of 1,463km^2. The river catchments in this group are the River Leven, River Ore, Keithing Burn, Bluther Burn, River Avon, River Carron, Bonny Water and Grange Burn. Some of the catchments have larger lochs or reservoirs such as Loch Leven and the Carron Valley Reservoir.

The average annual rainfall for this catchment is low to average for Scotland, with 600-700mm falling in the lower part of the catchment, rising to 1500-2000mm in the upper catchment. This is based on rainfall data from 1961-1990.

Topography and soils

The topography is generally relatively gently sloping although there are steep areas particularly in the headwaters of the larger catchments.

On average its soils are generally dry due to its sheltered location on the east coast. The general soil type is of fine to medium textured lodgement till (formerly boulder clay), glacio-lacustrine and estuarine deposits overlain by non-calcareous mineral gleys with wetness class III or IV[2].

[2] Based in the Hydrology of Soil Types (HOST) classification, Scottish Soils; http://preview.scottishsoils.aea.com/

Groundwater

This type of flooding is caused by water rising up from underlying rocks or flowing from springs. Groundwater is generally a contributing factor to flooding in Scotland rather than the primary source. Based on the SEPA groundwater flood maps there are areas surrounding Dunfermline and Cairneyhill where groundwater will significantly influence the duration and extent of flooding from other sources in this catchment.

The SEPA ground water flood map can be viewed on the SEPA website.

Land cover

This catchment has a high distribution of urban and suburban areas compared to other catchments in the south east region. The majority of the catchment is made up of arable and horticultural land with widespread areas of grassland. The north and west of the catchment has some patchy coverage of coniferous woodland.

The main types of land cover present in the Firth of Forth catchment are:

- 29% improved grassland
- 27% arable and horticulture
- 18% other
- 9% acid grassland
- 6% coniferous woodland
- 5% suburban
- 4% heather and heather grassland
- 2% urban.

Potential for natural flood management

Further information on natural flood management is provided in the Local Plan District overview chapter. Maps showing potential for natural flood management are available on the SEPA website.

Runoff reduction

This catchment is heavily urbanised and contains several areas of potential for runoff reduction. The south west of the catchment contains large areas of both medium and high potential sites located within the Carron Valley Forest. There is some potential north of the Carron Valley Reservoir at Cairnoch Hill and Earl's Hill and surrounding the Earls Burn Reservoirs. These sites would require further investigation to determine whether they can contribute to reducing flood risk.

Floodplain storage

Areas of both medium and high floodplain storage potential are located throughout the catchment. High potential is present around the Carron Valley Reservoir and Loch Leven. A number of other areas of medium or high potential for floodplain storage are located within the Potentially Vulnerable Area boundaries and therefore merit further investigation.

Sediment management

High levels of channel erosion are experienced at various locations throughout the catchment. Notable locations include the Earls Burn south west of Stirling, the Westquarter Burn southeast of Falkirk and the River Leven. Sediment deposition is also widespread throughout the catchment. Areas where further investigation of sediment management options may be beneficial include the Ball and Harperleas Reservoirs in the Lomond Hills, Loch Ore and the River Ore, particularly north of Lochgelly and north of Kirckaldy. Several Potentially Vulnerable Areas (Kinross, Milnathort, Glenrothes, Kinglassie) are widely affected by both channel erosion and sediment deposition throughout. While much of this will be attributable to natural processes there may be reaches which would benefit from actions that reduce erosion such as improvement of bankside vegetation.

Links with river basin planning

There are 67 river water bodies in the Firth of Forth catchment group, of which there are 14 river water bodies that are less than good status due to loss or damage to habitat, and 21 due to water quality partially caused by rural diffuse pollution. There are also 13 water bodies designated as heavily modified, 10 of which need actions taken to reach good ecological potential. The Mains Burn is designated as heavily modified for flood protection and urbanisation and needs actions taken to reach good ecological potential. There are also 5 other water bodies designated as heavily modified for urbanisation, 2 for rural land use, 4 for drinking water supply and 1 for nature conservation.

Appendix

Further Information on existing actions

As well as the formal flood protection schemes, other actions exist that reduce the risk of river flooding. This may include other structures and natural features and are listed in Table A1.

Location	Type of structure of feature	Description	Owned and / or maintained by
Dunnipace	Flood wall	Flood wall on the Avon Burn at Allan Crescent, Dunipace. Wall is approx. 50m in length (both banks) and has a 1 in 200 year Standard of Protection.	Falkirk Council
Bathgate	Boghead and Bog Burn flood attenuation	Bog Burn and Boghead Burn flood alleviation schemes. Include flood attenuation structures.	West Lothian Council

Table A1: Actions and natural features that contribute to the management of river flooding

FORTH ESTUARY LOCAL PLAN DISTRICT

COASTAL FLOODING

The area of the Forth Estuary Local Plan District that is affected by coastal flooding[1] is shown in Figure 1. This Local Plan District has 375km of coastline stretching from Fife Ness in the north to the Scottish Borders in the south. The coastline includes the Firth of Forth and areas of coast exposed to the North Sea. Several urban areas are situated along the coastline including Grangemouth, Bo'ness, Edinburgh, Musselburgh, North Berwick and Eyemouth. Altogether there are 22 Potentially Vulnerable Areas in this Local Plan District that have a risk of coastal flooding (Figure 1).

Impacts of coastal flooding

Within the Local Plan District approximately 1,700 residential properties and 340 non-residential properties are at a medium likelihood of coastal flooding. The Annual Average Damages in the district are approximately £4.0 million. It is estimated that 97% of residential and non-residential properties at a medium likelihood of coastal flooding are location within the Potentially Vulnerable Areas.

Main urban centres and infrastructure at risk

The main urban areas with a risk of coastal flooding can be seen in Table 1. Table 1 shows the number of residential properties at risk and the Annual Average Damages caused by coastal flooding. This includes damages to residential properties, non-residential properties, transport and agriculture. Figure 2 shows the distribution of Annual Average Damages throughout the Local Plan District.

Locations	Number of residential properties at a medium likelihood of flooding	Annual Average Damages
Grangemouth	670	£520,000
Musselburgh	380	£660,000
Kincardine	150	£350,000
Culross	130	£320,000
Airth	110	£670,000
Eyemouth	60	£240,000
Edinburgh	30	£100,000
Inverkeithing-North Queensferry	20	£42,000
North Berwick	20	£13,000
South Queensferry	10	£20,000
Carron-Carronshore	<10	£110,000
Dunbar and West Barns	<10	£26,000
Anstruther-Pittenweem	<10	£22,000
Prestonpans, Cockenzie & Port Seton	<10	£20,000
Limekilns	<10	£6,000

[1] The term coastal flooding is used under the Flood Risk Management (Scotland) Act 2009, but can also be referred to as tidal flooding in estuaries and river channels that are influenced by tidal flows.

Locations	Number of residential properties at a medium likelihood of flooding	Annual Average Damages
Bo'ness	<10	£2,000

Table 1: Main urban centres with a risk of coastal flooding[2]

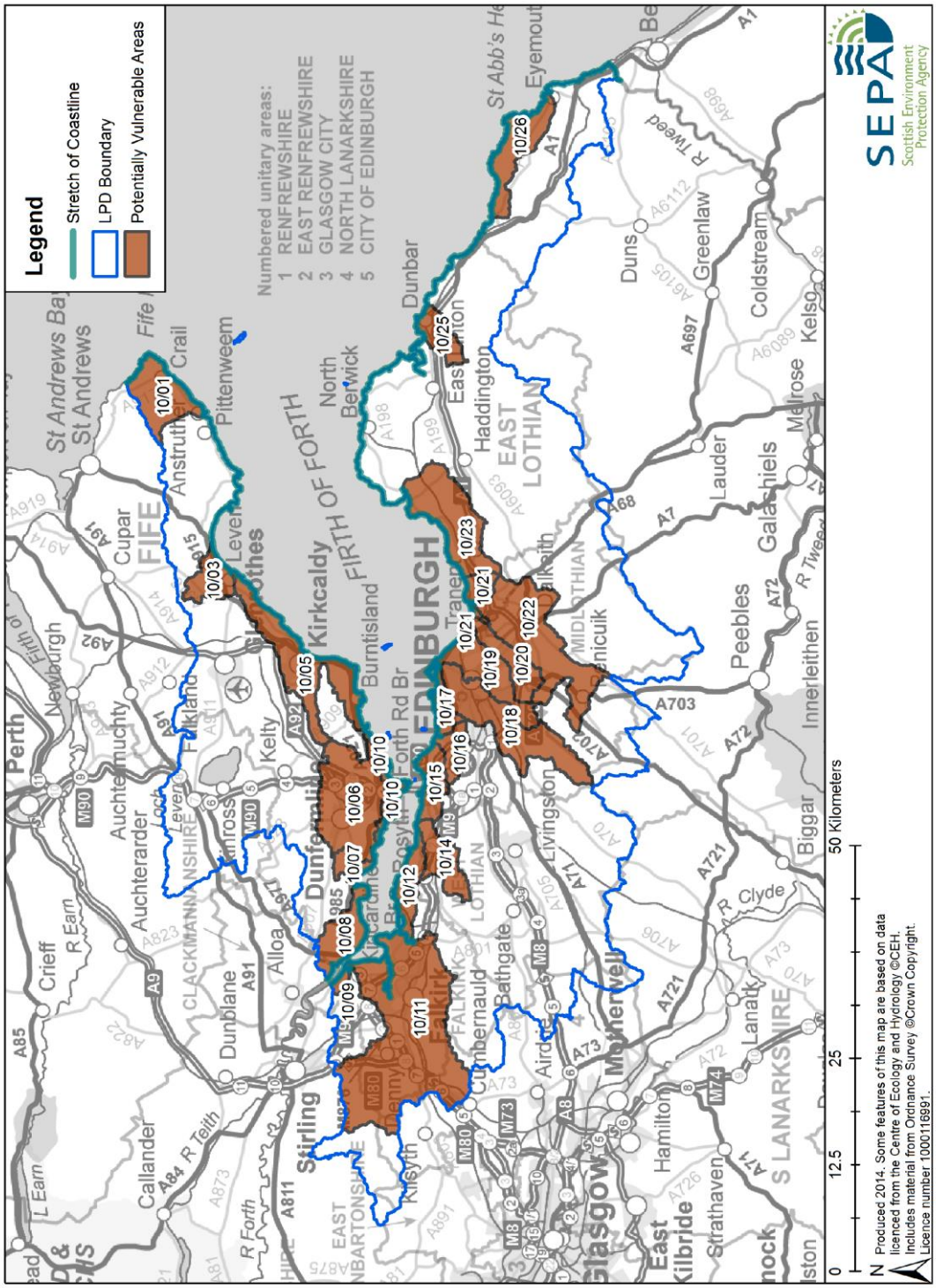


Figure 1: Forth Estuary Local Plan District coastal area and Potentially Vulnerable Areas with a risk of coastal flooding

[2] Table 1 does not show properties at risk if they are protected by a formal flood protection scheme with a known standard of protection of 1 in 200 years.

Within the Local Plan District a number of utility assets, community facilities and transport routes have a medium likelihood of coastal flooding. The approximate numbers include:

- Utility assets:
    - 40 energy production sites
    - <10 radar sites
    - <10 control buildings

- Community facilities:
    - <10 schools

- Transport routes:
    - 18 roads (13 A roads affected at 69 locations, 5 B roads affected at 30 locations)
    - 1 railway route (Fife circle, Dalmeny to Winchburgh and Haymarket West Junctions, affected at 3 locations).

Economic activity

The Annual Average Damages caused by coastal flooding in the Forth Estuary district are approximately £4.0 million. This consists of:

- 54% residential properties (£1,650,000 direct damages, £500,000 indirect damages)
- 32% non-residential properties (£1,300,000 direct damages)
- 6% emergency services (£250,000 indirect damages)
- 4% roads (£170,000 direct damages)
- 3% vehicles (£100,000 direct damages)
- 1% agriculture (£25,000 direct damages).

Out of the economic damages assessed the highest damages are to residential properties followed by damages to non-residential properties.

Higher damages are seen around the Musselburgh area due to the large number of both residential and non-residential properties along the coastline.

Higher damages in Rosyth are identified largely due to the industrial units located in and around Rosyth Dockyard.

The greatest number of properties at risk is in Grangemouth. Industrial areas around Grangemouth, Kincardine and Culross also contribute to high damage values.

Higher damages can be seen in the Airth area due to the large number of residential properties along the coastline.

Higher damages in Eyemouth are due to commercial and business properties around the harbour.

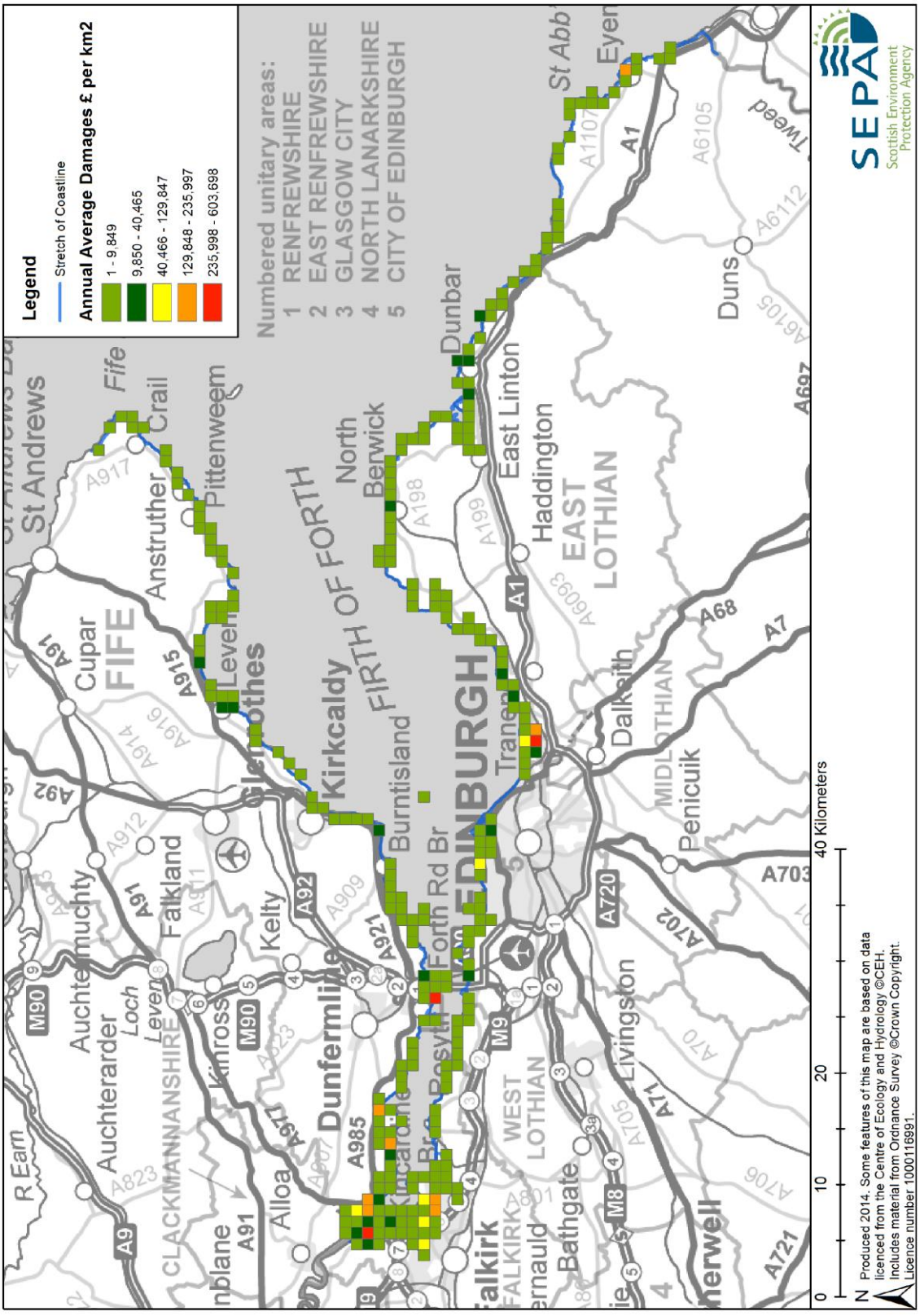


Figure 2: Annual Average Damages from coastal flooding

History of coastal flooding

The following flood events have been identified as having significant coastal influence by local authorities and SEPA's historical flood database:

- 04 January 2014: A tidal surge combined with a storm surge affected coastal areas across the east of Scotland, particularly around the Forth Estuary
- 05 December 2013: A North Sea surge of 1.0m in height combined with a high spring tide of 5.4m caused flooding along the east coast. Eyemouth was affected with almost all of Harbour Road inundated. Approximately 10 properties were flooded, which is less than may have been expected as a result of council and property owner preventative action
- 15 December 2012: A combination of wind and high tides caused large waves and coastal flooding along the east coast of Scotland. There was significant damage to North Berwick Harbour and damage to the communal slipway at Dunbar Harbour
- 30 and 31 March 2010: A tidal surge coinciding with the highest mean tides of the year caused extensive flooding along the east coast of Scotland. The Firth of Forth was one of the worst affected areas, affecting Leith, Musselburgh, Prestonpans, Port Seton, Kirkcaldy, Dunbar, Eyemouth and North Berwick. Impacts included flooding of properties, damage to harbours, seawalls, Kirkcaldy Esplanade and roads. Edinburgh City Council estimating the cost to repair damages in the region of £650,000
- 14 October 2010: Flooding from wave overtopping from the sea occurred at the Promenade, Musselburgh and the picnic areas at White Sands in Dunbar. Minor erosion to the coastal walkway at Prestonlinks, Prestonpans also occurred
- 22 October 2002: A storm caused combined fluvial and coastal flooding in Eyemouth. Impacts included flooding of properties in Harbour Road and the High Street. Sea levels at Eyemouth were at 3.128m
- 1978: A tidal flood event caused flooding of farmland to the west and east of Airth. Damage to the seawall occurred at Blackness and flooding to Victoria Sawmills, Thomson and Balfour in Bo'ness. Flooding at Bothkennar resulted in a partial reconstruction of the bund on the Carron being necessary. This event also affected the Grangemouth laundry, Dalgrain Road and the Grangemouth old town area
- 01[8] March 1969 Esplanade flooded under two feet of water, 2 boats sunk in Kirkcaldy harbour. Transport services interrupted
- 30 September 1959: Grangemouth Docks flooded with highest tides on record at 4.47m
- 04 April 1958: 40 families evacuated in Kirkcaldy. Homes and businesses flooded, cars washed away and civil infrastructure damaged. Flooding affected other areas along the Fife coastline including Anstruther (Shore Street) and Pittenweem. Portobello promenade and nearby houses were also flooded during this event
- 01 October 1947: Waves up to 30 feet affected Kirkcaldy with properties and cars damaged from flood waters
- 17 October 1898: Newhaven Pier in Edinburgh washed away
- 28 November 1897: It was recorded that at North Berwick sailors drowned with many shipwrecks and damage to boats and roads
- 1881: the "Eyemouth Disaster" when 191 fisherman died at Eyemouth
- 1877: Sea wall washed away between Portobello and Joppa.

Areas of environmental and cultural importance at risk of flooding

Within the Local Plan District approximately 55 cultural heritage sites have a medium likelihood of coastal flooding. This includes 30 Scheduled Monuments, 20 Gardens and Designated Landscape Sites, 4 Battlefield Sites and 1 World Heritage Site.

Approximately 12 environmental sites have a medium likelihood of coastal flooding. This includes 1 Special Area of Conservation, 5 Special Protection Areas and 6 Sites of Special Scientific Interest.

Managing flood risk along the coastline

Many organisations work together to manage flood risk. Individuals also have a responsibility for taking action to protect themselves and their property from flooding. Further information on the roles of different organisations in flood risk management and details on what individuals or businesses can do to prepare for flooding can be found in the leaflet 'Prepare for flooding - a guide for residents and businesses' available on the SEPA website www.sepa.org.uk

Actions that are in place to manage coastal flood risk in the Local Plan District are described below.

Flood protection schemes

There are 3 formal flood protection schemes to reduce the risk of coastal flooding:

- Bo'ness - Coastal flood protection scheme, construction was completed in 2011 and has a standard of protection of 1 in 200 years
- Grangemouth - The Grange Burn flood protection scheme serves the area of Grangemouth - This is mainly a river protection scheme but also has some coastal protection benefits. It commences at an overflow on the Grange Burn immediately downstream of the M9 Motorway and Beancross Road. It discharges to the River Avon immediately upstream of Wholeflats Road Bridge. It has an unknown standard of protection
- Prestonpans - The Prestonpans coastal flood protection scheme has a standard of protection of 1 in 200 years.

Other actions exist that are not formal flood defences but may reduce the impact of coastal flooding. This may include other structures and natural features. These other actions can be seen in the Appendix in Table A1.

Coastal flood warning schemes

SEPA's Floodline service provides flood alerts and flood warnings throughout Scotland to the public and to organisations that have flooding related duties.

Flood alerts are issued over wide geographical areas (normally matching local authority boundaries). Information is used from the Met Office and SEPA to determine if flooding is possible within the flood alert area.

Where SEPA has a river or coastal flood monitoring system, flood warnings can be issued for a local target area that can more accurately predict the likelihood and timing of flooding.

There are 19 coastal flood warning target areas within the Forth Estuary Local Plan District, as shown in Table 2 and Figure 3. Table 2 shows the total number of properties within a flood warning target area and the percentage of properties that have registered to receive flooding warnings directly from SEPA. Please note that this is not the number of properties at risk of flooding.

Flood Warning Target Area (FWTA)	Number of properties within FWTA	% of properties registered – January 2014
Anstruther to Elie	124	15
Blackness	24	8
Burntisland to Aberdour	26	15
Culross, Longannet ans Kincardine	615	9
Dunbar including West Barns	198	30
Eyemouth Coastal	88	20
Grangemouth	1,340	12
Granton and Leith	3,545	7
Kinghorn	50	6
Kirkcaldy	156	7
Leven and Methil	285	9
Lower Largo	38	39
Musselburgh Coastal	2,085	13
North Berwick	48	58
North Queensferry and Inverkeithing Bay	184	15
Portobello Esplanade	162	10
Prestonpans, Cockenzie and Port Seton	297	10
Rosyth, Limekilns and Charlestown	106	13
Torryburn and Newmills	29	10

Table 2: Flood warning target areas

Awareness raising campaigns and community flood action groups

SEPA and the local authorities work closely with many other organisations that have flooding related duties. These include the police, fire and rescue services, the Scottish Government, Scottish Flood Forum and local coastal partnerships. SEPA and the local authorities, often in partnership with these organisations, undertake various awareness raising campaigns that include community events, information leaflets, educational plays in schools, the use of social media and advertising.

In addition the following community groups that help with flood resilience are known to operate within this Local Plan District:

- Burnmouth Resilient Community Group
- Coastal Regeneration Group for Port Seton and Cockenzie
- Cockburnpath Resilient Community Group
- Dunbar Shore and Harbour Neighbourhood Group
- East Lothian Biodiversity Group and Local Community Councils
- Eyemouth Resilient Community Group
- Friends of the River Tyne
- Musselburgh Waterfront Group
- North Berwick Environment Group
- St Abbs Resilient Community Group.

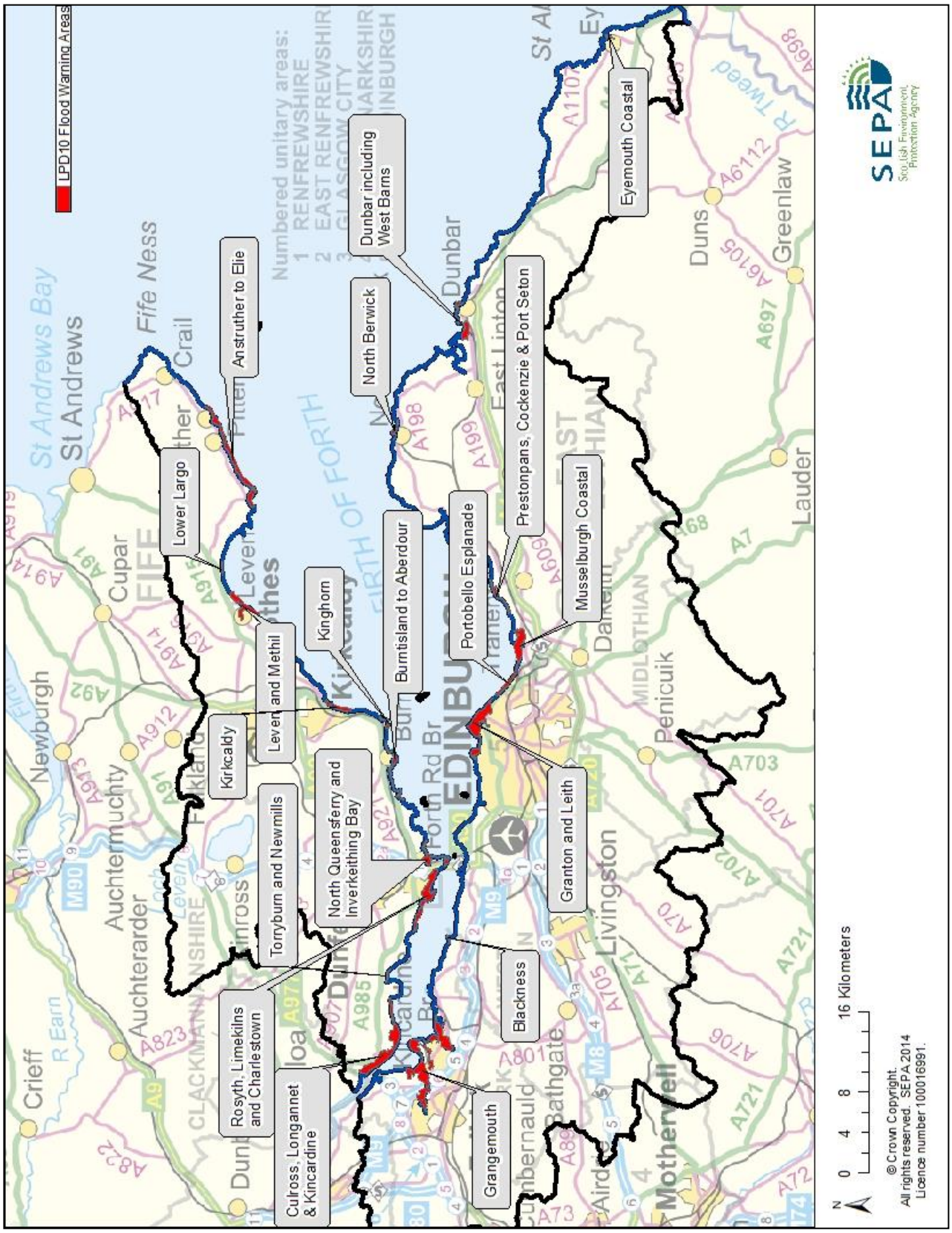


Figure 3: Flood warning target areas

Property level resilience/resistance

Some local authorities have their own policies regarding property level protection. Contact your local authority or view their website for more information.

The following incentives or subsidies have been put in place to provide property owners with property level resilience/resistance:

- East Lothian Council strategically deploys temporary flood barriers and sand bags when properties are threatened by flooding
- Fife Council provides Aquasacs for use in emergencies
- Scottish Borders Council operates a subsidised flood protection products scheme for residential and non-residential property owners in flood risk areas. Scottish Borders Council has provided and maintains dedicated sandbag stores in areas of flood risk to ensure sandbags are available to the public in the event of a flood
- The City of Edinburgh Council stores sandbags at key fire stations to be used in the event of flooding.

Flood risk management studies

The following coastal flood risk management related studies have been identified in the Local Plan District:

- East Lothian Shoreline Management Plan (East Lothian Council)
- Fife Shoreline Management Plan (Fife Council)
- St Abb's Head to River Tyne Shoreline Management Plan (Posford Dvivier,1998)
- Portobello Beach, Review of past performance and options for improvement (HR Wallingford, 2002)
- Granton Waterfront, Wave and water level conditions report (HR Wallingford, 2002)
- Coastal defence survey, East Lothian Shoreline Management Plan (2002)
- Causes of beach lowering at Dunbar, Eastern Scotland, UK (Maritime Engineering 01/2006;59(MA4):157-166 (Pontee, 2006))
- Grangemouth flood study (Sir Frederick Snow and Partners, 2006)
- Portobello seawall Standard of flood protection study (HR Wallingford, 2007)
- Eyemouth Seawall - Inspection, Testing and Options Report (Royal Haskoning,2009)
- Asset Management Plan (Edinburgh) (Jacobs, 2009)
- Grangemouth Flood Study (Halcrow Group Ltd, 2011 and 2012)
- SEPA Coastal Flood Warning Improvement Project Phase 3: Firth of Forth and Tay (Royal Haskoning, 2012)
- Review of coastal flooding documents (City of Edinburgh Council, 2013)
- Eyemouth Overtopping and Flood Study (Royal Haskoning, 2013).

Although not specifically relating to coastal flooding, the following documentation may contain relevant information relating to coastal flood management:

- Water of Leith Flood Prevention Scheme modelling (model includes Fluvial and Coastal interface at Leith)
- Musselburgh Flood Study (Jacobs).

Climate change and future flood risk

UK Climate Projections (UKCP09) predicts future climate change may lead to increased sea levels. The predicted magnitude of sea level rise due to climate change varies around the coastline based on UKCP09 2080 horizon projections. SEPA's coastal flooding has been modelled as a still water level projection, without wave action. Therefore there has been no consideration of the impacts of future climate on wave overtopping or storminess which could increase the number of people affected by coastal flooding.

For the UKCP09 high emissions scenario, the predicted average increase around the Forth Estuary Local Plan District ranges from 0.47-0.5m by 2080. It is estimated that the medium likelihood plus climate change scenario may increase the number of residential properties at risk of coastal flooding from approximately 1,700 to approximately 4,300. The number of non-residential properties may increase from approximately 340 to approximately 1,300.

The predicted average sea level increase and the associated increase in coastal flood risk are outlined below:

Mid Firth of Forth (North and south coast from Clackmannanshire Bridge to North and South Queensferry)

The predicted average sea level increase is 0.47m by 2080. The medium likelihood plus climate change scenario may increase the number of residential properties at risk of coastal flooding from approximately 1,100 to approximately 1,900 and the number of non-residential properties from approximately 150 to approximately 700. The Grangemouth area is likely to experience the biggest increase in coastal flooding under this scenario.

North Queensferry to Fife Ness (Outer Firth of Forth)

The predicted average sea level increase is 0.49m by 2080. The medium likelihood plus climate change scenario may increase the number of residential properties at risk of coastal flooding from approximately 30 to approximately 140 and the number of non-residential properties from approximately 40 to approximately 170. The urban centres of Kirkcaldy and Buckhaven-Methil-Leven would also be affected by coastal flooding under this scenario.

South Queensferry to North Berwick (Outer Firth of Forth)

The predicted average sea level increase is 0.49m by 2080. The medium likelihood plus climate change scenario may increase the number of residential properties at risk of coastal flooding from approximately 480 to approximately 2,200 and the number of non-residential properties from approximately 100 to approximately 440. The largest increases in properties at risk will be seen in Edinburgh and Musselburgh with the urban centre of Cockenzie and Port Seton also being affected by coastal flooding under this scenario.

North Berwick to English border

The predicted average sea level increase is 0.50m by 2080. The medium likelihood plus climate change scenario may increase the number of residential properties at risk of coastal flooding from approximately 70 properties to approximately 130 properties and the number of non-residential properties from approximately 60 properties to approximately 80 properties.

Coastal processes

The Forth Estuary Local Plan District has 375km of coastline stretching from Fife Ness in the north to the Scottish Borders in the south. The coastline includes the Firth of Forth and the coastline from North Berwick to the English border exposed to the North Sea.

The Firth of Forth is the largest estuary on the east coast of Scotland and extends 95km from Stirling in the west, where the River Forth flows into the estuary, to Fife Ness in the east where it meets the North Sea. The Forth Estuary Local Plan District includes the mid and outer Firth of Forth.

The main influences of coastal flooding in the Firth of Forth are storm surges and locally generated waves. Due to the sheltering effects of the estuary the Firth of Forth is less affected by swell waves but the influence of these increases towards the outer Firth of Forth.

The coast from around North Berwick to the Scottish border is exposed to the North Sea. In this area storm surges, swell waves and locally generated waves all influence coastal flooding.

Sediments in the inner Firth of Forth are generally characterised by finer sediments and mud, creating habitats such as mudflats, salt marshes and reed beds. These habitats can be seen at Skinflats north of Grangemouth and the Alloa Inches. Over the last two hundred years, much of the mudflat areas of the inner and mid Firth of Forth have been drained and lost to allow agricultural and industrial development. Toward the outer Firth of Forth the sediments in the estuary become coarser creating habitats such as sandy beaches and dunes, as can be seen at Gullane Bay and Aberlady Bay.

SEPA has assessed where erosion is likely to affect actions to reduce the risk of coastal flooding and a summary is provided below. The assessment does not take into account existing coast protection or flood protection structures which may reduce susceptibility to erosion. Neither does it indicate areas that will erode or the timescales over which erosion could occur. For further information on the natural susceptibility of coastal erosion please contact SEPA.

Mid Firth of Forth (North and south coast from Clackmannanshire Bridge to North and South Queensferry)

Most of the coastline around the mid Firth of Forth has a medium and medium to high susceptibility to coastal erosion. Areas including to the west of Grangemouth, Bo'ness and Kincardine are particularly susceptible to coastal erosion. Although the areas around Grangemouth, Bo'ness and North Queensferry are shown to be naturally slightly more susceptible to coastal erosion, structures that may help manage coastal erosion are present along much of the coastline.

North Queensferry to Fife Ness (Outer Firth of Forth)

Most of the coastline along North Queensferry to Fife Ness has a low susceptibility to coastal erosion. However, Burntisland and Methil are considered to be more susceptible. Although the areas around Burntisland, Kirkcaldy and Methil are shown to be naturally slightly more susceptible to coastal erosion, there are a number of structures that may help manage coastal erosion present that mostly coincide with the urban areas of Kirkcaldy, Burntisland, Inverkeithing, Methil, Buckhaven and Anstruther.

South Queensferry to North Berwick (Outer Firth of Forth)

Most of the coastline along South Queensferry to North Berwick has a medium susceptibility to coastal erosion.However, there are isolated areas, notably between Leith and Portobello that are more susceptible to coastal erosion. Although the area around Edinburgh is shown to be naturally slightly more susceptible to coastal erosion, structures that may help manage coastal erosion are present particularly between Cramond and Prestonpans.

North Berwick to English border

Most of the coastline along North Berwick to the English border has a low to medium susceptibility to coastal erosion with areas including the coastline between Dunbar and Thorntonloch noted as being particularly susceptible to coastal erosion. Although the areas around Dunbar, St Abb's and Burnmouth are shown to be naturally more susceptible to coastal erosion, structures that may help manage coastal erosion are present in the West Barns area near Dunbar, at the Torness Nuclear Power Station, at St Abb's and at Burnmouth.

Potential for natural flood management

Further information on natural flood management is provided in the Local Plan District overview chapter and maps showing potential for natural flood management are available on the SEPA website (http://map.sepa.org.uk/floodmap/map.htm).

Mid Firth of Forth (North and south coast from Clackmannanshire Bridge to North and South Queensferry)

There is potential for estuarine surge attenuation to reduce flood risk in and around Kincardine and Rosyth. Along much of the mid Firth of Forth there is also medium potential for estuarine surge attenuation, particularly around parts of Grangemouth, Bo'ness and South Queensferry. There appears to be a greater potential for wave dissipation, which could provide possible flood risk benefits around Grangemouth and South Queensferry, with lesser potential at Bo'ness. The feasibility of implementing any natural flood management actions may however be limited due to the large amount of industry along this coastline.

North Queensferry to Fife Ness (Outer Firth of Forth)

Whilst the potential for estuarine surge attenuation along the North Queensferry to Fife Ness coastline is limited, there is potential for benefits around North Queensferry and Inverkeithing. The potential for wave dissipation is more widespread with medium to high potential along most of the coastline in this area.

South Queensferry to North Berwick (Outer Firth of Forth)

There is medium to high potential for estuarine surge attenuation to the west of Edinburgh at South Queensferry. There is also high potential for wave dissipation along most of the South Queensferry to North Berwick coastline.

North Berwick to English border

There is limited to no potential for estuarine surge attenuation along North Berwick to the English border, however there may be potential for wave dissipation in this area, particularly around Dunbar and within Berwickshire Potentially Vulnerable Area.

Links with river basin planning

North Queensferry to Fife Ness

There are 3 coastal water bodies in the North Queensferry to Fife Ness coastal area. All the water bodies are at good or better status. This means it is unlikely any opportunities to improve habitats will be prioritised. However, SEPA recognise there are gaps in our understanding of the condition of estuarine and coastal habitats and current classification may underestimate these impacts. Changes to water bodies identified as pressures in this coastal area include approximately 8.5km of shoreline protection structures and 1.5km of land reclaimed from the sea.

Mid Firth of Forth (North and south coast from Clackmannashire Bridge to North and South Queensferry)

There is 1 estuarine and 4 coastal water bodies in the Mid Firth of Forth coastal area. The Mid Forth Estuary water body is designated as heavily modified and requires actions to reach good ecological potential. Changes to water bodies identified as pressures in this coastal area include approximately 1.5km of flood protection structures and 9.5km of shoreline protection structures. There is also approximately 15.5km^2 of land reclaimed from the sea.

South Queensferry to North Berwick

There is 1 estuarine and 4 coastal water bodies in the South Queensferry to North Berwick coastal area. The Leith Docks to Port Seton water body is designated as heavily modified and requires actions to reach good ecological potential. Changes to water bodies identified as pressures in this coastal area include approximately 16.0km of shoreline protection structures and 4.0km of land reclaimed from the sea.

North Berwick to English border

There is 1 estuarine and 3 coastal water bodies in the North Berwick to English border coastal area. All the water bodies are at good or better status. This means it is unlikely that any opportunities to improve habitats will be prioritised. However, SEPA recognise there are gaps in our understanding of the condition of estuarine and coastal habitats and current classification may underestimate these impacts. Changes to water bodies identified as pressures in this coastal area include approximately 2.5km of flood protection structures and 2.0km of shoreline protection structures. There is also approximately 0.5km^2 of land reclaimed from the sea.

Appendix

Further information on existing actions

As well as the formal flood protection schemes, other actions exist that reduce the risk of coastal flooding in this Local Plan District. This includes existing structures and natural features listed in Table A1.

Location	Name of structure or natural feature	Description	Owned and/or maintained by
Cramond	Cramond mole	Masonry and concrete mole, sewer outfall	City of Edinburgh Council, Scottish Water
Eastfield	Coastal defence	Masonry wall and rock armour revetment	City of Edinburgh Council, Non local authority
Joppa	Coastal defence	Masonry wall and revetment, some rock armour. Pumping station.	City of Edinburgh Council, Scottish Water, Non local authority
Newhaven to Granton	Coastal defence	Masonry walls and revetment. Pumping station.	City of Edinburgh Council, Scottish Water
Portobello	Promenade and beach	Concrete wave wall & replenished beach	City of Edinburgh Council, Non local authority
Portobello, Leith and Granton	Coastal defence	Wave Return Walls	City of Edinburgh Council
Seafield	Coastal defence	Concrete wave wall, concrete and masonry revetment	City of Edinburgh Council, Non local authority
Silverknowes/Cramond	Promenade	Rock armour and concrete revetment, concrete wave wall.	City of Edinburgh Council
South Queensferry	Various, including buildings	Masonry and concrete walls. Coast Protection Act stops at Hound Point, on Dalmeny foreshore.	City of Edinburgh Council, Non local authority
West Shore Rd	Coastal defence	Masonry wall, concrete wall, rock armour	City of Edinburgh Council, Non local authority
Aberlady Bay	Coastal defence	Man-made: concrete, masonry wall. Natural: beaches, saltmarshes, mudflats. (approx. 5km in length)	East Lothian Council
Archerfield and Yellowcraig	Coastal defence	Man-made: none identified. Natural: shingle beach (approx. 3km in length)	East Lothian Council, Non local authority
Belhaven Bay	Coastal defence	Man-made: earthen embankment, masonry wall. Natural: sand beach, saltmarsh, mudflat (approx. 7km in length)	East Lothian Council
Broad Sands and West Links	Coastal defence	Man-made: gabions, timber wall. Natural: sand beach (approx. 3km in length)	East Lothian Council
Cockenzie and Port	Coastal defence	Man-made: harbours,	East Lothian Council,

Location	Name of structure or natural feature	Description	Owned and/or maintained by
Seton		masonry property walls, concrete walls, rock armour. Natural: sand beach (approx. 2km in length)	Non local authority
Dunbar Cliffs	Coastal defence	Man-made: gabions, rock revetment, concrete walls, harbour. Natural: rock outcrops (approx. 1.5km in length)	East Lothian Council
Dunbar East Beach	Coastal defence	Man-made: concrete, masonry walls, groyne. Natural: rock outcrops, sand beach (approx. 1.5km in length)	East Lothian Council
Eastfield to River Esk (Musselburgh)	Coastal defence	Man-made: concrete/masonry walls (some of which are property walls). Rock armour. River training works at the River Esk. Natural: mudflats, beaches (approx. 2km in length)	East Lothian Council
Gosford Bay	Coastal defence	Man-made: masonry sea wall with gabions, rock revetment consisting of tank traps and tipped rubble. Natural: sand beach and rock platforms (approx. 6km in length)	East Lothian Council
Gullane Bay	Coastal defence	Man-made: none, although the dunes have been heavily modified and stabilised in the 1960's and 1970's. Natural: sand beach (approx. 5km in length)	East Lothian Council
Humlocks and Cockenzie Power Station	Coastal defence	Man-made: rock revetment, concrete wall, with rock armour protection at toe (approx. 1km in length)	East Lothian Council
North Berwick	Coastal defence	Man-made: timber wall, concrete/masonry walls, harbour, geotextile, rock revetment (tipped rocks) Natural: sand beach (approx. 2.5km in length)	East Lothian Council
Prestonpans	Coastal defence	Man-made: masonry or concrete walls (mainly property walls). A wide flat concrete platform covering pipes from the power station fronts the property walls. Natural: beach (approx. 1.5km in length)	East Lothian Council

Location	Name of structure or natural feature	Description	Owned and/or maintained by
The Cast (Prestonpans)	Coastal defence	Man-made: rock revetment (mix of rocks tipped at back of beach), gabions backed by geotextile matting. Natural: beach (approx. 1km in length)	East Lothian Council
Thorntonloch	Coastal defence	Man-made: rock revetment (tank-traps) and dune planting. Natural: sand beach (approx. 4.5km in length)	East Lothian Council
West Barns	Coastal defence	Natural: rock outcrops, pocket beaches (approx. 5.5km in length)	East Lothian Council
Winterfield Golf Course	Coastal defence	Man-made: gabions, rock revetment (consisting of anti-tank traps), masonry wall. Natural: rock outcrops (approx. 1.5km in length)	East Lothian Council
Bo'ness	Flood defences	Flood defence walls, bunds and harbour entrance works. Scheme under '61 Act	Falkirk Council
Grange Burn, Grangemouth	Flood defences	Burn embankments and flood relief channel. Scheme under the 1961 Act	Falkirk Council
Aberdour	Coastal defence	Masonry wall, masonry revetment	Fife Council, Non local authority
Aberdour to Silvershands	Coastal defence	Masonry harbour, docks, masonry embankment, cliff/escarpment, beach/foreshore	Fife Council, Non local authority
Craigfoot Walk to Kirkcaldy Harbour	Coastal defence	Concrete wall, concrete/masonry harbour/docks	Fife Council, Non local authority
Dysart	Coastal defence	Rock armour revetment	Fife Council
Dysart to West Wemyss Harbour	Coastal defence	Coal mining spoil cliff/escarpment, coal mining spoil embankment, shingle beach/foreshore, masonry wall	Fife Council, Non local authority
Kirkcaldy Harbour to Dysart Harbour	Coastal defence	Made ground beach/foreshore, bedrock cliff/escarpment, masonry/sheet pile harbour/docks	Fife Council, Non local authority
Leven	Coastal defence	Concrete sea wall, brickwork promenade	Fife Council
Ross Point to Pettycur Bay	Coastal defence	Harbour/docks, rock armour revetment, sand dunes, bedrock cliff/escarpment, masonry wall	Fife Council, Non local authority
North Queensferry to Preston Crescent	Coastal defence	Harbour/docks, masonry revetment	Fife Council, Non local authority

Location	Name of structure or natural feature	Description	Owned and/or maintained by
West Wemyss	Coastal defence	Masonry harbour/docks, rock armour revetment, concrete wall	Fife Council, Non local authority
Burnmouth (Cowdrait)	Cowdrait sea wall	Other structure (approx. 200m in length)	Scottish Borders Council
Eyemouth	Bantry sea wall	Coastal defence promoted under the Coast Protection Act 1948 (approximately 330m in length	Scottish Borders Council
Eyemouth	Wellsbrae sea wall	Other structure (approx. 80m in length)	Scottish Borders Council
Anstruther	Coastal defence	Masonry walls, masonry harbour/docks	Non local authority
Anstruther Easter to Crail	Coastal defence	Bedrock beach/foreshore, bedrock cliff/escarpment	Non local authority
Ash Lagoons (Musselburgh)	Coastal defence	Man-made: concrete sea wall (approx. 3km in length)	Non local authority
Bendameer Ho to Ross Point	Coastal defence	Rock armour revetment, concrete parapet wall	Non local authority
Braefoot Point	Coastal defence	Rock armour embankment, steel/concrete embankment	Non local authority
Braefoot Point to Aberdour	Coastal defence	Sand/shingle beach/foreshore, masonry wall	Non local authority
Buckhaven (East)	Coastal defence	Rock armour revetment, sheet piling harbour/docks	Non local authority
Buckhaven (West)	Coastal defence	Rock armour Revetment	Non local authority
Burnmouth (Cowdrait)	Cowdrait beach	Natural feature: shingle beach (approx. 180m in length)	N/A
Burnmouth (Partanhall)	Burnmouth Hill	Natural feature: rocky headland (approx. 239m in length)	N/A
Burnmouth (Lower)	Lower Burnmouth sea wall	Other structure (approx. 80m in length)	Non local authority
Burnmouth (Lower)	Burnmouth Harbour	Other structure	Non local authority
Burnmouth (Partanhall)	Partanhall sea wall	Other structure (approx. 190m in length)	Non local authority
Burnmouth (Ross)	Ross Point	Natural feature: rocky headland (approx. 135m in length)	N/A
Burnmouth (Ross)	Ross sea wall	Other structure (approx. 90m in length)	Non local authority
Charlestown	Coastal defence	Masonry revetment and masonry harbour/docks	Non local authority
Charlestown to Limekilns	Coastal defence	Concrete/masonry wall, masonry pier, gabion wall	Non local authority
Coldingham sands	Milldown point	Natural feature: rocky headland (approx. 148m in length)	N/A
Coldingham sands	Coldingham sands	Natural feature: dunes and sandy beach (approx. 500m in length)	N/A
Coldingham sands	Jock's Nose	Natural feature: rocky headland (approx. 569m in	N/A

Location	Name of structure or natural feature	Description	Owned and/or maintained by
		length)	
Cove Harbour	Horse road rock	Natural feature: rocky headland (approx. 350m in length)	N/A
Cove Harbour	The Boyne dyke	Natural feature: rocky headland (approx. 60m in length)	N/A
Cove Harbour	Cove Harbour	Other structure	Non local authority
Crail	Coastal defence	Soil/bedrock, cliff/escarpment, masonry harbour/docks, masonry/concrete/gabion walls	Non local authority
Crombie Pier to Charlestown	Coastal defence	Masonry revetment	Non local authority
Dalmeny	Dalmeny foreshore	Natural, masonry revetment and walls at Barnbougle Castle	Non local authority
Dunbar Golf Course	Coastal defence	Man-made: masonry wall, gabions, rock revetment (tipped rocks) Natural: rock outcrops, pocket beaches (approx. 2km in length)	Non local authority
Earlsferry to Elie	Coastal defence	Masonry wall, sand/vegetation dunes, wall, masonry harbour	Non local authority
East of Pitenweem to Anstruther Wester	Coastal defence	Bedrock cliff/escarpment, bedrock beach/foreshore, concrete/masonry wall	Non local authority
East Wemyss	Coastal defence	Rock armour revetment	Non local authority
East Wemyss to Buckhaven	Coastal defence	Soil/vegetation embankment	Non local authority
Elie to St Monans	Coastal defence	Soil/bedrock cliff/escarpment	Non local authority
Eyemouth	Dulse Craig	Natural feature: rocky headland (approx. 110m in length)	N/A
Eyemouth	Eyemouth Harbour	Other structure: embankment and harbour walls	Non local authority
Eyemouth	Eyemouth beach	Natural feature: sandy beach beside the sea walls	N/A
Eyemouth	Kings Mount	Natural feature: rocky headland (approx. 120m in length)	N/A
Eyemouth	Hurter and Luff hard rocks	Natural feature: offshore rocks	N/A
Grangemouth Docks	Coastal structures	Masonry structures	Non local authority
Granton	Granton Harbour	Masonry and concrete walls and revetments	Non local authority
Kincardine to Preston Island	Coastal defence	Masonry revetment	Non local authority
Kinghorn Beach to Craigfoot	Coastal defence	Bedrock cliff/escarpment, masonry wall, concrete pier	Non local authority
Leith	Leith Docks	Various, with impounding sea lock	Non local authority

Location	Name of structure or natural feature	Description	Owned and/or maintained by
Leven to Lundin Links	Coastal defence	Gabion mattress embankment, sand/vegetation dunes, sand/timber dunes, masonry wall	Non local authority
Limekilns to Rosyth	Coastal defence	Soil/vegetation embankment	Non local authority
Lower Largo	Coastal defence	Masonry walls, masonry pier	Non local authority
Lower Largo to Earlsferry	Coastal defence	Sand/vegetation dunes, bedrock cliff/escarpment	Non local authority
Methil	Coastal defence	Concrete/masonry harbour/docks, concrete/masonry wall	Non local authority
North Queensferry	Coastal defence	Masonry walls, masonry railway pier, masonry town pier, gabion walls, bedrock cliff/escarpment	Non local authority
Pease Bay	Greenheugh Point	Natural feature: rocky headland (approx. 410m in length)	N/A
Pease Bay	Pease Bay	Natural feature: shingle beach with some erosion protection (beach approx. 270m in length)	N/A (erosion protection non local authority structure)
Pease Bay	Pease Sands	Natural feature: sandy beach with sand dunes (the bents) (approx. 660m in length)	N/A
Pettycur Bay to Kinghorn Beach	Coastal defence	Bedrock cliff/escarpment	Non local authority
Pittenween	Coastal defence	Masonry walls, masonry harbour/docks, bedrock cliff/escarpment	Non local authority
Preston Crescent to St Davids Bay	Coastal defence	Rock armour revetment	Non local authority
Preston Island	Coastal defence	Masonry revetment	Non local authority
Preston Island to Torryburn	Coastal defence	Masonry revetment and masonry wall	Non local authority
Rosyth to North Queensferry	Coastal defence	Harbour/docks, rock armour revetment	Non local authority
Silvershands to Bendameer Ho	Coastal defence	Masonry revetment, bedrock rock outcrops	Non local authority
St Abbs	Castle Rock	Natural feature: rocky cliffs (approx. 90m in length)	N/A
St Abbs	Black Craighead	Natural feature: rocky cliffs (approx. 190m in length)	N/A
St Abbs	Maw Carr	Natural feature: offshore rocks	N/A
St Abbs	St Abbs marine station sea walls	Other structure: (approx. 143m in length)	Non local authority
St Abbs	St Abbs Harbour	Other structure	Non local authority
St Abbs	Rockhouse sea wall	Other structure: (approx. 70m in length)	Non local authority
St Davids Bay to Braefoot Point	Coastal defence	Rock armour revetment, sand/shingle	Non local authority

Location	Name of structure or natural feature	Description	Owned and/or maintained by
		beach/foreshore	
St Monans	Coastal defence	Masonry/concrete walls, masonry harbour/docks	Non local authority
St Monans to Pittenween	Coastal defence	Bedrock/made ground cliff/escarpment, concrete/masonry outdoor pools	Non local authority
Torness Power Station	Coastal defence	Man-made: concrete revetment/wall with rock armouring (approx. 4.5km in length)	Non local authority
Torryburn to Crombie Pier	Coastal defence	Made ground embankment	Non local authority
West Wemyss to East Wemyss	Coastal defence	Sand/shingle beach/foreshore, made ground cliff/escarpment, rock armour revetment	Non local authority

Table A1: Actions and natural features that contribute to the management of coastal flooding

Crail (Potentially Vulnerable Area 10/01)

Local Plan District	Local Authorities	Main Catchment
10 Forth Estuary	Fife Council	South Fife Coastal

Background

This Potentially Vulnerable Area covers an area of 42km^2 and is part of the Firth of Forth catchment. This is a small coastal area in the north east of the catchment containing the villages of Crail and Anstruther Easter. Its main watercourse is the Crail Burn which flows through Crail and discharges into the Firth of Forth (Figure 1).

The highest risk of flooding and therefore the majority of the flood damages are caused by the Crail Burn to the village of Crail (Figure 2).

Figure 1: Crail Potentially Vulnerable Area

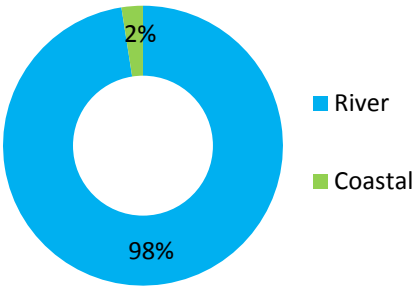


Figure 2: Annual Average Damages by flood source

Summary of flooding impacts

Approximately 120 residential properties and 40 non-residential properties are at a medium likelihood of flooding from river and coastal flooding. A summary of the impacts of flooding can be seen in Table 1. A map showing the impacts from all sources at a medium likelihood of flooding can be seen in Figure 4.

The total Annual Average Damages from all sources of flooding are approximately £300,000. This includes damages to residential properties, non-residential properties, transport and agriculture. The economic damages incurred for each return period can be seen in Figure 3. For this Potentially Vulnerable Area the highest damages are to residential properties followed by damages to non-residential properties.

In 2010 Scottish Water carried out a Flood Risk Assessment Study of water and wastewater assets across Scotland. One water asset and one wastewater asset were identified as being at risk of flooding within this Potentially Vulnerable Area.

	High likelihood	Medium likelihood	Low likelihood
No. of residential properties	<10	120	260
No. of non-residential Properties	<10	40	50
No. of people	10	260	570
Community facilities	<10 Educational buildings	<10 Educational buildings	<10 Educational buildings
Utilities	0	<10 Energy sites <10 Scottish Water assets	<10 Energy sites <10 Scottish Water assets
Transport links (excluding minor roads)	2 Roads affected at 8 locations • 1 A road • 1 B road	3 Roads affected at 12 locations • 1 A road • 2 B roads	3 Roads affected at 14 locations • 1 A road • 2 B roads
Environmental designated areas (km^2)	0.1km^2 • 3 SSSI • 1 SAC • 1 SPA	0.1km^2 • 3 SSSI • 1 SAC • 1 SPA	0.1km^2 • 3 SSSI • 1 SAC • 1 SPA
No. of cultural heritage sites	6	6	7
Agricultural land (km^2)	0.3km^2	0.4km^2	0.5km^2

Table 1: Summary of flooding impacts

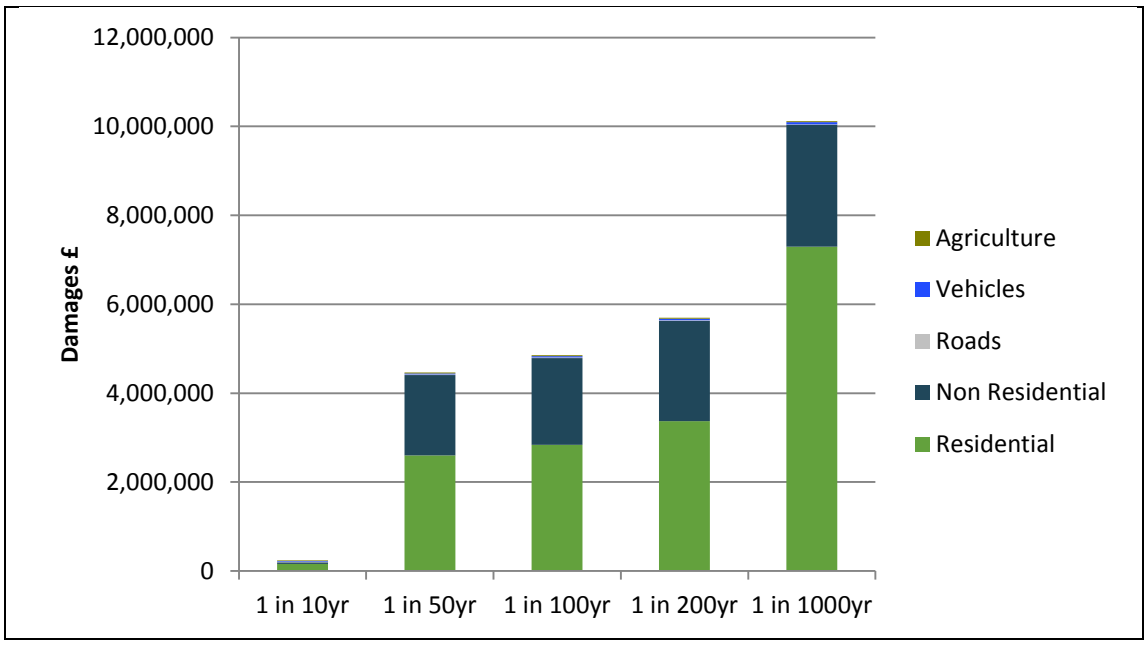


Figure 3: Damages by flood frequency

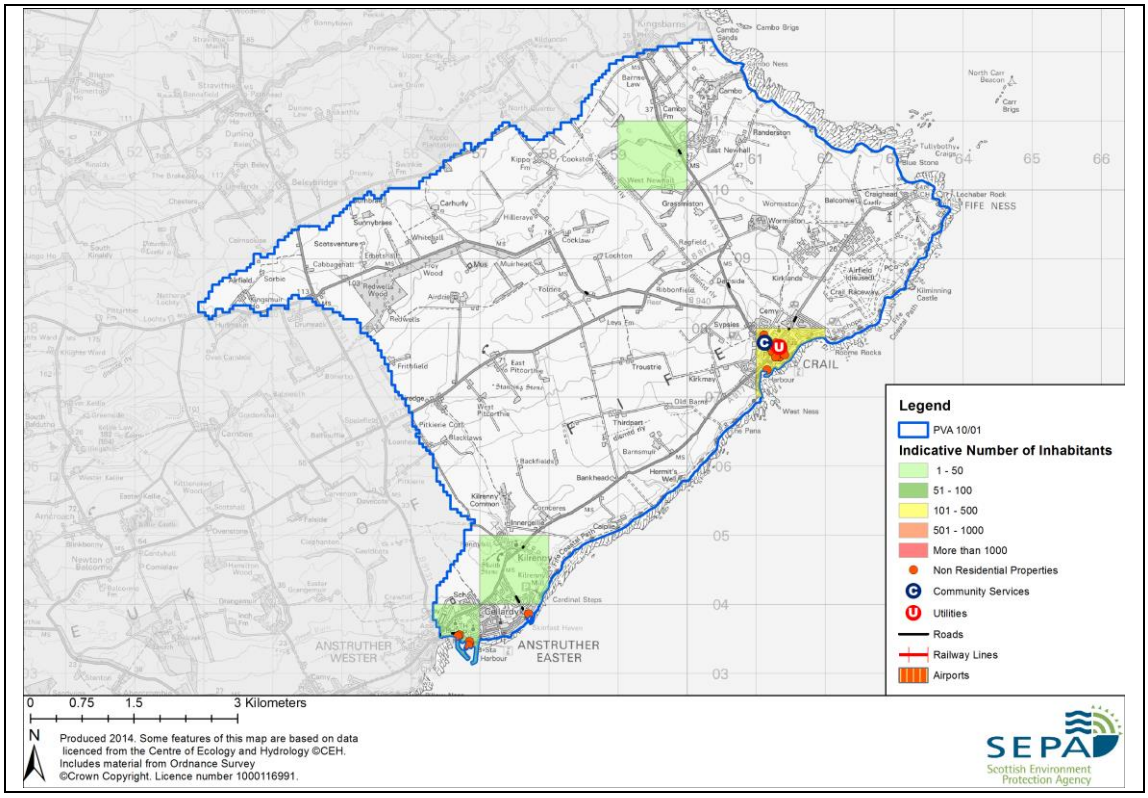


Figure 4: Impacts from all sources at a medium likelihood of flooding

History of flooding

The following coastal flood has been identified as significant:

- 4 April 1958: Homes and businesses flooded, cars washed away and civil infrastructure damaged. Flooding affected areas along the Fife coastline including Anstruther.

No significant river or surface water floods have been recorded in this Potentially Vulnerable Area.

Summary of existing local actions to manage risk

There are no formal flood protection schemes in this Potentially Vulnerable Area. However, other actions and natural features may reduce the risk of flooding. These are referenced in the river, coastal and surface water flooding reports.

There is one flood warning target area within this Potentially Vulnerable Area:

- Anstruther to Elie - Coastal flood warning, Firth of Forth

SEPA and the local authorities work closely with many other organisations that have flooding related duties and interests. These include the police, fire and rescue services, the Scottish Government and the Scottish Flood Forum. SEPA and the local authorities, often in partnership with these organisations, undertake various awareness raising campaigns that include community events, information leaflets, educational plays in schools, the use of social media and advertising.

In addition to the above, the following incentives or subsidies have been put in place to provide property owners with property level resilience/resistance actions:

- Fife Council provides Aquasacs for use in emergencies and these are available from stores located throughout Fife;
- Fife Council also operates an Emergency Flood Plan.

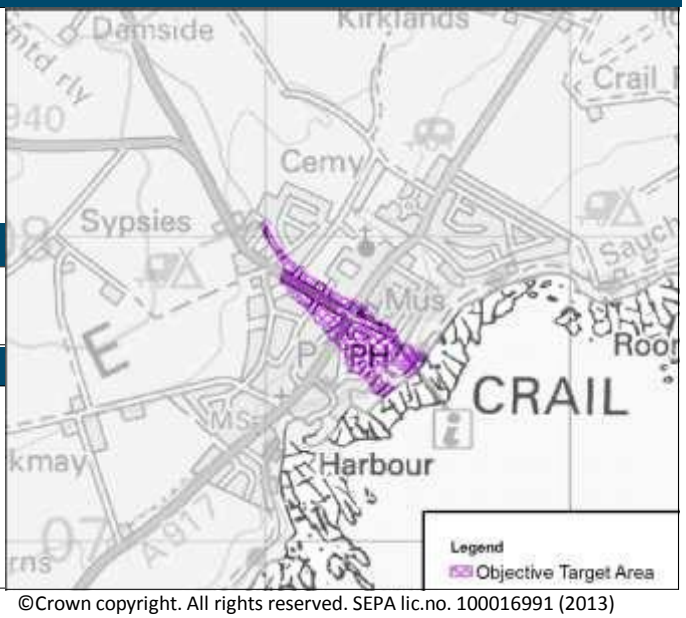
Crail
Potentially Vulnerable Area 10/01
Objectives and potential actions

Unless otherwise stated, information on the following objectives is contained in this document.

IMPORTANT; potential actions that apply across the whole local plan district including flood warning, land use planning, surface water management planning, and other generic actions are described in the Forth Estuary Local Plan District document.

Location	Objective	Objective ID
Applies across Forth Estuary Local Plan District	Avoid an overall increase in flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10001
Applies across Forth Estuary Local Plan District	Reduce overall flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10099
Crail	Reduce economic damages to residential and non-residential properties and flood risk to community facilities in Crail caused by flooding from the Crail Burn.	10002

Crail
Potentially Vulnerable Area 10/01
Objectives and potential actions

Objective(s):	Crail objective target area
Reduce economic damages to residential and non-residential properties and flood risk to community facilities in Crail caused by flooding from the Crail Burn.	
Objective ID:	
10002	
Indicators:	
£160,000 annual average damages (residential properties) £91,000 annual average damages (non-residential properties)	

Potential action	Action ID	Description
Sediment management	100020700	*Sediment management can help control the influence of eroded material on flooding by maintaining channel capacity and reducing the impact of siltation.*
Modification of conveyance	100021100	*Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing channel capacity. The potential benefits of these actions are greatest in areas of frequent flooding.*
Installation / modification of river control structures	100021200	*Control structures on a river can reduce flood levels either by restricting or increasing flow in the channel. The impact of these structures can vary significantly depending on type and location of the structures being added or modified.*
Construction of direct flood defences	100021400	Within Crail, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*
Property level protection	100021700	Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection. *Property level protection can reduce flood impacts by restricting water entering a property, or using construction techniques which increase the resilience of property to flood water. It is most beneficial for flood depths less than 0.6m, in areas prone to frequent flooding.*
Site protection plans	100022100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Improved understanding	100022200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*

Crail (Potentially Vulnerable Area 10/01)

Action	Action ID	Description	Status and Timing	Funding	Responsibility
ONGOING AND CONFIRMED ACTIONS. Actions that are either underway or where the funding has been confirmed for 2016-2021.					
Flood Warning	100993491810	Maintain Firth of Forth and Tay flood warning scheme	Ongoing.	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	SEPA
Self Help / Awareness Raising		Self help actions (individuals taking action to protect themselves and their property against flooding) can be undertaken by any individuals, businesses, organisations or communities at risk of flooding. They are applicable to all sources and probabilities of flooding. They focus on awareness and understanding of the flood risk.	Ongoing. Flooding advice is provided on Fife Council website and via Public information leaflets. These give practical advice and contact information. Fife Council has provided 'Flood Pods' in locations of vulnerable properties which owners can access in times of flood threat.		Fife Council Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
			Owners have the right to protect their properties through purchase of property level protection		Owners
Emergency Plans		Emergency response plans are applicable for all flood sources and likelihoods. They set out the steps to be taken during a flood event to maximise safety and minimise impacts where possible.	Ongoing. Flooding is included within Fife Council's Emergency planning procedures	Council revenue	Fife Council Emergency Services
Land Use Planning	-	Application of national and local planning policies, including objectives and actions identified in the LPD development plan.	Ongoing	Fife Council's revenue budget	Fife Council
Watercourse Maintenance		Watercourse maintenance can prevent debris accumulating within channels, which may otherwise result in an increased flood risk. It can be undertaken as a regular planned activity or in response to a flood event.	Ongoing, Pre-flood checks undertaken at critical sites. Inspection and maintenance on a regular basis for other locations.	Council Revenue allocation	Fife Council/ Landowners

POTENTIAL ACTIONS. The actions below are being consulted upon to support the process of identifying preferred actions. Preferred actions may not be

Action	Action ID	Description	Status and Timing	Funding	Responsibility
able to be implemented during the period 2016-2021 due to project lead-in times and / or funding constraints.					
Sediment Management	100020700	Sediment management can help control the sediment balance in the catchment, maintain channel capacity and reduce the impact of siltation at structures and other key areas.	Not identified.		Fife Council
Modification of Conveyance	100021100	Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing cross sectional area. The potential benefits of these actions are greatest during high probability events.	Not identified.		
Installation / modification of fluvial control structures	100021200	Fluvial control structures can reduce flood levels to a target area by either restricting or increasing channel flow. The impact of these structures can vary significantly depending on type and location of the structures being added or modified	Not identified.		
Construction of Direct flood Defences	100021400	**Within Crail, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood**	This is a potential action identified through SEPA's strategic options. Further study/assessment required Subject to funding.		Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		event.. Direct defence actions aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at flood risk.			
Property level protection	100021700	**Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection.** Property level protection can reduce flood impact by restricting water entering a property, or using construction techniques which are resilient to flood water. It is most beneficial for flood depths <0.6m in areas of high probability flooding			
Flood warning schemes	100021800	Flood warning actions enable people and organisations to prepare for an event. They enable the risk of the event to be reduced by moving people / possessions out of the floodplain and by placing temporary barriers to reduce flooding impacts.	Not identified.		SEPA

Delivery Plan for Consultation

Action	Action ID	Description	Status and Timing	Funding	Responsibility
Site protection plans	100022100	Site protection plans are developed to identify whether normal operation of a facility can be maintained during an event. This may be due to existing protection or resilience of the facility or the network.	Not identified.		
Modelling and other assessments to improve knowledge of flood hazards and impacts	100022200	Improved knowledge of the risks from different events helps to develop plans to avoid or mitigate future flooding to sensitive areas.	Fife Council undertakes flood studies of known flood risk areas and subject to funding will continue to do so where it is considered such knowledge may be of benefit in developing plans to reduce flood risk.		Fife Council
Flood Warning	100993491822	Improve signup of Firth of Forth and Tay flood warning scheme	Potential actions are drawn from a short list of options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being of priority are dependent on funding.		SEPA
Flood Warning	100993491830	Simplify Firth of Forth and Tay flood warning scheme	Potential actions are drawn from a short list of options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being of priority are dependent on funding.		SEPA
Flood Warning	100994361800	Develop new flood warning. Properties in Crail affected by flooding from the Crail Burn.	Potential actions are drawn from a short list of options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being of priority are dependent on funding.		SEPA

Pittenweem (Potentially Vulnerable Area 10/02)

Local Plan District	Local Authorities	Main Catchment
10 Forth Estuary	Fife Council	South Fife Coastal

Background

This Potentially Vulnerable Area covers an area of 3km^2 and is part of the Firth of Forth catchment. This is a small coastal area in the north east of the catchment containing the villages of Anstruther Wester, Pittenweem and the majority of the seaside town of St Monans (Figure 1).

There is only limited flooding within this Potentially Vulnerable Area. Flood damages by source are provided in Figure 2.

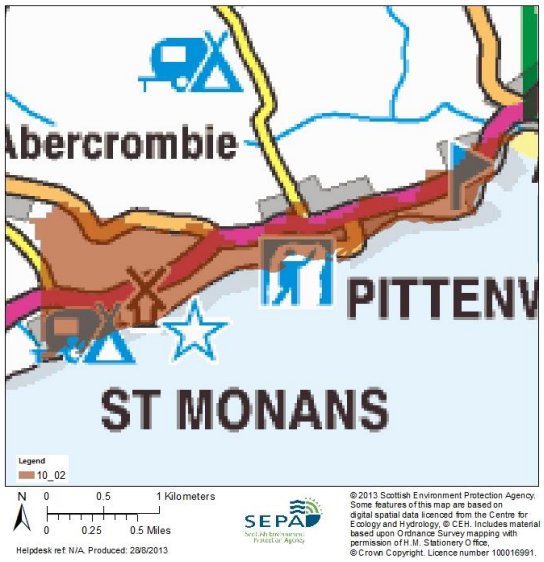


Figure 1: Pittenweem Potentially Vulnerable Area

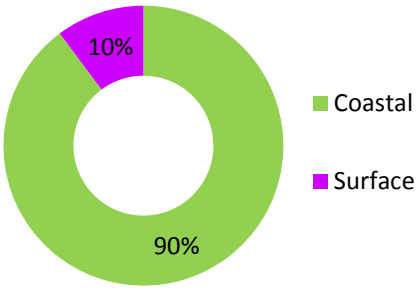


Figure 2: Annual Average Damages by flood source

Summary of flooding impacts

Within this Potentially Vulnerable Area less than 10 residential properties are at a medium likelihood of flooding. A summary of the impacts of flooding can be seen in Table 1. A map showing the impacts from all sources at a medium likelihood of flooding can be seen in Figure 4.

The total Annual Average Damages from all sources of flooding are approximately £16,000. This includes damages to residential properties, non-residential properties, transport and agriculture. The economic damages incurred for each return period can be seen in Figure 3.

In 2010 Scottish Water carried out a Flood Risk Assessment Study of water and wastewater assets across Scotland. Of the assets assessed, one water asset and one wastewater asset were identified as being at risk of flooding within this Potentially Vulnerable Area.

	High likelihood	Medium likelihood	Low likelihood
No. of residential properties	<10	<10	<10
No. of non-residential properties	<10	<10	<10
No. of people	<10	<10	10
Community facilities	0	0	0
Utilities	0	<10 Energy sites <10 Scottish Water assets	<10 Energy sites <10 Scottish Water assets
Transport links (excluding minor roads)	1 A Road affected at 1 location	1 A Road affected at 1 location	1 A Road affected at 1 location
Environmental designated areas (km^2)	$0.1km^2$ • 1 SSSI	$0.1km^2$ • 1 SSSI	$0.1km^2$ • 1 SSSI
No. of cultural heritage sites	2	2	2
Agricultural land (km^2)	< $0.01km^2$	< $0.01km^2$	< $0.01km^2$

Table 1: Summary of flooding impacts

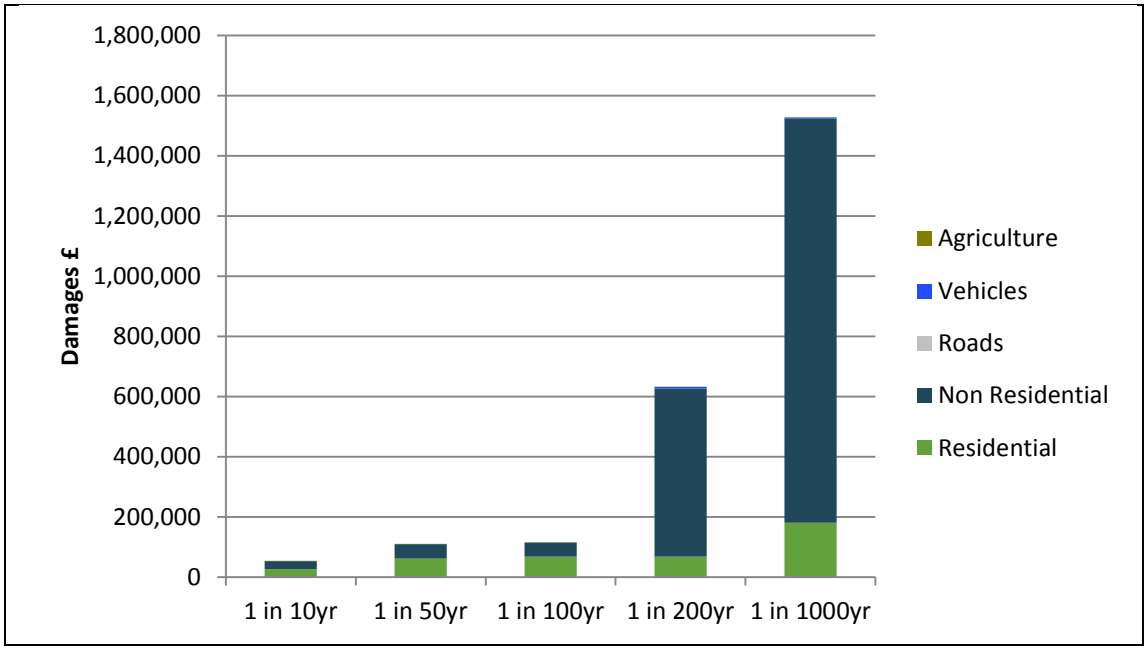


Figure 3: Damages by flood frequency

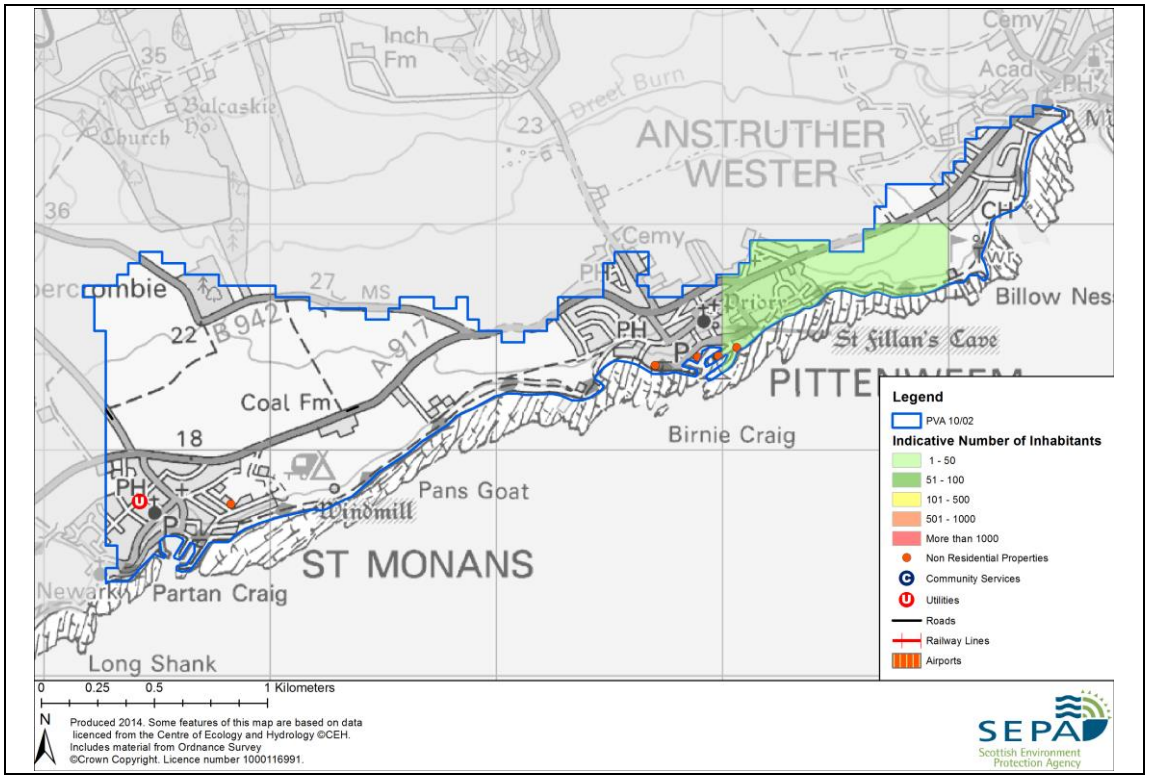


Figure 4: Impacts from all sources at a medium likelihood of flooding

History of flooding

The following coastal flood has been identified as significant in this Potentially Vulnerable Area:

- 4 April 1958: Homes and businesses flooded, cars washed away and civil infrastructure damaged. Flooding affected areas along the Fife coastline including Anstruther (Shore Street) and Pittenweem.

No significant surface water or river floods have been recorded in this Potentially Vulnerable Area.

Summary of existing local actions to manage risk

There are no formal flood protection schemes in this Potentially Vulnerable Area. However, other actions and natural features may reduce the risk of flooding. These are referenced in the river, coastal and surface water flooding reports.

There is one flood warning target area within this Potentially Vulnerable Area:

- Anstruther to Elie - Coastal flood warning, Firth of Forth

SEPA and the local authorities work closely with many other organisations that have flooding related duties and interests. These include the police, fire and rescue services, the Scottish Government and the Scottish Flood Forum. SEPA and the local authorities, often in partnership with these organisations, undertake various awareness raising campaigns that include community events, information leaflets, educational plays in schools, the use of social media and advertising.

In addition to the above, the following incentives or subsidies have been put in place to provide property owners with property level resilience/resistance actions:

- Fife Council provides Aquasacs for use in emergencies and these are available from stores located throughout Fife;
- Fife Council also operates an Emergency Flood Plan.

Pittenween
Potentially Vulnerable Area 10/02
Objectives and potential actions

Unless otherwise stated, information on the following objectives is contained in this document.

IMPORTANT; Potential actions for flood warning, land use planning and surface water planning are described in the Local Plan District document.

Location	Objective	Objective ID
Applies across Forth Estuary Local Plan District	Avoid an overall increase in flood risk. For further information see Applies across Forth Estuary Local Plan District Local Plan District objectives and potential actions.	10001
Applies across Forth Estuary Local Plan District	Reduce overall flood risk. For further information see Applies across Forth Estuary Local Plan District Local Plan District objectives and potential actions.	10099

Pittenweem, St Monans (Potentially Vulnerable Area 10/02)

Action	Action ID	Description	Status and Timing	Funding	Responsibility
ONGOING AND CONFIRMED ACTIONS. Actions that are either underway or where the funding has been confirmed for 2016-2021.					
Flood warning schemes – Maintain Firth of Forth and Tay **coastal** flood warning scheme	100993491810	This action has been identified for all existing flood warning schemes. It will be appropriate where the existing scheme meets the needs of the local community.	Ongoing	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	SEPA
Flood Warning	100993491810	Maintain Firth of Forth and Tay flood warning scheme	Ongoing.	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	SEPA
Land Use Planning	-	Application of national and local planning policies, including objectives and actions identified in the LPD development plan.	Ongoing	Fife Council's revenue budget	Fife Council

Delivery Plan for Consultation

Action	Action ID	Description	Status and Timing	Funding	Responsibility

POTENTIAL ACTIONS. The actions below are being consulted upon to support the process of identifying preferred actions. Preferred actions may not be able to be implemented during the period 2016-2021 due to project lead-in times and / or funding constraints.

Flood warning schemes – Improve sign up of Firth of Forth and Tay **coastal** flood warning scheme	100993491822	This action has been identified because the sign-up rate in some of the FWTAs within this scheme is less than the target of 40%. If the action is progressed, the sign-up rate for the relevant FWTAs will be improved via a targeted communications campaign.	Potential actions are drawn from a short list of options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being of priority are dependent on funding.	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	SEPA
Flood warning schemes – Simplify Firth of Forth and Tay **coastal** flood warning scheme	100993491830	This action has been identified because other structural actions are being considered in this area which may reduce the need for a detailed flood warning scheme.	Potential actions are drawn from a short list of options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being of priority are dependent on funding.	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	SEPA

Leven (Potentially Vulnerable Area 10/03)

Local Plan District	Local Authorities	Main Catchment
10 Forth Estuary	Fife Council	River Leven (Fife)

Background

This Potentially Vulnerable Area covers an area of 22km^2 and is part of the Firth of Forth catchment. This is a small coastal area in the north east of the catchment containing the towns of Leven and Methil and villages of Kennoway and Lower Largo (Figure 1). The main watercourse is the River Leven to the south of Leven. There is one other notable watercourse, this being the Scoonie Burn which is situated to the north of Leven.

The highest risks of river flooding are from the River Leven and the Scoonie Burn to Methil and Leven. The highest risk of surface water flooding is in Leven. The majority of flood damages are caused by river flooding (Figure 2).

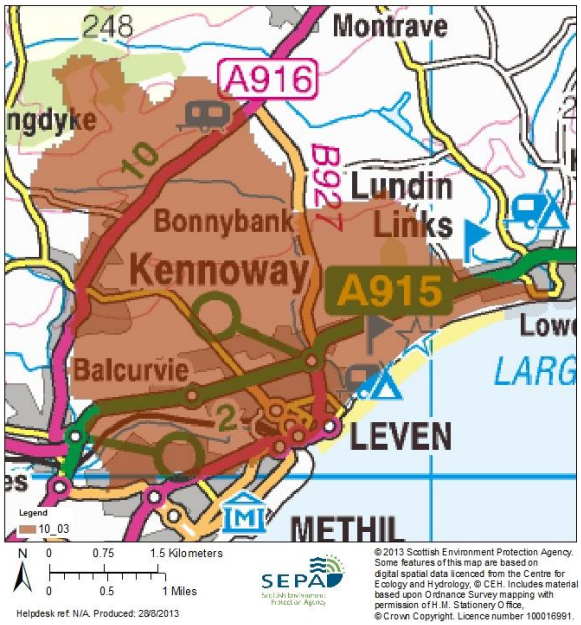


Figure 1: Leven Potentially Vulnerable Area

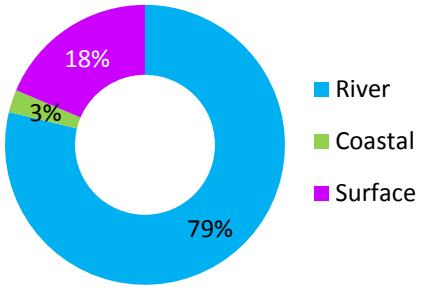


Figure 2: Annual Average Damages by flood source

Summary of flooding impacts

Approximately 180 residential properties and 90 non-residential properties are at a medium likelihood of flooding from one or more sources. A summary of the impacts of flooding can be seen in Table 1. A map showing the impacts from all sources at a medium likelihood of flooding can be seen in Figure 4.

The total Annual Average Damages from all sources of flooding are approximately £790,000. This includes damages to residential properties, non-residential properties, transport and agriculture. The economic damages incurred for each return period can

be seen in Figure 3. For this Potentially Vulnerable Area the highest damages are to residential properties followed by damages to non-residential properties.

In 2010 Scottish Water carried out a Flood Risk Assessment Study of water and wastewater assets across Scotland. Of the assets assessed, one wastewater asset was identified as being at risk of flooding within this Potentially Vulnerable Area.

	High likelihood	Medium likelihood	Low likelihood
No. of residential properties	50	180	260
No. of non-residential properties	40	90	100
No. of people	110	400	570
Community facilities	<10 Emergency service buildings	<10 Emergency service buildings	<10 Emergency service buildings
Utilities	<10 Energy sites	10 Energy sites <10 Scottish Water assets	10 Energy sites <10 Scottish Water assets
Transport links (excluding minor roads)	4 Roads affected at 28 locations • 2 A roads • 2 B roads	5 Roads affected at 82 locations • 3 A roads • 2 B roads	5 Roads affected at 94 locations • 3 A roads • 2 B roads
Environmental designated areas (km^2)	$0.1km^2$ • 1 SSSI • 1SAC • 1 SPA	$0.1km^2$ • 1 SSSI • 1SAC • 1 SPA	$0.1km^2$ • 1 SSSI • 1SAC • 1 SPA
No. of cultural heritage sites	2	2	2
Agricultural land (km^2)	$0.2km^2$	$0.3km^2$	$0.3km^2$

Table 1: Summary of flooding impacts

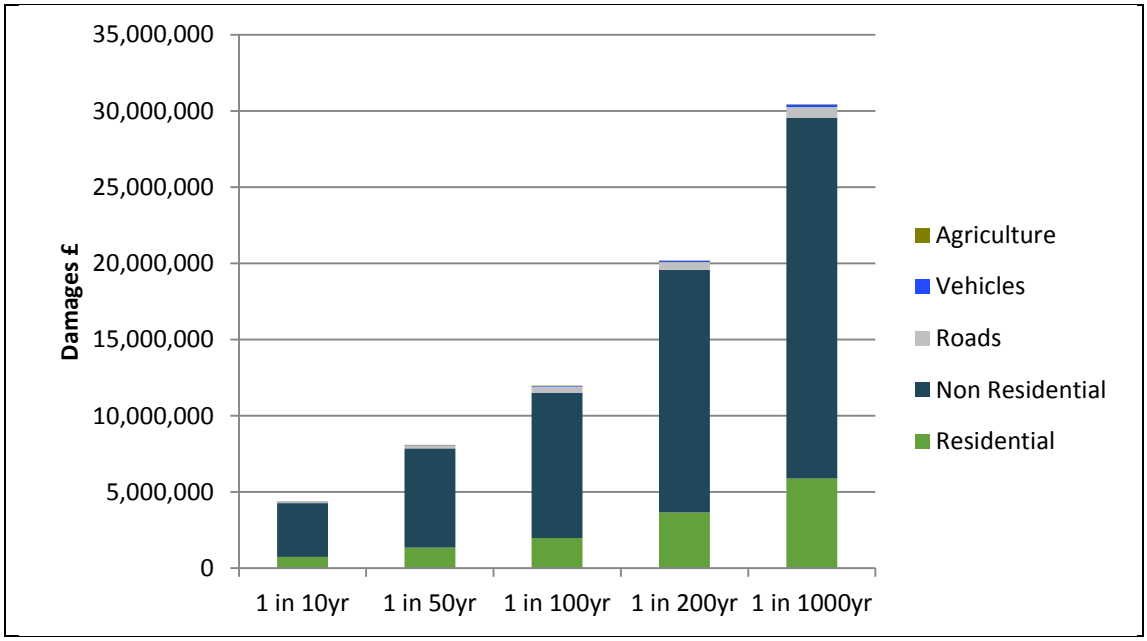


Figure 3: Damages by flood frequency

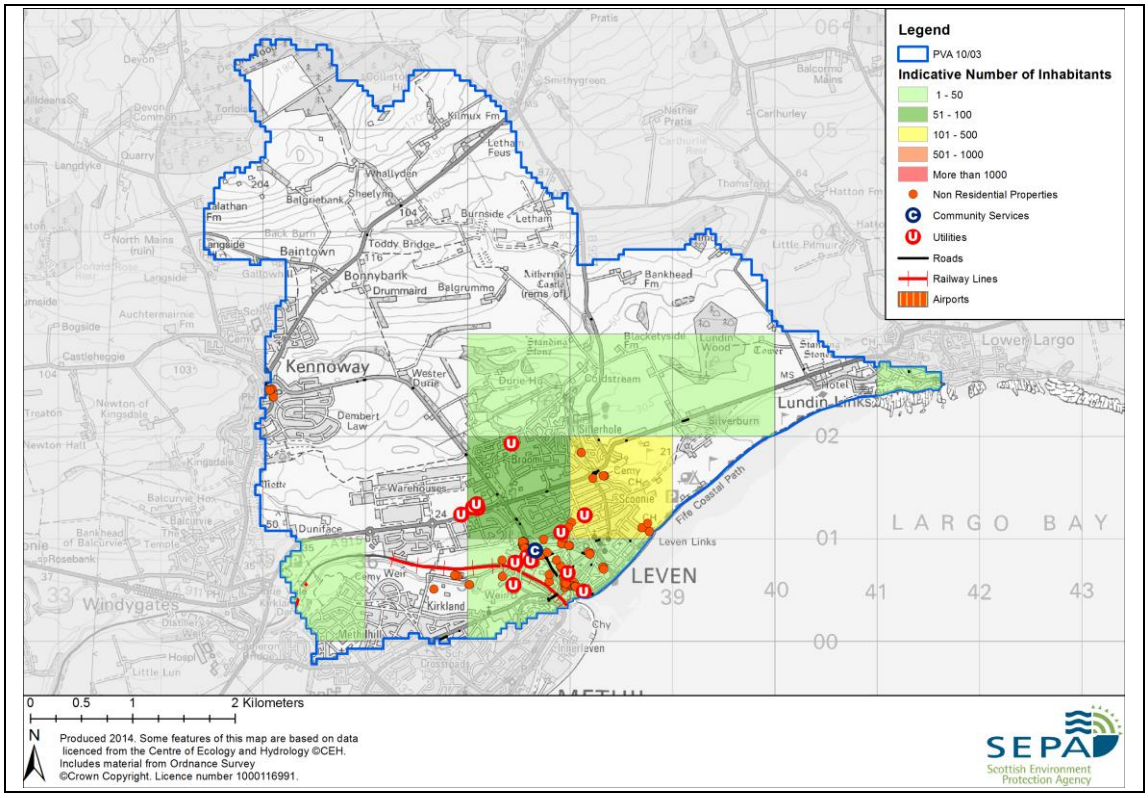


Figure 4: Impacts from all sources at a medium likelihood of flooding

History of flooding

No significant river, coastal or surface water floods have been recorded in this Potentially Vulnerable Area.

Summary of existing local actions to manage risk

There are no formal flood protection schemes in this Potentially Vulnerable Area. However, other actions and natural features may reduce the risk of flooding. These are referenced in the river, coastal and surface water flooding reports.

There are two flood warning target areas within this Potentially Vulnerable Area:

- Lower Largo - Coastal flood warning, Firth of Forth
- Leven and Methil - Coastal flood warning, Firth of Forth.

SEPA and the local authorities work closely with many other organisations that have flooding related duties and interests. These include the police, fire and rescue services, the Scottish Government and the Scottish Flood Forum. SEPA and the local authorities, often in partnership with these organisations, undertake various awareness raising campaigns that include community events, information leaflets, educational plays in schools, the use of social media and advertising.

In addition to the above, the following incentives or subsidies have been put in place to provide property owners with property level resilience/resistance actions:

- Fife Council provides Aquasacs for use in emergencies and these are available from stores located throughout Fife
- Fife Council also operates an Emergency Flood Plan.

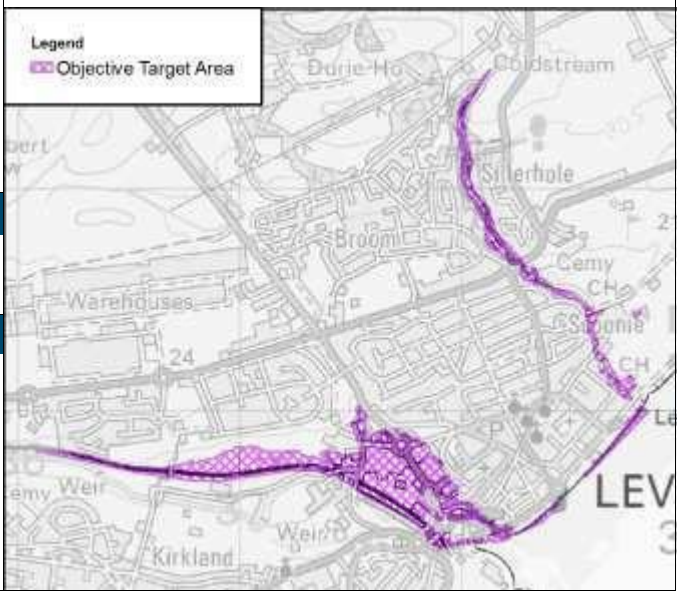
Leven
Potentially Vulnerable Area 10/03
Objectives and potential actions

Unless otherwise stated, information on the following objectives is contained in this document.

IMPORTANT; potential actions that apply across the whole local plan district including flood warning, land use planning, surface water management planning, and other generic actions are described in the Forth Estuary Local Plan District document.

Location	Objective	Objective ID
Applies across Forth Estuary Local Plan District	Avoid an overall increase in flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10001
Applies across Forth Estuary Local Plan District	Reduce overall flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10099
Leven	Reduce economic damages to residential and non-residential properties in Leven caused by flooding from the River Leven and Scoonie Burn. Reduce risk to people in Leven from river flooding from the river Leven and Scoonie Burn.	10006 10007

Leven
Potentially Vulnerable Area 10/03
Objectives and potential actions

Objective(s):	Leven objective target area
Reduce economic damages to residential and non-residential properties in Leven caused by flooding from the River Leven and Scoonie Burn. Reduce risk to people in Leven caused by flooding from the River Leven and Scoonie Burn.	
Objective ID:	
10006, 10007	
Indicators:	
£53,000 annual average damages (residential properties) £330,000 annual average damages (non-residential properties) 90 people at risk (from a medium likelihood event) 1 emergency services building	

Potential action	Action ID	Description
River or floodplain restoration	100060600	Upstream of Leven land with the potential for river or floodplain restoration has been identified. This could offer some reduction in flood risk along the Carriston Reservoir, Kennoway Burn and other watercourses for a high likelihood flood. *Restoring the river corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.*
Sediment management	100060700	*Sediment management can help control the influence of eroded material on flooding by maintaining channel capacity and reducing the impact of siltation.*
Construction of online and offline storage	100061000	Upstream of Leven land with the potential to be used for online or offline storage has been identified. This could offer a reduction in flood risk along the Letham and Scoonie Burn and River Leven for medium likelihood floods. *Flood storage actions retain water in the upper catchment or away from the watercourse, reducing the level and flow in the river. The benefit of these actions decreases further downstream although they can be designed to benefit multiple communities.*
Modification of conveyance	100061100	*Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing channel capacity. The potential benefits of these actions are greatest in areas of frequent flooding.*
Construction of direct flood defences	100061400	Within Leven, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*

Leven
Potentially Vulnerable Area 10/03
Objectives and potential actions

Property level protection	100061700	Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection. *Property level protection can reduce flood impacts by restricting water entering a property, or using construction techniques which increase the resilience of property to flood water. It is most beneficial for flood depths less than 0.6m, in areas prone to frequent flooding.*
Site protection plans	100062100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Improved understanding	100062200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*

Leven (Potentially Vulnerable Area 10/03)

Action	Action ID	Description	Status and Timing	Funding	Responsibility
ONGOING AND CONFIRMED ACTIONS. Actions that are either underway or where the funding has been confirmed for 2016-2021.					
Surface Water Management	10004239	An integrated catchment study will be carried out for Cowdenbeath, Glenrothes, Markinch, Leven and Methil to improve knowledge and understanding of surface water flood risk and interactions with other sources of flooding e.g. with the sewer network, watercourses and the sea.	Confirmed. Planned to be carried out between 2015-2021.	Scottish Water/Fife Council	Scottish Water led in partnership with Fife Council and SEPA
Flood warning schemes – Maintain Firth of Forth and Tay **coastal** flood warning scheme	100993491810	This action has been identified for all existing flood warning schemes. It will be appropriate where the existing scheme meets the needs of the local community.	Ongoing	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	SEPA
Self Help / Awareness Raising		Self help actions (individuals taking action to protect themselves and their property against flooding) can be undertaken by any	Ongoing. Flooding advice is provided on Fife Council website and via Public		Fife Council

Delivery Plan for Consultation

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		individuals, businesses, organisations or communities at risk of flooding. They are applicable to all sources and probabilities of flooding. They focus on awareness and understanding of the flood risk.	information leaflets. These give practical advice and contact information. Fife Council has provided 'Flood Pods' in locations of vulnerable properties which owners can access in times of flood threat. Owners have the right to protect their properties through purchase of property level protection		Fife Council Owners
Emergency Plans		Emergency response plans are applicable for all flood sources and likelihoods. They set out the steps to be taken during a flood event to maximise safety and minimise impacts where possible.	Ongoing. Flooding is included within Fife Council's Emergency planning procedures		Fife Council Emergency Services
Land Use Planning	-	Application of national and local planning policies, including objectives and actions identified in the LPD development plan.	Ongoing	Fife Council's revenue budget	Fife Council
Watercourse Maintenance		Watercourse maintenance	Ongoing, Pre-flood	Council Revenue	Fife Council/

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		can prevent debris accumulating within channels, which may otherwise result in an increased flood risk. It can be undertaken as a regular planned activity or in response to a flood event.	checks undertaken at critical sites. Inspection and maintenance on a regular basis for other locations.	allocation	Landowners

POTENTIAL ACTIONS. The actions below are being consulted upon to support the process of identifying preferred actions. Preferred actions may not be able to be implemented during the period 2016-2021 due to project lead-in times and / or funding constraints.

River or floodplain restoration	100060600	**Upstream of Leven land with the potential for river or floodplain restoration has been identified. This could offer a limited reduction in flood risk along the Carriston Reservoir, Kennoway Burn and other watercourses for a high likelihood event**. Restoring the river corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.	This is a potential action identified through SEPA's strategic options appraisal. Further study/assessment required. Subject to funding availability.	Fife Council
Sediment Management	100060700	Sediment management can help control the sediment balance in the catchment, maintain channel capacity		

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		and reduce the impact of siltation at structures and other key areas.			
Construction of Online and Offline storage	100061000	**Upstream of Leven land with the potential to be used for online or offline storage has been identified. This could offer a reduction in flood risk along the Letham Burn and River Leven for medium likelihood events**. Flood storage actions retain water in the upper catchment or away from the channel, to reduce level and flow in the river. The benefit of these actions decreases further downstream although they can be designed to benefit multiple communities.	This is a potential action identified through SEPA's strategic options appraisal. Further study/assessment required. Subject to funding availability.		Fife Council
Modification of Conveyance	100061100	Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing cross sectional area. The potential benefits of these actions are greatest during high probability events.			
Construction of Direct flood Defences	100061400	**Within Leven, the potential to construct direct**	This is a potential action identified through SEPA's strategic options appraisal. Further		Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood event. Direct defence actions aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at flood risk.	study/assessment required. Subject to funding availability.		
Property level protection	100061700	**Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection.** Property level protection can reduce flood impact by restricting water entering a property, or using construction techniques which are resilient to flood water. It is most beneficial for flood depths <0.6m in areas of high probability flooding	Identified through SEPA's strategic options appraisal. Owners have the right to purchase property level protection. Fife Council provides and maintains flood pods in known flood risk locations which owners of vulnerable property may use if threatened.		Property Owners Fife council
Flood warning schemes	100061800	Flood warning actions enable people and organisations to prepare for an event. They enable the risk of the event to be reduce by moving			

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		people / possessions out of the floodplain and by placing temporary barriers to reduce flooding impacts.			
Site protection plans	100062100	Site protection plans are developed to identify whether normal operation of a facility can be maintained during an event. This may be due to existing protection or resilience of the facility or the network.			
Modelling and other assessments to improve knowledge of flood hazards and impacts	100062200	Improved knowledge of the risks from different events helps to develop plans to avoid or mitigate future flooding to sensitive areas.	Fife Council undertakes flood studies of known flood risk areas and subject to funding will continue to do so where it is considered such knowledge may be of benefit in developing plans to reduce flood risk.		Fife Council
River or floodplain restoration	100070600	**Upstream of Leven land with the potential for river or floodplain restoration has been identified. This could offer a limited reduction in flood risk along the Carriston Reservoir, Kennoway Burn and other watercourses for a high likelihood event.** Restoring the river corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of	This is a potential action identified through SEPA's strategic options appraisal. Further study/assessment required. Subject to funding availability.		Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		flooding downstream.			
Sediment Management	100070700	Sediment management can help control the sediment balance in the catchment, maintain channel capacity and reduce the impact of siltation at structures and other key areas.			
Construction of Online and Offline storage	100071000	**Upstream of Leven land with the potential to be used for online or offline storage has been identified. This could offer a reduction in flood risk along the Letham Burn and River Leven for medium likelihood events.** Flood storage actions retain water in the upper catchment or away from the channel, to reduce level and flow in the river. The benefit of these actions decreases further downstream although they can be designed to benefit multiple communities.	This is a potential action identified through SEPA's strategic options appraisal. Further study/assessment required. Subject to funding availability.		Fife Council
Modification of Conveyance	100071100	Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing cross sectional area. The			

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		potential benefits of these actions are greatest during high probability events.			
Construction of Direct flood Defences	100071400	**Within Leven , the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood event.** Direct defence actions aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at flood risk.	This is a potential action identified through SEPA's strategic options appraisal. Further study/assessment required. Subject to funding availability.		Fife Council
Property level protection	100071700	**Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection.** Property level protection can reduce flood impact by restricting water entering a property, or using construction techniques which are resilient to flood water. It is most beneficial for flood depths <0.6m in areas of high probability flooding	Identified through SEPA's strategic options appraisal. Owners have the right to purchase property level protection. Fife Council provides and maintains flood pods in known flood risk locations which owners of vulnerable property may use if threatened.		Property Owners Fife council

Delivery Plan for Consultation

Action	Action ID	Description	Status and Timing	Funding	Responsibility
Flood warning schemes	100071800	Flood warning actions enable people and organisations to prepare for an event. They enable the risk of the event to be reduce by moving people / possessions out of the floodplain and by placing temporary barriers to reduce flooding impacts.			
Site protection plans	100072100	Site protection plans are developed to identify whether normal operation of a facility can be maintained during an event. This may be due to existing protection or resilience of the facility or the network.			
Modelling and other assessments to improve knowledge of flood hazards and impacts	100072200	Improved knowledge of the risks from different events helps to develop plans to avoid or mitigate future	Fife Council undertakes flood studies of known flood risk areas and subject to funding will continue to do so where it is considered such knowledge may be of benefit in developing plans to reduce flood risk.		Fife Council
Surface water management	10004238	Develop a plan for Leven and eastern Methil for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	Recommended actions agreed by all partners identified by 2019.		Fife Council
Develop new flood warning. Properties in Leven affected	100994401800	The inclusion of these areas of potential hasn't taken into	Potential actions are drawn from a short list of	The maintenance of SEPA's flood warning	SEPA

Action	Action ID	Description	Status and Timing	Funding	Responsibility
by flooding from the River Ore.		account the feasibility of offering a warning in each location so they will be subject to further screening and analysis of technical, operational and financial feasibility.	options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being of priority are dependent on funding.	service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	
Flood warning schemes – Improve sign up of Firth of Forth and Tay **coastal** flood warning scheme	100993491822	This action has been identified because the sign-up rate in some of the FWTAs within this scheme is less than the target of 40%. If the action is progressed, the sign-up rate for the relevant FWTAs will be improved via a targeted communications campaign.	Potential actions are drawn from a short list of options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being of priority are dependent on funding.	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	SEPA
Flood warning schemes – Simplify Firth of Forth and Tay **coastal** flood warning scheme	100993491830	This action has been identified because other structural actions are being considered in this area which may reduce the need for a detailed flood warning scheme.	Potential actions are drawn from a short list of options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being of priority are dependent on funding.	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	SEPA

Kinross, Milnathort, Glenrothes and Kinglassie (Potentially Vulnerable Area 10/04)

Local Plan District	Local Authorities	Main Catchment
10 Forth Estuary	Fife, Perth and Kinross	River Leven (Fife)

Background

This Potentially Vulnerable Area covers an area of 201km^2 and covers the north half of the River Leven catchment (Figure 1). It includes Glenrothes, Kinross and Milnathort. The main watercourses are the River Leven and its tributaries, the Lochty Burn, North and South Queich and the Back Burn.

The main source of flooding is surface water, closely followed by river flooding (Figure 2). The highest risk of flooding is in Glenrothes from the River Leven and surface water.

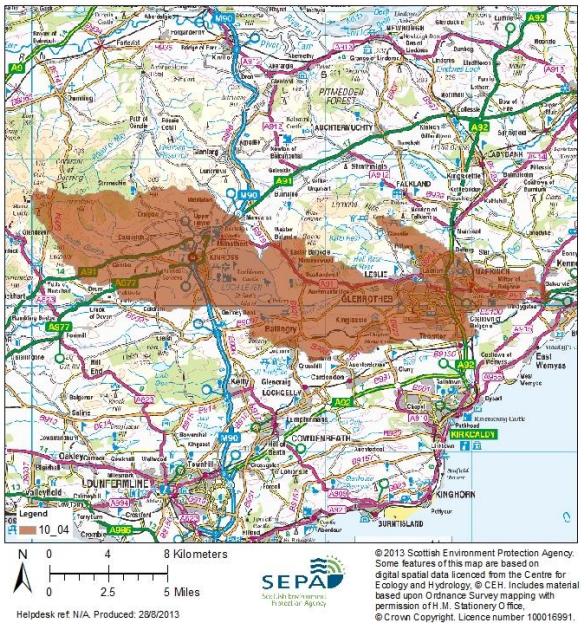


Figure 1: Potentially Vulnerable Area 10/04

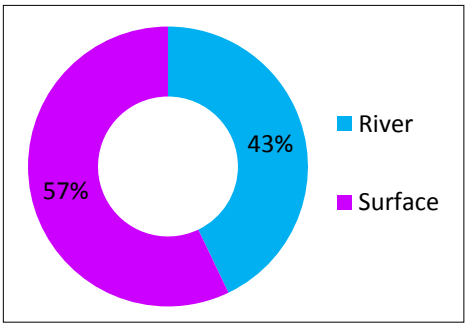


Figure 2: Annual Average Damages by flood source

Summary of flooding impacts

Approximately 210 residential properties and 150 non-residential properties are at a medium likelihood of flooding from one or more sources. A summary of the impacts from flooding can be seen in Table 1. A map showing the impacts of flooding from all sources during a medium likelihood event can be seen in Figure 4.

The total Annual Average Damages from all sources of flooding are approximately £1.2 million. This includes damages to residential properties, non-residential properties, transport and agriculture. The economic damages incurred for each return period can be seen in Figure 3. For this Potentially Vulnerable Area the highest damages are to non-residential properties followed by damages to roads.

	High likelihood	Medium likelihood	Low likelihood
No. of residential properties	60	210	320
No. of non-residential properties	50	150	200
No. of people	130	460	700
Community facilities	<10 Educational buildings	<10 Educational buildings <10 Care homes	<10 Educational buildings <10 Care homes
Utilities	<10 Energy sites	30 Energy sites	40 Energy sites
Transport links (excluding minor roads)	17 roads affected at 205 locations • 1 M road: M90 • 7 A roads • 9 B roads 2 railway routes affected at 13 locations • Fife Circle: Dalmeny to Winchburgh and Haymarket West Junctions • Perth to Ladybank	17 roads affected at 326 locations • 1 M road: M90 • 7 A roads • 9 B roads 2 railway routes affected at 16 locations • Fife Circle: Dalmeny to Winchburgh and Haymarket West Junctions • Perth to Ladybank Fife Airport	17 roads affected at 360 locations • 1 M road: M90 • 7 A roads • 9 B roads 2 railway routes affected at 16 locations • Fife Circle: Dalmeny to Winchburgh and Haymarket West Junctions • Perth to Ladybank Fife Airport
Environmental designated areas (km^2)	$46.5km^2$ • 2 SSSI • 1 SPA • 1 SAC	$46.5km^2$ • 2 SSSI • 1 SPA • 1 SAC	$46.5km^2$ • 2 SSSI • 1 SPA • 1 SAC
No. of cultural heritage sites	6	7	7
Agricultural land (km^2)	$8.0km^2$	$10.5km^2$	$11.1km^2$

Table 1: Summary of flooding impacts

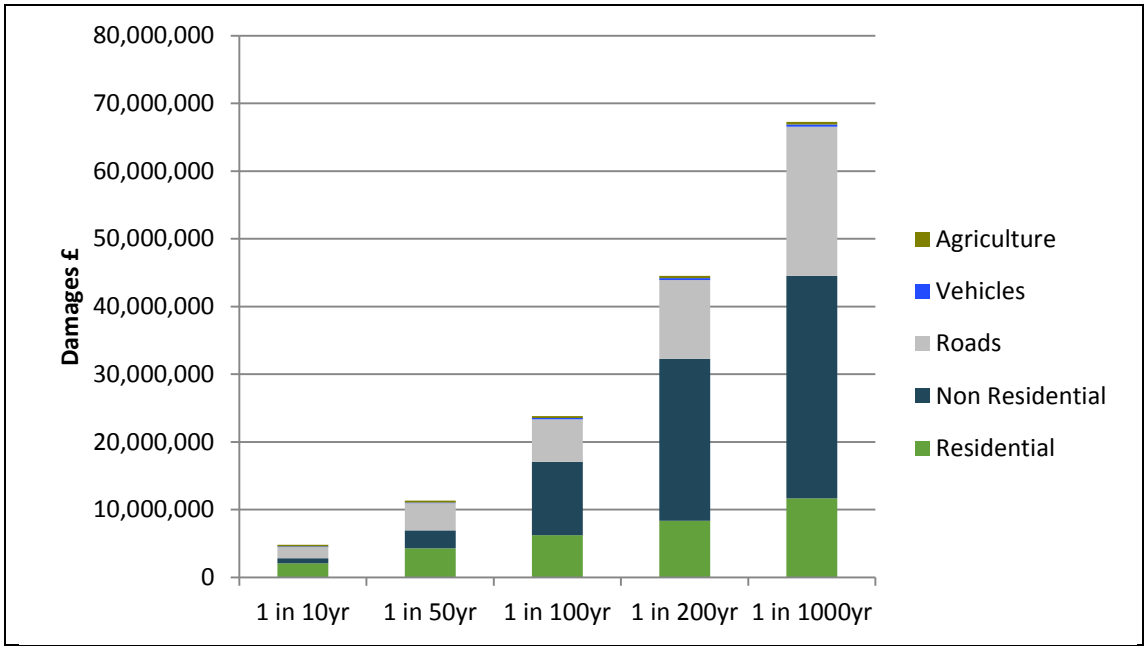


Figure 3: Damages by flood frequency

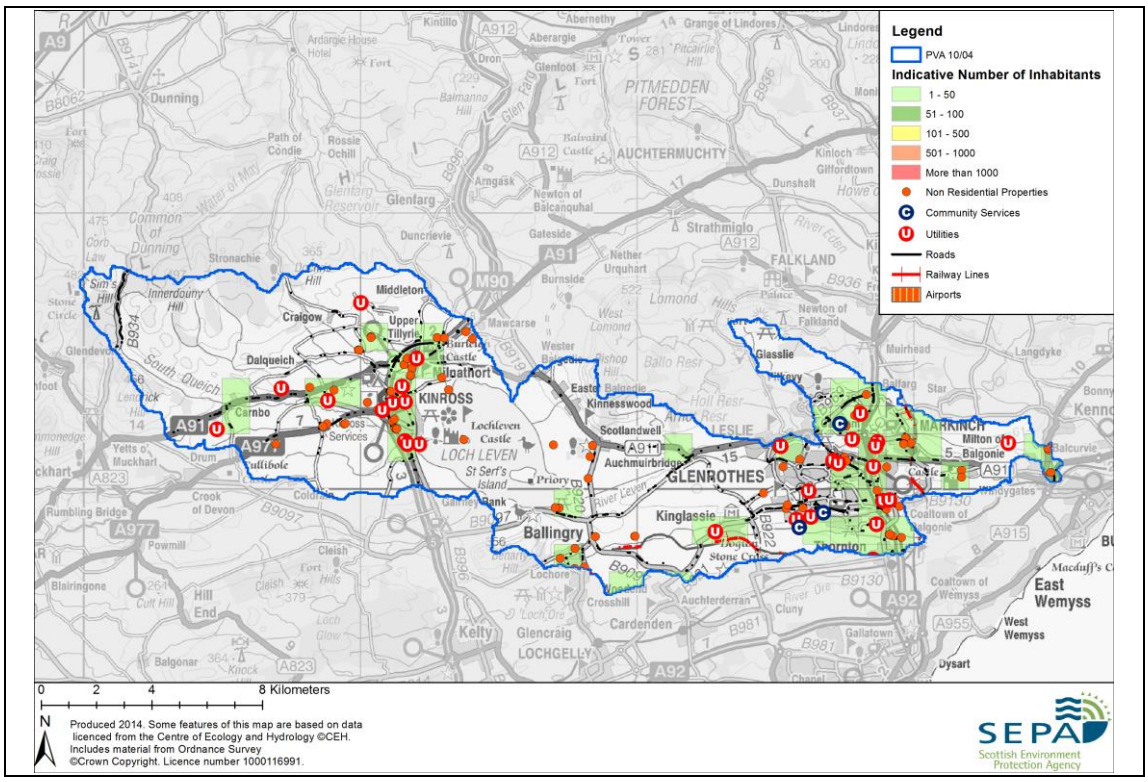


Figure 4: Impacts from all sources at a medium likelihood of flooding

History of flooding

The following river floods have been identified as significant in this Potentially Vulnerable Area:

- 13 December 2006: The centre of Milnathort was flooded from the Back Burn affecting a number of commercial, industrial and domestic properties. In Kinross, properties were affected on the north and south banks of the South Queich in the vicinity of the Industrial Estate, Queich Place, High Street and the Auction Mart
- 13 & 14 January 1993, Milnathort/Kinross: The centre of Milnathort was flooded from the Back Burn. The South Queich also affected houses and industrial properties in the South of Kinross

The following surface water flood has been identified as significant in this Potentially Vulnerable Area:

- 6 June 2009: Heavy rain caused surface water flooding in areas of Fife and Perth and Kinross, including Milnathort

Summary of existing local actions to manage risk

There is one formal flood protection scheme in this Potentially Vulnerable Area. This is the Milnathort Flood Protection Scheme. Other actions and natural features may also reduce the risk of flooding. These are referenced in the river, coastal and surface water flooding reports.

SEPA and the local authorities work closely with many other organisations that have flooding related duties and interests. These include the police, fire and rescue services, the Scottish Government and the Scottish Flood Forum. SEPA and the local authorities, often in partnership with these organisations, undertake various awareness raising campaigns that include community events, information leaflets, educational plays in schools, the use of social media and advertising.

In addition, Perth and Kinross Council are part of a wider community resilience group which works with various communities including Milnathort to develop community resilience plans.

As well as the above, the following incentives or subsidies have been put in place to provide property owners with property level resilience/resistance actions:

- Fife Council provides Aquasacs for use in emergencies and these are available from stores (‘flood pods’) located throughout Fife;
- Fife Council also operates an Emergency Flood Plan;
- Protecting property from flooding is the responsibility of the owner of the property, but Perth & Kinross Council can sometimes provide sandbags to properties. However, the Council only has the resources to supply sandbags to residents where there is an imminent risk of flooding;
- Perth and Kinross Council is currently working towards introducing a pilot project for flood protection products for properties in flood risk areas.

Kinross, Milnathort, Glenrothes, Kinglassie Potentially Vulnerable Area 10/04 Objectives and potential actions

Unless otherwise stated, information on the following objectives is contained in this document.

IMPORTANT; potential actions that apply across the whole local plan district including flood warning, land use planning, surface water management planning, and other generic actions are described in the Forth Estuary Local Plan District document.

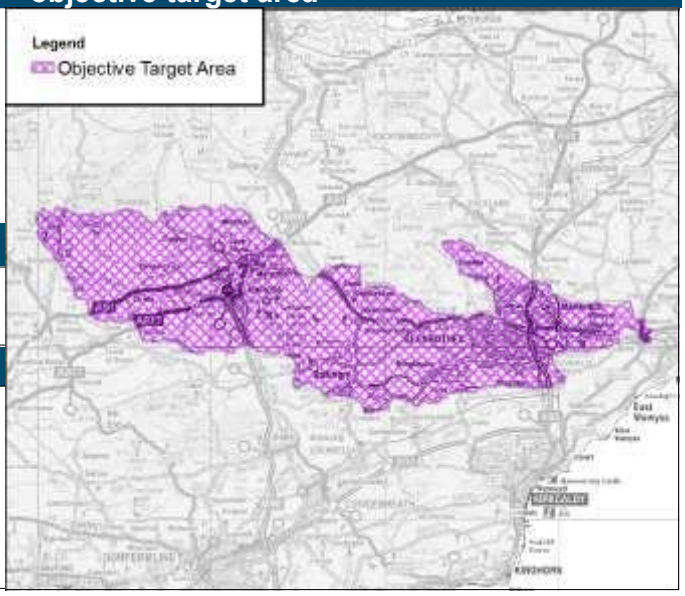
Location	Objective	Objective ID
Applies across Forth Estuary Local Plan District	Avoid an overall increase in flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10001
Applies across Forth Estuary Local Plan District	Reduce overall flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10099
Milnathort	Accept that significant flood risk in Milnathort is being managed appropriately. Maintain existing actions that reduce the risk of flooding in Milnathort from the Back Burn.	10010
Remainder of the Potentially Vulnerable Area	Reduce economic damages to residential and non-residential properties caused by river flooding.	10011
Glenrothes	Reduce risk to people in Glenrothes from river flooding.	10012

Kinross, Milnathort, Glenrothes, Kinglassie Potentially Vulnerable Area 10/04 Objectives and potential actions

Objective(s):	Milnathort objective target area
Accept that significant flood risk in Milnathort is being managed appropriately. Maintain existing actions that reduce the risk of flooding in Milnathort from the Back Burn.	
Objective ID:	
10010	
Indicators:	
40 residential properties and non-residential properties protected (from 1 in 100 year flood). £260,000 damages avoided.	

Potential action	Action ID	Description
Maintenance of existing flood protection schemes	100100100	Existing defences along the Back Burn provide protection to residential and/or non-residential properties up to a 1 in 100 year flood. *Ongoing maintenance of existing defences will ensure they continue to offer protection from flooding. This applies to all types of existing defences although appropriate maintenance activities may vary.*
Improved understanding	100102200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*
Site protection plans	100102100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*

Kinross, Milnathort, Glenrothes, Kinglassie Potentially Vulnerable Area 10/04 Objectives and potential actions

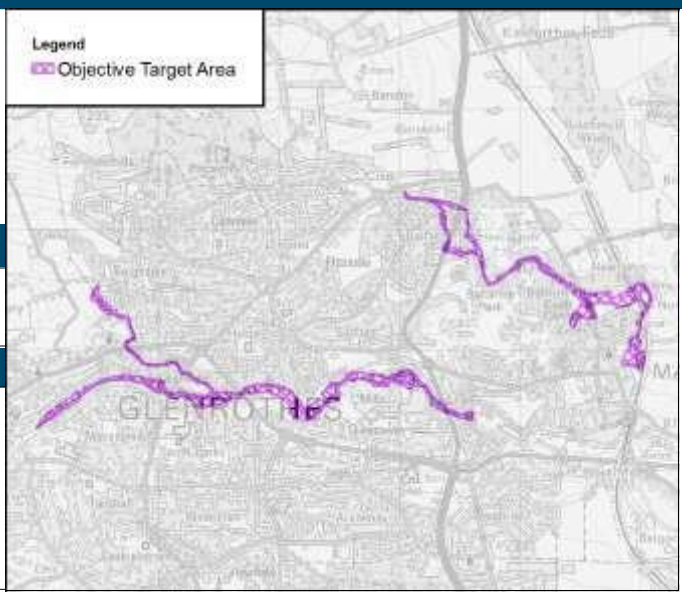
Objective(s):	Remainder of the Potentially Vulnerable Area objective target area
Reduce economic damages to residential and non-residential properties caused by river flooding.	
Objective ID:	
10011	
Indicators:	
£180,000 annual average damages (residential properties) £250,000 annual average damages (non-residential properties)	

Potential action	Action ID	Description
Maintenance of existing flood protection schemes	100110100	Existing flood defences provide protection to residential and/or non-residential properties up to a 1 in 100 year flood. *Ongoing maintenance of existing defences will ensure they continue to offer protection from flooding. This applies to all types of existing defences although appropriate maintenance activities may vary.*
Runoff control	100110500	An area with the potential to be used for runoff control has been identified. Further analysis has shown that due to its positioning within the catchment and / or its size, this action may not reduce flood risk in the target areas. *Runoff control looks to enhance the ability of the catchment to capture and slow water reaching the receiving watercourses. These actions often achieve the greatest benefits in areas of frequent flooding.*
River or floodplain restoration	100110600	Land with the potential to be used for river or floodplain restoration has been identified. This could offer some reduction in flood risk for a high likelihood flood. *Restoring the river corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.*
Sediment management	100110700	*Sediment management can help control the influence of eroded material on flooding by maintaining channel capacity and reducing the impact of siltation.*
Construction of online and offline storage	100111000	Land with the potential to be used for online or offline storage has been identified. This could offer a reduction in flood risk for medium likelihood floods. *Flood storage actions retain water in the upper catchment or away from the watercourse, reducing the level and flow in the river. The benefit of these actions decreases further downstream although they can be designed to benefit multiple communities.*

Kinross, Milnathort, Glenrothes, Kinglassie Potentially Vulnerable Area 10/04 Objectives and potential actions

Modification of conveyance	100111100	*Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing channel capacity. The potential benefits of these actions are greatest in areas of frequent flooding.*
Construction of direct flood defences	100111400	The potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*
Property level protection	100111700	Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection. *Property level protection can reduce flood impacts by restricting water entering a property, or using construction techniques which increase the resilience of property to flood water. It is most beneficial for flood depths less than 0.6m, in areas prone to frequent flooding.*
Site protection plans	100112100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Improved understanding	100112200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*
Relocation	100110200	Some of the properties that have been identified to be at risk of flooding may be suitable for relocation. *Relocation of properties or infrastructure may be applicable in locations where frequent flooding is expected and where areas may otherwise be difficult or uneconomical to protect.*

Kinross, Milnathort, Glenrothes, Kinglassie Potentially Vulnerable Area 10/04 Objectives and potential actions

Objective(s):	Glenrothes objective target area
Reduce risk to people in Glenrothes from river flooding.	
Objective ID:	
10012	
Indicators:	
30 people at risk (from a medium likelihood flood)	

Potential action	Action ID	Description
Modification of conveyance	100121100	*Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing channel capacity. The potential benefits of these actions are greatest in areas of frequent flooding.*
Improved understanding	100122200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*

Kinross, Milnathort, Glenrothes, Kinglassie (Potentially Vulnerable Area 10/04)

Action	Action ID	Description	Status and Timing	Funding	Responsibility
ONGOING AND CONFIRMED ACTIONS. Actions that are either underway or where the funding has been confirmed for 2016-2021.					
Surface Water Management	10004239	An integrated catchment study will be carried out for Cowdenbeath, Glenrothes, Markinch, Leven and Methil to improve knowledge and understanding of surface water flood risk and interactions with other sources of flooding e.g. with the sewer network, watercourses and the sea.	Confirmed. Planned to be carried out between 2015-2021.	Scottish Water/Fife Council	Scottish Water led in partnership with Fife Council and SEPA
Maintenance of existing flood protection schemes	100100100 100110100	Existing defences along the Back (or Fochy) Burn provide protection to residential and non residential properties up to a 1 in 100 year event. Ongoing maintenance of existing defences will ensure that they continue to offer protection from flooding. This applies to all types of existing defences although appropriate maintenance activities may vary.	On-going	Perth and Kinross Council revenue budget	Perth and Kinross Council

Delivery Plan for Consultation

Action	Action ID	Description	Status and Timing	Funding	Responsibility
Self Help / Awareness Raising		Self help actions (individuals taking action to protect themselves and their property against flooding) can be undertaken by any individuals, businesses, organisations or communities at risk of flooding. They are applicable to all sources and probabilities of flooding. They focus on awareness and understanding of the flood risk.	Ongoing. Flooding advice is provided on Council websites and via Public information leaflets. These give practical advice and contact information. Fife Council has provided 'Flood Pods' in locations of vulnerable properties which owners can access in times of flood threat. Owners have the right to protect their properties through purchase of property level protection		Fife Council / Perth & Kinross Council Fife Council Owners
Emergency Plans		Emergency response plans are applicable for all flood sources and likelihoods. They set out the steps to be taken during a flood event to maximise safety and minimise impacts where possible.	Ongoing. Flooding is included within Fife and Perth & Kinross Council's Emergency planning procedures	Proportional funding by appropriate Council's Revenue Budgets	Fife Council Perth & Kinross Council Emergency Services
Land Use Planning	-	Application of national and	Ongoing	Proportional funding by	Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		local planning policies, including objectives and actions identified in the LPD development plan.		appropriate Council's Revenue Budgets	Perth & Kinross Council
Watercourse Maintenance		Watercourse maintenance can prevent debris accumulating within channels, which may otherwise result in an increased flood risk. It can be undertaken as a regular planned activity or in response to a flood event.	Ongoing, Pre-flood checks undertaken at critical sites. Inspection and maintenance on a regular basis for other locations.	Proportional funding by appropriate Council's Revenue Budgets	Fife Council Perth & Kinross Council Property Owner

POTENTIAL ACTIONS. The actions below are being consulted upon to support the process of identifying preferred actions. Preferred actions may not be able to be implemented during the period 2016-2021 due to project lead-in times and / or funding constraints.

Relocation of properties/infrastructure away from flood risk areas	100110200	**Properties have been identified to be at risk in a high likelihood event and may therefore be suitable for relocation.** Relocation of properties or infrastructure, currently at risk of flooding, away from the flood risk area may be applicable in locations where frequent flooding is expected to a limited area that may be otherwise	Fife and Perth and Kinross Council have not at this stage identified any properties for relocation and have no plans to implement this measure in this PVA.	Perth & Kinross Council Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		difficult or uneconomical to protect.			
Runoff Control	100110500	**An area with the potential to be used for runoff control has been identified. Further analysis has shown that due to its positioning within the catchment and / or its size, this action will not reduce flood risk in the target area.** Runoff control actions look to enhance the natural catchment ability to capture and slow runoff water reaching the receiving watercourses. These actions often experience the greatest benefits in areas of high probability flooding.	This is a potential action identified through SEPA's strategic option appraisal. Subject to funding, work may be required to further investigate flood risk and potential solutions. If any resulting potential action is found to be viable then Perth & Kinross Council will seek funding to carry out the necessary detailed study work from existing budgets or the funding settlement from the Scottish Government for the period 2016-2021.		Perth & Kinross Council
River or floodplain restoration	100110600	**Land with the potential to be used for river or floodplain restoration has been identified. This could offer a limited reduction in flood risk along the Back Burn, North Queich Burn for a high likelihood event.** Restoring the river	This is a potential action identified through SEPA's strategic option appraisal Work may be required to further investigate flood risk and potential solutions. If any resulting potential action is found to be viable then Perth & Kinross Council will seek funding to carry out the necessary detailed study work from existing budgets or the funding		Perth & Kinross Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.	settlement from the Scottish Government for the period 2016-2021.		
Sediment Management	100110700	Sediment management can help control the sediment balance in the catchment, maintain channel capacity and reduce the impact of siltation at structures and other key areas.	This is a potential action identified through SEPA's strategic option appraisal. Subject to funding work may be required to further investigate flood risk and potential solutions. If any resulting potential action is found to be viable then Perth & Kinross Council will seek funding to carry out the necessary detailed study work from existing budgets or the funding settlement from the Scottish Government for the period 2016-2021.		Perth & Kinross Council
Construction of Online and Offline storage	100111000	**Upstream of Milnathort land with the potential to be used for online or offline storage has been identified. This could offer a reduction in flood risk along the Back Burn for medium likelihood events.** Flood storage actions retain water in the upper catchment or away from the channel, to reduce level and flow in the river.	This is a potential action identified through SEPA's strategic option appraisal. Work may be required to further investigate flood risk and potential solutions. If any resulting potential action is found to be viable then Perth & Kinross Council will seek funding to carry out the necessary detailed study work from existing budgets or the funding settlement from the Scottish Government for the period 2016-2021.		Perth & Kinross Council

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Action	Action ID	Description	Status and Timing	Funding	Responsibility
		The benefit of these actions decreases further downstream although they can be designed to benefit multiple communities.			
Modification of Conveyance	100111100	Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing cross sectional area. The potential benefits of these actions are greatest during high probability events.	This is a potential action identified through SEPA's strategic option appraisal. Subject to funding work may be required to further investigate flood risk and potential solutions. If any resulting potential action is found to be viable then Perth & Kinross Council will seek funding to carry out the necessary detailed study work from existing budgets or the funding settlement from the Scottish Government for the period 2016-2021.		Fife Council Perth & Kinross Council
Construction of Direct flood Defences	100111400	**The potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood event.** Direct defence actions aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at flood risk.	This is a potential action identified through SEPA's strategic option appraisal. Subject to funding work may be required to further investigate flood risk and potential solutions. If any resulting potential action is found to be viable then Perth & Kinross Council will seek funding to carry out the necessary detailed study work from existing budgets or the funding settlement from the Scottish Government for the period 2016-2021.		Fife Council Perth & Kinross Council

Delivery Plan for Consultation

Action	Action ID	Description	Status and Timing	Funding	Responsibility
Property level protection	100111700	**Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection.** Property level protection can reduce flood impact by restricting water entering a property, or using construction techniques which are resilient to flood water. It is most beneficial for flood depths <0.6m in areas of high probability flooding	Owners have the right to purchase property level protection. Statutory authorities will help to raise awareness among property owners. Fife Council provides and maintains flood pods in known flood risk locations which owners of vulnerable property may use if threatened.		Property Owners Fife council
Site protection plans	100102100 100112100	Site protection plans are developed to identify whether normal operation of a facility can be maintained during an event. This may be due to existing protection or resilience of the facility or the network.	This is a potential action identified through SEPA's strategic option appraisal. The site landowner or operator is responsible for taking measures to manage flood risk on their site as such they should develop their own plans.		Site landowner/ Operator
Modelling and other assessments to improve knowledge of flood hazards and impacts	100102200 100112200	Improved knowledge of the risks from different events helps to develop plans to avoid or mitigate future flooding to sensitive areas.	Fife Council undertakes flood studies of known flood risk areas and subject to funding will continue to do so where it is considered such knowledge may be of benefit in developing plans to reduce flood risk. This is a potential action identified through SEPA's strategic option		Fife Council SEPA/ Perth & Kinross Council/

Action	Action ID	Description	Status and Timing	Funding	Responsibility
			appraisal. Subject to funding work may be required to further investigate flood risk and potential solutions. If any resulting potential action is found to be viable then Perth & Kinross Council will seek funding to carry out the necessary detailed study work from existing budgets or the funding settlement from the Scottish Government for the period 2016-2021.		Scottish Water
Maintenance of existing flood protection schemes	100120100	Ongoing maintenance of existing defences will ensure they continue to offer protection from flooding. This applies to all types of existing defences although appropriate maintenance activities may vary.			
Sediment Management	100120700	Sediment management can help control the sediment balance in the catchment, maintain channel capacity and reduce the impact of siltation at structures and other key areas.			
Modification of Conveyance	100121100	Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or			

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		increasing cross sectional area. The potential benefits of these actions are greatest during high probability events.			
Construction of Direct flood Defences	100121400	**Within Glenrothes, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood event.** Direct defence actions aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at flood risk.	This is a potential action identified through SEPA's strategic options appraisal. Further study/assessment required. Subject to funding availability		Fife Council
Property level protection	100121700	**No properties have been identified to be at risk in a high likelihood event and therefore suitable for property level protection.** Property level protection can reduce flood impact by restricting water entering a property, or	Owners have the right to purchase property level protection. Fife Council provides and maintains flood pods in known flood risk locations which owners of vulnerable property may use if threatened.		Property Owners Fife council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		using construction techniques which are resilient to flood water. It is most beneficial for flood depths <0.6m in areas of high probability flooding			
Flood warning schemes	100121800	Flood warning actions enable people and organisations to prepare for an event. They enable the risk of the event to be reduce by moving people / possessions out of the floodplain and by placing temporary barriers to reduce flooding impacts.			SEPA
Site protection plans	100122100	Site protection plans are developed to identify whether normal operation of a facility can be maintained during an event. This may be due to existing protection or resilience of the facility or the network.			
Modelling and other assessments to improve knowledge of flood hazards and impacts	100122200	Improved knowledge of the risks from different events helps to develop plans to avoid or mitigate future flooding to sensitive areas.			
Glenrothes and Markinch covered by a surface water management plan	100082381	The area must be covered by a surface water	Potential. Recommended actions agreed by all partners identified by 2019.		Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		management plan or plans that set objectives for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.			
Develop new flood warning. Properties in Kinross affected by flooding from the River Leven	100994391800	The inclusion of these areas of potential hasn't taken into account the feasibility of offering a warning in each location so they will be subject to further screening and analysis of technical, operational and financial feasibility.	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes. Potential actions are drawn from a short list of options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being of priority are dependent on funding.		SEPA
Milnathort covered by a surface water management plan	10008238	The area must be covered by a surface water management plan or plans that set objectives for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	Yet to commence. Perth & Kinross Council to seek funding to progress.		Perth & Kinross Council/ Scottish Water

Kirkcaldy, East Wemyss and Methil (Potentially Vulnerable Area 10/05)

Local Plan District	Local Authorities	Main Catchment
10 Forth Estuary	Fife Council	South Fife Coastal

Background

This Potentially Vulnerable Area covers an area of 71km^2 and is part of the Firth of Forth catchment. This is a moderately sized, partially urbanised costal area in the east of the catchment containing the towns of Kircaldy, Burntisland and Methil (Figure 1). The main watercourses are the Tiel and East/Den Burns in Kirkcaldy and the Chemiss/Kingslaw Burn in East Wemyss.

The highest risk of river flooding is from Tiel Burn to Kirkcaldy. The highest risk of surface water flooding is also in Kirkcaldy. The majority of flood damages are caused by river flooding (Figure 2).

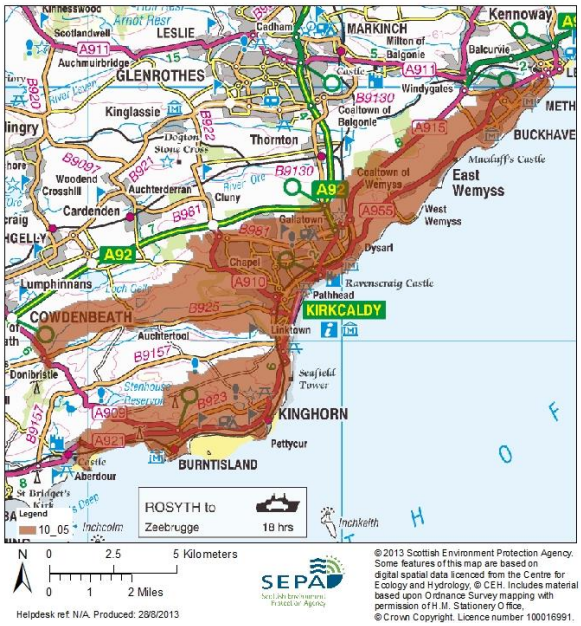


Figure 1: Potentially Vulnerable Area 10/05

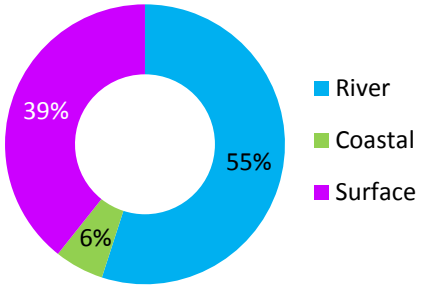


Figure 2: Annual Average Damages by flood source

Summary of flooding impacts

Approximately 190 residential properties and 180 non-residential properties are at a medium likelihood of flooding from one or more sources. A summary of the impacts from flooding can be seen in Table 1. A map showing the impacts from all sources at a medium likelihood of flooding can be seen in Figure 4.

The total Annual Average Damages from all sources of flooding are approximately £840,000. This includes damages to residential properties, non-residential properties, transport and agriculture. The economic damages incurred for each return period can be seen in Figure 3. For this Potentially Vulnerable Area the highest damages are to non-residential property followed by damages to residential properties.

In 2010 Scottish Water carried out a Flood Risk Assessment Study of water and wastewater assets across Scotland. Of the assets assessed, seven wastewater assets were identified as being at risk of flooding within this Potentially Vulnerable Area.

	High likelihood	Medium likelihood	Low likelihood
No. of residential properties	40	190	510
No. of non-residential Properties	80	180	260
No. of people	90	420	1,100
Community facilities	<10 Care homes	<10 Care homes	<10 Educational buildings <10 Emergency services buildings <10 Care homes
Utilities	10 Energy sites	~30 Energy sites <10 Communications sites <10 Scottish Water assets	~40 Energy sites <10 Communications sites <10 Scottish Water assets
Transport links (excluding minor roads)	15 Roads affected at 85 locations • 6 A roads • 9 B roads 2 Railway routes affected at 12 locations • Fife Circle • Dalmeny to Winchburgh and Haymarket West Junctions	16 Roads affected at 165 locations • 6 A roads • 10 B roads 2 Railway routes affected at 33 locations • Fife Circle • Dalmeny to Winchburgh and Haymarket West Junctions	16 Roads affected at 203 locations • 6 A roads • 10 B roads 2 Railway routes affected at 40 locations • Fife Circle • Dalmeny to Winchburgh and Haymarket West Junctions
Environmental designated areas (km^2)	$0.5km^2$ • 2 SSSI • 1 SPA • 1 SAC	$0.5km^2$ • 2 SSSI • 1 SPA • 1 SAC	$0.5km^2$ • 2 SSSI • 1 SPA • 1 SAC
No. of cultural heritage sites	6	7	8
Agricultural land (km^2)	$0.4km^2$	$0.5km^2$	$0.6km^2$

Table 1: Summary of flooding impacts

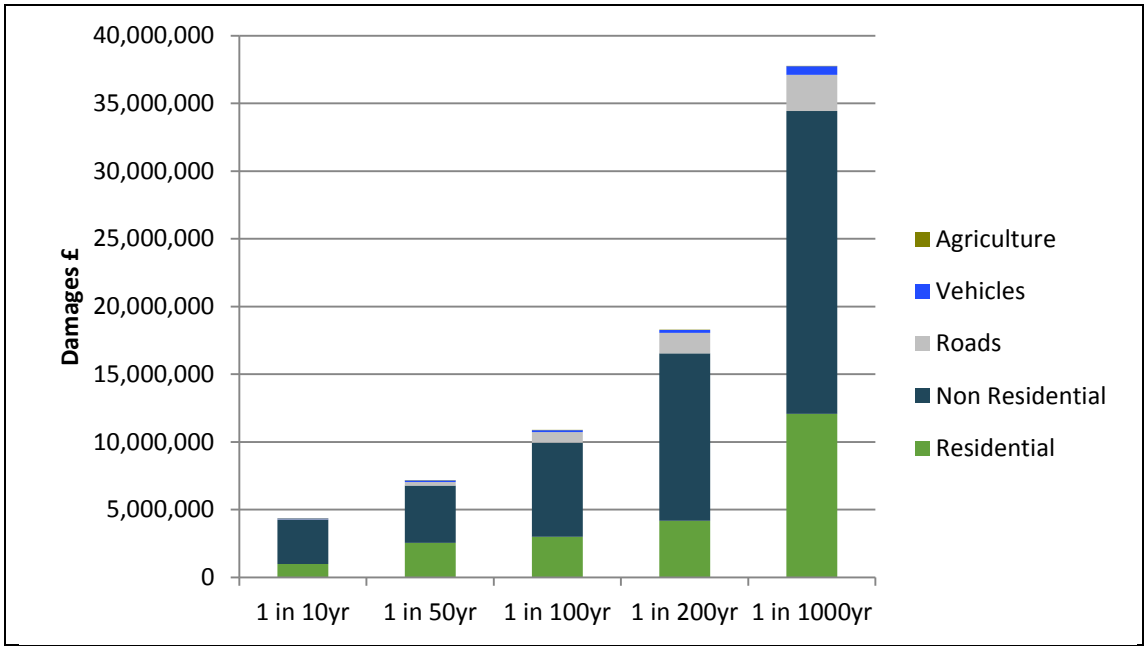


Figure 3: Damages by flood frequency

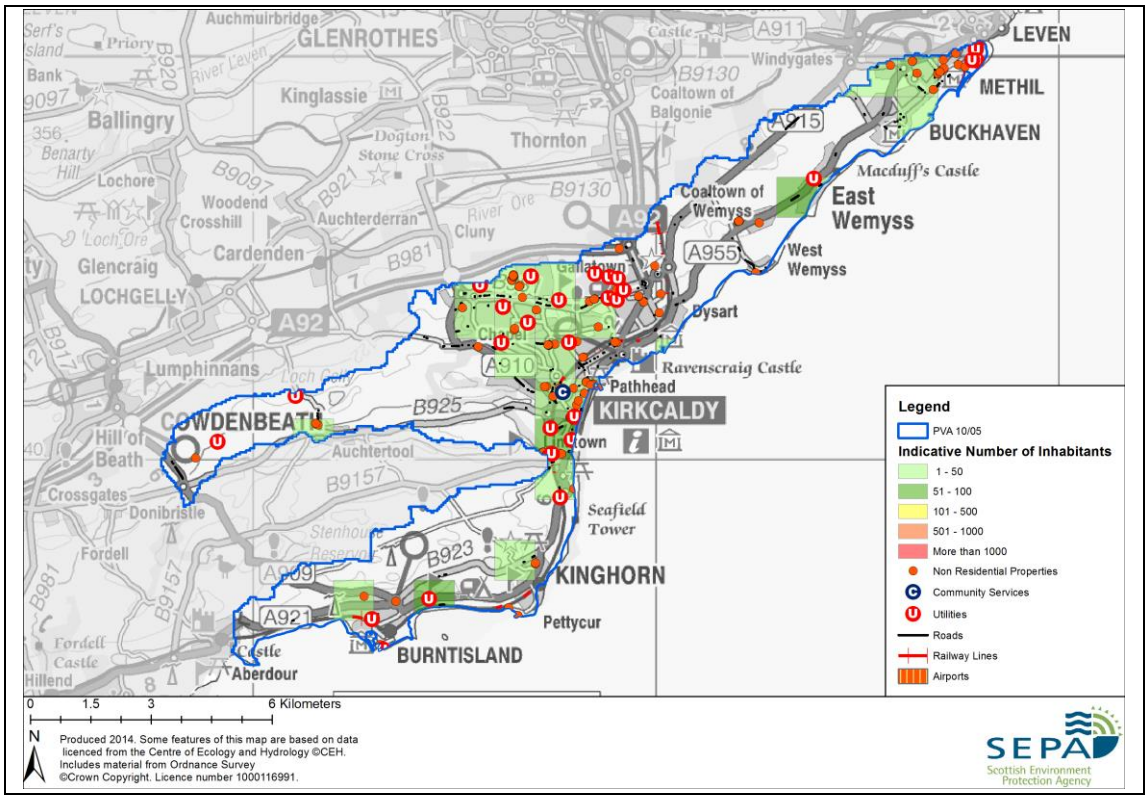


Figure 4: Impacts from all sources at a medium likelihood of flooding

History of flooding

The following coastal floods have been identified as significant in this Potentially Vulnerable Area:

- 30 March 2010: The Mercat and Acorn Pets, Kirkcaldy closed after flooding to Esplanade Road.
- 18 March 1969: 2 boats sunk in harbour and esplanade flooded under 2 feet of water. Transport services interrupted.
- 4 April 1958: 40 families evacuated in Kirkcaldy. Homes and businesses flooded, cars washed away and civil infrastructure damaged.
- 1 October 1947: Waves up to 30 feet affected Kirkcaldy with properties and cars damaged from flood waters.

No significant river or surface water floods have been recorded in this Potentially Vulnerable Area.

Summary of existing local actions to manage risk

There are no formal flood protection schemes in this Potentially Vulnerable Area. However, other actions and natural features may reduce the risk of flooding. These are referenced in the river, coastal and surface water flooding reports.

There are four flood warning target areas within this Potentially Vulnerable Area:

- Kinghorn - Coastal flood warning, Firth of Forth;
- Burntisland to Aberdour - Coastal flood warning, Firth of Forth;
- Kirkcaldy - Coastal flood warning, Firth of Forth;
- Leven and Methil - Coastal flood warning, Firth of Forth.

SEPA and the local authorities work closely with many other organisations that have flooding related duties and interests. These include the police, fire and rescue services, the Scottish Government and the Scottish Flood Forum. SEPA and the local authorities, often in partnership with these organisations, undertake various awareness raising campaigns that include community events, information leaflets, educational plays in schools, the use of social media and advertising.

In addition to the above, the following incentives or subsidies have been put in place to provide property owners with property level resilience/resistance actions:

- Fife Council provides Aquasacs for use in emergencies and these are available from stores located throughout Fife
- Fife Council also operates an Emergency Flood Plan.

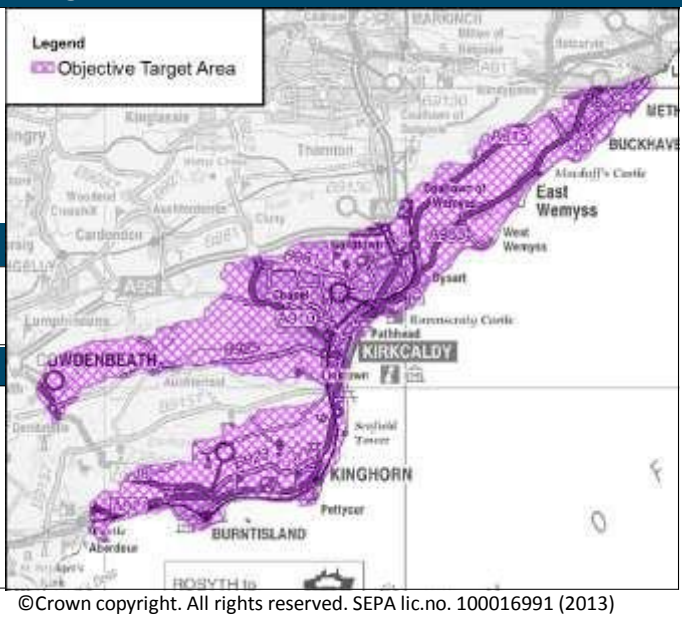
Kirkcaldy, East Wemyss, Methil Potentially Vulnerable Area 10/05 Objectives and potential actions

Unless otherwise stated, information on the following objectives is contained in this document.

IMPORTANT; potential actions that apply across the whole local plan district including flood warning, land use planning, surface water management planning, and other generic actions are described in the Forth Estuary Local Plan District document.

Location	Objective	Objective ID
Applies across Forth Estuary Local Plan District	Avoid an overall increase in flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10001
Applies across Forth Estuary Local Plan District	Reduce overall flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10099
Kirkcaldy, East Wemyss, Methil	Reduce economic damages to residential and non-residential properties caused by river and coastal flooding.	10015
Kirkcaldy	Reduce risk to people in Kirkcaldy from river flooding.	10016

Kirkcaldy, East Wemyss, Methil Potentially Vulnerable Area 10/05 Objectives and potential actions

Objective(s):	Kirkcaldy, Easy Wemyss, Methil objective target area
Reduce economic damages to residential and non-residential properties caused by river and coastal flooding.	
Objective ID:	
10015	
Indicators:	
£130,000 annual average damages (residential properties) £330,000 annual average damages (non-residential properties)	

Potential action	Action ID	Description
Maintenance of existing flood protection schemes	100150100	Existing coastal defences provide protection to residential and/or non-residential properties. *Ongoing maintenance of existing defences will ensure they continue to offer protection from flooding. This applies to all types of existing defences although appropriate maintenance activities may vary.*
Runoff control	100150500	An area with the potential to be used for runoff control has been identified. This could offer some reduction in flood risk for high likelihood floods. *Runoff control looks to enhance the ability of the catchment to capture and slow water reaching the receiving watercourses. These actions often achieve the greatest benefits in areas of frequent flooding.*
River or floodplain restoration	100150600	Land with the potential to be used for river or floodplain restoration has been identified. This could offer some reduction in flood risk for high likelihood floods. *Restoring the river corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.*
Sediment management	100150700	*Sediment management can help control the influence of eroded material on flooding by maintaining channel capacity and reducing the impact of siltation.*
Wave attenuation	100150800	*Wave attenuation uses the natural characteristics of coastal land cover either to reduce the impact of waves and coastal erosion, or to act as a physical barrier to tidal waters.*
Construction of online and offline storage	100151000	An area of land with the potential to be used for online or offline storage has been identified. This could offer a reduction in flood risk for medium likelihood floods. *Flood storage actions retain water in the upper catchment or away from the watercourse, reducing the level and flow in the river. The benefit of these actions decreases further downstream although they can be designed to benefit multiple communities.*

Kirkcaldy, East Wemyss, Methil Potentially Vulnerable Area 10/05 Objectives and potential actions

Modification of conveyance	100151100	*Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing channel capacity. The potential benefits of these actions are greatest in areas of frequent flooding.*
Construction of direct flood defences	100151400	The potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*
Property level protection	100151700	Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection. *Property level protection can reduce flood impacts by restricting water entering a property, or using construction techniques which increase the resilience of property to flood water. It is most beneficial for flood depths less than 0.6m, in areas prone to frequent flooding.*
Site protection plans	100152100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Improved understanding	100152200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*
Relocation	100150200	Some of the properties that have been identified to be at risk of flooding may be suitable for relocation. *Relocation of properties or infrastructure may be applicable in locations where frequent flooding is expected and where areas may otherwise be difficult or uneconomical to protect.*

Kirkcaldy, East Wemyss, Methil
Potentially Vulnerable Area 10/05
Objectives and potential actions

Objective(s):	Kirkcaldy objective target area
Reduce risk to people in Kirkcaldy from river flooding.	
Objective ID:	
10016	
Indicators:	
110 people at risk (from a medium likelihood flood)	

Potential action	Action ID	Description
Runoff control	100160500	Upstream of Kirkcaldy an area with the potential to be used for runoff control has been identified. This could offer some reduction in flood risk along the Tiel Burn, Bottom Burn and Dronachy Burn for high likelihood floods. *Runoff control looks to enhance the ability of the catchment to capture and slow water reaching the receiving watercourses. These actions often achieve the greatest benefits in areas of frequent flooding.*
River or floodplain restoration	100160600	Upstream of Kirkcaldy land with the potential to be used for river or floodplain restoration has been identified. This could offer some reduction in flood risk along the Dronachy Burn and Tiel Burn for high likelihood floods. *Restoring the river corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.*
Sediment management	100160700	*Sediment management can help control the influence of eroded material on flooding by maintaining channel capacity and reducing the impact of siltation.*
Construction of online and offline storage	100161000	Upstream of Kirkcaldy land with the potential to be used for online or offline storage has been identified. This could offer a reduction in flood risk along the Tiel Burn, Tyrie Burn and an unnamed burn for medium likelihood floods. *Flood storage actions retain water in the upper catchment or away from the watercourse, reducing the level and flow in the river. The benefit of these actions decreases further downstream although they can be designed to benefit multiple communities.*
Modification of conveyance	100161100	*Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing channel capacity. The potential benefits of these actions are greatest in areas of frequent flooding.*

Kirkcaldy, East Wemyss, Methil Potentially Vulnerable Area 10/05 Objectives and potential actions

Construction of direct flood defences	100161400	Within Kirkcaldy, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*
Property level protection	100161700	Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection. *Property level protection can reduce flood impacts by restricting water entering a property, or using construction techniques which increase the resilience of property to flood water. It is most beneficial for flood depths less than 0.6m, in areas prone to frequent flooding.*

Kirkcaldy, East Wemyss, Methil (Potentially Vulnerable Area 10/05)

Action	Action ID	Description	Status and Timing	Funding	Responsibility
ONGOING AND CONFIRMED ACTIONS. Actions that are either underway or where the funding has been confirmed for 2016-2021.					
Surface Water Management	10004239	An integrated catchment study will be carried out for Cowdenbeath, Glenrothes, Markinch, Leven and Methil to improve knowledge and understanding of surface water flood risk and interactions with other sources of flooding e.g. with the sewer network, watercourses and the sea.	Confirmed. Planned to be carried out between 2015-2021.	Scottish Water/Fife Council	Scottish Water led in partnership with Fife Council and SEPA
Flood warning schemes – Maintain Firth of Forth and Tay **coastal** flood warning scheme	100993491810	This action has been identified for all existing flood warning schemes. It will be appropriate where the existing scheme meets the needs of the local community.	Ongoing	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	SEPA
Maintenance of existing flood protection schemes	100150100	**Existing coastal defences provide protection to residential and/or non-residential properties.**	Ongoing (Kirkcaldy Seawall only)	Council Revenue Allocations	Fife Council

Delivery Plan for Consultation

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		Ongoing maintenance of existing coastal defences will ensure they continue to offer protection from flooding. This applies to all types of existing defences although appropriate maintenance activities may vary.			
Self Help / Awareness Raising		Self-help actions (individuals taking action to protect themselves and their property against flooding) can be undertaken by any individuals, businesses, organisations or communities at risk of flooding. They are applicable to all sources and probabilities of flooding. They focus on awareness and understanding of the flood risk.	Ongoing. Flooding advice is provided on Fife Council website and via Public information leaflets. These give practical advice and contact information. Fife Council has provided 'Flood Pods' in locations of vulnerable properties which owners can access in times of flood threat. Owners have the right to protect their properties through purchase of property level protection		Fife Council Fife Council Owners
Emergency Plans		Emergency response plans are applicable for all flood sources and likelihoods.	Ongoing. Flooding is included within Fife Council's Emergency		Fife Council Emergency Services

Delivery Plan for Consultation

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		They set out the steps to be taken during a flood event to maximise safety and minimise impacts where possible.	planning procedures		
Land Use Planning	-	Application of national and local planning policies, including objectives and actions identified in the LPD development plan.	Ongoing	Fife Council's revenue budget	Fife Council
Watercourse Maintenance		Watercourse maintenance can prevent debris accumulating within channels, which may otherwise result in an increased flood risk. It can be undertaken as a regular planned activity or in response to a flood event.	Ongoing, Pre-flood checks undertaken at critical sites. Inspection and maintenance on a regular basis for other locations.	Council Revenue allocation	Fife Council/ Landowners

POTENTIAL ACTIONS. The actions below are being consulted upon to support the process of identifying preferred actions. Preferred actions may not be able to be implemented during the period 2016-2021 due to project lead-in times and / or funding constraints.

Relocation of properties/infrastructure away from flood risk areas	100150200	**Properties have been identified to be at risk in a high likelihood event and may therefore be suitable for relocation.**	This is a potential action identified through SEPA's strategic options. Further study/assessment required. Not a current Fife Council policy.	Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		Relocation of properties or infrastructure, currently at risk of flooding, away from the flood risk area may be applicable in locations where frequent flooding is expected to a limited area that may be otherwise difficult or uneconomical to protect.			
Runoff Control	100150500	**An area with the potential to be used for runoff control has been identified. This could offer a limited reduction in flood risk for high likelihood events**. Runoff control actions look to enhance the natural catchment ability to capture and slow runoff water reaching the receiving watercourses. These actions often experience the greatest benefits in areas of high probability flooding.	This is a potential action identified through SEPA's strategic options. Further study/assessment required Subject to funding.		Fife Council
River or floodplain restoration	100150600	**Land with the potential to be used for river or floodplain restoration has been identified. This could offer a limited reduction in flood risk for high likelihood events.**	This is a potential action identified through SEPA's strategic options. Further study/assessment required Subject to funding.		Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		Restoring the river corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.			
Sediment Management	100150700	Sediment management can help control the sediment balance in the catchment, maintain channel capacity and reduce the impact of siltation at structures and other key areas.			
Wave attenuation	100150800	Wave attenuation actions use the natural characteristics of different types of coastal land cover to either reduce the impact of waves and coastal erosion or to act as a physical barrier to tidal waters.			
Construction of Online and Offline storage	100151000	**An area of land with the potential to be used for online or offline storage has been identified. This could offer a reduction in flood risk for medium likelihood events.** Flood storage actions retain water in the upper catchment or away from the channel, to	This is a potential action identified through SEPA's strategic options. Further study/assessment required Subject to funding.		Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		reduce level and flow in the river. The benefit of these actions decreases further downstream although they can be designed to benefit multiple communities.			
Modification of Conveyance	100151100	Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing cross sectional area. The potential benefits of these actions are greatest during high probability events.			
Construction of Direct flood Defences	100151400	**The potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood event.** Direct defence actions aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at flood risk.	This is a potential action identified through SEPA's strategic options. Further study/assessment required Subject to funding.		Fife Council
Property level protection	100151700	**Some of the properties that have been identified to be at risk of flooding may be suitable for property**	Identified through SEPA's strategic options appraisal. Owners have the right to purchase property level protection.		Property Owners Fife council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		level protection. Property level protection can reduce flood impact by restricting water entering a property, or using construction techniques which are resilient to flood water. It is most beneficial for flood depths <0.6m in areas of high probability flooding	Fife Council provides and maintains flood pods in known flood risk locations which owners of vulnerable property may use if threatened.		
Flood warning schemes	100151800	Flood warning actions enable people and organisations to prepare for an event. They enable the risk of the event to be reduced by moving people / possessions out of the floodplain and by placing temporary barriers to reduce flooding impacts.			
Site protection plans	100152100	Site protection plans are developed to identify whether normal operation of a facility can be maintained during an event. This may be due to existing protection or resilience of the facility or the network.			
Modelling and other assessments to improve knowledge of flood hazards and impacts	100152200	Improved knowledge of the risks from different events helps to develop plans to avoid or mitigate future	Fife Council undertakes flood studies of known flood risk areas and subject to funding will continue to do so where it is considered such knowledge may be of benefit in developing plans to reduce flood risk.		Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		flooding to sensitive areas.			
Runoff Control	100160500	**Upstream of Kirkcaldy an area with the potential to be used for runoff control has been identified. This could offer a limited reduction in flood risk along the Tiel Burn, Bottom Burn and Dronachy Burn for high likelihood events**. Runoff control actions look to enhance the natural catchment ability to capture and slow runoff water reaching the receiving watercourses. These actions often experience the greatest benefits in areas of high probability flooding.	This is a potential action identified through SEPA's strategic options. Further study/assessment required Subject to funding.		Fife Council
River or floodplain restoration	100160600	**Upstream of Kirkcaldy land with the potential to be used for river or floodplain restoration has been identified. This could offer a limited reduction in flood risk along the Dronachy Burn and Tiel Burn for high likelihood events.** Restoring the river corridor to a more natural state aims to	This is a potential action identified through SEPA's strategic options. Further study/assessment required Subject to funding.		Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.			
Sediment Management	100160700	Sediment management can help control the sediment balance in the catchment, maintain channel capacity and reduce the impact of siltation at structures and other key areas.			
Construction of Online and Offline storage	100161000	**Upstream of Kirkcaldy land with the potential to be used for online or offline storage has been identified. This could offer a reduction in flood risk along the Tiel Burn, Tyrie Burn and an unnamed burn for medium likelihood events.** Flood storage actions retain water in the upper catchment or away from the channel, to reduce level and flow in the river. The benefit of these actions decreases further downstream although they can be designed to benefit multiple communities.	This is a potential action identified through SEPA's strategic options. Further study/assessment required Subject to funding.		Fife Council
Modification of Conveyance	100161100	Conveyance modification aims to reduce flooding by			

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		moving flow more efficiently: speeding it up, removing constrictions or increasing cross sectional area. The potential benefits of these actions are greatest during high probability events.			
Construction of Direct flood Defences	100161400	**Within Kirkcaldy, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood event.** Direct defence actions aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at flood risk.	This is a potential action identified through SEPA's strategic options. Further study/assessment required Subject to funding.		Fife Council
Property level protection	100161700	**Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection.** Property level protection can reduce flood impact by restricting water entering a property, or using construction techniques	Identified through SEPA's strategic options appraisal. Owners have the right to purchase property level protection. Fife Council provides and maintains flood pods in known flood risk locations which owners of vulnerable property may use if threatened.		Property Owners Fife council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		which are resilient to flood water. It is most beneficial for flood depths <0.6m in areas of high probability flooding			
Site protection plans	100162100	Site protection plans are developed to identify whether normal operation of a facility can be maintained during an event. This may be due to existing protection or resilience of the facility or the network.			
Surface water management	10004238	Develop a plan for Leven and eastern Methil for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	Recommended actions agreed by all partners identified by 2019.		Fife Council
Flood warning schemes – Improve sign up of Firth of Forth and Tay **coastal** flood warning scheme	100993491822	This action has been identified because the sign-up rate in some of the FWTAs within this scheme is less than the target of 40%. If the action is progressed, the sign-up rate for the relevant FWTAs will be improved via a targeted communications campaign.	Potential actions are drawn from a short list of options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being of priority are dependent on funding.	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	SEPA
Flood warning schemes –	100993491830	This action has been	Potential actions are	The maintenance of	SEPA

Action	Action ID	Description	Status and Timing	Funding	Responsibility
Simplify Firth of Forth and Tay **coastal** flood warning scheme		identified because other structural actions are being considered in this area which may reduce the need for a detailed flood warning scheme.	drawn from a short list of options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being of priority are dependent on funding.	SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	

Inverkeithing, Rosyth, Dunfermline, Wellwood (Potentially Vulnerable Area 10/06)

Local Plan District	Local Authorities	Main Catchment
10 Forth Estuary	Fife Council	South Fife Coastal

Background

This Potentially Vulnerable Area covers an area of 82km^2 and is part of the Firth of Forth catchment. This is a moderately sized, partially urbanised area centrally located within the catchment. It contains the towns of Dunfermline, Rosyth and the majority of Inverkeithing (Figure 1). Its main watercourses is the Lyne Burn, flowing from its source in the north east westward through Dunfermline until it discharges into the Firth of Forth at Charleston. Other notable watercourses include the Tower Burn, Baldridge Burn, Broomhead Burn and the Keithing Burn.

The highest risk of river flooding is from Tower Burn and the Lyne Burn to Dunfermline, Rosyth and Inverkeithing. The highest risk of surface water flooding is in Dunfermline. The majority of flood damages are caused by river flooding (Figure 2).

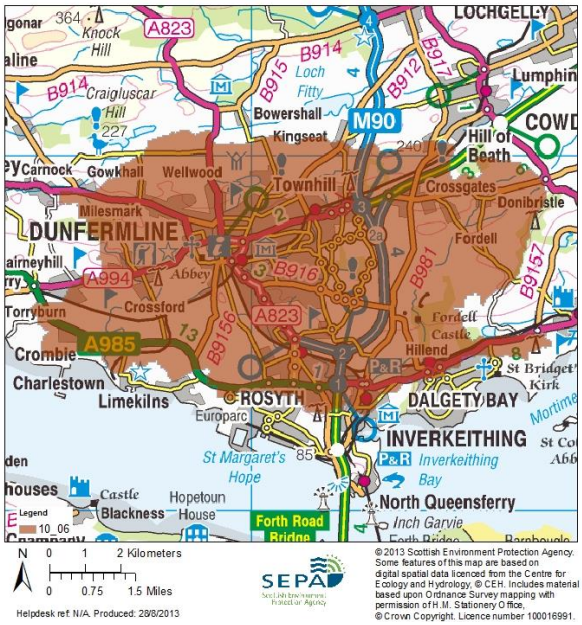


Figure 1: Potentially Vulnerable Area 10/06

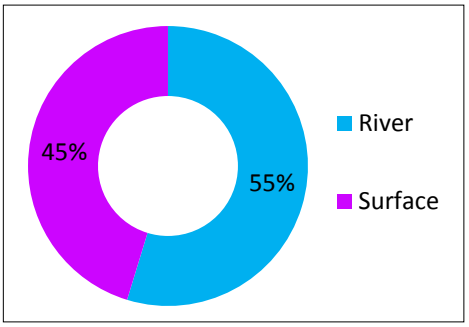


Figure 2: Annual Average Damages by flood source

Summary of flooding impacts

Approximately 410 residential properties and 230 non-residential properties are at a medium likelihood of flooding from one or more sources. A summary of the impacts from flooding can be seen in Table 1. A map showing the impacts from all sources at a medium likelihood of flooding can be seen in Figure 4.

The total Annual Average Damages from all sources of flooding are approximately £1.9 million. This includes damages to residential properties, non-residential properties, transport and agriculture. The economic damages incurred for each return period can be seen in Figure 3. For this Potentially Vulnerable Area the highest damages are to non-residential properties followed by residential properties.

In 2010 Scottish Water carried out a Flood Risk Assessment Study of water and wastewater assets across Scotland. Three wastewater assets were identified as being at risk of flooding within this Potentially Vulnerable Area.

	High likelihood	Medium likelihood	Low likelihood
No. of residential properties	50	410	730
No. of non-residential properties	70	230	260
No. of people	110	900	1,600
Community facilities	0	<10 Educational buildings	<10 Educational buildings
Utilities	10 Energy sites <10 Communications sites	30 Energy sites <10 Communications sites <10 Scottish Water assets	30 Energy sites <10 Communications sites <10 Scottish Water assets
Transport links (excluding minor roads)	17 Roads affected at 158 locations • M90 • 8 A roads • 8 B roads 1 Railway route affected at 41 locations • Fife Circle: Dalmeny to Winchburgh and Haymarket West Junctions	17 Roads affected at 283 locations • M90 • 8 A roads • 8 B roads 1 Railway route affected at 63 locations • Fife Circle: Dalmeny to Winchburgh and Haymarket West Junctions	17 Roads affected at 330 locations • M90 • 8 A roads • 8 B roads 1 Railway route affected at 63 locations • Fife Circle: Dalmeny to Winchburgh and Haymarket West Junctions
Environmental designated areas (km^2)	0.1km^2 • 1 SSSI • 1 SPA • 1 SAC	0.1km^2 • 1 SSSI • 1 SPA • 1 SAC	0.1km^2 • 1 SSSI • 1 SPA • 1 SAC
No. of cultural heritage sites	5	5	6
Agricultural land (km^2)	2.3km^2	2.8km^2	3.0km^2

Table 1: Summary of flooding impacts

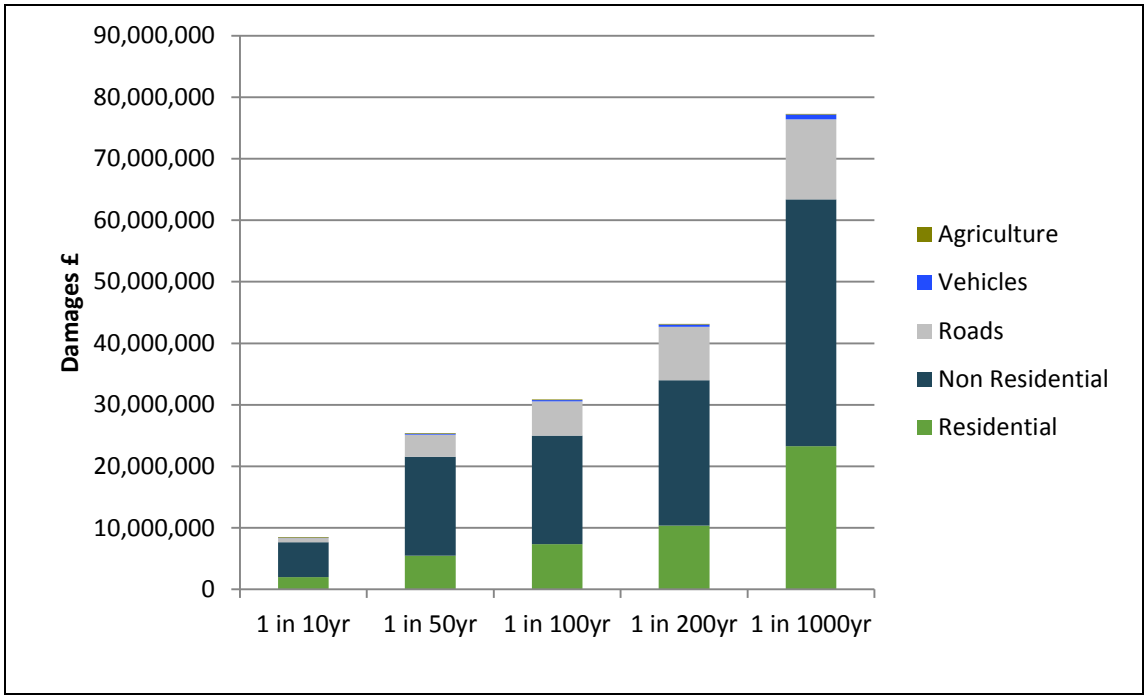


Figure 3: Damages by flood frequency

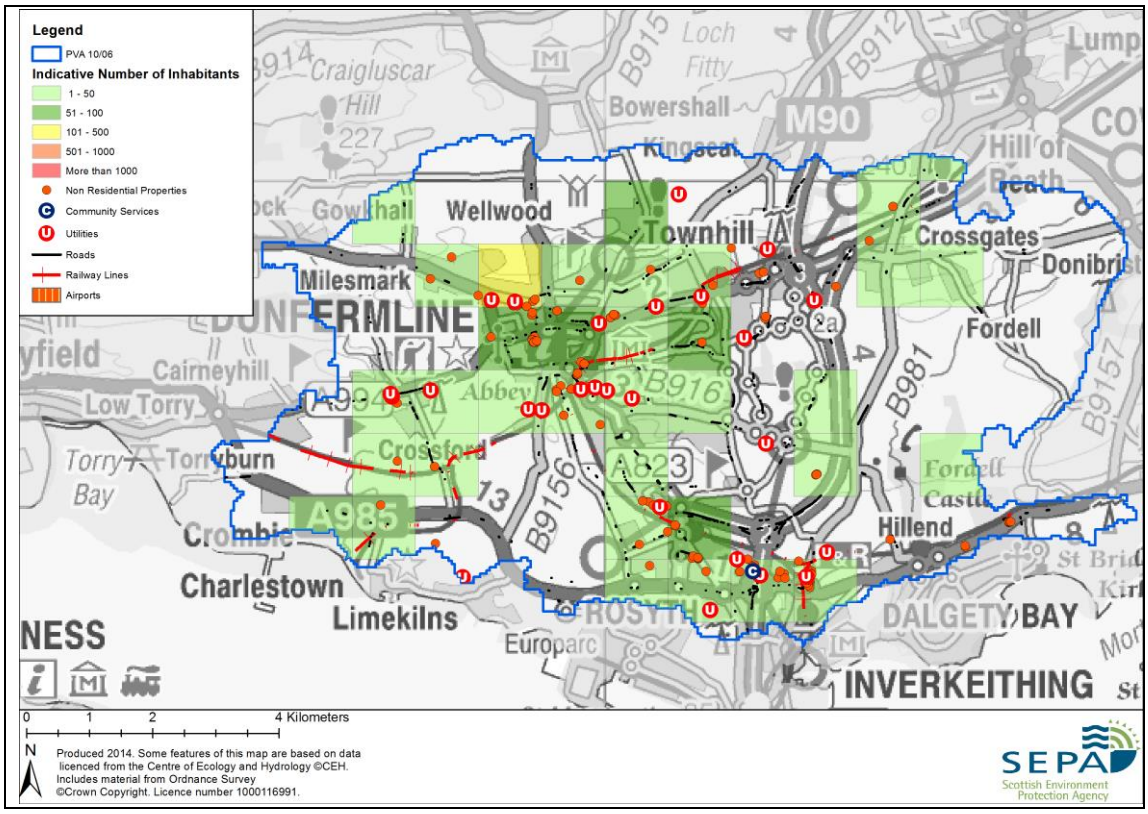


Figure 4: Impacts from all sources at a medium likelihood of flooding

History of flooding

The following river floods have been identified as significant in this Potentially Vulnerable Area:

- 1 April 1992: An extreme flood event generated overtopping of the Lyne Burn and tributaries, the Tower Burn and Calais Burn resulting in wide spread flooding affecting residential, commercial and industrial properties in Dunfermline.
- April 1992: Widespread flooding throughout Fife when more than 80mm of rain fell in 24 hours. This included significant flooding in Dunfermline from the Lyne Burn, Tower Burn and Calais Burn.

No significant surface water floods have been recorded in this Potentially Vulnerable Area.

Summary of existing local actions to manage risk

There are two formal flood protection schemes in this Potentially Vulnerable Area:

- Parkneuk Flood Prevention Scheme 1987
- Dunfermline Flood Prevention Scheme - A £24 million scheme currently under construction in Dunfermline. Design Standard of Protection is 1 in 200 years return period.

Other actions and natural features may also reduce the risk of flooding. These are referenced in the river, coastal and surface water flooding reports.

There is one flood warning target area within this Potentially Vulnerable Area:

- North Queensferry and Inverkeithing Bay - Coastal flood warning, Firth of Forth and Tay.

SEPA and the local authorities work closely with many other organisations that have flooding related duties and interests. These include the police, fire and rescue services, the Scottish Government and the Scottish Flood Forum. SEPA and the local authorities, often in partnership with these organisations, undertake various awareness raising campaigns that include community events, information leaflets, educational plays in schools, the use of social media and advertising.

In addition to the above, the following incentives or subsidies have been put in place to provide property owners with property level resilience/resistance actions:

- Fife Council provides Aquasacs for use in emergencies and these are available from stores located throughout Fife
- Fife Council also operates an Emergency Flood Plan.

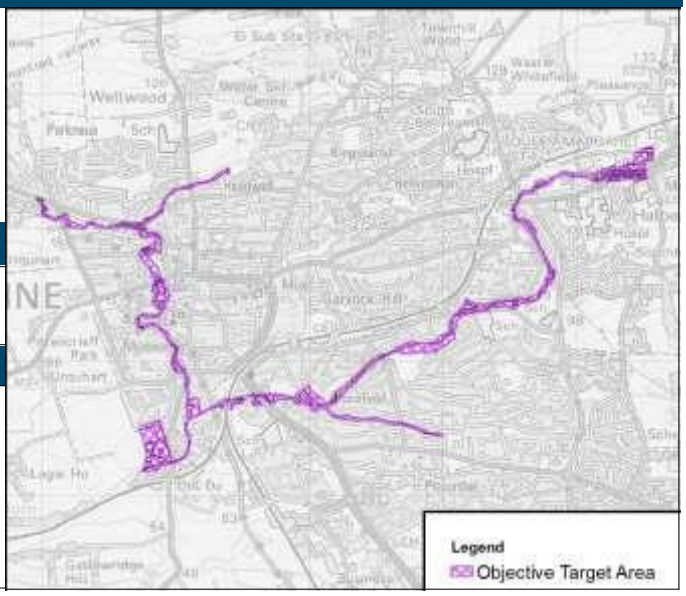
Inverkeithing, Rosyth, Dunfermline, Wellwood Potentially Vulnerable Area 10/06 Objectives and potential actions

Unless otherwise stated, information on the following objectives is contained in this document.

IMPORTANT; potential actions that apply across the whole local plan district including flood warning, land use planning, surface water management planning, and other generic actions are described in the Forth Estuary Local Plan District document.

Location	Objective	Objective ID
Applies across Forth Estuary Local Plan District	Avoid an overall increase in flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10001
Applies across Forth Estuary Local Plan District	Reduce overall flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10099
Dunfermline	Reduce economic damages to residential and non-residential properties in Dunfermline caused by flooding from the Lynn Burn and Tower Burn. Reduce risk to people in Dunfermline from river flooding.	10019 10022
Rosyth and Inverkeithing	Reduce economic damages to residential and non-residential properties and flood risk to community facilities in Rosyth/ Inverkeithing caused by river flooding.	10020
Remainder of the Potentially Vulnerable Area	Reduce economic damages to residential and non-residential properties caused by river flooding.	10021

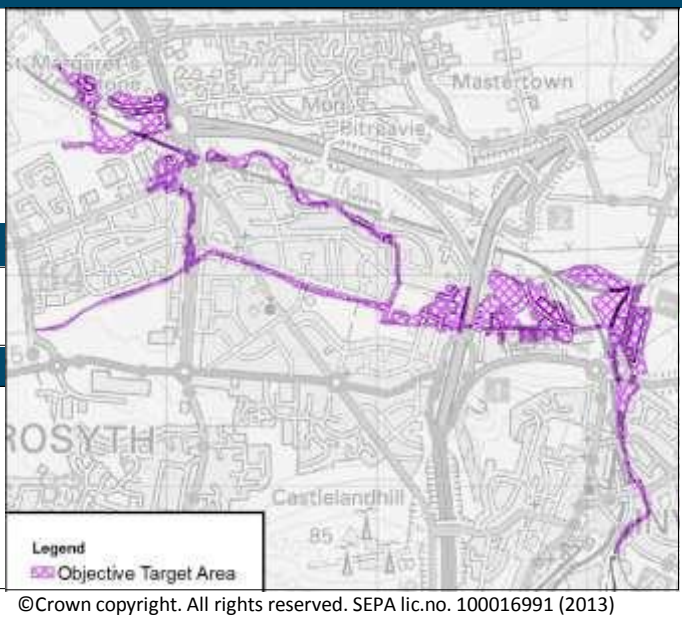
Inverkeithing, Rosyth, Dunfermline, Wellwood Potentially Vulnerable Area 10/06 Objectives and potential actions

Objective(s)	Dunfermline objective target area
Reduce economic damages to residential and non-residential properties in Dunfermline caused by flooding from the Lynn Burn and Tower Burn. Reduce risk to people in Dunfermline from river flooding.	
Objective(s) ID:	
10019, 10022	
Indicators:	
£190,000 annual average damages (residential properties) £450,000 annual average damages (non- residential properties) 206 people at risk (from a medium likelihood flood)	

Potential action	Action ID	Description
Maintenance of existing flood protection schemes	100190100	Existing defences along the Baldridge Burn provide protection to residential and/or non-residential properties up to a 1 in 200 year flood. *Ongoing maintenance of existing defences will ensure they continue to offer protection from flooding. This applies to all types of existing defences although appropriate maintenance activities may vary.*
Runoff control	100190500	Upstream of Dunfermline an area with the potential to be used for runoff control has been identified. This could offer some reduction in flood risk along the Castleblair/ Broomhead Burn for high likelihood floods. *Runoff control looks to enhance the ability of the catchment to capture and slow water reaching the receiving watercourses. These actions often achieve the greatest benefits in areas of frequent flooding.*
River or floodplain restoration	100190600	Upstream of Dunfermline land with the potential for river or floodplain restoration has been identified. Further analysis has shown that due to its positioning within the catchment and/or its size this action may not reduce flood risk in the target area. *Restoring the river corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.*
Sediment management	100190700	*Sediment management can help control the influence of eroded material on flooding by maintaining channel capacity and reducing the impact of siltation.*
Modification of conveyance	100191100	*Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing channel capacity. The potential benefits of these actions are greatest in areas of frequent flooding.*
Installation / modification of river control structures	100191200	*Control structures on a river can reduce flood levels either by restricting or increasing flow in the channel. The impact of these structures can vary significantly depending on type and location of the structures being added or modified.*

Construction of direct flood defences	100191400	Within Dunfermline, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*
Property level protection	100191700	Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection. *Property level protection can reduce flood impacts by restricting water entering a property, or using construction techniques which increase the resilience of property to flood water. It is most beneficial for flood depths less than 0.6m, in areas prone to frequent flooding.*
Site protection plans	100192100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Improved understanding	100192200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*
Relocation	100190200	Some of the properties that have been identified to be at risk of flooding may be suitable for relocation. *Relocation of properties or infrastructure may be applicable in locations where frequent flooding is expected and where areas may otherwise be difficult or uneconomical to protect.*

Inverkeithing, Rosyth, Dunfermline, Wellwood Potentially Vulnerable Area 10/06 Objectives and potential actions

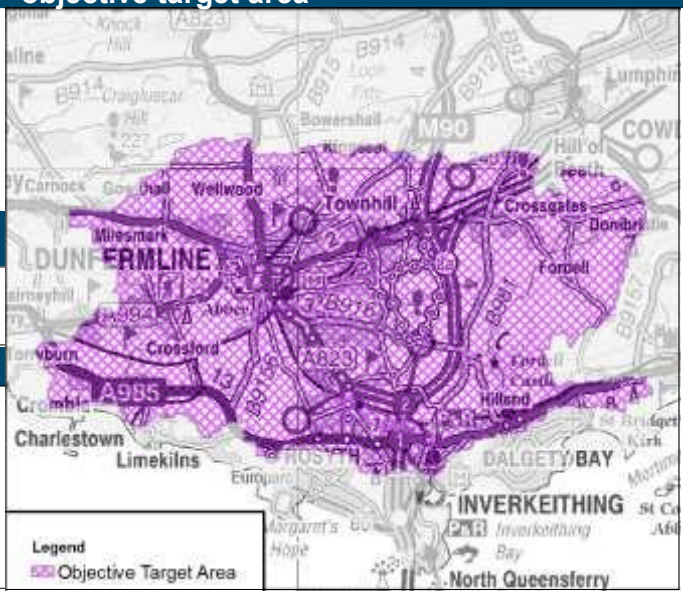
Objective(s):	Rosyth & Inverkeithing objective target area
Reduce economic damages to residential and non-residential properties and flood risk to community facilities in Rosyth and Inverkeithing caused by river flooding.	
Objective ID:	
10020	
Indicators:	
£42,000 annual average damages (residential properties) £280,000 annual average damages (non-residential properties)	

Potential action	Action ID	Description
Runoff control	100200500	Upstream of Rosyth an area with the potential to be used for runoff control has been identified. This could offer some reduction in flood risk along the Fordell, Keithing and Craignanet Burns for high likelihood floods. *Runoff control looks to enhance the ability of the catchment to capture and slow water reaching the receiving watercourses. These actions often achieve the greatest benefits in areas of frequent flooding.*
River or floodplain restoration	100200600	Upstream of Rosyth and Inverkeithing land with the potential to be used for river or floodplain restoration has been identified. This could offer some reduction in flood risk along the Fordell, Keithing and Craignanet Burns for high likelihood floods. *Restoring the river corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.*
Sediment management	100200700	The management of sediment within the canalised section of the Brankholm Burn at Bellknows may offer a reduction in flood risk. *Sediment management can help control the influence of eroded material on flooding by maintaining channel capacity and reducing the impact of siltation.*
Construction of online and offline storage	100201000	Upstream of Rosyth and Inverkeithing land with the potential to be used for online or offline storage has been identified. This could offer a reduction in flood risk along the Fordell and Keithing Burn for medium likelihood floods. *Flood storage actions retain water in the upper catchment or away from the watercourse, reducing the level and flow in the river. The benefit of these actions decreases further downstream although they can be designed to benefit multiple communities.*

Inverkeithing, Rosyth, Dunfermline, Wellwood Potentially Vulnerable Area 10/06 Objectives and potential actions

Modification of conveyance	100201100	The potential to use an old stilling basin in Inverkeithing as an additional flow route has been identified which could reduce flood risk upstream. *Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing channel capacity. The potential benefits of these actions are greatest in areas of frequent flooding.*
Installation / modification of river control structures	100201200	*Control structures on a river can reduce flood levels either by restricting or increasing flow in the channel. The impact of these structures can vary significantly depending on type and location of the structures being added or modified.*
Construction of direct flood defences	100201400	Within Rosyth and Inverkeithing, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*
Property level protection	100201700	Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection. *Property level protection can reduce flood impacts by restricting water entering a property, or using construction techniques which increase the resilience of property to flood water. It is most beneficial for flood depths less than 0.6m, in areas prone to frequent flooding.*
Site protection plans	100202100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Improved understanding	100202200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*

Inverkeithing, Rosyth, Dunfermline, Wellwood Potentially Vulnerable Area 10/06 Objectives and potential actions

Objective(s):	Remainder of the Potentially Vulnerable Area objective target area
Reduce economic damages to residential and non-residential properties caused by river flooding.	
Objective ID:	
10021	
Indicators:	
£21,000 annual average damages (residential properties) £1,300 annual average damages (non-residential properties)	

Potential action	Action ID	Description
Runoff control	100210500	An area with the potential to be used for runoff control has been identified. Further analysis has shown that due to its positioning within the catchment and / or its size, this action may not reduce flood risk in the target area. *Runoff control looks to enhance the ability of the catchment to capture and slow water reaching the receiving watercourses. These actions often achieve the greatest benefits in areas of frequent flooding.*
River or floodplain restoration	100210600	Land with the potential to be used for river or floodplain restoration has been identified. Further analysis has shown that due to its positioning within the catchment and / or its size, this action may not reduce flood risk in the target area. *Restoring the river corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.*
Sediment management	100210700	*Sediment management can help control the influence of eroded material on flooding by maintaining channel capacity and reducing the impact of siltation.*
Modification of conveyance	100211100	*Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing channel capacity. The potential benefits of these actions are greatest in areas of frequent flooding.*
Installation / modification of river control structures	100211200	*Control structures on a river can reduce flood levels either by restricting or increasing flow in the channel. The impact of these structures can vary significantly depending on type and location of the structures being added or modified.*
Construction of direct flood defences	100211400	The potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*

Inverkeithing, Rosyth, Dunfermline, Wellwood Potentially Vulnerable Area 10/06 Objectives and potential actions

Site protection plans	100212100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Improved understanding	100212200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*

Inverkeithing, Rosyth, Dunfermline, Wellwood (Potentially Vulnerable Area 10/06)

Action	Action ID	Description	Status and Timing	Funding	Responsibility
ONGOING AND CONFIRMED ACTIONS. Actions that are either underway or where the funding has been confirmed for 2016-2021.					
Modification of Conveyance	100201100	**Increase in conveyance has been identified in Inverkeithing by routing additional flow through a disused stilling basin to reduce upstream levels.** Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing cross sectional area. The potential benefits of these actions are greatest during high probability events.	Underway/Ongoing	Council Revenue allocation	Fife Council
Maintenance of existing flood protection schemes	100220100	**Existing defences along the Baldridge Burn/Tower Burn and Lyne Burn provide protection to residential and/or non-residential properties.** Ongoing maintenance of existing defences will ensure they continue to offer protection from flooding. This applies to all types of existing defences although	Ongoing	Council Revenue allocation	Fife Council

Delivery Plan for Consultation

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		appropriate maintenance activities may vary.			
Surface Water Management.	10024239	An integrated catchment study will be carried out for Dunfermline, Cairneyhill and Rosyth to improve knowledge and understanding of surface water flood risk and interactions with other sources of flooding e.g. with the sewer network, watercourses and the sea.	Confirmed. Planned to be carried out between 2015-2021.	Scottish Water/Fife Council	Scottish Water led in partnership with Fife Council and SEPA
Self Help / Awareness Raising		Self help actions (individuals taking action to protect themselves and their property against flooding) can be undertaken by any individuals, businesses, organisations or communities at risk of flooding. They are applicable to all sources and probabilities of flooding. They focus on awareness and understanding of the flood risk.	Ongoing. Flooding advice is provided on Fife Council website and via Public information leaflets. These give practical advice and contact information. Fife Council has provided 'Flood Pods' in locations of vulnerable properties which owners can access in times of flood threat. Owners have the right to protect their properties through purchase of		Fife Council Fife Council Owners

Action	Action ID	Description	Status and Timing	Funding	Responsibility
			property level protection		
Emergency Plans		Emergency response plans are applicable for all flood sources and likelihoods. They set out the steps to be taken during a flood event to maximise safety and minimise impacts where possible.	Ongoing. Flooding is included within Fife Council's Emergency planning procedures		Fife Council Emergency Services
Land Use Planning	-	Application of national and local planning policies, including objectives and actions identified in the LPD development plan.	Ongoing	Fife Council's revenue budget	Fife Council
Watercourse Maintenance		Watercourse maintenance can prevent debris accumulating within channels, which may otherwise result in an increased flood risk. It can be undertaken as a regular planned activity or in response to a flood event.	Ongoing, Pre-flood checks undertaken at critical sites. Inspection and maintenance as required on a regular basis for other locations.	Council Revenue allocation	Fife Council/ Landowners

POTENTIAL ACTIONS. The actions below are being consulted upon to support the process of identifying preferred actions. Preferred actions may not be able to be implemented during the period 2016-2021 due to project lead-in times and / or funding constraints.

Runoff Control	100200500	**Upstream of Rosyth and Inverkeithing an area with**	This is a potential action identified through SEPA's strategic option appraisal. Further study/assessment	Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		potential to be used for run-off control. This could offer a limited reduction in flood risk along the Keithing Burn and Brankholm Burn for high likelihood events. Runoff control actions look to enhance the natural catchment ability to capture and slow runoff water reaching the receiving watercourses. These actions often experience the greatest benefits in areas of high probability flooding.	required. Subject to funding availability.		
River or floodplain restoration	100200600	**Upstream of Rosyth and Inverkeithing land with the potential to be used for river or flood plain restoration has been identified. This could offer a limited reduction in flood risk along the Craiganet, Keithing and Fordell Burns for high likelihood events.** Restoring the river corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.	This is a potential action identified through SEPA's strategic option appraisal. Further study/assessment required. Subject to funding availability.		Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
Sediment Management	100200700	Sediment management can help control the sediment balance in the catchment, maintain channel capacity and reduce the impact of siltation at structures and other key areas.	Not identified.		
Construction of Online and Offline storage	100201000	**Upstream of Rosyth and Inverkeithing land with the potential to be used for online or offline storage has been identified. This could offer a reduction in flood risk along the Fordell Burn for medium likelihood events.** Flood storage actions retain water in the upper catchment or away from the channel, to reduce level and flow in the river. The benefit of these actions decreases further downstream although they can be designed to benefit multiple communities.	This is a potential action identified through SEPA's strategic option appraisal. Further study/assessment required. Subject to funding availability.		
Installation / modification of fluvial control structures	100201200	Fluvial control structures can reduce flood levels to a target area by either restricting or increasing channel flow. The impact of these structures can vary significantly	Not identified.		

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		depending on type and location of the structures being added or modified			
Construction of Direct flood Defences	100201400	**Within Rosyth and Inverkeithing the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood event** Direct defence actions aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at flood risk.	Defences identified by Fife Council showed marginal cost benefit. Further study/assessment required. Subject to funding.		Fife Council
Property level protection	100201700	**Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection.** Property level protection can reduce flood impact by restricting water entering a property, or using construction techniques which are resilient to flood water. It is most beneficial for flood depths <0.6m in areas	Owners have the right to purchase property level protection. Fife Council provides and maintains flood pods in known flood risk locations which owners of vulnerable property may use if threatened.		Property Owners Fife council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		of high probability flooding			
Site protection plans	100202100	Site protection plans are developed to identify whether normal operation of a facility can be maintained during an event. This may be due to existing protection or resilience of the facility or the network.	Not identified.		
Modelling and other assessments to improve knowledge of flood hazards and impacts	100202200	Improved knowledge of the risks from different events helps to develop plans to avoid or mitigate future flooding to sensitive areas.	Fife Council undertakes flood studies of known flood risk areas and subject to funding will continue to do so where it is considered such knowledge may be of benefit in developing plans to reduce flood risk.		Fife Council
Runoff Control	100210500	**An area with the potential to be used for runoff control has been identified. Further analysis has shown that due to its positioning within the catchment and / or its size, this action will not reduce flood risk in the target area.** Runoff control actions look to enhance the natural catchment ability to capture and slow runoff water reaching the receiving watercourses. These actions often experience the greatest benefits in areas of high probability flooding.	This potential action has been ruled out through SEPA's strategic option appraisal.		

Delivery Plan for Consultation

Action	Action ID	Description	Status and Timing	Funding	Responsibility
River or floodplain restoration	100210600	**Land with the potential to be used for river or floodplain restoration has been identified. Further analysis has shown that due to its positioning within the catchment and / or its size, this action will not reduce flood risk in the target area.** Restoring the river corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.	This potential action has been ruled out through SEPA's strategic option appraisal.		
Sediment Management	100210700	Sediment management can help control the sediment balance in the catchment, maintain channel capacity and reduce the impact of siltation at structures and other key areas.			
Modification of Conveyance	100211100	Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing cross sectional area. The potential benefits of these actions are greatest during high probability events.			

Delivery Plan for Consultation

Action	Action ID	Description	Status and Timing	Funding	Responsibility
Installation / modification of fluvial control structures	100211200	Fluvial control structures can reduce flood levels to a target area by either restricting or increasing channel flow. The impact of these structures can vary significantly depending on type and location of the structures being added or modified			
Construction of Direct flood Defences	100211400	**The potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood event.** Direct defence actions aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at flood risk.	This is a potential action identified through SEPA's strategic option appraisal. Further study/assessment required. Subject to funding availability.		
Site protection plans	100212100	Site protection plans are developed to identify whether normal operation of a facility can be maintained during an event. This may be due to existing protection or resilience of the facility or the network.			
Modelling and other assessments to improve	100212200	Improved knowledge of the risks from different events	Fife Council undertakes flood studies of known flood risk areas and subject to funding will continue to do		Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
knowledge of flood hazards and impacts		helps to develop plans to avoid or mitigate future flooding to sensitive areas.	so where it is considered such knowledge may be of benefit in developing plans to reduce flood risk.		
Relocation of properties/infrastructure away from flood risk areas	100220200	**Properties have been identified to be at risk in a high likelihood event and may therefore be suitable for relocation.** Relocation of properties or infrastructure, currently at risk of flooding, away from the flood risk area may be applicable in locations where frequent flooding is expected to a limited area that may be otherwise difficult or uneconomical to protect.	Identified through SEPA's strategic options appraisal. Not a current Fife Council Policy		Fife Council
Runoff Control	100220500	**Upstream of Dunfermline an area with the potential to be used for runoff control has been identified. This could offer a limited reduction in flood risk along the Broomhead Burn for high likelihood events.** Runoff control actions look to enhance the natural catchment ability to capture and slow runoff water reaching the receiving watercourses. These actions	This is a potential action identified through SEPA's strategic option appraisal. Further study/assessment required. Subject to funding		Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		often experience the greatest benefits in areas of high probability flooding.			
River or floodplain restoration	100220600	**Upstream of Dunfermline land with the potential for river or floodplain restoration has been identified. Further analysis has shown that due to its positioning within the catchment and/or its size this action will not reduce flood risk in the target area.** Restoring the river corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.	This potential action has been ruled out through SEPA's strategic option appraisal.		
Sediment Management	100220700	Sediment management can help control the sediment balance in the catchment, maintain channel capacity and reduce the impact of siltation at structures and other key areas.			
Modification of Conveyance	100221100	Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing cross sectional area. The			

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		potential benefits of these actions are greatest during high probability events.			
Installation / modification of fluvial control structures	100221200	Fluvial control structures can reduce flood levels to a target area by either restricting or increasing channel flow. The impact of these structures can vary significantly depending on type and location of the structures being added or modified			
Construction of Direct flood Defences	100221400	**Within Dunfermline, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood event.** Direct defence actions aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at flood risk.	This is a potential action identified through SEPA's strategic option appraisal. Further study/assessment required. Subject to funding availability.		
Property level protection	100221700	**Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection.**	Owners have the right to purchase property level protection. Fife Council provides and maintains flood pods in known flood risk locations which owners of vulnerable property may use if threatened.		Property Owners Fife council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		Property level protection can reduce flood impact by restricting water entering a property, or using construction techniques which are resilient to flood water. It is most beneficial for flood depths <0.6m in areas of high probability flooding			
Flood warning schemes	100221800	Flood warning actions enable people and organisations to prepare for an event. They enable the risk of the event to be reduced by moving people / possessions out of the floodplain and by placing temporary barriers to reduce flooding impacts.			SEPA
Site protection plans	100222100	Site protection plans are developed to identify whether normal operation of a facility can be maintained during an event. This may be due to existing protection or resilience of the facility or the network.			
Modelling and other assessments to improve knowledge of flood hazards and impacts	100222200	Improved knowledge of the risks from different events helps to develop plans to avoid or mitigate future flooding to sensitive areas.	Fife Council undertakes flood studies of known flood risk areas and subject to funding will continue to do so where it is considered such knowledge may be of benefit in developing plans to reduce flood risk.		Fife Council
Flood warning	100994371800	Develop new flood warning. Properties in Dunfermline	SEPA recommendation. Feasibility to be determined. Subject to further screening and analysis of technical,		SEPA

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		affected by flooding from the Lyne Burn and Tower Burn.	operational and financial feasibility.		
Surface water management	10023238	Develop a plan for Cairneyhill, Crombie and Muirside for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	Recommended actions agreed by all partners identified by 2019.		Fife Council
Surface water management	10017238	Develop a plan for Dunfermline, Boweshall, Crossford, Wellwood, Townhill and Halbeath for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	Recommended actions agreed by all partners identified by 2019.		Fife Council

Cairneyhill (Potentially Vulnerable Area 10/07)

Local Plan District	Local Authorities	Main Catchment
10 Forth Estuary	Fife Council	South Fife Coastal

Background

This Potentially Vulnerable Area covers an area of 11km^2 and is part of the Firth of Forth catchment. This is a small, largely rural coastal area centrally located within the catchment containing the villages of Cairneyhill and Torryburn (Figure 1). Its main watercourse is the Torry Burn, flowing though Cairneyhill westward before discharging into the Torry Bay on the Firth of Forth.

The highest risk of river flooding is from the Torry Burn to Cairneyhill and Torryburn. The highest risk of coastal flooding is from the Firth of Forth to Newmills and Torryburn. Finally, the highest risk of surface water flooding is in Cairneyhill and South Crombie. The majority of flood damages are caused by surface water flooding (Figure 2).

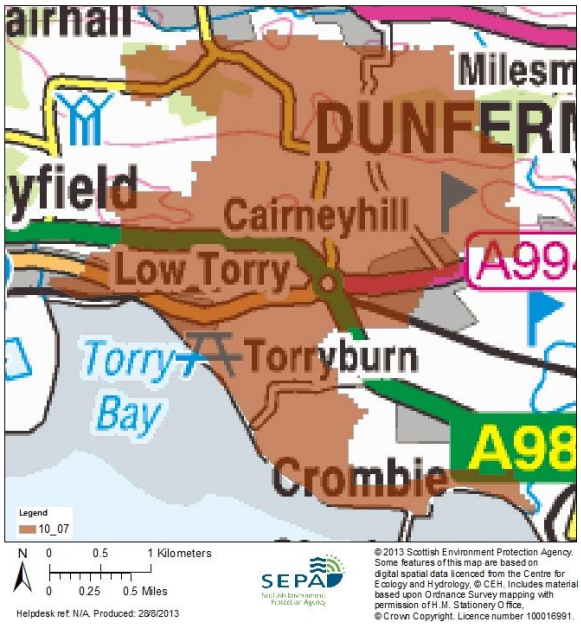


Figure 1: Cairneyhill Potentially Vulnerable Area

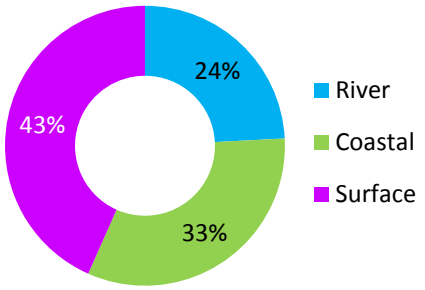


Figure 2: Annual Average Damages by flood source

Summary of flooding impacts

Approximately 110 residential properties and 10 non-residential properties are at a medium likelihood of flooding from one or more sources. A summary of the impacts from flooding can be seen in Table 1. A map showing the impacts from all sources at a medium likelihood of flooding can be seen in Figure 4.

The total Annual Average Damages from all sources of flooding are approximately £500,000. This includes damages to residential properties, non-residential properties, transport and agriculture. The economic damages incurred for each return period can be seen in Figure 3. For this Potentially Vulnerable Area the highest damages are to non-residential properties followed by damages to residential properties.

In 2010 Scottish Water carried out a Flood Risk Assessment Study of water and wastewater assets across Scotland. Three wastewater assets were identified as being at risk of flooding within this Potentially Vulnerable Area.

	High likelihood	Medium likelihood	Low likelihood
No. of residential properties	40	110	240
No. of non-residential properties	7	10	20
No. of people	90	240	530
Community facilities	0	0	0
Utilities	0	<10 Energy sites <10 Scottish Water Assets	<10 Energy sites <10 Scottish Water assets
Transport links (excluding minor roads)	3 A Roads affected at 18 locations	3 A Roads affected at 27 locations	3 A Roads affected at 27 locations
Environmental designated areas (km^2)	0.1km^2 • 1 SSSI • 1 SPA • 1 SAC	0.2km^2 • 1 SSSI • 1 SPA • 1 SAC	0.2km^2 • 1 SSSI • 1 SPA • 1 SAC
No. of cultural heritage sites	1	1	1
Agricultural land (km^2)	< 0.01km^2	< 0.01km^2	< 0.01km^2

Table 1: Summary of flooding impacts

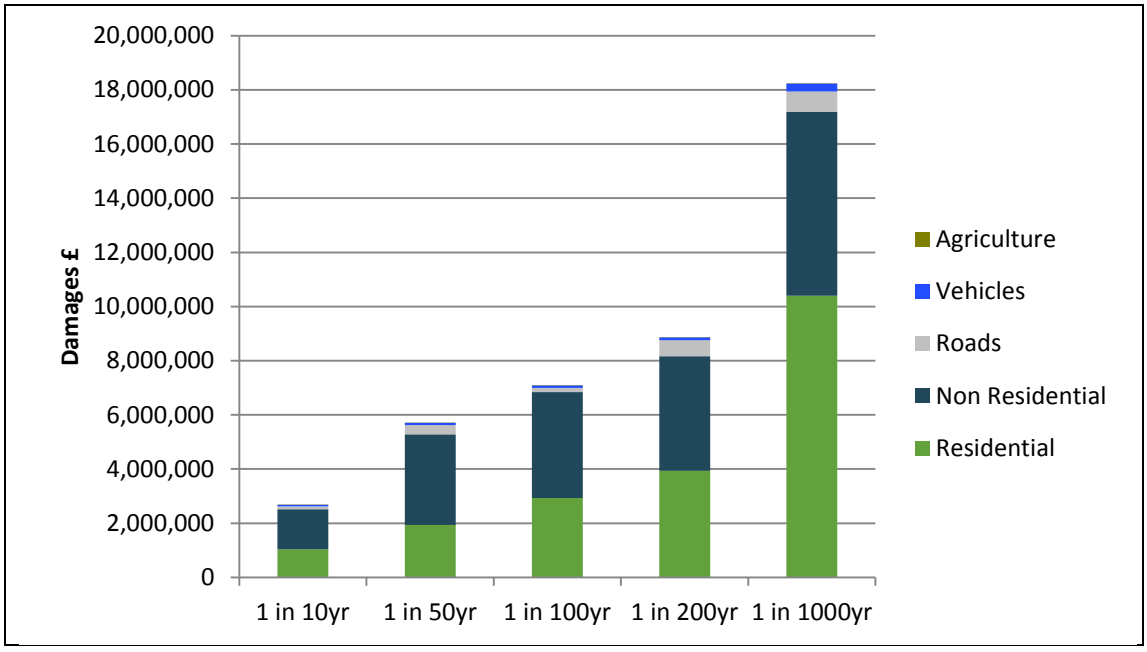


Figure 3: Damages by flood frequency

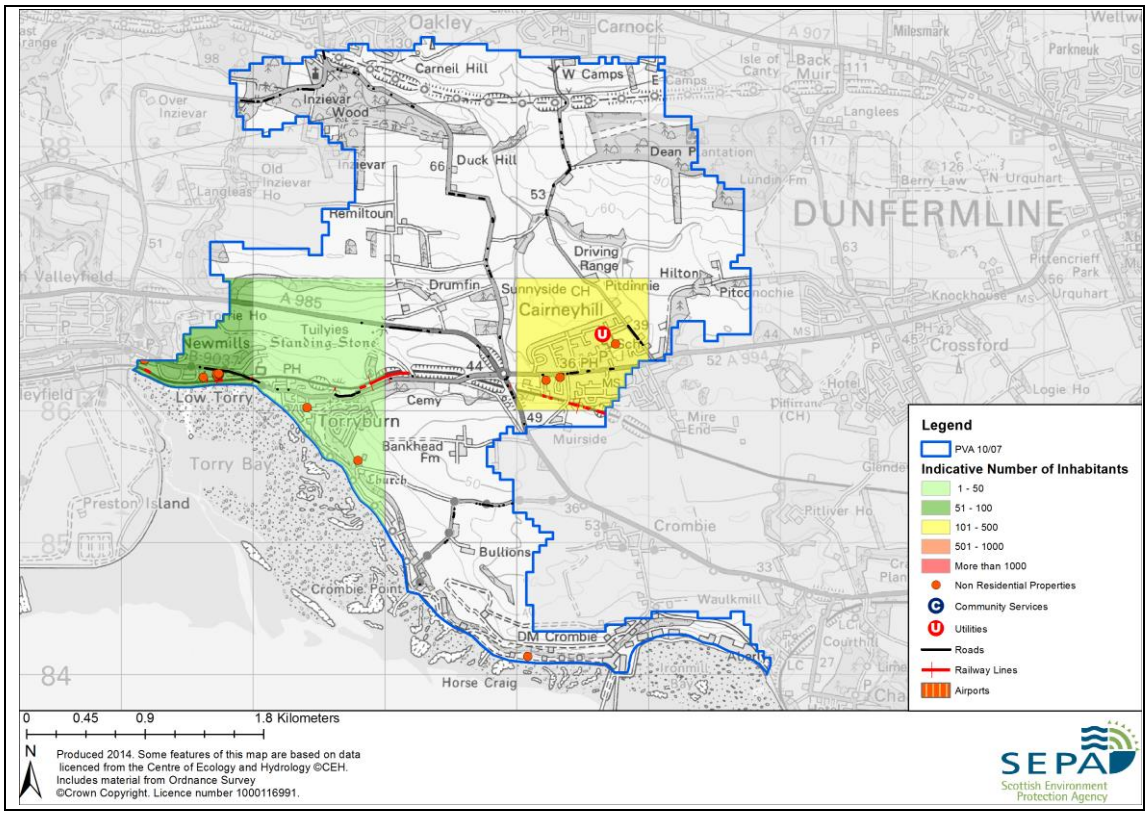


Figure 4: Impacts from all sources at a medium likelihood of flooding

History of flooding

No significant river, coastal or surface water floods have been recorded in this Potentially Vulnerable Area.

Summary of existing local actions to manage risk

There is one formal flood protection scheme in this potentially Vulnerable Area. This is the Cairmeyhill Flood Protection Scheme. Other actions and natural features may also reduce the risk of flooding. These are referenced in the river, coastal and surface water flooding reports.

There is one flood warning target area within this Potentially Vulnerable Area:

- Torryburn and Newmills - Coastal flood warning, Firth of Forth.

SEPA and the local authorities work closely with many other organisations that have flooding related duties and interests. These include the police, fire and rescue services, the Scottish Government and the Scottish Flood Forum. SEPA and the local authorities, often in partnership with these organisations, undertake various awareness raising campaigns that include community events, information leaflets, educational plays in schools, the use of social media and advertising.

In addition to the above, the following incentives or subsidies have been put in place to provide property owners with property level resilience/resistance actions:

- Fife Council provides Aquasacs for use in emergencies and these are available from stores located throughout Fife
- Fife Council also operates an Emergency Flood Plan.

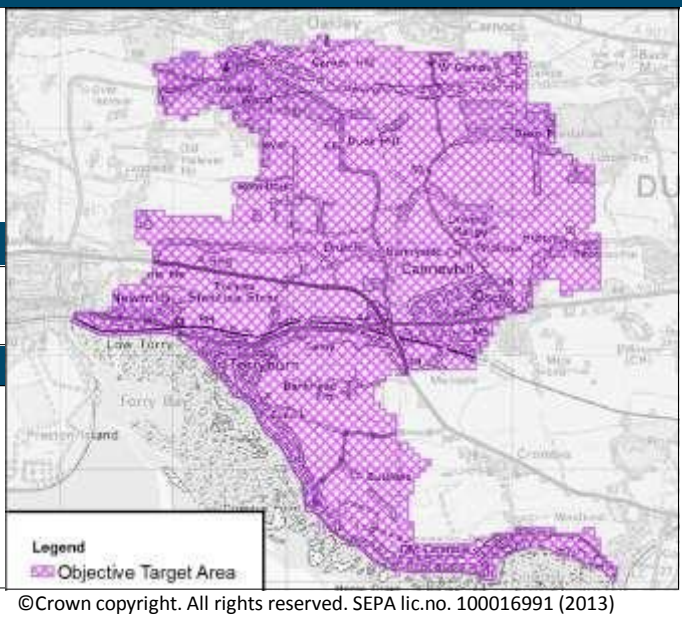
Cairneyhill
Potentially Vulnerable Area 10/07
Objectives and potential actions

Unless otherwise stated, information on the following objectives is contained in this document.

IMPORTANT; potential actions that apply across the whole local plan district including flood warning, land use planning, surface water management planning, and other generic actions are described in the Forth Estuary Local Plan District document.

Location	Objective	Objective ID
Applies across Forth Estuary Local Plan District	Avoid an overall increase in flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10001
Applies across Forth Estuary Local Plan District	Reduce overall flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10099
Cairneyhill	Reduce economic damages to residential and non-residential properties caused by river and coastal flooding.	10025

Cairneyhill
Potentially Vulnerable Area 10/07
Objectives and potential actions

Objective(s):	Cairneyhill objective target area
Reduce economic damages to residential and non-residential properties caused by river and coastal flooding.	
Objective ID:	
10025	
Indicators:	
£120,000 annual average damages (residential properties) £130,000 annual average damages (non-residential properties)	

Potential action	Action ID	Description
Maintenance of existing flood protection schemes	100250100	Existing coastal defences and a flow diversion scheme and defences along the Torry Burn provide protection to residential and/or non-residential properties. *Ongoing maintenance of existing defences will ensure they continue to offer protection from flooding. This applies to all types of existing defences although appropriate maintenance activities may vary.*
Runoff control	100250500	Upstream of Cairneyhill an area with the potential to be used for runoff control has been identified. This could offer some reduction in flood risk along the Torry Burn for high likelihood floods. *Runoff control looks to enhance the ability of the catchment to capture and slow water reaching the receiving watercourses. These actions often achieve the greatest benefits in areas of frequent flooding.*
Sediment management	100250700	*Sediment management can help control the influence of eroded material on flooding by maintaining channel capacity and reducing the impact of siltation.*
Wave attenuation	100250800	*Wave attenuation uses the natural characteristics of coastal land cover either to reduce the impact of waves and coastal erosion, or to act as a physical barrier to tidal waters.*
Modification of conveyance	100251100	*Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing channel capacity. The potential benefits of these actions are greatest in areas of frequent flooding.*
Installation / modification of river control structures	100251200	*Control structures on a river can reduce flood levels either by restricting or increasing flow in the channel. The impact of these structures can vary significantly depending on type and location of the structures being added or modified.*

Cairneyhill
Potentially Vulnerable Area 10/07
Objectives and potential actions

Construction of direct flood defences	100251400	The potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*
Property level protection	100251700	Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection. *Property level protection can reduce flood impacts by restricting water entering a property, or using construction techniques which increase the resilience of property to flood water. It is most beneficial for flood depths less than 0.6m, in areas prone to frequent flooding.*
Site protection plans	100252100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Improved understanding	100252200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*
Relocation	100250200	Some of the properties that have been identified to be at risk of flooding may be suitable for relocation. *Relocation of properties or infrastructure may be applicable in locations where frequent flooding is expected and where areas may otherwise be difficult or uneconomical to protect.*

Cairneyhill (Potentially Vulnerable Area 10/07)

Action	Action ID	Description	Status and Timing	Funding	Responsibility
ONGOING AND CONFIRMED ACTIONS. Actions that are either underway or where the funding has been confirmed for 2016-2021.					
Maintenance of existing flood protection schemes	100250100	**Existing coastal defences and defences along the Torry Burn and an unnamed watercourse provide protection to residential and/or non-residential properties.** Ongoing maintenance of existing defences will ensure they continue to offer protection from flooding. This applies to all types of existing defences although appropriate maintenance activities may vary.	Ongoing.	Fife Council revenue.	Fife Council
Sediment Management	100250700	Sediment management can help control the sediment balance in the catchment, maintain channel capacity and reduce the impact of siltation at structures and other key areas.	Ongoing maintenance carried out at structures.	Fife Council revenue.	Fife Council
Surface Water Management	10024239	An integrated catchment study will be carried out for Dunfermline, Cairneyhill and Rosyth to improve knowledge and understanding of surface water flood risk and	Confirmed. Planned to be carried out between 2015-2021.	Scottish Water/Fife Council	Scottish Water led in partnership with Fife Council and SEPA

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		interactions with other sources of flooding e.g. with the sewer network, watercourses and the sea.			
Flood warning schemes – Maintain Firth of Forth and Tay **coastal** flood warning scheme	100993491810	This action has been identified for all existing flood warning schemes. It will be appropriate where the existing scheme meets the needs of the local community.	Ongoing	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	SEPA
Self Help / Awareness Raising		Self help actions (individuals taking action to protect themselves and their property against flooding) can be undertaken by any individuals, businesses, organisations or communities at risk of flooding. They are applicable to all sources and probabilities of flooding. They focus on awareness and understanding of the flood risk.	Ongoing. Flooding advice is provided on Fife Council website and via Public information leaflets. These give practical advice and contact information. Fife Council has provided 'Flood Pods' in locations of vulnerable properties which owners can access in times of flood threat.		Fife Council Fife Council

Delivery Plan for Consultation

Action	Action ID	Description	Status and Timing	Funding	Responsibility
			Owners have the right to protect their properties through purchase of property level protection		Owners
Emergency Plans		Emergency response plans are applicable for all flood sources and likelihoods. They set out the steps to be taken during a flood event to maximise safety and minimise impacts where possible.	Ongoing. Flooding is included within Fife Council's Emergency planning procedures		Fife Council Emergency Services
Land Use Planning	-	Application of national and local planning policies, including objectives and actions identified in the LPD development plan.	Ongoing	Fife Council's revenue budget	Fife Council
Watercourse Maintenance		Watercourse maintenance can prevent debris accumulating within channels, which may otherwise result in an increased flood risk. It can be undertaken as a regular planned activity or in response to a flood event.	Ongoing, Pre-flood checks undertaken at critical sites. Inspection and maintenance on a regular basis for other locations.	Council Revenue allocation	Fife Council/ Landowners

POTENTIAL ACTIONS. The actions below are being consulted upon to support the process of identifying preferred actions. Preferred actions may not be

Action	Action ID	Description	Status and Timing	Funding	Responsibility
able to be implemented during the period 2016-2021 due to project lead-in times and / or funding constraints.					
Relocation of properties/infrastructure away from flood risk areas	100250200	**Properties have been identified to be at risk in a high likelihood event and may therefore be suitable for relocation.** Relocation of properties or infrastructure, currently at risk of flooding, away from the flood risk area may be applicable in locations where frequent flooding is expected to a limited area that may be otherwise difficult or uneconomical to protect.	This is a potential action identified through SEPA's strategic option appraisal. Not a current Council policy.		Fife Council
Runoff Control	100250500	Upstream of Cairneyhill an area with the potential to be used for runoff control has been identified. This could offer a limited reduction in flood risk along the Torry Burn for high likelihood events. Runoff control actions look to enhance the natural catchment ability to capture and slow runoff water reaching the receiving watercourses. These actions often experience the greatest benefits in areas of high	This is a potential action identified through SEPA's strategic option appraisal. Would require further study. Timing subject to Capital funding availability.		Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		probability flooding.			
Wave attenuation	100250800	Wave attenuation actions use the natural characteristics of different types of coastal land cover to either reduce the impact of waves and coastal erosion or to act as a physical barrier to tidal waters.			
Modification of Conveyance	100251100	Conveyance modification aims to reduce flooding by moving flow more efficiently: speeding it up, removing constrictions or increasing cross sectional area. The potential benefits of these actions are greatest during high probability events.	Fife Council has identified a need to increase capacity at structures. Further study required to identify options. Timing subject to Capital funding availability.		Fife Council
Installation / modification of fluvial control structures	100251200	Fluvial control structures can reduce flood levels to a target area by either restricting or increasing channel flow. The impact of these structures can vary significantly depending on type and location of the structures being added or modified	Further study required to identify options. Timing subject to Capital funding availability.		Fife Council
Construction of Direct flood Defences	100251400	The potential to construct direct coastal defences has been identified to reduce the risk to residential and non-residential properties from a	This is a potential action identified through SEPA's strategic option appraisal. Would require further study. Timing subject to Capital funding availability.		

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		medium likelihood flood event. Direct defence actions aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at flood risk.			
Property level protection	100251700	**Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection.** Property level protection can reduce flood impact by restricting water entering a property, or using construction techniques which are resilient to flood water. It is most beneficial for flood depths <0.6m in areas of high probability flooding	This is a potential action identified by SEPA's strategic option appraisal. Owners have the right to purchase property level protection Fife Council provides and maintains flood pods at known flood risk locations which owners of vulnerable property may use if threatened.		Property owners. Fife Council
Flood warning schemes	100251800	Flood warning actions enable people and organisations to prepare for an event. They enable the risk of the event to be reduced by moving people / possessions out of the floodplain and by placing temporary barriers to reduce	No new or improved service identified. Flood warning scheme development would be subject to technical feasibility and Scottish Government funding.		SEPA

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		flooding impacts.			
Site protection plans	100252100	Site protection plans are developed to identify whether normal operation of a facility can be maintained during an event. This may be due to existing protection or resilience of the facility or the network.			
Modelling and other assessments to improve knowledge of flood hazards and impacts	100252200	Improved knowledge of the risks from different events helps to develop plans to avoid or mitigate future flooding to sensitive areas.	Fife Council undertakes flood studies of known flood risk areas and subject to funding will continue to do so where it is considered such knowledge may be of benefit in developing plans to reduce flood risk.		Fife Council
Surface water management	10023238	Develop a plan for Cairneyhill, Crombie and Muirside for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	Recommended actions agreed by all partners identified by 2019.		Fife Council
Flood warning schemes – Improve sign up of Firth of Forth and Tay **coastal** flood warning scheme	100993491822	This action has been identified because the sign-up rate in some of the FWTAs within this scheme is less than the target of 40%. If the action is progressed, the sign-up rate for the relevant FWTAs will be improved via a targeted	Potential actions are drawn from a short list of options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being of	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable	SEPA

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		communications campaign.	priority are dependent on funding.	SEPA to implement new flood warning schemes.	
Flood warning schemes – Simplify Firth of Forth and Tay **coastal** flood warning scheme	100993491830	This action has been identified because other structural actions are being considered in this area which may reduce the need for a detailed flood warning scheme.	Potential actions are drawn from a short list of options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being of priority are dependent on funding.	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	SEPA

Hawkhill, Kincardine, Kennet Pans and Culross (Potentially Vulnerable Area 10/08)

Local Plan District	Local Authorities	Main Catchment
10 Forth Estuary	Clackmannanshire Council, Fife Council	South Fife Coastal

Background

This Potentially Vulnerable Area covers an area of 31km^2 and is part of the Firth of Forth catchment. This is a small coastal area in the west of the catchment containing the villages of Kincardine and Culross (Figure 1). The area does not have a main watercourse; however there are numerous unnamed burns around Kincardine which collectively cause flooding issues in the area.

The highest risk of coastal flooding is from the Firth of Forth to Culross and Kincardine. The highest risk of river flooding is to Kincardine. The majority of flood damages are caused by coastal flooding (Figure 2).

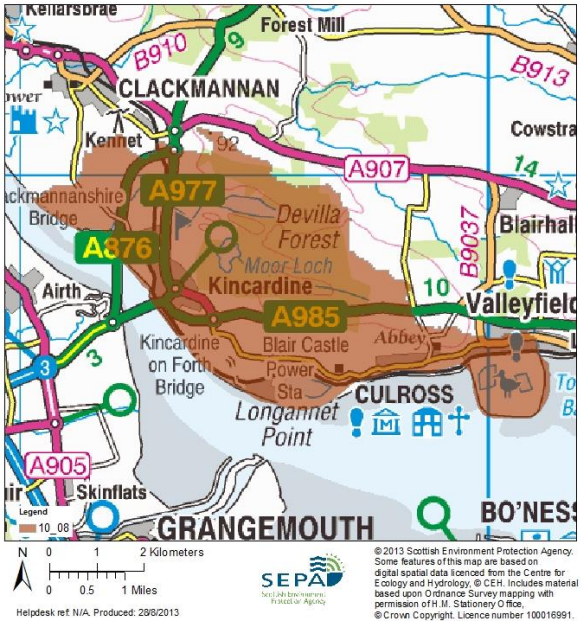


Figure 1: Potentially Vulnerable Area 10/08

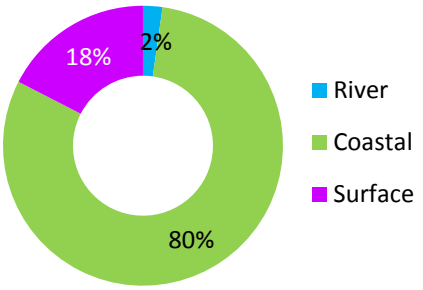


Figure 2: Annual Average Damages by flood source

Summary of flooding impacts

Approximately 240 residential properties and 30 non-residential properties are at a medium likelihood of flooding from one or more sources. A summary of the impacts from flooding can be seen in Table 1 and a map showing the impacts from all sources at a medium likelihood of flooding can be seen in Figure 4.

The total Annual Average Damages from all sources of flooding are approximately £740,000. This includes damages to residential properties, non-residential properties, transport and agriculture. The economic damages incurred for each return period can be seen in Figure 3. For this Potentially Vulnerable Area the highest damages are to residential properties followed by damages to non-residential properties.

In 2010 Scottish Water carried out a Flood Risk Assessment Study of water and wastewater assets across Scotland. Six wastewater assets were identified as being at risk of flooding within this Potentially Vulnerable Area.

	High likelihood	Medium likelihood	Low likelihood
No. of residential properties	80	240	330
No. of non-residential properties	20	30	40
No. of people	180	530	730
Community facilities	0	0	<10 Educational buildings
Utilities	<10 Energy sites <10 Communications sites	<10 Energy sites <10 Communications sites <10 Scottish Water assets	<10 Energy sites <10 Communications sites <10 Scottish Water assets
Transport links (excluding minor roads)	4 Roads affected at 14 locations • 3 A roads • 1 B road	4 Roads affected at 19 locations • 3 A roads • 1 B road	4 Roads affected at 23 locations • 3 A roads • 1 B road
Environmental designated areas (km^2)	0.2km^2 • 1 SSSI • 1 SPA • 1 SAC	0.3km^2 • 1 SSSI • 1 SPA • 1 SAC	0.3km^2 • 1 SSSI • 1 SPA • 1 SAC
No. of cultural heritage sites	5	6	6
Agricultural land (km^2)	2.9km^2	3.2km^2	3.6km^2

Table 1: Summary of flooding impacts

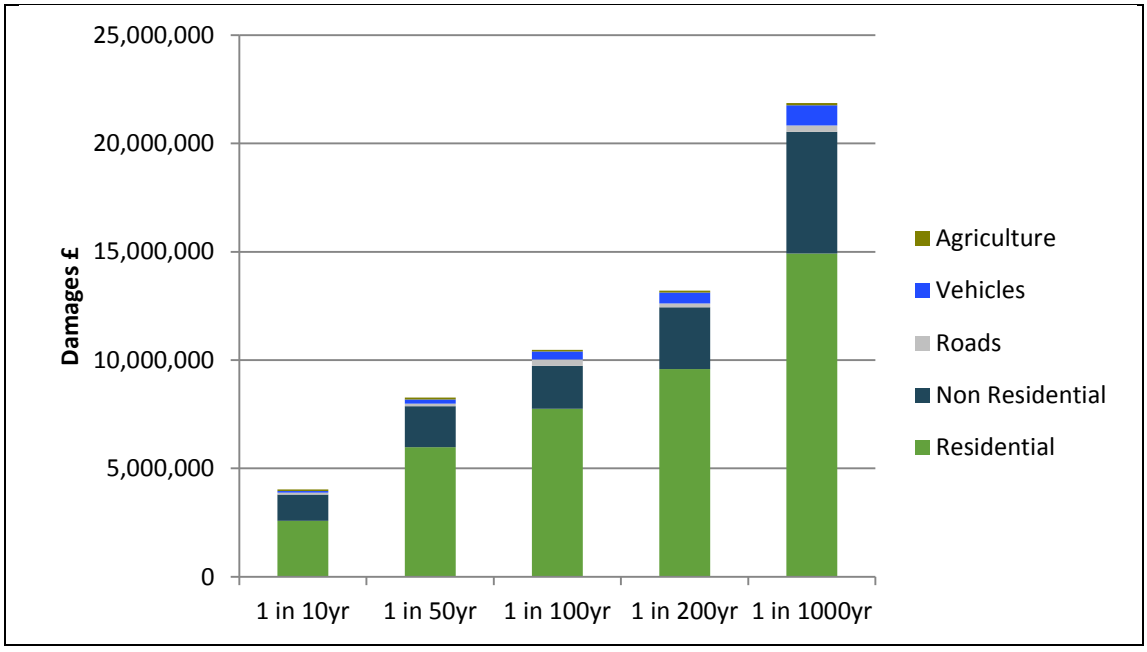


Figure 3: Damages by flood frequency

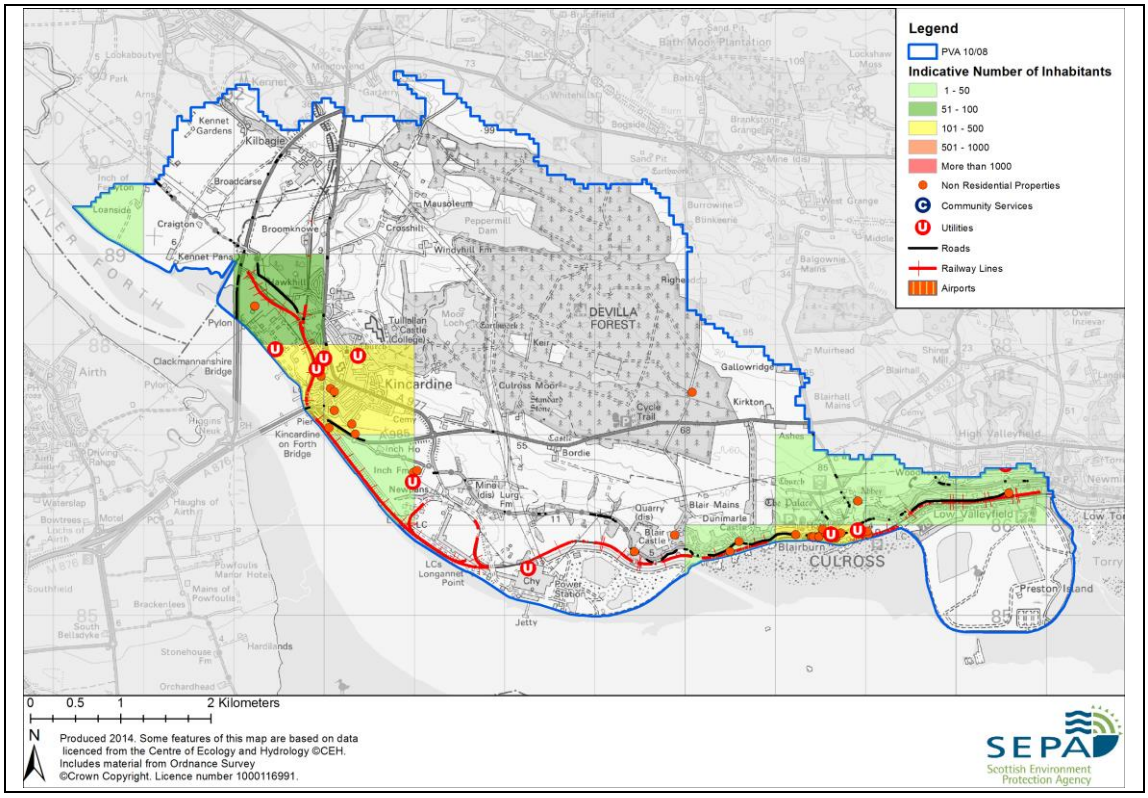


Figure 4: Impacts from all sources at a medium likelihood of flooding

History of flooding

No significant river, coastal or surface water floods have been recorded in this Potentially Vulnerable Area.

Summary of existing local actions to manage risk

There is one formal flood protection scheme in this Potentially Vulnerable Area. This is the Kincardine-on-Forth Flood Protection Scheme. Other actions and natural features may also reduce the risk of flooding. These are referenced in the river, coastal and surface water flooding reports.

There are two flood warning target areas within this Potentially Vulnerable Area:

- Culross, Longannet and Kincardine - Coastal flood warning, Firth of Forth
- Torryburn and Newmills - Coastal flood warning, Firth of Forth.

SEPA and the local authorities work closely with many other organisations that have flooding related duties and interests. These include the police, fire and rescue services, the Scottish Government and the Scottish Flood Forum. SEPA and the local authorities, often in partnership with these organisations, undertake various awareness raising campaigns that include community events, information leaflets, educational plays in schools, the use of social media and advertising.

In addition to the above, the following incentives or subsidies have been put in place to provide property owners with property level resilience/resistance actions:

- Fife Council provides Aquasacs for use in emergencies and these are available from stores located throughout Fife
- Fife Council also operates an Emergency Flood Plan.

Some local authorities have their own policies regarding property level protection. Contact your local authority or view their website for more information.

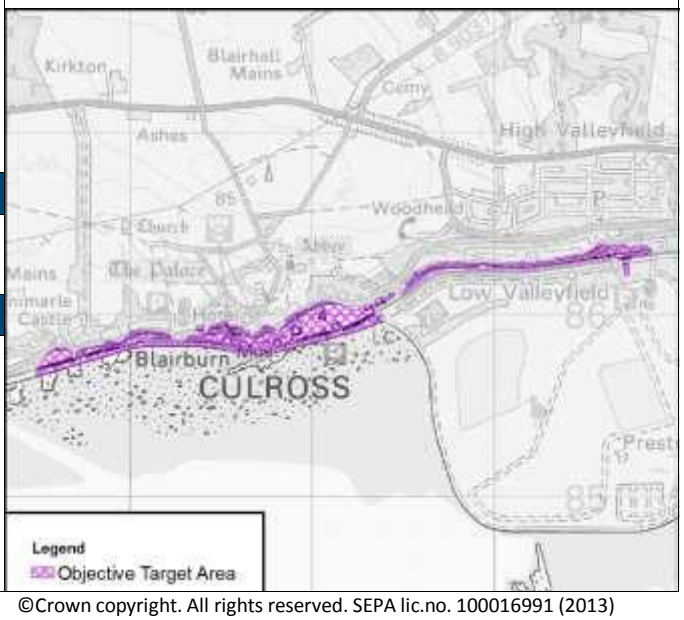
Hawkhill, Kincardine, Kennet Pans, Culross Potentially Vulnerable Area 10/08 Objectives and potential actions

Unless otherwise stated, information on the following objectives is contained in this document.

IMPORTANT; potential actions that apply across the whole local plan district including flood warning, land use planning, surface water management planning, and other generic actions are described in the Forth Estuary Local Plan District document.

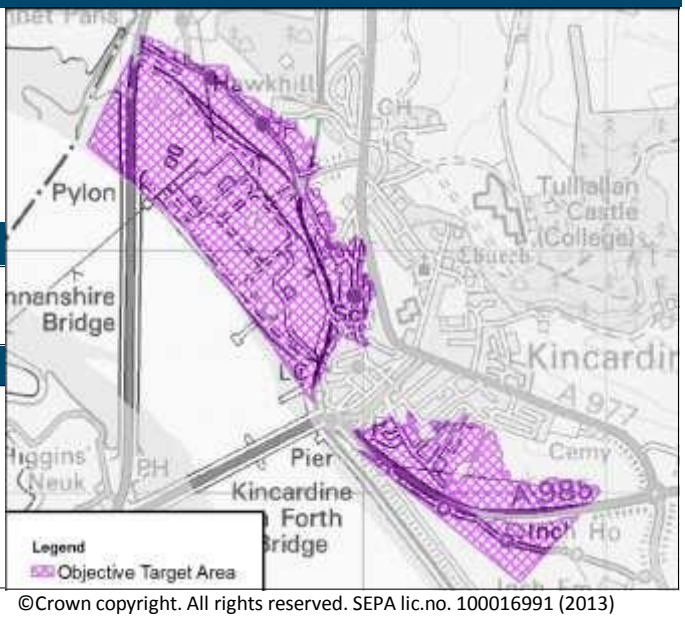
Location	Objective	Objective ID
Applies across Forth Estuary Local Plan District	Avoid an overall increase in flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10001
Applies across Forth Estuary Local Plan District	Reduce overall flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10099
Culross	Reduce economic damages to residential and non-residential properties in Culross caused by coastal flooding. Reduce risk to people in Culross from coastal flooding.	10026 10028
Kincardine	Reduce economic damages to residential and non-residential properties in Kincardine caused by river flooding and coastal flooding.	10027

Hawkhill, Kincardine, Kennet Pans, Culross Potentially Vulnerable Area 10/08 Objectives and potential actions

Objective(s):	Culross objective target area
Reduce economic damages to residential and non-residential properties in Culross caused by coastal flooding. Reduce risk to people in Culross from coastal flooding.	
Objective ID:	
10026, 10028	
Indicators:	
£120,000 annual average damages (residential properties) £14,000 annual average damages (non-residential properties) 200 people at risk (from a medium likelihood flood)	

Potential action	Action ID	Description
Wave attenuation	100260800	*Wave attenuation uses the natural characteristics of coastal land cover either to reduce the impact of waves and coastal erosion, or to act as a physical barrier to tidal waters.*
Surge attenuation	100260900	*Creation and restoration of intertidal areas (the foreshore area between the mean high and low water levels) can protect and enhance these ecologically diverse areas, and create space to manage and store tidal flooding, reducing the risk elsewhere.*
Construction of direct flood defences	100261400	Within Culross, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*
Property level protection	100261700	Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection. *Property level protection can reduce flood impacts by restricting water entering a property, or using construction techniques which increase the resilience of property to flood water. It is most beneficial for flood depths less than 0.6m, in areas prone to frequent flooding.*
Site protection plans	100262100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Improved understanding	100262200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*

Hawkhill, Kincardine, Kennet Pans, Culross Potentially Vulnerable Area 10/08 Objectives and potential actions

Objective(s):	Kincardine objective target area
Reduce economic damages to residential and non-residential properties in Kincardine caused by river flooding and coastal flooding.	
Objective ID:	
10027	
Indicators:	
£300,000 annual average damages (residential properties) £79,000 annual average damages (non-residential properties)	

Potential action	Action ID	Description
Maintenance of existing flood protection schemes	100270100	Flow diversion from the Moor Loch Burn provides protection to residential and/or non-residential properties up to a 1 in 5 year event. *Ongoing maintenance of existing defences will ensure they continue to offer protection from flooding. This applies to all types of existing defences although appropriate maintenance activities may vary.*
River or floodplain restoration	100270600	Upstream of Kincardine land with the potential for river or floodplain restoration has been identified. Further analysis has shown that due to its positioning within the catchment and/or its size this action may not reduce flood risk in the target area. *Restoring the river corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.*
Sediment management	100270700	*Sediment management can help control the influence of eroded material on flooding by maintaining channel capacity and reducing the impact of siltation.*
Surge attenuation	100270900	*Creation and restoration of intertidal areas (the foreshore area between the mean high and low water levels) can protect and enhance these ecologically diverse areas, and create space to manage and store tidal flooding, reducing the risk elsewhere.*
Construction of online and offline storage	100271000	Upstream of Kincardine land with the potential to be used for online or offline storage has been identified. This could offer a reduction in flood risk along the Moor Loch and Peppermill Dam for medium likelihood floods. *Flood storage actions retain water in the upper catchment or away from the watercourse, reducing the level and flow in the river. The benefit of these actions decreases further downstream although they can be designed to benefit multiple communities.*

Hawkhill, Kincardine, Kennet Pans, Culross Potentially Vulnerable Area 10/08 Objectives and potential actions

Coastal management	100271300	*Coastal management actions aim to reduce the risk of coastal flooding using designed materials and structures. The actions reduce the impact of waves and erosion by modifying wave action or acting as a barrier to increasing sea levels.*
Construction of direct flood defences	100271400	Within Kincardine, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*
Property level protection	100271700	Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection. *Property level protection can reduce flood impacts by restricting water entering a property, or using construction techniques which increase the resilience of property to flood water. It is most beneficial for flood depths less than 0.6m, in areas prone to frequent flooding.*
Site protection plans	100272100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Improved understanding	100272200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*

Hawkhill, Kincardine, Kennet Pans, Culross (Potentially Vulnerable Area 10/08)

Action	Action ID	Description	Status and Timing	Funding	Responsibility
ONGOING AND CONFIRMED ACTIONS. Actions that are either underway or where the funding has been confirmed for 2016-2021.					
Maintenance of existing flood protection schemes	100270100	**Existing defences along an unnamed watercourse (small tributary of the River Forth) provide protection to residential and/or non-residential properties in Kincardine up to a 1 in 5 year event.** Ongoing maintenance of existing defences will ensure they continue to offer protection from flooding. This applies to all types of existing defences although appropriate maintenance activities may vary.	Ongoing	Fife Council revenue allocation.	Fife Council
Sediment Management	100270700	**Moor Loch Burn in Kincardine requires channel capacity maintained through removal of sediment as well as at structures.** Sediment management can help control the sediment balance in the catchment, maintain channel capacity and reduce the impact of	Ongoing. Undertaken by Fife Council in absence of action by owner.	Fife Council revenue allocation	Landowner

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		siltation at structures and other key areas.			
Flood warning schemes – Maintain Firth of Forth and Tay **coastal** flood warning scheme	100993491810	This action has been identified for all existing flood warning schemes. It will be appropriate where the existing scheme meets the needs of the local community.	Ongoing	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	SEPA
Self Help / Awareness Raising		Self help actions (individuals taking action to protect themselves and their property against flooding) can be undertaken by any individuals, businesses, organisations or communities at risk of flooding. They are applicable to all sources and probabilities of flooding. They focus on awareness and understanding of the flood risk.	Ongoing. Flooding advice is provided on Fife Council website and via Public information leaflets. These give practical advice and contact information. Fife Council has provided 'Flood Pods' in locations of vulnerable properties which owners can access in times of flood threat. Owners have the right to protect their properties	Fife Council Revenue Budget Self funded	Fife Council Fife Council Owners

Delivery Plan for Consultation

Action	Action ID	Description	Status and Timing	Funding	Responsibility
			through purchase of property level protection		
Emergency Plans		Emergency response plans are applicable for all flood sources and likelihoods. They set out the steps to be taken during a flood event to maximise safety and minimise impacts where possible.	Ongoing. Flooding is included within Fife Council's Emergency planning procedures	Proportional funding by appropriate Council's Revenue Budget	Fife Council Clackmannanshire Council
Land Use Planning	-	Application of national and local planning policies, including objectives and actions identified in the LPD development plan.	Ongoing	Proportional funding by appropriate Council's Revenue Budget	Fife Council Clackmannanshire Council
Watercourse Maintenance		Watercourse maintenance can prevent debris accumulating within channels, which may otherwise result in an increased flood risk. It can be undertaken as a regular planned activity or in response to a flood event.	Ongoing, Pre-flood checks undertaken at critical sites. Inspection and maintenance on a regular basis for other locations.	Proportional funding by appropriate Council's Revenue Budget	Fife Council Clackmannanshire Council Landowners

POTENTIAL ACTIONS. The actions below are being consulted upon to support the process of identifying preferred actions. Preferred actions may not be able to be implemented during the period 2016-2021 due to project lead-in times and / or funding constraints.

Wave attenuation	100260800	Wave attenuation actions use the natural			

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		characteristics of different types of coastal land cover to either reduce the impact of waves and coastal erosion or to act as a physical barrier to tidal waters.			
Creation/restoration of intertidal area including mudflats and saltmarsh, and regulated tidal exchange	100260900	Creation and restoration of intertidal areas (the foreshore area between the mean high and low water levels) can protect and enhance these ecologically diverse areas, and create space to manage and store tidal flooding, reducing the risk elsewhere.			
Construction of Direct flood Defences	100261400	**Within Culross, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood event.** Direct defence actions aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at flood risk.	This is a potential action identified through SEPA's strategic option appraisal. Further study/assessment required. Subject to funding being available.		Fife Council
Property level protection	100261700	**Some of the properties that have been identified to**	This is a potential action identified through SEPA's strategic option appraisal		

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		be at risk of flooding may be suitable for property level protection. Property level protection can reduce flood impact by restricting water entering a property, or using construction techniques which are resilient to flood water. It is most beneficial for flood depths <0.6m in areas of high probability flooding	Owners have the right to purchase property level protection. Fife council provides and maintains flood pods in known flood risk locations which owners of vulnerable property may use if threatened.		Property owners Fife Council
Flood warning schemes	100261800	Flood warning actions enable people and organisations to prepare for an event. They enable the risk of the event to be reduced by moving people / possessions out of the floodplain and by placing temporary barriers to reduce flooding impacts.			SEPA
Site protection plans	100262100	Site protection plans are developed to identify whether normal operation of a facility can be maintained during an event. This may be due to existing protection or resilience of the facility or the network.			
Modelling and other assessments to improve	100262200	Improved knowledge of the risks from different events	Fife Council undertakes flood studies of known flood risk areas and subject to funding will continue to do		Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
knowledge of flood hazards and impacts		helps to develop plans to avoid or mitigate future flooding to sensitive areas.	so where it is considered such knowledge may be of benefit in developing plans to reduce flood risk.		
River or floodplain restoration	100270600	**Upstream of Kincardine land with the potential for river or floodplain restoration has been identified. Further analysis has shown that due to its positioning within the catchment and/or its size this action will not reduce flood risk in the target area.** Restoring the river corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.	This potential action has been ruled out through SEPA's strategic option appraisal.		
Creation/restoration of intertidal area including mudflats and saltmarsh, and regulated tidal exchange	100270900	Creation and restoration of intertidal areas (the foreshore area between the mean high and low water levels) can protect and enhance these ecologically diverse areas, and create space to manage and store tidal flooding, reducing the risk elsewhere.			
Construction of Online and Offline storage	100271000	**Upstream of Kincardine land with the potential to**	This is a potential action identified through SEPA's strategic option appraisal. Further study/assessment		Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		be used for online or offline storage has been identified. This could offer a reduction in flood risk along the Moor Loch and Peppermill Dam for medium likelihood events. Flood storage actions retain water in the upper catchment or away from the channel, to reduce level and flow in the river. The benefit of these actions decreases further downstream although they can be designed to benefit multiple communities.	required. Subject to funding being available.		
Coastal management	100271300	Coastal management actions aim to reduce the risk of coastal flooding using designed materials and structures. The actions reduce the impact of waves and erosion by modifying wave action or acting as a barrier to increasing sea levels.			
Construction of Direct flood Defences	100271400	**Within Kincardine, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from**	This is a potential action identified through SEPA's strategic option appraisal. Further study/assessment required. Subject to funding being available.		

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		a medium likelihood flood event. Direct defence actions aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at flood risk.			
Property level protection	100271700	**Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection.** Property level protection can reduce flood impact by restricting water entering a property, or using construction techniques which are resilient to flood water. It is most beneficial for flood depths <0.6m in areas of high probability flooding	This is a potential action identified through SEPA's strategic option appraisal Owners have the right to purchase property level protection. Fife council provides and maintains flood pods in known flood risk locations which owners of vulnerable property may use if threatened.		Owners Fife Council
Flood warning schemes	100271800	Flood warning actions enable people and organisations to prepare for an event. They enable the risk of the event to be reduced by moving people / possessions out of the floodplain and by placing temporary barriers to reduce			SEPA

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		flooding impacts.			
Site protection plans	100272100	Site protection plans are developed to identify whether normal operation of a facility can be maintained during an event. This may be due to existing protection or resilience of the facility or the network.			
Modelling and other assessments to improve knowledge of flood hazards and impacts	100272200	Improved knowledge of the risks from different events helps to develop plans to avoid or mitigate future flooding to sensitive areas.	Fife Council undertakes flood studies of known flood risk areas and subject to funding will continue to do so where it is considered such knowledge may be of benefit in developing plans to reduce flood risk.		Fife Council
Maintenance of existing flood protection schemes	100280100	Ongoing maintenance of existing defences will ensure they continue to offer protection from flooding. This applies to all types of existing defences although appropriate maintenance activities may vary.			
River or floodplain restoration	100280600	Restoring the river corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.			
Sediment Management	100280700	Sediment management can help control the sediment balance in the catchment, maintain channel capacity and reduce the impact of			

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		siltation at structures and other key areas.			
Construction of Online and Offline storage	100281000	Flood storage actions retain water in the upper catchment or away from the channel, to reduce level and flow in the river. The benefit of these actions decreases further downstream although they can be designed to benefit multiple communities.			
Property level protection	100281700	**Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection.** Property level protection can reduce flood impact by restricting water entering a property, or using construction techniques which are resilient to flood water. It is most beneficial for flood depths <0.6m in areas of high probability flooding	This is a potential action identified through SEPA's strategic option appraisal Owners have the right to purchase property level protection. Fife council provides and maintains flood pods in known flood risk locations which owners of vulnerable property may use if threatened.		Owners Fife Council
Site protection plans	100282100	Site protection plans are developed to identify whether normal operation of a facility can be maintained during an event. This may be due to existing protection or resilience of the facility or the			

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		network.			
Modelling and other assessments to improve knowledge of flood hazards and impacts	100282200	Improved knowledge of the risks from different events helps to develop plans to avoid or mitigate future flooding to sensitive areas.	Fife Council undertakes flood studies of known flood risk areas and subject to funding will continue to do so where it is considered such knowledge may be of benefit in developing plans to reduce flood risk.		Fife Council
Flood warning schemes – Improve sign up of Firth of Forth and Tay **coastal** flood warning scheme	100993491822	This action has been identified because the sign-up rate in some of the FWTAs within this scheme is less than the target of 40%. If the action is progressed, the sign-up rate for the relevant FWTAs will be improved via a targeted communications campaign.	Potential actions are drawn from a short list of options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being of priority are dependent on funding.	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	SEPA
Flood warning schemes – Simplify Firth of Forth and Tay **coastal** flood warning scheme	100993491830	This action has been identified because other structural actions are being considered in this area which may reduce the need for a detailed flood warning scheme.	Potential actions are drawn from a short list of options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being of priority are dependent on funding.	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	SEPA

Airth (Potentially Vulnerable Area 10/09)

Local Plan District	Local Authorities	Main Catchment
10 Forth Estuary	Falkirk Council	Forth Estuary (South) Coastal

Background

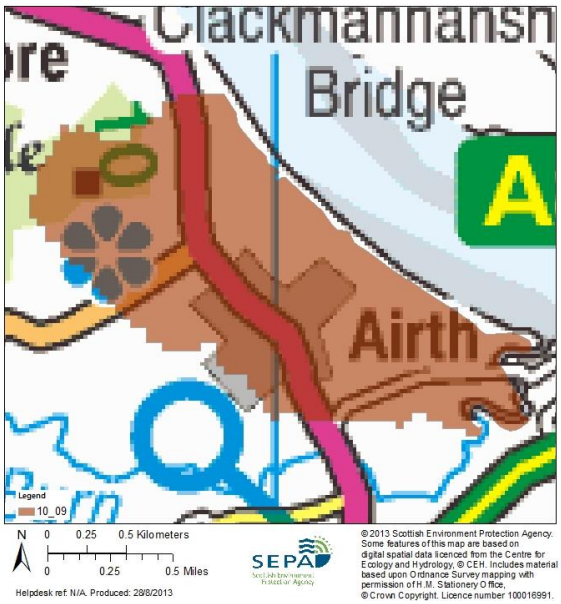


Figure 1: Airth Potentially Vulnerable Area

This Potentially Vulnerable Area covers an area of 4km^2 and is part of the Firth of Forth catchment. This is a small coastal area in the west of the catchment containing the village of Airth (Figure 1).

All of the damages in this Potentially Vulnerable Area are caused by coastal flooding to the town of Airth.

Summary of flooding impacts

Approximately 110 residential properties and less than 10 non-residential properties are at a medium likelihood of flooding from coastal flooding. A summary of the impacts from flooding can be seen in Table 1 and a map showing the impacts from all sources at a medium likelihood of flooding can be seen in Figure 3.

The total Annual Average Damages from all sources of flooding are approximately £680,000. This includes damages to residential properties, non-residential properties, transport and agriculture. The economic damages incurred for each return period can be seen in Figure 2. For this Potentially Vulnerable Area the highest damages are to residential properties followed by damages to non-residential properties.

In 2010 Scottish Water carried out a Flood Risk Assessment Study of water and wastewater assets across Scotland. One water asset and one wastewater asset were identified as being at risk of flooding within this Potentially Vulnerable Area.

	High likelihood	Medium likelihood	Low likelihood
No. of residential properties	90	110	120
No. of non-residential properties	<10	<10	<10
No. of people	200	240	260
Community facilities	0	0	0
Utilities	<10 Scottish Water assets	<10 Scottish Water assets	<10 Scottish Water assets
Transport links (excluding minor roads)	2 A Roads affected at 2 locations	2 A Roads affected at 4 locations	2 A Roads affected at 4 locations
Environmental designated areas (km^2)	0.1km^2 • 1 SSSI • 1 SPA • 1 SAC	0.1km^2 • 1 SSSI • 1 SPA • 1 SAC	0.1km^2 • 1 SSSI • 1 SPA • 1 SAC
No. of cultural heritage sites	1	1	1
Agricultural land (km^2)	1.3km^2	1.4km^2	1.5km^2

Table 1: Summary of flooding impacts

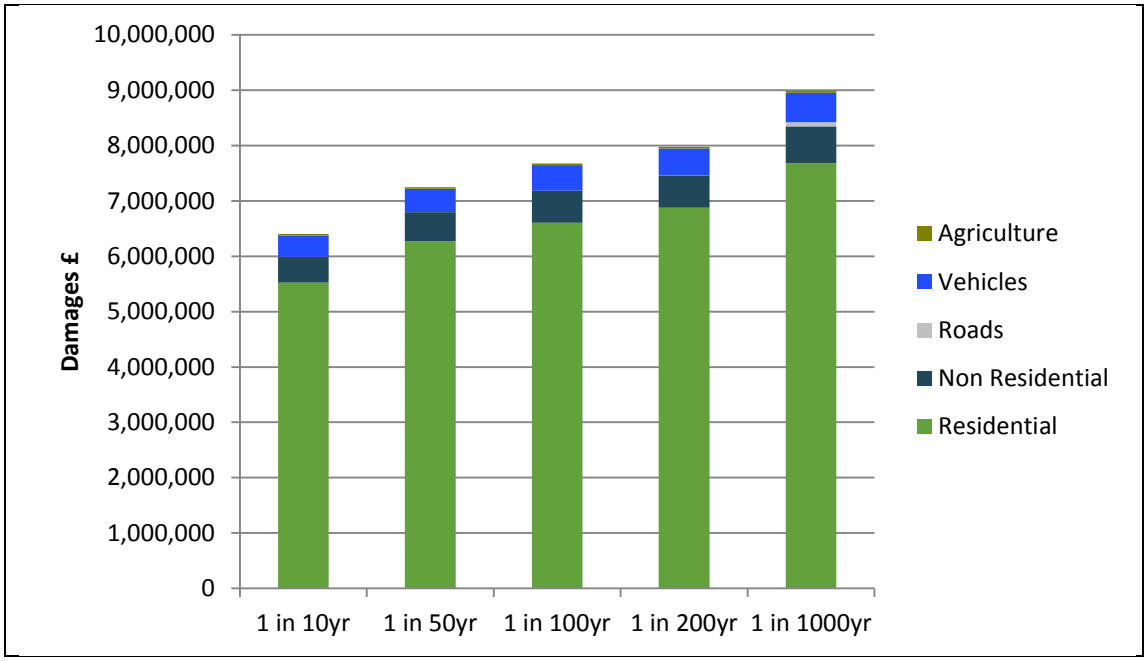


Figure 2: Damages by flood frequency

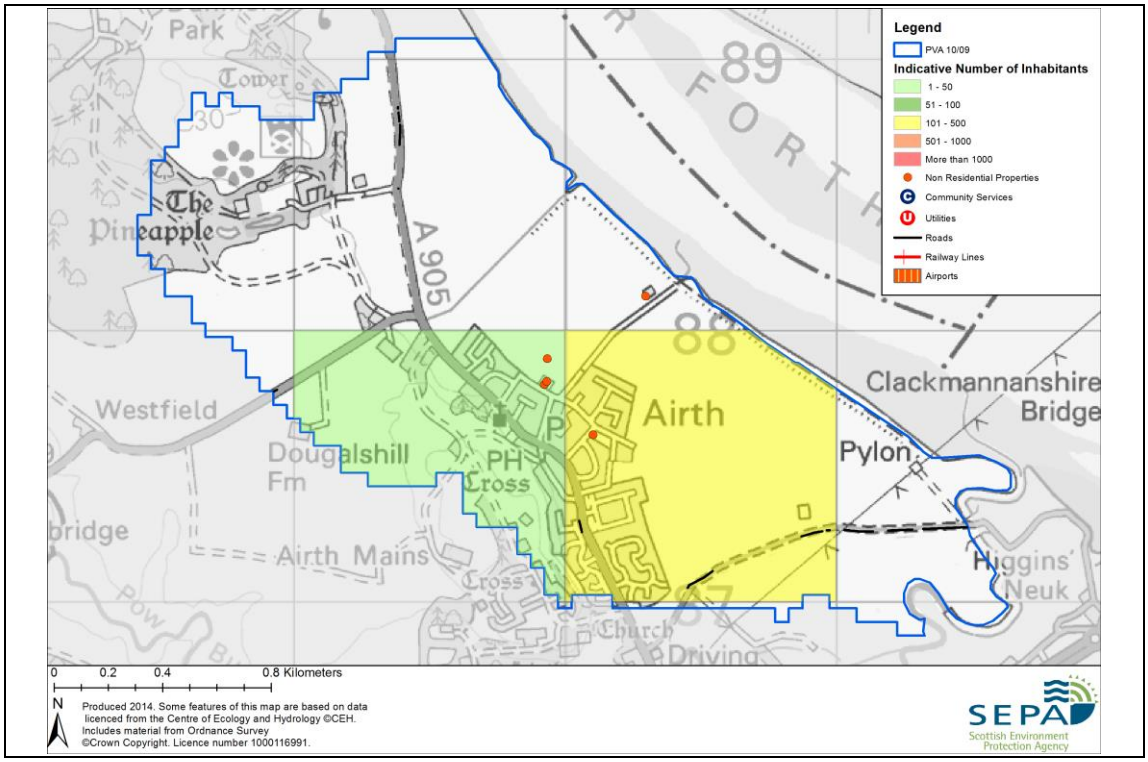


Figure 3: Impacts from all sources at a medium likelihood of flooding

History of flooding

The following coastal flood event has been identified as significant in this Potentially Vulnerable Area:

- December 2013: A breach of the existing bund during a combination of surge and high tide (approximately a 1 in 25 year event) resulted in flooding of Airth Wastewater Treatment Works and agricultural land.

No significant river or surface water flood events have been recorded in this Potentially Vulnerable Area.

Summary of existing local actions to manage risk

There are no formal flood protection schemes in this Potentially Vulnerable Area. However, other actions and natural features may reduce the risk of flooding. These are referenced in the river, coastal and surface water flooding reports.

SEPA and the local authorities work closely with many other organisations that have flooding related duties and interests. These include the police, fire and rescue services, the Scottish Government and the Scottish Flood Forum. SEPA and the local authorities, often in partnership with these organisations, undertake various awareness raising campaigns that include community events, information leaflets, educational plays in schools, the use of social media and advertising.

Some local authorities have their own policies regarding property level protection. Contact your local authority or view their website for more information.

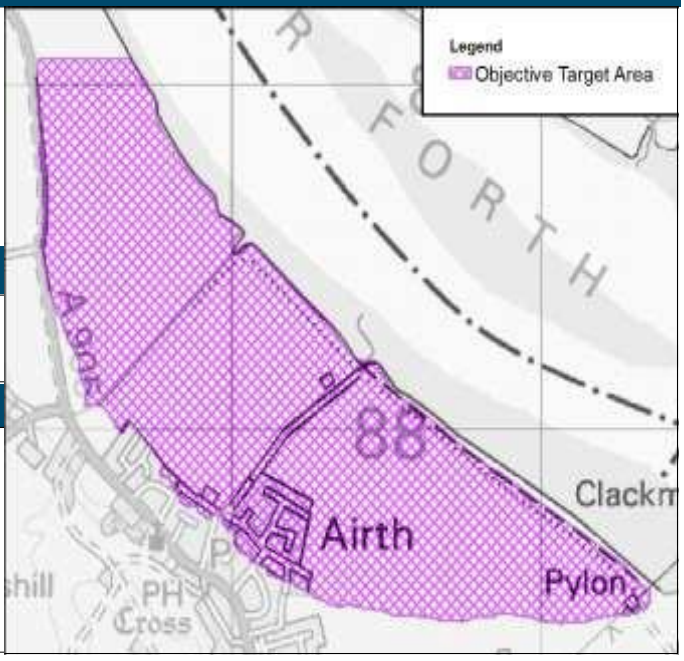
Airth
Potentially Vulnerable Area 10/09
Objectives and potential actions

Unless otherwise stated, information on the following objectives is contained in this document.

IMPORTANT; potential actions that apply across the whole local plan district including flood warning, land use planning, surface water management planning, and other generic actions are described in the Forth Estuary Local Plan District document.

Location	Objective	Objective ID
Applies across Forth Estuary Local Plan District	Avoid an overall increase in flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10001
Applies across Forth Estuary Local Plan District	Reduce overall flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10099
Airth	Reduce economic damages to residential and non-residential properties in Airth caused by coastal flooding. Reduce risk to people in Airth from coastal flooding.	10029 10030

Airth
Potentially Vulnerable Area 10/09
Objectives and potential actions

Objective(s):	Airth objective target area
Reduce economic damages to residential and non-residential properties in Airth caused by coastal flooding. Reduce risk to people in Airth from coastal flooding.	
Objective ID:	
10029, 10030	
Indicators:	
£530,000 annual average damages (residential properties) £47,000 annual average damages (non- residential properties) 320 people at risk (from a medium likelihood flood)	

Potential action	Action ID	Description
Surge attenuation	100290900	*Creation and restoration of intertidal areas (the foreshore area between the mean high and low water levels) can protect and enhance these ecologically diverse areas, and create space to manage and store tidal flooding, reducing the risk elsewhere.*
Coastal management	100291300	*Coastal management actions aim to reduce the risk of coastal flooding using designed materials and structures. The actions reduce the impact of waves and erosion by modifying wave action or acting as a barrier to increasing sea levels.*
Construction of direct flood defences	100291400	Within Airth, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*
Property level protection	100291700	Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection. *Property level protection can reduce flood impacts by restricting water entering a property, or using construction techniques which increase the resilience of property to flood water. It is most beneficial for flood depths less than 0.6m, in areas prone to frequent flooding.*
Site protection plans	100292100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Improved understanding	100292200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*

Delivery Plan for Consultation

AIRTH (Potentially Vulnerable Area 10/09)

Action	Action ID	Description	Status and Timing	Funding	Responsibility
ONGOING AND CONFIRMED ACTIONS. Actions that are either underway or where the funding has been confirmed for 2016-2021.					
Modelling and other assessments to improve knowledge of flood hazards and impacts	100292200 100302200	To reduce economic damages to both residential and non residential properties in the Village of Airth. Improved knowledge of the risks from different event scenarios will help to develop plans to avoid or mitigate future flooding.	Ongoing. Progression of studies/modelling to improve knowledge in areas of identified risk. Incorporation where applicable within SEPA's indicative flood maps.	Falkirk Council Revenue Budget	Falkirk Council
Self Help/ Awareness Raising	-	Self help actions (individuals taking action to protect themselves and their property against flooding) can be undertaken by any individuals, businesses, organisations or communities at risk of flooding. They are applicable to all sources and probabilities of flooding. They focus on awareness and understanding of the flood risk.	Ongoing	No specific funding identified	Individuals, businesses, organisations or communities
Emergency Plans	-	Emergency response plans are applicable for all flood sources and likelihoods. They set out the steps to be taken during a flood event to	Ongoing The council prepares and reviews Flood emergency response plans under statutory obligations	Falkirk Council Revenue budget	Falkirk Council Emergency Services

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		maximise safety and minimise impacts where possible.	towards the Civil Contingencies Act 2004. Risk Assessment indicates that the Falkirk area is particularly at risk of Coastal/Tidal flooding together with a lesser risk of fluvial or surface water flooding. These plans are implemented as part of the Councils Emergency Response Procedures to flooding incidents within the Council area or, if necessary, as part of a multi-agency response by the Forth Valley Local Resilience Partnership to incidents of a more severe and widespread nature.		
Land Use Planning	-	Application of national and local planning policies, including objectives and actions identified in the LPD development plan.	Ongoing	Falkirk Council's revenue budget	Falkirk Council
Watercourse Maintenance	-	Watercourse maintenance can prevent debris accumulating within channels, which may	Ongoing.	Falkirk Council Revenue budget.	Falkirk Council Landowners

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		otherwise result in an increased flood risk. It can be undertaken as a regular planned activity or in response to a flood event.			

POTENTIAL ACTIONS. The actions below are being consulted upon to support the process of identifying preferred actions. Preferred actions may not be able to be implemented during the period 2016-2021 due to project lead-in times and / or funding constraints.

Relocation of properties/infrastructure away from flood risk areas	100290200 100300200	No properties have been identified to be at risk in a high likelihood event and therefore suitable for relocation. Relocation of properties or infrastructure, currently at risk of flooding, away from the flood risk area may be applicable in locations where frequent flooding is expected to a limited area that may be otherwise difficult or uneconomical to protect.	Falkirk Council does not have a relocation policy and has not currently identified a need to progress this.	Falkirk Council
Creation/restoration of intertidal area including mudflats and saltmarsh, and regulated tidal exchange	100290900 100300900	Creation and restoration of intertidal areas(the foreshore area between the mean high and low water levels) can protect and enhance these ecologically diverse areas, and create space to manage	Should Falkirk Council have revenue funding available to progress a scheme to protect Airth from coastal flood risk this will require consideration of NFM measures during the option-engineering phase. The availability of funding will dictate progression and timing. Scheme delivery if confirmation attained will be dependent on Capital allocation	Falkirk Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		and store tidal flooding , reducing the risk elsewhere.			
Coastal Management	100291300 100301300	Coastal Management actions aim to reduce the risk of coastal flooding using designated materials and structures. The actions reduce the impact of waves and erosion by modifying wave action or acting as a barrier to increase sea levels.	If confirmed as appropriate would require to be progressed during the option engineering phase of any schemes being progressed. The progression of projects leading towards scheme submission is dependant on Revenue allocation. Scheme delivery if confirmation attained will be dependent on Capital allocation		Falkirk Council
Construction of Direct Flood Defences	100291400 100301400	**Within Airth, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood event.** Direct defence action aims to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at flood risk.	Should Falkirk Council have revenue funding available to progress a scheme to protect Airth from coastal flood risk this will require consideration of type/appropriateness of direct defences during the option-engineering phase. Scheme delivery if confirmation attained will be dependent on Capital allocation		Falkirk Council
Property level protection	100291700 100301700	**Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection.**	The provision of property level protection is at the discretion of the property owner.		Property Owner

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		Property level protection can reduce flood impact by restricting water entering a property, or using construction techniques which are resilient to flood water. It is most beneficial for flood depths <0.6m in areas of high probability flooding			
Flood warning schemes	100994451800	Develop a new flood warning. Properties affected by coastal flooding at Airth. Flood warning actions enable people and organisations to prepare for an event. They enable the risk of the event to be reduced by moving people / possessions out of the floodplain and by placing temporary barriers to reduce flooding impacts.	Potential actions are drawn from a short list of options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being a priority are dependent on funding. The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.		SEPA
Flood warning schemes	100291800 100301800	Flood warning actions enable people and organisations to prepare for an event. They enable the risk of the event to be reduce by moving people / possessions out of the	Potential actions are drawn from a short list of options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being a priority are dependent on funding. The maintenance of SEPA's flood warning service is		SEPA

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		floodplain and by placing temporary barriers to reduce flooding impacts	funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.		
Site protection plans	100292100 100302100	Site protection plans are developed to identify whether normal operation of a facility can be maintained during an event. This may be due to existing protection or resilience of the facility or the network	Awareness raising from SEPA will help business owners determine their own needs.		Business Owner/Network Operator

North Queensferry and Inverkeithing (Potentially Vulnerable Area 10/10)

Local Plan District	Local Authorities	Main Catchment
10 Forth Estuary	Fife Council	South Fife Coastal

Background

This Potentially Vulnerable Area covers an area of 15km^2 and is part of the Firth of Forth catchment. This is a large coastal area in the south of the catchment containing the towns of Dalgety Bay, North Queensferry, Rosyth and Inverkeithing (Figure 1).

The highest risk of coastal flooding is from the Forth of Forth to Rosyth, Inverkeithing and North Queensferry. The majority of flood damages are caused by coastal flooding (Figure 2).

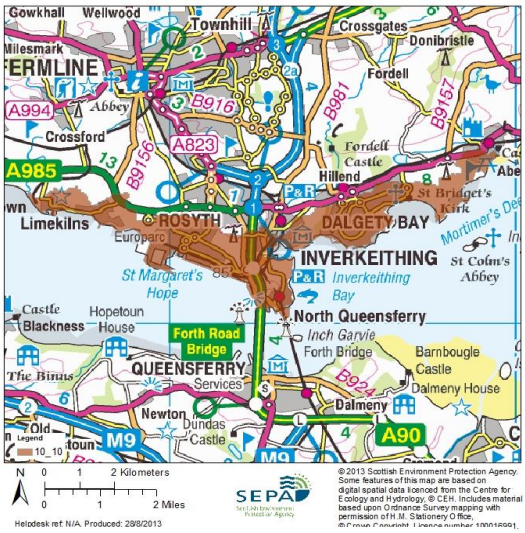


Figure 1: North Queensferry and Inverkeithing Potentially Vulnerable Area

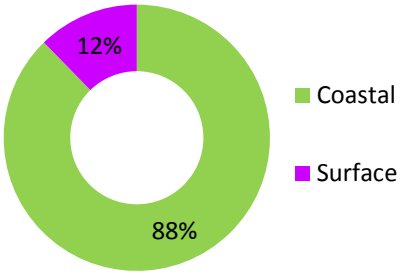


Figure 2: Annual Average Damages by flood source

Summary of flooding impacts

Approximately 40 residential properties and 30 non-residential properties are at a medium likelihood of flooding from one or more sources. A summary of the impacts from flooding can be seen in Table 1 and a map showing the impacts from all sources at a medium likelihood of flooding can be seen in Figure 4.

The total Annual Average Damages from all sources of flooding are approximately £390,000. This includes damages to residential properties, non-residential properties, transport and agriculture. The economic damages incurred for each return period can be seen in Figure 3. For this Potentially Vulnerable Area the highest damages are to non-residential property followed by damages to residential properties.

In 2010 Scottish Water carried out a Flood Risk Assessment Study of water and wastewater assets across Scotland. Seven wastewater assets were identified as being at risk of flooding within this Potentially Vulnerable Area.

	High likelihood	Medium likelihood	Low likelihood
No. of residential properties	<10	40	70
No. of non-residential properties	10	30	60
No. of people	<10	90	150
Community facilities	0	0	0
Utilities	<10 Energy sites	<10 Energy sites <10 Scottish Water assets	<10 Energy sites <10 Scottish Water assets
Transport links (excluding minor roads)	3 Roads affected at 26 locations • 1 A road • 2 B roads 1 Railway route affected at 3 locations • Fife Circle: Dalmeny to Winchburgh and Haymarket West Junctions	3 Roads affected at 34 locations • 1 A road • 2 B roads 1 Railway route affected at 7 locations • Fife Circle: Dalmeny to Winchburgh and Haymarket West Junctions	3 Roads affected at 36 locations • 1 A road • 2 B roads 1 Railway route affected at 11 locations • Fife Circle: Dalmeny to Winchburgh and Haymarket West Junctions
Environmental designated areas (km^2)	$0.4km^2$ • 3 SSSI • 1 SPA • 1 SAC	$0.4km^2$ • 3 SSSI • 1 SPA • 1 SAC	$0.5km^2$ • 3 SSSI • 1 SPA • 1 SAC
No. of cultural heritage sites	6	6	7
Agricultural land (km^2)	$0.1km^2$	$0.2km^2$	$0.3km^2$

Table 1: Summary of flooding impacts

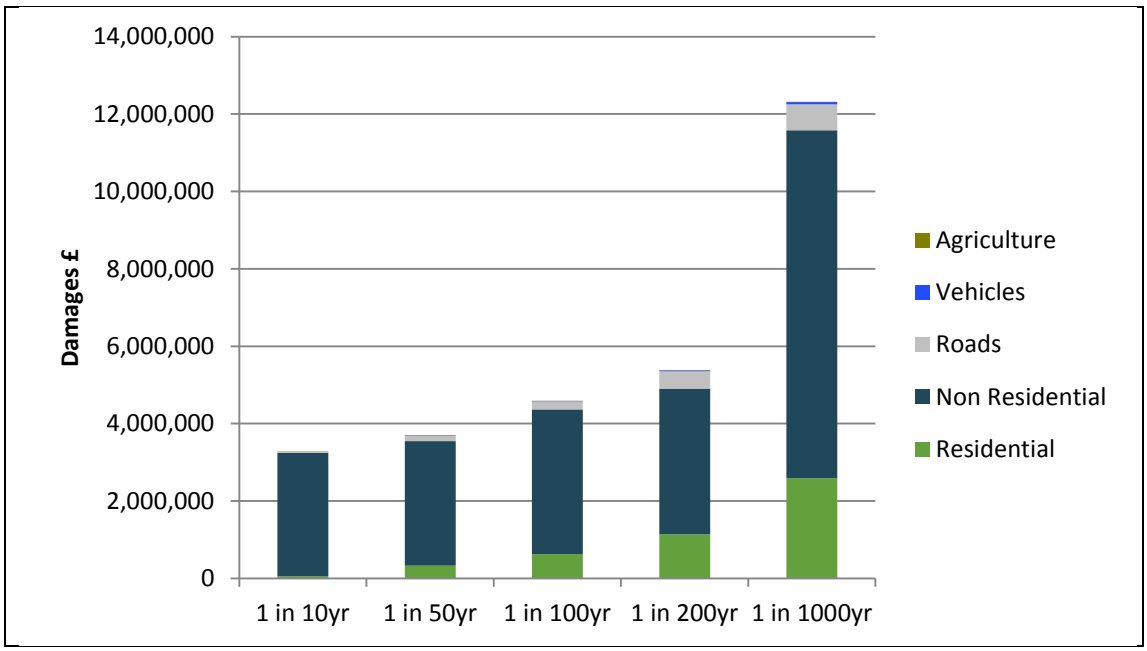


Figure 3: Damages by flood frequency

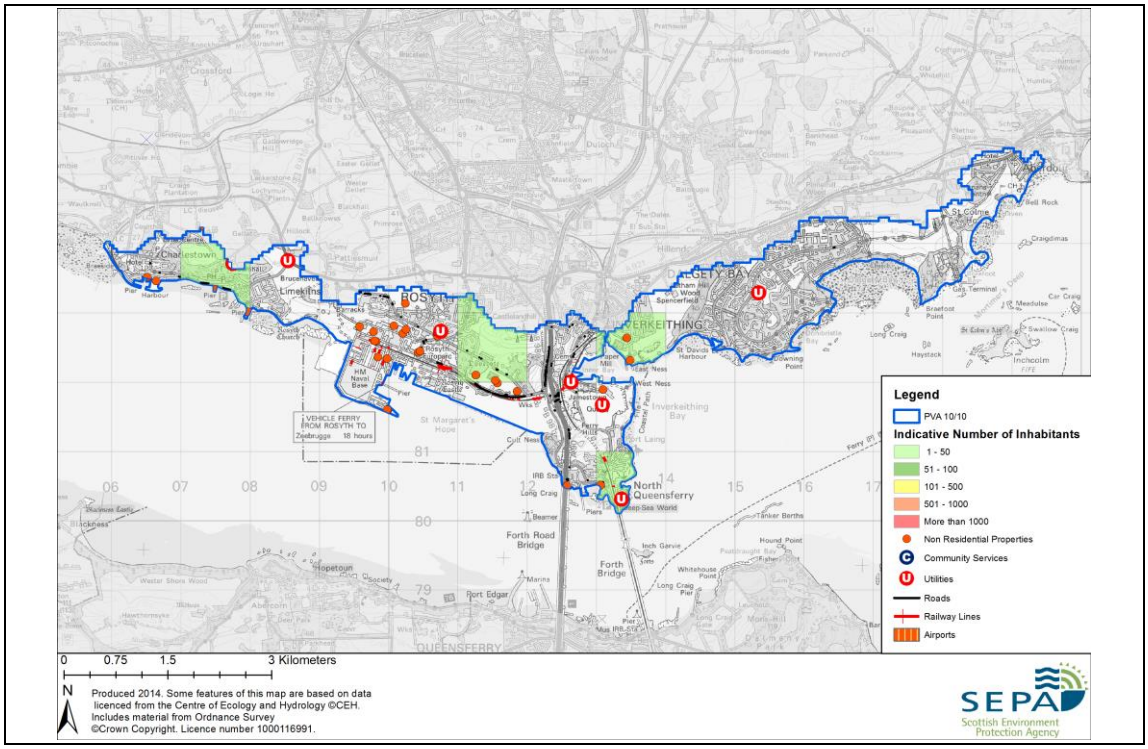


Figure 4: Impacts from all sources at a medium likelihood of flooding

History of flooding

No significant river, coastal or surface water floods have been recorded in this Potentially Vulnerable Area.

Summary of existing local actions to manage risk

There are no formal flood protection schemes in this Potentially Vulnerable Area. However, other actions and natural features may reduce the risk of flooding. These are referenced in the river, coastal and surface water flooding reports.

There are three flood warning target areas within this Potentially Vulnerable Area:

- Burntisland to Aberdour - Coastal flood warning, Firth of Forth;
- North Queensferry and Inverkeithing Bay - Coastal flood warning, Firth of Forth;
- Rosyth, Limekilns and Charlestown - Coastal flood warning, Firth of Forth.

SEPA and the local authorities work closely with many other organisations that have flooding related duties and interests. These include the police, fire and rescue services, the Scottish Government and the Scottish Flood Forum. SEPA and the local authorities, often in partnership with these organisations, undertake various awareness raising campaigns that include community events, information leaflets, educational plays in schools, the use of social media and advertising.

In addition to the above, the following incentives or subsidies have been put in place to provide property owners with property level resilience/resistance actions:

- Fife Council provides Aquasacs for use in emergencies and these are available from stores located throughout Fife
- Fife Council also operates an Emergency Flood Plan.

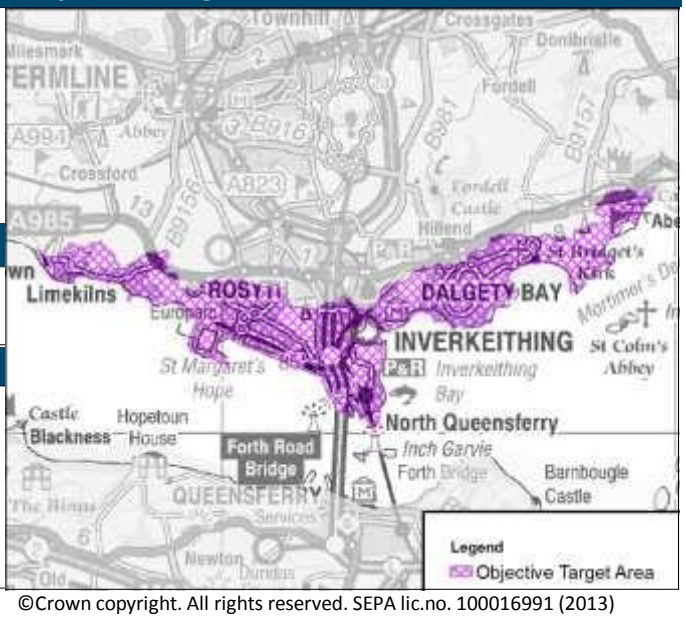
North Queensferry, Inverkeithing Potentially Vulnerable Area 10/10 Objectives and potential actions

Unless otherwise stated, information on the following objectives is contained in this document.

IMPORTANT; potential actions that apply across the whole local plan district including flood warning, land use planning, surface water management planning, and other generic actions are described in the Forth Estuary Local Plan District document.

Location	Objective	Objective ID
Applies across Forth Estuary Local Plan District	Avoid an overall increase in flood risk. For further information see *Forth Estuary District Local Plan District objectives and potential actions*.	10001
Applies across Forth Estuary Local Plan District	Reduce overall flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10099
North Queensferry and Inverkeithing	Reduce economic damages to residential and non-residential properties caused by coastal flooding.	10031
North Queensferry and Inverkeithing	Reduce risk to people in Inverkeithing from coastal flooding.	10032

North Queensferry, Inverkeithing Potentially Vulnerable Area 10/10 Objectives and potential actions

Objective(s):	North Queensferry and Inverkeithing objective target area
Reduce economic damages to residential and non-residential properties caused by coastal flooding.	
Objective ID:	
10031	
Indicators:	
£13,000 annual average damages (residential properties) £310,000 annual average damages (non-residential properties)	

Potential action	Action ID	Description
Maintenance of existing flood protection schemes	100310100	Existing coastal defences provide protection to residential and non-residential properties. *Ongoing maintenance of existing defences will ensure they continue to offer protection from flooding. This applies to all types of existing defences although appropriate maintenance activities may vary.*
Wave attenuation	100310800	*Wave attenuation uses the natural characteristics of coastal land cover either to reduce the impact of waves and coastal erosion, or to act as a physical barrier to tidal waters.*
Surge attenuation	100310900	*Creation and restoration of intertidal areas (the foreshore area between the mean high and low water levels) can protect and enhance these ecologically diverse areas, and create space to manage and store tidal flooding, reducing the risk elsewhere.*
Construction of direct flood defences	100311400	The potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*
Site protection plans	100312100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Improved understanding	100312200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*

North Queensferry, Inverkeithing Potentially Vulnerable Area 10/10 Objectives and potential actions

Objective(s):	North Queensferry and Inverkeithing objective target area
Reduce risk to people in Inverkeithing from coastal flooding.	

Objective ID:

10032

Indicators:

50 people at risk (from a medium likelihood flood)

Potential action	Action ID	Description
Maintenance of existing flood protection schemes	100320100	Existing coastal defences provide protection to residential and non-residential properties. *Ongoing maintenance of existing defences will ensure they continue to offer protection from flooding. This applies to all types of existing defences although appropriate maintenance activities may vary.*
Wave attenuation	100320800	*Wave attenuation uses the natural characteristics of coastal land cover either to reduce the impact of waves and coastal erosion, or to act as a physical barrier to tidal waters.*
Surge attenuation	100320900	*Creation and restoration of intertidal areas (the foreshore area between the mean high and low water levels) can protect and enhance these ecologically diverse areas, and create space to manage and store tidal flooding, reducing the risk elsewhere.*
Construction of direct flood defences	100321400	*Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*
Improved understanding	100322200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*

Delivery Plan for Consultation

North Queensferry (Potentially Vulnerable Area 10/10)

Action	Action ID	Description	Status and Timing	Funding	Responsibility
ONGOING AND CONFIRMED ACTIONS. Actions that are either underway or where the funding has been confirmed for 2016-2021.					
Surface Water Management.		An integrated catchment study will be carried out for Dunfermline, Cairneyhill and Rosyth to improve knowledge and understanding of surface water flood risk and interactions with other sources of flooding e.g. with the sewer network, watercourses and the sea.	Confirmed. Planned to be carried out between 2015-2021.	Scottish Water/Fife Council	Scottish Water led in partnership with Fife Council and SEPA
Flood warning schemes – Maintain Firth of Forth and Tay **coastal** flood warning scheme	100993491810	This action has been identified for all existing flood warning schemes. It will be appropriate where the existing scheme meets the needs of the local community.	Ongoing	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	SEPA
Self Help / Awareness Raising		Self help actions (individuals taking action to protect themselves and their property against flooding) can be undertaken by any individuals, businesses,	Ongoing. Flooding advice is provided on Fife Council website and via Public information leaflets.		Fife Council

Delivery Plan for Consultation

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		organisations or communities at risk of flooding. They are applicable to all sources and probabilities of flooding. They focus on awareness and understanding of the flood risk.	These give practical advice and contact information. Fife Council has provided 'Flood Pods' in locations of vulnerable properties which owners can access in times of flood threat. Owners have the right to protect their properties through purchase of property level protection		Fife Council Owners
Emergency Plans		Emergency response plans are applicable for all flood sources and likelihoods. They set out the steps to be taken during a flood event to maximise safety and minimise impacts where possible.	Ongoing. Flooding is included within Fife Council's Emergency planning procedures		Fife Council Emergency Services
Land Use Planning	-	Application of national and local planning policies, including objectives and actions identified in the LPD development plan.	Ongoing	Fife Council's revenue budget	Fife Council
Watercourse Maintenance		Watercourse maintenance can prevent debris accumulating within	Ongoing, Pre-flood checks undertaken at critical sites. Inspection	Council Revenue allocation	Fife Council/ Landowners

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		channels, which may otherwise result in an increased flood risk. It can be undertaken as a regular planned activity or in response to a flood event.	and maintenance on a regular basis for other locations.		

POTENTIAL ACTIONS. The actions below are being consulted upon to support the process of identifying preferred actions. Preferred actions may not be able to be implemented during the period 2016-2021 due to project lead-in times and / or funding constraints.

Maintenance of existing flood protection schemes	100310100	**Existing coastal defences provide protection to residential and non-residential properties.** Ongoing maintenance of existing defences will ensure they continue to offer protection from flooding. This applies to all types of existing defences although appropriate maintenance activities may vary.	No formal flood protection schemes. Maintenance to coastal defences is carried out where Fife council has that responsibility. Minor maintenance is funded from Council revenue budget, larger maintenance items would require to apply for separate funding.		Fife Council
Wave attenuation	100310800	Wave attenuation actions use the natural characteristics of different types of coastal land cover to either reduce the impact of waves and coastal erosion or to act as a physical barrier to tidal waters.			
Creation/restoration of intertidal area including mudflats and saltmarsh, and	100310900	Creation and restoration of intertidal areas (the foreshore area between the			

Action	Action ID	Description	Status and Timing	Funding	Responsibility
regulated tidal exchange		mean high and low water levels) can protect and enhance these ecologically diverse areas, and create space to manage and store tidal flooding, reducing the risk elsewhere.			
Construction of Direct flood Defences	100311400	**The potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood event**. Direct defence actions aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at flood risk.	This is a potential action identified through SEPA's strategic option appraisal. Further study/assessment would be required. Subject to funding being available.		Fife Council
Flood warning schemes	100311800	Flood warning actions enable people and organisations to prepare for an event. They enable the risk of the event to be reduce by moving people / possessions out of the floodplain and by placing temporary barriers to reduce flooding impacts.			SEPA
Site protection plans	100312100	Site protection plans are developed to identify whether normal operation of			

Action	Action ID	Description	Status and Timing	Funding	Responsibility
		a facility can be maintained during an event. This may be due to existing protection or resilience of the facility or the network.			
Modelling and other assessments to improve knowledge of flood hazards and impacts	100312200	Improved knowledge of the risks from different events helps to develop plans to avoid or mitigate future flooding to sensitive areas.	Fife Council undertakes flood studies of known flood risk areas and subject to funding will continue to do so where it is considered such knowledge may be of benefit in developing plans to reduce flood risk.		Fife Council
Maintenance of existing flood protection schemes	100320100	**Existing coastal defences provide protection to residential and non residential properties.** Ongoing maintenance of existing defences will ensure they continue to offer protection from flooding. This applies to all types of existing defences although appropriate maintenance activities may vary.	No formal flood protection schemes. Maintenance to coastal defences is carried out where Fife council has that responsibility. Minor maintenance is funded from Council revenue budget, larger maintenance items would require to apply for separate funding.		Fife Council
Wave attenuation	100320800	Wave attenuation actions use the natural characteristics of different types of coastal land cover to either reduce the impact of waves and coastal erosion or to act as a physical barrier to tidal waters.			
Creation/restoration of intertidal area including mudflats and saltmarsh, and	100320900	Creation and restoration of intertidal areas (the foreshore area between the			

Action	Action ID	Description	Status and Timing	Funding	Responsibility
regulated tidal exchange		mean high and low water levels) can protect and enhance these ecologically diverse areas, and create space to manage and store tidal flooding, reducing the risk elsewhere.			
Construction of Direct flood Defences	100321400	Direct defence actions aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at flood risk.			
Flood warning schemes	100321800	Flood warning actions enable people and organisations to prepare for an event. They enable the risk of the event to be reduced by moving people / possessions out of the floodplain and by placing temporary barriers to reduce flooding impacts.			SEPA
Site protection plans	100322100	Site protection plans are developed to identify whether normal operation of a facility can be maintained during an event. This may be due to existing protection or resilience of the facility or the network.			
Modelling and other assessments to improve	100322200	Improved knowledge of the risks from different events	Fife Council undertakes flood studies of known flood risk areas and subject to funding will continue to do		Fife Council

Action	Action ID	Description	Status and Timing	Funding	Responsibility
knowledge of flood hazards and impacts		helps to develop plans to avoid or mitigate future flooding to sensitive areas.	so where it is considered such knowledge may be of benefit in developing plans to reduce flood risk.		
Flood warning schemes – Improve sign up of Firth of Forth and Tay **coastal** flood warning scheme	100993491822	This action has been identified because the sign-up rate in some of the FWTAs within this scheme is less than the target of 40%. If the action is progressed, the sign-up rate for the relevant FWTAs will be improved via a targeted communications campaign.	Potential actions are drawn from a short list of options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being of priority are dependent on funding.	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	SEPA
Flood warning schemes – Simplify Firth of Forth and Tay **coastal** flood warning scheme	100993491830	This action has been identified because other structural actions are being considered in this area which may reduce the need for a detailed flood warning scheme.	Potential actions are drawn from a short list of options that are undergoing further analysis in terms of their relative cost and benefit. The delivery and timing of those actions that are identified as being of priority are dependent on funding.	The maintenance of SEPA's flood warning service is funded by Scottish Government through SEPA's grant in aid settlement. In addition, the Government provide grant funding to enable SEPA to implement new flood warning schemes.	SEPA
Surface water management	10024238	Develop a plan for Rosyth for the management of surface water flood risk and identify the most sustainable actions to achieve the objectives.	Recommended actions agreed by all partners identified by 2019.		Fife Council

Falkirk, Grangemouth, Lauriston, Denny, Redding, Dunipace, Cumbernauld, Carron and Stenhousemuir (Potentially Vulnerable Area: 10/11)

Local Plan District	Local Authorities	Main Catchment
10 Forth Estuary	Stirling Council, North Lanarkshire Council, Falkirk Council	Forth Estuary (South) Coastal

Background

This Potentially Vulnerable Area covers an area of 215km^2 and is part of the Firth of Forth catchment. This is a large, partially urbanised area in the south of the catchment containing the towns of Grangemouth, Falkirk, Denny and eastern Cumbernauld (Figure 1). Its main watercourse is the River Carron, flowing from its source at the Carron Valley Reservoir just outside of the Potentially Vulnerable Area's western boundary. It flows through Dunipace and Denny where it converges with the Bonny Water before flowing eastward through Larbert, Stenhousemuir and Carron before discharging into the Firth of Forth at Grangemouth. Other notable watercourses include the Westquarter Burn and the Bonny Water.

Coastal and river flooding interaction occurs on the River Carron. Coastal flooding extends upstream affecting areas of Grangemouth, Carron/Carronshore and Falkirk. Coastal and river interaction also occurs downstream of the River Avon and the Pow Burn south of Airth.

The majority of flood damages are caused by river flooding followed by coastal flooding (Figure 2). The highest risk of river flooding is from the River Carron in the Carron/Carronshore area, the Grange Burn in Grangemouth, the Westquarter Burn in Falkirk Westquarter, and the River Carron, Avon Burn and Castlerankine Burn in Denny/Dunipace. The highest risk of coastal flooding is from the Firth of Forth in Grangemouth and Carron/Carronshore. The highest risk of surface water flooding is in Falkirk, Denny and Cumbernauld.

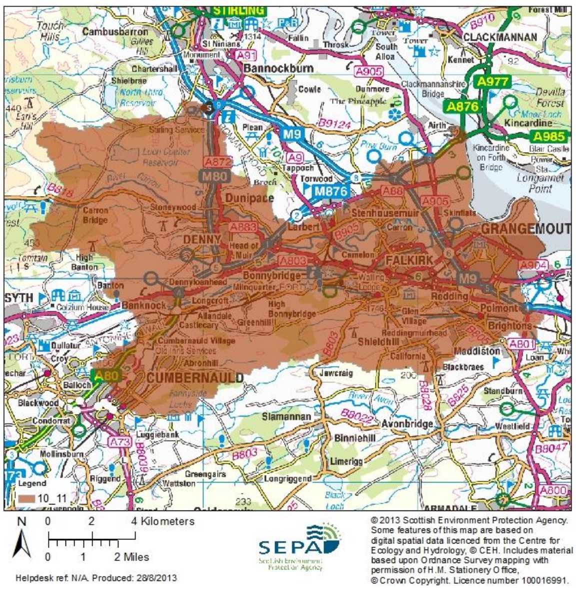


Figure 1: Potentially Vulnerable Area 10/11

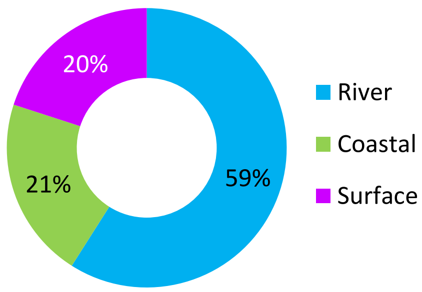


Figure 2: Annual Average Damages by flood source

Summary of flooding impacts

Approximately 2,000 residential properties and 330 non-residential properties are at a medium likelihood of flooding from one or more sources. A summary of the impacts from flooding can be seen in Table 1. A map showing the impacts from all sources at a medium likelihood of flooding can be seen in Figure 4.

The total Annual Average Damages from all sources of flooding are approximately £3.4 million. This includes damages to residential properties, non-residential properties, transport and agriculture. The economic damages incurred for each return period can be seen in Figure 3. For this Potentially Vulnerable Area the highest damages are to residential property followed by damages to non-residential properties. Other damages sustained in this Potentially Vulnerable Area are from roads, vehicles and agricultural land.

In 2010 Scottish Water carried out a Flood Risk Assessment Study of water and wastewater assets across Scotland. Of the assets assessed, 6 wastewater assets were identified as being at risk of flooding within this Potentially Vulnerable Area.

Table 1: Summary of flooding impacts

	High likelihood	Medium likelihood	Low likelihood
No. of residential properties	240	2,000	2,700
No. of non-residential properties	80	330	870
No. of people	530	4,400	5,900
Community facilities	<10 Child day care centres	<10 Educational buildings <10 Child day care centres	10 Educational buildings <10 Child day care centres <10 Care homes <10 Emergency services buildings
Utilities	20 Energy sites <10 Communications sites	90 Energy sites <10 Communications sites <10 Scottish Water assets	270 Energy sites <10 Communications sites <10 Scottish Water assets
Transport links (excluding minor roads)	25 Roads affected at 344 locations • 3 Motorways: M80, M876, M9 • 11 A roads • 11 B roads 3 Railway routes affected at 80 locations • Carmuirs Junction to Polmont Junction • Dunblane to Greenhill Lower • Edinburgh Waverly to Glasgow Queen Street	27 Roads affected at 563 locations • 3 Motorways: M80, M876, M9 • 12 A roads • 12 B roads 3 Railway routes affected at 115 locations • Carmuirs Junction to Polmont Junction • Dunblane to Larbert/Stirling • Edinburgh Waverly to Glasgow Queen Street	27 Roads affected at 614 locations • 3 Motorways: M80, M876, M9 • 12 A roads • 12 B roads 3 Railway routes affected at 144 locations • Carmuirs Junction to Polmont Junction • Dunblane to Larbert/Stirling • Edinburgh Waverly to Glasgow Queen Street

Table 1: Summary of flooding impacts

	High likelihood	Medium likelihood	Low likelihood
Environmental designated areas (km^2)	1.0km^2 • 2 SSSI • 1 SPA	1.7km^2 • 3 SSSI • 1 SPA	1.8km^2 • 3 SSSI • 1 SPA
No. of cultural heritage sites	31	38	46
Agricultural land (km^2)	6.4km^2	8.5km^2	10.6km^2

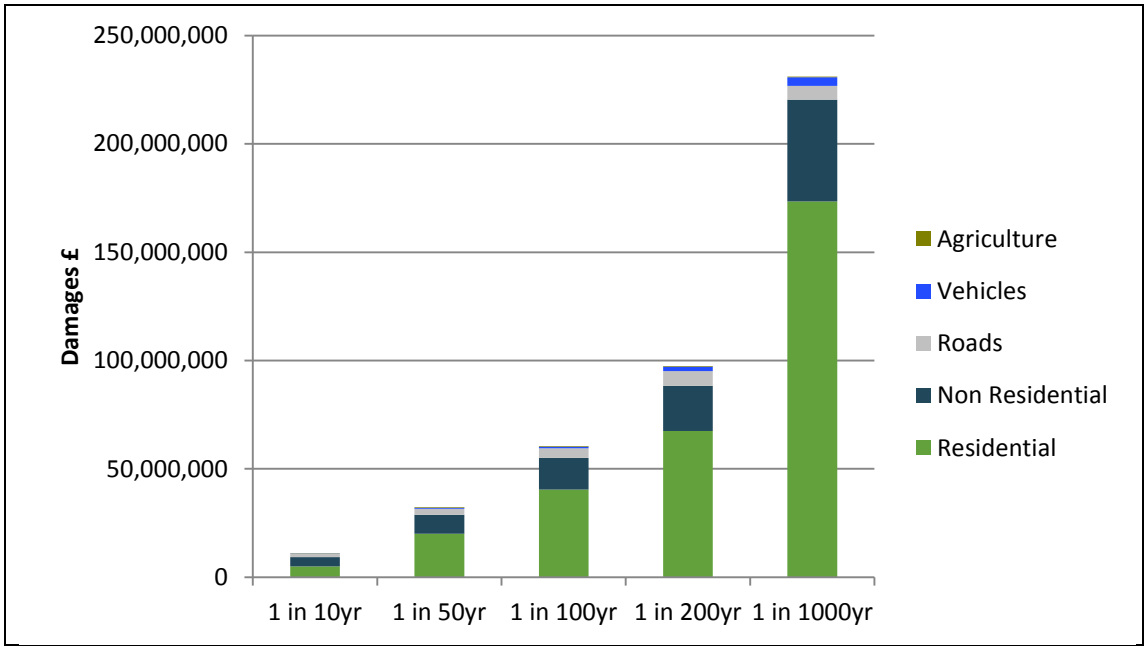


Figure 3: Damages by flood frequency

History of flooding

The following river floods have been identified as significant in this Potentially Vulnerable Area:

- 13 December 2006: Widespread flooding throughout the Falkirk area with a large bus depot on Stirling Road flooded as a result. Anchor Burn Footbridge was washed away and there was flooding to residential properties. Numerous gardens flooded and an electricity substation was threatened. Flooding resulted in the closure of the A803 at Checkbar. Three residential and 2 non-residential properties flooded at Threepwood along the River Carron. Flooding also presented issues on Bogend Road as a result of flooding on the Tor Burn
- 2002: Flooding of the Chapel Burn affected Alloa Road in Stenhousemuir. This resulted in the flooding of 22 properties with up to 60 threatened during the flood event.

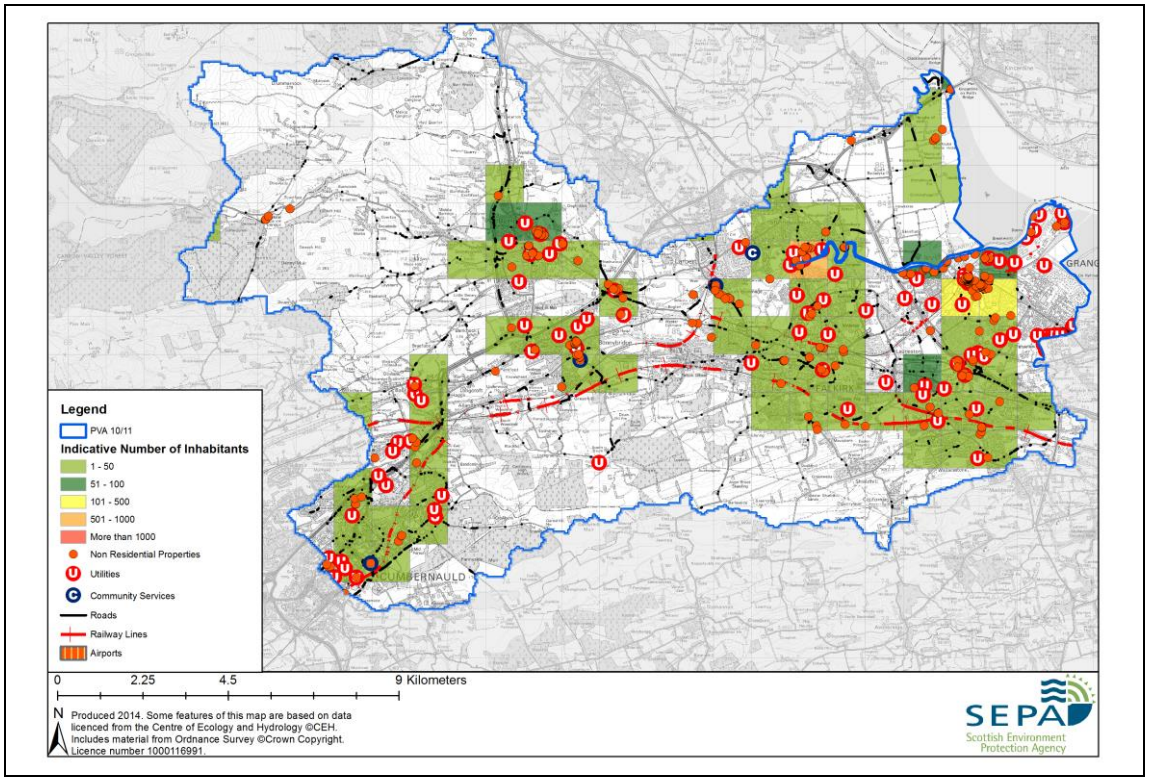


Figure 4: Impacts from all sources at a medium likelihood of flooding

The following coastal flood has been identified as significant in this Potentially Vulnerable Area:

- 30 September 1959: Grangemouth Docks flooded with highest tides on record at 4.47m above ordinance datum.

No significant surface water floods have been recorded in this Potentially Vulnerable Area.

Summary of existing local actions to manage risk

There is one formal flood protection scheme in this potentially Vulnerable Area. This is the Grange Burn Flood Protection Scheme which reduces the risk of river flooding. Other actions and natural features may also reduce the risk of flooding. These are referenced in the river, coastal and surface water flooding reports.

There is one flood warning target area within this Potentially Vulnerable Area:

- Grangemouth; - Coastal flood warning, Firth of Forth.

SEPA and the local authorities work closely with many other organisations that have flooding related duties and interests. These include the police, fire and rescue services, the Scottish Government and the Scottish Flood Forum. SEPA and the local authorities, often in partnership with these organisations, undertake various awareness raising campaigns that include community events, information leaflets, educational plays in schools, the use of social media and advertising.

In addition, the following community groups that help with flood resilience are known to operate within this Potentially Vulnerable Area:

- Carronvale Residents and Tenants Association.

Some local authorities have their own policies regarding property level protection. Contact your local authority or view their website for more information.

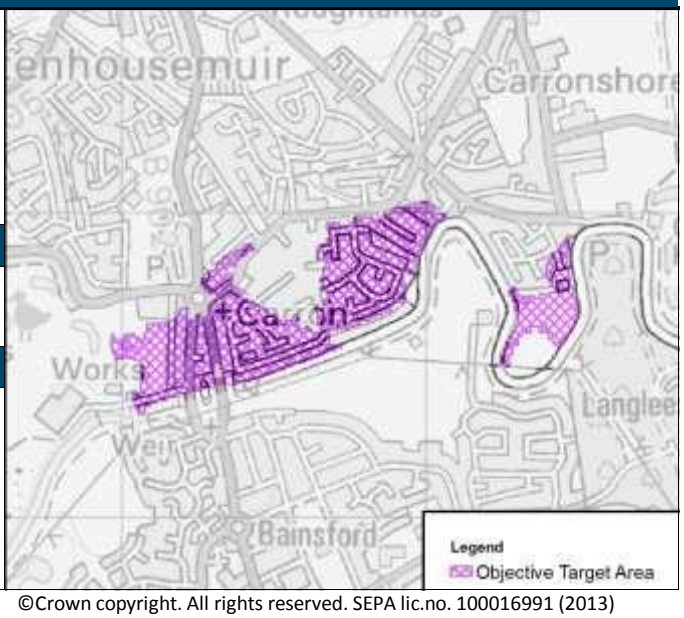
Falkirk, Grangemouth, Lauriston, Denny, Redding, Dunipace, Cumbernauld, Carron, Stehousemuir Potentially Vulnerable Area 10/11

Unless otherwise stated, information on the following objectives is contained in this document.

IMPORTANT; potential actions that apply across the whole local plan district including flood warning, land use planning, surface water management planning, and other generic actions are described in the Forth Estuary Local Plan District document.

Location	Objective	Objective ID
Applies across Forth Estuary Local Plan District	Avoid an overall increase in flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10001
Applies across Forth Estuary Local Plan District	Reduce overall flood risk. For further information see *Forth Estuary Local Plan District objectives and potential actions*.	10099
Carron/ Carronshore	Reduce economic damages to residential and non-residential properties in Carrron/ Carronshore caused by flooding from the River Carron and coastal flooding.	10035
Falkirk	Reduce economic damages to residential and non-residential properties in Falkirk caused by flooding from the River Carron.	10036
Falkirk Westquarter	Reduce economic damages to residential and non-residential properties in Falkirk West Quarter caused by flooding from the Westquarter Burn.	10037
Denny/ Dunipace	Reduce economic damages to residential and non-residential properties in Denny/ Dunipace caused by flooding from the River Carron, Avon Burn and Castlerankine Burn.	10038
Bonnybridge/ Banknock	Reduce economic damages to residential and non-residential properties and flood risk to community facilities in Bonnybridge/ Banknock caused by flooding from the Bonny Water and its tributaries.	10039
Grangemouth	Reduce economic damages to residential and non-residential properties in Grangemouth caused by river flooding and coastal flooding.	10040
Bonnybridge, Denny, Stenhousemuir and Grangemouth	Reduce risk to people in Bonnybridge, Denny, Carron and Grangemouth from river and coastal flooding.	10041

Falkirk, Grangemouth, Lauriston, Denny, Redding, Dunipace, Cumbernauld, Carron, Stehousemuir Potentially Vulnerable Area 10/11

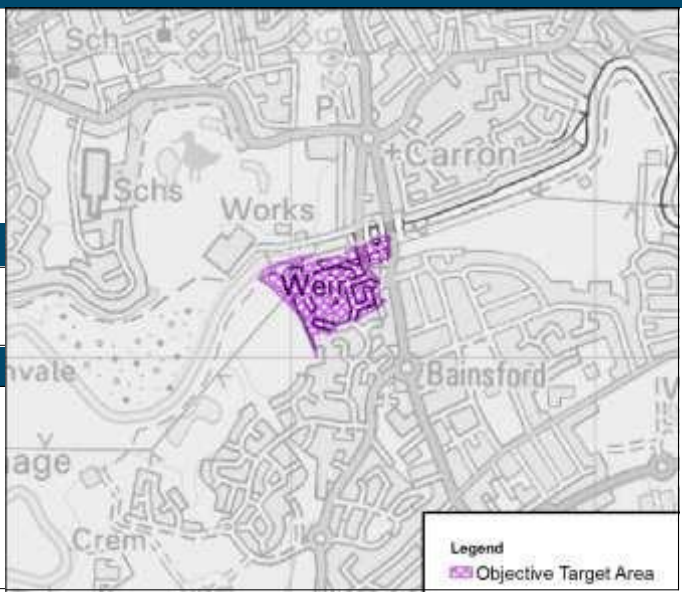
Objective(s):	Carron/ Carronshore objective target area
Reduce economic damages to residential and non-residential properties in Carrron/ Carronshore caused by flooding from the River Carron and coastal flooding.	
Objective ID:	
10035	
Indicators:	
£280,000 annual average damages (residential properties) £190,000 annual average damages (non-residential properties)	

Potential action	Action ID	Description
Runoff control	100350500	Upstream of Carrron/ Carronshore an area with the potential for runoff control has been identified. Further analysis has shown that due to its positioning within the catchment and /or its size this action may not reduce flood risk in the target area. *Runoff control looks to enhance the ability of the catchment to capture and slow water reaching the receiving watercourses. These actions often achieve the greatest benefits in areas of frequent flooding.*
River or floodplain restoration	100350600	Upstream of the target area, land with potential for river or floodplain restoration has been identified. Further analysis has shown that due to its positioning within the catchment and/or its size this action may not reduce flood risk in the target area *Restoring the river corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.*
Sediment management	100350700	*Sediment management can help control the influence of eroded material on flooding by maintaining channel capacity and reducing the impact of siltation.*
Construction of direct flood defences	100351400	Within Carrron and Carronshore, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*
Property level protection	100351700	Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection. *Property level protection can reduce flood impacts by restricting water entering a property, or using construction techniques which increase the resilience of property to flood water. It is most beneficial for flood depths less than 0.6m, in areas prone to frequent flooding.*

Falkirk, Grangemouth, Lauriston, Denny, Redding, Dunipace, Cumbernauld, Carron, Stehousemuir Potentially Vulnerable Area 10/11

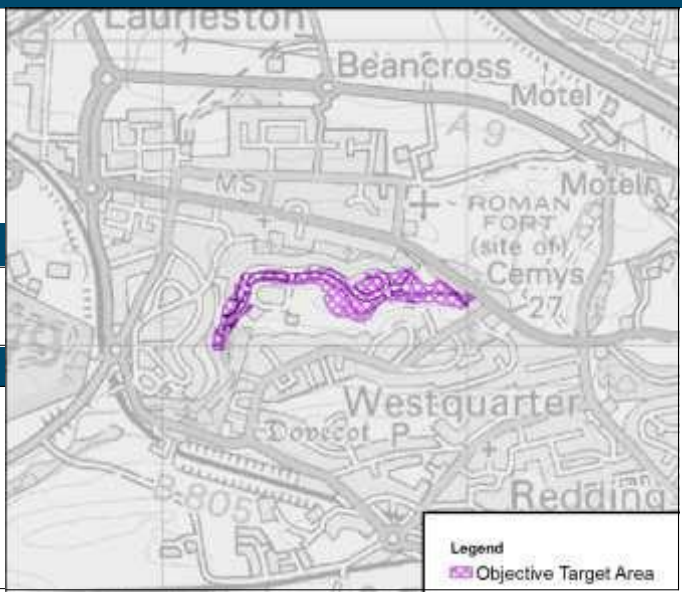
Site protection plans	100352100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Improved understanding	100352200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*

Falkirk, Grangemouth, Lauriston, Denny, Redding, Dunipace, Cumbernauld, Carrion, Stehousemuir Potentially Vulnerable Area 10/11

Objective(s):	Falkirk objective target area
Reduce economic damages to residential and non-residential properties in Falkirk caused by flooding from the River Carron.	
Objective ID:	
10036	
Indicators:	
£400,000 annual average damages (residential properties) £10,000 annual average damages (non-residential properties)	

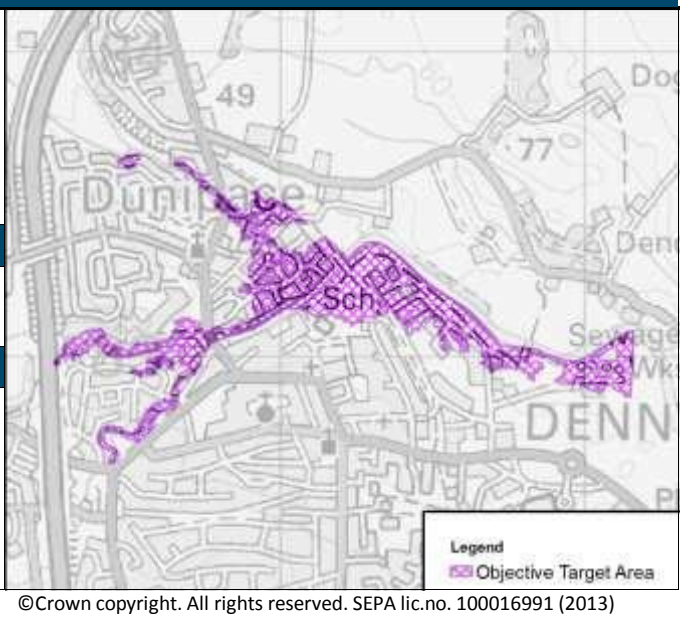
Potential action	Action ID	Description
Runoff control	100360500	Upstream of Falkirk an area with the potential to be used for runoff control has been identified. This could offer some reduction in flood risk along the River Carron, Earl's Burn, Loch Coulter Burn and Avon Burn for high likelihood floods. *Runoff control looks to enhance the ability of the catchment to capture and slow water reaching the receiving watercourses. These actions often achieve the greatest benefits in areas of frequent flooding.*
Sediment management	100360700	*Sediment management can help control the influence of eroded material on flooding by maintaining channel capacity and reducing the impact of siltation.*
Construction of direct flood defences	100361400	Within Falkirk, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*
Property level protection	100361700	Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection. *Property level protection can reduce flood impacts by restricting water entering a property, or using construction techniques which increase the resilience of property to flood water. It is most beneficial for flood depths less than 0.6m, in areas prone to frequent flooding.*
Site protection plans	100362100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Improved understanding	100362200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*

Falkirk, Grangemouth, Lauriston, Denny, Redding, Dunipace, Cumbernauld, Carron, Stehousemuir Potentially Vulnerable Area 10/11

Objective(s):	Falkirk Westquarter objective target area
Reduce economic damages to residential and non-residential properties in Falkirk West Quarter caused by flooding from the Westquarter Burn.	
Objective ID:	
10037	
Indicators:	
£130,000 annual average damages (residential properties) £280 annual average damages (non-residential properties)	

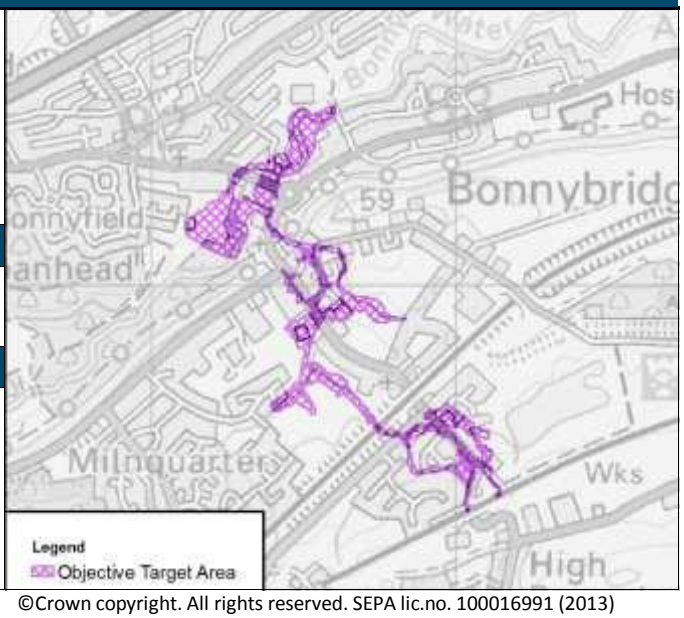
Potential action	Action ID	Description
Runoff control	100370500	Upstream of Falkirk Westquarter an area with the potential to be used for runoff control has been identified. This could offer some reduction in flood risk along the Glen Burn and Westquarter Burn for high likelihood events. *Runoff control looks to enhance the ability of the catchment to capture and slow water reaching the receiving watercourses. These actions often achieve the greatest benefits in areas of frequent flooding.*
Sediment management	100370700	*Sediment management can help control the influence of eroded material on flooding by maintaining channel capacity and reducing the impact of siltation.*
Construction of direct flood defences	100371400	Within Falkirk Westquarter, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*
Site protection plans	100372100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Improved understanding	100372200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*

Falkirk, Grangemouth, Lauriston, Denny, Redding, Dunipace, Cumbernauld, Carron, Stehousemuir Potentially Vulnerable Area 10/11

Objective(s):	Denny/ Dunipace objective target area
Reduce economic damages to residential and non-residential properties in Denny/ Dunipace caused by flooding from the River Carron, Avon Burn and Castlerankine Burn.	
Objective ID:	
10038	
Indicators:	
£260,000 annual average damages (residential properties) £42,000 annual average damages (non-residential properties)	

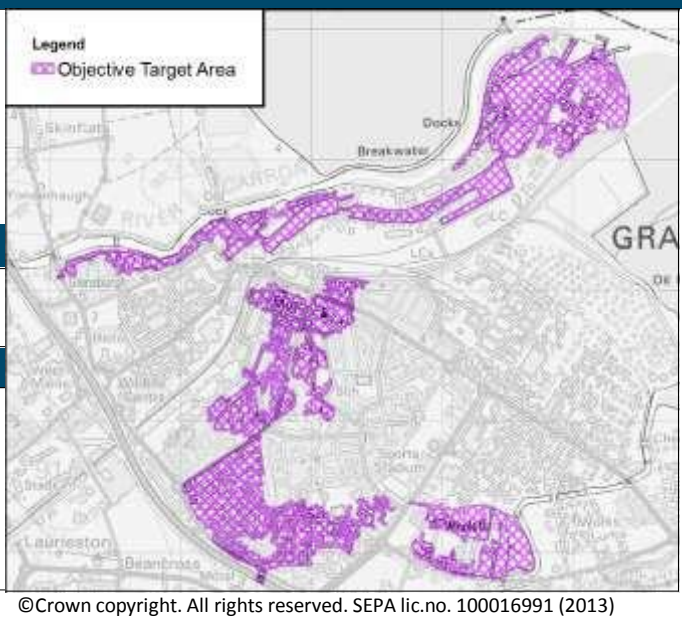
Potential action	Action ID	Description
Runoff control	100380500	Upstream of Denny and Dunipace an area with the potential to be used for runoff control has been identified. This could offer some reduction in flood risk along the River Carron, Loch Coulter Burn and Earl's Burn for high likelihood floods. *Runoff control looks to enhance the ability of the catchment to capture and slow water reaching the receiving watercourses. These actions often achieve the greatest benefits in areas of frequent flooding.*
Sediment management	100380700	*Sediment management can help control the influence of eroded material on flooding by maintaining channel capacity and reducing the impact of siltation.*
Construction of direct flood defences	100381400	Within Denny and Dunipace, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*
Property level protection	100381700	Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection. *Property level protection can reduce flood impacts by restricting water entering a property, or using construction techniques which increase the resilience of property to flood water. It is most beneficial for flood depths less than 0.6m, in areas prone to frequent flooding.*
Site protection plans	100382100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Improved understanding	100382200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*

Falkirk, Grangemouth, Lauriston, Denny, Redding, Dunipace, Cumbernauld, Carron, Stehousemuir Potentially Vulnerable Area 10/11

Objective(s):	Bonnybridge/ Banknock objective target area
Reduce economic damages to residential and non-residential properties and flood risk to community facilities in Bonnybridge/ Banknock caused by flooding from the Bonny Water and its tributaries.	
Objective ID:	
10039	
Indicators:	
£52,000 annual average damages (residential properties) £69,000 annual average damages (non-residential properties)	

Potential action	Action ID	Description
Runoff control	100390500	Upstream of Bonnybridge and Banknock an area with the potential for runoff control has been identified. This could offer some reduction in flood risk along the Red Burn, Forth and Clyde canals, Doups Burn and Bonny Water for high likelihood floods. *Runoff control looks to enhance the ability of the catchment to capture and slow water reaching the receiving watercourses. These actions often achieve the greatest benefits in areas of frequent flooding.*
Sediment management	100390700	*Sediment management can help control the influence of eroded material on flooding by maintaining channel capacity and reducing the impact of siltation.*
Construction of direct flood defences	100391400	Within Bonnybridge and Banknock, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*
Site protection plans	100392100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Improved understanding	100392200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*

Falkirk, Grangemouth, Lauriston, Denny, Redding, Dunipace, Cumbernauld, Carron, Stehousemuir Potentially Vulnerable Area 10/11

Objective(s):	Grangemouth objective target area
Reduce economic damages to residential and non-residential properties in Grangemouth caused by river flooding and coastal flooding.	
Objective ID:	
10040	
Indicators:	
£630,000 annual average damages (residential properties) £53,000 annual average damages (non-residential properties)	

Potential action	Action ID	Description
Maintenance of existing flood protection schemes	100400100	Existing defences along the Grange Burn provide protection to residential and/or non-residential properties. *Ongoing maintenance of existing defences will ensure they continue to offer protection from flooding. This applies to all types of existing defences although appropriate maintenance activities may vary.*
Runoff control	100400500	Upstream of Grangemouth an area with the potential to be used for runoff control has been identified. This could offer some reduction in flood risk along the Glen Burn, Westquarter Burn and some drains for high likelihood floods. *Runoff control looks to enhance the ability of the catchment to capture and slow water reaching the receiving watercourses. These actions often achieve the greatest benefits in areas of frequent flooding.*
River or floodplain restoration	100400600	Upstream of Grangemouth land with the potential for river or floodplain restoration has been identified. Further analysis has shown that due to its positioning within the catchment and/or its size this action may not reduce flood risk in the target area. *Restoring the river corridor to a more natural state aims to enhance the capacity of the floodplain to hold back water which can reduce the risk of flooding downstream.*
Sediment management	100400700	*Sediment management can help control the influence of eroded material on flooding by maintaining channel capacity and reducing the impact of siltation.*
Surge attenuation	100400900	*Creation and restoration of intertidal areas (the foreshore area between the mean high and low water levels) can protect and enhance these ecologically diverse areas, and create space to manage and store tidal flooding, reducing the risk elsewhere.*
Installation / modification of river control structures	100401200	*Control structures on a river can reduce flood levels either by restricting or increasing flow in the channel. The impact of these structures can vary significantly depending on type and location of the structures being added or modified.*

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Coastal management	100401300	*Coastal management actions aim to reduce the risk of coastal flooding using designed materials and structures. The actions reduce the impact of waves and erosion by modifying wave action or acting as a barrier to increasing sea levels.*
Construction of direct flood defences	100401400	Within Grangemouth, the potential to construct direct defences has been identified to reduce the risk to residential and non-residential properties from a medium likelihood flood. *Direct defences aim to reduce the risk of flooding by placing a designed barrier between the flooding source and the receptors at risk.*
Property level protection	100401700	Some of the properties that have been identified to be at risk of flooding may be suitable for property level protection. *Property level protection can reduce flood impacts by restricting water entering a property, or using construction techniques which increase the resilience of property to flood water. It is most beneficial for flood depths less than 0.6m, in areas prone to frequent flooding.*
Site protection plans	100402100	*Site protection plans are developed to identify whether normal operation of a facility can be maintained during a flood. This may be due to existing protection or resilience of the facility or the network.*
Improved understanding	100402200	*Improved knowledge of flood risk informs the development of plans to avoid or mitigate future flooding to sensitive areas.*