Fife Stage 1 Strategic Flood Risk Assessment

Final report

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This report describes work commissioned by Fife Council, by an instruction dated 6 April 2023. The Client's representative for the contract was Dominick Mennie of Fife Council. Mike Williamson and Laura Thompson of JBA Consulting carried out this work.

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Abbreviations

CIRIA	Company providing research and training in the construction industry
DEFRA	Department of the Environment, Food and Rural Affairs (formerly MAFF)
FRA	Flood Risk Assessment
FRM	Flood Risk Management
FRMP	Flood Risk Management Plan
GIS	Geographical Information System
LDP	Local Development Plan
LPA	Local Planning Authority
mAOD	metres Above Ordnance Datum
NFM	Natural Flood Management
PFR	Property Flood Resilience
RBMP	River Basin Management Plan
SEPA	Scottish Environment Protection Agency
SFRA	Strategic Flood Risk Assessment
SMP	Shoreline Management Plan
SUDS	Sustainable Urban Drainage Systems

Executive Summary

Fife Council's Planning Service requires a Strategic Flood Risk Assessment (SFRA) to support work for the region's next Local Development Plan (LDP) by delivering the intention of National Planning Framework 4 (NPF4) Policy 22 and Policy 10 to strengthen resilience to flood risk by promoting avoidance as a first principle and reducing the vulnerability of existing and future development to flooding.

The Fife SFRA will inform development planning processes; ensuring that flood risk is considered in the formulation of the Council's spatial strategy; in the identification of development allocations; and in the review of land use policies, whilst contributing towards satisfying the statutory duties Fife Council has under the Flood Risk Management (Scotland) Act 2009.

This report entails a Stage 1 SFRA which includes a high-level, map-based and strategic-level assessment used to inform the broad direction of the Spatial Strategy. Appendix A includes high-level flood risk maps covering Fife.

The key objectives of this Stage 1 SFRA include the following:

- Provision of a sound and up to date evidence base to inform the preparation of the LDP,
- Provision of a reference and policy document to advise and inform the public and private and commercial developers of their obligations under the latest planning guidance,
- Provision of a strategic assessment of the risk to Fife of flooding from all sources including from rivers (fluvial) and the coast (including for the designation of functional floodplain), coastal erosion and geomorphic change, pluvial (surface water), sewer, groundwater, and residual risk from reservoirs (available online), whilst accounting for the impacts of climate change,
- Identification of any significant cross boundary issues, hydrological linkages and cumulative impacts,
- Identification of opportunities to reduce flood risk to existing communities and developments through better management of surface water, provision for conveyance, storage of floodwater through appropriate Sustainable Urban Drainage Systems (SUDS),
- Identification of natural flood management techniques and the use of blue / green infrastructure and open space for flood storage and amenity use,
- Consideration of Property Flood Resilience (PFR) measures, emergency planning capability, and ensuring safe access and egress from potential development sites,
- Assessment of flood defence infrastructure, including defence types, Standards of Protection, condition, and associated residual risks,
- Documentation of current or planned flood risk management schemes, strategies, and plans,

- Identification of the requirements for site-specific flood risk assessments in high risk locations.

Gaps in information have been recorded and listed in Section 4.2. The Hazard Maps presented in this SFRA are part of the SEPA Flood Map Version 2.0, published in November 2020. These maps include an allowance for climate change for the 0.5% annual probability flood. However, as discussed in Section 5.3, these maps are not based on the latest allowances for climate change.

A precautionary approach to climate change has therefore been adopted for this Stage 1 SFRA whereby the 0.1% annual probability flood outline is used to represent the future functional floodplain.

Once new, updated, or further information becomes available, the LPA should look to update this SFRA, either through an update of this Stage 1 SFRA or through the more detailed Stage 2 SFRA which will assess flood risk to individual sites. The SFRA should be maintained as, a 'live' entity that is updated as and when required (when new modelling or flood risk information becomes available).

1 Introduction

Fife Council's Planning Service requires a Strategic Flood Risk Assessment (SFRA) to support work for the region's next Local Development Plan (LDP) by delivering the intention of National Planning Framework 4 Policy 22 and Policy 10 to strengthen resilience to flood risk by promoting avoidance as a first principle and reducing the vulnerability of existing and future development to flooding.

The Fife SFRA will inform development planning processes; ensuring that flood risk is considered in the formulation of the Council's spatial strategy; in the identification of development allocations; and in the review of land use policies, whilst contributing towards satisfying the statutory duties Fife Council has under the Flood Risk Management (Scotland) Act 2009.

The Scottish Environment Protection Agency (SEPA) has stated that SFRAs could take the form of a staged approach whereby Stage 1 includes a high-level, map-based and strategic-level assessment used to inform the broad direction of the Spatial Strategy. Stage 2 would involve a more detailed site-by-site assessment of risk.

Both stages of the SFRA should be prepared in line with the following guidance and best practice documents:

- Policy 10 and Policy 22 of the National Planning Framework 4[1] (NPF4), the revised draft of which was approved by Scottish Ministers on 11 January 2023 with adoption and publication on 13 February 2023,
- Local Development Planning Guidance[2], May 2023,
- Strategic Flood Risk Assessment: SEPA technical guidance to support development planning[3], 2015,
- How to prepare a strategic flood risk assessment[4], 2022 (Environment Agency in England however principles still relevant),
- The good practice guide to producing SFRAs[5], 2021 (Environment Agency in England however principles still relevant),
- Updated Climate change allowances for flood risk assessment in land use planning[6] (March 2022),
- National Flood Risk Assessment (2018) Scotland.

1 National Planning Framework 4 | Scottish Government | February 2023

2 Local Development Planning Guidance, May 2023. Scottish Government

3 Planning Guidance, Strategic Flood Risk Assessment: SEPA technical guidance to support development planning, 2015. Scottish Environment Protection Agency

4 How to prepare a strategic flood risk assessment, 2022. Environment Agency

5 Strategic Flood Risk Assessments, A Good Practice Guide, 2021. Association of Directors of Environment, Economy, Planning & Transport

6 Climate change allowances for flood risk assessment in land use planning, Version 2, 2022. Scottish Environment Protection Agency

SEPA also shared a Draft Guidance for planning authorities on Strategic Flood Risk Assessment version 4.0 document in August 2023 intended to assist planning authorities in progressing their LDP Evidence Reports. It is envisaged that this guidance will be updated once the Development Plan Regulations and Guidance are published and there is greater clarity and detail on the new LDP process. This draft guidance has also been considered in the preparation of this SFRA.

1.1 Stage 1 SFRA

Stage 1 of the Fife SFRA includes this report together with the SFRA Maps provided in Appendix A. This Stage 1 SFRA is a high level strategic assessment designed to be included as part of the Evidence Report. Stage 2 will include an assessment of flood risk on specific LDP sites and a consideration of cumulative flood risk prepared to support the Proposed Plan.

1.1.1 Stage 1 objectives

The key objectives of this Stage 1 SFRA, considering Fife Council's requirements and the aforementioned guidance documents, include the following:

- Provision of a sound and up to date evidence base to inform the preparation of the LDP,
- Provision of a reference and policy document to advise and inform the public and private and commercial developers of their obligations under the latest planning guidance,
- Provision of a strategic assessment of the risk to Fife of flooding from all sources including from rivers (fluvial) and the coast (including for the designation of functional floodplain), coastal erosion and geomorphic change, pluvial (surface water), sewer, groundwater, and residual risk from reservoirs, whilst accounting for the impacts of climate change,
- Identification of any significant cross boundary issues, hydrological linkages and cumulative impacts (surface water management relative to planned and permitted development, which is considered likely to come forward, including any valid planning permissions and programming information from the most up to date land use audits and the FIFEplan Action Programme),
- Identification of opportunities to reduce flood risk to existing communities and developments through better management of surface water, provision for conveyance, storage of floodwater through appropriate Sustainable Urban Drainage Systems (SUDS) and areas of critical drainage, including retrofitting SUDS for existing communities and formulating policy for surface water management from new development i.e. restrictions to greenfield rates, percentage betterments on current, etc.,
- Identification of natural flood management techniques and the use of blue / green infrastructure and open space for flood storage and amenity use,

- Consideration of Property Flood Resilience (PFR) measures, emergency planning capability, and ensuring safe access and egress from potential development sites,
- Assessment of flood defence infrastructure, including defence types, Standards of Protection, condition, and associated residual risks,
- Documentation of current or planned flood risk management schemes, strategies, and plans,
- Identification of the requirements for site-specific flood risk assessments in high risk locations.

2 Study area

Fife is situated on the east coast of Scotland on the North Sea between the Firth of Tay to the north and Firth of Forth to the south, covering an area of 1,372 km^2. Neighbouring authorities include Perth and Kinross to the north-west and Clackmannanshire to the west. Fife had a population of just over 374,000 in 2021 according to STATISTICS.GOV.SCOT with the majority of people living in the City of Dunfermline, Glenrothes and Kirkcaldy.

The main river catchments in Fife include the Firth of Forth estuary and River Leven in the south and the Firth of Tay estuary and River Eden in the north. All other catchments are purely coastal. There are many other smaller watercourses that act as tributaries within these main river catchments and others that drain directly to the coast.

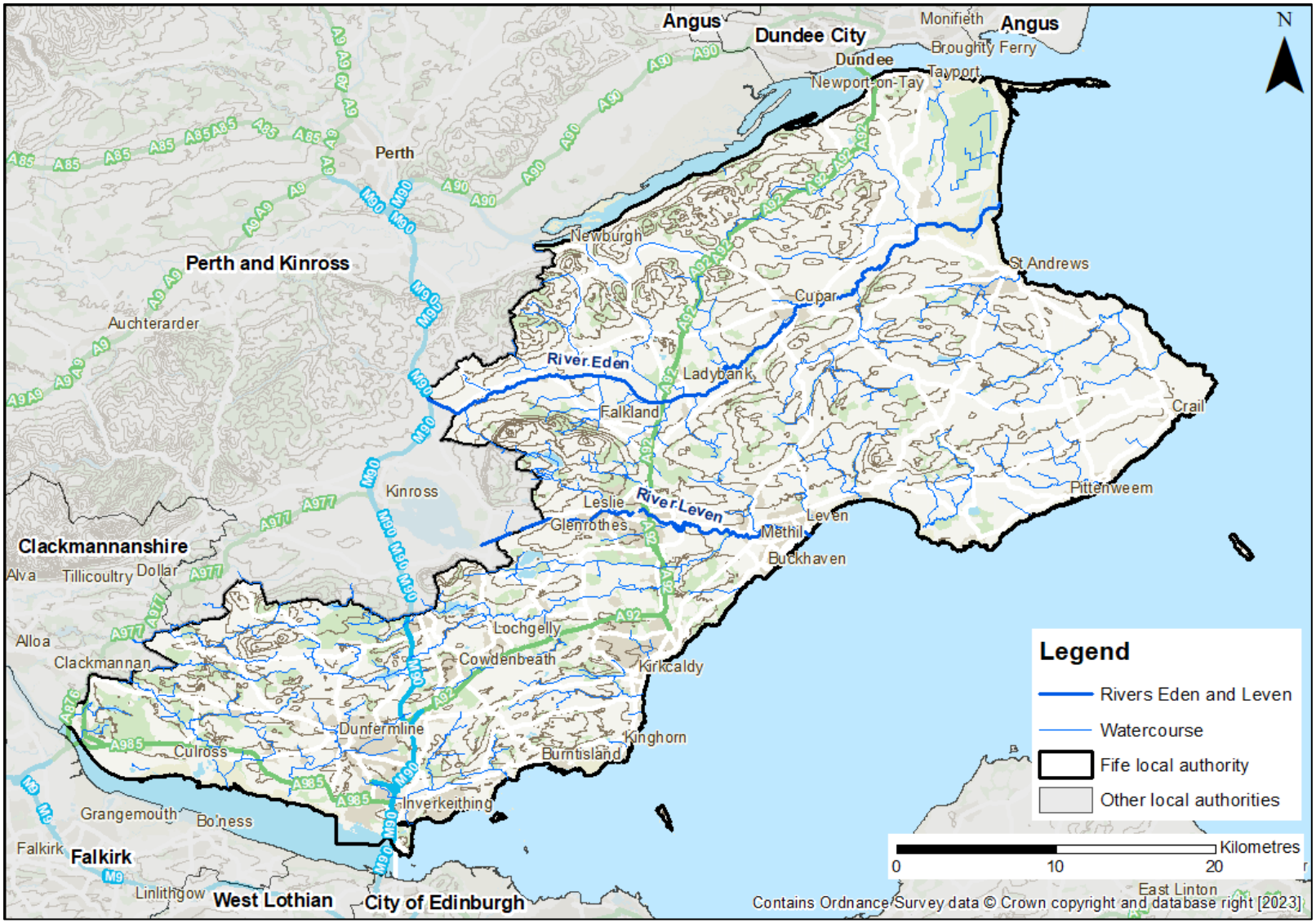

Figure 2-1: Fife local authority area

2.1 Geology and topography

The geology and topography are considerably varied across Fife given the large area covered. The majority of Fife is predominantly characterised by permeable sedimentary bedrock including limestone, mudstone, sandstone and coal deposits. The key communities of the City of Dunfermline, Kirkcaldy and Glenrothes are located on this bedrock as are the central and southern communities and the far eastern areas to the coast. The north of Fife is mainly underlain by less permeable mafic lava and mafic tuff bedrock along the Firth of Tay. Further south from Gateside to the coast includes interbedded conglomerate and permeable sandstone. There are sporadic areas of dolerite and basalt.

Areas located on permeable bedrock, such as those previously mentioned, may experience a greater risk of groundwater flooding in basements and cellars. During periods of prolonged rainfall, permeable bedrock can become saturated leading to increased surface runoff.

The majority of the bedrock of Fife is overlain by superficial deposits of till with sporadic areas of glacial sand and gravel. There are also smaller pockets of clay and silt deposits throughout.

The topography of the region is varied, ranging from flat, low-lying land to the east along coastal reaches and along the estuaries. There are two areas of significantly higher altitude towards the east, namely the area comprising the Lomond Hills north-west of Glenrothes and the area north of the City of Dunfermline around Black Rigg Moss and Tipperton Moss. There are also areas of high land further east at Devon Common and New Gilston.

There are areas of high ground between the Firth of Tay and the floodplain of the River Eden. The River Eden has a large floodplain around Auchtermuchty and Ladybank and flows to the North Sea in the east.

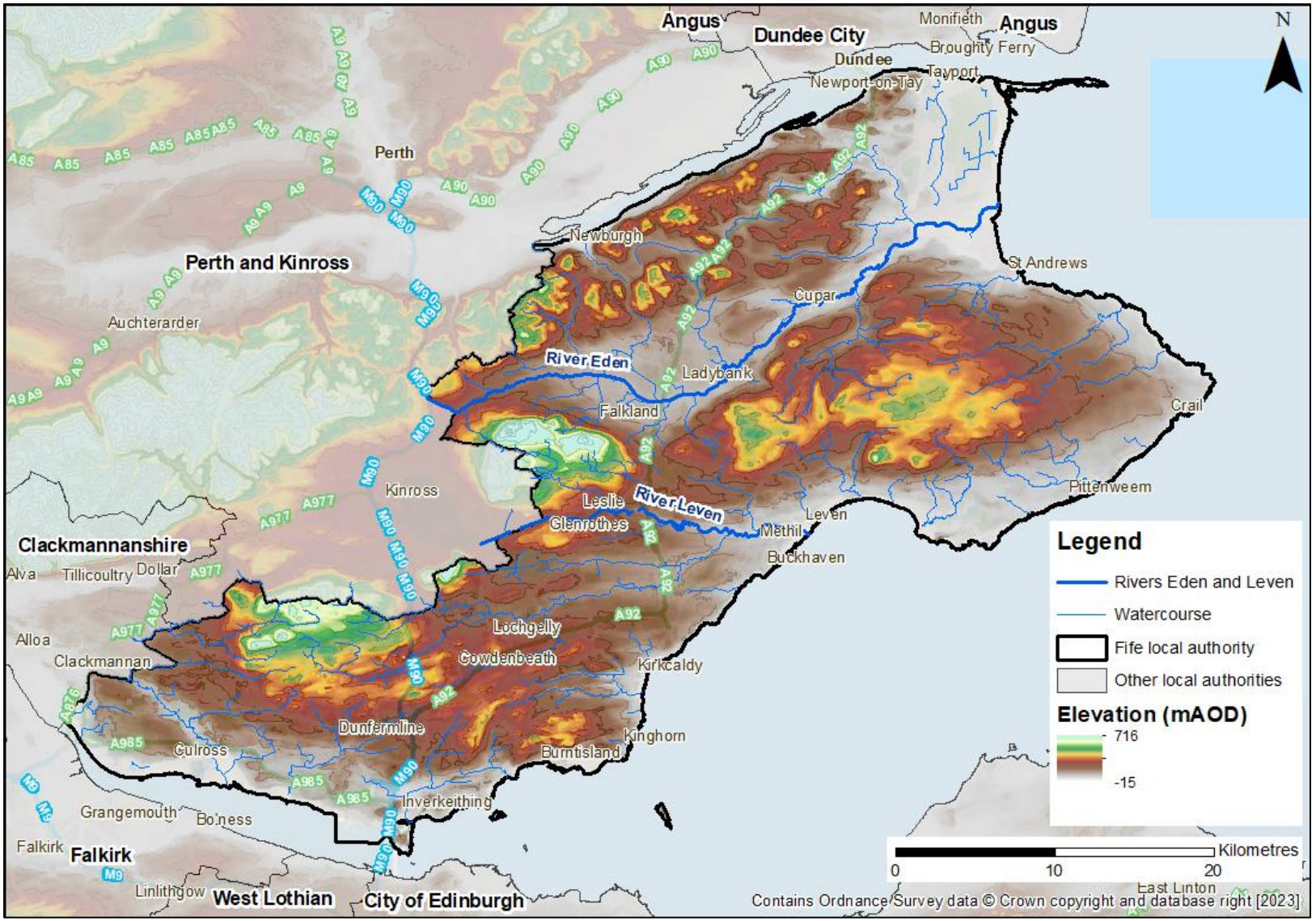

Figure 2-2: topography of Fife

3 Planning policy, flood risk guidance, plans, and strategies

This chapter summarises the relevant planning policy and flood risk documents, ranging from Government guidance to national and local strategies and plans that may influence planning and flood risk in Fife.

3.1 Legislation and guidance summary

Table 3-1 summarises the planning policy, flood risk guidance, plans, and strategies discussed in Section 3.

Table 3-1 Legislation and guidance summary table

Legislation / Guidance	Summary
National Planning Framework 4 (NPF4), 2023	NPF4 includes the national spatial strategy for Scotland, adopted and published on 13 February 2023, replacing NPF3 and Scottish Planning Policy.
Fife Local Development Plan	The new Local Development Plan will replace the existing FIFEplan approved in 2017 and will set out planning policies and proposals for the use and development of land across Fife.
Forth Estuary Flood Risk Management Plan, 2021	The Forth Estuary Flood Risk Management Plan outlines Scotland's route map for reducing the effects of flooding on local communities in the Forth Estuary.
Tay Estuary and Montrose Basin Local Flood Risk Management Plan, 2021	The Tay Estuary and Montrose Basin Local Flood Risk Management Plan outlines Scotland's route map for reducing the effects of flooding on local communities in the Tay Estuary and Montrose Basin.
The River Basin Management Plan for Scotland, 2021	The River Basin Management Plan (RBMP) for Scotland sets out a framework for protecting and improving the benefits provided by the water environment in Scotland.
Fife Shoreline Management Plan (SMP), 2011	The Fife SMP provides an assessment of the risks associated with shoreline evolution, coastal flooding and erosion and presents a framework for policy to address risks to people and the developed, historic and natural environment for a sustainable future. At the time of writing the SMP is due to be reviewed and will take into account the Dynamic Coast mapping information.

Legislation / Guidance	Summary
Dunfermline local flood study, 2022	The Dunfermline local flood study involves an assessment of all significant watercourses and their catchments within Dunfermline.
Section 16 Assessment Dunfermline & Iron Mill Bay, 2020	The aim of the Section 16 Assessment study for the Dunfermline and Iron Mill Bay Drainage Operational Areas is to identify the extents and depths of predicted flooding from the sewerage system.
SEPA Planning Background Paper Flood Risk, 2018	This paper provides SEPA guidance on land use policy and flood risk, based on national planning policies and duties and requirements under relevant legislation.
SEPA Flood Risk and Land Use Vulnerability Guidance, 2018	This guidance provides an understanding of the vulnerability to flooding of different land uses and assists in the interpretation of SEPA's Flood Risk Planning Guidance.
SEPA Development Plan Guidance on Flood Risk, 2018	The aim of this guidance document is to provide advice to planning authorities regarding flood risk in the development plan process, promoting safe and resilient communities and businesses through sustainable flood risk management.
SEPA Development Management Guidance on Flood Risk, 2018	This guidance document provides information on the role of development management in delivering sustainable flood risk management.
SEPA Planning Information Note 4, 2018	This guidance note outlines the role of SEPA on proposed development protected by a Flood Protection Scheme.
SEPA standing advice for planning authorities and developers on development management consultations, 2020	This guidance document simplifies SEPA's engagement with the planning system, by highlighting the types of developments they should be consulted on, set out in the Advice for planning authorities on how and when to consult SEPA.
SEPA – Planning Authority Protocol (Policy 41) Development at Risk of Flooding: Advice and Consultations, 2016	This document provides principles to be followed by both SEPA and planning authorities regarding advice and consultation on flood risk issues.
SEPA Flood Modelling Guidance for Responsible Authorities, 2016	This technical flood modelling guidance supports those in Responsible Authorities who develop and commission flood studies in respect of flood risk management planning.
Technical Flood Risk Guidance for Stakeholders - SEPA requirements for undertaking a Flood Risk Assessment, 2022	This document provides guidance on carrying out a Flood Risk Assessment.

Legislation / Guidance	Summary
Design Criteria Guidance on Flooding and Surface Water Management Plan Requirements, 2022	This guidance document has been prepared by Fife Council to inform developers, their consultants and all stakeholders involved in the planning process in relation to flooding and surface water management of the requirements of the council.

3.2 Legislation

3.2.1 National Planning Framework 4

The National Planning Framework 4 (NPF4) includes the national spatial strategy for Scotland, adopted and published on 13 February 2023, replacing NPF3 and Scottish Planning Policy.

Policy 22 of NPF4 relates to flood risk and water management with the purpose of increasing resilience to flood risk in place making. Avoiding new development in areas of flood risk should be the first approach followed by the reduction of the vulnerability of new and existing development to flooding.

Policy 10 relates to development in coastal areas with the policy intent being to protect coastal communities and assets and support resilience to the impacts of climate change so coastal areas can be developed sustainably.

3.3 Development plans

Development plans set out how places will change into the future, including where development should and shouldn't happen. Development plans show where new homes and workplaces will be built, how services and facilities such as schools and travel will be provided, and identify the places and buildings we value and want to protect. Plans bring together many different sectors and interests to achieve the desired change for places and communities. (Local Development Planning Guidance, May 2023. Scottish Government).

The 'statutory development plan' covers the whole of Scotland and is made up of the NPF4 and the LDPs.

3.4 Local Development Plans

Planning authorities must prepare one or more LDP considering the statutory development plan and the NPF4, including for any relevant registered local place plans. As with the statutory development plan, the LDP must show how local places will change into the future, including where development should and should not happen. The LDP, must have regard to the planning authority's adopted Regional Spatial Strategy (RSS) and any local outcomes improvement plan (LOIP) (within the meaning of section 6 of the Community Empowerment (Scotland) Act 2015) for the area.

The NPF4 content relating to LDPs can be summarised as follows:

- LDPs should consider the ambitions and outcomes for an area, looking 20 years ahead,
- LDPs should be place-based, visual, and tell a clear and compelling story about the future of local places,
- LDPs should encourage, promote and facilitate development that addresses the global climate emergency and nature crisis, in order to reflect the significant weight that this carries within NPF4,
- LDPs should implement national planning policies by setting out a spatial strategy that shows what they mean for change and development in a particular place,
- LDPs should be people-centred and be prepared to best meet the needs and aspirations of the different people who have an interest in a local place,
- The LDP should support decisions to invest in a place, identifying priorities and making strong links with the local authority's Delivery Programme,
- LDPs must be kept under review by the planning authority, considering any changes in legislation and the impacts of the LDP policies and proposals.

Following legislation changes, Planning (Scotland) Act 2019 states that planning authorities are now required to prepare an evidence report before preparing the LDP. The purpose of the evidence report is to set out the planning authority's view on a range of matters for land within the LDP area. The evidence (data and information) collated and presented in the evidence report will inform the policies and proposals in the LDP.

The Local Development Planning Guidance [2], 2023 states that an SFRA should have regard to the SEPA flood maps, support the implementation of relevant actions and objectives listed in the Forth Estuary Flood Risk Management Plan 2021[7] (FRMP), the Tay Estuary and Montrose Basin Flood Risk Management Plan 2021[8] and the River Basin Management Plan for Scotland 2021[9] (RBMP), and account for any significant cross boundary flood risk issues.

3.4.1 Fife Local Development Plan

The council is preparing a new LDP to be shaped by the views and aspirations of communities across Fife. The plan will replace the existing FIFEplan[10] approved in 2017 and will set out planning policies and proposals for the use and development of land across Fife. It is anticipated that the new LDP will be adopted in 2027. A Stage 2 SFRA will be

7 Flood Risk Management Plan | Forth Estuary Local Plan District | Scottish Environment Protection Agency | 2021

8 Flood Risk Management Plan | Tay Estuary and Montrose Basin | Scottish Environment Protection Agency | 2021

9 The River Basin Management Plan for Scotland 2021-2027 | Scottish Environment Protection Agency | December 2021

10 FIFEplan | Fife Council | 2017

prepared alongside the new LDP to help understand the flood risk associated with specific sites.

3.5 Flood studies, strategies and plans

Flood Risk Management Plans and Local Flood Risk Management Plans are developed on a six-yearly cycle. Cycle One was from 2016-2022 and Cycle 2 will be from 2022-2028. SEPA are responsible for the development of Flood Risk Management Plans and certain Lead Local Authorities are responsible for the development of Local Flood Risk Management Plans. Scotland has been separated into 14 Local Plan Districts to produce the Flood Risk Management Plans. Fife is located within the Forth Estuary and Tay Estuary and Montrose Basin Local Plan Districts.

3.5.1 Flood Risk Management Plan, Forth Estuary Local Plan District, 2021

Flood Risk Management Plans are Scotland's route map for reducing the effects of flooding on local communities. They are designed such that efforts to reduce flood risk are coordinated between key organisations. Each Local Plan District across Scotland have a Flood Risk Management Plan to set out the long-term ambition for flood risk management.

The Forth Estuary Local Plan District covers approximately 3,300km^2 and has a population of around 1.4 million people. It covers the area north and south of the Forth Estuary, and has a 380km coastline that includes Fife Ness, the Firth of Forth and the Berwickshire coast. Key urban settlements include the City of Edinburgh, Dunbar, the City of Dunfermline, Eyemouth, Falkirk, Glenrothes, Kirkcaldy and Livingston.

Across the Local Plan District, there are areas at risk of river, surface water and coastal flood risk. Notable flood events include heavy rainfall in the summer of 2019 contributing to surface water flooding, and a significant rainfall event in August 2020, flooding a number of properties in Kirkcaldy. It is currently estimated that there are around 115,000 people and 65,000 homes and businesses at risk of flooding, which is anticipated to increase as a result of climate change.

SEPA and responsible authorities carry out actions in all areas of the Local Plan District which help to manage current and future flooding. These actions are scheduled to take place over the 6 years following the publication of the latest Flood Risk Management Plan and are carried out on an ongoing basis. The actions cover a wide range of themes, including:

- Awareness raising
- Data to support climate resilience
- Emergency plans
- Flood forecasting
- Flood warning development framework
- Future flood risk management planning
- Guidance development
- Hazard mapping updates

- Land use planning
- Maintenance
- Natural flood management mapping
- National flood risk assessment
- National surface water mapping
- Reservoirs
- Scottish Flood Defence Asset Database, and
- Self help

The Flood Risk Management Plan has identified a number of Potentially Vulnerable Areas (PVA) across the Forth Estuary based on the potential current and future flood risk. The Flood Risk Management Plan details current and future flood risk to each PVA and identifies specific objectives to tackle the impacts of flooding. Potentially Vulnerable Areas within Fife Council are outlined in Table 3-2 below.

Table 3-2 Potentially Vulnerable Areas in the Forth Estuary Local Plan District

Potentially Vulnerable Areas	Main source of flood risk	Number of people / properties at risk from flooding (present day)	Number of people / properties at risk from flooding (2080s climate change)
Crail	River (Crail Burn)	320 people 200 homes and businesses	350 people 210 homes and businesses
Leven	Surface water	1,400 people 820 homes and businesses	1,700 people 1,000 homes and businesses
Lower Largo and Lundkin Links	River and coastal	140 people 90 homes and businesses	160 people 100 homes and businesses
Glenrothes, Markinch and Kinglassie	Surface water and river (Lochty Burn in Kinglassie)	1,900 people 1,200 homes and businesses	2,600 people 1,700 homes and businesses
Kirkcaldy	Surface water, river and coastal	1,900 people 1,310 homes and businesses	3,200 people 2,000 homes and businesses
Cardenden	River (River Ore and small watercourses)	290 people 160 homes and businesses	310 people 170 homes and businesses
Cowdenbeath	Surface water and river	560 people 360 homes and businesses	700 people 450 homes and businesses
Inverkeithing	River, coastal and surface water	80 people 90 homes and businesses	90 people 110 homes and businesses

Potentially Vulnerable Areas	Main source of flood risk	Number of people / properties at risk from flooding (present day)	Number of people / properties at risk from flooding (2080s climate change)
Rosyth	Surface water, river and coastal	610 people 380 homes and businesses	800 people 500 homes and businesses
City of Dunfermline	River and surface water	2,500 people 1,400 homes and businesses	3,100 people 1,700 homes and businesses
Cairneyhill	River and surface water	520 people 270 homes and businesses	620 people 320 homes and businesses
Kincardine	Coastal and river flooding	540 people 280 homes and businesses	900 people 480 homes and businesses
Culross	Coastal and surface water	250 people 150 homes and businesses	330 people 190 homes and businesses

3.5.2 Flood Risk Management Plan, Tay Estuary and Montrose Basin Local Plan District, 2021

As noted above, Flood Risk Management Plans are Scotland's route map for reducing the effects of flooding on local communities. The Tay Estuary and Montrose Basin Local Plan District covers approximately 2,700km² and has a population of around 340,000 people. It covers part of the Cairngorms National Park and the low-lying coastal areas to the north and south of the Firth of Tay. The Local Plan District includes a 230km stretch of coastline from Inverbervie to St Andrews, including the Firth of Tay.

Throughout the Local Plan District, there is flood risk from rivers, surface water and the coast. Historic flood events include Storms Frank and Desmond in December 2015, which caused river flooding across the area, with damages exacerbated by the storms in January 2016. It is estimated that there are approximately 21,000 people and 14,000 homes and businesses at risk from flooding, which may increase to 29,000 people and 19,000 homes and businesses by the 2080s due to climate change.

SEPA and responsible authorities carry out actions in all areas of the Local Plan District which help to manage current and future flooding. These actions are scheduled to take place over the 6 years following the publication of the latest Flood Risk Management Plan and are carried out on an ongoing basis. The actions cover the same themes outlined within the Forth Estuary Flood Risk Management Plan in Section 3.5.1.

The Flood Risk Management Plan has identified a number of Potentially Vulnerable Areas (PVA) across the Tay Estuary and Montrose Basin based on the potential current and future

flood risk. The Flood Risk Management Plan details current and future flood risk to each PVA and identifies specific objectives to tackle the impacts of flooding. Potentially Vulnerable Areas within Fife Council are outlined in Table 3-3 below.

Table 3-3 Potentially Vulnerable Areas in the Tay Estuary and Montrose Basin Local Plan District

Potentially Vulnerable Areas	Main source of flood risk	Number of people / properties at risk from flooding (present day)	Number of people / properties at risk from flooding (2080s climate change)
Newburgh	Coastal	310 people 150 homes and businesses	380 people 190 homes and businesses
St Andrews	Surface water, river and coastal	1,200 people 700 homes and businesses	1,500 people 860 homes and businesses
Pitscottie and Kemback	River	110 people 70 homes and businesses	120 people 80 homes and businesses
Ceres	River (Ceres Burn, Craigrothie Burn and the Latch Burn)	20 people 10 homes and businesses	30 people 15 homes and businesses
Cupar	River and surface water	1,000 people 680 homes and businesses	1,300 people 830 homes and businesses
Springfield	Surface water	80 people 40 homes and businesses	No increase expected
Kingskettle and Kettlebridge	River (Kettle Burn)	80 people 40 homes and businesses	100 people 50 homes and businesses
Dunshalt	River	80 people 60 homes and businesses	110 people 80 homes and businesses
Auchtermuchty	River (existing flood protection scheme offers some protection)	260 people 160 homes and businesses	270 people 170 homes and businesses

3.5.3 The River Basin Management Plan for Scotland 2021 - 2027

The River Basin Management Plan (RBMP) for Scotland sets out a framework for protecting and improving the benefits provided by the water environment in Scotland. It provides a set of actions to ensure that Scotland's rivers, lochs, estuaries, coastal areas and groundwater bodies can continue to supply drinking water, support fisheries, offer an essential resource for businesses and agriculture and serve as a source of recreation.

The actions within the RBMP cover four main themes: to create healthier and more resilient communities; water supply and wastewater; sustainable and resilient rural land use; and removing barriers to fish migration.

Action to create healthier and more resilient communities

The RBMP aims to protect and improve the water environment by restoring rivers and improving how surface water is managed during storms. By achieving this, attractive and accessible blue-green river corridors can be created within communities to be used for active travel and recreation.

SEPA are aiming to deliver up to 51 new restoration projects that have the potential to improve the ecological condition of rivers in Scotland's towns and cities. The potential projects are highlighted in the Water Environment Hub[11], 9 of the potential projects are relevant to Fife.

Water supply and wastewater

Climate change and population growth are affecting demand on water, water quality, raw water quality and risk of sewer and surface water flooding in towns. There are three key aims outlined within the RBMP to create a circular economy for water supply and wastewater:

- Water is being used wisely and efficiently to ensure Scotland can meet its water need in a changing climate
- Towns and cities incorporate nature based solutions to absorb and safely convey rainwater in new developments, and where feasible, older developments
- Minimise use of energy and materials and convert sewage and other wastes into valuable resources.

SEPA are aiming to deliver improvements to wastewater treatment works and sewage discharges, publish a route-map setting out steps to reduce sewage litter and spills from CSOs, and develop guidance for developers and households to help them install more sustainable water supplies and wastewater treatment.

Sustainable and resilient rural land use and management

The way land is managed contributes to producing food, timber and offering recreation opportunities. The RBMP aims to ensure land is used and managed in a way that secures sustainable and long-term improvements to the water environment and supports the response to the climate emergency. Climate change could mean a reduction in crop yields

11 Water Environment Hub | SEPA

and an increase in the frequency and severity of flooding. Land management that uses resources more efficiently; adapts and is more resilient to climate change; reduces its carbon footprint; and restores natural capital will contribute to protecting and improving the water environment.

Actions being taken to tackle this theme include:

- Working with land managers to ensure compliance with legislation
- Take a spatial approach to prioritising action
- Promote the sustainable use of water

Removing man-made barriers to fish migration

Migratory fish species are iconic species for Scotland, providing a valuable cultural and recreational amenity and are an important part of the rural economy. Migratory fish are facing significant challenge from a number of pressures, including the effects of climate change, with higher temperatures and droughts having an impact on their survival. Man-made barriers to fish migration are now the main factor preventing recovery of migratory fish populations. Barrier removal or easement can be achieved by removal of structures or installations of fish passes or other means of easement.

A catchment approach is needed on river systems with multiple barriers and delivery mechanisms, which requires planning and engagement with stakeholders and owners. SEPA are aiming to remove or ease 244 impassable man-made barriers during the RBMP plan period. These include weirs, bridges and culverts.

3.5.4 Fife Shoreline Management Plan, 2011

The Fife SMP is now out of date with current policy. There is due to be a review of the Shoreline Management Plan which will incorporate the Dynamic Coast mapping.

The Fife SMP provides an assessment of the risks associated with shoreline evolution, coastal flooding and erosion and presents a framework for policy to address risks to people and the developed, historic and natural environment for a sustainable future. The SMP covers an area of shoreline between Kincardine and Newburgh. The aim of the SMP is to:

- Reduce the threat of flooding and coastal erosion to people and their property; and
- Deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles.

The SMP uses DEFRA's policy options as a guide to managing each coastal zone within Fife, which include; Hold The Line (HTL), Advance The Line (ATL), Managed Realignment (MR) and No Active Intervention (NAI). Table 3 within the SMP indicates which management policy should be considered for coastal zone.

3.5.5 City of Dunfermline local flood study, 2022

The Dunfermline local flood study involves an assessment of all significant watercourses and their catchments within the City of Dunfermline, including reaches of the Lyne Burn,

Calais Burn, Mowbray Burn, Baldridge/Tower Burn and the Castleblair Burn. Watercourses have been modelled for a variety of flood events and climate change scenarios to assess the maximum flood levels and extents across key reaches.

The study investigated various options for flood mitigation in each area that was identified to have a risk of fluvial flooding in the 200 year + 40% climate change event. The 40% climate change uplift allowance applied within this flood study is not up to date with the latest SEPA climate change allowances documented within Section 5.3.1. The measures identified are outlined within Table 3-4.

Table 3-4 Flood risk management measures considered in the Dunfermline local flood study

Watercourse	Measure
Baldridge Burn	Additional lengths of floodwalls and attenuation storage to prevent overland flow over the right bank of the watercourse on Rumblingwell Road. A sealed manhole and an embankment on the left bank of the burn to the east of William Street are also proposed to prevent overtopping of the bank and flooding to the properties to the north.
Castleblair Burn	Property Level Protection (PLP) is proposed for 5 properties on Broomhead Drive to mitigate flood concerns arising from inundation of the culvert inlet prior to discharging to the Tower Burn.
Calais Burn	Throttling of flows in Duloch Park to maximise attenuation capacity as well as channel widening and flood walls implemented on downstream reaches of the Calais Burn. Sealed manholes are also recommended to overcome sewer flooding in the Rex Park area.
Lyne Burn	Maintenance and desilting of Halbeath Park retail park SUDS, thus creating additional online storage capacity (as designed). Embankments are also proposed to protect properties.
Tower Burn	Pittencrief Park trash screen embankment extended by 10m to prevent overland flow routing south west.

3.5.6 Kemback and Pitscottie flood study, 2022

The Kemback and Pitscottie flood study aims to inform future flood mitigation actions for the area. The study modelled flood risk within the area to identify the level of existing risk. Several options were identified to mitigate flooding impacts:

- Direct defences - new flood protection such as walls and embankments to help protect areas and properties at risk

- Natural Flood Management - use natural processes to manage flooding, such as storage ponds, planting trees, restoring rivers, creating wetlands or building leaky barriers
- Property Level Protection - involves property owners making adaptations to their own properties

3.5.7 Section 16 Assessment Dunfermline & Iron Mill Bay

The aim of the Section 16 Assessment study for the Dunfermline and Iron Mill Bay Drainage Operational Areas is to produce flood mapping identifying the extents and depths of predicted flooding from the sewerage system up to a return period of 1 in 200. Modelling covered the following watercourses:

- Whinny Burn
- Brankholm Burn
- Keithing Burn
- Tower Burn
- Lyne Burn; and
- Mowbray Burn

3.6 Flood risk and planning guidance

There are several online guidance documents listed below available from SEPA for plan making and development management in relation to flood risk. However, at the time of writing, these documents are being reviewed and updated to reflect new policies in NPF4. SEPA states that its responses to planning applications may therefore be different to what is included in the guidance documents briefly described in the following sections.

3.6.1 SEPA Planning Background Paper Flood Risk[12]

This paper provides SEPA guidance on land use policy and flood risk, based on national planning policies and duties and requirements under relevant legislation. It summarises the requirements and recommendations relating to flood risk that should be incorporated into strategic and local development plans. It also highlights SEPA's approach to development management, including:

- Development in fluvial or coastal flood risk areas;
- Flood impacts elsewhere as a result of development;
- Access and egress;
- Freeboard;
- Climate change;
- Flood resilient design; and
- Pluvial flooding.

12 Planning Background Paper. Flood Risk. Version 3. July 2018. Scottish Environment Protection Agency

3.6.2 SEPA Flood Risk and Land Use Vulnerability Guidance[13]

This guidance provides an understanding of the vulnerability to flooding of different land uses and assists in the interpretation of SEPA's Flood Risk Planning Guidance. It classifies land use according to how they are impacted by flooding, including:

- Most Vulnerable Uses - civil infrastructure, nurseries, residential institutions, basements and caravans
- Highly Vulnerable Uses - residential properties, social services homes, hotels, student residences, landfill and hazardous waste sites
- Least Vulnerable Uses - shops, professional services, restaurants, cafes, offices, general industry, land used for agriculture and forestry etc.
- Essential Infrastructure - essential transport infrastructure and essential utility infrastructure
- Water compatible uses - flood control infrastructure, environmental monitoring stations, pumping stations, navigation facilities etc.

The guidance provides development constraints based on flood risk depending on which vulnerability category the proposed land use type falls within.

3.6.3 SEPA Development Plan Guidance on Flood Risk[14]

The aim of this guidance document is to provide advice to planning authorities regarding flood risk in the development plan process, promoting safe and resilient communities and businesses through sustainable flood risk management. The guidance outlines the requirements of Strategic Development Plans and Local Development Plans, including advice on policies and strategic allocations.

3.6.4 SEPA Development Management Guidance on Flood Risk[15]

This guidance document provides information on the role of development management in delivering sustainable flood risk management. It summarises SEPA's hierarchy of development management requirements and recommendations as set out in the SEPA Planning Background Paper Flood Risk document.

3.6.5 SEPA Planning Information Note 4[16]

This guidance note outlines the role of SEPA on proposed development protected by a Flood Protection Scheme. It summarises what categories of development would be

13 Flood Risk and Land Use Vulnerability Guidance. Version 4. July 2018 Scottish Environment Protection Agency
14 Development Plan Guidance. Flood Risk. Version 4. July 2018. Scottish Environment Protection Agency
15 Development Management Guidance. Flood Risk. Version 2. July 2018. Scottish Environment Protection Agency
16 SEPA Planning Information Note 4. Version 2. July 2018. Scottish Environment Protection Agency.

acceptable when protected by an existing or planned formal flood protection scheme in a built up area. It is recommended that any development protected by a formal scheme is built to a water resilient design and has adequate evacuation procedures in place that are appropriate to the level of risk and use.

3.6.6 SEPA standing advice for planning authorities and developers on development management consultations[17]

This guidance document simplifies SEPA's engagement with the planning system, by highlighting the types of developments they should be consulted on, set out in the Advice for planning authorities on how and when to consult SEPA[18]. It provides standing guidance on circumstances where SEPA should not be consulted, including:

- Waste water drainage;
- Swimming pool drainage;
- Surface water drainage;
- Engineering activities;
- Space for waste management provision;
- Oil storage;
- Contaminated land;
- Air quality and noise;
- Agricultural developments;
- Pollution prevention;
- Groundwater abstractions; and
- Shellfish applications.

3.6.7 SEPA – Planning Authority Protocol (Policy 41) Development at Risk of Flooding: Advice and Consultations[19]

This document provides principles to be followed by both SEPA and planning authorities regarding advice and consultation on flood risk issues. The Protocol is intended to enable planning authorities and SEPA to work together on planning matters where there is considered to be flood risk. The Protocol comprises three sections:

- The framework for consultation: the statutory position, the roles of SEPA and planning authorities and consultation arrangements;
- Information source for screening and flood risk assessment; and
- SEPA's formal comments to planning authorities on planning applications.

17 SEPA standing advice for planning authorities and developers on development management consultations. Land Use Planning System. Version 10. September 2016. Scottish Environment Protection Agency

18 Advice for planning authorities on how and when to consult SEPA. December 2015. Scottish Environment Protection Agency.

19 SEPA – Planning Authority Protocol (Policy 41) Development at Risk of Flooding: Advice and Consultations. October 2016. Scottish Environment Protection Agency

3.6.8 SEPA Flood Modelling Guidance for Responsible Authorities[20]

This technical flood modelling guidance supports those in Responsible Authorities who develop and commission flood studies in respect of flood risk management planning. It summarises where uncertainty may arise in flood modelling and how it may be managed through the modelling process so that it can inform appropriate decisions.

3.6.9 Technical Flood Risk Guidance for Stakeholders - SEPA requirements for undertaking a Flood Risk Assessment[21]

This document provides guidance on carrying out a Flood Risk Assessment, including:

- How to use the SEPA Flood Maps
- Minimum and detailed requirements for a FRA
- Fluvial design flow estimation
- Hydraulic flood modelling
- Coastal FRAs
- Consideration of surface water flooding and modelling
- Groundwater assessments
- Consideration of mitigation measures for land raising and compensatory flood storage

Note: the interim guidance produced by SEPA on Strategic Flood Risk Assessments should be consulted following the release of NPF4.

3.6.10 Design Criteria Guidance on Flooding and Surface Water Management Plan Requirements, Fife Council[22]

This guidance document has been prepared by Fife Council to inform developers, their consultants and all stakeholders involved in the planning process in relation to flooding and surface water management of the requirements of the council. It is based on existing legislation, planning policy, technical guidance, and best practice. It aims to encourage and promote an increased awareness, understanding and knowledge in flooding and surface water management.

20 Flood Modelling Guidance for Responsible Authorities. Version 1.1. Scottish Environment Protection Agency.
21 Technical Flood Risk Guidance for Stakeholders. SEPA requirements for undertaking a Flood Risk Assessment. Version 13 June 2022
22 Design Criteria Guidance on Flooding and Surface Water Management Plan Requirements. Version 2.1. Fife Council. May 2022.

4 Information gathering

This chapter summarises the data and information required for the Stage 1 SFRA including what was available, what has been used, and what was not available to inform Stage 1

4.1 Data and information requested and received

A data and information request was submitted to Fife Council early in the Stage 1 process for sharing with key stakeholders and data holders to gather the most up to date and available information on flood risk for Fife. Table 4-1 lists the data and information requested, based on what is listed in the draft SFRA guidance V4 and the Council's Brief document.

Table 4-1 datasets and information gathered for the SFRA

Dataset / information	Description	Data owner
Flood Maps	Flood hazard/extent maps for all sources of flooding (river, coastal and surface water) including future flood maps	SEPA
Natural Flood Management Maps	Runoff reduction map, Floodplain storage map, Sediment management map, Estuarine surge attenuation map, Wave energy dissipation map	SEPA
Dynamic Coast 2	Coastal change GIS datasets	Scottish Government
Shoreline Management Plan	Report/GIS showing risks associated with shoreline evolution and coastal flooding	Fife Council
Scottish Flood Defence Asset Database (SFDAD)	GIS dataset of Flood Prevention Schemes and defence assets	SEPA/Scottish Government
Local flood studies	Dunfermline Flood Study Report	Fife Council
Flood Risk Management Plans and River Basin Management Plans	Forth Estuary Flood Risk Management Plan and the River Basin Management Plan for Scotland	SEPA

Dataset / information	Description	Data owner
Section 16 assessments	Section 16 assessments for seven catchments within Fife	Scottish Water

4.2 Gap analysis

Table 4-2 lists the datasets and information from Table 4-1 that are not available for Stage 1.

Table 4-2 datasets and information not available for the SFRA

Dataset / information	Reason not available
Reservoir flood maps	Only available to view online
Residual risk	No modelled data available on possible defence breaches or structural blockages
Integrated Catchment Study modelling	Data outstanding
Historic flood event records	Data outstanding
Housing Land Audit	Received data, although to be used in the Stage 2 assessment only
Candidate sites to be assessed	Only required for the Stage 2 assessment
Information on development / planning information from neighbouring authorities	Data outstanding
Climate change uplifted flood maps	Climate change uplifted flood maps were produced in 2020. Since 2020, SEPA have updated their peak flow allowances. Flood maps will need to be updated to reflect updated allowances. The 0.1% AP flood maps will be used as a proxy approach to representing climate change.

The LPA must ensure it is satisfied this Stage 1 SFRA contains sufficient information to inform the Evidence Report to guarantee the Evidence Report is acceptable for the Gate Check. It may be necessary to carry out a further update of this Stage 1 SFRA if the LPA consider any of the missing datasets to compromise the robustness of the Evidence Report. The DP guidance[23] states:

"*To assist in the Gate Check process, the planning authority should identify where there are any potential gaps in the evidence gathered or uncertainty in data and evidence within the Evidence Report together with an explanation of the authority's reasoning for accepting this evidence and including it in the Report. This should be clearly set out under the 'Summary of Evidence' heading within the template*".

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5 Flood hazards in Fife

This chapter summarises the flood risk across Fife, based on available flood risk datasets. The SFRA Maps in Appendix A present this information spatially.

5.1 Historical flooding in Fife

5.1.1 Historic river flooding

There is a significant risk of river flooding across Fife, with the River Eden and River Leven flowing through the local authority area. In February 2001, a river flood event was reported in Cupar along the River Eden. This was recorded to have been a 1 in 5-year AP event. Other historic river flooding instances have been reported along Kinness Burn at St Andrews. In August 2004, residential properties at Murray Park, Auld Burn Park and Dempster Terrace were flooded. Similarly, in April 1998, properties at Dempster Court, St Nicholas Street and Wood Burn Place were flooded. Heavy rainfall in April 1992 contributed to the highest ever recorded level on the River Eden which led to flooding in Cupar.

5.1.2 Historic coastal flooding

Given the extensive coastline within the Fife Council boundary, there is considerable risk of coastal flooding. Evidence of this has been noted at St Andrews, where a combination of strong wind and high tides contributed to coastal flooding in December 2012. Additionally, St Andrews experienced coastal flooding in March 2010 as a result of a tidal surge. Crail and Pittenweem experienced coastal flooding in April 1958, where homes and businesses along the coastline experience significant flooding. Coastal flooding has been recorded at Kirkcaldy in April 1958 and March 2010.

5.1.3 Historic surface water flooding

Fife consists of areas of low-lying, flat areas along coastal reaches and along the estuaries, combined with areas of steeper gradients causing increased surface water runoff. This contributes to the heightened risk of surface water ponding and causing flooding to homes and businesses. Recent surface water flooding has occurred in Dunfermline in January 2023, where Halbeath retail park experienced significant flooding as a result of torrential rainfall coupled with a blockage in the drainage system. August 2020 saw flooding occur in Kirkcaldy, particularly at Victoria Hospital where the car park was flooded, causing damage to a significant number of cars. Cupar has experienced extensive surface water flooding, most recently in October 2012. This caused considerable damage to homes within the area. In addition, flooding also occurred in Cupar in July 2009, where heavy rainfall caused large areas of surface water flooding, affecting homes, businesses and road infrastructure.

Other areas that have experienced surface water flooding include Falkland in July 2011 after a period of prolonged and heavy rainfall. Leven saw considerable surface water

flooding in February 2001, where heavy rainfall was combined with thawing snowfall. Inverkeithing, Rosyth and the City of Dunfermline experience heavy rainfall in April 1992, which caused surface water flooding to impact both residential and non-residential properties.

5.2 Sources of flooding

Flooding is a natural process and can happen at any time in a wide variety of locations. It constitutes a temporary covering of land not normally covered by water and presents a risk when human or environmental assets are present in the area that floods. Assets at risk from flooding can include housing, transport, and public service infrastructure (including vulnerable services such as hospitals and schools), commercial and industrial enterprises, agricultural land, and environmental and cultural heritage. Flooding in Fife can occur from many different and combined sources such as rivers (fluvial), surface water, groundwater, sewers or indirectly from infrastructure failure. Although flooding is a natural process, it can be exacerbated by manmade interventions, whether that be to watercourses or increasing the impermeable area through development.

Different types and forms of flooding present a range of different risks and the flood hazards of speed of inundation, depth and duration of flooding can vary greatly. With climate change, the frequency, pattern, and severity of flooding are expected to change and become more damaging.

5.2.1 Rivers (fluvial)

River flooding is the inundation of floodplains from rivers and watercourses; the inundation of areas outside the floodplain due to the influence of bridges, embankments and other features that artificially raise water levels; overtopping or breaching of defences; and blockages of culverts or flood channels/corridors.

River flooding is associated with the exceedance of channel capacity during higher flows or because of blockage (residual risk). The process of flooding from a watercourse depends on several characteristics associated with the catchment including geographical location and variation in rainfall; steepness of the channel and surrounding floodplain; and infiltration and rate of runoff associated with urban and rural catchments.

The SFRA Interactive Maps in Appendix A present SEPA's River Flood Hazard maps. The flood hazard maps provide the flood extents for the 1 in 10 year (10% AP), 1 in 200 year (0.5% AP), and 1 in 1000 year (0.1% AP) flood events. These are categorised into high, medium and low likelihood of flooding respectively. The River Flood Hazard maps also provide an indicative medium risk plus climate change scenario. Given the indicative and strategic nature of the flood maps, it is inappropriate for them to be used to assess flood risk to an individual property.

There are a number of areas across Fife that are shown to be at high risk of river flooding. Table 5-1 highlights these areas and indicates the detailed map tiles in Appendix A representing the area at risk.

Table 5-1 Areas at risk of river flooding in Fife

Area	Detailed map
Ladybank	Map 125, Map 125, Map 126, Map 147, Map 148
Dunshalt	Map 100, Map 101, Map 122, Map 123
City of Dunfermline	Map 307, Map 308, Map 324
Crossford	Map 323
Cairneyhill	Map 322
Rosyth and Inverkeithing	Map 338, Map 339
Thornton	Map 244, Map 245
Cupar	Map 86, Map 87

Guidance on how the River Flood Hazard Maps have been produced can be accessed via the SEPA website[24].

5.2.2 Coastal (tidal) including erosion

Tidal flooding is caused in times of high astronomical tides and can also be caused by storm surge and wave action. Coastal regions and areas along tidal estuaries are at risk from tidal flooding.

The SFRA Interactive Maps in Appendix A present SEPA's Coastal Flood Hazard maps. The flood hazard maps provide the flood extents for the 1 in 10 year (10% AP), 1 in 200 year (0.5% AP), and 1 in 1000 year (0.1% AP) flood events. These are categorised into high, medium and low likelihood of flooding respectively. The Coastal Flood Hazard maps also provide an indicative medium risk plus climate change scenario. Given the indicative and strategic nature of the flood maps, it is inappropriate for them to be used to assess flood risk to an individual property.

There are a number of areas across Fife that are shown to be at high risk of coastal flooding. Table 5-2 highlights these areas and indicates the detailed map tiles in Appendix A representing the area at risk.

Table 5-2 Areas at risk of coastal flooding in Fife

Area	Detailed map
Newburgh	Map 48
St Andrews	Map 75, Map 75
Anstruther	Map 202, Map 203
Inverkeithing	Map 338, Map 339
North Queensferry	Map 343, Map 344
Culross	Map 318, Map 319, Map 320

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Area	Detailed map
Kincardine	Map 300

5.2.2.1 Dynamic Coast

The Dynamic Coast project was commissioned by Scottish Government to provide evidence on the extent of coastal erosion in Scotland. This was used to indicate the areas at the highest risk of coastal erosion, and points to where a more detailed investigation is needed. The project modelled anticipated coastal erosion where recent coastal changes are considered alongside relative sea level rise, projecting this forward to identify areas at risk of future coastal erosion for a number of emissions scenarios. Coastal erosion has the potential to contribute to a loss of coastal transport infrastructure, development and habitat.

The Dynamic Coast evidence base can be viewed on the SFRA Interactive Maps in Appendix A.

5.2.3 Surface water (pluvial)

Surface water or pluvial flooding of land from surface water runoff is usually caused by intense rainfall that may only last a few hours. In these instances, the volume of water from rural land can exceed infiltration rates in a short amount of time, resulting in the flow of water over land. Within urban areas, this intensity can be too great for the urban drainage network resulting in excess water flowing along roads, through properties and ponding in lower areas or natural depressions. Areas at risk of pluvial flooding can, therefore, lie outside of the fluvial flood zones.

Pluvial flooding within the urban areas of Fife will typically be associated with events equal to or greater than the 1 in 30 year (3.3% AP) design standard of new sewer systems. Some older sewer and highway drainage networks will have a lower capacity than is required to mitigate for the 3.3% AP event. There is also residual risk associated with these networks due to possible network failures, blockages, or collapses.

There are certain locations, generally within the urban areas, where the probability and consequence of pluvial flooding are more prominent due to the complex hydraulic interactions that exist in the urban environment. Urban watercourse connectivity, surface water or combined sewer capacity and the location and condition of highway gullies all have a major role to play in surface water flood risk.

Surface water flood risk should be afforded equal standing in importance and consideration as fluvial and groundwater flood risk, given the increase in rainfall intensities due to climate change and the increase in impermeable land use due to development. It should be acknowledged that once an area is flooded during a large rainfall event, it is often difficult to identify the route, cause and ultimately the source of flooding without undertaking further site-specific and detailed investigations.

The SFRA Interactive Maps in Appendix A present SEPA's Surface Water Flood Hazard maps. The flood hazard maps provides the flood extents for the 1 in 10 year (10% AP), 1 in

200 year (0.5% AP), and 1 in 200 year plus climate change (0.5% AP +CC) flood events. These are categorised into high, medium and low likelihood of flooding respectively.

There are a number of areas across Fife that are shown to be at high risk of surface water flooding. Table 5-3 highlights these areas and indicates the detailed map tiles in Appendix A representing the area at risk.

Table 5-3 Areas at risk of surface water flooding in Fife

Area	Detailed map
Crossford	Map 323
Cairneyhill	Map 322
Rosyth and Inverkeithing	Map 338, Map 339
Cupar	Map 86, Map 87
Auchterderran	Map 240, Map 241, Map 258, Map 259
Markinch and Glenrothes	Map 189, Map 190, Map 207, Map 208, Map 209
Leven	Map 212

Guidance on how the Surface Water Flood Hazard Maps have been produced can be accessed via the SEPA website[25]. At the time of writing, the pluvial flood maps for Scotland are in the process of being updated and will be available from mid-2024.

5.2.4 Functional floodplain or flood risk area

SEPAs Technical Flood Risk Guidance for Stakeholders[21] identifies the functional floodplain as land where there is a 0.5% or greater annual probability of flooding from any source in any year. However, NPF4 states that a flood risk area (also known as the functional floodplain) must also include an appropriate allowance for climate change. Development is not appropriate within the functional floodplain. The allowances for peak river flows, peak rainfall intensities, and sea level rise applicable to Fife are documented within Section 5.3. For this SFRA, the 1 in 1000 year (0.1% AP) flood event has been used to indicate the future functional floodplain extent.

SEPAs Technical Flood Risk guidance also indicates that modelled 0.5% structure blockage scenario should be considered as the functional floodplain in locations where this is applicable. In keeping with NPF4, this should also account for an allowance for climate change.

5.2.5 Sewers

Flooding from the sewer network can occur when flow entering the system, such as an urban storm water drainage system, exceeds its available discharge capacity, the system becomes blocked or it cannot discharge due to a high water level in the receiving

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watercourse. Pinch points and failures within the drainage network may also restrict flows. Water then begins to back up through the sewers and surcharge through manholes, potentially flooding highways, and properties. It must be noted that sewer flooding in 'dry weather' resulting from blockage, collapse or pumping station mechanical failure (for example), is the sole concern of the drainage undertaker.

Combined sewers spread extensively across urban areas serving residential homes, business, and highways, conveying waste and surface water to treatment works. Some areas may also be served by separate waste and surface water sewers which convey wastewater to treatment works and surface water into local watercourses or combined sewers.

Scottish Water (SW) is the organisation responsible for the management of the public sewer drainage network across Scotland. SW have produced Section 16 flood risk assessment reports and mapping, which assesses the possible risk of flooding from sewerage systems in areas in Fife designated as potentially vulnerable by SEPA. The areas covered by Section 16 assessments are noted in Table 5-4. They quantify the areas that have the potential to be flooded from manholes and have produced predicted flood depth outputs.

Table 5-4 Scottish Water Section 16 assessment locations

S16 catchments	Areas covered
STW001981	St Andrews
STW001983	Levenmouth
STW002023	Bowhouse
STW002167	Strathmiglo
STW002191	Cornceres
DOA000206 / DOA000208	Dunfermline and Ironmill Bay
DOA002460	Levenmouth

5.2.6 Groundwater

Groundwater water flooding occurs when the water table rises after prolonged rainfall to emerge above ground level remote from a watercourse. It is most likely to occur in low-lying areas underlain by permeable rock (aquifers) and groundwater recovery areas, after pumping for mining or industry has ceased. Warmer, wetter winters due to climate change may have significant impacts on groundwater levels.

Groundwater flooding is caused by the emergence of water from beneath the ground, either at point or diffuse locations. The occurrence of groundwater flooding is usually local and unlike flooding from rivers, does not generally pose a significant risk to life due to the slow rate at which the water level rises. However, groundwater flooding can cause significant damage to property, especially in urban areas and can pose further risks to the environment and ground stability.

There are several mechanisms that increase the risk of groundwater flooding including prolonged rainfall, high in-bank river levels, artificial structures, groundwater rebound, and mine water rebound. Properties with basements or cellars or properties that are located within areas deemed to be susceptible to groundwater flooding are at particular risk. Development within areas that are susceptible to groundwater flooding will generally not be suited to infiltration SUDS; however, this is dependent on detailed site investigation and risk assessment at the FRA stage.

This SFRA assesses groundwater flood risk through JBAs 5m Groundwater Flood Risk Map, which provides a general broadscale assessment of the groundwater flood hazard. The map is categorised by grid code, explained in Table 5-5.

Table 5-5 Groundwater flood hazard classification of the JBA groundwater map

Groundwater head difference (m)*	Grid code	Class label
0 to 0.025	4	Groundwater levels are either at, or very near (within 0.025m of), the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	3	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	2	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event. There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
>5	1	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	0	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local

Groundwater head difference (m)*	Grid code	Class label
		geological deposits.
*Difference is defined as ground surface in mAOD minus modelled groundwater table in mAOD.		

There are a number of areas across Fife that are shown to be at high risk of groundwater flooding. Table 5-6 highlights these areas and indicates the detailed map tiles in Appendix A representing the area at risk.

Table 5-6 Areas at risk of groundwater flooding in Fife

Area	Detailed map
Tayport and Tentsmuir Forest	Map 11, Map 12, Map 13, Map 23, Map 24, Map 33, Map 34, Map 45
Falkland	Map 122, Map 123, Map 145, Map 146
Ladybank	Map 102, Map 103, Map 104, Map 124, Map 125, Map 126
Kingskettle	Map 147, Map 148, Map 149
Cupar	Map 86, Map 87, Map 88
St Andrews	Map 74, Map 75
Leven	Map 212, Map 213, Map 229
Burntisland	Map 330, Map 331

5.2.7 Reservoirs

A reservoir can usually be described as an artificial or non-natural lake where water is stored for use. The risk of flooding associated with reservoirs is residual and is associated with failure of reservoir outfalls or dam breaching. This risk is reduced through regular inspection and maintenance by the operating authority. Reservoirs in the UK have an extremely good safety record with no incidents resulting in the loss of life since 1925.

SEPA are the single regulatory authority for reservoir safety within Scotland, under the Reservoirs (Scotland) Act 2011[26], which supersedes the Reservoirs Act 1975. Reservoirs with a volume of greater than 25,000m3 must be registered with SEPA and have an appointed approved panel engineer depending on the reservoirs risk designation. The risk designation is assigned by SEPA based on the consequences of an uncontrolled release of water from the reservoir.

SEPA have produced reservoir inundation maps showing the area of land likely to be flooded in the event of an uncontrolled release of water. They show the extent, depth and velocity of water in the flooded area. Reservoir maps can be viewed online via the Controlled Reservoirs Register at: Reservoirs Map

26 Reservoirs (Scotland) Act | GOV.UK | 2011

SEPA do not consider that the reservoir inundation maps should be used for land use planning purposes.

5.3 Climate change

The Stage 1 SFRA should be the starting point for any local authority to assess the effects of climate change on flood risk across the local plan area. At this stage, this Stage 1 SFRA has not modelled the impacts of climate change. The impact of climate change on the functional floodplain has been assessed through using the 1 in 1000 year (0.1% AP) flood event as a proxy flood extent. However, it is recommended that the effects of climate change on flood risk are assessed by the local authority as part of the Stage 2 SFRA, once potential allocations are confirmed.

5.3.1 Climate change allowances

The SFRA must account for the changes in fluvial flows, rainfall intensities, and sea level rise, and also coastal erosion as a result of climate change. Version 2.0 is the most up to date SEPA flood hazard mapping available that is used and presented in this SFRA. However, SEPA has since published an updated 'Climate change allowances for flood risk assessment in land use planning[6]' (March 2022) guidance document. This document updates the climate change uplift figures for peak flow, peak rainfall and the sea level rise that need to be considered as part of the understanding of flood risk.

Fife is located within the Tay and Forth River Basin Regions. The relevant climate change uplift values are noted within Table 5-7 and Table 5-8.

Table 5-7 Tay River Basin Region climate change uplifts

Type of allowance	Applicable climate change uplift value
Peak river flow (total change to the year 2100)	53%
Peak rainfall intensity (total change to the year 2080)	39%
Sea level rise (cumulative rise in metres from 2017 to 2100)	0.85 m

Table 5-8 Forth River Basin Region climate change uplifts

Type of allowance	Applicable climate change uplift value
Peak river flow (total change to the year 2100)	56%
Peak rainfall intensity (total change to the year 2080)	39%
Sea level rise (cumulative rise in metres from 2017 to 2100)	0.86 m

5.3.2 Future functional floodplain / future flood risk area

At the time of writing, the predicted impact of climate change on areas at risk of flooding has not been mapped by SEPA. Therefore, a precautionary approach to climate change is taken for this SFRA in that the future functional floodplain / future flood risk area is defined by the current SEPA 0.1% annual probability flood, in the absence of a mapped 0.5% annual probability plus climate change uplift event.

5.4 Cumulative and cross boundary flood risk

When allocating land for development, consideration should be given to the potential cumulative impact of the loss of storage volume, as well as the impact of increased flows on flood risk downstream. Whilst the loss of storage for individual developments may only have a minimal impact on flood risk, the cumulative effect of multiple developments may be more severe.

All developments are required to demonstrate they will not increase flood risk elsewhere. Therefore, providing all new development complies with the latest guidance and legislation relating to flood risk and sustainable drainage, in theory there should not be any increase in flood risk downstream.

Strategic solutions may include upstream flood storage, integrated major infrastructure/Flood Risk Management schemes, new defences, and watercourse improvements as part of regeneration and enhancing green infrastructure, with opportunities for Natural Flood Management and retrofitting of SUDS to existing development.

Through the Local Development Plan (LDP), Fife should consider the following strategic solutions:

- Use of sustainable flood storage and mitigation schemes to store water and manage surface water runoff in locations that provide overall flood risk reduction as well as environmental benefits;
- In areas where flood risk is being managed effectively, there will be a need in the future to keep pace with increasing flood risk as a result of climate change;
- Assessment of long-term opportunities to move development away from the floodplain and to create blue/green river corridors throughout the Fife area;
- Identification of opportunities to use areas of floodplain to store water during high flows, to reduce long-term dependence on engineered flood defences located both within and outside the Fife area;
- Safeguarding the natural floodplain from inappropriate development;
- Where possible, changes in land management should look to reduce runoff rates from development whilst maintaining or enhancing the capacity of the natural floodplain to retain water. Land management and uses that reduce runoff rates in upland areas should be supported;
- Use of this SFRA to inform future development and minimise flood risk from all sources; and

- Implementation of upstream catchment management i.e., slow the flow and flood storage schemes could be implemented in upper catchments to reduce risk downstream and across neighbouring authority boundaries.

5.4.1 Hydrological linkages

The majority of cross boundary watercourses within Fife originate from outside of the local authority boundary. Therefore, major land use changes within neighbouring catchments may have a significant impact on flow regimes and flood risk. Bluther Burn enters the western boundary of Fife from Clackmannanshire. The River Eden, River Leven, Kinnaird Burn and Bow Burn enter the northern boundary of Fife from Perth and Kinross. Development control and responsible land management across neighbouring authorities is crucial to ensuring sustainable development within Fife. The River Forth borders Fife to the west, therefore development within the upstream catchment could have an impact on flood risk within Fife. Close partnerships between Fife and the neighbouring authorities of Clackmannanshire and Perth and Kinross will need to be maintained.

Were the above strategic solutions not considered in upstream development planning, the following issues may occur:

- Reduction in upstream floodplain storage capacity; and
- Increase in impermeable areas leading to a reduction in rainfall infiltration and subsequent increased runoff to the detriment of downstream communities.

The need for consistent regional development policies controlling runoff or development in floodplains within contributing districts is therefore crucial as this would have wider benefits for neighbouring local authorities.

5.5 Flood risk management

The aim of this section of the SFRA is to identify existing Flood Risk Management (FRM) assets and proposed FRM schemes. The location, condition and design standard of existing assets will have a significant impact on actual flood risk mechanisms. Whilst future schemes in high flood risk areas carry the possibility of reducing the probability of flood events and reducing the overall level of risk. Both existing assets and future schemes will have a further impact on the type, form and location of new development or regeneration.

5.5.1 Defence infrastructure

The Scottish Flood Defence Asset Database (SFDAD) provides information on Flood Prevention Schemes and defence assets. It provides a record of where flood defences exist, the level of protection provided and the areas benefitting from the defences. The areas benefitting from flood defence assets within Fife are noted within Table 5-9.

Table 5-9 Flood defence assets within Fife (SFDAD)

Area benefitting	Defence type
City of Dunfermline	Channel improvements, embankment and flood wall
Cairneyhill	Flood storage area at Pitdinnie Road
Auchtermuchty	Channel improvements, embankment and flood wall
Ceres	Channel improvements, embankment, flood wall and bridge raising
Pitscottie	Channel improvements, embankment and flood wall
Dunshalt	Channel improvements
Millfield	Flood storage area on the Mill lade
Parkneuk	Channel improvements
Kincardine	Channel improvements and earth embankments

Details of flood defences along the coastline of Fife are noted within the Shoreline Management Plan[27]. The Scottish Flood Defence Asset Database features can be viewed on the SFRA Interactive Maps in Appendix A.

5.5.1.1 Local schemes

Proposed flood schemes applicable to Fife are outlined in both the Forth Estuary and Tay Estuary and Montrose Basin Local Flood Risk Management Plans. The Fife local flood schemes are outlined in Table 5-10.

Table 5-10 Fife local flood schemes

Area	Flood scheme
Leven and Lower Largo	Leven flood study - surveys, modelling, and assessment of the impact of climate change. Flood risk from the River Leven and Scoonie Burn to be investigated. Delivered by Fife Council. Leven sewer flood risk assessment - targeted at high priority catchments. Delivered by Scottish Water. Lower Largo strategic mapping improvements - coastal modelling to identify where it may be appropriate to include the impact of waves on coastal flooding. Delivered by SEPA and Fife Council. Lower Largo and Lundin Links flood study - surveys, modelling, and assessment of the impact of climate change. Delivered by Fife Council.

27 Shoreline Management Plan | Fife Council | 2011

Area	Flood scheme
East Wemyss and Kirkcaldy	Strategic mapping improvements - coastal modelling to identify where it may be appropriate to include the impact of waves on coastal flooding. Delivered by SEPA and Fife Council. East Wemyss / Kirkcaldy / Methil and Buckhaven Adaption Plan - a climate change adaptation plan should be developed in relation to management of the existing defences owned by Fife Council. Kirkcaldy flood study options appraisal - explore solutions for a flood protection scheme. Delivered by Fife Council. Kirkcaldy / Methil and Buckhaven sewer flood risk assessment - targeted at high priority catchments. Delivered by Scottish Water.
Inverkeithing, Rosyth, the City of Dunfermline and Wellwood	Crossford / the City of Dunfermline / Inverkeithing / Rosyth sewer flood risk assessment - targeted at high priority catchments. Delivered by Scottish Water. The City of Dunfermline / Inverkeithing Adaption Plan - a climate change adaptation plan should be developed in relation to management of the existing defences owned by Fife Council. Rosyth flood study options appraisal - study to look at potential options to manage sewer flooding in the Park Road area of Rosyth. Delivered by Scottish Water in coordination with Fife Council.
Glenrothes and Kinglassie	Glenrothes / Markinch / Kinglassie sewer flood risk assessment - targeted at high priority catchments. Delivered by Scottish Water.
Cardenden and Cowdenbeath	Cardenden flood scheme - comprised of bridge replacement to increase capacity, widening of channel at Cardenden bridge, provision of a 2 stage channel upstream of the bridge, lowering the channel bed and construction of flood embankments/walls. SEPA to coordinate with Fife Council. Cardenden flood warning scoping - potential to provide a new flood warning scheme. SEPA to coordinate with Fife Council. Cardenden / Cowdenbeath sewer flood risk assessment - targeted at high priority catchments. Delivered by Scottish Water.
Cairneyhill	Flood study and options appraisal - detailed design phase. Should include consideration of the impacts of climate change on scheme performance. Adaptation plan may need to be developed. Delivered by Fife Council.
Torryburn	Strategic mapping improvements - coastal modelling to identify where it may be appropriate to include the impact of waves on coastal flooding. Delivered by SEPA and Fife

Area	Flood scheme
	Council.
Culross and Kincardine	Kincardine and Culross flood study - proceed with the option with the best cost benefit ratio. Delivered by SEPA and Fife Council. Strategic mapping improvements - coastal modelling to identify where it may be appropriate to include the impact of waves on coastal flooding. Delivered by SEPA and Fife Council. Kincardine flood scheme - to be developed through outline and detailed design.

5.5.2 Natural flood management

The Flood Risk Management (Scotland) Act 2009 (FRM Act) focusses on an integrated and sustainable approach to flood risk management in Scotland. SEPA is required to consider whether techniques that work with natural features and characteristics can contribute to managing flood risk, referred to as natural flood management (NFM). NFM is a type of nature-based flood risk management used to protect, restore and re-naturalise the function of catchments and rivers to reduce flood and coastal erosion risk. NFM has the potential to provide environmentally sensitive approaches to minimising flood risk, to reduce flood risk in areas where hard flood defences are not feasible and to increase the lifespan of existing flood defences.

A wide range of techniques can be used that aim to reduce flooding by working with natural features and processes in order to store or slow down floodwaters before they can damage flood risk receptors (e.g. people, property, infrastructure, etc.). NFM involves taking action to manage flood and coastal erosion risk by protecting, restoring and emulating the natural regulating functions of catchments, rivers, floodplains and coasts.

SEPA have produced a set of strategic, high-level maps which provide guidance on where NFM techniques would be most effective within Scotland. They should be interpreted with other key datasets such as flood risk information, land cover, flood protection and water bodies. The maps show areas where there are opportunities for:

- Runoff reduction;
- Floodplain storage;
- Sediment management;
- Estuarine surge attenuation; and
- Wave energy dissipation.

The SFRA Interactive Maps in Appendix A present SEPA's natural flood management maps. Guidance on how the natural flood management maps have been produced can be accessed via the SEPA website[28].

28 Identifying Opportunities for Natural Flood Management | SEPA | 2013

6 Development and flood risk

This chapter summarises the NPF4 planning guidance that planners and developers should refer to when plan making and considering flood risk in planning applications.

When defining flood risk for planning purposes, the NPF4 refers to 'flood risk areas' or 'areas of flood risk'. The existing suite of SEPA guidance documents refer to functional floodplain. Each term refers to the same thing i.e. an area at risk of flooding in a 0.5% or greater annual probability event plus an allowance for climate change.

6.1 NPF4 flood risk area or area at risk of flooding

NPF4 identifies areas at flood risk for planning purposes as:

'land or built form with an annual probability of being flooded of greater than 0.5% which must include an appropriate allowance for future climate change.'

SEPA's Flood Hazard Maps, presented on the SFRA Maps in Appendix A, should be consulted as to whether an area is considered to be at risk of flooding. The Hazard Maps presented in this SFRA are part of the SEPA Flood Map Version 2.0, published in November 2020. These maps include an allowance for climate change for the 0.5% annual probability flood. However, as discussed in Section 5.3, these maps are not based on the latest allowances for climate change.

NPF4 states that the determination of flood risk to an area can account for defence infrastructure. Where the risk of flooding to an area is less than the defence threshold, the site will not be considered at risk of flooding for planning purposes. However, this does not mean the area is risk free, only that the risk is sufficiently low to be acceptable for the purpose of planning. This includes areas where the risk of flooding is reduced below this threshold due to a formal flood protection scheme.

It should be noted that this guidance assumes that the flood protection scheme is of a 0.5% or greater annual probability event plus an allowance for climate change. However, not all schemes are of this standard and the SEPA climate change allowances are ever evolving with SEPA's expectation being that the most recent allowances are considered when evaluating development behind a scheme[16].

6.2 NPF4 Policy 22

As discussed in Section 3.2.1, the intention of Policy 22 is to increase resilience to flood risk through avoidance first followed by reducing the vulnerability of new and existing development to flooding. Policy 22 should be referred to by the LPA in plan making and by developers for specific developments.

In relation to new and existing development, Policy 22 states:

a) Development proposals at risk of flooding or in a flood risk area will only be supported if they are for:

i) essential infrastructure where the location is required for operational reasons;

ii) water compatible uses;

iii) redevelopment of an existing building or site for an equal or less vulnerable use; or

iv) redevelopment of previously used sites in built up areas where the LDP has identified a need to bring these into positive use and where proposals demonstrate that long term safety and resilience can be secured in accordance with relevant SEPA advice.

The protection offered by an existing formal flood protection scheme or one under construction can be taken into account when determining flood risk.

In such cases, it will be demonstrated by the applicant that:

- *all risks of flooding are understood and addressed;*
- *there is no reduction in floodplain capacity, increased risk for others, or a need for future flood protection schemes;*
- *the development remains safe and operational during floods;*
- *flood resistant and resilient materials and construction methods are used; and*
- *future adaptations can be made to accommodate the effects of climate change.*

Additionally, for development proposals meeting criteria part 4), where flood risk is managed at the site rather than avoided these will also require:

- *the first occupied / utilised floor, and the underside of the development if relevant, to be above the flood risk level and have an additional allowance for freeboard; and*
- *that the proposal does not create an island of development and that safe access / egress can be achieved.*

b) Small scale extensions and alterations to existing buildings will only be supported where they will not significantly increase flood risk.

c) Development proposals will:

i) not increase the risk of surface water flooding to others, or itself be at risk;

ii) manage all rain and surface water through sustainable urban drainage systems (SUDS), which should form part of and integrate with proposed and existing blue green infrastructure. All proposals should presume no surface water connection to the combined sewer;

iii) seek to minimise the area of impermeable surface.

e) Development proposals which create, expand or enhance opportunities for natural flood risk management, including blue and green infrastructure, will be supported.

6.3 NPF4 Policy 10

As discussed in Section 3.2.1, the intention of Policy 10 is to protect coastal communities and assets and support resilience to the impacts of climate change. Policy 10 should be referred to by the LPA in plan making and by developers for specific developments in coastal areas and along the Tay and Forth estuaries.

In relation to new and existing development, Policy 10 states:

a) Development proposals in developed coastal areas will only be supported where the proposal:

i) does not result in the need for further coastal protection measures taking into account future sea level change; or increase the risk to people of coastal flooding or coastal erosion, including through the loss of natural coastal defences including dune systems; and

ii) is anticipated to be supportable in the long term, taking into account projected climate change.

b) Development proposals in undeveloped coastal areas will only be supported where they:

i) are necessary to support the blue economy, net zero emissions or to contribute to the economy or wellbeing of communities whose livelihood depend on marine or coastal activities, or is for essential infrastructure, where there is a specific locational need and no other suitable site;

ii) do not result in the need for further coastal protection measures taking into account future sea level change; or increase the risk to people of coastal flooding or coastal erosion, including through the loss of natural coastal defences including dune systems; and

iii) are anticipated to be supportable in the long-term, taking into account projected climate change; or

iv) are designed to have a very short lifespan.

c) Development proposals for coastal defence measures will be supported if:

i) they are consistent with relevant coastal or marine plans;

ii) nature-based solutions are utilised and allow for managed future coastal change wherever practical; and

iii) any in-perpetuity hard defence measures can be demonstrated to be necessary to protect essential assets.

d) Where a design statement is submitted with any planning application that may impact on the coast it will take into account, as appropriate, long-term coastal vulnerability and resilience.

6.4 Flood Risk Assessments

The latest SEPA guidance on Flood Risk Assessments (FRA) is available online[21] and was published in June 2022, in advance of the latest NPF4 published in February 2023. This guidance document is therefore, at the time of writing, being reviewed and updated to

reflect new policies. SEPA states that its responses to planning applications may therefore be different to what is included in this guidance document.

As stated in Section 5.2.4, a flood risk area or functional floodplain should be based on the 0.5% or greater AP event plus an allowance for climate change.

According to SEPA's Land use vulnerability guidance[13], the 0.5% or greater annual probability event is considered to be a medium to high risk event. Generally, development in this flood risk area / functional floodplain is not considered suitable, depending on site use vulnerability as described in Table 2 of SEPA's Flood risk and land use vulnerability guidance[13]. Stage 2 of this SFRA will assess potential LDP sites against the flood risk areas using this matrix, unless this guidance is updated or changed, though with an allowance for climate change.

An FRA should be undertaken where, for LDP sites, the SFRA shows flood risk to the site or where development may increase flood risk elsewhere. This will be informed by Stage 2 of this SFRA. The FRA must include sufficient information to provide a robust assessment of flood risk. more detailed assessments will be required where flood risk is greater or more complex. The LPA ultimately determines the requirement for an FRA to be undertaken. However, the primary aim is to avoid development in flood risk areas, using the most up to date SEPA maps available.

6.5 Mitigation measures

Ideally, there would be no allocations for development in flood risk areas. Any exceptions must meet the criteria in NPF4 and be supported by an appropriately detailed FRA. Whilst Policy 22 of NPF4 promotes avoidance, there may be cases where flood risk can be managed onsite for certain sites within flood risk areas, depending on certain criteria as detailed in Section 6.2. However, best practice would be to locate proposed development outside of the functional floodplain, including for climate change.

The following sub-sections summarise generic mitigation measures that may be available for new development and for existing developments at flood risk.

6.5.1 Site layout and design

Flood risk should be considered at the first stage in planning the layout and design of a site to provide an opportunity to reduce flood risk within the development. Development should avoid areas of flood risk where possible through site zoning whereby lower areas of flood risk are considered ahead of higher flood risk areas. Ideally flood risk areas would be converted to open greenspace designed to flood or blue green infrastructure which can provide social, amenity and ecological benefits. Proposals must ensure an island of development surrounded by a flood risk area is not created and that safe access / egress routes can be achieved at all times.

Site use vulnerability should also be considered. A risk-based approach should be applied to try to locate more vulnerable land use away from areas of flood risk for example to higher ground, while more flood-compatible development (e.g., vehicular parking, recreational

space) can be in higher risk areas that may be on lower ground. Whether parking in floodplains is appropriate will be based on the likely flood depths and hazard, evacuation procedures and availability of flood warning. Where existing development in a flood risk area is to be redeveloped, a change of use to a higher vulnerability should be avoided.

Waterside areas, or areas along known flow routes, can act as blue green infrastructure, being used for recreation, amenity, and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives. Landscaping should ensure safe access to higher ground from these areas and avoid the creation of isolated islands as water levels rise.

6.5.2 Sustainable Urban Drainage Systems

NPF4 Policy 22 states that all development proposals must not increase surface water flood risk elsewhere and should manage rain and surface water through Sustainable Urban Drainage Systems (SUDS). There should be no surface water drainage to combined sewers and the impermeable area of a site should be minimised as much as possible.

SUDS provide a means of dealing with the quantity and quality of surface water and can also provide amenity and biodiversity benefits. Given the flexible nature of SuDS they can be used in most situations within new developments as well as being retrofitted into existing developments. SUDS can also be designed to fit into most spaces. For example, permeable paving could be used in parking spaces or rainwater gardens as part of traffic calming measures.

The developer should be responsible for ensuring the design, construction and future/ongoing maintenance of any SUDS scheme is carefully and clearly defined, and a clear and comprehensive understanding of the existing catchment hydrological processes and current drainage arrangements is essential.

Developers should refer to the CIRIA The SuDS Manual (C753)[29] and Sewers for Scotland30 design guidance.

6.5.3 Modification of ground levels

Modifying ground levels to raise land above the required flood level is an effective way of reducing flood risk to a particular site in circumstances where the land does not act as conveyance for floodwaters. However, care must be taken as raising land above the floodplain could reduce conveyance or flood storage in the floodplain and could adversely impact flood risk downstream or on neighbouring land. Raising ground levels can also deflect flood flows, so analyses through modelling should be performed to demonstrate that there are no adverse effects on third party land or property.

29 The SuDS Manual. CIRIA. 2015
30 Sewers for Scotland v4.0. Scottish Water. 2018

Compensatory flood storage should be provided and would normally be on a level-for-level, volume-for-volume basis on land that does not currently flood but is adjacent to the floodplain (for it to fill and drain). It should be in the vicinity of the site and within the red line of the planning application boundary (unless the site is strategically allocated).

Where proposed development results in a change in building footprint, the developer should make sure that it does not impact upon the ability of the floodplain to store or convey water and seek opportunities to provide floodplain betterment.

Raising levels can also create areas where surface water might pond during significant rainfall events. Any proposals to raise ground levels should be tested through appropriate modelling to make sure that it would not cause increased ponding or build-up of surface runoff on third party land.

Policy 22 states that the first occupied / utilised floor, and the underside of the development if relevant, should be placed above the flood risk level and have an additional allowance for freeboard. Any proposal for modification of ground levels will need to be assessed as part of a detailed FRA.

6.5.4 Raised floor levels

The minimum Finished Floor Level (FFL) may change dependent upon the vulnerability and flood risk to the development. NPF4 advises that minimum FFLs should be set above the design flood level[31] plus a further 600mm freeboard. The design level should be the 0.5% or greater AP event plus an allowance for climate change. An additional allowance may be required because of risks relating to blockages to the channel, culvert or bridge structures and should be considered as part of an FRA.

Allocating the ground floor of a building for less vulnerable, non-residential, use is an effective way of raising living space above flood levels. Single storey buildings such as ground floor flats or bungalows are especially vulnerable to rapid rise of water (such as that experienced during a breach). This risk can be reduced by use of multiple storey construction and raised areas that provide an escape route from the development to safe areas. Similarly, the use of basements should be avoided. Habitable uses of basements within a flood risk area should not be permitted.

6.5.5 Property Flood Resilience (PFR)

Flood resilience and resistance measures are mainly designed to mitigate flood risk and reduce damage and adverse consequences to existing property where formal flood warnings are in place. Such measures may aim to help residents and businesses recover more quickly following a flood event.

31 In line with CIRIA Guidance C624 Development and Flood Risk – Guidance for the Construction Industry 2004

The 'Code of practice for property flood resilience', published by CIRIA in 2021[32], defines active PFR measures as '…measures which are not permanently installed into the property and will require deployment before a flood event (e.g. a door guard)'. Passive PFR measures are defined as '…measures which are installed into the property and do not require further deployment or activation before a flood event (e.g. a flood door or automatic airbrick cover)'.

Research[33] carried out by the Environment Agency in England recommended that the use of PFR measures should generally be limited to a nominal protection height of 600mm above ground level, the lowest point of ground abutting the external property walls. This is because the structural integrity of the property may be compromised above this level. The Environment Agency recommends that advice from a structural engineer should be sought for any measures to resist a depth of 600 mm or more.

It should be noted that it is not possible to completely prevent flooding to all communities and businesses. Also, PFR measures would not be expected to cause an increase in flood risk to other properties or other parts of the local community. They will help mitigate against flood risk but, as with any flood alleviation scheme, flood risk cannot be removed completely. Emergency plans should, therefore, be in place that describe the installation of measures and residual risks.

As the flood risk posed to a property cannot be removed completely, it is recommended that PFR products are deployed in conjunction with pumps of a sufficient capacity. Pumps help manage residual flood risks not addressed by PFR measures alone such as rising groundwater.

6.6 Emergency planning

The provisions for emergency planning for local authorities as Category 1 responders are set out by the Civil Contingencies Act 2004[34]. Under the Civil Contingencies Act, Fife Council are classified as Category 1 responders and therefore have duties to assess the risk of emergencies occurring, and use this to:

- Assess the risk of an emergency occurring and use this to inform contingency
- planning
- Plan for emergencies, including training and exercising
- Develop arrangements to warn and inform the public both before and during
- emergencies
- Share information with other responders to enhance co-ordination
- Co-operate with other responders to enhance co-ordination and efficiency
- Put in place and maintain business continuity plans

32 CIRIA (2021) Code of practice for property flood resilience (C790F)

33 DCLG & EA (2007) Improving the Flood Performance of New Buildings - Flood Resilient Construction

34 Civil Contingencies Act | GOV.UK | 2004

- Provide business continuity management advice and assistance to businesses and voluntary organisations

During an emergency, such as a flood event, the local authority must co-operate with other Category 1 responders (such as the emergency services and SEPA) to provide the core response. Fife Council's Resilience Policy and Framework[35] ensures that the authority carries out its duties under the Civil Contingencies Act 2004.

Fife Council have produced emergency plans, consulted on with external partner such as the emergency services and utility companies, on the following themes:

- Incident Management Plan;
- Fife External Management Plan;
- Pollution Continency Plan;
- Human Communicable Diseases Plan;
- Notifiable Animal Diseases Plan;
- Fuel Shortage Plan; and
- Severe Weather Arrangements Plan.

6.6.1 Fife Local Resilience Partnership

The Fife Local Resilience Partnership (LRP) comprises organisations who are required to prepare and plan for, respond to and recover from major disruptions and emergencies in the Fife area. The Fife LRP is a group of organisations that work together to prepare and respond to emergencies in Fife. The partnership works to enhance the safety of Fife and its local communities.

6.6.2 Community Risk Register

The Fife LRP produces the Community Risk Register (CRR) for the Fife, which highlight the risks that have the highest likelihood and potential to have significant impact. The CRR provides information on steps that can be taken to become better prepared and more resilient. The CRR covers naturally occurring emergencies, including:

- Pandemics;
- Severe weather;
- Flooding;
- Industrial site incidents; and
- Transport disruptions.

6.6.3 Community Emergency Plan

Communities may need to rely on their own resources to minimise the impact of an emergency, including a flood, before the emergency services arrive. Many communities already help each other in times of need, but experience shows that those who are prepared cope better during an emergency. Communities with local knowledge, enthusiasm

35 Resilience Policy and Framework | Fife Council | April 2022

and information are a great asset and a Community Emergency Plan can help. Details on how to produce a community emergency plan, including a toolkit and template, are available from the Government's website[36].

6.6.4 Local flood plans

This SFRA provides several flood risk data sources that should be used when producing or updating flood plans. The LPA will be unable to write their own specific flood plans for new developments at flood risk. Developers should write their own. Generally, owners with individual properties at risk should write their own individual flood plans, however larger developments or regeneration areas, such as retail parks, hotels and leisure complexes, should consider writing one collective plan for the assets within an area.

This SFRA can help to:

- Update these flood plans if appropriate;
- Inform emergency planners in understanding the possibility, likelihood and spatial distribution of all sources of flooding;
- Identify safe evacuation routes and access routes for emergency services;
- Identify key strategic locations to be protected in flooding emergencies, and the locations of refuge areas that are capable of remaining operational during flood events;
- Provide information on risks in relation to key infrastructure, and any risk management activities, plans or business continuity arrangements;
- Raise awareness and engage local communities;
- Support emergency responders in planning for and delivering a proportionate, scalable and flexible response to the level of risk; and
- Provide flood risk evidence for further studies.

6.6.5 Flood warning and evacuation plans

Developments that include areas that are designed to flood (e.g., amenity greenspace areas) or have a residual risk associated with them (e.g., located behind a flood defence), will need to contain an existing flood warning scheme and instructions so users and residents are safe in the event of a flood. This will include both physical warning signs and written flood warning and evacuation plans. Those using any new development should be made aware of any evacuation plans.

SEPA operate formal river and coastal flood warning schemes in Fife, which issue targeted flood warning messages for properties located within the scheme boundary. Areas covered by a flood warning scheme can be found on the SEPA Floodline website[37].

In relation to a new development, it is up to the LPA in consultation with SEPA to determine whether the flood warning and evacuation plans, or equivalent procedures, are sufficient or

36 Resilience in society: infrastructure, communities and businesses | GOV.UK | 2013
37 Flood Warning Areas | SEPA Floodline

not. If the LPA is not satisfied, considering all relevant considerations, that a development can be considered safe without the provision of safe access and egress, then planning permission should be refused. Whilst there is no statutory requirement on SEPA or the emergency services to approve evacuation plans, LPAs are accountable under their Civil Contingencies duties, via planning condition or agreement, to make sure that plans are suitable. This should be done in consultation with development management officers and emergency planners.

It may be useful for both the LLFA and spatial planners to consider whether, as a condition of planning approval, flood evacuation plans should be provided by the developer that aim to safely evacuate people out of flood risk areas, using as few emergency service resources as possible. It may also be useful to consider how key parts of agreed flood evacuation plans could be incorporated within local development documents, including in terms of protecting evacuation routes and assembly areas from inappropriate development. Once the development receives planning permission, it will be the requirement of the plan owner (developer) to make sure the plan is put in place, and to liaise with the LPA and LLFA regarding maintenance and updating of the plan.

7 Conclusions and recommendations

This high-level map-based Stage 1 SFRA provides a single repository planning tool relating to flood risk across Fife, entailing this report together with the SFRA Maps provided in Appendix A. This Stage 1 SFRA is a high-level strategic assessment designed to be included as part of the Evidence Report. The data and information used throughout the SFRA process is the most up-to-date data available at the time of writing.

All available and relevant flood risk information on all flood sources has been gathered into one comprehensive high-level map-based assessment. Gaps in information have been recorded and listed in Section 4.2. The Hazard Maps presented in this SFRA are part of the SEPA Flood Map Version 2.0, published in November 2020. These maps include an allowance for climate change for the 0.5% annual probability flood. However, as discussed in Section 5.3, these maps are not based on the latest allowances for climate change.

A precautionary approach to climate change has therefore been adopted for this Stage 1 SFRA whereby the 0.1% annual probability flood outline is used to represent the future functional floodplain.

Once new, updated, or further information becomes available, the LPA should look to update this SFRA, either through an update of this Stage 1 SFRA or through the more detailed Stage 2 SFRA which will assess flood risk to individual sites. The SFRA as a whole should be maintained as, a 'live' entity that is updated as and when required (when new modelling or flood risk information becomes available). Stage 2 requirements are listed in Section 7.1.

7.1 Stage 2 SFRA

According to Fife Council's Brief document and based on the findings of this Stage 1 SFRA, the Stage 2 SFRA will:

- Provide an assessment of the potential flood risk from all sources on proposed development sites and consider the potential cumulative impact of proposed development and possible growth pressures,
- Consider the cumulative impact on surface water flood risk, proximity of sites to surface water features and an indication of surface geology of sites proposed for development in the Proposed Plan,
- Provide a high-level assessment of the potential to reduce runoff rates to greenfield or less-than greenfield levels,
- Assess the impacts of climate change on flood risk using the latest allowances[6],
- Attempt to fill gaps in data and information as stated in Section 4.2,
- Provide a more detailed assessment of flood risk management infrastructure and potential opportunities for natural flood management.

A SFRA Maps

The SFRA Maps consist of all flood risk information used within the SFRA, by way of interactive GeoPDFs. Open the Overview Map in Adobe Acrobat. The Overview Map includes a set of grid squares; clicking on one of these squares will open up one of the Index Maps covering Fife. Clicking on one of these squares on the Index Map will open up one of the Detailed Maps of the area.

Within the detailed maps, use the zoom tools and the hand tool to zoom in/out and pan around the open detailed map. In the legend on the right-hand side of the detailed maps, layers can be switched on and off when required by way of a dropdown arrow.

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