

Aberdeenshire Coastal Change Adaptation Plan

Invercairn & Fraserburgh

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Executive Summary

The report documents the Coastal Change Adaptation Plan (CCAP) for the Invercairn and Fraserburgh Community Area (CA) in Aberdeenshire.

The CCAP provides an overview of the coastal flood and erosion risks to Invercairn and Fraserburgh, which are used to underpin development of possible Adaptation Pathways for this community. These are presented, along with a framework to support proactive coastal risk management, enable implementation of climate change adaptation actions and link with climate resilient development planning along Aberdeenshire's coast.

The Plan has been developed using available, datasets from Aberdeenshire Council, SEPA and the Dynamic Coast Project. It aims to directly support statutory and non-statutory Aberdeenshire Council policies, plans and strategies and aligns with key coastal climate change adaptation guidance and resources within and beyond Aberdeenshire Council.

This Plan documents the Phase 0 starting point of adaptation, meaning that no definitive preferred Adaptation Pathway and associated Action Plan have been developed. Rather this Plan sets out a framework and process for Aberdeenshire Council to implement to effectively plan and support sustainable adaptation.

To develop Adaptation Pathways, the coast of the CA was classified into Coastal Management Units (CMUs) defined by:

- Classification of coastal landform type.
- Risk associated with coastal flooding and erosion.
- A total of eight CMUs were identified, and six associated Adaptation Pathways were developed for each CMU.

To support delivery, an economic impact assessment was undertaken. This, in conjunction with the risk assessment, was used to establish initial outcome policies for each CMU.

These are set as either:

1. No intervention
2. Enhance natural features
3. Protect
4. Create Space

Delivery of these outcome policies is described by an Implementation Plan by defining Triggers and setting associated Actions against these. A single Implementation Plan is applied to the entire CA, where the outcome of the process determines what direction will be followed within the Adaptation Pathway. The Implementation Plan has three key stages:

1. Monitoring and Triggers
2. Actions
3. Outcomes

Trigger points are identified, and set following a risk-based approach and will be identified through repeat monitoring of available data that informs coastal flood and erosion risk.

Realisation of Triggers signal a need for review or change of the Adaptation Pathway. Actions bridge the gap between Triggers and Outcomes and define what processes need to be implemented before actions that deliver the desired policy Outcomes can be set. To date the Plans and pathways have been developed using available national and regional data. At this local level however, certain Trigger realisation may require improvements to data sources to support decisions and a robust outcome.

A set of Phase 0 Actions have been identified, that require immediate attention because of Triggers being met in this iteration of the Invercairn and Fraserburgh Local Plan. Furthermore, this initial stage of the adaptation planning process has identified several knowledge gaps and opportunities for activities to be undertaken upfront to support coastal change adaptation at Invercairn and Fraserburgh.

The current iteration of the CCAP is at Phase 0. In Table i, the Triggers met in Phase 0 of the Adaptation Pathway and associated Actions for each CMU are summarised.

Table i: Phase 0 Triggers and Actions for each CMU in Invercairn and Fraserburgh.

CMU	Trigger	Action
1	No current Triggers	No current actions
2	Flooding Trigger met (Level 1)	Increase monitoring and plan for assessment
3	Flooding Trigger met (Level 2)	Undertake assessment and plan for intervention
4	Flooding Trigger met (Level 2)	Undertake assessment and plan for intervention
5	No current Triggers	No current actions
6	Flooding Trigger met (Level 2)	Undertake assessment and plan for intervention
6	Erosion Trigger met (Level 1)	Increase monitoring and plan for assessment
7	No current Triggers	No current actions
8	No current Triggers	No current actions

As well as Triggers and Actions that correspond directly to the Adaptation Pathway and specified CMUs, Proactive Actions, which should be ongoing to support coastal change adaptation for the whole of Invercairn and Fraserburgh are summarised below:

1. Investigate opportunities for dune enhancement.
2. Develop modelling framework to support future assessments.
3. Investigate opportunities for Fraserburgh Caravan Park re-location.
4. Investigate opportunities for road access west of Fraserburgh.
5. Establish coordinated and consistent beach monitoring plan for Natural CMUs.
6. Adaptation and resilience workshop with local community and stakeholders.

7. Identify landownership and safeguarding
8. Integrate future erosion projections into Local Development Planning to establish Coastal Change Management Areas

1 Introduction

1.1 Coastal Change Adaptation Planning in Aberdeenshire

Our climate is changing and throughout history, the coast has responded to changes in sea level, storms, and other climate drivers. This means that the current position of Aberdeenshire's coast is not fixed, but dynamic, and will continue to evolve as our climate changes.

In a changing climate, traditional coastal risk management approaches will become a less sustainable means of managing and protecting communities against these risks. Rather, we need to become more resilient and adapt to our changing coast through combined coastal risk management with climate resilient development planning on land near the coast. To enable this, we must be proactive in making combined coastal risk and land management decisions which provide long-term space for the coast to naturally respond to coastal climate change risks.

Developing and implementing an Adaptive Framework now to address how we respond to the current and future risks can help to reduce costs and negative impacts such as assets eroding into the sea or suffering repeat frequent flooding. More positively, a proactive approach to adaptation and climate resilient development planning now can generate wider benefits and opportunities for coastal communities and the ecosystems which sustain and support them.

The Coastal Change Adaptation Plans (CCAPs) provide a key first step in this process; they are a practical mechanism to enable proactive engagement with and involvement of communities to co-develop a shared vision for long-term societal resilience to coastal climate change risk and impacts.

To support this adaptation journey in Aberdeenshire, the coast has been subdivided into Community Areas (CAs) (Figure 1-1). Invercairn and Fraserburgh is one of the CAs identified as being a priority for a CCAP. The coast of the Invercairn and Fraserburgh is a mixture of soft, natural coast, defended coast with sea walls and rock armour defences and Fraserburgh harbour with extensive engineered structures. This provides primary motivations for a more detailed, local, CCAP which is contained in this document.



Figure 1-1: Extent and location of CAs within Aberdeenshire.

1.2 What is a Local CCAP?

A Local CCAP follows the same principle as the Regional CCAP¹ but is assessed and developed at a finer level of detail for a specified CA. A local CCAP is developed where a CA has been identified as a high priority, based on risk, development, management and socio-economic Indicators (see Regional Plan for more details). It divides the coast of the CA into individual Coastal Management Units (CMUs) and presents Adaptation Pathways for each. See section 2.2 for more details on CMUs and CMU classification.

¹ Aberdeenshire Coastal Change Adaption Plan - Regional Plan

1.3 What are adaptation pathways?

Adaptation Pathways offer flexible tools for local authorities, politicians, businesses, and residents to make informed decisions about coastal change and uncertainty. Beyond traditional management, these pathways highlight the value of working with natural processes, enhancing the environment, and implementing supportive steps like land safeguarding to prepare for rising sea levels, erosion, and flooding.

Their goal is to identify climate-resilient risk management and development options for each CMU, allowing decisions to be adjusted dynamically over time. Triggers within Adaptation Pathways indicate when current approaches should be reviewed and possibly changed based on new information or shifting risks.

1.4 What is the focus of the Local CCAP?

Adapting to coastal and climate change requires two parallel streams:

1. Land-based initiatives to prevent new future risk.
2. Management initiatives to reduce current and future risk.

The Local CCAP presented here focuses only the management initiatives but, only by considering these in parallel with those land-based will result in a sustainable adaptation journey for Aberdeenshire. This should identify both the need and practical steps required to safeguard land to support where areas of retreat may be considered in the future.

1.5 Where are we on the adaptation journey?

The aim of this first CCAP is to consolidate our understanding of the physical risks and how these interact with communities and their assets to identify the present day and future hazards of our changing coast for Invercairn and Fraserburgh. It then identifies and promotes a process that, when implemented by Aberdeenshire Council, will support community adaptation to coastal change.

The adaptation journey is a multiphase, multiyear process and aims to transition communities into a more sustainable and resilient future. We are currently at Phase 0, meaning that no definitive preferred Adaptation Pathway and associated Action Plan have been developed. Rather initial and end outcome policies are defined. Through the process these will be implemented through identified actions for delivery.

1.6 What is the Phase 0 Adaptation Framework?

The overall aim of the Adaptation Framework set out in this Local CCAPs is to:

Guide Aberdeenshire Council towards development of detailed Adaptation Pathways and associated Action Plans for the Invercairn and Fraserburgh CA.

To achieve this goal the following objectives have been set for Phase 0:

- Identify and characterise local CMUs within the CA suitable for development future Adaptation Pathways.
- Present coastal flood and erosion risk for each CMU.
- Identify CA and CMU specific Triggers that will influence adaptation decision making.
- Develop an Implementation Plan to be used by Aberdeenshire Council to support adaptive decision making, future action planning and evaluation of adaptation options.
- Identify and set Proactive Actions that will support delivery of the CCAP in each CMU.
- Inform and support the Local Development Plan² and Local Planning Policy. These should be implemented in parallel to avoid future risk by making space for change.

1.7 How has this framework been developed?

The approach to coastal change adaptation in Aberdeenshire is presented in the Regional Plan which distils the Scottish Government guidance³ into four key pillars of adaptation (Figure 1-2). Development and application of the CCAP Implementation Plan should align with these principles.

² [Aberdeenshire Council Local Development Plan 2023](#)

³ [Coastal Change Adaption Plan Guidance - Scottish Government](#)

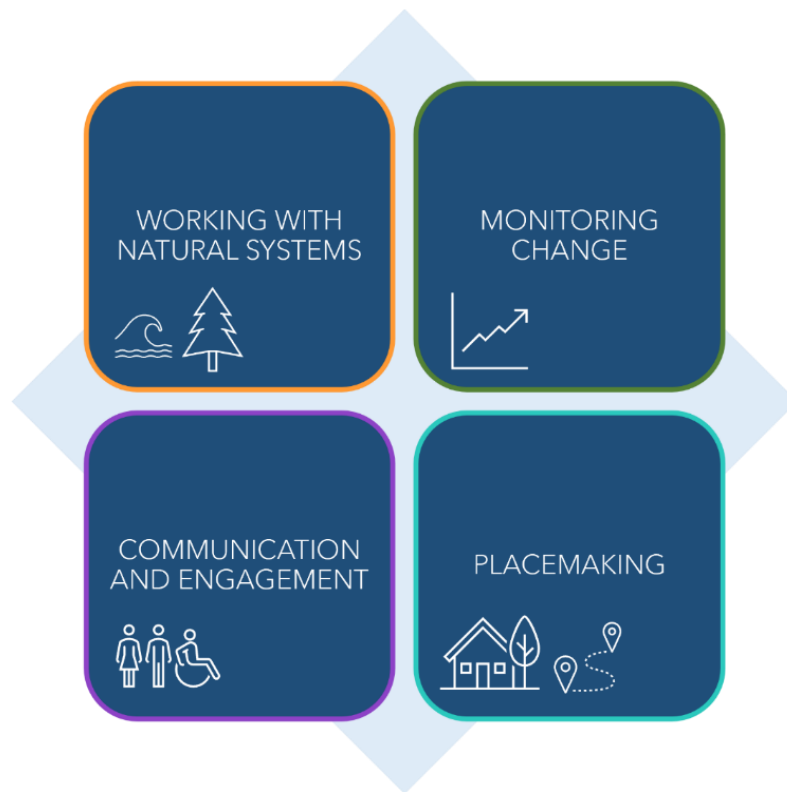


Figure 1-2: Four pillars of coastal adaptation for Aberdeenshire.

1.8 How does the Local CCAP link to the Regional CCAP?

The Regional CCAP links to the Local CCAP by:

1. Defining the prioritisation of Local CCAP with risk, development, management, and socio-economic Influence Factors (see Regional Plan for more details).
2. Setting wide Proactive Actions that, when implemented, should be used to support Local CCAP Action Plans.
3. Providing the links between the land-based components of the Adaptation Planning process. This includes links with the LDP and delivery of necessary regional actions required to effectively support and plan for adaptation at a local level e.g. land safeguarding.

2 Plan Overview

2.1 Plan Area and Characteristics

The Invercairn and Fraserburgh CA covers an area of ca.68 km² and is located between Sandhaven, Pitullie & Rosehearty CA and Buchan East CA. The CA includes a range of coastal environments and land use areas (Figure 2-1).

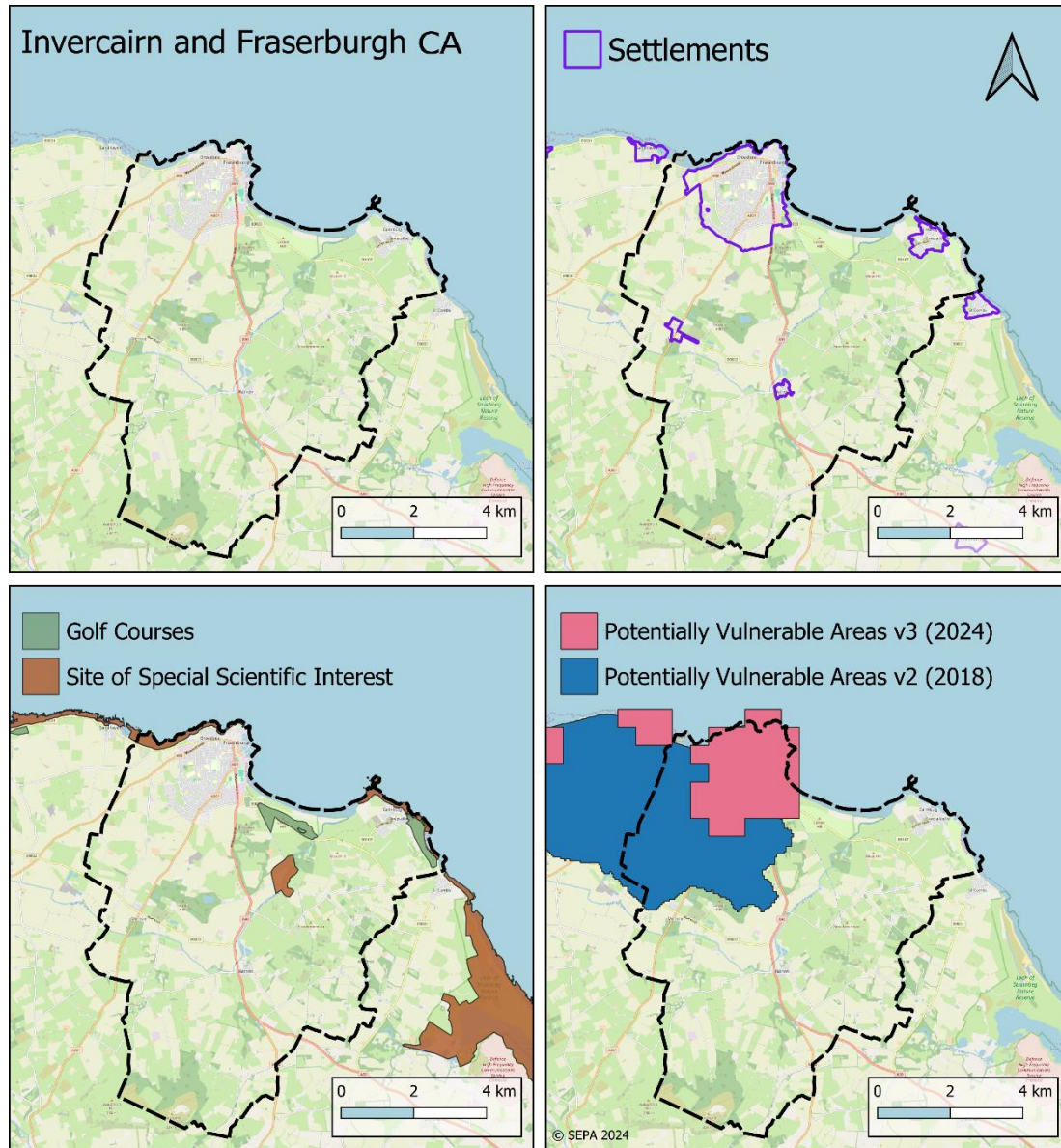


Figure 2-1: Invercairn and Fraserburgh CA, showing settlements, greenspace and environment and special consideration areas.

Settlements:

The Invercairn and Fraserburgh CA includes the coastal settlements of Fraserburgh to the west and Cairnbulg & Inverallochy to the east, and smaller inland settlements Memsie and Rathen. Fraserburgh has the largest population with 12,570 and 5,931 households⁴.

Greenspace and Environment:

The coast of the Invercairn and Fraserburgh CA from its western extent to the end of the cliffs at Kinnaird Head is a Nature Scot designated Site of Special Scientific Interest (SSSI). A coastal SSSI also exists from West Haven Bay to the southern extent of Inverallochy Golf Club, excluding Whitelinks Bay. Inverallochy and Fraserburgh Golf Clubs are in the CA and provide valuable recreational and tourist amenity for the town and surrounding area.

Special consideration areas:

The Invercairn and Fraserburgh CA contains part of the Fraserburgh and Rosehearty (v2) Potentially Vulnerable Area (PVA) as identified in the North East Local Plan District – Local Flood Risk Management Plan (2022 - 2028) (LDP6)⁵. Within this exists the Fraserburgh Targeted Area which has been the focus of further assessment.

Habitats:

There are six key habitats along the coastal extent of Invercairn and Fraserburgh as identified by NatureScot (Figure 2-2). These habitats include buildings/town, vegetated shingle, shifting dunes, unvegetated mobile shingle, unvegetated sand beaches and fixed dunes.

⁴ Aberdeenshire Council - Population Statistics

⁵ Aberdeenshire Council. 2022. Northeast Local Plan District - Local Flood Risk Management Plan. <https://www.aberdeenshire.gov.uk/media/27479/local-flood-risk-management-plan-2022-2028.pdf>

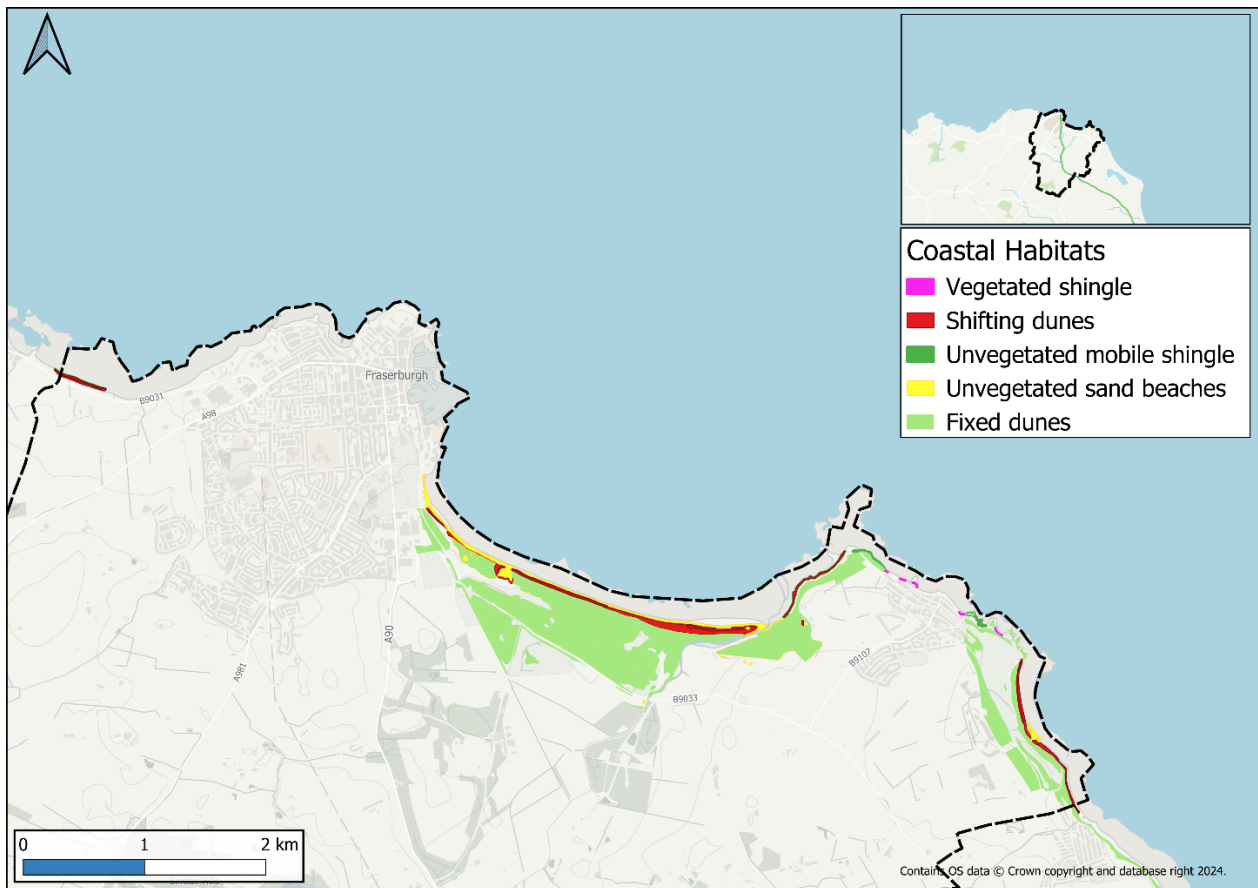


Figure 2-2: Coastal habitats at Invercairn and Fraserburgh as identified by NatureScot.

2.2 Coastal Management Units

To facilitate the development of this Local CCAP, the coast of the CA is classified into Coastal Management Units (CMUs) defined by:

1. Classification of coast type.
 - Natural – beaches, cliffs, dunes, saltmarshes, etc.
 - Defended – formal engineered structures.
 - Hybrid – combination of a and b
2. Risk associated with coastal flooding and erosion.
 - Risk and Hazard
Assets present in CMU, which are at risk of flooding/erosion hazard.
 - Risk and Unknown Hazard
Assets present in CMU, no data on flood/erosion risk available.
 - No Risk and Hazard
No assets present in CMU, but there is still a flooding/erosion hazard.
 - No Risk and No Hazard
No assets present in CMU, no flooding/erosion hazard.

Following this, the Invercairn and Fraserburgh CA coast has been subdivided into eight CMUs (Figure 2-3). These are described below including a summary of the coastal change and flood risk.

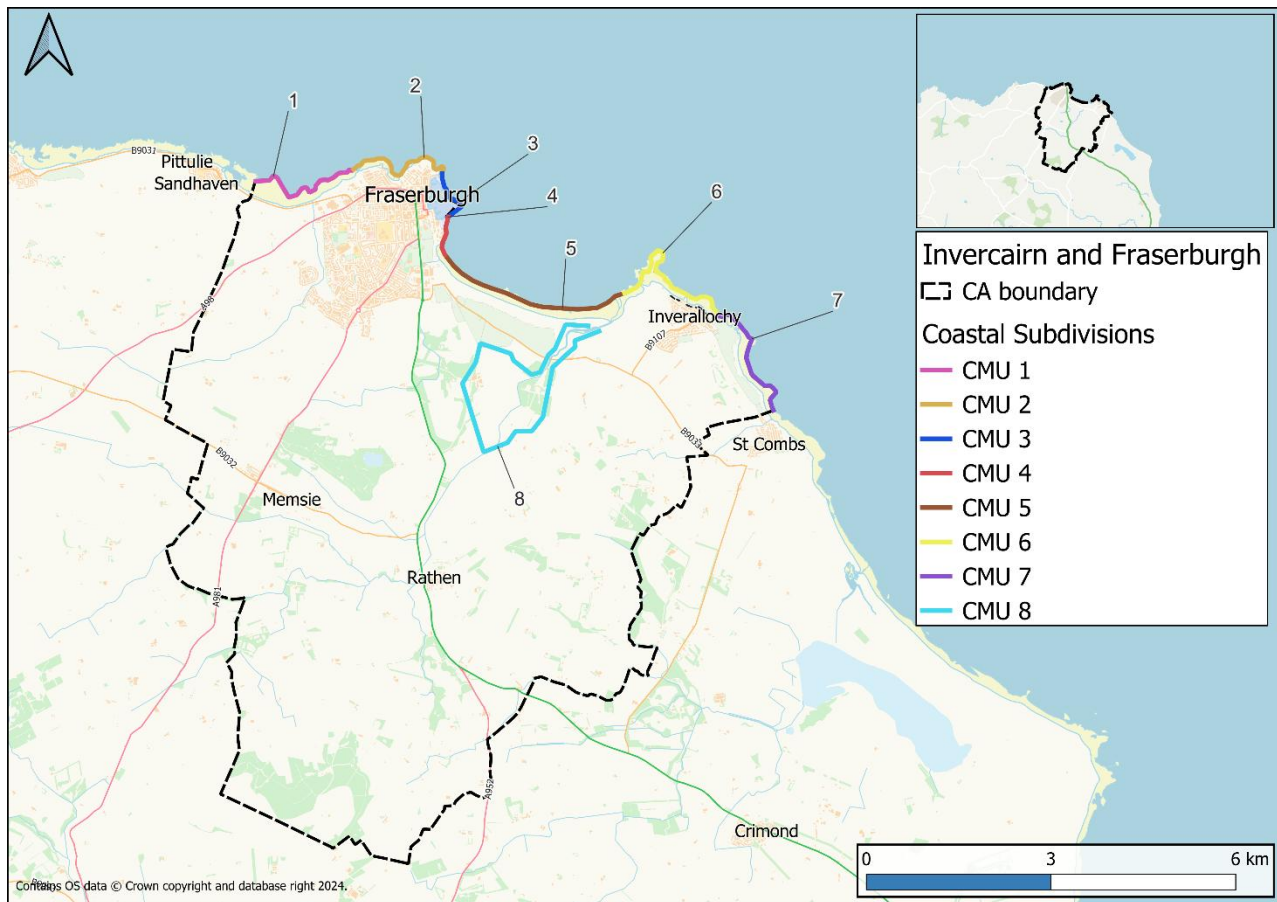


Figure 2-3: CMUs within the Invercairn and Fraserburgh CA.

2.2.1 CMU 1: Hybrid

CMU 1 is a natural shingle and rock section of the coast with a variety of piecemeal coastal protection structures at its eastern extent. Available information shows there is currently risk predicted from coastal erosion by 2100 in this CMU to the B9031 road west of ASDA supermarket. A 160 m concrete wall is the current protection at this location and rock filled gabion baskets stabilise and protect a concrete culvert outflow channel (See Section 7.2.5). This CMU sits within the Rosehearty to Fraserburgh Coast SSSI. Dynamic Coast 2 data shows that historically, this CMU has eroded at a maximum rate of 0.5 m/yr. Predicted land loss caused by shoreline retreat may reach a maximum of 45 m by 2100 (Table 2-1).

Approximately 630 m of the B9031 road, adjacent solar panel array, and Scottish Water treatment plant, is potentially at risk from a 1 in 200-year flood event and an additional ca. 300 m of road from a 1 in 200 future flood event (Figure 2-4).

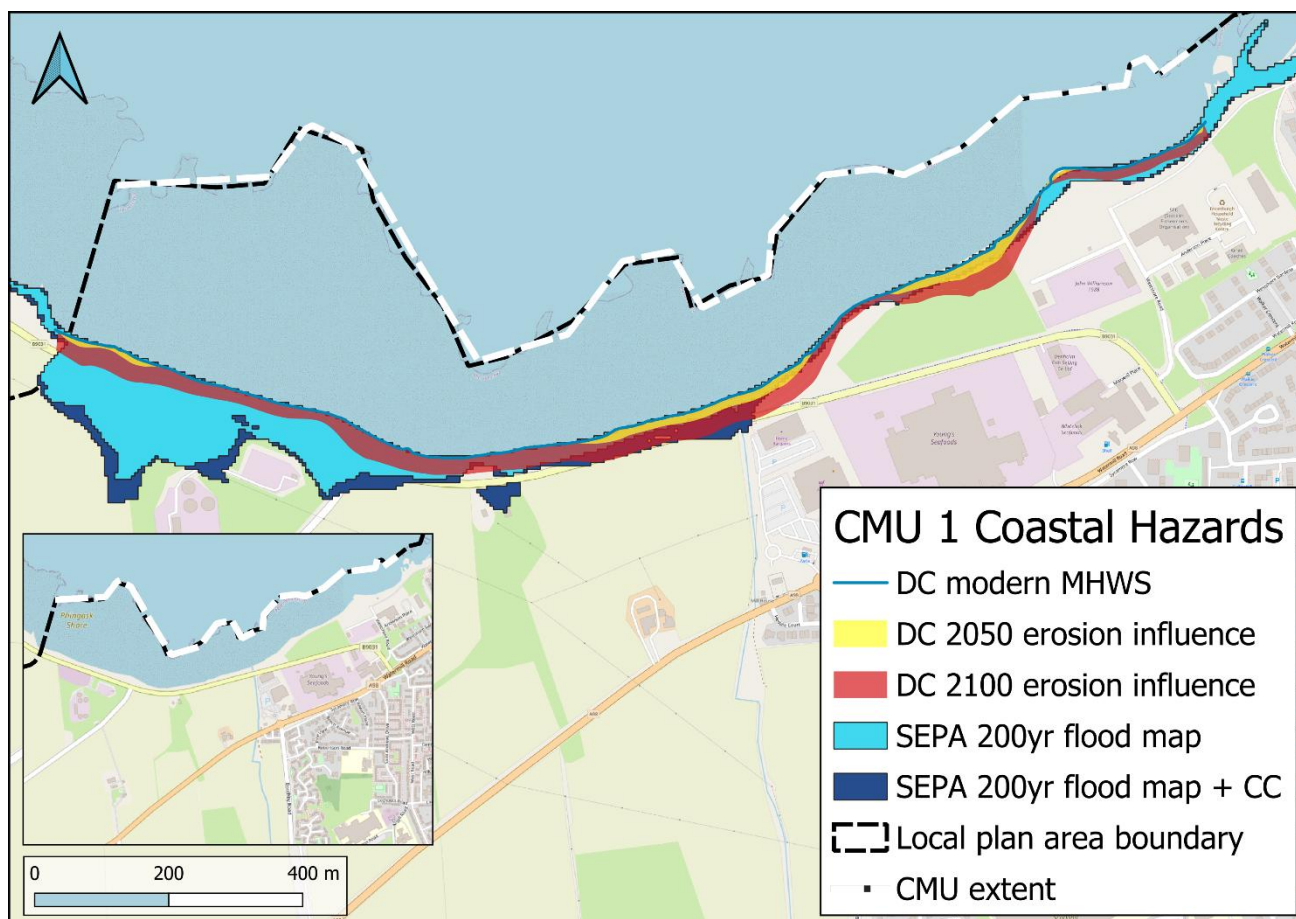


Figure 2-4: CMU 1: Coastal hazards map showing SEPA flooding extents and Dynamic Coast (DC) future erosion. Inset shows CMU without coastal hazards.

Table 2-1: CMU 1 Dynamic Coast erosion summary.

Dynamic Coast calculation	Results	
Historical rate	0.5 m/yr	Maximum
	+0.1 m/yr (accretion)	Median
2050 rate	0.5 m/yr	Maximum
	0.1 m/yr	Median
2050 distance	12.5 m	Maximum
	1 m	Median
2100 rate	0.7 m/yr	Maximum
	0.6 m/yr	Median
2100 distance	44.5 m	Maximum
	21.7 m	Median

2.2.2 CMU 2: Hybrid

CMU 2 contains both natural sections of coast, with rocky shore and cliff, and defended sections of the coast, with sea walls and small areas of rock armour. Available information from SEPA shows two residential properties are predicted to be at risk from coastal flooding

in this unit under a 1 in 200-year flood event (Figure 2-5). Dynamic Coast 2 data shows that historically, this section of coast eroded at a maximum rate of 0.1 m/yr. Predicted land loss caused by shoreline retreat may reach a maximum of 24 m by 2100. There is little predicted risk to existing assets from erosion by 2100 with only ca 200 m of coastal length in a small natural harbour predicted to be at risk of erosion (Table 2-2: CMU 2 Dynamic Coast erosion summary.).

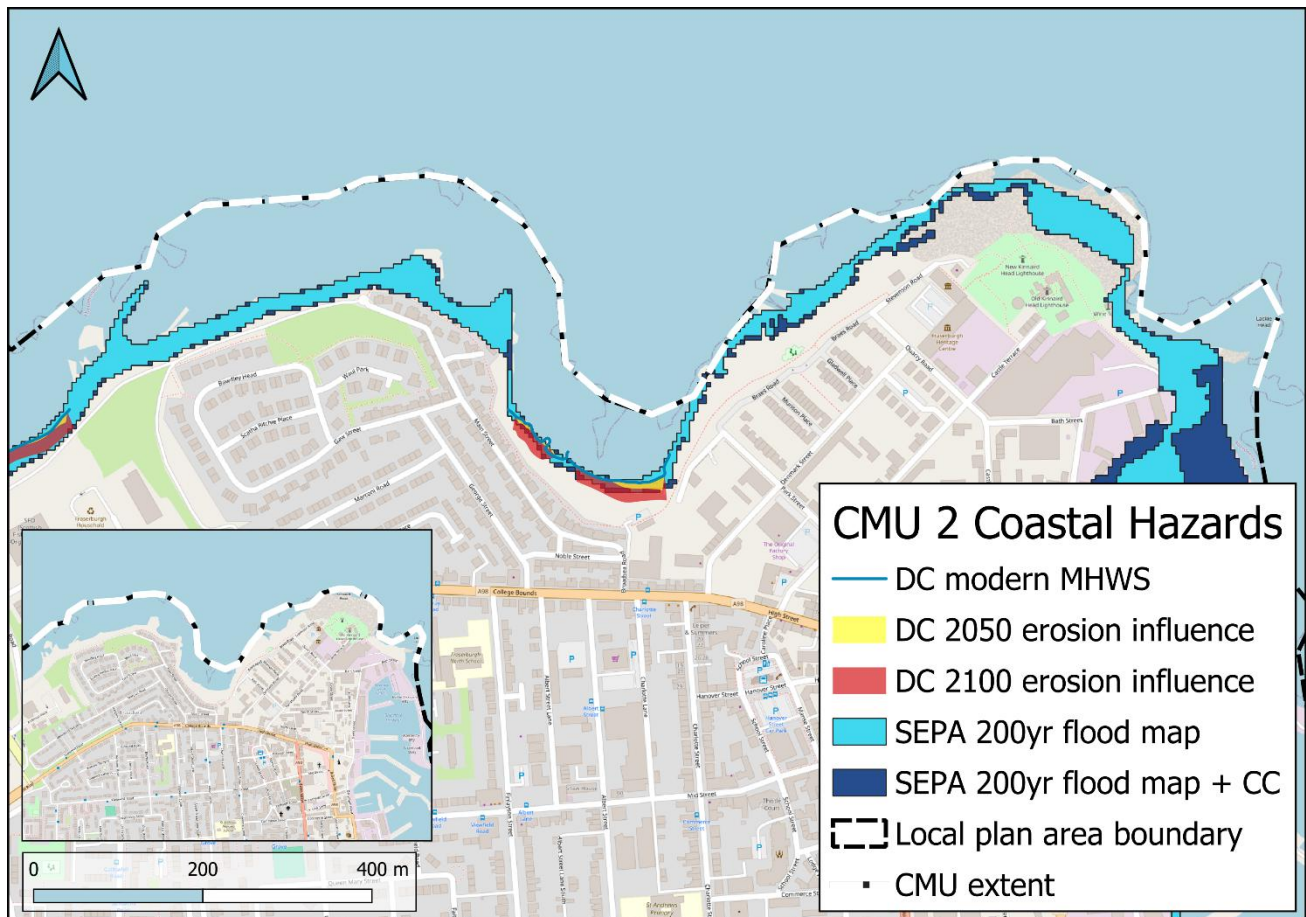


Figure 2-5: CMU 2: Coastal hazards map showing SEPA flooding extents and Dynamic Coast (DC) future erosion. Inset shows CMU without coastal hazards.

Table 2-2: CMU 2 Dynamic Coast erosion summary.

Dynamic Coast calculation	Results	
Historical rate	0.1 m/yr	Maximum
	0 m/yr	Median
2050 rate	0.2 m/yr	Maximum
	0.1 m/yr	Median
2050 distance	5.9 m	Maximum
	0.7 m	Median
2100 rate	0.4 m/yr	Maximum
	0.3 m/yr	Median
2100 distance	23.8 m	Maximum
	10.4 m	Median

2.2.3 CMU 3: Defended

CMU 3 includes Fraserburgh harbour and marina and the northeastern edge of Fraserburgh town following Shore Street to the north and ending at Fraserburgh Harbour Lighthouse. CMU 3 is entirely defended with a hard engineered seawall. There is no data on coastal erosion from Dynamic Coast 2 as a result.

Under a 1 in 200-year flood event scenario, flooding is largely contained within the harbour but is likely to also affect five non-residential properties at the north end. The flooding to the south is attributed to CMU 4 given the lack of flooding within the harbour at this location (Figure 2-6: CMU 3: Coastal hazards map showing SEPA flooding extents. Erosion data unavailable. Inset shows CMU without coastal hazards.).

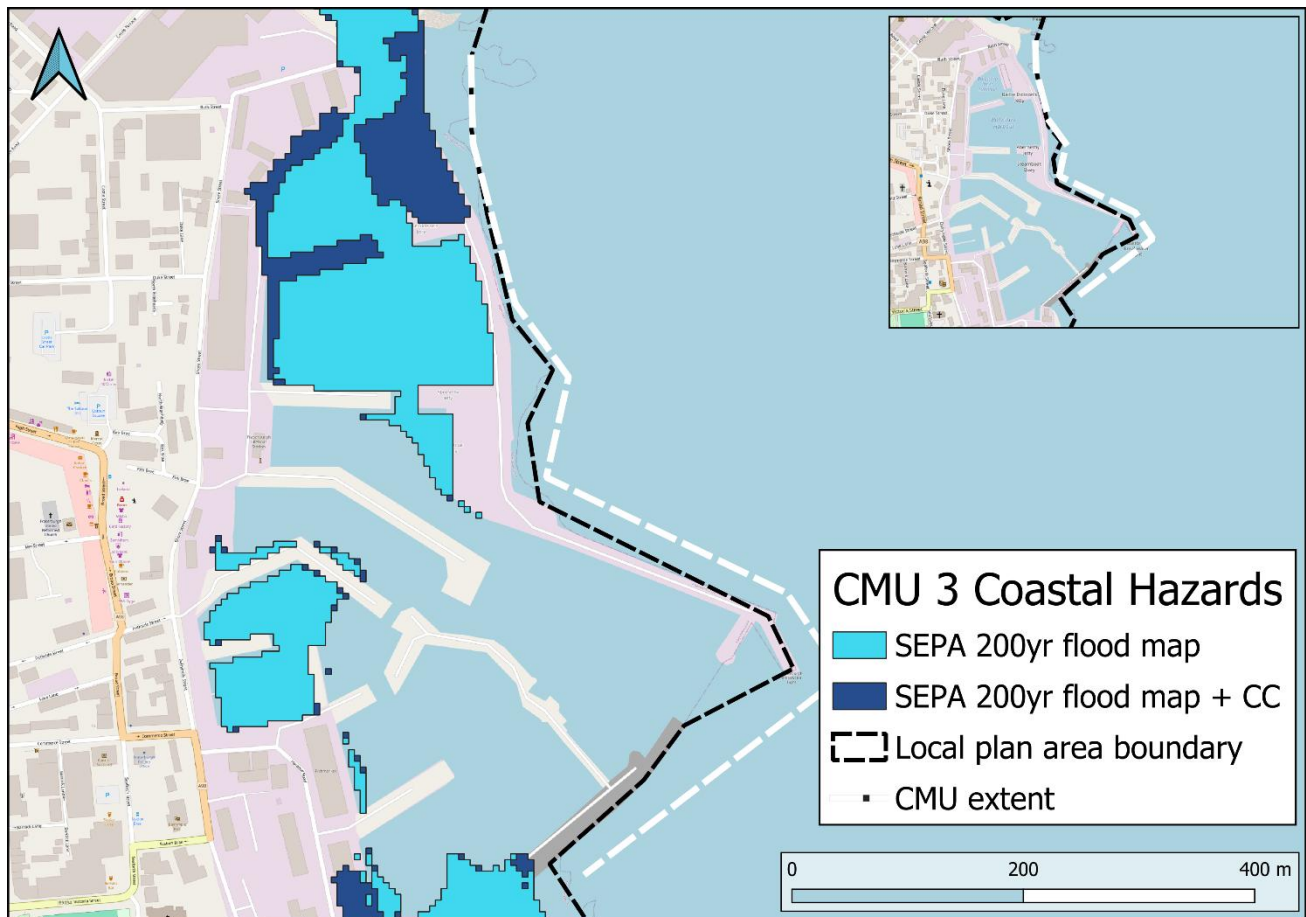


Figure 2-6: CMU 3: Coastal hazards map showing SEPA flooding extents. Erosion data unavailable. Inset shows CMU without coastal hazards.

2.2.4 CMU 4: Hybrid

CMU 4 is a natural, rock shore, section of coast, which is protected from flooding and erosion by rock armour and a stone wall throughout its length. CMU 4 contains mainly marine focused commercial properties and Fraserburgh Caravan Park. Dynamic Coast 2 data shows that historically, this section of coast eroded at a maximum rate of 1.1 m/yr. Predicted land loss caused by shoreline retreat may reach a maximum of 128 m by 2100. One commercial property and a small section of core path are at risk from coastal erosion by 2100.

Under the 1 in 200-year flood event, 38 NRPs, including the caravan park, are at risk. An additional ten NRPs are at risk under the 1 in 200-year future flood event.

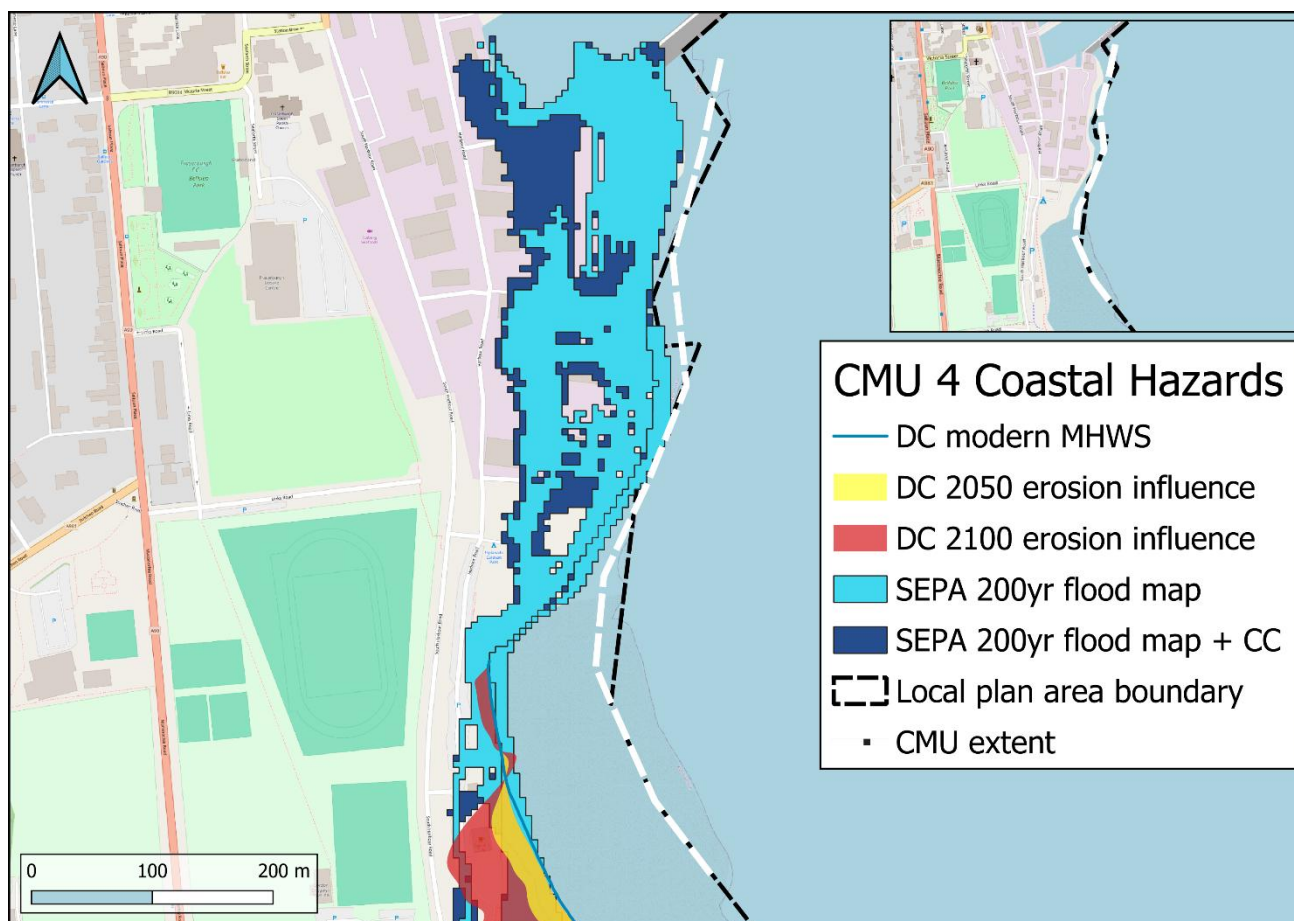


Figure 2-7: CMU 4: Coastal hazards map showing SEPA flooding extents and Dynamic Coast (DC) future erosion. Inset shows CMU without coastal hazards.

Table 2-3: CMU 4 Dynamic Coast erosion summary.

Dynamic Coast calculation	Results	
Historical rate	1.1 m/yr	Maximum
	+0.3 m/yr (accretion)	Median
2050 rate	1.4 m/yr	Maximum
	0 m/yr	Median
2050 distance	39.3 m	Maximum
	+4.3 m (accretion)	Median
2100 rate	1.9 m/yr	Maximum
	0.5 m/yr	Median
2100 distance	128.4 m	Maximum
	10.9 m	Median

2.2.5 CMU 5: Natural

CMU 5 includes the dynamic natural features of the sand beach and dune system from the south of Fraserburgh harbour to the mouth of the Water of Philorth west of Inverallochy. Currently, the natural features in CMU 5 protect the land and settlements from erosion and

flooding. Dune fencing is also present to enhance sediment accumulation, but those are in a dilapidated state (See Appendix A.1). The beach and dune system at CMU 5 is vulnerable to erosion and Dynamic Coast 2 data shows that historically, this coastal section has retreated rapidly, at a maximum rate of 3 m/yr. A substantial amount of land loss caused by coastal erosion is predicted by 2100, reaching a maximum of 285 m. Assets to the western and eastern extent of CMU 5 are at risk from coastal erosion by 2100. This would affect approximately 200 m of core path.

No assets are predicted to be at risk from coastal flooding under a 1 in 200-year future flood event.

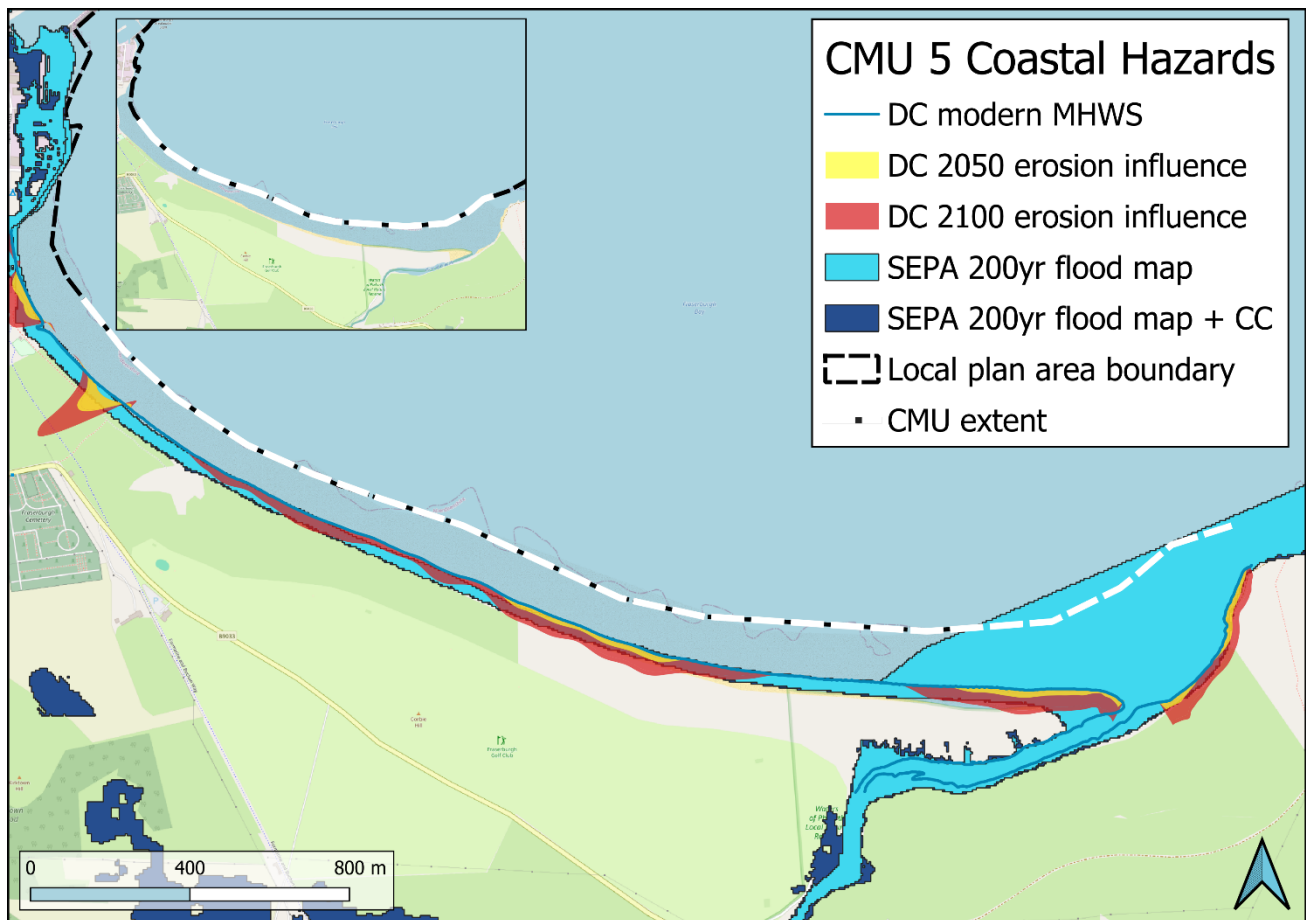


Figure 2-8: CMU 5: Sand beach dunes east natural coastal hazards map showing SEPA flooding extents and Dynamic Coast (DC) future erosion. Inset shows CMU without coastal hazards.

Table 2-4: CMU 5 Dynamic Coast erosion summary.

Dynamic Coast calculation	Results	
Historical rate	3 m/yr	Maximum
	+0.2 m/yr (accretion)	Median
2050 rate	3.4 m/yr	Maximum
	0.2 m/yr	Median
2050 distance	97 m	Maximum
	1.5 m	Median
2100 rate	4 m/yr	Maximum
	0.6 m/yr	Median
2100 distance	285.3 m	Maximum
	27.3 m	Median

2.2.6 CMU 6: Hybrid

CMU 6 is a subsection of natural coast fronted by primarily shingle beach. The area inland contains the village of Inverallochy to the east, and a narrow section of fixed dune to the west. A small harbour to the west is protected by a concrete wall and rock armour at its foot. The village has natural protection from a shingle beach and shingle vegetation, and hard defences including rock armour, rubble and a concrete block wall.

There is risk from coastal flooding and erosion to the land and its assets. Dynamic Coast 2 data shows that historically, the coast at this CMU has not eroded, but future erosion could result in a maximum 34 m of land loss caused by shoreline retreat by 2100. Assets at risk from coastal erosion by 2100 include 23 residential and two non-residential properties.

Under a 1 in 200-year flood event, 60 residential and 12 non-residential properties, are at risk. Under a 1 in 200-year future flood event an additional seven residential and three non-residential properties, are at risk.

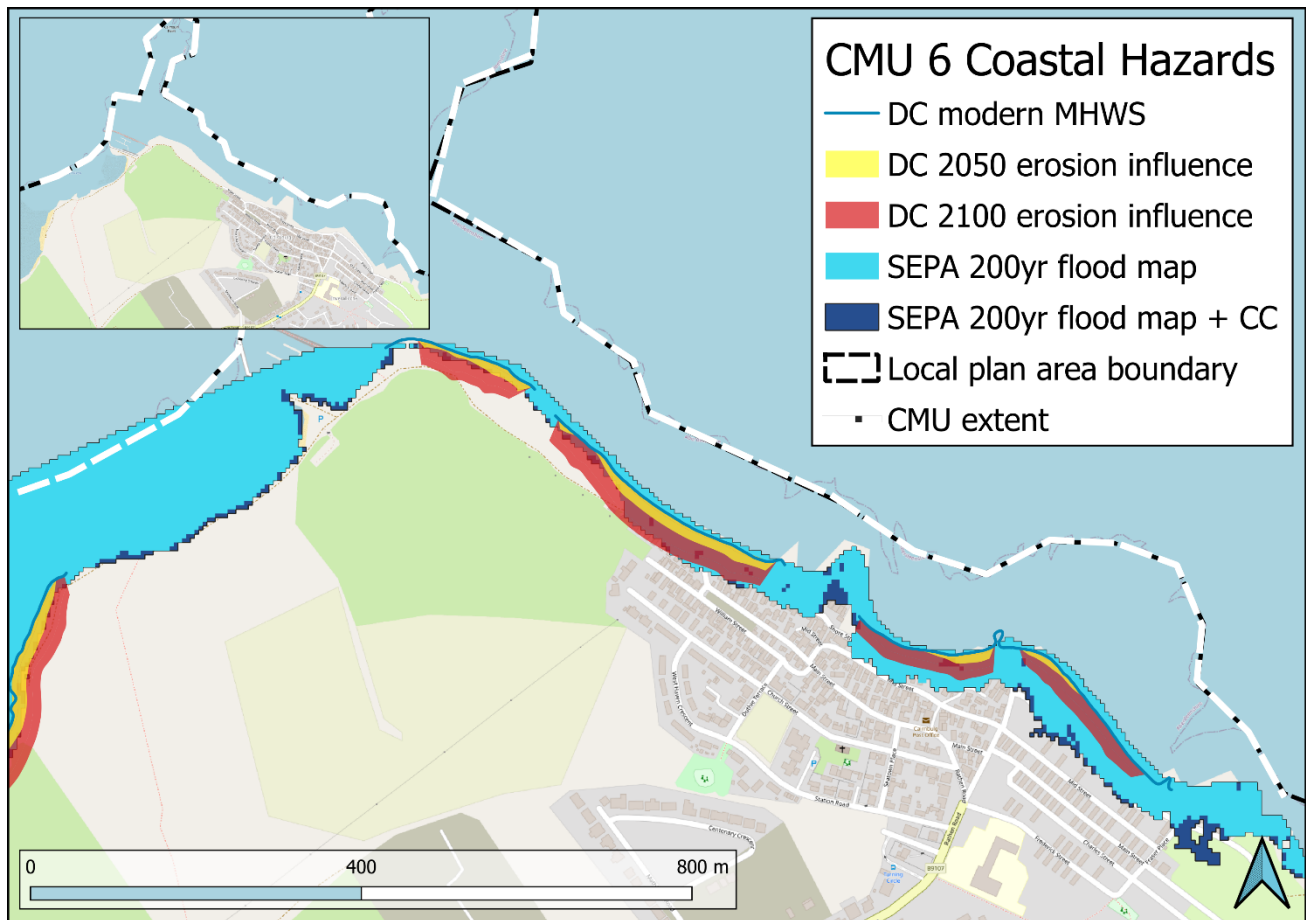


Figure 2-9: CMU 6: Coastal hazards map showing SEPA flooding extents and Dynamic Coast (DC) future erosion. Inset shows CMU without coastal hazards.

Table 2-5: CMU 6 Dynamic Coast erosion summary.

Dynamic Coast calculation	Results	
Historical rate	0 m/yr	Maximum
	+0.1 m/yr (accretion)	Median
2050 rate	0.4 m/yr	Maximum
	0.2 m/yr	Median
2050 distance	8.5 m	Maximum
	3.4 m	Median
2100 rate	0.7 m/yr	Maximum
	0.5 m/yr	Median
2100 distance	33.9 m	Maximum
	25.5 m	Median

2.2.7 CMU 7: Natural

CMU 7 is a natural coastline which changes from shingle beach in the north to sand beach in the south. Inland the habitat changes from a dune system to Inverallochy golf course. Dynamic Coast 2 data shows that historically, the coast at this CMU has eroded at a

maximum rate of 0.3 m/yr. Predicted land loss caused by shoreline retreat may reach a maximum of 68 m by 2100. The golf course is at risk from coastal erosion by 2100.

Under a 1 in 200-year flood event, the golf course is at risk.

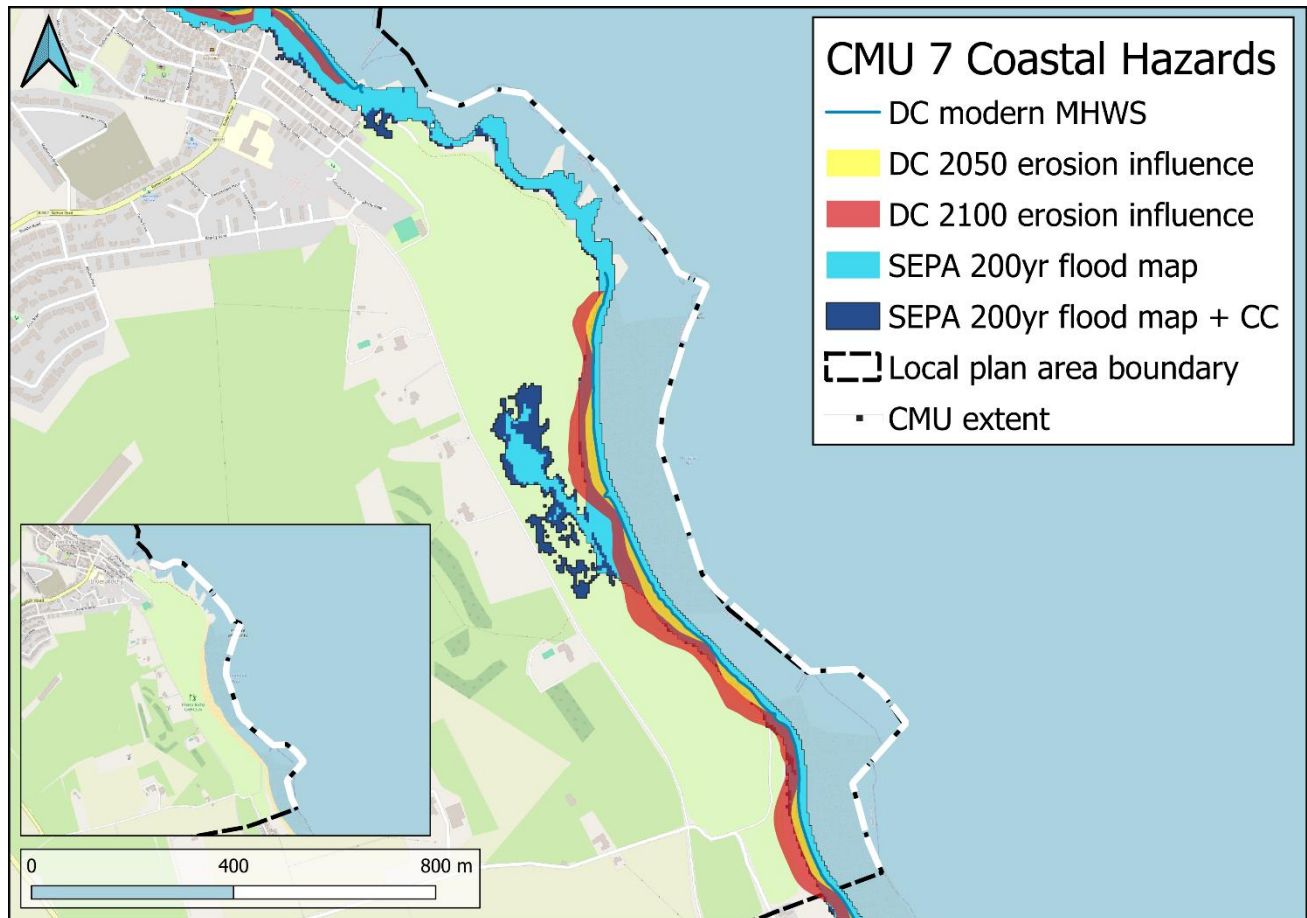


Figure 2-10: CMU 7: Coastal hazards map showing SEPA flooding extents and Dynamic Coast (DC) future erosion. Inset shows CMU without coastal hazards.

Table 2-6: CMU 7 Dynamic Coast erosion summary.

Dynamic Coast calculation	Results	
Historical rate	0.3 m/yr	Maximum
	0 m/yr	Median
2050 rate	0.7 m/yr	Maximum
	0.3 m/yr	Median
2050 distance	16.7 m	Maximum
	6.8 m	Median
2100 rate	1.2 m/yr	Maximum
	0.8 m/yr	Median
2100 distance	68 m	Maximum
	37.6 m	Median

2.2.8 CMU 8: Natural

CMU 8 covers the inland extent of a 200-year future coastal flood event via the Water of Philorth river. As a result, no coastal erosion is present here. Flooding is predicted to affect farmland south of the B9033, but no properties are expected to be at risk.

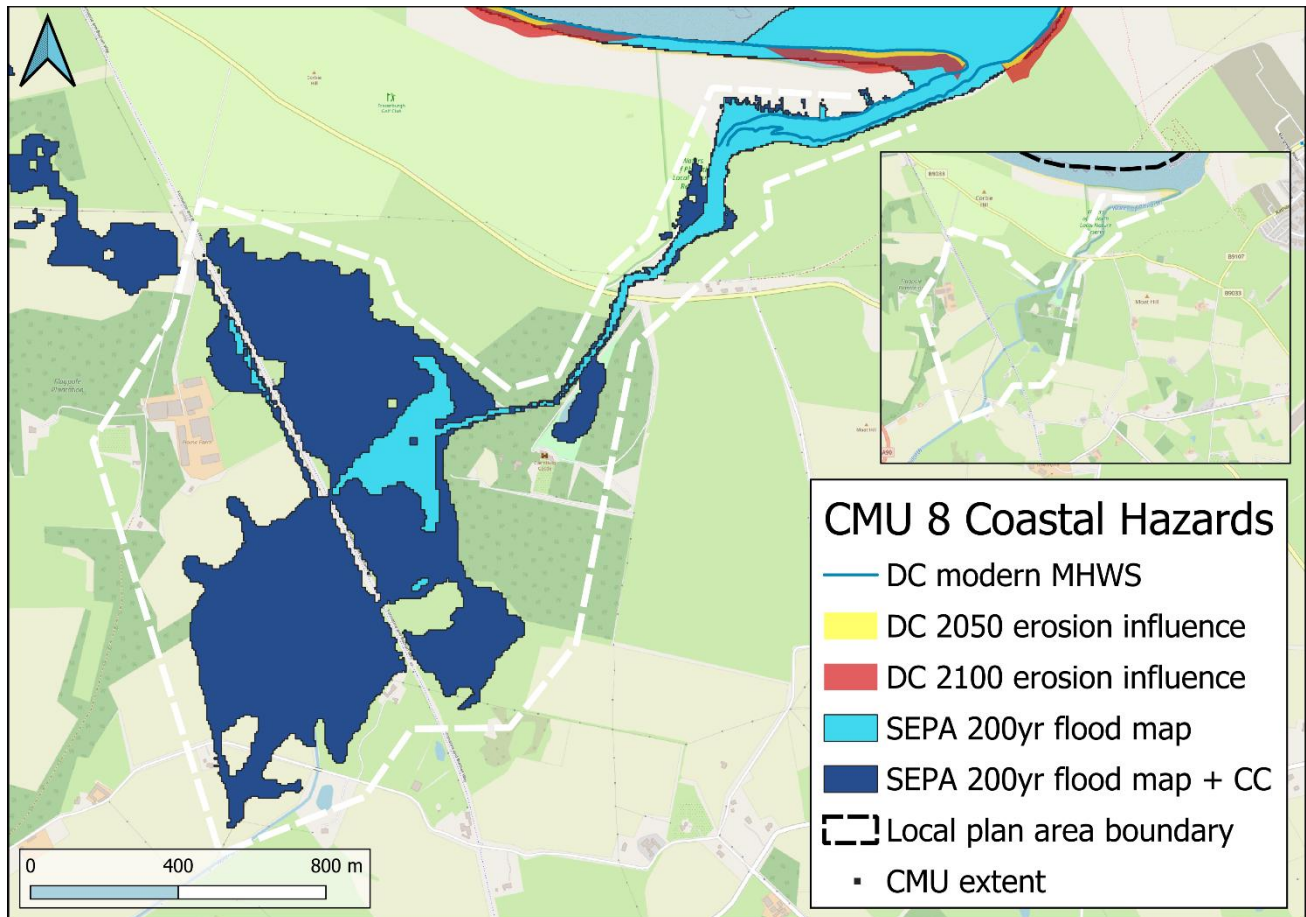


Figure 2-11: CMU 8: Inland natural coastal hazards map showing SEPA flooding extents and Dynamic Coast (DC) future erosion. Inset shows CMU without coastal hazards.

3 Coastal Management Policies

Delivery of adaptation actions relies in a clearly defined management policy for each CMU. Fundamental to this is Aberdeenshire Council's Coast Protection Policy⁶. Here the policy statement highlights, that provision of new coastal protection works will only be considered subject to a positive benefit cost ratio and securing appropriate contributions from beneficiaries. Neither of these conditions have been satisfied during Phase 0 so the Policies for each CMU will only be established to set the initial direction of travel, not outline how this will be achieved.

To support this, it is therefore critical to understand the potential damages that could be realised from coastal erosion, should nothing be done. We have undertaken a review of Dynamic Coast to evaluate economic damages.

3.1 Erosion damages assessment

An assessment has been undertaken to calculate damages to residential properties and non-residential properties at risk from coastal erosion in the CA. This is based on assets considered at risk or in the vicinity of areas at risk (within approximately 50m) of coastal erosion contours as recorded in the Dynamic Coast receptor at risk dataset.

Coastal erosion damages are based on the market value of buildings being written off in the year in which they are impacted by erosion. To determine present value damages, the value of the assets written off by erosion damage is discounted by the discount factor associated with the year of loss as set out in the Green Book (HM Treasury, 2022). Residential and non-residential property values are set out in sections 3.1.1 and 3.1.2 respectively.

3.1.1 Residential property values

Residential property market values were obtained for each property type using 2023 annual house price statistics provided by Registers of Scotland for Aberdeenshire Council. Regional values are used to represent 'risk-free' valuations as specified by the Flood Hazard Research Centre. This information, broken down by property type, is shown in Table 3-1. Residential property types were determined by cross referencing the information in the Dynamic Coast receptors at risk dataset with the most up to date Multi-Coloured Handbook codes and property descriptions.

⁶ Aberdeenshire Council (2024) Coast Protection Policy.

Table 3-1: Market value of residential properties by property type (2025).

Property type	Market value (£)
Detached	205,611
Semi-detached	126,100
Terraced	107,744
Flat	75,095

3.1.2 Non-residential property values

Non-residential property market values were calculated using MCM guidance. Market values for non-residential properties were estimated from a property's rateable value per metre squared of floor space, as per Table 5.4 of the MCM. Rateable values for the northeast of England were used and are a suitable proxy for Scotland. Prime yield multipliers, informed by MCM Table 3.4, are given for certain categories of non-residential properties, and associated multipliers are calculated by dividing 100 by the prime yield percentage. Property areas are provided by the Dynamic Coast receptor at risk dataset.

A non-residential property market value per metre square can be calculated by multiplying the mean rateable value per m² by the prime yield multiplier, found in Table 3-2.

Table 3-2: Rateable value per m², prime yield, and market value for non-residential properties

NRP type	Mean rateable value per m ²	Prime yield (%)	Multiplier (100/prime yield)	Market value per m ²
Other	58	6.0	16.7	£969

3.1.3 Erosion damage results

Erosion damages have been calculated for properties only as direct damages. Indirect property damages, intangible damages including increased vulnerability, and transport disruption have not been calculated.

For the CA these have been split into Fraserburgh and Inverallochy and associated present-value damages in each are presented in Table 3-3.

Table 3-3: Receptor counts, and present-value damages associated with coastal erosion

Area	Receptor count	Present-value damages (£k)
Fraserburgh	2	£2,450
Inverallochy	6	£7,500

3.2 Flood damage assessment

3.2.1 Methodology

Flood damages are derived from properties from the 2017 SEPA coastal flood receptor data that lie within SEPA's coastal flood maps.

Annual Average Damage (AAD) values for residential and non-residential properties are recorded in SEPA's coastal flood receptor dataset. These AADs are based on direct residential and non-residential property damages, vehicle damages, intangible health damages, indirect evacuation costs and indirect commercial damages. Property AADs are capped by their market value within the SEPA coastal receptor dataset for residential and non-residential properties. Capped AADs for each property at risk within the study area have been extracted to estimate coastal flood damages for properties in Fraserburgh.

The Office for National Statistics GDP deflator is used to update SEPA's 2017 receptor AAD values to 2024 values. The 2024 AAD values for properties impacted by coastal flooding are converted to a Present Value damage over the 100-year appraisal period using the standard Treasury discount factors.

AAD under climate change scenarios is not provided by SEPA, so a long term PVd that considers increased sea level rise over the appraisal period cannot be calculated without additional modelling.

3.2.2 Results – flood damages

Table-3-4 presents the capped Annual Average Damage (AAD) and capped present-value damages (PVd) for each benefit zone in Fraserburgh and for the entire study area combined. A total PVd of £4.2 million is estimated for the full area based on a 100-year appraisal period. All the properties predicted to be impacted by flooding are in Fraserburgh, with the vast majority located near the port area. Some additional residential properties are at risk around Main Street in the north of the town.

Table-3-4: Coastal flooding damage summary

	No. of properties at risk	AAD (£k)	PVd (£k)
Fraserburgh	59	140	4,163
Inverallochy*	0	0	0
All	0	140	4,163

*Note: This is a likely consequence of the SEPA NFRA not being updated with the latest coastal flood maps used to determined receptors at risk. It is likely that flood damages for both Fraserburgh and Inverallochy are underestimated based on information available to this assessment.

3.2.3 Wider Economic Impact

As well as the direct flood and erosion damages to properties, these hazards will contribute to wider economic impact across the CA by affect several key sectors. Together these will result in additional consequences for local and regional economic growth.

The harbour area, which is integral to the fishing and renewable energy sectors operating out of Fraserburgh, has multiple commercial properties and infrastructure identified as being at risk of coastal flooding. The data used for this assessment suggests that these properties face a high flood risk and flood related disruption could severely affect business operations in these sectors. As the harbour plays a critical role in the local economy this disruption would have a knock-on impact on economic growth, supply chains and employment in Fraserburgh and the wider area. A separate exercise has been undertaken to understand the scale of impact from indirect losses as a result of coastal flooding and erosion⁷.

A more detailed risk assessment is needed to quantify the frequency, extent, and long-term implications of these risks, which would support strategic planning for resilience measures.

While the risks associated with coastal flooding at Fraserburgh present a more immediate risk, coastal erosion also poses a long-term threat to economic development. Key areas at risk include:

- The B9031 Road (Fraserburgh to Sandhaven) is predicted to be affected by erosion by 2100. The loss of this road would likely lead to traffic disruption in the area, affecting commuter routes and access to local services, potentially increasing costs for businesses reliant on transport links.
- The industrial area near the B9031 is also projected to be impacted by erosion by 2100. This could lead to disruption to businesses, increased operational costs and potential job losses. The exact timing of these impacts is uncertain, but planning for coastal adaptation could help mitigate economic consequences.
- Fraserburgh Beach is an important site for recreation and local amenities in the area. By 2050 coastal erosion could lead to the loss of beach area and sand dunes, along with damage to beachfront infrastructure. Although the tourism and recreation sectors are less significant contributor to the local economy than other industrial sectors, the loss of sand dunes and beachfront infrastructure would likely have a significant impact on future economic growth and development in Fraserburgh. The caravan park is at risk of coastal flooding from wave overtopping and detailed assessment of this is required to understand the impact and opportunities to maintain this function.
- At Inverallochy the primary impact is on residential properties along the shorefront. This disruption, while significant, is not expected to cause large disruption to the wider regional economy. However, some recreational and wellbeing benefits provided by the coastal area and access may be realised.

⁷ OKA-JBA-XX-XX-RP-EA-0002-S3-P01-Wider_Economic_Impacts

4 Nature Based Solutions

Working with natural processes forms one of the four key pillars of adaptation. Nature based solutions (NBS) in a coastal setting focus on the use and enhancement of natural systems to reduce the impacts of erosion and flooding while maintaining resilience to climate change. This could either be through "buying time" by slowing down erosion, or from enhancement through engineering to form part of the coastal defences. Opportunities for NBS for each CMU are shown below (Figure 4-1).

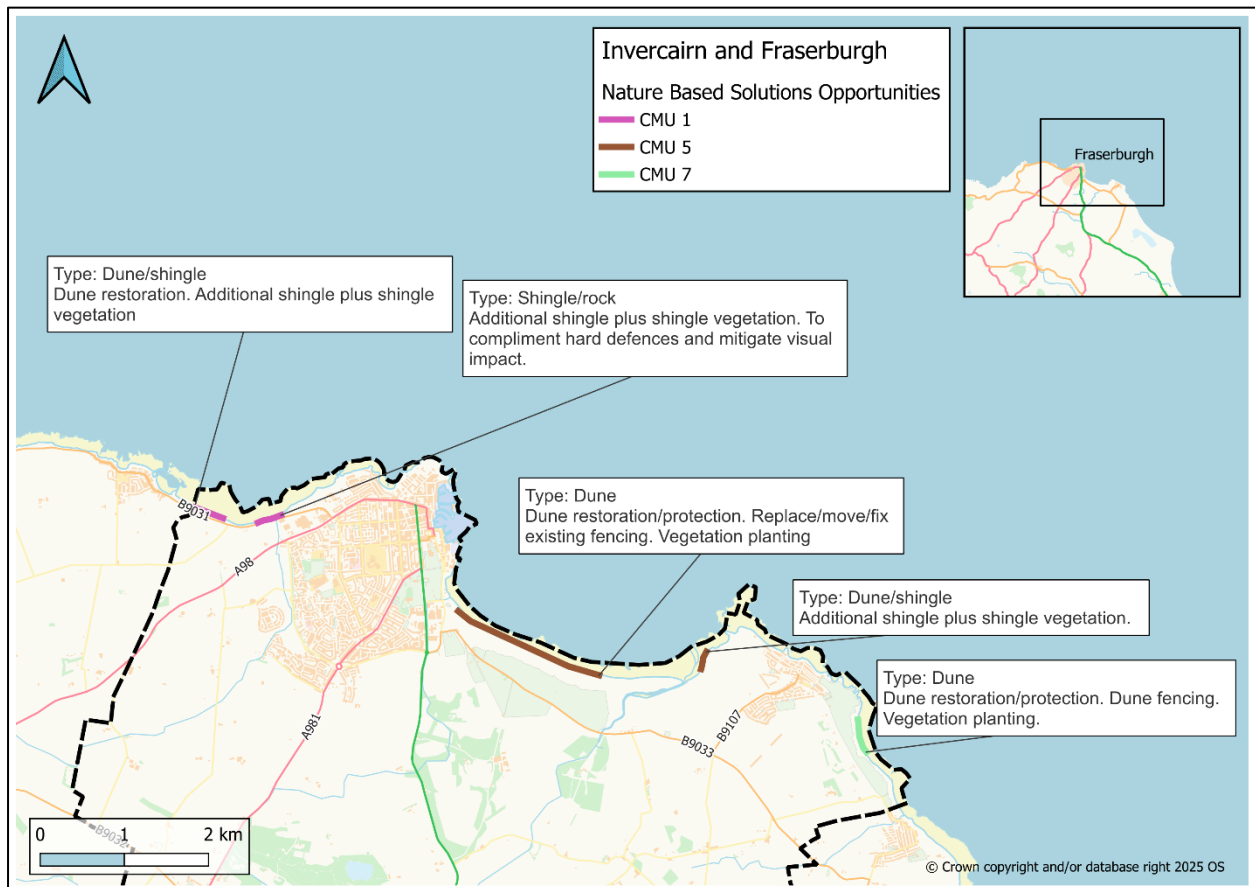


Figure 4-1: Suggested NBS locations and extent, with associated CMU

4.1 NBS Opportunities

Healthy dune systems can help slow down or prevent the loss of land from erosion and flooding or storm events. Vegetation planting on the upper shore can act as a natural barrier to those events as well as increasing biodiversity and improving social well-being through aesthetic benefits.

Where possible this should be supported by dune fencing to trap wind-blown sand, preserving the dune system's integrity as well as promoting vegetation growth and resilience.

Where shingle is already present, there could be opportunities to enhance the volume develop a dynamic natural revetment that can absorb and dissipate wave energy,

stabilising the shoreline. These revetments, if in longshore equilibrium, will also respond naturally to sea level rise, migrating landwards and upwards in response to higher water levels.

4.1.1 CMU 1

The two stretches of CMU 1 shoreline highlighted in Figure 4-1 could benefit from the addition of shingle and shingle vegetation to help stabilise the narrow section of dune in front of the B9031 road. This added protection would help slow down erosion which is currently predicted to reach the road by 2100. The HABMOS classification for the shore at the west end of CMU 1 is shifting dunes and unvegetated mobile shingle, so any introduced vegetation needs to be in keeping with the natural environment.

4.1.2 CMU 5 and CMU 7

Within CMU 5 is a ca 3.5 km stretch of sand beach with an extensive dune habitat along its length. Coastal erosion is predicted along much of its length with risk to core paths and the shifting dune habitat. Erosion predicted by 2100 will affect a section of core path north of Fraserburgh cemetery. The existing dune fencing should be replaced or repaired at this location to encourage windblown sand retention, vegetation growth and new dune formation.

A further section of coast within CMU 5, where the Water of Philorth enters the North Sea, is at risk from erosion by 2100. The dune system is fronted by an unvegetated mobile shingle beach which could benefit from the addition of shingle and shingle vegetation to stabilise the dune and act as a natural buffer to wave induced erosion at the dune toe. As with CMU 1, any addition of vegetation should be of plants of a local nature.

Whitelinks Bay includes a 1 km stretch of sand beach and shifting dune habitat in CMU 7. Inverallochy Golf Course which sits behind the full length of the beach is at risk from erosion by 2100 and future flooding under a 1 in 200-year event. As with CMU5, fencing is recommended along the seaward face of the dunes to slow down future erosion by reducing the movement inland of sand and encouraging vegetation growth and new dune formation.

4.2 NBS Prioritisation

Within the Invercairn and Fraserburgh CA where natural coast exists, and artificial defences are absent, core paths are the most vulnerable assets at risk from erosion and can be used to help prioritise where NBS may provide the greatest benefit.

The location and extent of core path sections predicted to be at risk are shown below (Figure 4-2).

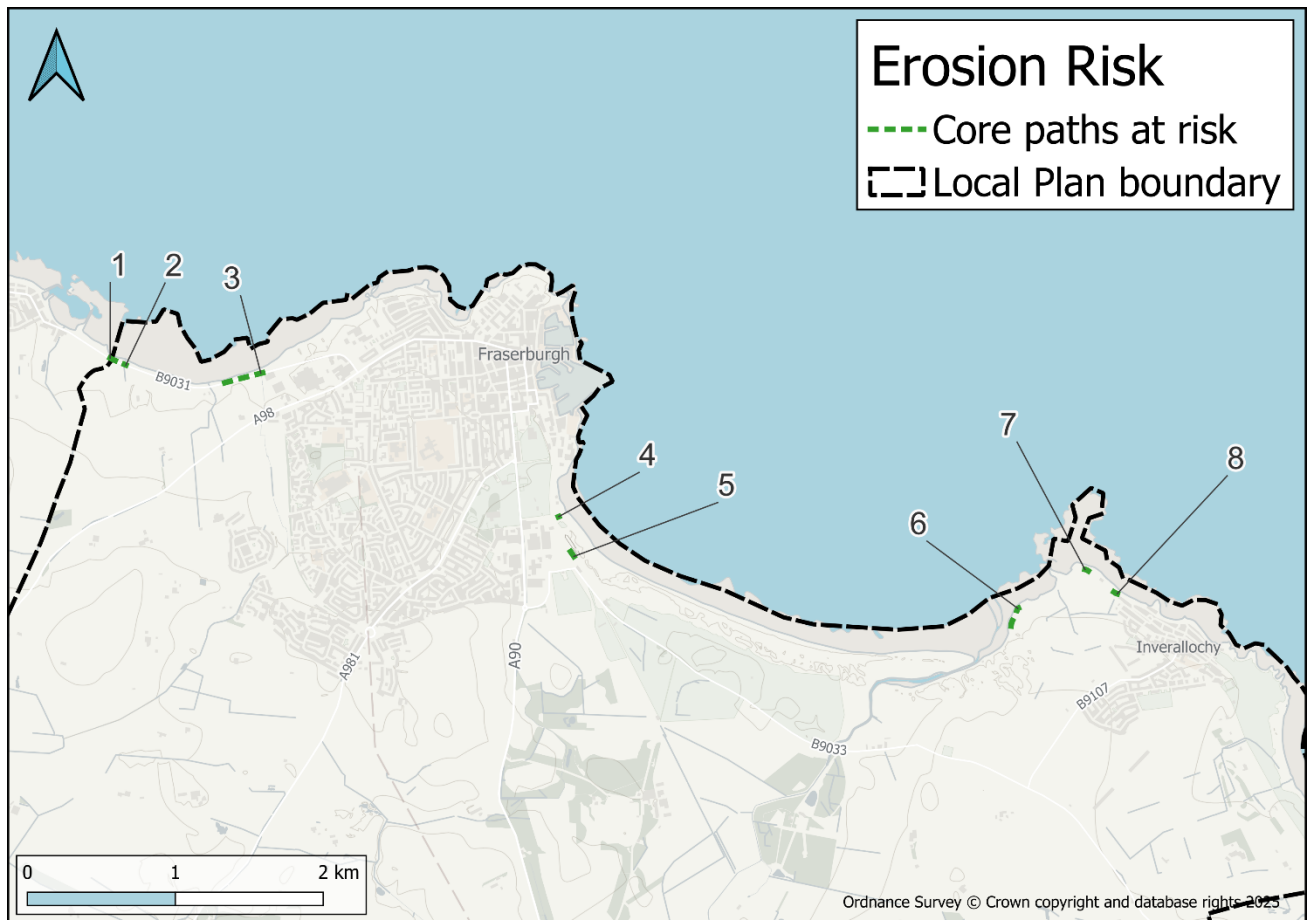


Figure 4-2: Coastal erosion risk for Invercairn and Fraserburgh core paths. Numbers refer to core path sections at risk by 2100, detailed in Table 4-1

Using Dynamic Coast projected data, a matrix was produced to highlight the sections of core path at risk from erosion by 2100 (Table 4-1).

Table 4-1: Invercairn and Fraserburgh. Core path sections at risk from erosion by 2100

Core Path network name	Feature ID	Mean land loss by 2100 (10m intervals)	Core Path affected by 2100 (m)	Approximate total land loss by 2100 (m ²)	Distance to shore (m)	Rank - 2100 land loss total
Coastal Path Sandhaven to Fraserburgh	3	-32	315	10,080	24	1
The Formartine & Buchan Way: Fraserburgh Links	5	-188	39	7,332	156	2
Coastal Path Waters of Philorth to Cairnbulg	6	-29	133	3,857	16	3
Coastal Path Sandhaven to Fraserburgh	1	-28	58	1,624	26	4
Coastal Path Waters of Philorth to Cairnbulg	8	-30	26	780	27	5
Coastal Path Waters of Philorth to Cairnbulg	7	-24	25	600	28	6
Coastal Path Sandhaven to Fraserburgh	2	-32	11	352	36	7
The Formartine & Buchan Way: Fraserburgh Links	4	-96	3	288	58	8

No sections of core path are predicted to be at risk by 2050. The sections have been ranked according to the approximate amount of land predicted to be affected by erosion by 2100. The ranking considers the product of path length and mean predicted total erosion distance from Dynamic Coast.

Although Sections 3 and 5 have the most land lost predicted by 2100, Section 6 may be considered as being of more concern than Section 5 given its distance to shore of 16 m compared to 156 m for Section 5.

A complete review of the impacts of erosion is recommended to make sure that NBS opportunities are developed where appropriate and future realignment or re-development of the core paths consider these future risks.

5 Land Based Opportunities

Where possible, the delivery of adaptation should include land-based actions. Fundamentally these include actions that support more sustainable planning and the potential future relocation of assets and receptors that are, or will be, at risk of erosion or flooding. To identify this a land-based opportunities mapping exercise was undertaken. This focused on each CMU and the CA to understand potential to identify areas where future erosion losses could be offset through safeguarding.

Consideration here is to fundamentally support that although the location of assets or receptors must change the functional impact on the CA should not be lost. Various future needs such as environmental sustainability, urban development, societal and economic development should be considered.

Land-based opportunities in the Invercairn and Fraserburgh CA are highlighted below (Figure 5-1).

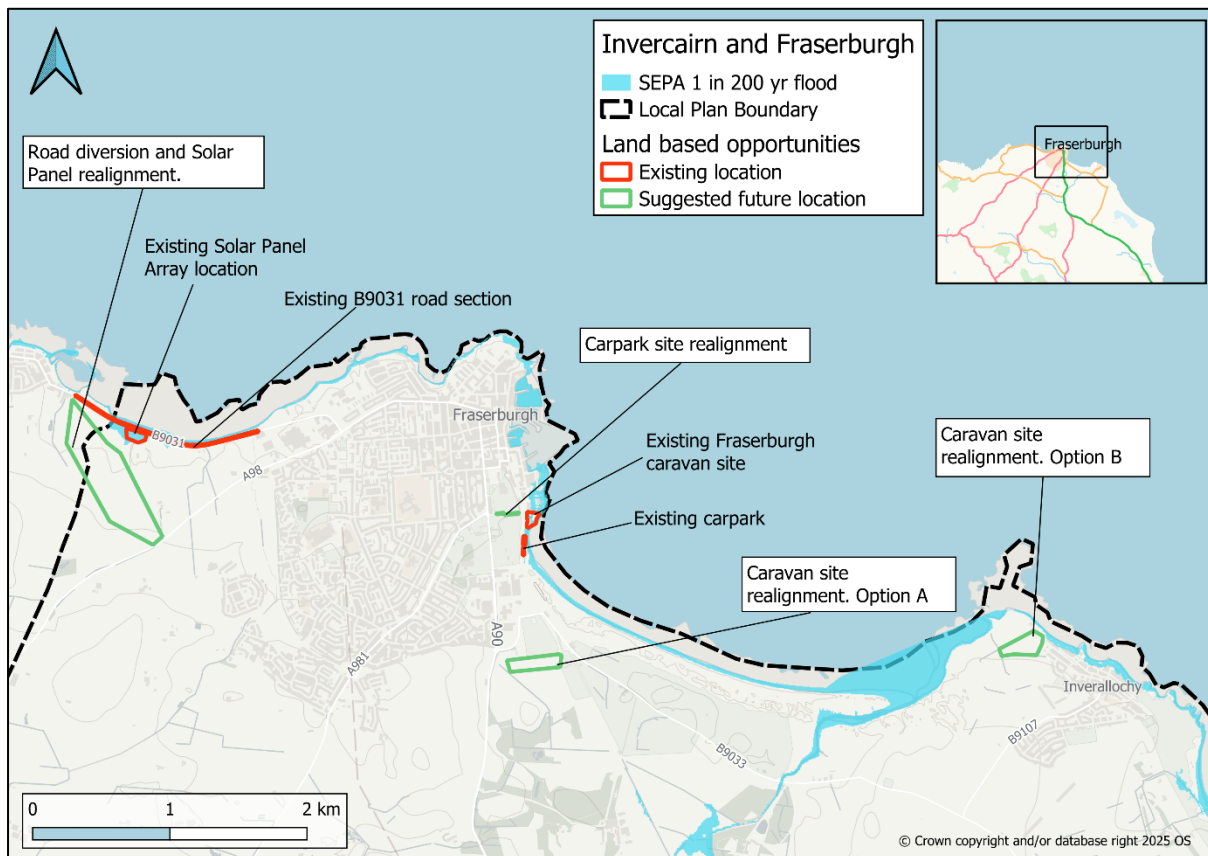


Figure 5-1: Land based opportunities.

5.1 B9031 diversion and Solar panel array realignment

The B9031 west of Fraserburgh and the solar panel array south of the road are at risk from a 1 in 200-year flood, but only the solar panel array is at risk from a 1 in 10-year flood. The road is also at risk from erosion influence by 2100. Consideration should be given to a

permanent realignment of the road and a site to relocate the solar array should be investigated if the road's flooding or erosion triggers are realised (Figure 5-1).

5.2 Fraserburgh Caravan Park

Fraserburgh Caravan Park sits south of Fraserburgh Harbour and is currently protected from coastal erosion by rock armour, but its entire area is at risk from a 1 in 200-year flood event from wave overtopping. Additionally, the structure itself has a finite life and with any new works being subject to a positive benefit cost ratio, and securing necessary funding, consideration should be given to relocate this asset in the future.

Two possible suitable sites for relocation are south of Fraserburgh cemetery on what is currently arable land, and west of Inverallochy currently identified as Flushing Meadows on Scotland's Register of Sasines (Figure 5-1).

Critical to any decision on relocation of amenity assets will be working with the community and owners to make sure that there are positive impacts on tourism and recreation sectors. Relocation, while potentially undesirable, should be undertaken following a place-based approach with a view of enhancing the overall function of the CA.

5.3 Beach Carpark Relocation

The beach front car park south of the caravan park is at risk of erosion influence by 2100 and from a 1 in 200-year flood event. Consideration should be given to a site to relocate this asset in the future.

One possible site is at Links Road ca 170m northwest of the existing site. The existing carpark here could be extended eastwards to create more space. Land in the public grassland park across the road at this location could also be utilised if additional space is required.

6 Adaptation Pathways

6.1 CMU Policies

Management policies have been classified based on the Scottish Government guidance into five categories. These will form the basis for development and delivery of the adaptation pathways.

1. **No Active Intervention** - Do nothing.
2. **Maintain** - Where existing structures, owned by the Council exist.
3. **Protect** - Where existing structures exist, residential properties are at risk and there is potential for a positive cost benefit to be achieved.
4. **Enhance Natural Features** - Where realistic opportunities exist for NBS to serve as risk mitigation.
5. **Make Space** - Where land use opportunities mapping has identified areas for safeguarding, offsetting loss and/or relocation of receptors.

Policies have been set based on the information available, and presented above, to outline both the current approach and idealistic end outcome for each CMU. It should be noted that, at this stage in the CCAP process, Idealistic Outcome Policies are not definitive and, depending on future Triggers, Actions and investigations may change. They do however, provide an initial starting point for Adaptation Pathways to work towards.

Review of the characteristics and risk associated with each CMU led to the classifications and policies in Table 6-1. These were used to develop initial Adaptation Pathways, Triggers, and an associated Implementation Plan.

Table 6-1: Invercairn and Fraserburgh CMU categorisation.

CMU	Coastal Type	Risk	Initial Policy	Idealistic Outcome Policy
1	Hybrid	Risk	Maintain	Make Space
2	Hybrid	Risk	Maintain	Protect
3	Defended	Risk	Maintain	Protect
4	Hybrid	Risk	Maintain	Make Space
5	Natural	Risk	Enhance Natural Features	Make Space
6	Hybrid	Risk	Maintain	Protect
7	Natural	Risk	No Active Intervention	No Active Intervention
8	Natural	Risk	No Active Intervention	No Active Intervention

6.2 Adaptation Pathways

Development of Adaptation Pathways for each CMU are based on the classification presented above. This aims to provide a flexible approach to adaptation that works towards a defined and desirable end outcome for the CMU and CA.

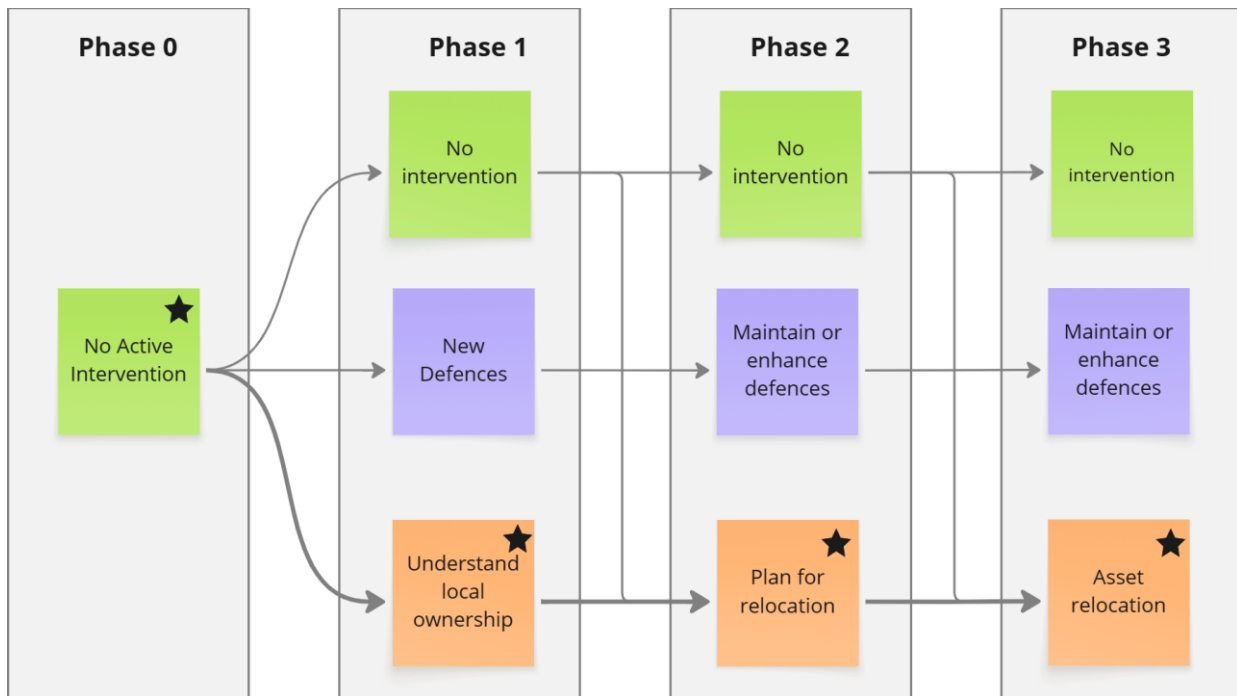
Details of this outcome are however, not defined at this stage, and will ultimately be dependent on monitoring changes at the coast, generation and improvement of local evidence, or implementation or advances in other areas that influence climate resilience e.g.

- Climate
 - Climate change guidance.
 - SEPA flood maps or risk assessments.
 - Coastal flood occurrence.
- Risk exposure
 - Change in defence condition.
 - Update to SEPA flood warning system
 - Erosion risk buffer exceeded
 - Flood risk threshold exceeded
- Socio-economics
 - Changes of asset ownership
 - Changes of land ownership
 - Community pressures

Adaptation Pathways for each CMU are presented in the following sections. How, when or if, this will be achieved is dependent on the identified Triggers being realised and the outcomes of the associated Actions.

6.3 CMU 1 Hybrid coast with risk

CMU 1 is a hybrid coast with a mix of natural features and artificial defences, it is described in more detail above. The existing policy (Phase 0) for this CMU is defined as No Active Intervention and moving towards an end outcome of Make Space (Figure 6-1).



★ Preferred pathway

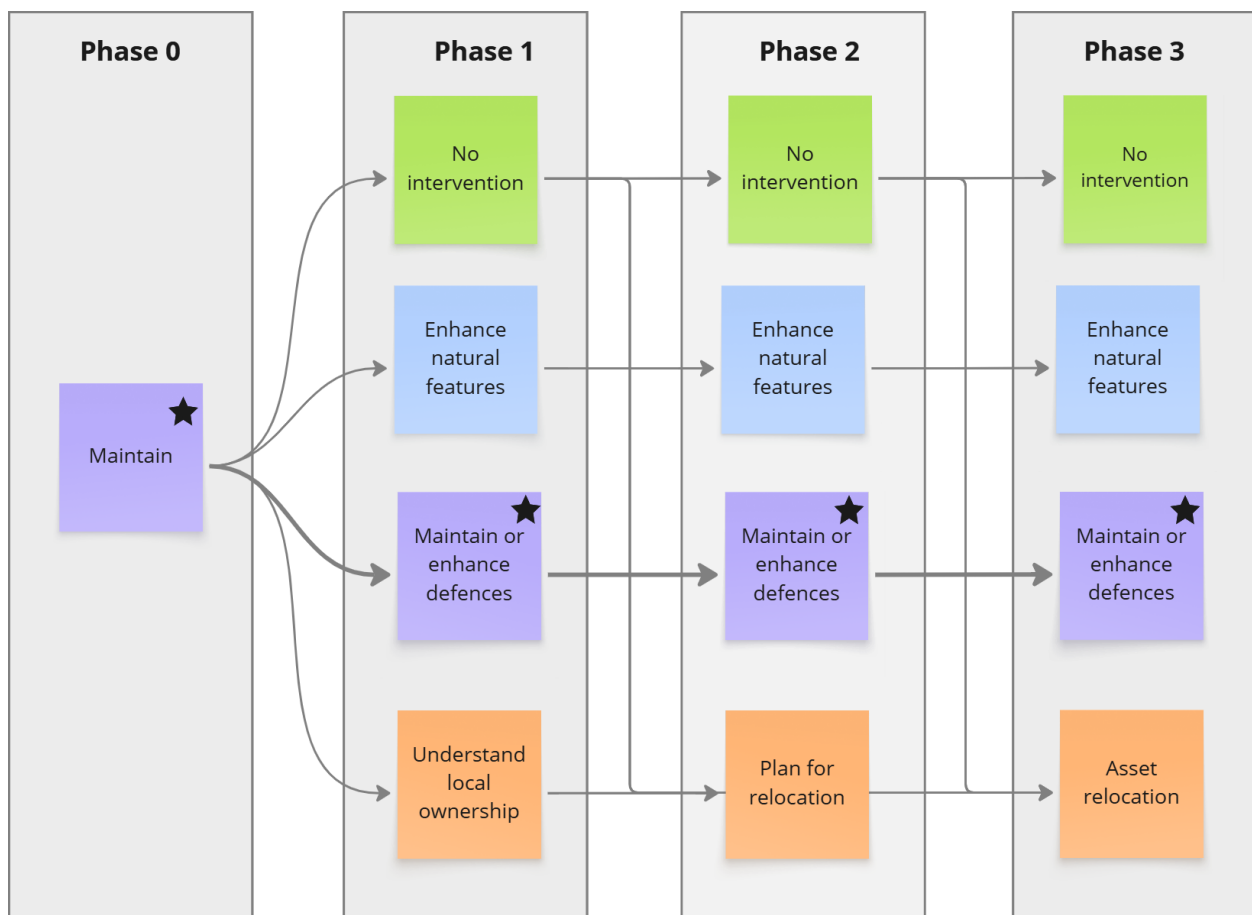
Figure 6-1. Identified preferred adaptation pathway for Invercairn and Fraserburgh CMU 1

6.4 CMU 2, and 6 Hybrid coast with risk

CMUs 2 and 6 are classified as hybrid coasts with risk of erosion and flooding. CMU 2 is predominantly a natural coast that is enhanced with rock armour, stone filled gabions and concrete walls to protect the properties on Main Street and gabions to protect the core path at Braes Street. Gabions and rock armour protect the car park area to the north of Fraserburgh Harbour.

CMU 6 is a narrow stretch of natural shingle beach with rock armour and a section of concrete lock block wall protecting the shoreline properties of Inverallochy and Cairnbulg. A small harbour to the west of Cairnbulg is protected with a mixture of rubble and rock armour in front of a concrete harbour wall.

Both CMUs have initial policies of Maintain and move towards a desired end outcome of Protect (Figure 6-2). This is primarily due to the existence of coastal protection structures, residential properties being at risk and the limited space to support localised retreat. Minor opportunities here to support delivery of the pathway through enhancing natural features exist.



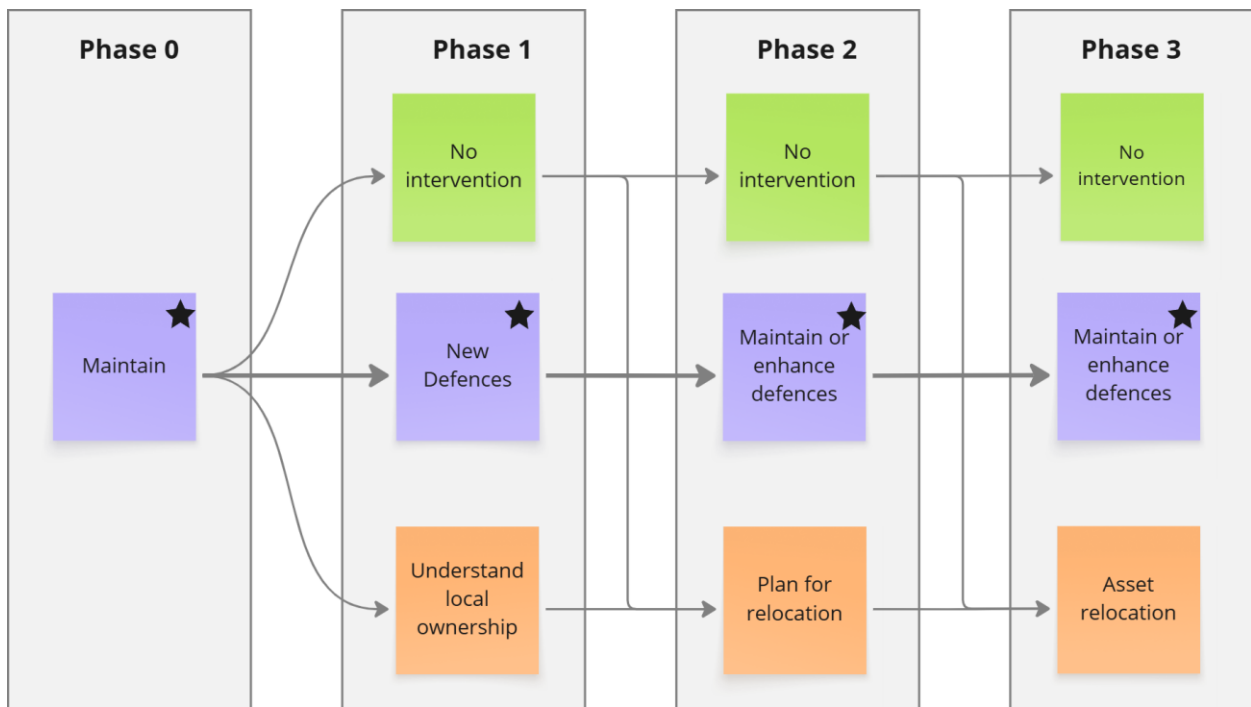
★ Preferred pathway

Figure 6-2. Identified preferred adaptation pathway for Invercairn and Fraserburgh CMU 2 and 6.

6.5 CMU 3 defended coast with risk

CMU 3 includes Fraserburgh Harbour, formed of concrete and stone walls and is classified as defended with a risk of flooding (section 2.2.3).

Both CMUs have initial policies of Maintain and move towards a desired end outcome of Protect (Figure 6-3). This is primarily due to the existence of coastal protection structures, residential properties being at risk and the limited space to support localised retreat.



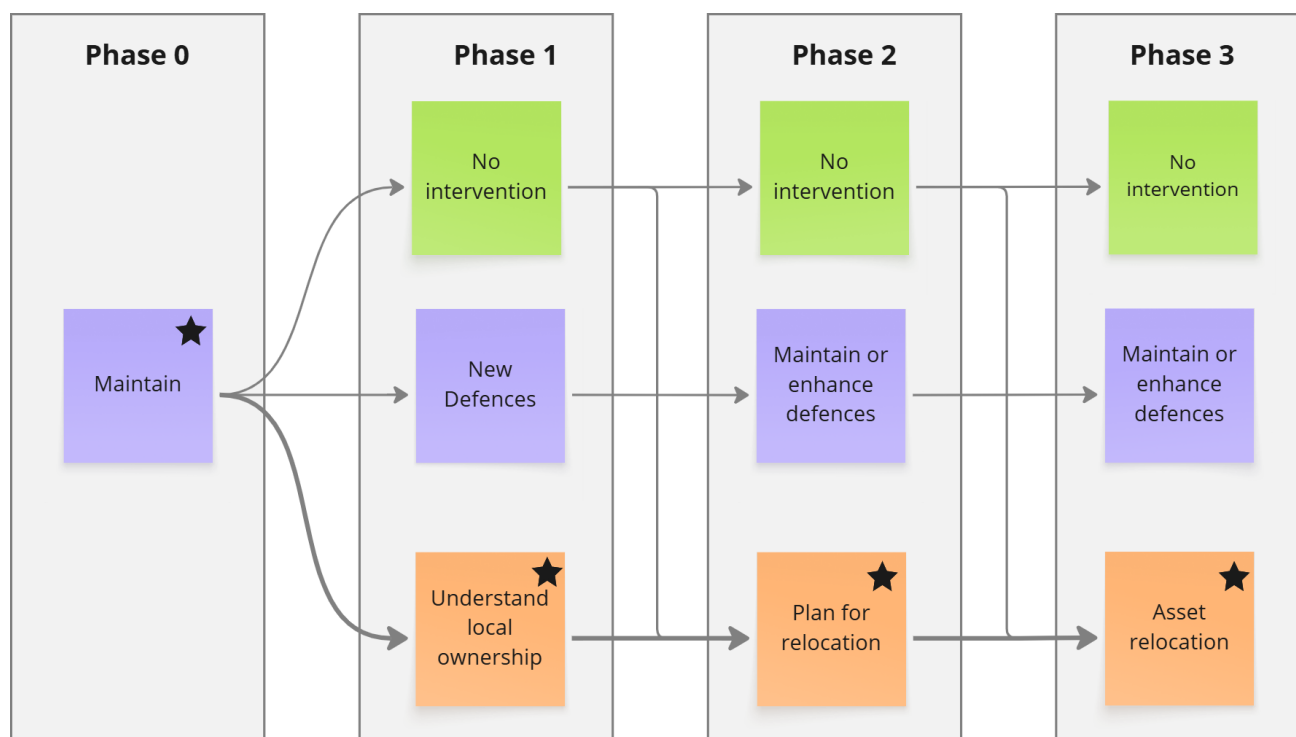
★ Preferred pathway

Figure 6-3. Identified preferred adaptation pathway for Invercairn and Fraserburgh CMU 3.

6.6 CMU 4 Hybrid coast with risk

CMU 4 is defended coast, with rock armour from south of Fraserburgh harbour to where the Fraserburgh caravan site meets the coast. A stone wall protects the car park and commercial properties behind the beach.

CMU 4 is a defended stretch of coast in an urbanised area, it is described in more detail above in section 2.2.4. The current policy (Phase 0) for this CMU is judged to be protect. Given the local geography, rates of erosion, future flooding, and economic value at risk the final policy (Phase 3) has been proposed as Asset Relocation. See Figure 6-4 below for the adaptation pathway for CMU 4.

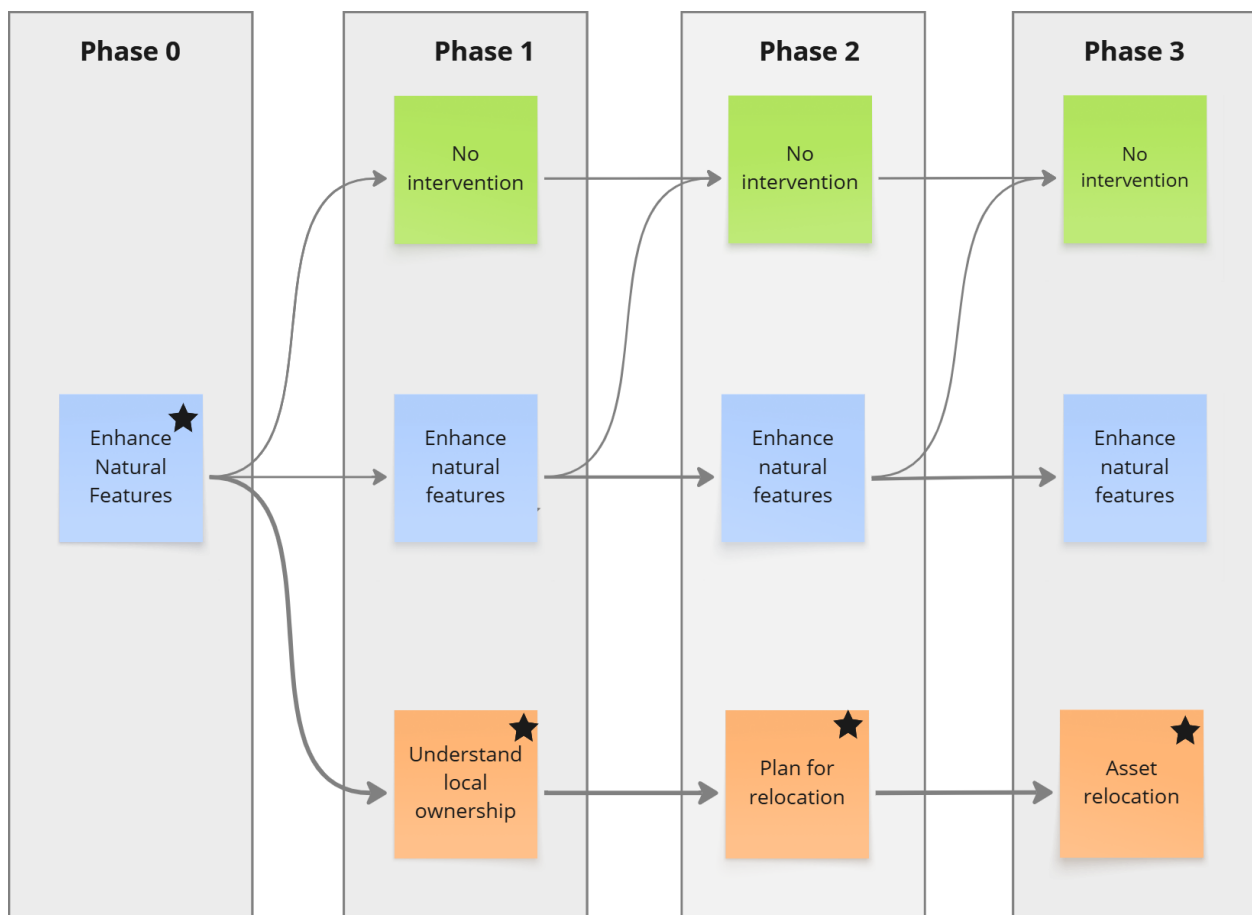


★ Preferred pathway

Figure 6-4. Identified preferred adaptation pathway for Invercairn and Fraserburgh CMU 4.

6.7 CMU 5 Natural coast with risk

CMUs 5 is classified as natural coast and has been assigned an adaptive pathway for natural coasts with predicted risk of erosion or flooding to receptors. Both the NBS and Land use opportunities exercises have developed potential to support adaptation through enhancing natural features and making space. The existing policy (Phase 0) for this CMU is therefore defined as Enhance Natural Features and moving towards an end outcome of Make Space (Figure 6-5).



★ Preferred pathway

Figure 6-5. Identified preferred adaptation pathway for Invercairn and Fraserburgh CMU 5

6.8 CMU 7 and 8 Natural coast with risk

CMUs 7 and 8 are classified as natural coasts and have been assigned an adaptive pathway for natural coasts with no predicted risk of erosion or flooding to sensitive receptors, that would result in direct economic impact. Arable land and a Inverallochy Golf Course are however at risk from flooding and erosion by 2100.

The current policy (Phase 0) for this CMU is No Active Intervention, and it is expected that, when supported by the Proactive Actions, this will also be the end outcome.

7 Adaptation Process

7.1 Implementation Plan

To support the delivery of the Adaptation Framework, a single Implementation Plan is applied to the entire CA with generic triggers and actions set that are relevant across the CA. Specific triggers and actions are then assigned to each CMU based on the Risk Assessment. Outcomes of the Implementation Plan link to the Adaptation Pathway specific to each CMU.

Delivery of the Implementation Plan has three stages (Figure 7-1):

1. Monitoring and Triggers (section 7.2)
2. Actions (section 7.3)
3. Outcomes (section 7.4)

The outcome of the Implementation Plan determines what direction will be followed within the Adaptation Pathway when moving to a new phase.

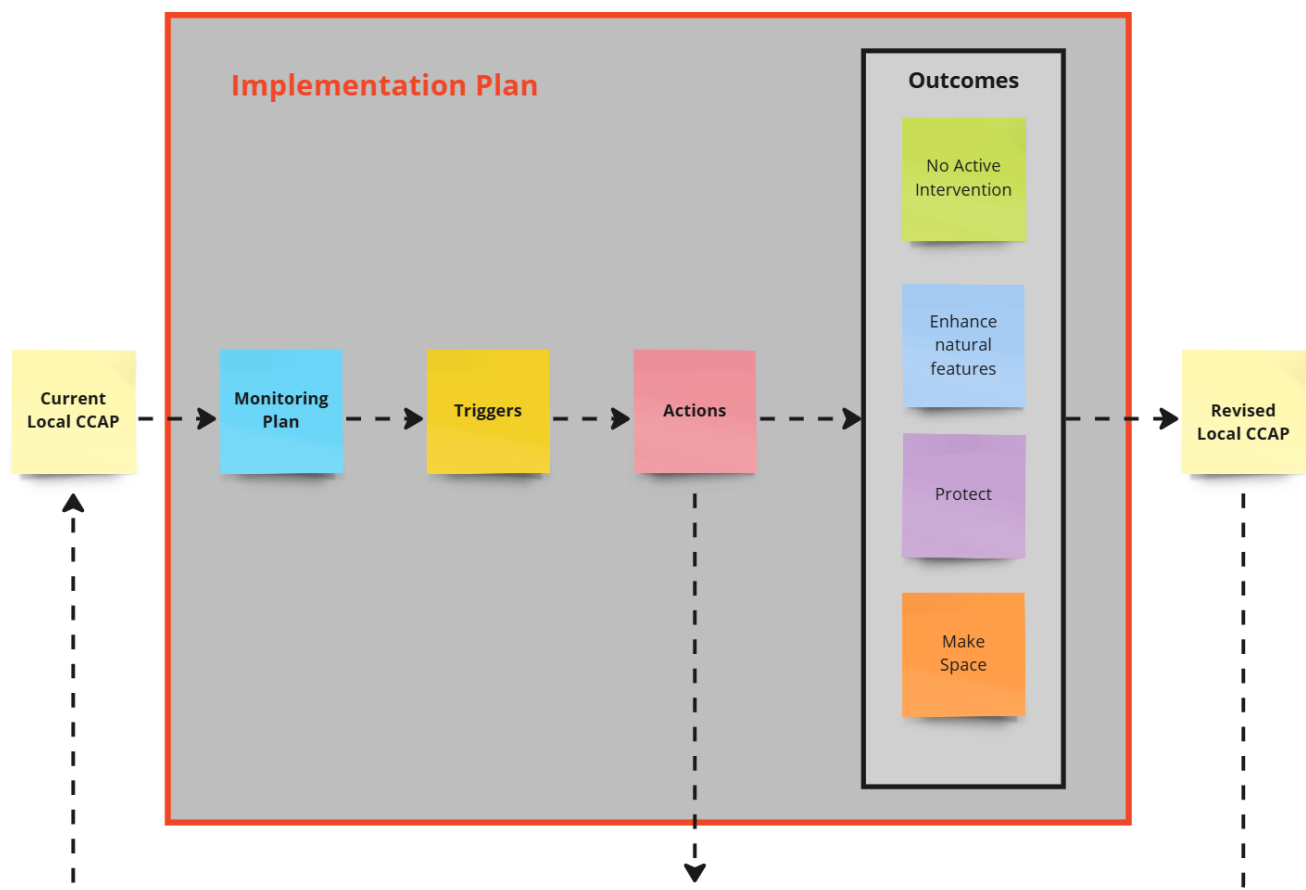


Figure 7-1: Implementation Plan.

7.2 Monitoring and Triggers

7.2.1 Monitoring

Triggers are realised through monitoring of available data that informs risk of flooding and erosion. Triggers signal the requirement to deliver the Implementation Plan, which may lead to a review of the Risk Assessment and potentially change to the Adaptation Pathway.

Triggers are categorised as:

- Natural systems triggers.
- Climate triggers.
- Risk exposure triggers.
- Socio-economic triggers.

These are subsequently grouped into categories with each requiring a plan for monitoring within the CA:

- Third party data and information
- Aberdeenshire Council data and information
- Aberdeenshire Council monitoring
- External pressure

7.2.2 Trigger Classification

Classification of the Triggers fall into two parts.

1. Generic triggers applicable to the entire CA.
2. Bespoke triggers applicable to individual CMUs.

Climate, natural system, and socio-economic triggers are generic for the whole CA, but risk exposure triggers related to physical flooding, erosion and overtopping thresholds are specific to each CMU. For the Invercairn and Fraserburgh CA these are summarised in Table 7-3.

Effective review of these requires development of a monitoring plan of risk at each CMU as follows:

- CMU 1: monitoring of erosion, flood risk and defence condition.
- CMU 2: monitoring of erosion, flood risk and defence condition.
- CMU 3: monitoring of flood risk and defence condition.
- CMU 4: monitoring of erosion, flood risk and defence condition.
- CMU 5: monitoring of erosion risk and defence condition (dune fencing).
- CMU 6: monitoring of erosion, flood risk and defence condition.
- CMU 7: monitoring of flood risk.
- CMU 8: monitoring of flood risk.

7.2.3 CMU specific flooding triggers

Based on SEPA's NFRA data, where there is risk of flooding, the lowest asset per flood risk location is used to determine when a flooding trigger will be activated. Assets considered at risk from flooding include:

- Residential properties.
- Key roads.
- Coastal defences that provide extreme sea level flood protection.

Where flood risk is present in a CMU, the lowest residential property (minus 300mm freeboard) or point on a key road is used to determine trigger level status based on 1 in 2 year (road only), 1 in 10 year and 1 in 200 year flood predictions (Table 7-1).

In the absence of a SEPA 1 in 2-year flood map, UK CFB Extreme Sea Level data was used in conjunction with the SEPA Phase 2 DTM to derive a 1 in 2-year flood map for CMU 1 to establish if the B9031 road is at risk. SEPA flood maps are available for 1 in 10, 1 in 200 and future 1 in 200-year coastal flood events.

The CMU-specific flooding trigger is realised if the receptor lies within the specified flood extent. There are two levels to this Trigger realisation that result in different Actions. These also vary depending on the consequence of flooding:

- **Residential properties**
 - 1) Within 1 in **200-year** flood extent.
 - Increase monitoring and plan for assessment.
 - 2) Within 1 in **10-year** flood extent.
 - Undertake assessment and plan for intervention.
- **Key Roads**
 - 1) Within 1 in **10-year** flood extent.
 - Increase monitoring and plan for assessment.
 - 2) Within 1 in **2-year** flood extent.
 - Undertake assessment and plan for intervention.

Locations of the assets used to define the flooding Triggers are shown in Figure 7-2. All property and road flooding triggers for CMU 1, CMU 2, CMU 4 and CMU 6 for the Invercairn and Fraserburgh CA (Table 7-1) with topographic information provided in Appendix B.1

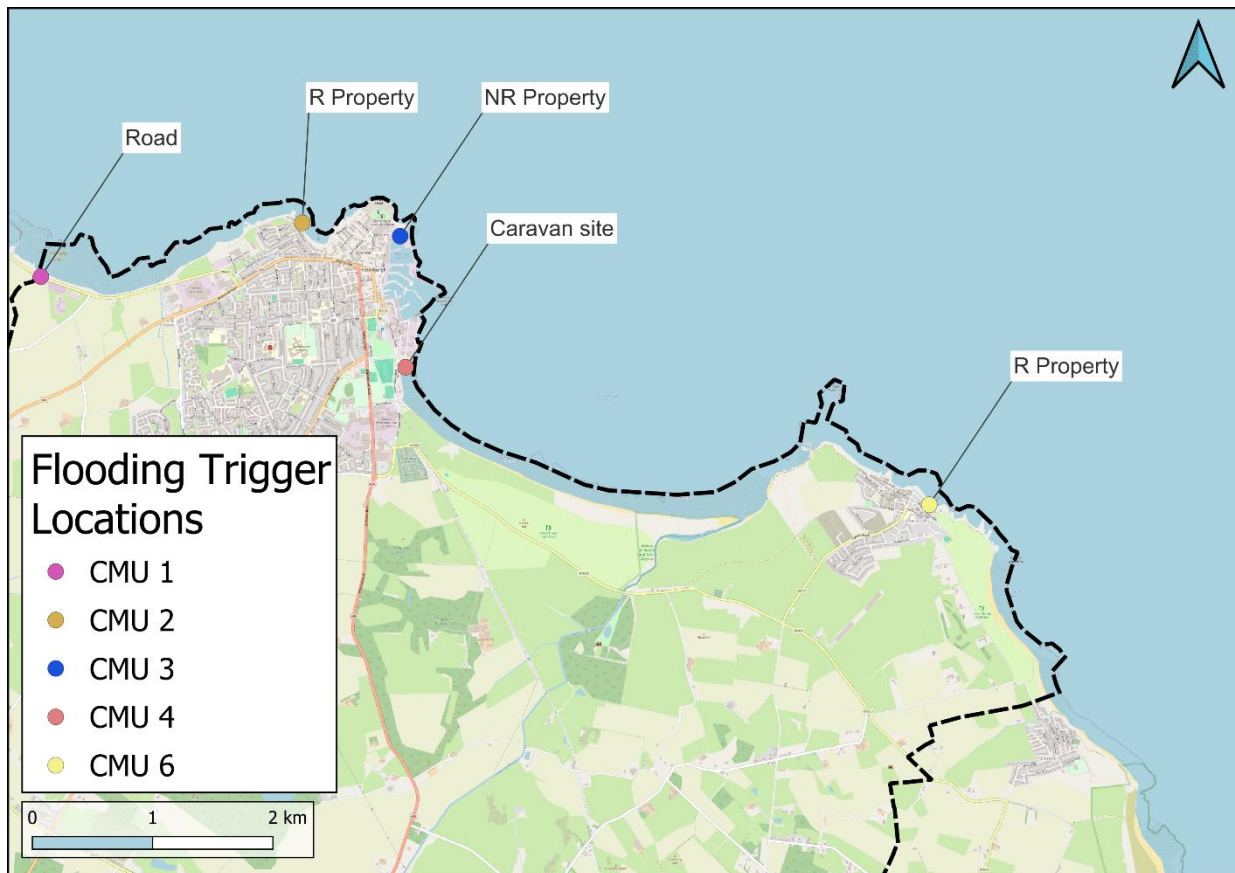


Figure 7-2: Overview of Invercairn and Fraserburgh flooding trigger locations.

7.2.3.1 CMU 1 flooding triggers

The B9031 is not predicted to flood during present day 1 in 2 or 1 in 10-year flood events (Table 7-1). The low point of the road is at 4.2 mAOD which is ca. 0.1 m above the level of a 1 in 2-year event. Both flood maps show flooding to the south of the road affecting the solar panel array. In addition, the solar panels are on raised stilts and unlikely to be directly affected, but it is unclear whether other infrastructure is more vulnerable. A narrow dune bank at 4.7 mAOD offers additional natural protection to the road (Appendix B.1).

7.2.3.2 CMU 2 flooding triggers

The property asset for the CMU 2 flooding trigger has an elevation of 6.6 mAOD which is within the SEPA 1 in 200-year flood event zone but outside the 1 in 10-year zone (Table 7-1). A Level 1 property flooding trigger is therefore realised.

It should be noted that CFB water levels for a 1 in 200-year event at this location are at 4.52 mAOD, so predicted flooding is likely to be caused by wave overtopping (Appendix B.1).

There is no road flooding trigger for CMU 2 as the lowest road elevations are significantly higher than the property trigger, with a minimum elevation of ca 7.5 mAOD and therefore, not at immediate risk from flooding.

7.2.3.3 CMU 3 flooding triggers

The property asset for the CMU 3 flooding trigger has an elevation of 3.2 mAOD which is within the SEPA 1 in 10-year flood event zone (Table 7-1). A Level 2 property flooding trigger is therefore realised.

There is no road flooding trigger for CMU 2 as the lowest road elevations are the same as the property trigger and immediately in front of the property which is the more sensitive receptor.

7.2.3.4 CMU 4 flooding triggers

The Caravan Park south of Fraserburgh Harbour is shown to be at flood risk in CMU 4. The trigger location is at one of the lowest points of the Caravan Park and is within the SEPA 1 in 10-year flood event extent, so a Level 2 flooding trigger has been realised. An assessment should therefore be undertaken to develop a definitive Action Plan to deliver on the pathway.

The caravan park site is protected by rock armour, which will mitigate the effects of flooding. LiDAR indicates the rock armour is elevated to 5.2 mAOD, 0.3 m higher than the caravan park (Appendix B.1). The assessment should consider the condition, stability and wave overtopping performance of this asset. See Section 7.2.5 for details on asset condition and associated triggers.

7.2.3.5 CMU 6 flooding triggers

The villages of Cairnbulg and Inverallochy share Shore Street, a road which is within 30 m from the MHWS line. Over 60 properties run along this road throughout its length. The lowest property at risk from flooding is to the east end of Inverallochy and acts as a flooding trigger for CMU 6 (Table 7-1). At 4.8 mAOD the property is within the SEPA 1 in 10-year flood event extent, so a Level 2 flooding trigger has been realised. An assessment of the impacts of flooding should be undertaken and defined actions delivered to support the Pathway.

Table 7-1: CMU-specific flooding triggers for Fraserburgh and Invercairn properties and roads.

CMU	Lowest level of Property/Road (mOD)		Property – Freeboard (mOD)	Trigger met
1	B9031	4.2	3.9	No
2	Property	6.6	6.3	Yes (Level 1)
3	Property	3.2	2.9	Yes (Level 2)
4	Caravan park	4.9	4.6	Yes (Level 2)
6	Property	4.8	4.5	Yes (Level 2)

7.2.4 CMU-specific erosion triggers

Where there is risk of erosion, the distance from the asset at risk to the coast is used to define the Trigger. For properties, roads and other features, the coast is defined by the present day MHWS position in Dynamic Coast. Assets considered at risk from erosion include:

- Residential properties.
- Key roads.
- Other features, such as car parks and golf courses.

To note, if two assets are in the same location (e.g. a road and property) only the most seaward asset is used to define the Trigger for that CMU.

As with the other CMU-specific triggers, a two-level approach is defined using buffers around the asset at risk. The associated action is, again, dependent on the consequence and asset at risk.

Erosion buffer distances (metres) for each level are defined as follows:

- **Residential properties**
 1. Maximum of historic erosion rate multiplied by 20 or 20m.
 - Increase monitoring and plan for assessment.
 2. Maximum of historic erosion rate multiplied by 10 or 10m.
 - Undertake assessment and plan for intervention.
- **Roads and other features**
 1. Maximum of historic erosion rate multiplied by 5 or 5m.
 - Increase monitoring and plan for assessment.
 2. Maximum of historic erosion rate multiplied by 2 or 2m.
 - Undertake assessment and plan for intervention.

The Level 1 erosion trigger has been met for properties in CMU6 to the east end of the town of Inverallochy (Appendix B.2). Location of all assets used for erosion triggers are shown in Figure 7-3 and Appendix B.2.

Table 7-2: CMU-specific erosion triggers for Invercairn and Fraserburgh properties, roads and features. Cells shaded red indicate that the erosion trigger has been met.

CMU	Maximum historical change rate (m/year)	Present-day distance of Property to coast (m)		Erosion trigger level 1: Coast X m from property	Erosion trigger level 2: Coast X m from property
4	1.1	NRP	29.0	22.0	11.0
6	0.0	RP (east)	19.0	20.0	10.0
6	0.0	RP(west)	25.0	20.0	10.0
CMU	Maximum historical change rate (m/year)	Present-day distance of Road or core path to coast (m)		Erosion trigger level 1: Coast X m from road	Erosion trigger level 2: Coast X m from road
1	0.0	B9031(west)	27.0	5.0	2.0
1	0.2	B9031(east)	24.0	5.0	2.0
5	3	Core path	170	15.0	6.0

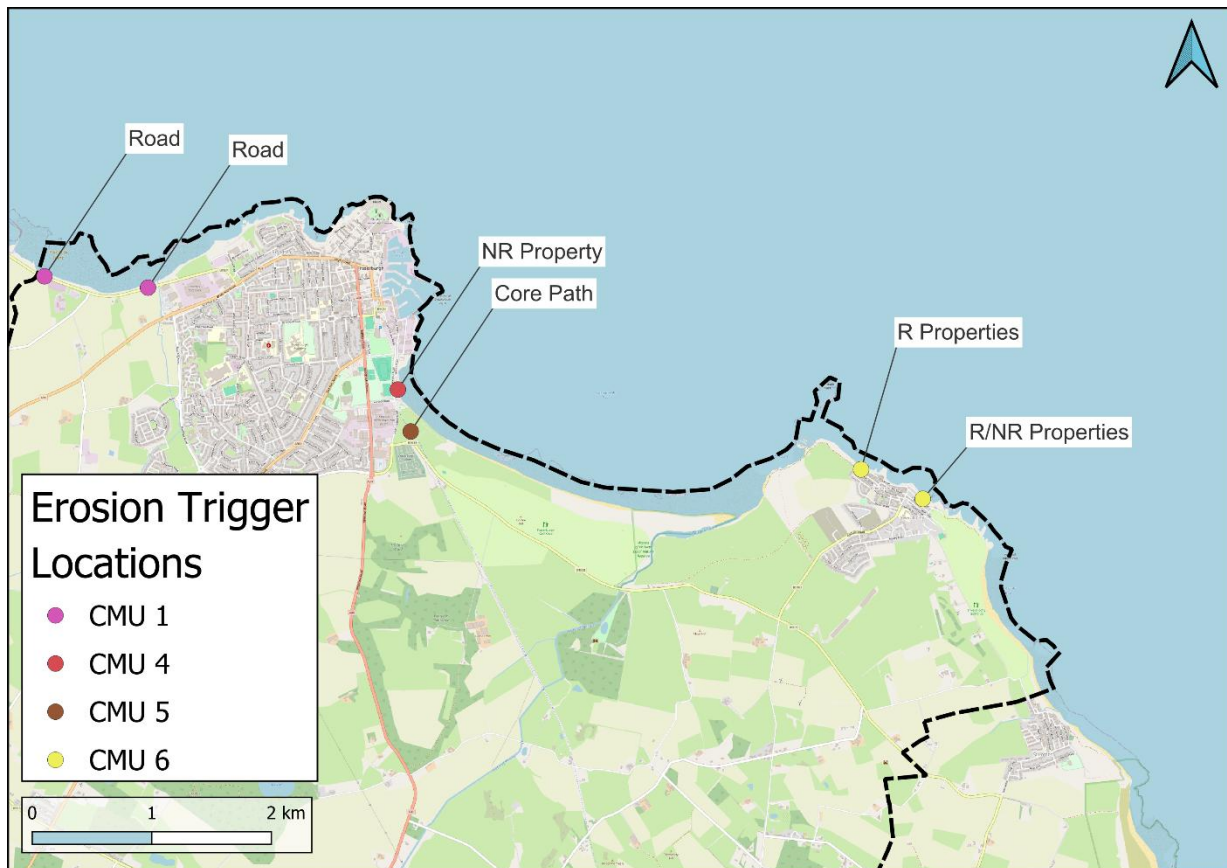


Figure 7-3: Invercairn and Fraserburgh erosion trigger locations.

7.2.5 CMU-specific condition triggers

Where a coastal defence is present in a CMU, a CMU-specific trigger will be applied to the condition of the coastal defence. Currently, coastal defences are present in:

- CMU 1
- CMU 2
- CMU 3
- CMU 4
- CMU 5
- CMU 6

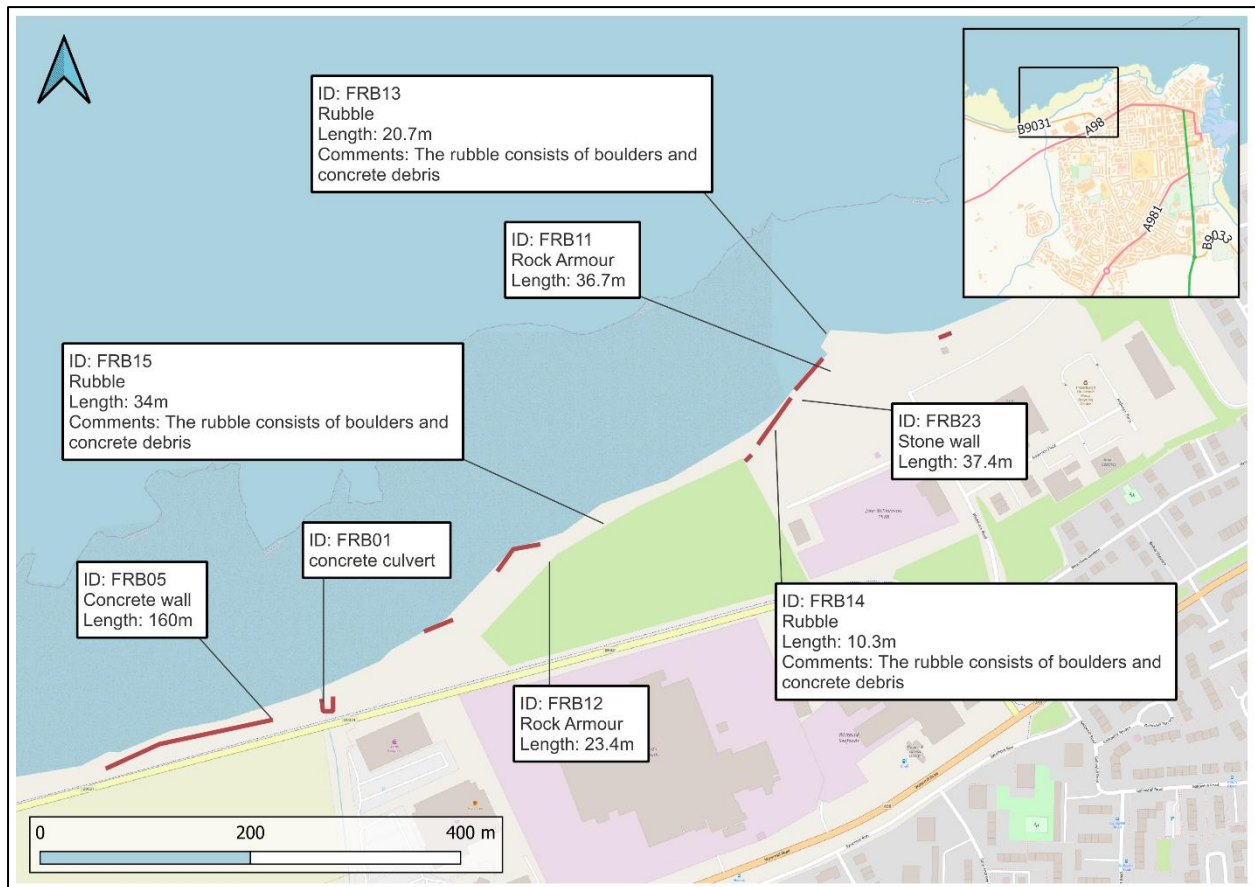


Figure 7-4: Coastal defences - Fraserburgh West. DC indicative locations shown by red lines. Text descriptions from Aberdeenshire Council.

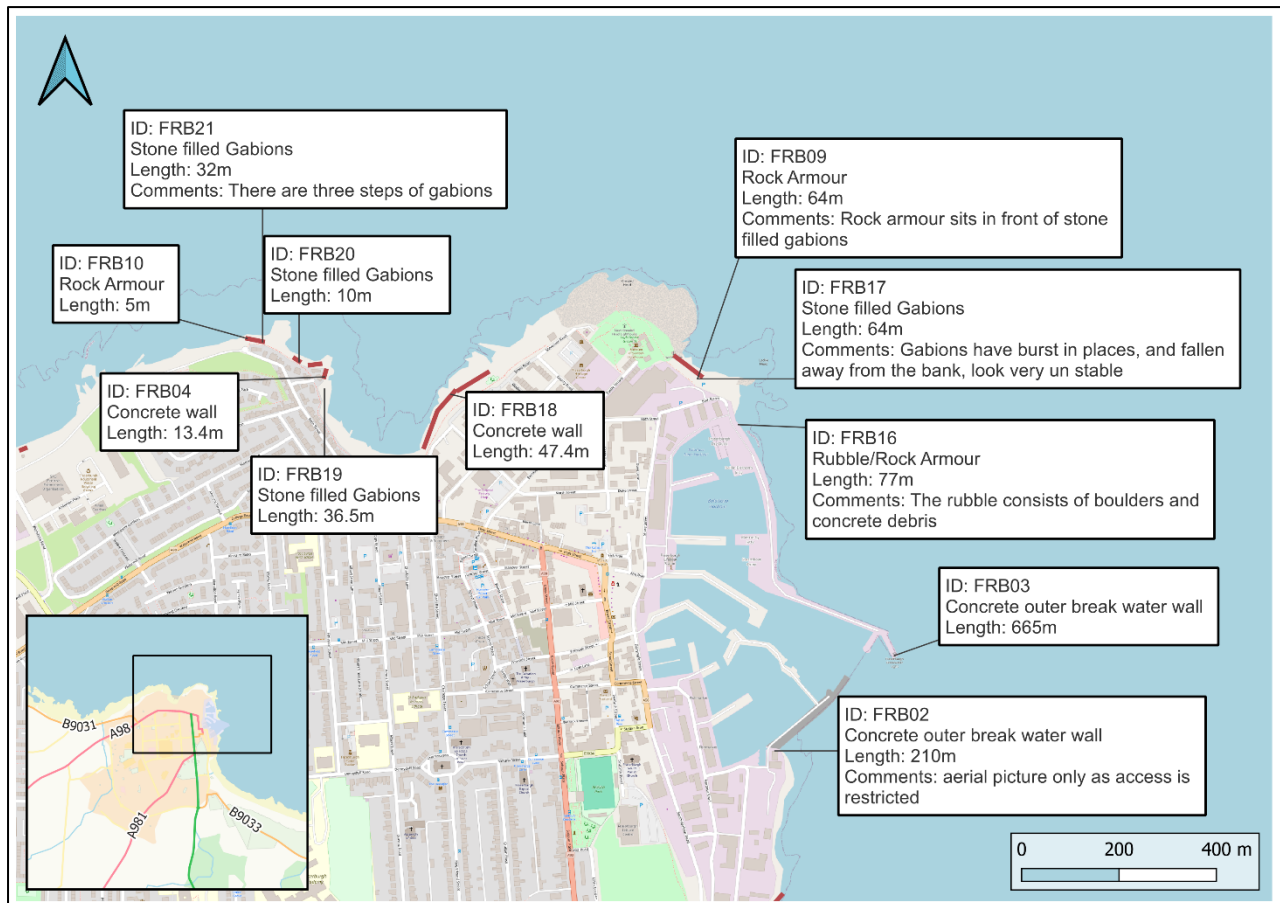


Figure 7-5: Coastal defences - Fraserburgh. DC indicative locations shown by red lines. Text descriptions from Aberdeenshire Council.



Figure 7-6: Coastal defences - Fraserburgh South. DC indicative locations shown by red lines. Text descriptions from Aberdeenshire Council.

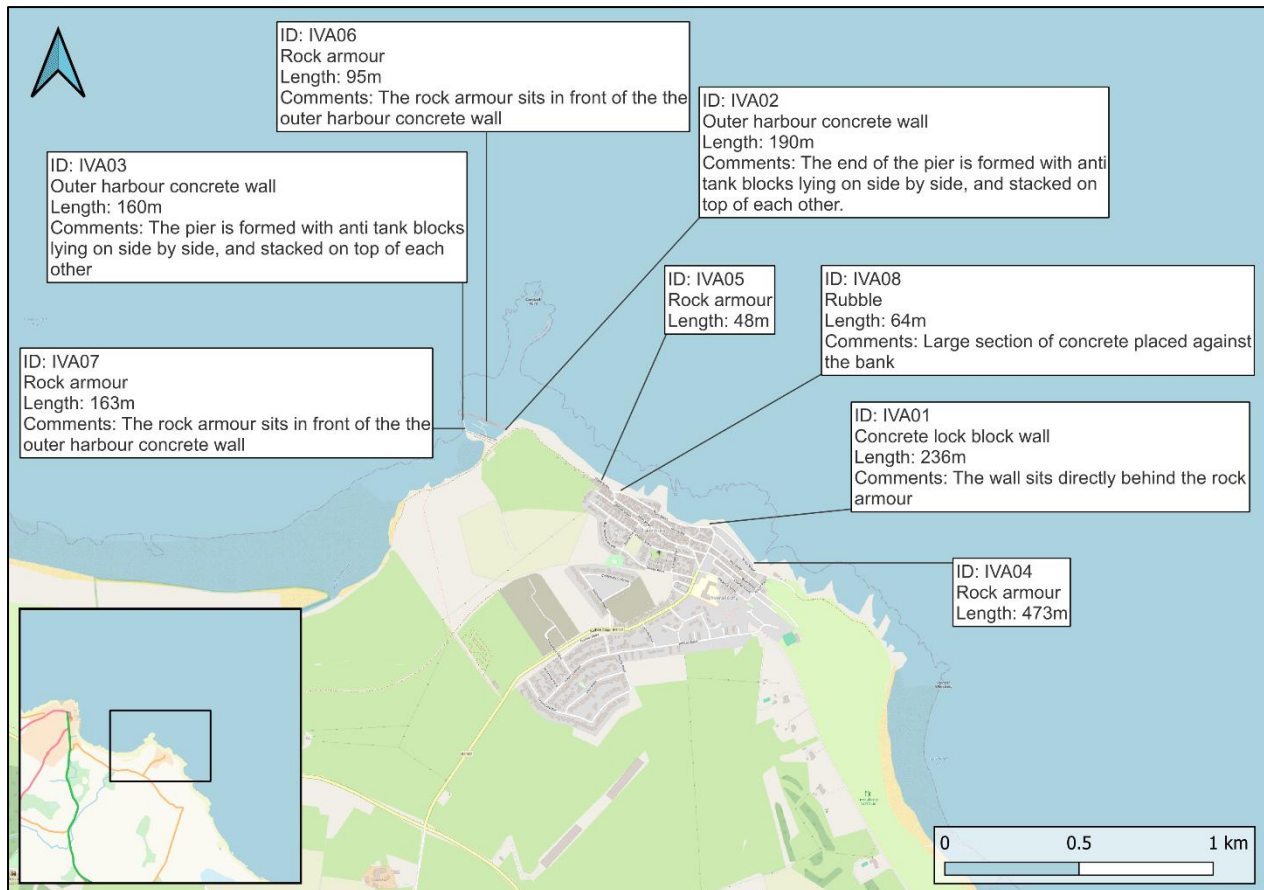


Figure 7-7: Coastal defences - Inverallochy. Text descriptions from Aberdeenshire Council.

As with the other CMU-specific triggers, a two-level condition trigger approach and associated action is defined using the Grades of coastal defence condition according to the EA and Defra condition assessments⁸.

- **Condition Trigger level 1:**
 - Defence condition Grade 4
 - Increase monitoring and plan for assessment.
- **Condition Trigger level 2:**
 - Defence condition Grade 5:
 - Undertake assessment and plan for intervention.

A prioritisation matrix for monitoring the status of defence assets in the CA is given in Appendix A. If the condition grade for an asset exceeds the maximum level for that asset's maintenance regime, then action should be taken to ensure the asset remains effective. The Alert flag in the matrix highlights such assets. Risk scores consider the Maintenance Regime (assumed), Grade, time to next grade transition and whether there is flood and/or erosion risk to properties at the defence location.

⁸ Environment Agency (2013) Practical guidance on determining asset deterioration and the use of condition grade deterioration curves: Revision 1.

7.3 Actions

Actions, like Triggers, can also be applied to the entire CA, or to specific CMUs where the risk of flooding and/or erosion is identified. Actions will be specific to CMUs where, for example, a coastal defence is present; a natural protective feature is present; the risk of flooding/erosion is localised; assets are at risk of flooding/erosion.

Actions applicable to all and specific CMUs in Invercairn and Fraserburgh CA have been identified in (Table 7-3).

Review risk assessment:

- Involves a review of available data and associated risk assessment. Increased monitoring, planning, and implementing an assessment, and planning for intervention because of the erosion and flooding triggers are included in the review risk assessment action.

Community engagement:

- **Places:** Involves local groups, such as Councillors and community groups.
- **Practice:** Involves third party stakeholders, such as SEPA, Scottish Government, Nature Scot etc.
- **Asset:** Includes private defences harbours and utilities specific to defended or hybrid CMUs.

Post flood data collection:

- Involves community engagement, surveys, photographs etc.

New risk assessment:

- Following a review of the current risk assessment and/or community engagement, a new risk assessment may be required. Should a new assessment be deemed necessary this should follow appropriate guidance⁹ and include all necessary components to develop a preferred Adaptation Pathway and associated Action Plan for delivery. E.g. risk, economics, social, environment, engineering, land use planning etc.

Actions bridge the gap between Triggers and Outcomes and define what processes need to be implemented before the most appropriate Outcome is recognised and delivered for each CMU. Actions linked to specific triggers and relevant Aberdeenshire CMU is included in Table 7-3.

⁹ Scottish Government. 2016. Flood protection appraisals: guidance for SEPA and responsible authorities <https://www.gov.scot/publications/guidance-support-sepa-responsible-authorities/pages/2/>

Table 7-3: Triggers, trigger categories and associated actions for each Invercairn and Fraserburgh CMU.

Category	Trigger	Action	Invercairn & Fraserburgh CMU
Natural Systems	Changes to habitat	Community engagement (places)	All except CMU 3
	Changes to greenspace	Community engagement (places)	All except CMU 3
Climate	Update to climate guidance	Review risk assessment Community engagement (practice)	All
	Update to SEPA flood maps	Review risk assessment Community engagement (practice)	All
	Coastal flood occurrence	Review risk assessment Community engagement (places, asset) Post flood survey	All
Risk exposure	Defence condition	Community engagement (asset)	CMU 1 CMU 2 CMU 3 CMU 4 CMU 5 CMU 6
	Update to SEPA flood warning	Review risk assessment Community engagement (places, practice)	All
	Erosion buffer exceeded	Review risk assessment Community engagement (places)	CMU 1 CMU 4 CMU 5 CMU 6
	Flood risk threshold exceeded	Review risk assessment Community engagement (places)	CMU 1 CMU 2 CMU 3 CMU 4 CMU 6

	Update to Dynamic Coast	Review risk assessment Community engagement (practice)	All
Socio-economic	Changes of asset use	Community engagement (asset)	All
	Changes of asset owner	Community engagement (asset)	All
	Community pressure	Review risk assessment Community engagement (places)	All

7.4 Phase 0 Actions

Phase 0 Actions require immediate attention and have been identified by associated triggers realised through the development process of this initial CCAP for Invercairn and Fraserburgh. These are outlined below. All Trigger are realised at Level 2 meaning that capital intervention should be planned for in the short-term.

- CMU 2:
 - Trigger: Flooding risk threshold exceeded (level 1)
 - **Action:** Increase monitoring and plan for assessment.
- CMU 3:
 - Trigger: Flooding risk threshold exceeded (level 2)
 - **Action:** Undertake assessment and plan for intervention.
- CMU 4:
 - Trigger: Flooding risk threshold exceeded (level 2)
 - **Action:** Undertake assessment and plan for intervention.
- CMU 6:
 - Trigger: Flooding risk threshold exceeded (level 2)
 - **Action:** Undertake assessment and plan for intervention.
- CMU 6:
 - Trigger: Erosion risk threshold exceeded (level 1)
 - **Action:** Increase monitoring and plan for assessment.

As the Implementation Plan is applied at CMU level, the ultimate outcome is dependent on the CMU and the associated Adaptation Pathway. Table 4-5 summarises the general and specific CMU outcomes for the Invercairn and Fraserburgh CA.

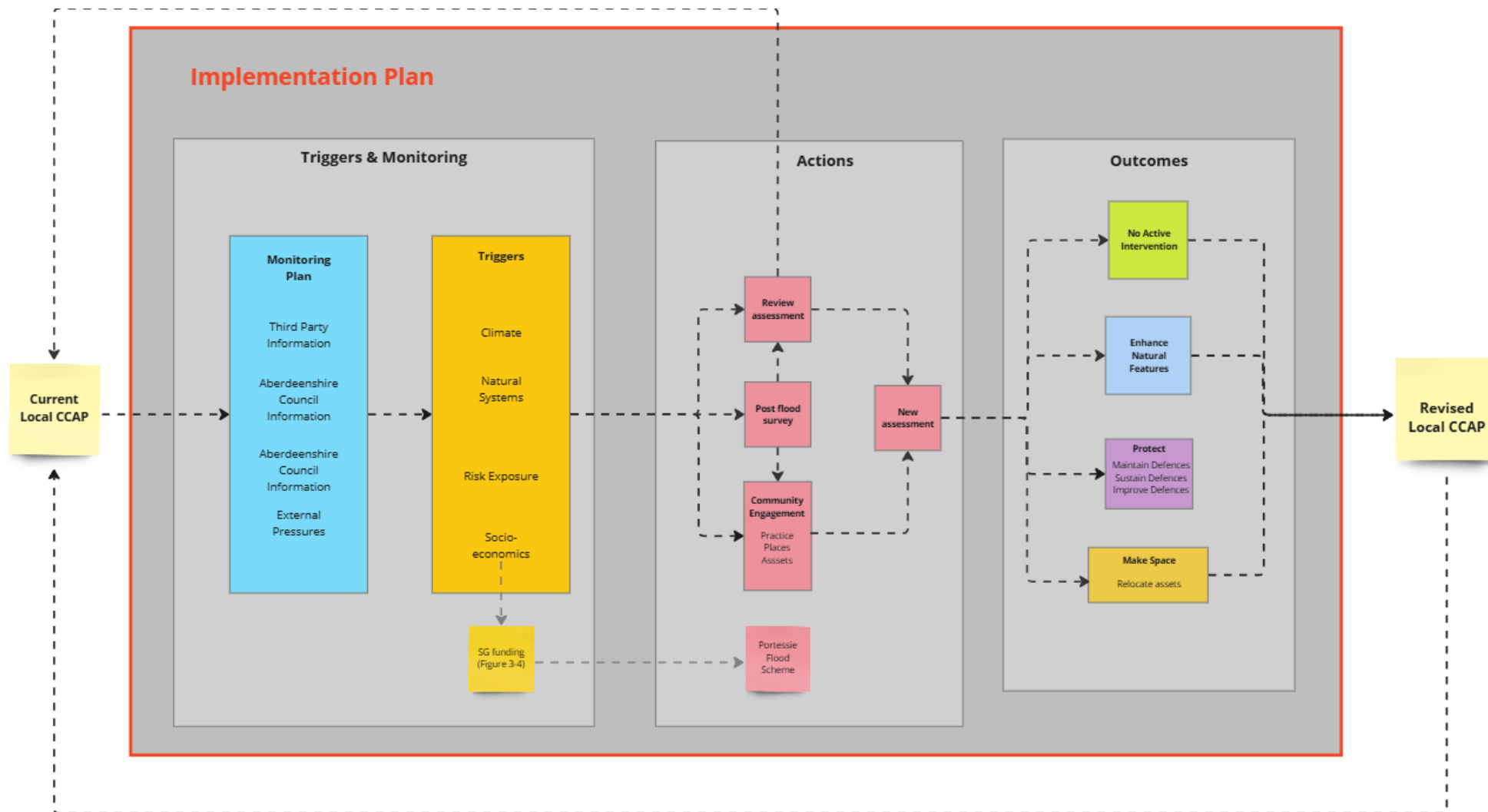


Figure 7-8: Complete Implementation Plan for Invercairn and Fraserburgh CCAP

7.5 Example application

Figure 7-9 provides a schematic describing an example application of the Implementation Plan and how it fits in with the wider Adaptation Framework for Lossiemouth. The red box highlights the processes described in this iteration of the CCAP.

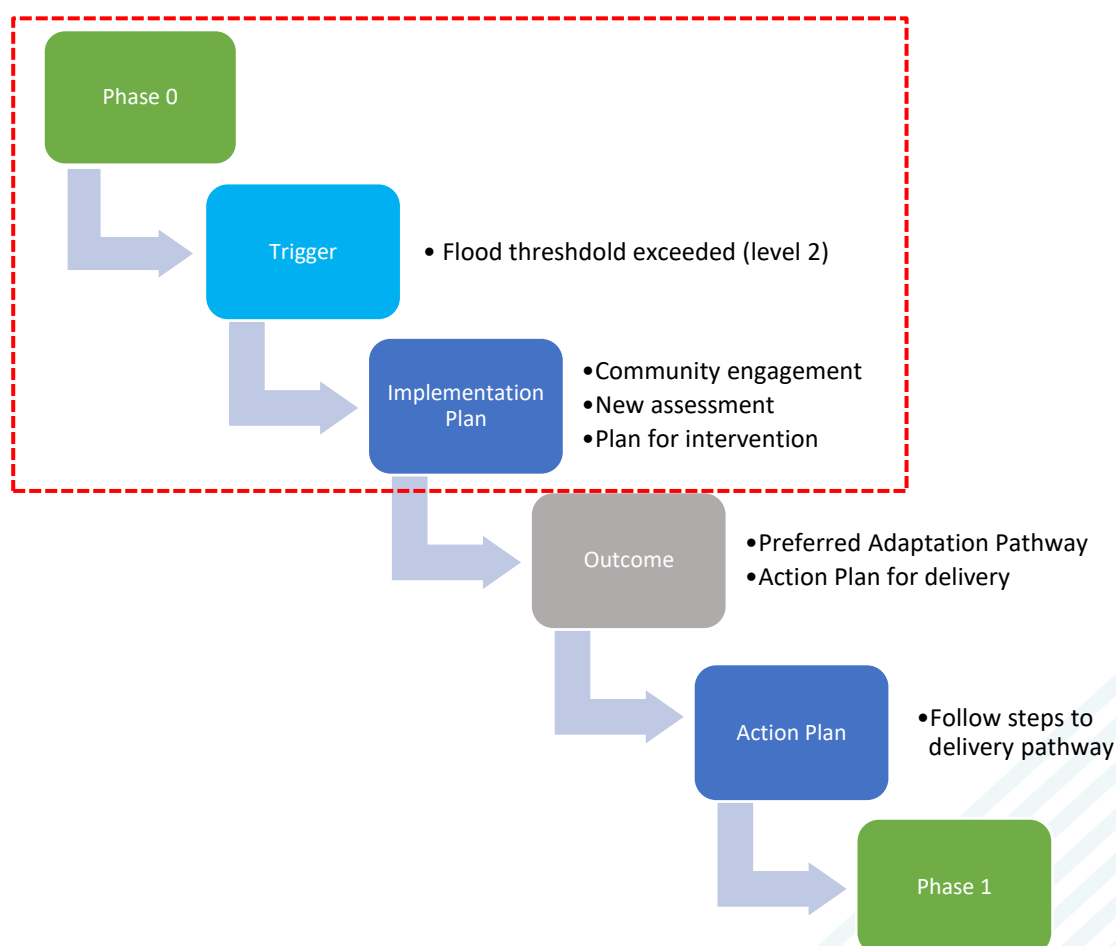


Figure 7-9: Example application of Phase 0 to Phase 1 of the adaptation process and how the Implementation Plan works with Adaptation Pathways and Action Plans.

7.6 Supporting Steps and Proactive Actions

The nature of adaptation means that future decisions and directions are unknown and will be affected by external changes not necessarily under Aberdeenshire Council's influence. It is critical that proactive supporting steps and Proactive Actions are undertaken to enable effective decision making in the future.

Proactive Actions are defined as those whereby there should only be benefit. Undertaking these can therefore only have a positive impact on supporting adaptation or increasing resilience.

At this stage in the adaptation planning process eight such actions have been identified. These have been developed focusing on the key pillar identified previously and through review and understanding of key knowledge gaps. They therefore aim to close these knowledge gaps at this stage and support alignment with wider aspects of the adaptation plan for the region. A summary of these actions is provided in Table 7-4. These are designed to complement the wider Proactive Actions identified in the Regional CCAP.

Table 7-4: Local Proactive Actions

Action	Details	Pillars	
1	Undertaken dune enhancement in CMU 5 and locations with vulnerable core paths	Working with Natural Processes	
2	Develop modelling framework to support future assessments	Working with Natural Processes	
4	Establish coordinated and consistent beach monitoring plan for Natural CMUs	Monitoring Change	
5	Adaptation and resilience workshop with local community and stakeholders	Community and Engagement	
6	Identify landownership and to support safeguarding and land-based planning for CMU with Make Space outcome policies	Place Making	
7	Undertake critical third party sector engagement to quantify wider economic impacts	Community and Engagement	

Action	Details	Pillars	
8	Integrate future erosion projections into Local Development Planning to establish Coastal Change Management Areas	Place Making	

8 Summary and Next Steps

8.1 Approach

This document presents the local CCAP for the Invercairn and Fraserburgh CA. It is the first iteration and will be subject to ongoing review and update to effectively guide the adaptation process. The approach for developing the Plan makes use of available, national information on coastal flood and erosion risk and combines these with relevant local datasets.

Adaptation in Aberdeenshire has been steered by relevant published documentation and the Scottish Governments interim guidance on CCAPs. These have been used to develop a Regional CCAP. This has been simplified into four key pillars of adaptation:

- 1. Working with Natural Processes**
- 2. Monitoring Change**
- 3. Community and Engagement**
- 4. Climate Resilient Placemaking**

This local Plan builds on the Regional Plan by focusing on these pillars to develop an Adaptation Framework that can effectively support Invercairn and Fraserburgh preparing for the impact that climate change will have on the coast. This will be delivered by following the Implementation Plan, presented here, that outlines triggers and associated actions to develop Adaptation Pathways and an Action Plan. This will happen when the process moves into Phase 1.

The following sections provide summaries of the key findings of this initial stage of the adaptation planning process.

8.2 Coastal Management Units and Risks

The Invercairn and Fraserburgh CA was subdivided into eight CMUs. For each of these a refined assessment was undertaken to determine coastal type and associated current and future flood and erosion risk. These are summarised as:

- CMU 1 – Hybrid with Risk
- CMU 2 – Hybrid with Risk
- CMU 3 – Defended with Risk
- CMU 4 – Hybrid with Risk
- CMU 5 – Natural with Risk
- CMU 6 – Hybrid with Risk
- CMU 7 – Natural with Risk
- CMU 8 – Natural with Risk

These were then taken forward to develop Adaptation Pathways and an Implementation Plan with Triggers and Actions associated with each CMU.

8.3 Adaptation Pathways

To enable effective implementation of this CCAP, each CMU has been assigned a generic Adaptation Pathway. This is specific to the CMU classification.

The adaptation journey is a multiphase, multiyear process and aims to transition communities into a more sustainable and resilient future. We are currently at **Phase 0**, meaning that no definitive preferred Adaptation Pathway and associated Action Plan have been developed. To move to **Phase 1** of the Adaptation Pathway, a trigger must be realised that results in New Assessment and a preferred pathway and associated Action Plan must be identified:

1. Phase 0:
 - Development of the Implementation Plan
 - Delivery of Phase 0 Actions
 - Delivery of Phase 0 Proactive Actions
2. Phase 1:
 - Implementation Plan outcomes:
 - Preferred Adaptation Pathway
 - Action Plan for delivery
 - Delivery of Phase 1 Proactive Actions
3. Phase 2+:
 - Implementation Plan outcomes:
 - Preferred Adaptation Pathway
(Continue or revise Phase 1)
 - Action Plan for delivery
(Continue or revise Phase 1)
 - Delivery of Phase 2 Proactive Actions

While ultimately the Adaptation Pathways have a desired outcome, what that looks like and how it will be reached cannot be defined at this stage. Effective monitoring against the set triggers will enable the CCAP to evolve through Phases and support Aberdeenshire Council decision making to aim to achieve this end-outcome.

8.4 Implementation Plan

The Implementation Plan was developed by defining Triggers and setting Actions against these. Implementation of the Plan will result in end outcomes that will ultimately influence the direction of the Adaptation Pathways.

At this stage the pathways do not result in definitive end points. Triggers, while tangible, provide markers whereby Aberdeenshire Council will undertake actions, guided by the

Implementation Plan. The Outcomes of these however, are unknown and the elements of the pathway in the future therefore cannot be defined.

As well as Actions that rely on Triggers being realised. This initial stage of the adaptation planning process has identified several knowledge gaps and opportunities for activities to be undertaken upfront. These are defined as Proactive, whereby undertaking these will only benefit and support Aberdeenshire's adaptation to coastal change.

In total, eight Proactive Actions have been set.

8.5 Next Steps

Adaptation to coastal change will be a continual journey and it is therefore important that the process is ongoing. Here, the following key steps require implementing by Aberdeenshire Council to support this journey and follow CCAP:

- Implement internal governance processes to review and monitor Triggers.
- Deliver local Phase 0 Actions.
- Deliver local Proactive Actions.

A Defence Conditions

A.1 Fraserburgh

CMU	Defence ID (point)	Beach type	Structure Type	Maintenance Regime	Grade	Deterioration Status (S/M/F)	Time to Grade Transition	Date of last assessment	Alert flag	Priority (Regime * grade)	Combination ID	Combo Priority	Flood zone (200yr+CC by 2080)	Erosion (2100)	Risk Score	Rank
1	FRB05	shingle/rock	Concrete wall	2	4	M	7.5	2007	x	8			Y	Y	14.40	6.00
	FRB12	shingle/rock	Rock Armour	2	4	M	5	2007	x	8				Y	18.00	3.00
	FRB15	shingle	Rubble	2	4	M	5	2007	x	8				Y	18.00	3.00
	FRB01	shingle/rock	culvert/gabion baskets	1	2	M	2.5	2007		2			Y	Y	7.20	10.00
	FRB14	shingle	Rubble	2	4	M	5	2007	x	8				Y	18.00	3.00
	FRB23	shingle	Stone wall	2	3	M	10	2007		6					3.00	15.00
	FRB11	shingle	Rock Armour	2	2	M	7.5	2007		4				Y	4.00	11.00
	FRB13	shingle	Rubble	2	5	M	0	2007	x	10				Y	112.50	1.00
2	FRB10	shingle	Rock Armour	2	3	M	10	2025		6					3.00	15.00
	FRB21	shingle	gabion baskets	1	1	M	1.5	2025		1					3.33	12.00
	FRB20	shingle	gabion baskets	1	1	M	1.5	2025		1					3.33	12.00
	FRB04	shingle	Concrete wall	2	1	M	7.5	2025		2			Y		1.60	23.00
	FRB19	shingle	gabion baskets	1	1	M	1.5	2025		1					3.33	12.00
	FRB18	shingle	Concrete wall	2	1	M	7.5	2025		2					1.33	24.00
	FRB09	shingle/rock	Rock Armour	2	4	M	5	2007	x	8	2	8			12.00	7.00
	FRB17	shingle/rock	gabion baskets	1	5	M	0	2007	x	5	2	8			60.00	2.00
3	FRB02	None	Concrete outer break wall	2	2	M	7.5	2007		4					2.67	18.00
	FRB03	None	Concrete outer break wall	2	3	M	10	2007		6					3.00	15.00
	FRB16	Rock	Rubble/Rock Armour	2	4	M	5	2007	x	8					12.00	7.00
4	FRB08	Sand	Rock Armour	2	1	M	7.5	2025		2				Y	2.00	22.00
	FRB07	Sand	Rock Armour	2	1	M	7.5	2025		2			Y	Y	2.40	19.00
	FRB22	Sand	Stone wall	2	1	M	7.5	2025		2			Y	Y	2.40	19.00
	FRB06	Sand	Rock Armour	2	1	M	7.5	2025		2			Y	Y	2.40	19.00
5	FRB24	Dunes	Wooden fences	2	4	M	10	2007	x	8				Y	9.00	9.00

A.2 Inverallochy

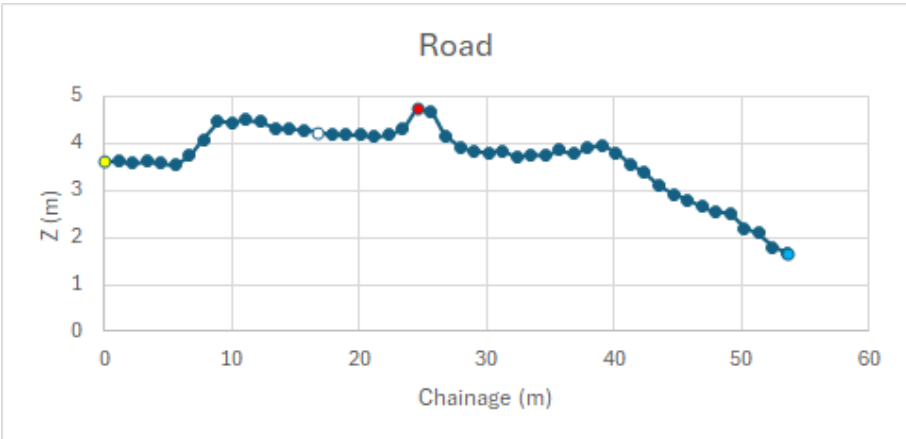
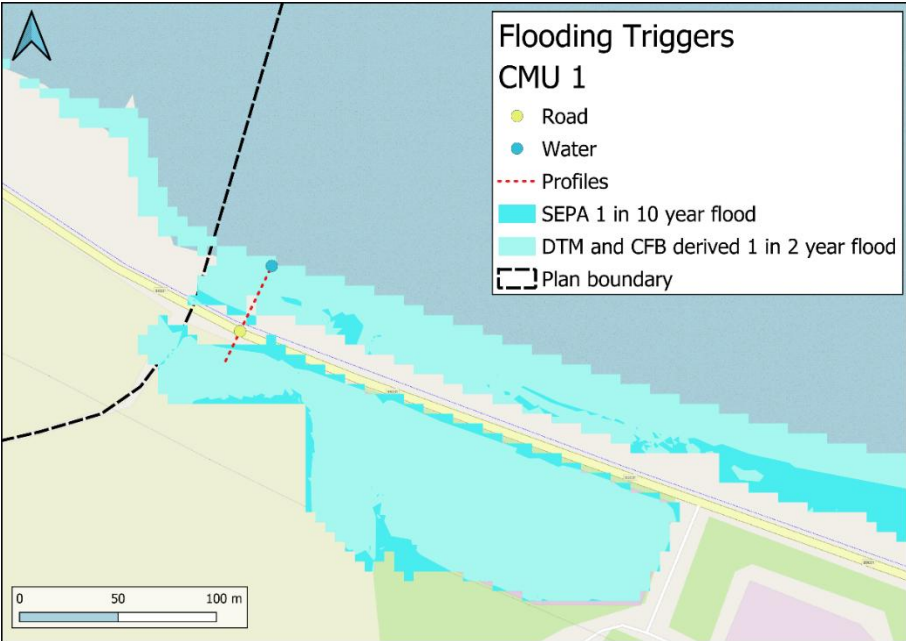
Defence asset IVA08 assumed to be Grade 3 as unable to verify condition from available data.

CMU	Defence ID (point)	Beach type	Structure Type	Maintenance Regime	Grade	Deterioration Status (S/M/F)	Time to Grade Transition	Date of last assessment	Alert flag	Priority (Regime * grade)	Combination ID	Combo Priority	Flood zone (200yr+CC by 2080)	Erosion (2100)	Risk Score	Rank
6	IVA01	Shingle	Concrete lock block wall	2	3	M	10	2018		6			Y	Y	5.40	4
6	IVA02	Rock	Outer harbour concrete wall	2	2	M	7.5	2021		4					2.67	5
6	IVA03	None	Outer harbour concrete wall	2	2	M	7.5	2021		4					2.67	5
6	IVA04	Shingle	Rock armour	2	4	M	5	2018	x	8			Y	Y	21.60	1
6	IVA05	Shingle	Rock armour	2	3	M	5	2023		6			Y	Y	10.80	2
6	IVA06	None	Rock armour	2	2	M	7.5	2021		4					2.67	5
6	IVA07	Sand	Rock armour	2	2	M	7.5	2021		4					2.67	5
6	IVA08	Shingle	Rubble	2	3	M	5	Unknown		6			Y	Y	10.80	2

B Triggers

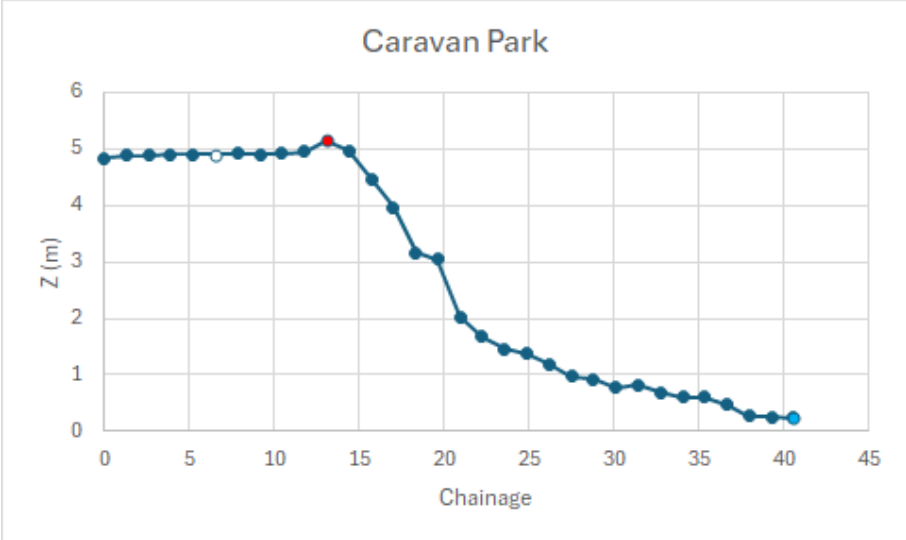
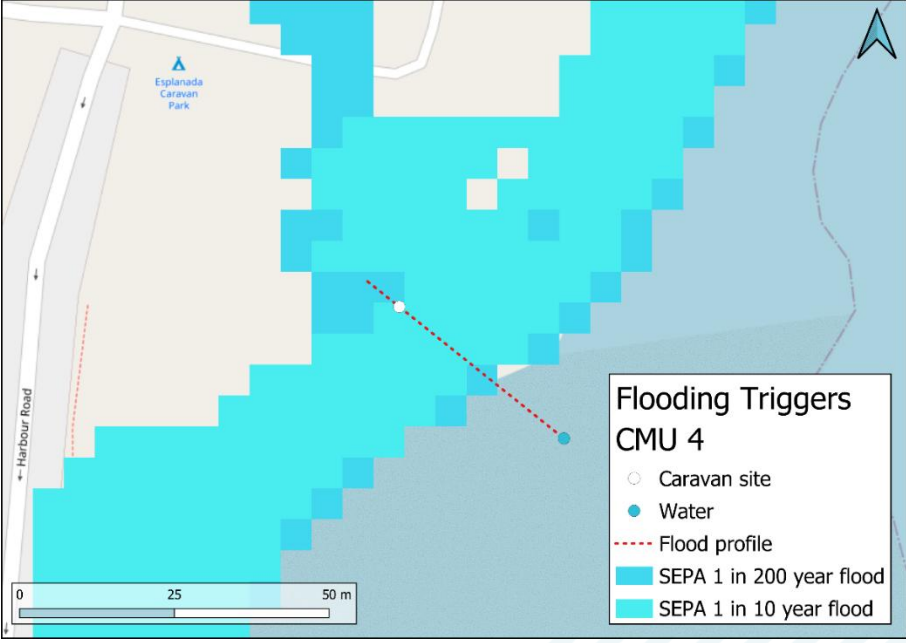
B.1 Flooding Trigger Profiles

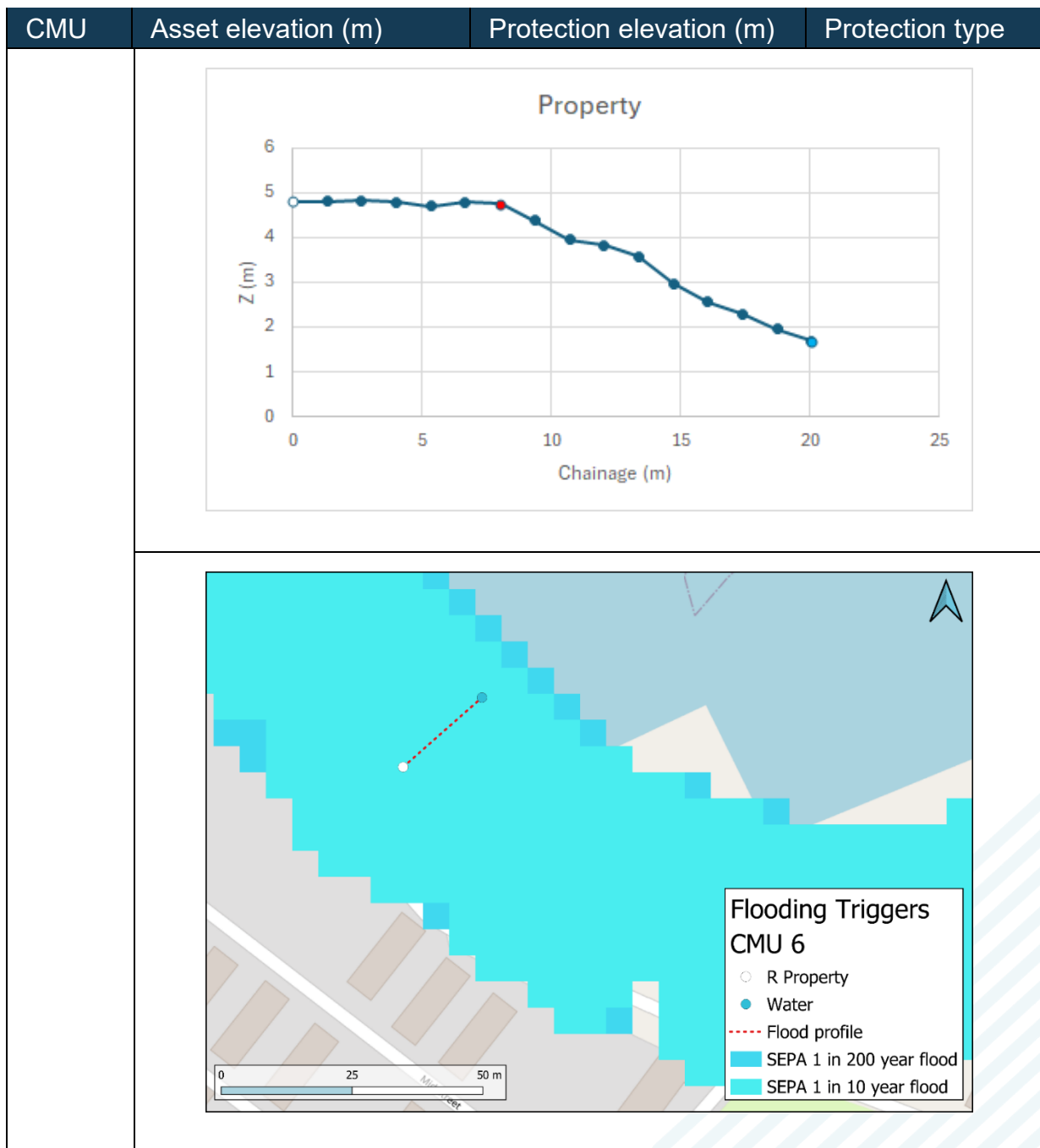
Table 8-1: CMU flooding trigger profiles. Showing elevation for asset at risk and any natural or artificial protection, represented by a red dot.

CMU	Asset elevation (m)	Protection elevation (m)	Protection type
1	4.2	4.7	Dune
			
			
2	6.6	5.7	Concrete wall

CMU	Asset elevation (m)	Protection elevation (m)	Protection type
	Property Z (m) Chainage (m) Flooding Triggers CMU 2 ○ R Property ● Water --- Flood profile - SEPA 1 in 200 year flood - SEPA 1 in 10 year flood 0 50 100 m		
3	3.2	3.2	Inner harbour wall

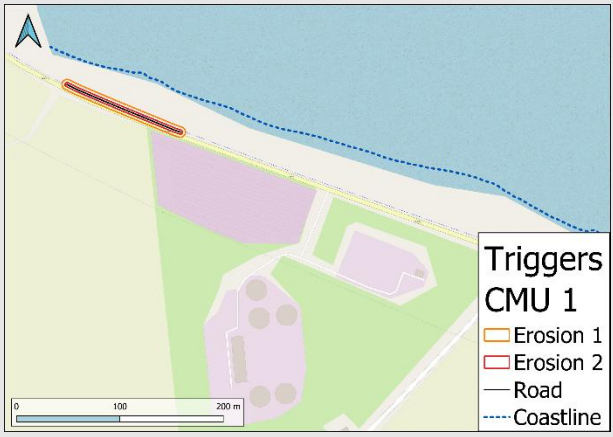
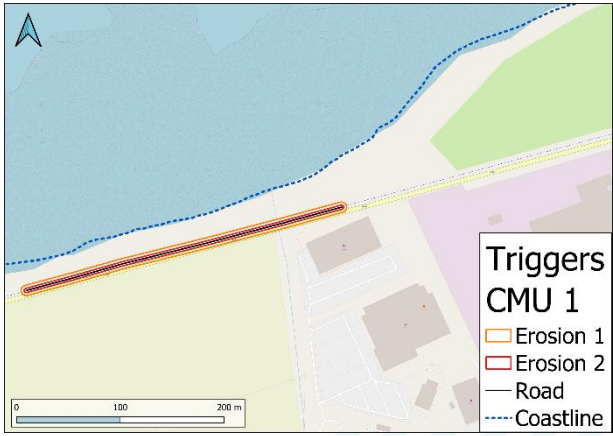
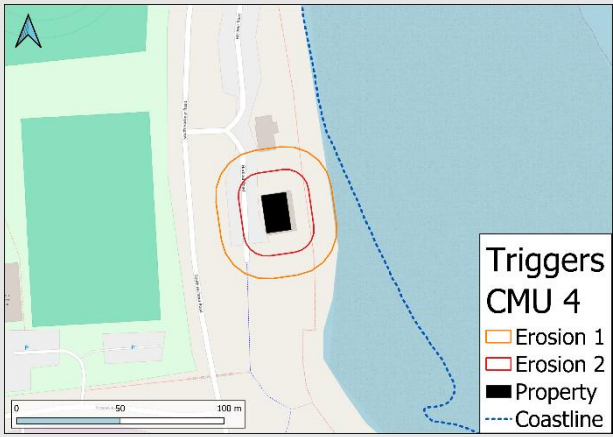
CMU	Asset elevation (m)	Protection elevation (m)	Protection type																																																																		
	Property <table><caption>Property Elevation Data</caption><thead><tr><th>Chainage (m)</th><th>Elevation Z (m)</th></tr></thead><tbody><tr><td>0</td><td>3.20</td></tr><tr><td>1</td><td>3.13</td></tr><tr><td>2</td><td>3.14</td></tr><tr><td>3</td><td>3.18</td></tr><tr><td>4</td><td>3.23</td></tr><tr><td>5</td><td>3.19</td></tr><tr><td>6</td><td>3.19</td></tr><tr><td>7</td><td>3.23</td></tr><tr><td>8</td><td>3.20</td></tr><tr><td>9</td><td>3.25</td></tr><tr><td>10</td><td>3.21</td></tr><tr><td>11</td><td>3.23</td></tr><tr><td>12</td><td>3.19</td></tr><tr><td>13</td><td>3.17</td></tr><tr><td>14</td><td>3.17</td></tr><tr><td>15</td><td>2.88</td></tr><tr><td>16</td><td>2.88</td></tr><tr><td>17</td><td>2.88</td></tr><tr><td>18</td><td>2.88</td></tr><tr><td>19</td><td>2.88</td></tr><tr><td>20</td><td>2.88</td></tr><tr><td>21</td><td>2.88</td></tr><tr><td>22</td><td>2.88</td></tr><tr><td>23</td><td>2.88</td></tr><tr><td>24</td><td>2.88</td></tr><tr><td>25</td><td>2.88</td></tr><tr><td>26</td><td>2.88</td></tr><tr><td>27</td><td>2.88</td></tr><tr><td>28</td><td>2.88</td></tr><tr><td>29</td><td>2.88</td></tr><tr><td>30</td><td>2.88</td></tr><tr><td>31</td><td>2.88</td></tr></tbody></table>			Chainage (m)	Elevation Z (m)	0	3.20	1	3.13	2	3.14	3	3.18	4	3.23	5	3.19	6	3.19	7	3.23	8	3.20	9	3.25	10	3.21	11	3.23	12	3.19	13	3.17	14	3.17	15	2.88	16	2.88	17	2.88	18	2.88	19	2.88	20	2.88	21	2.88	22	2.88	23	2.88	24	2.88	25	2.88	26	2.88	27	2.88	28	2.88	29	2.88	30	2.88	31	2.88
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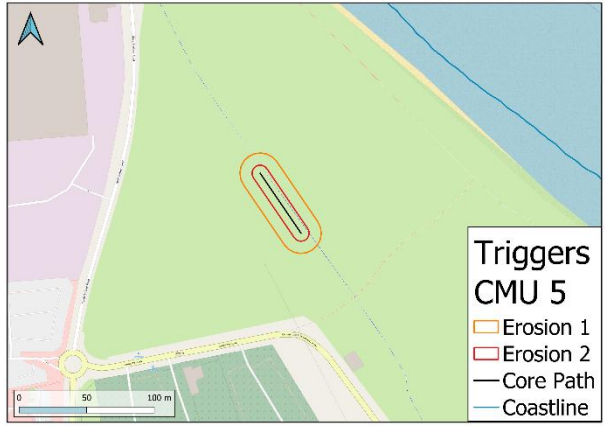
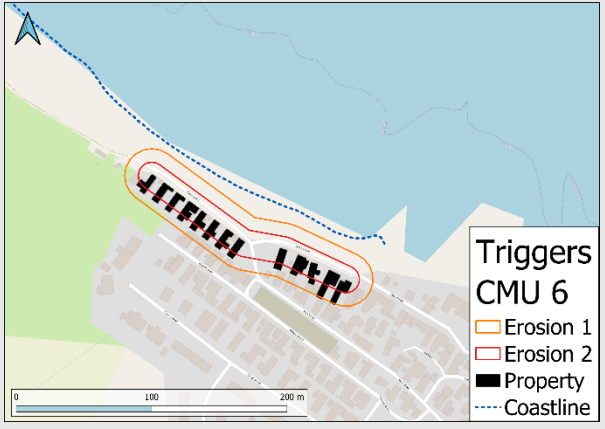
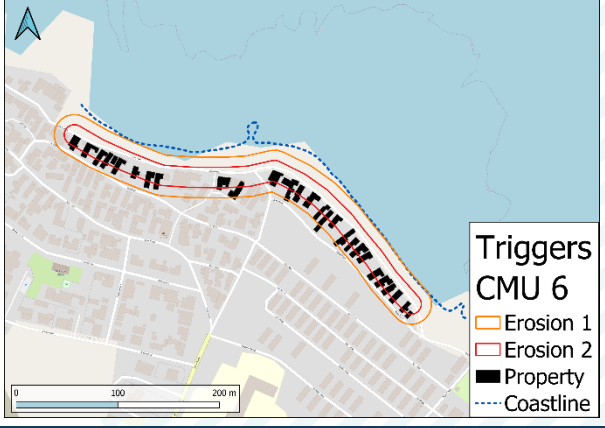
CMU	Asset elevation (m)	Protection elevation (m)	Protection type
	 		
6	4.8	4.8	Concrete lock block wall



B.2 Erosion Trigger Profiles

Table 8-2: Invercairn and Fraserburgh erosion triggers.

CMU	Asset	Trigger Met	Erosion Trigger
1	Road (B9031 – west)	No	 Triggers CMU 1 - Erosion 1 - Erosion 2 - Road - Coastline
1	Road (B9031 - east)	No	 Triggers CMU 1 - Erosion 1 - Erosion 2 - Road - Coastline
4	NRP	No	 Triggers CMU 4 - Erosion 1 - Erosion 2 - Property - Coastline

CMU	Asset	Trigger Met	Erosion Trigger
5	Core path	No	
6	RP	No	
6	RP/NRP	Yes (Level 1)	

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Bristol
Coleshill
Doncaster
Dublin
Edinburgh
Exeter
Glasgow
Haywards Heath
Isle of Man
Leeds
Limerick
Newcastle upon Tyne
Newport
Peterborough
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