

Moray Coastal Change Adaptation Plan

Kinloss to Hatton Coast

Final Report

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Contract

This report describes work commissioned by Will Burnish, on behalf of Moray Council, by a letter dated 9 August 2022. Moray Council’s representative for the contract was Will Burnish. William Mortimer, Katie Corbett, and Doug Pender of JBA Consulting carried out this work.

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Purpose

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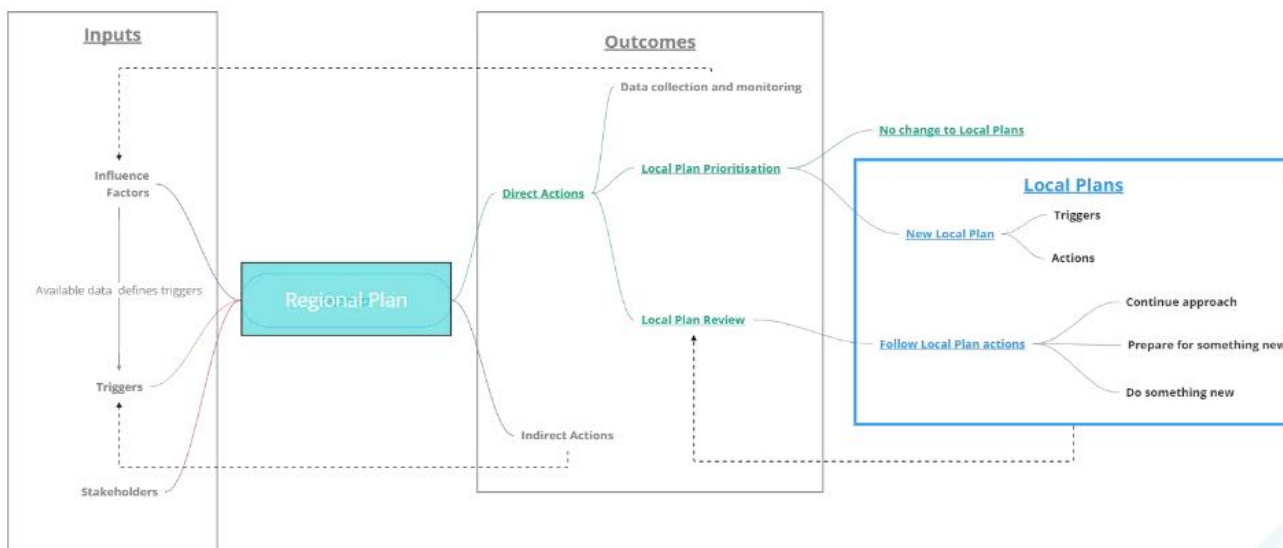
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Executive summary

The report documents the Coastal Change Adaptation Plan (CCAP) for the Kinloss to Hatton Community Area (CA) in Moray. It forms one of the eleven Local Plans, for the Moray Council region.

It aligns with the wider Regional Plan¹ and forms the highest level of detail of the overall Coastal Change Adaptation Planning process adopted by Moray Council.



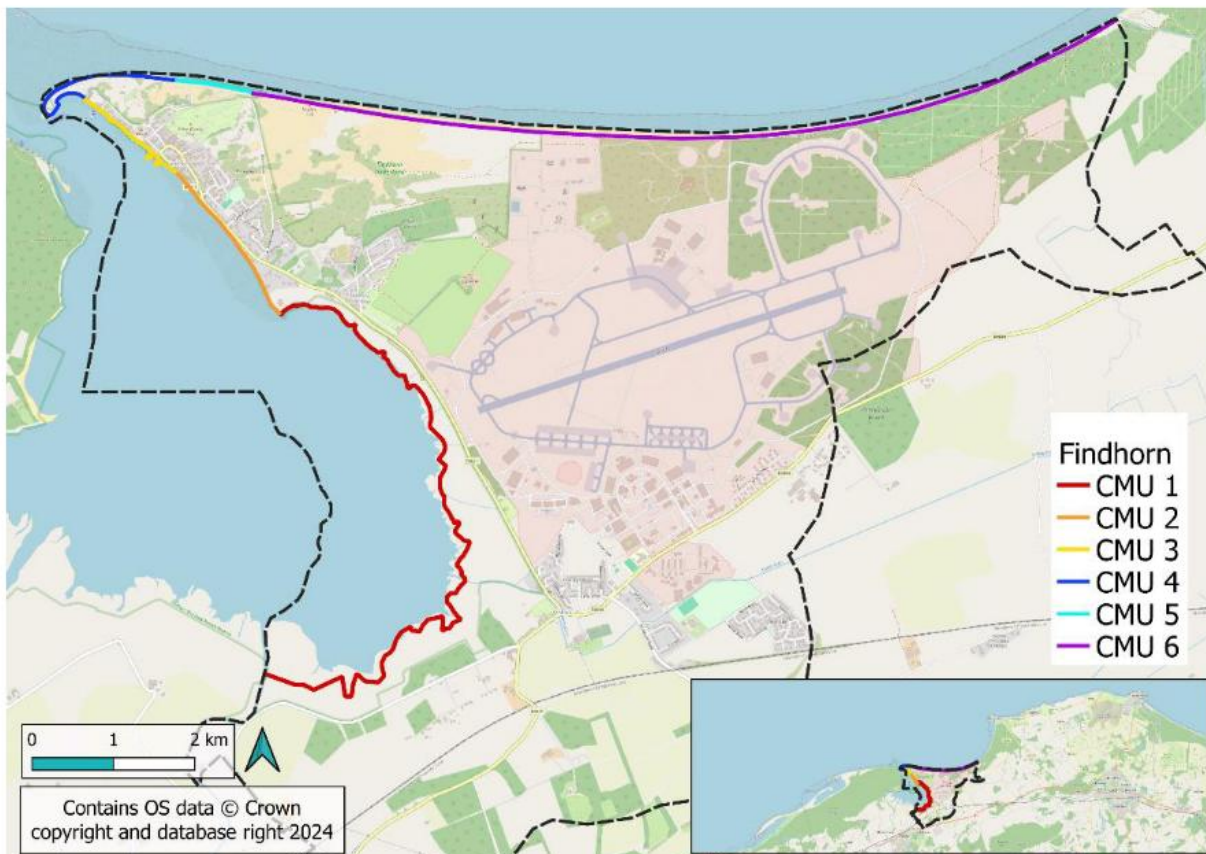
The CCAP provides an overview of the coastal flood and erosion risks to the Kinloss to Hatton Coast, which are used to underpin development of possible Adaptation Pathways for this community. These are presented, along with a framework to support proactive coastal risk management, enable implementation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

The Plan has been developed using available datasets from Moray Council, SEPA, and the Dynamic Coast Project. It aims to directly support statutory and non-statutory Moray Council policies, plans, and strategies and aligns with key coastal climate change adaptation guidance and resources within and beyond Moray 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 Moray 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 1) classification of coastal landform type, and 2) risk associated with coastal flooding and erosion. A total of six CMUs were identified, and associated Adaptation Pathways developed for each.

¹ Moray Coastal Change Adaptation Plan: Regional Plan - IRR-JBAU-XX-XX-RP-MO-0001-S4-P03-Regional_Plan



The framework is to be delivered through the defined 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 an appropriate Outcome is identified. Adaptation interventions are potential measures that can be applied. There are four possible categories:

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

A set of Phase 0 Actions have been identified, that require immediate attention because of Triggers being met in this iteration of the Kinloss to Hatton Coast CCAP. 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 across the Kinloss to Hatton Coast.

The current iteration of the Kinloss to Hatton Coast CCAP is at Phase 0. Triggers met in Phase 0 and associated Actions for each CMU are summarised in the table below. These will be delivered during the first cycle.

Full details of the Phase 0 Actions are included in Appendix C and documented in Section 4.4.

CMU	Trigger	Action
1	Flood Trigger Exceeded	Undertake assessment and plan for intervention
2	No current Triggers	No current Actions
3	Flood and Erosion Trigger Exceeded	Undertake assessment and plan for intervention
4	No current Triggers	No current Actions
5	No current Triggers	No current Actions
6	No current Triggers	No current Actions

As well as Triggers and Actions that correspond directly to the Adaptation Pathway and specified CMUs, Proactive Actions that support the whole of the Kinloss to Hatton Coast are summarised below:

- 1) Investigate opportunities for natural dune enhancement.
- 2) Establish coordinated and consistent beach monitoring plan for Natural CMUs.
- 3) Adaptation and resilience workshop with local community and stakeholders.
- 4) Identify landownership and safeguarding space.
- 5) Develop modelling framework to support future assessments of natural processes and Moray defences.

Again, these will be delivered during this first cycle.

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Abbreviations

CCAP	Coastal Change Adaptation plan
CA	Community Area
CMU	Coastal Management Unit
DC	Dynamic Coast
mAOD	meters Above Ordinance Datum
MHWS	Mean High Water Spring
NFRA	National Flood Risk Assessment
NRP	Non-residential Property
RCP	Representative Concentration Pathways
RP	Residential Property
SEPA	Scottish Environment Protection Agency
SLR	Sea Level Rise

Glossary

Accretion*	The build-up of sediment resulting in the seaward movement of the coast/ Mean High Water Springs.
Actions*	A plan or policy option that promotes an adaptive approach to coastal change that makes use of long term or resilient solutions such as preserving natural features.
Action Plan*	The proposed strategy or course of action to be taken depending on trigger point reached.
Adaptation*	The adjustment in economic, social, or natural systems in response to actual or expected climate change, to limit harmful consequences and exploit beneficial opportunities.
Adaptation Pathways*	A flexible way of managing future uncertainty by planning for multiple scenarios without rigid timelines responding to the nature of future changes as they unfold.
Asset*	An item, such as a building, that is deemed to have an economic, social, or cultural value (or combination of).
Decision point*	A management action based on a trigger being reached.
Erosion*	The removal of sediment resulting in the landward movement of the coast (Mean High Water Springs)
Hard coast*	Coast that is comprised mainly of materials resistant to erosion such as hard rock types or artificial structures.
Implementation Plan	The framework developed in this first iteration, or Phase 0 of the Adaptation Pathway to support Moray Council in the development of Action Plans for each CMU.
Implementation Plan Actions	Actions that Moray Council will deliver in response to a Trigger being met and will determine the Outcome of the phase of the Adaptation pathway.
Outcomes	Outcomes of the Implementation Plan determine the current path of the Adaptation Pathway.
Soft coast*	A coast composed of unconsolidated sediments, which is not inherently resilient to erosion, but relies on the balance of natural processes to maintain its shape in response to storms and everyday processes.
Triggers*	Either a physical process or an enabler/inhibitor that when reached or a threshold crossed.

*Term definitions from Scottish Government Coastal Change Adaptation Plan Guidance²

² https://www.dynamiccoast.com/files/ccapg_2023feb.pdf

1 Introduction

1.1 Coastal Change Adaptation Planning in Moray

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

We can no longer use traditional, engineered, coastal risk management approaches in isolation to protect society against these risks. Instead, we must, as a society, 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 society responds to the current and future risks can help to reduce costs and negative impacts, such as assets eroding into the sea or suffering an increased flooding frequency. 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 Moray the coast has been subdivided into Community Areas (CAs) (Figure 1-1). The Kinloss to Hatton Coast is one of eleven Cas, recognised in the Regional Coastal Change Adaptation Plan (CCAP). The coast of the Kinloss to Hatton CA comprises a wide estuarine bay, a soft natural sandy spit, and an expansive sandy beach backed by dunes. The coast is generally soft and easily eroded. For example, in the future the Dynamic Coast has projected as much as 246 m of shoreline retreat could be realised by 2100 at the western extent of Findhorn Beach. In addition, the southern edge of Findhorn is already at risk from coastal flooding, which will increase in the future with the addition of climate change pressures.

This provides the justification for a more detailed local CCAP, which is contained in this document.

The entire Coastal Change Adaptation Plan for Moray is contained within a series of documents, the following should be consulted alongside this CCAP to provide context on the overall process.

- IRR-JBAU-XX-XX-RP-MO-0001-S4-P03-Regional_Plan
 - Provides the region wide plan and process to deliver coastal adaptation across Moray.
- IRR-JBAU-XX-XX-RP-MO-0007-S4-P03-Coastal_Change_Adaptation
 - Provides information on the concept of coastal change adaptation and how this has been applied to the Moray Coastal Change Adaption Plan.

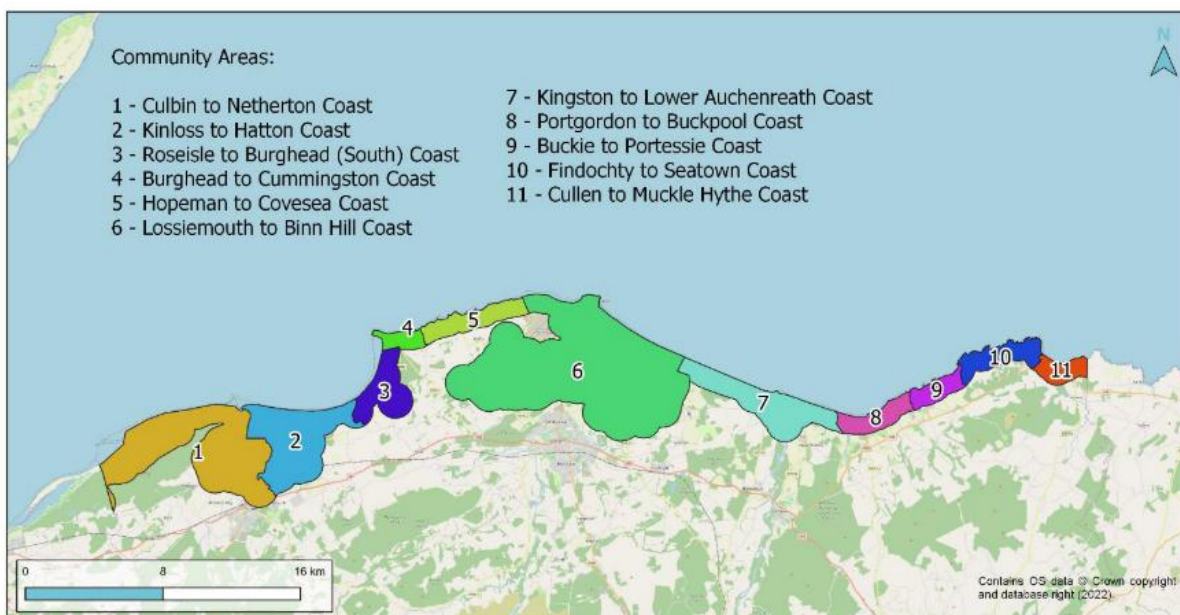


Figure 1-1: Extent and location of CAs within Moray

1.2 What is a Local CCAP?

A Local CCAP follows the same principle as the Regional CCAP 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 Influence Factors (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.

1.3 What are adaptation pathways?

Adaptation Pathways are flexible tools that can be used by local authorities, politicians, local businesses, and residents to make current and future decisions across all involved sectors to accommodate coastal change and associated uncertainty.

As well as the traditional management, they should identify opportunities to work with natural processes, enhance the environment and include necessary supportive steps to **create space** (e.g. accommodate erosion through land safeguarding) in preparation for inevitable future sea level rise and associated increases in erosion and flooding.

1.4 What do adaptation pathways do?

Adaptation Pathways aim to identify climate resilient risk management and development pathways for each or CMU; the phases in the pathways, provide flexibility for decisions at various points on the pathway to be modified dynamically through time.

Triggers are used in Adaptation Pathways to signal when the current management approach should be reviewed, and possibly changed, in response to updated information or change of circumstance i.e., risk has increased.

1.5 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 that are land-based will result in a sustainable adaptation journey for Moray. 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.

1.6 Where are we on the adaptation journey?

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 Moray. 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.

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 Kinloss to Hatton Coast. It then identifies and promotes a process that, when implemented by Moray 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.

1.7 What is the Phase 0 Adaptation Framework?

The overall aim of the framework set out in this Local CCAP is to:

Guide Moray Council towards development of detailed Adaptation Pathways and associated Action Plans for the Kinloss to Hatton Coast 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 of future Adaptation Pathways.
- Present coastal flood and erosion risk for each CMU.
- Develop an Implementation Plan to be used by Moray Council to support adaptive decision making, future action planning and evaluation of adaptation options.
- Identify CA and CMU specific Triggers that will influence adaptation decision making.
- Identify and set Proactive Actions that will support delivery of the CCAP in each CMU.
- Inform and support the Local Development Plan⁵ and Local Planning Policy. These should be implemented in parallel to avoid future risk by making space for change.

1.8 How has this framework been developed?

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

³ Scottish Government (2023) Coastal Change Adaptation Plan Guidance – Interim
https://www.dynamiccoast.com/files/ccapg_2023feb.pdf

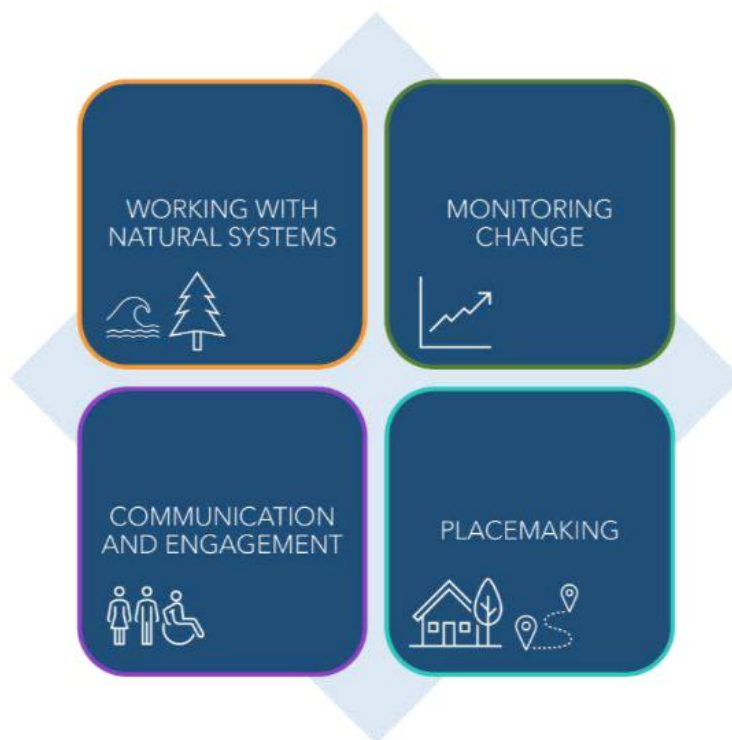


Figure 1-2: Four pillars of coastal adaptation for Moray

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

The Regional CCAP links to the Local CCAP in the following ways:

1. Defines the **prioritisation** of Local CCAP with risk, development, management, and socio-economic Influence Factors (see Regional Plan for more details).
2. Sets wide **Proactive Actions** that, when implemented, should be used to support Local CCAP Action Plans.
3. Provides 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 Kinloss to Hatton Coast CA covers an area of ca. 19.2 km² and is located between the Culbin to Netherton Coast CA and Roseisle to Burghead (South) CA (Figure 1-1). The CA includes a range of coastal environments and land use types. The southern part of the CA also sits within SEPA Potentially Vulnerable Area (PVA) due to the flood risk identified in the Flood Risk Management Plan⁴ (Figure 2-1).

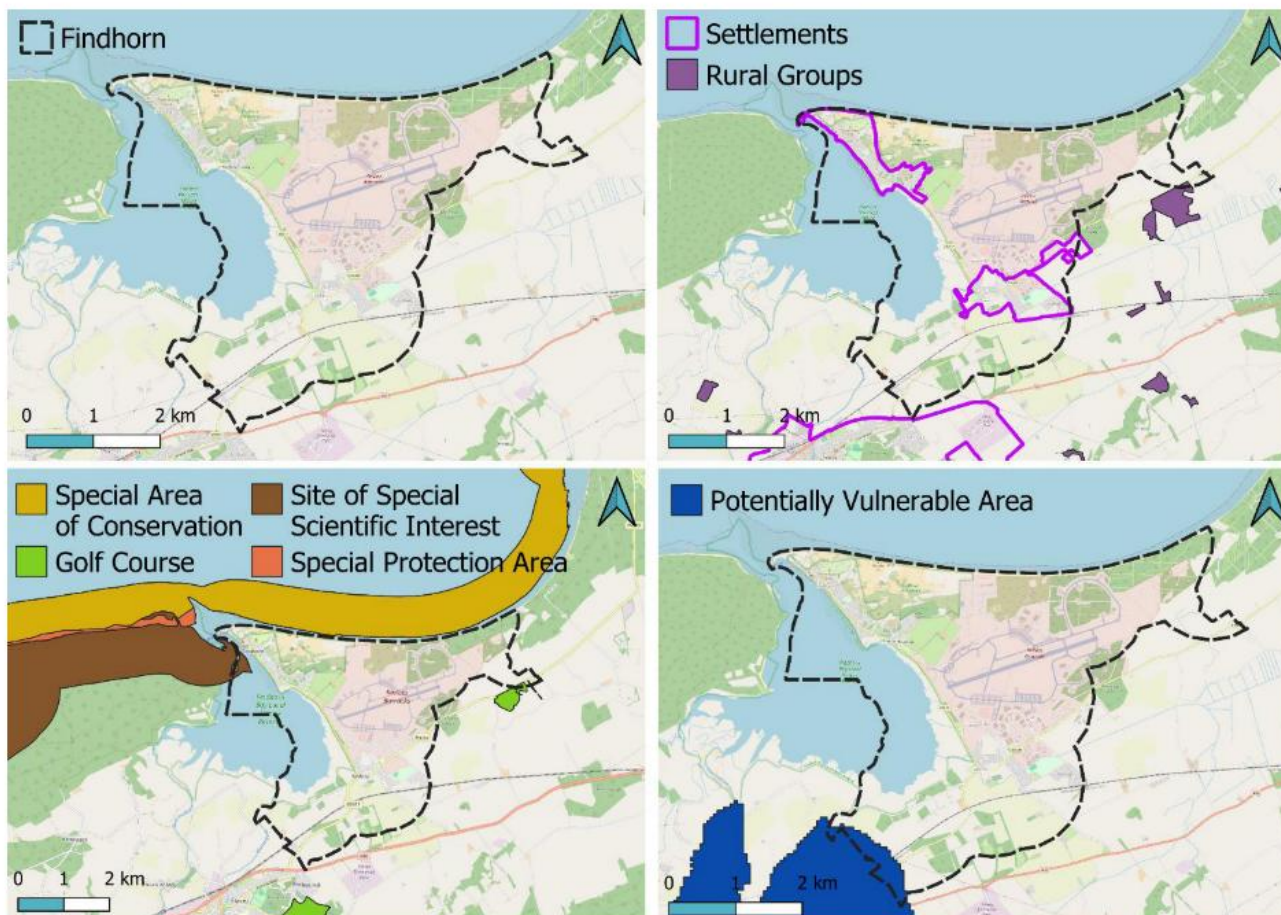


Figure 2-1: Kinloss to Hatton Coast CA, showing settlements, greenspace and environment and special consideration areas.

Settlements:

The Kinloss to Hatton Coast CA includes the settlements of Kinloss and Findhorn. This local area has a population of 2,401 residents with 950 households⁵. The Moray Council LDP has identified designation areas for specific land use in settlement. There are no identified rural groups⁶.

4 Moray Council. 2016. Findhorn, Nairn and Speyside Local Flood Risk Management Plan. Section 2.4.4. <http://www.moray.gov.uk/downloads/file105636.pdf>

5 Moray Council. 2020. Moray Local Development Plan. Volume 2: Settlement Statements. http://www.moray.gov.uk/moray_standard/page_133431.html

6 Moray Council. 2020. Moray Local Development Plan. Volume 3: Rural Groupings

Greenspace and Environment:

The CA is an environment of national importance. The entire coastline, including the coastal waters of the Kinloss to Hatton Coast CA is a NatureScot designated Special Area of Conservation (SAC) and Special Protected Area (SPA). The area of Findhorn Bay is a NatureScot designated Site of Special Scientific Interest (SSSI) and Local Nature Reserve (LNR) and designated a Ramsar Site under the Ramsar Convention. The entrance to Findhorn Bay is also a Geological Conservation Review Site.

Special consideration areas:

The Kinloss to Hatton Coast CA contains part of the Kinloss Potentially Vulnerable Area (PVA) (Figure 2-1 (d)) as identified in the Findhorn, Nairn, and Speyside Local Flood Risk Management Plan (02/05/14)⁷.

Habitats:

There are five key coastal habitats along the extent of the Kinloss to Hatton coast CA identified by NatureScot (Figure 2-2). These habitats include vegetated and unvegetated shingle, unvegetated mobile shingle, salt marsh and salt meadows, and dunes.

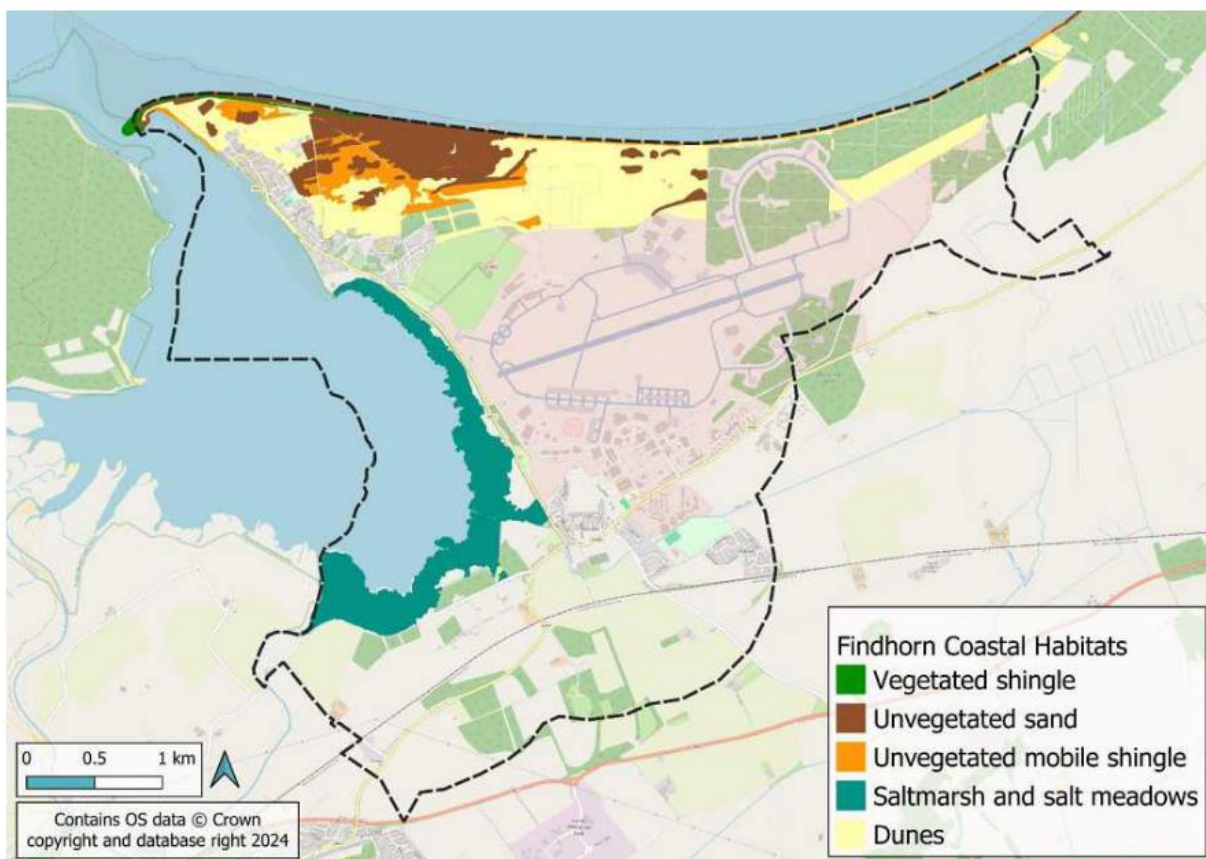


Figure 2-2: Coastal habitats at Kinloss to Hatton Coast as identified by NatureScot.

⁷ Moray Council - 2022 - Findhorn, Nairn, and Speyside Local Flood Risk Management Plan. <http://www.moray.gov.uk/downloads/file145841.pdf>

2.2 Coastal Management Units

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

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

Assets referred to in the risk classification include residential/non-residential properties, key roads, and infrastructure.

Following this, the Kinloss to Hatton Coast CA has been subdivided into six CMUs (Figure 2-3). The CMUs are described below including a summary of the coastal change and flood risk. Full details of each CMU are provided in Appendix A.

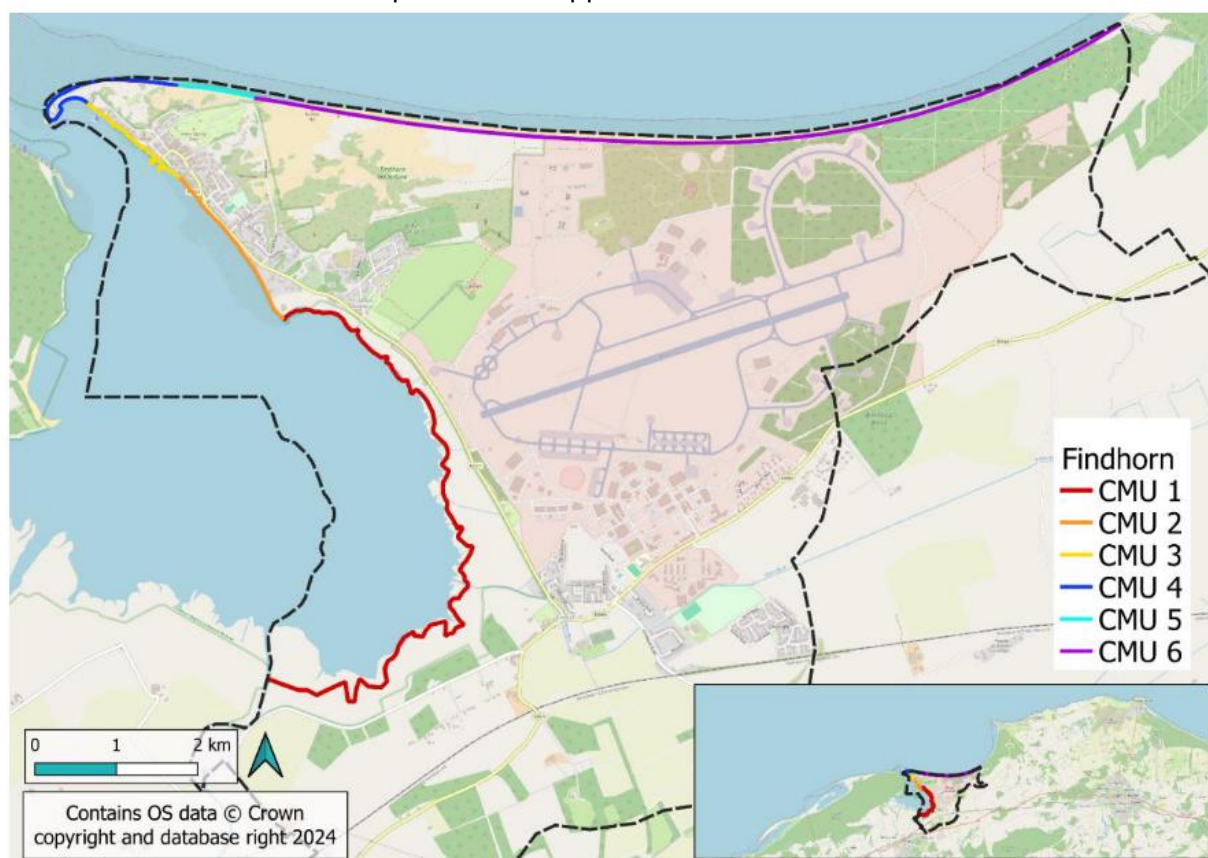


Figure 2-3: Kinloss to Hatton Coast CMU divided coastal extents.

2.2.1 CMU 1: Findhorn Bay - Natural

This CMU is natural and characterised by a low-lying intertidal estuary fronted by saltmarsh. The frontage comprises the south-eastern extent of Findhorn Bay, a delicate and important environment for ecology and bird conservation. There is no coastal erosion forecast by Dynamic Coast for the area and MHWs appear to have remained stable from 1890 to the present day. There are no engineered coastal defences present within this CMU.

Immediately south of the saltmarsh is Waterford Road leading to Kinloss in the east. East of the CMU frontage and north of Kinloss is the B9011 which leads to Kinloss Barracks, a Ministry of Defence (MOD) owned facility, is immediately adjacent to the eastern frontage of CMU 1. The end of the runway is approximately 450 m from the current coastline. SEPA coastal flood hazard maps show the runway and associated hangar buildings are potentially at risk from coastal flooding from a 1-in-200-year extreme sea level event in the present day, and increasingly so with climate change allowances.

2.2.2 CMU 2: Findhorn South – Built Structures

The frontage is defended with a combination of concrete revetments and rock armour. There are several properties located close to the coastline. The B9011 runs directly adjacent to the northern half of the CMU frontage, and the road is relatively low-lying. There is currently no coastal erosion predicted in this CMU by the Dynamic Coast project.

SEPA flood maps show that there is flood risk from a 1-in-200-year extreme sea level event in the present day to one non-residential property at the southern extent of the CMU. Allowing for climate change, the SEPA flood maps show there is no increase in flood risk to properties across the CMU compared to the present-day extent.

2.2.3 CMU 3: Findhorn Central – Built Structures

This CMU is defended by a series of structures. The unit comprises the central high-street of Findhorn. The frontage predominantly consists of concrete walls and rock armour atop a sand and shingle beach. There is a predicted hazard of both erosion and coastal flooding in this unit. As a result, several residential and non-residential properties, businesses, the B0911 road, and Findhorn Marina are within the Dynamic Coast projected erosion extents by 2100. The current maximum rate of erosion given by Dynamic Coast is 0.5m/yr, which is expected to rise to 1.1m/yr by 2100. This may result in a land loss of greater than 60m by 2100.

2.2.4 CMU 4: Findhorn Spit – Natural

This CMU is a natural sandy spit protruding west across the mouth of the Findhorn Bay estuary. The spit is dominated by well-established vegetated dunes and is fronted by a sandy beach to the north and a dynamic tidal inlet to the south. Being a spit, the CMU will be highly dynamic in position and may well retreat or advance in response to short-term storm events or variations in the Findhorn River flow. Dynamic Coast data shows that historically (from ca. 2003 to 2011) this section of coast eroded at a maximum rate of 1.6 m/yr. Maximum future erosion rates are expected to increase to 4.1 m/yr by 2100. This would result in a potential maximum 243 m of land loss caused by shoreline retreat by 2100.

The Findhorn Beach carpark, public toilets, and motorhome layover facility located on the north coast of this CMU is at risk of both coastal flooding and erosion. Dynamic Coast predicts that the carpark may be at risk of erosion by 2060 and is at risk of a 1-in-200-year extreme sea level event in the present day.

2.2.5 CMU 5: Findhorn Leisure Park – Hybrid

The frontage at this unit comprises a rock armour revetment fronted by a composite sand and shingle beach. Behind the rock armour revetment is an established strip of vegetated dunes, with the Dune Road carpark behind and the Findhorn Sands Leisure Park just south of the carpark.

SEPA flood maps show there is currently no predicted risk from flooding to assets, although two caravan positions may be at risk of coastal flooding when factoring for climate change allowances.

Erosion projections from Dynamic Coast show reduced erosion extents across CMU 5, due to the presence of the rock revetment. Dynamic Coast data shows that the shoreline in CMU 5 has retreated at a maximum rate of 1.6 m/yr. Maximum future erosion rates are expected to decrease to 1.1 m/yr by 2050 and to 0.0 m/yr by 2100. This would result in a maximum of 33.5 m of land loss caused by shoreline retreat by 2100. This however is highly uncertain and because of the interaction and assumptions around the rock armour structure.

2.2.6 CMU 6: Findhorn Beach East – Natural

This unit comprises a large natural sandy beach backed by established dunes and vegetation. South of the frontage here is the northern extent of Kinloss Barracks, owned by the MOD. Here, the Dynamic Coast data shows that historically (from ca. 2003 to 2011), this section of coast eroded at a maximum rate of 0.5 m/yr. Maximum future erosion rates are expected to increase to 4.2 m/yr by 2100. This would result in a maximum potential 227.2 m of land loss caused by shoreline retreat by 2100.

2.3 CMU categorisation for local adaptation plan

Review of the characteristics and risk associated with each CMU led to the classifications summarised in Table 2-1. These were used to develop initial Adaptation Pathways, Triggers, and an associated Implementation Plan.

Table 2-1: Kinloss to Hatton Coast CMU categorisation.

CMU	Coastal Type Classification	Risk Classification
1	Natural	Risk and Hazard
2	Built structures	Risk and Hazard
3	Built structures	Risk and Hazard
4	Natural	Risk and Hazard
5	Hybrid	Risk and Hazard
6	Natural	No Risk and Hazard

3 Adaptation Pathways

Development of Adaptation Pathways for each CMU are based on the classification presented in Table 2-1. 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 to the following factors at the coast and on land adjacent to the coast:

- **Natural systems**
 - Habitat.
 - Greenspace.
- **Climate**
 - Climate change guidance.
 - SEPA flood maps or risk assessments.
 - Coastal flood occurrence.
 - Coastal erosion risk.
- **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.
 - Tourism.

Adaptation Pathways for each CMU are presented in the following sections.

3.1 Natural Adaptation Pathways

CMU 1, 4 and 6 are all classified as natural coasts and have been assigned an adaptation pathway for natural coastlines with risk from erosion, flooding, or both (Figure 3-1):

- **CMU 1 = Natural with Risk and Hazard**
- **CMU 4 = Natural with Risk and Hazard**
- **CMU 6 = Natural with No Risk and Hazard**

Phase 0 of the adaptation pathway (1st column) is the current action undertaken by Moray Council in respect of these CMUs. Here this is **No Intervention**. This means that there will be no coastal and/or erosion risk management interventions during this phase.

For the adaptation pathway to move to Phase 1 (2nd column of potential actions) a pre-defined Trigger must be realised. Then, depending on the outcome of any Implementation Plan Actions, this may or may not result in a change to the management approach adopted for the CMU.

Consultation of the CCAP Implementation Plan (Section 4.1) will guide the process and ultimately the pathway to adaptation.

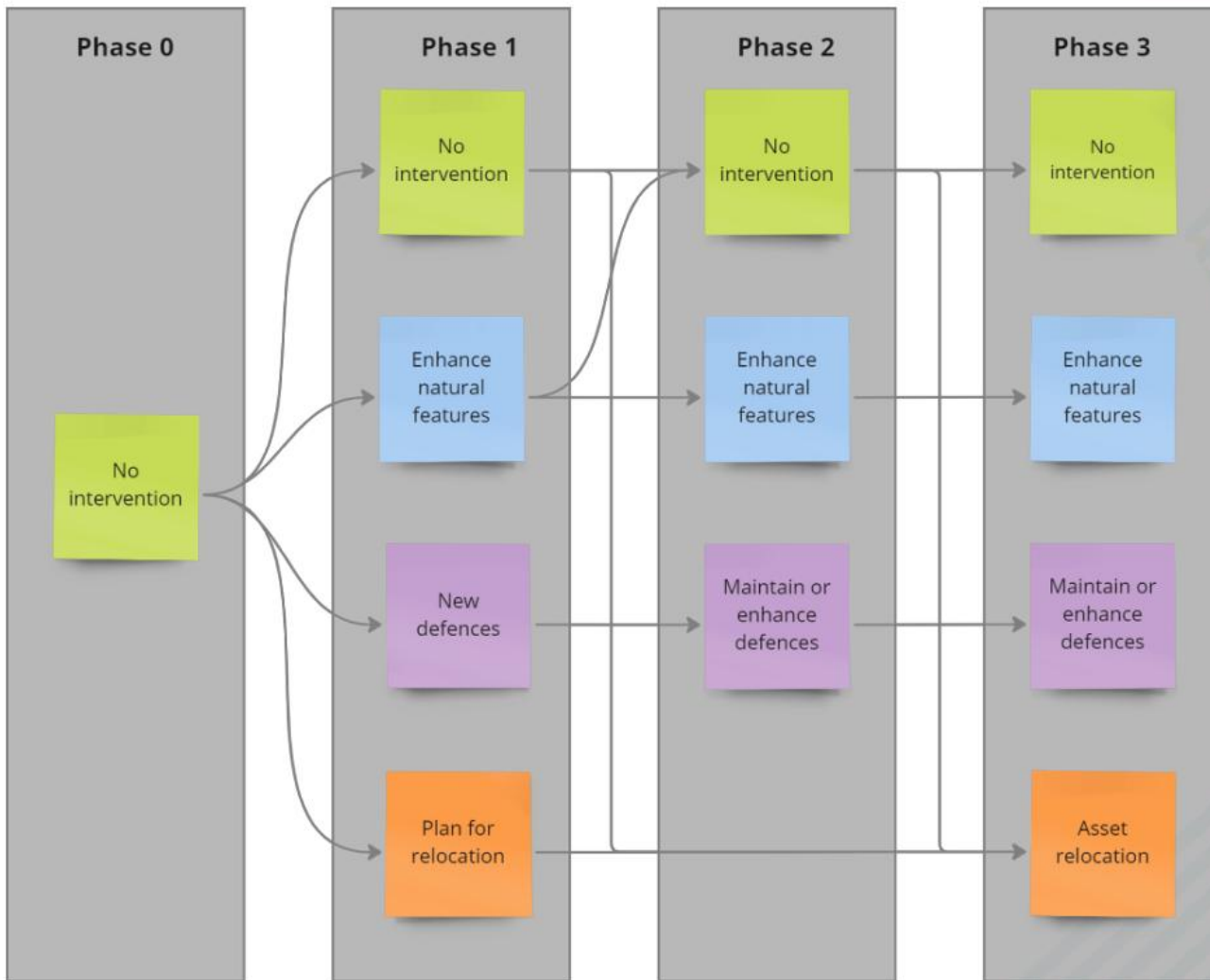


Figure 3-1: Adaptation Pathway for CMUs 1, 4, and 6 (natural coast). Grey lines represent possible future pathways.

3.2 Hybrid Adaptation Pathway

CMU 5 is classified as a hybrid coastline with risk and hazard from flooding and erosion (Figure 3-2). CMU 5 is predominantly natural composite sand shingle beach that is backed by a rock armour revetment. Within this unit there is a slight hazard presented by coastal flooding which marks three residential properties and two caravan sites on the leisure park at risk. There is also an erosion hazard that puts the rock armour revetment at risk. (Figure 3-2).

- **CMU 5 = Hybrid with Risk and Hazard**

Phase 0 of the adaptation pathway (1st column) is the current actions undertaken by Moray Council in respect of these CMUs, here this is **No Intervention**. There will be no coastal and/or erosion risk management interventions during this phase. However, maintenance of existing structures may be undertaken if there is a risk to public safety and if funding is available.

For the adaptation pathway to move to Phase 1 (2nd column of potential actions) a pre-defined Trigger must be realised. Then, depending on the outcome of any Implementation Plan

Actions, this may or may not result in a change to the management approach adopted for the CMU.

Consultation of the CCAP Implementation Plan (Section 4.1) will guide the process and ultimately the pathway to adaptation.

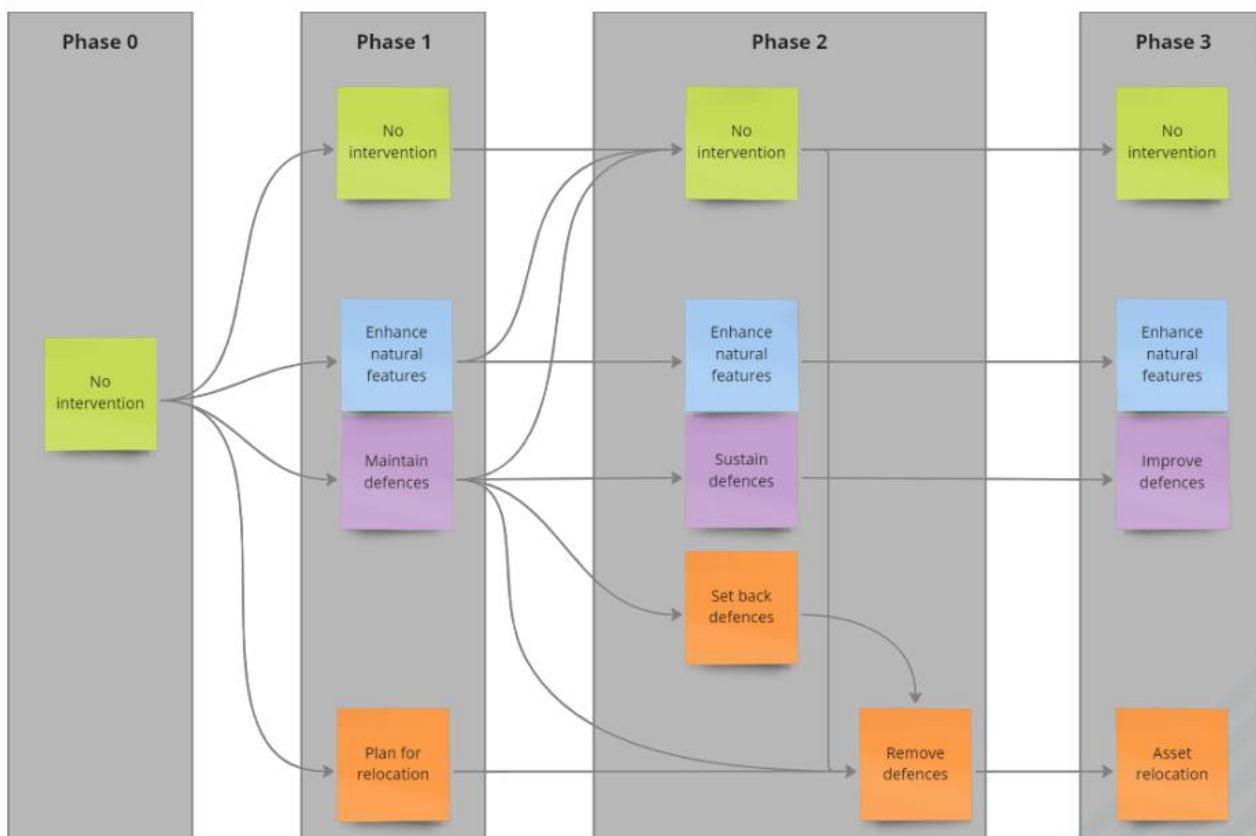


Figure 3-2: Adaptation Pathway for CMU 5 (hybrid coast). Grey lines represent possible future pathways.

3.3 Built Structures Adaptation Pathway

CMU 2 and 3 both have built structures defending the coastline. Within both CMUs there is risk of coastal flooding, and in CMU 3 there is a risk of erosion (Figure 3-3).

- **CMU 2 = Built Structures with risk and hazard**
- **CMU 3 = Built Structures with risk and hazard**

Phase 0 of the adaptation pathway (1st column) is the current actions undertaken by Moray Council in respect to these CMUs. In CMU 2 and 3 the pathway approach is **No Intervention**. This means that there will be no coastal and/or erosion risk management interventions during this phase. Maintenance of existing structures may be undertaken if there is a risk to public safety and if funding is available.

For the adaptation pathway to move to Phase 1 (2nd column containing potential actions) a pre-defined trigger must be realised. Then, depending on the outcome of any Implementation Plan Actions, this may or may not result in a change to the management approach adopted for the CMU.

Consultation of the CCAP Implementation Plan (Section 4.1) will guide the process and ultimately the pathway to adaptation.

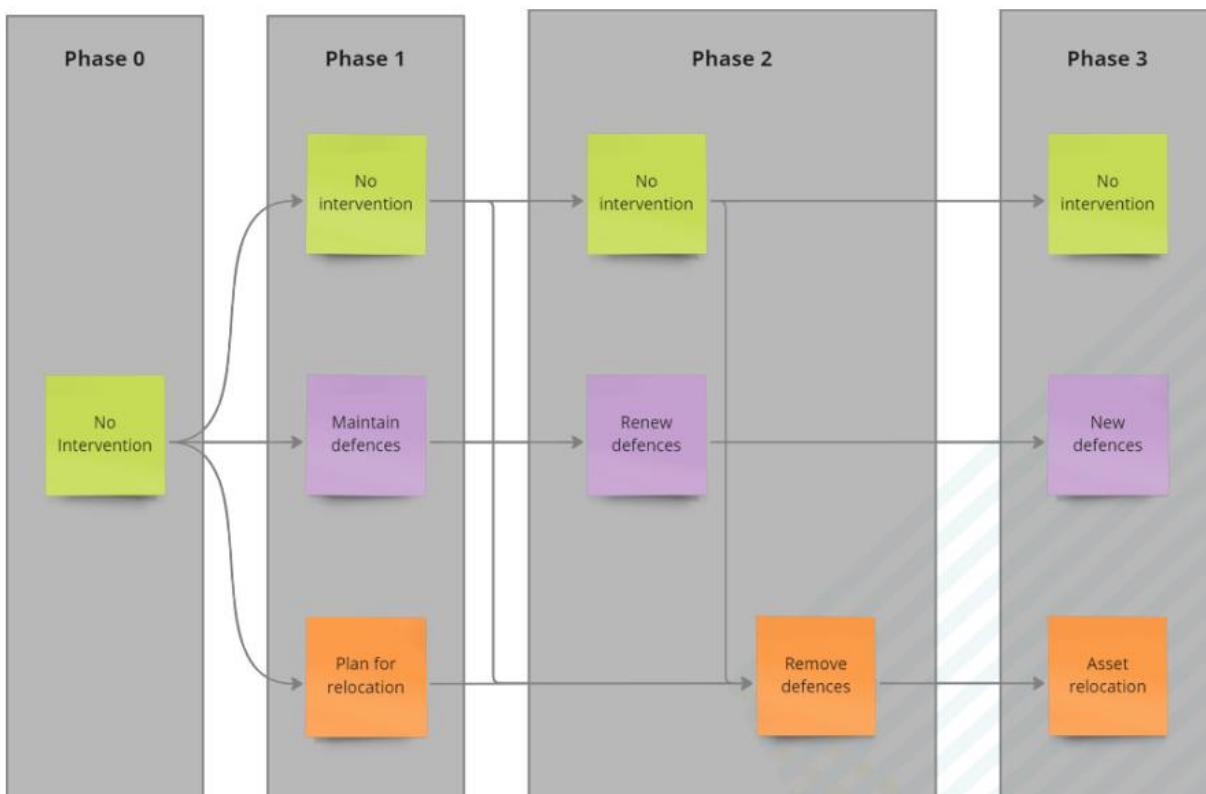


Figure 3-3: Adaptation Pathway for CMU 2 and 3 (built structures). Grey lines represent possible future pathways.

4 Adaptation Process

4.1 Implementation Plan

To support the delivery of the Adaptation Framework, a single Implementation Plan is applied to the entire Kinloss to Hatton Coast 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 4-1):

- 1) Monitoring and Triggers (Section 4.2)
- 2) Actions (Section 4.3)
- 3) Outcomes (Section 4.6)

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

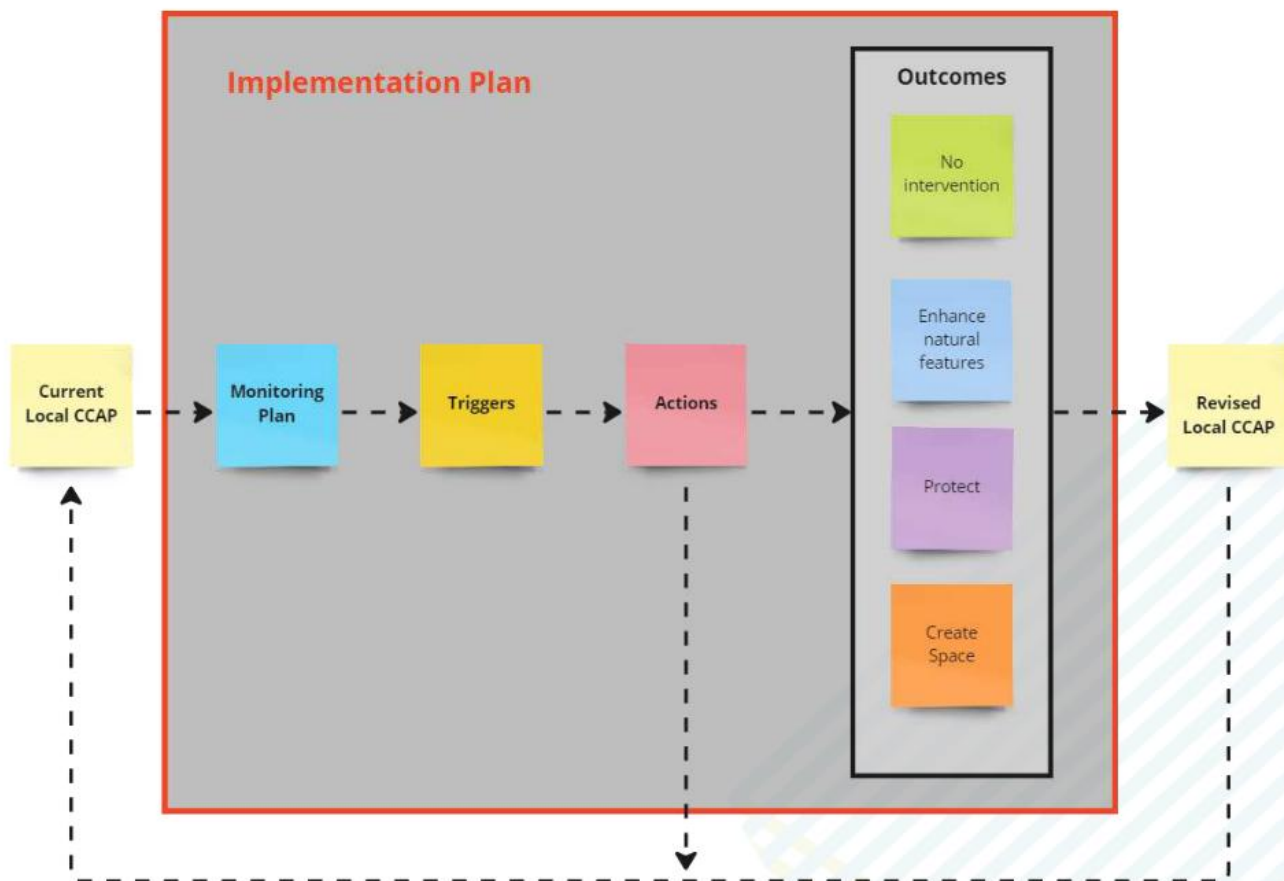


Figure 4-1: High-level Implementation Plan.

4.2 Monitoring and Triggers

4.2.1 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 potential 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.
- Moray Council data and information.
- Moray Council monitoring.
- External pressure.

4.2.2 Trigger Classification

Classification of the triggers falls 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 (Table 4-4), but risk exposure triggers related to physical flooding and erosion thresholds are specific to each CMU. For the Kinloss to Hatton Coast CA these are summarised in Table 4-4.

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

- CMU 1: Monitoring of flood hazard
- CMU 2: Monitoring of flood hazard
- CMU 3: Monitoring of flood and erosion hazard
- CMU 4: Monitoring of erosion hazard
- CMU 5: Monitoring of erosion hazard and rock armour condition
- CMU 6: Monitoring of erosion hazard

4.2.3 CMU-specific flooding trigger

Based on SEPA's NFRA data, where there is risk of flooding, the elevation of assets at risk are compared to sea levels taken from the SEPA tide gauge at Buckie. Assets considered at risk from flooding include:

- Residential properties.
- Key roads.

Where flood risk is present in a CMU, the lowest elevation of a residential property (minus 300mm freeboard) or key road is used to determine a frequency of exceedance using observed tide levels (Table 4-1), recorded at Buckie tide gauge (NOC Station ID: 1281).

At Kinloss to Hatton Coast, current SEPA maps indicate a flood risk in CMUs 1, 2 and 3.

Exceedance Frequency is defined currently as, the number of events that exceed the asset threshold in a 10-year period.

The CMU-specific flooding trigger is realised if the exceedance frequency increases beyond specified criteria. There are two levels to this Trigger realisation that result in different actions. These also vary depending on the type of asset at risk of flooding:

- **Residential properties**
 1. Exceedance frequency of **two** or more in a **ten-year window**.
 - Increase monitoring and plan for assessment.
 2. Exceedance frequency of **five** or more in a **ten-year window**.
 - Undertake assessment and plan for intervention.
- **Key Roads**
 1. Exceedance frequency of **five** or more in a **ten-year window**.
 - Increase monitoring and plan for assessment.
 2. Exceedance frequency of **ten** or more in a **ten-year window**.
 - Undertake assessment and plan for intervention.

Locations of these assets used to define the flooding triggers are shown in Figure 4-2. Currently, flooding trigger levels 1 and 2 have been met in CMU 1 and CMU 3 (Table 4-1).

It is important to note that the elevation of the asset compared to the sea level exceedance frequency is not a true representation of the actual risk of flooding. The risk of flooding is also associated with the elevation of the land surrounding the asset at risk.

Table 4-1: CMU-specific flooding triggers for Kinloss to Hatton Coast properties and roads. Cells shaded red indicate that the flooding trigger has already been met.

CMU	Lowest level of Property (mOD)		Property – Freeboard (mOD)	Current 10-year frequency	Flooding trigger Level 1 Exceedance Frequency:	Flooding trigger Level 2 Exceedance Frequency:
1	Property	2.5	2.2	222	2.0	5.0
3	Property	3.3	3.0	0.5	2.0	5.0
CMU	Lowest level of Road (mOD)			Current 10-year frequency	Flooding trigger Level 1 Exceedance Frequency:	Flooding trigger Level 2 Exceedance Frequency:
1	B9011		3.0	0.5	5.0	10.0
2	Dunes Road		2.8	2.3	5.0	10.0
3	B9011		1.7	988	5.0	10.0

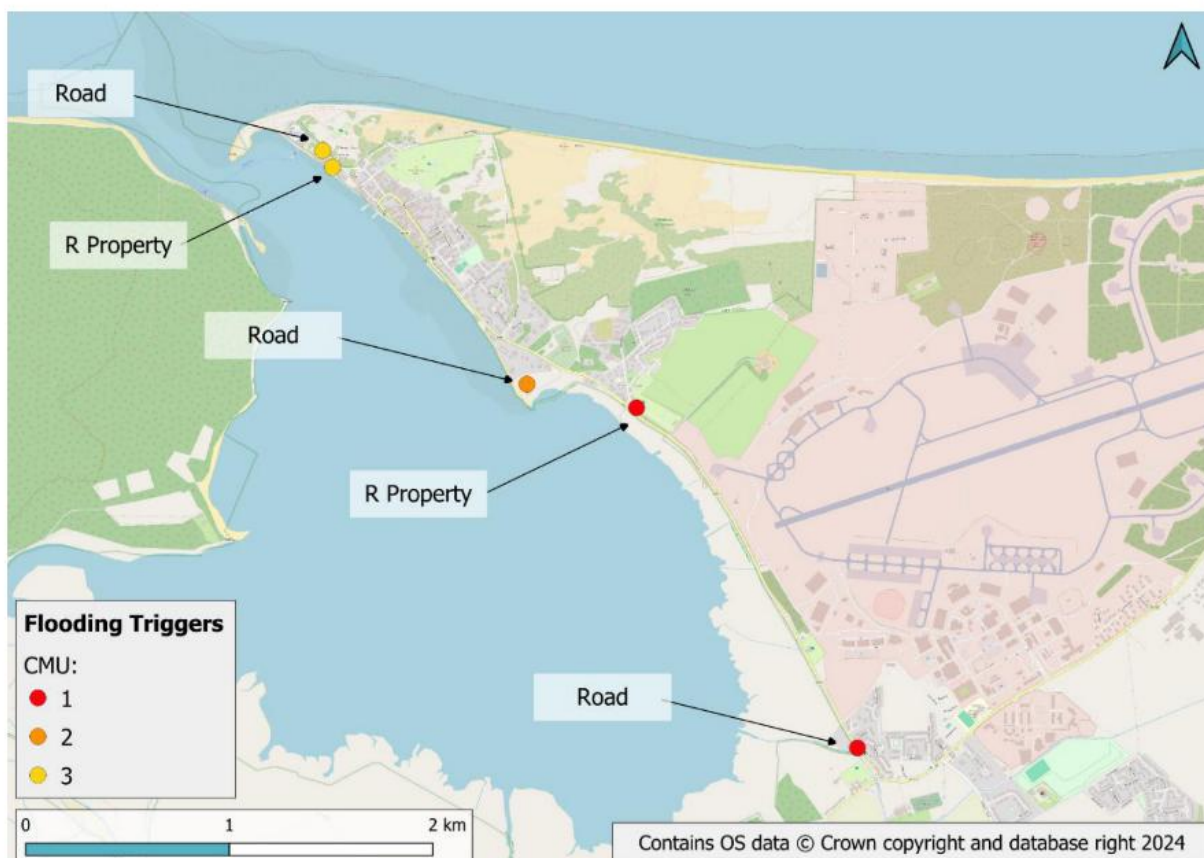


Figure 4-2: Kinloss to Hatton Coast flooding trigger locations.

4.2.4 CMU-specific erosion trigger

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 landward extent of the natural feature e.g. beach, barrier, spit, or cliff. Assets considered at risk from erosion include:

- Residential properties.
- Key roads.
- Other features, such as a marina, carparks, and a leisure park.

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.

Level 1 erosion trigger has been met for the property in CMU 2 (Table 4-2). Location of all assets used for erosion triggers are shown in Figure 4-3 and Table 4-2.

Table 4-2: CMU-specific erosion triggers for Kinloss to Hatton Coast properties, roads, and other 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
3	0.5	RP	6.8	20	10
CMU	Maximum historical change rate (m/year)	Present-day distance of Road to coast (m)		Erosion trigger level 1: Coast X m from road	Erosion trigger level 2: Coast X m from road
3	0.5	Road – B9011	6.5	5	2
CMU	Maximum historical change rate (m/year)	Present-day distance of feature to coast (m)		Erosion trigger level 1: Coast X m from feature	Erosion trigger level 2: Coast X m from feature
3	0.5	Findhorn Marina Clubhouse	7	5	2
4	1.6	Carpark / Motorhome layover	24	8	3.2
5	1.6	Dunes Road Carpark	14	8	3.2

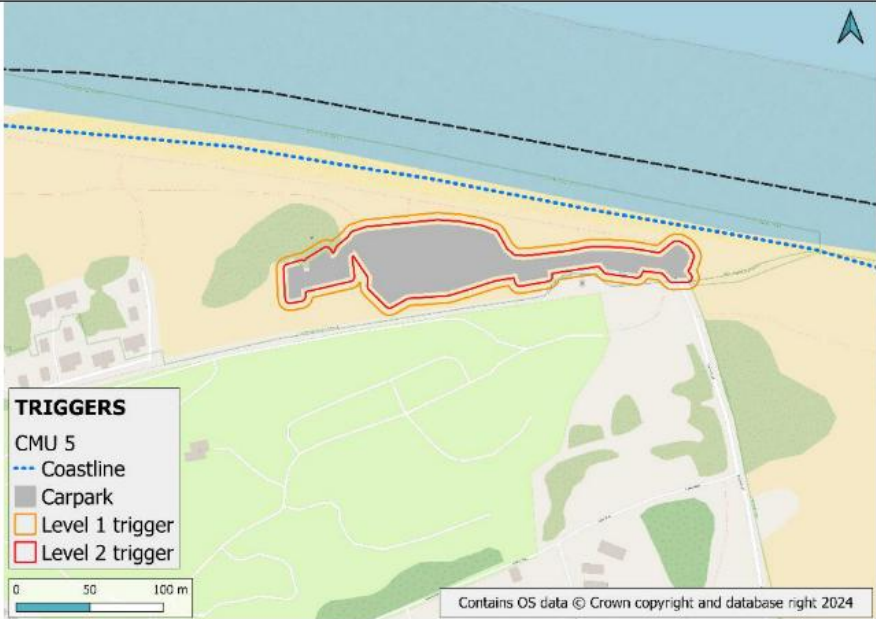


Figure 4-3: Kinloss to Hatton Coast erosion trigger locations for residential properties (R property), non-residential properties (NR property), roads and other key features.

Table 4-3: Kinloss to Hatton Coast erosion triggers.

CMU	Asset	Trigger Met	Erosion Trigger
3	Residential Property	Yes	<p>TRIGGERS CMU 3 - Coastline ■ Property □ Level 1 trigger □ Level 2 trigger</p> <p>0 0.1 0.2 km</p> <p>Contains OS data © Crown copyright and database right 2024</p>
3	Road – B9011	No	<p>TRIGGERS CMU 3 - Coastline - Road □ Level 1 trigger □ Level 2 trigger</p> <p>0 50 100 m</p> <p>Contains OS data © Crown copyright and database right 2024</p>

3	Other – Findhorn Marina Clubhouse	No	<p>TRIGGERS</p> <ul style="list-style-type: none"> CMU 3 Coastline Marina Level 1 trigger Level 2 trigger <p>0 50 100 m</p> <p>Contains OS data © Crown copyright and database right 2024</p>
4	Other – Carpark / Motorhome Layover	No	<p>TRIGGERS</p> <ul style="list-style-type: none"> CMU 4 Coastline Carpark Level 1 trigger Level 2 trigger <p>0 50 100 m</p> <p>Contains OS data © Crown copyright and database right 2024</p>

5	Other – Dunes Road Carpark	No	
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4.2.5 CMU-specific condition triggers

Where a Moray Council 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 5

Built structures are also present in CMUs 2 and 3.

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

These CMU-specific condition triggers assume coastal defences are currently Grade 3 but this should be reviewed upon completion of the Regional Proactive Actions for defence condition.

4.2.6 New information trigger

New information on hazards, vulnerability, built structures and infrastructure assets etc will become available all the time as the CCAP is implemented. The new information trigger acknowledges this and accounts for changes to properties, roads, key features, or assets available from Dynamic Coast or the NFRA.

This new information may be provided by a Council/ stakeholder member or local resident of the CA and would trigger a review of the relevant part of the CCAP.

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

- **New Information trigger:**
 1. New information received of asset at risk:
 - Understand risk and, if relevant, set adaptation triggers and actions.
 - Incorporate into monitoring plan.

4.2.7 Moray Coastal Trail

Impact of flooding and erosion on the Moray Coastal Trail⁹ (MCT) is yet to be quantified but it will likely become badly affected by coastal change and flooding in both the short and long-term.

As part of delivery of the Regional Plan a more detailed assessment will be undertaken to understand the impacts of climate change on the MCT (Regional Proactive Action). This will provide opportunities for investigation options to enhance and retain the amenity.

In this CA, the MCT may be severely impacted by coastal erosion, particularly in CMU's 4, 5, and 6.

4.3 Actions

Actions, like Triggers, are also 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 the Kinloss to Hatton Coast CA have been identified in Table 4-4. These are based on the Phase 0 Triggers only and it is possible that more will be required as a reactive response to change. Delivery of the Regional Plan¹⁰ Proactive are also required to support. The types of Actions are summarised below:

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, Scot Gov, NatureScot etc.
- **Asset:** Includes private defences and harbours and utilities specific to each built structures or hybrid CMUs.

Post flood data collection:

- Involve 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 guidance¹¹ and include all necessary components to

9 <https://www.morayways.org.uk/routes/the-moray-coast-trail/>

10 Moray Coastal Change Adaptation Plan: Regional Plan - IRR-JBAU-XX-XX-RP-MO-0001-S4-P03-Regional_Plan

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

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 to the Kinloss to Hatton Coast CMU are included in Table 4-4. These highlight what may be delivered during the Phase 0 cycle and are dependent on the associated Trigger being realised.

Table 4-4: Triggers, trigger categories and associated actions for each Kinloss to Hatton Coast CMU.

Category	Trigger	Action	CMU
Natural Systems	Changes to habitat	Community engagement (places)	All
	Changes to greenspace	Community engagement (places)	All
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 2 CMU 3 CMU 5
	Update to SEPA flood warning	Review risk assessment Community engagement (places, practice)	All
	Erosion buffer exceeded	Review risk assessment Community engagement (places)	CMU 3 CMU 4 CMU 5 CMU 6
	Flood risk threshold exceeded	Review risk assessment Community engagement (places)	CMU 1 CMU 2 CMU 3
	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

4.4 Phase 0 Actions

Phase 0 Actions require immediate attention and have been identified by triggers realised through the development process of this initial CCAP for the Kinloss to Hatton Coast.

These are outlined below:

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

An overall summary of all CMUs, Triggers, buffers, and Phase 0 Actions is provided as a standalone record in Appendix C for clarity.

4.5 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 Moray 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 six 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 4-5, with further details on each included in Appendix B. These are designed to complement the wider Proactive Actions identified in the Regional CCAP.

Table 4-5: Local Proactive Actions.

Action	Details	Pillars
1	Investigate opportunities for natural dune enhancement.	Working with Natural Processes
2	Establish coordinated and consistent beach monitoring plan for Natural CMUs.	Monitoring Change
3	Adaptation and resilience workshop with local community and stakeholders.	Community and Engagement
4	Identify landownership and safeguarding space.	Place Making
5	Develop modelling framework to support future assessments of natural processes.	Working with Natural Processes

4.6 Outcomes

Outcomes are the potential intervention measures that will be implemented after a trigger is realised and the associated actions, defined in the Implementation Plan, have been undertaken. There are four possible outcome categories:

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

These Categories however are general, and nuances and variations may result upon completion of any more detailed study.

As the Implementation Plan is applied at CMU level, the ultimate outcome is dependent on the CMU and the associated Adaptation Pathway. Table 4-6 summarises the general and specific CMU outcomes for the Kinloss to Hatton Coast CA.

Table 4-6: Kinloss to Hatton Coast CA possible outcomes.

Category	Outcome	Kinloss to Hatton CMU
No intervention	No intervention	All
Enhance natural features	Enhance natural features	CMU 1 CMU 4 CMU 5 CMU 6
Protect	Maintain defences	CMU 2 CMU 3 CMU 5
	Sustain* defences	CMU 2 CMU 3 CMU 5
	Improve** defences	CMU 2 CMU 3 CMU 5
Create space	Remove defences	CMU 5
	Set back defences	CMU 5
	Relocate assets	CMU 1 CMU 2 CMU 3 CMU 4 CMU 5
*standard of performance is sustained into the future in response to climate change		
**standard of performance is improved beyond the current and then maintained in response to climate change		

The complete Implementation Plan for Kinloss to Hatton Coast is shown in (Figure 4-5); structured using the three stages: 1) Monitoring and Triggers, 2) Actions, and 3) Outcomes.

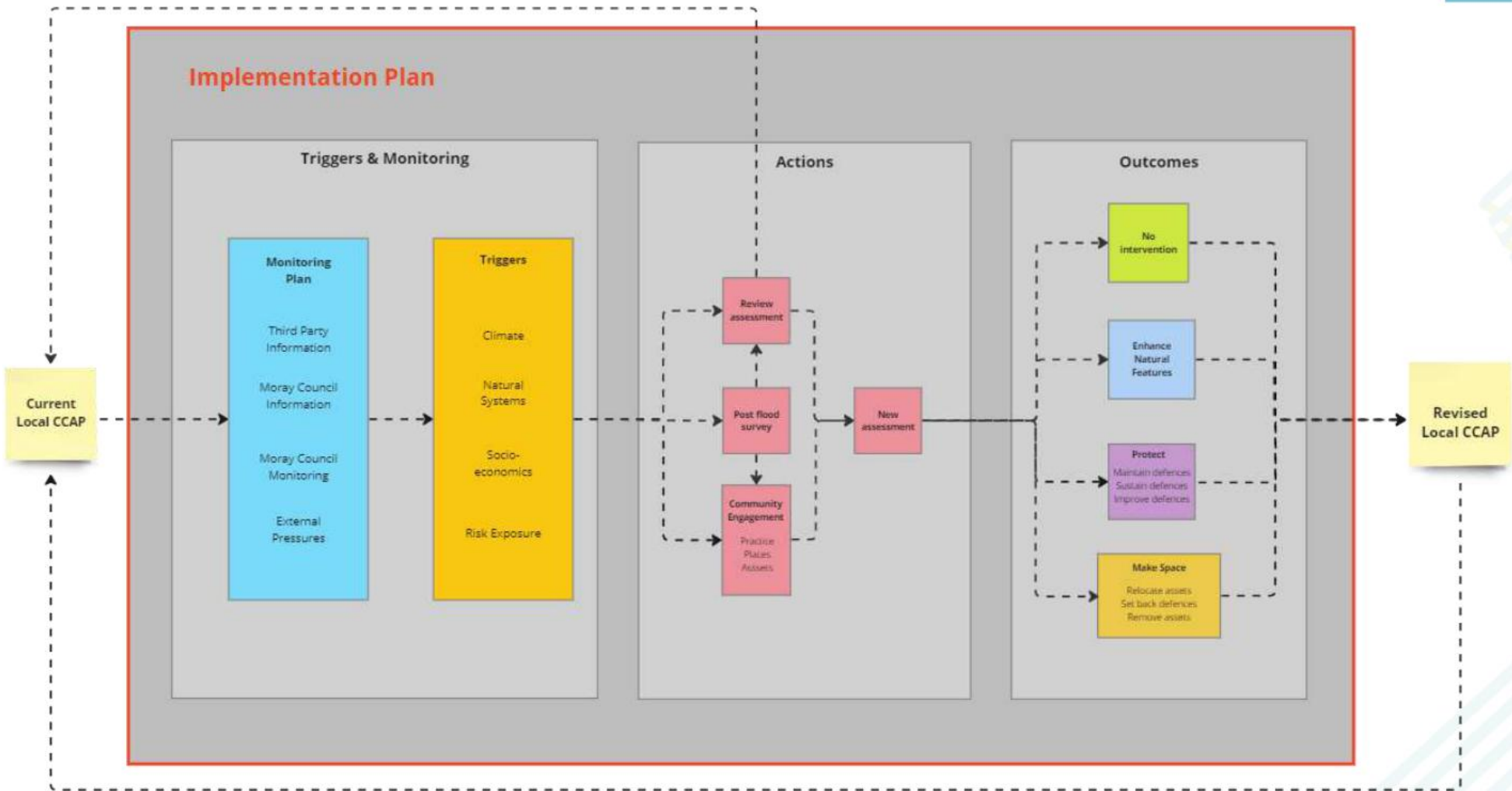


Figure 4-4: Complete Implementation Plan for Kinloss to Hatton Coast CA.

4.7 Example application

Figure 4-5 provides a schematic describing an example application of the Implementation Plan and how it fits in with the wider Adaptation Framework for Kinloss to Hatton Coast. The red box highlights the processes described in this iteration of the CCAP.

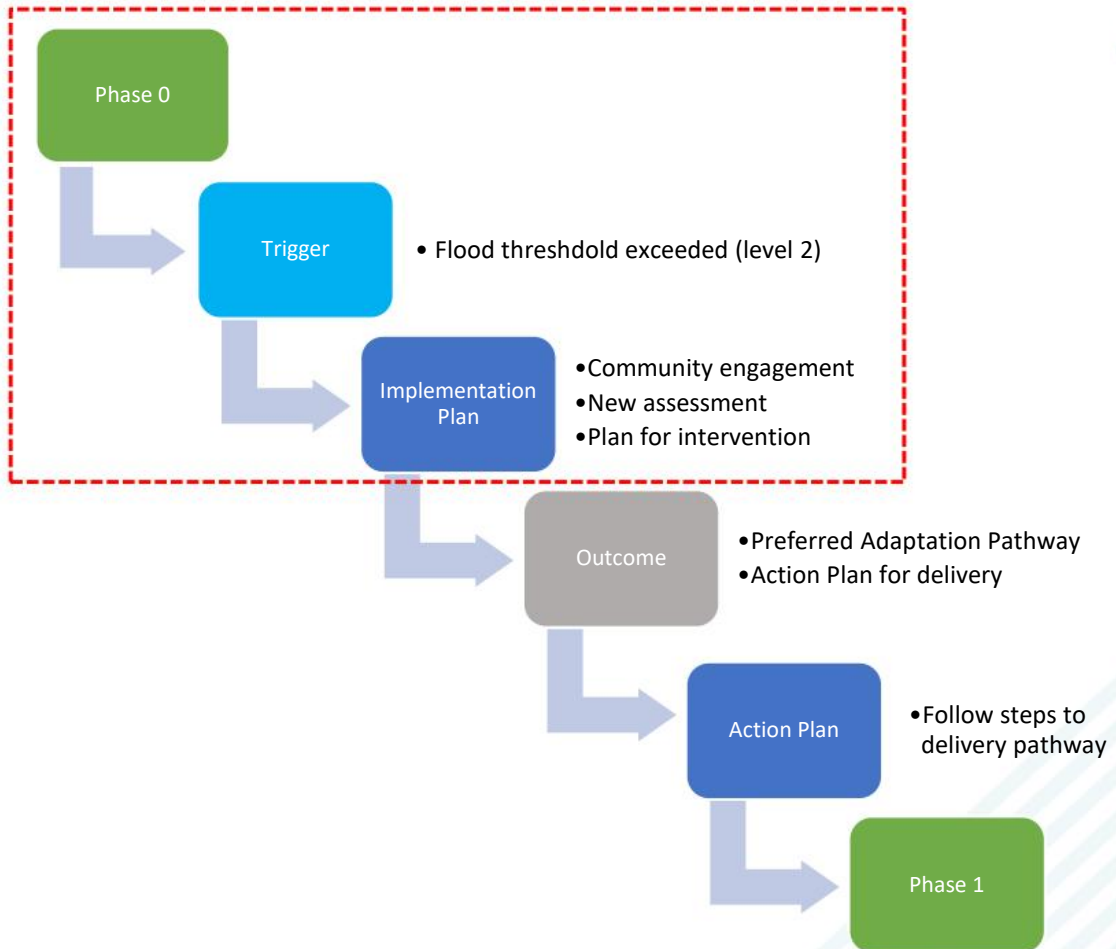


Figure 4-5: Example application of Phase 0 to Phase 1 of the adaptation process and how the Implementation Plan works with Adaptation Pathways and Action Plans.

5 Summary and Next Steps

5.1 Approach

This document presents the local CCAP for Kinloss to Hatton Coast. 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 Moray has been steered by relevant published documentation and the Scottish Governments interim guidance on CCAPs. These have been used to develop a 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 Kinloss to Hatton Coast 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 detailed Adaptation Pathways and an Action Plan for the Kinloss to Hatton Coast CA. This will happen when the process moves into Phase 1.

5.2 Coastal Management Units and Risks

The Kinloss to Hatton Coast CA was subdivided into six 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:

- CMU1 – Natural with Risk and Hazard
- CMU2 – Built Structures with Risk and Hazard
- CMU3 – Built Structures with Risk and Hazard
- CMU4 – Natural with Risk and Hazard
- CMU5 – Hybrid with Risk and Hazard
- CMU6 – Natural with No Risk and Hazard

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

5.3 Adaptation Pathways

To enable effective implementation of this CCAP across the Kinloss to Hatton Coast CA, 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 (Appendix C)
 - Delivery of Phase 0 Proactive Actions (Appendix B)
2. **Phase 1:**
 - Implementation Plan outcomes:
 - Preferred Adaptation Pathway
 - Action Plan for delivery
 - Delivery of Phase 1 No Regrets 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 No Regrets 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 Moray Council decision making to aim to achieve this end-outcome.

A detailed summary of Phase 0 Actions is included in Appendix C.

5.4 Implementation Plan

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

At this stage the pathways do not result in definitive end points. Triggers, while tangible, provide markers whereby Moray Council will undertake actions, guided by the Action Plan. The Outcomes of these, however, are unknown and the direction of the pathway in the future therefore cannot be defined.

Triggers focus on the updates to the data and documentation that has underpinned the development of the plan, and bespoke flooding or erosion thresholds being exceeded, through monitoring of physical processes.

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 Actions, whereby undertaking these will only benefit and support Moray's adaptation to coastal change.

In total, five Proactive Actions have been set.

5.5 Next Steps

Adapting 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 Moray 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.

Appendices

A CMU Risk Assessment

A.1 Data and overview

Coastal parameters and associated datasets summarising wave, tide, and sea level conditions for the Kinloss to Hatton Coast are summarised in Table A-1.

Table A-1: Coastal dataset summary for the Kinloss to Hatton Coast CA.

Coastal Data		Details		Data source
Hindcast wave height	0.62 m	50th percentile		CMEMS
	0.96 m	75th percentile		
	2.69 m	99th percentile		
Tide levels	HAT	2.5 mOD		TotalTide
	MHWS	2.0 mOD		
	MHWN	1.1 mOD		
	MSL	0.1 mOD		
	MLWN	-0.5 mOD		
	MLWS	-1.5 mOD		
Extreme Sea Levels	2.07 mOD	MHWS		CFB (Findhorn: 3040)
	2.83 mOD	2-year		
	3.12 mOD	50-year		
	3.19 mOD	100-year		
	3.25 mOD	200-year		
	3.40 mOD	1000-year		
Sea level rise projections	0.15 m	2050	70th percentile	UKCP18
	0.20 m	2050	95th percentile	
	0.59 m	2100	70th percentile	
	0.83 m	2100	95th percentile	

An overview of coastal flood and erosion hazards is provided for the Kinloss to Hatton Coast CA (Figure A-1). This has been produced using SEPA flood mapping for 1 in 200-year and 1 in 200-year plus climate change flood events as well as Dynamic Coast erosion projections for 2020 to 2100. The data has been analysed for each CMU individually and has been used to identify receptors at risk.

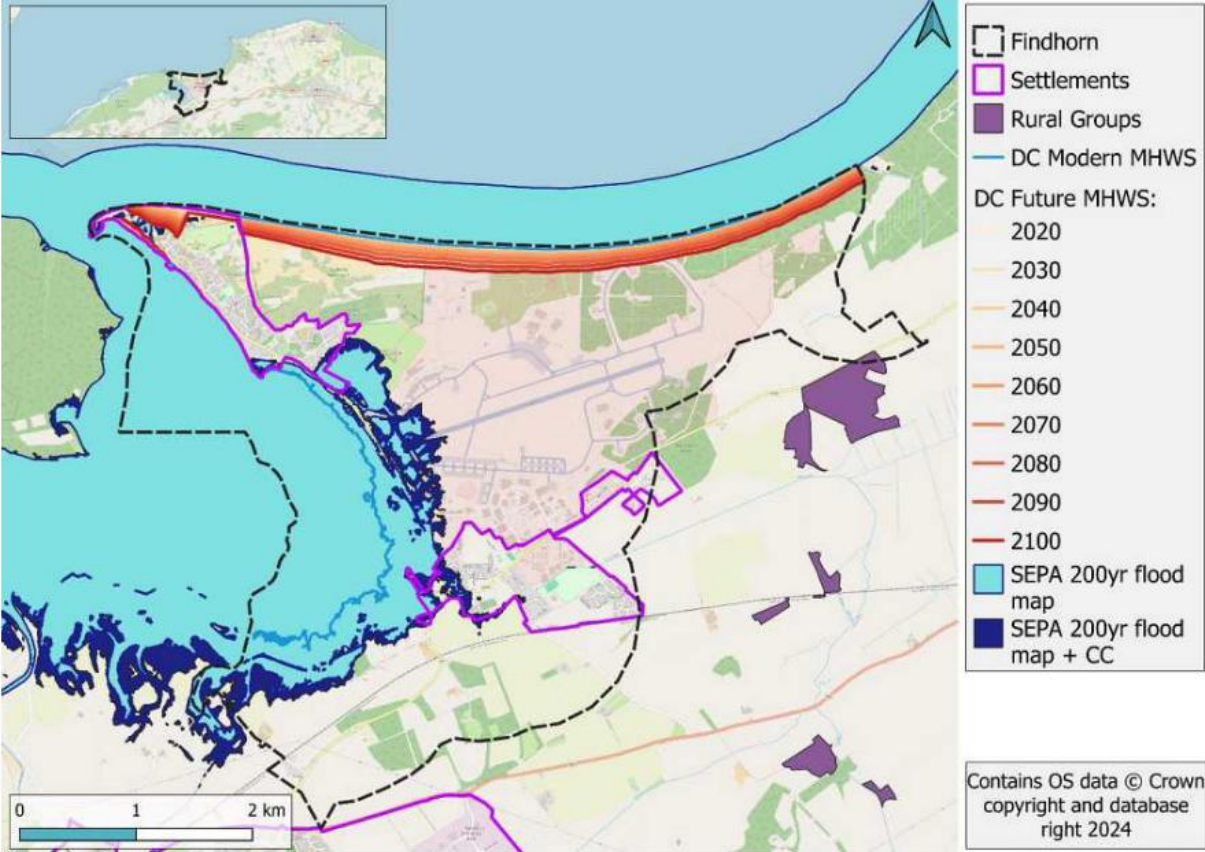


Figure A-1: Kinloss to Hatton Coast CA coastal flood and erosion hazard overview.

A.2 CMU 1: Findhorn Bay – Natural

This CMU is natural with no engineered structures present. It is characterised by a low-lying intertidal estuary fronted by saltmarsh.

There is an unknown hazard from coastal erosion as there is no data available from Dynamic Coast. MHWS appears to have remained stable across most of the CMU from 1890 to the present day.

SEPA flood maps show that Kinloss Barracks and parts of Kinloss are at threat from coastal flooding for a 1-in-200-year coastal flood event in the present day, and increasingly so with climate change allowances. Assets on land at risk from a 1 in 200-year flood event, according to NFRA data, are summarised below:

- 9 RPs (residential properties)
- 35 NRPs (non-residential properties)
- B9001
- Unnamed roads within Kinloss Barracks
- Waterford Road
- 2 unnamed roads within Findhorn village

Assets at risk from a 1 in 200-year plus climate change flood event include assets at risk from a 1 in 200-year flooding event (shown above) plus assets summarised below:

- 19 RPs
- 39 NRPs

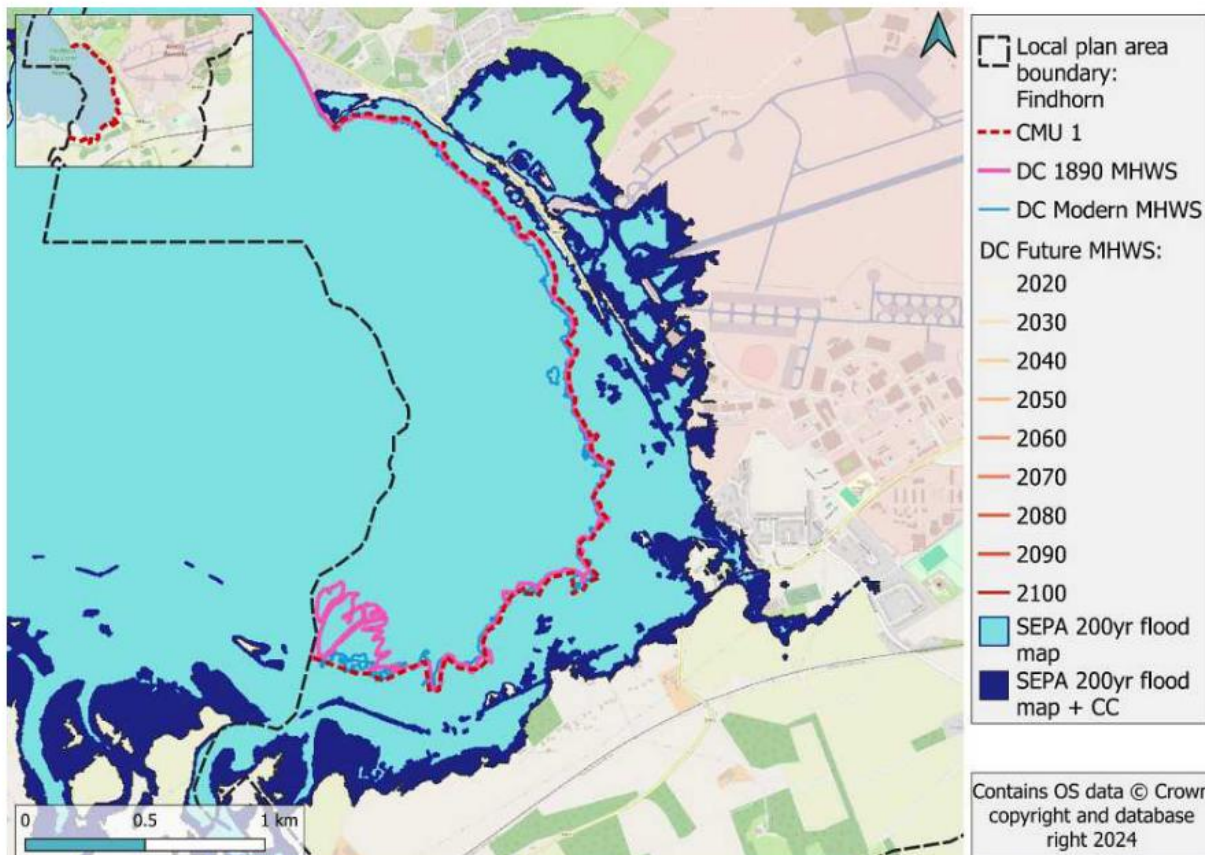


Figure A-2: CMU 1 (Findhorn Bay) coastal hazards map showing SEPA flood extents and Dynamic Coast (DC) past and future erosion. Inset shows unit without coastal hazards.

A.3 CMU 2: Findhorn South – Built Structures

A combination of concrete revetments and rock armour span CMU 2. These are fronted by a shingle beach. There are numerous residential properties situated close to the frontage and the B9011 runs parallel to the coast in the northern half of the CMU.

There is an unknown hazard from coastal erosion as there is no data available from Dynamic Coast. MHWS appears to have remained stable across most of the CMU from 1890 to the present day.

SEPA flood maps show that there is risk of flooding from 1-in-200-year and 1-in-200-year plus climate change events at the southern end of the CMU and negligible flood risk to the remaining coast. Assets on land at risk from a 1 in 200-year flood event, according to NFRA data, are summarised below:

- Dunes Road (~180m section)

Assets at risk from a 1 in 200-year plus climate change flood event include assets at risk from a 1 in 200-year flooding event (shown above) plus assets summarised below:

- 1 NRP (non-residential property)
- Dunes Road (~20m section)

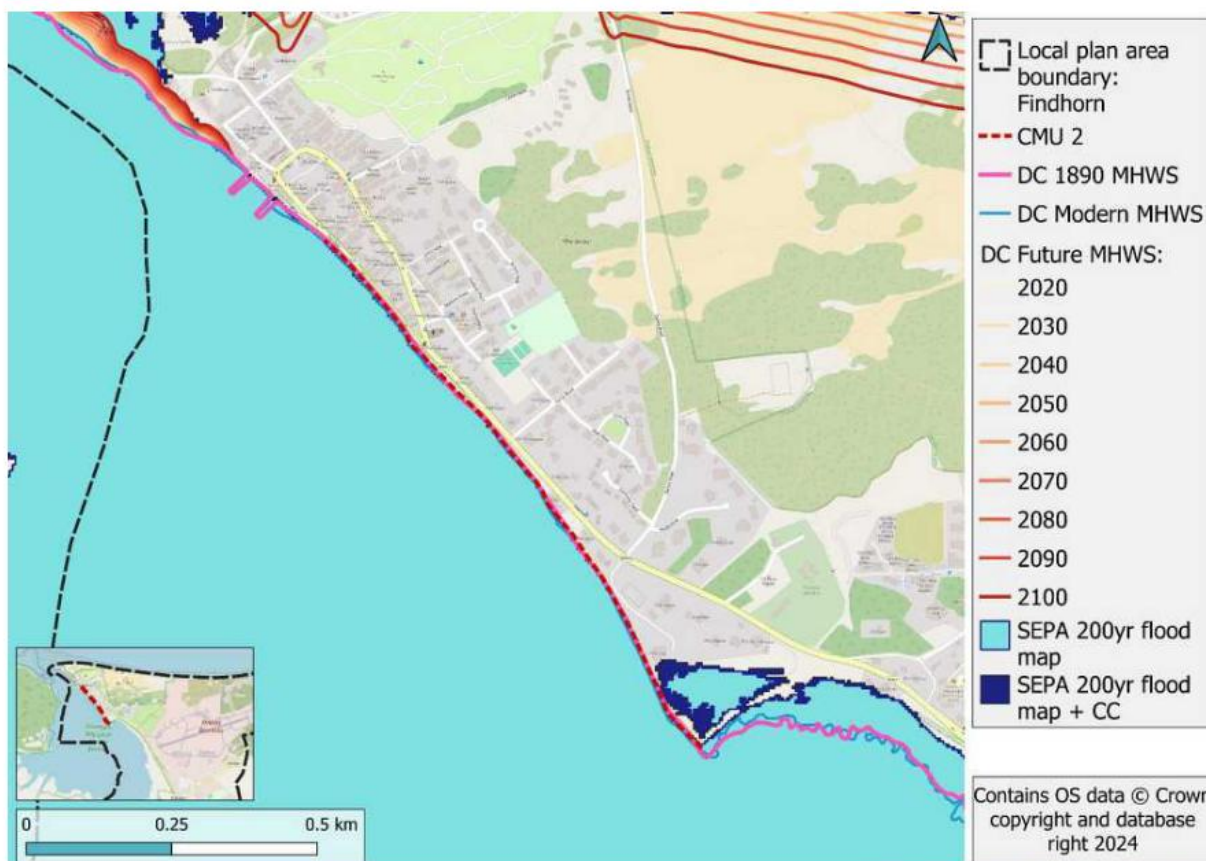


Figure A-3: CMU 2 (Findhorn South) coastal hazards map showing SEPA flood extents and Dynamic Coast (DC) past and future erosion. Inset shows unit without coastal hazards.

A.4 CMU 3: Findhorn Central – Built Structures

The central high-street of Findhorn village spans the CMU 3 coastline. The frontage is predominantly built up of concrete walls and rock armour atop a sand and shingle beach. This unit is at risk from flood and erosion risk.

SEPA flood maps show that there is risk of flooding from 1-in-200-year and 1-in-200-year plus climate change events at the southern end of the CMU and negligible flood risk to the remaining coast. Assets on land at risk from a 1 in 200-year flood event, according to NFRA data, are summarised below:

- 1 RP (residential property)
- 4 NRPs (non-residential properties)
- B9011 road (~170m section)

Assets at risk from a 1 in 200-year plus climate change flood event include assets at risk from a 1 in 200-year flooding event (shown above) plus assets summarised below:

- 1 NRP
- B9011 road (~35m section)

Although there are structures present along CMU 3, they are not known to be formal Moray Council adopted defences. Dynamic Coast data therefore predicts future retreat of this frontage. Dynamic Coast data shows that historically the shoreline has retreated at maximum rate of 0.5 m/yr. Maximum future erosion rates are expected to increase to 0.7 m/yr by 2050 and to 1.1 m/yr by 2100. This could result in a maximum of 61.7 m of land loss caused by shoreline retreat by 2100. Table A-1 summarises Dynamic Coast data for CMU 3. A range of properties are at risk of erosion as well as Findhorn Marina. Assets within Dynamic Coast’s projected erosion area or those in the vicinity of it in 2100 under the High Emission Scenario are summarised below:

- 21 RPs
- 12 NRPs

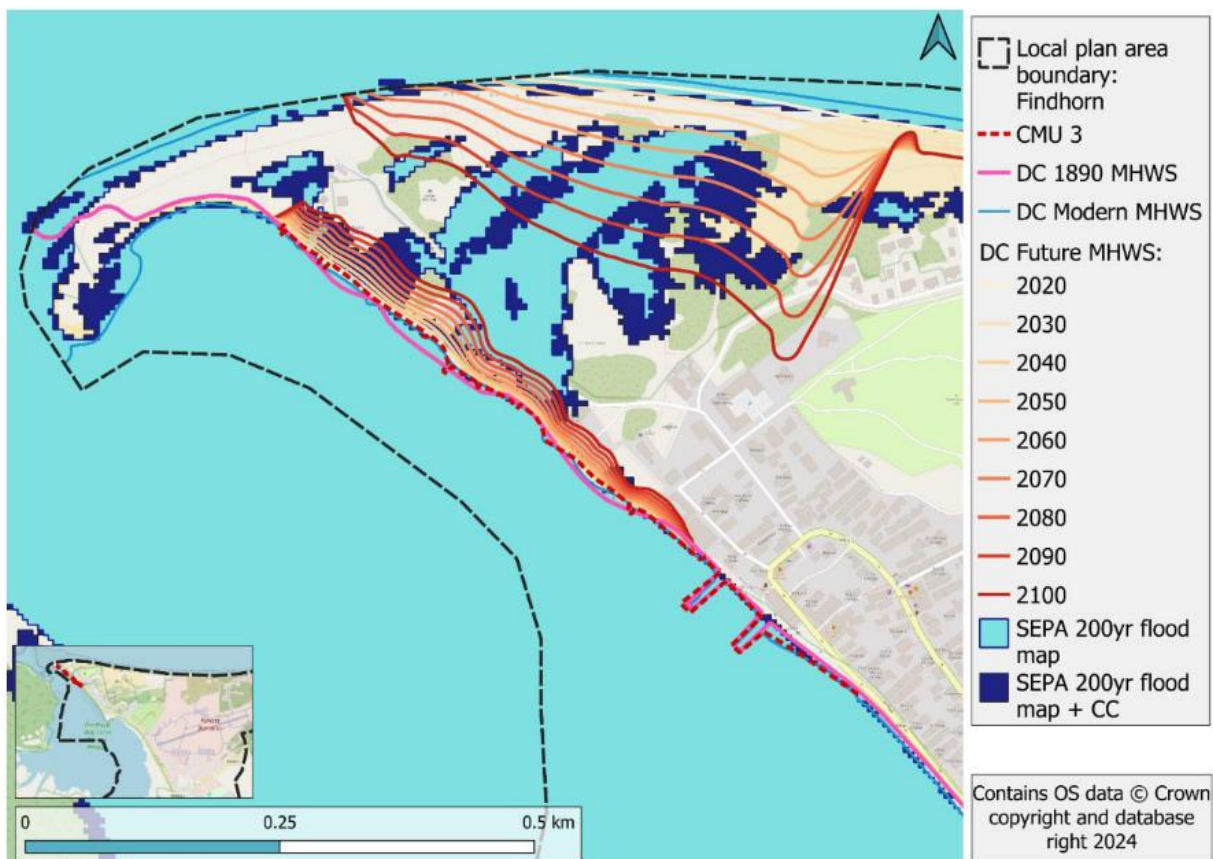


Figure A-4: CMU 3 (Findhorn Central) coastal hazards map showing SEPA flood extents and Dynamic Coast (DC) past and future erosion. Inset shows unit without coastal hazards.

Table A-1: CMU 3 Dynamic Coast erosion summary.

Dynamic calculation	Coast	Results	
Historical rate		0.5 m / yr	Maximum
		0.1 m / yr	Median
2050 rate		0.7 m / yr	Maximum
		0.4 m / yr	Median
2050 distance		18.2 m	Maximum
		8.8 m	Median
2100 rate		1.1 m / yr	Maximum
		0.6 m / yr	Median
2100 distance		61.7 m	Maximum
		36.7 m	Median

A.5 CMU 4: Findhorn Sand Spit – Natural

This CMU is a natural sandy spit protruding west across the mouth of the Findhorn Bay estuary. The spit is dominated by well-established vegetated dunes and is fronted by a sandy beach to the north and a meandering tidal river to the south. Being a spit, the CMU will be highly dynamic in position and may well retreat or advance in response to storm events.

SEPA flood maps for 1-in-200-year and 1-in-200-year plus climate change events show flood outlines will cover the beach and the head of the spit, however no properties or roads are at risk in this CMU. The large flood extent seen in Figure A-5 is a result of coastal flooding in CMU 3; flood receptors within this outline are reported with CMU 3.

Erosion projections from Dynamic Coast are only available for the eastern section of this CMU (not the spit). Dynamic Coast data shows that the shoreline has retreated in this part of the CMU at a maximum rate of 1.6 m/yr. Maximum future erosion rates are expected to increase to 2.5 m/yr by 2150 and 4.1 m/yr by 2100. This would result in a maximum of 243.2 m of land loss caused by shoreline retreat by 2100. Table A-2 summarises Dynamic Coast data for CMU 4. Assets at risk of erosion include Findhorn Local Nature Reserve, car parks and beach facilities. Those assets within Dynamic Coast’s projected erosion area or those in the vicinity of it in 2100 under the High Emission Scenario are summarised below:

- 11 RPs (residential properties)
- 2 NRPs (non-residential properties)

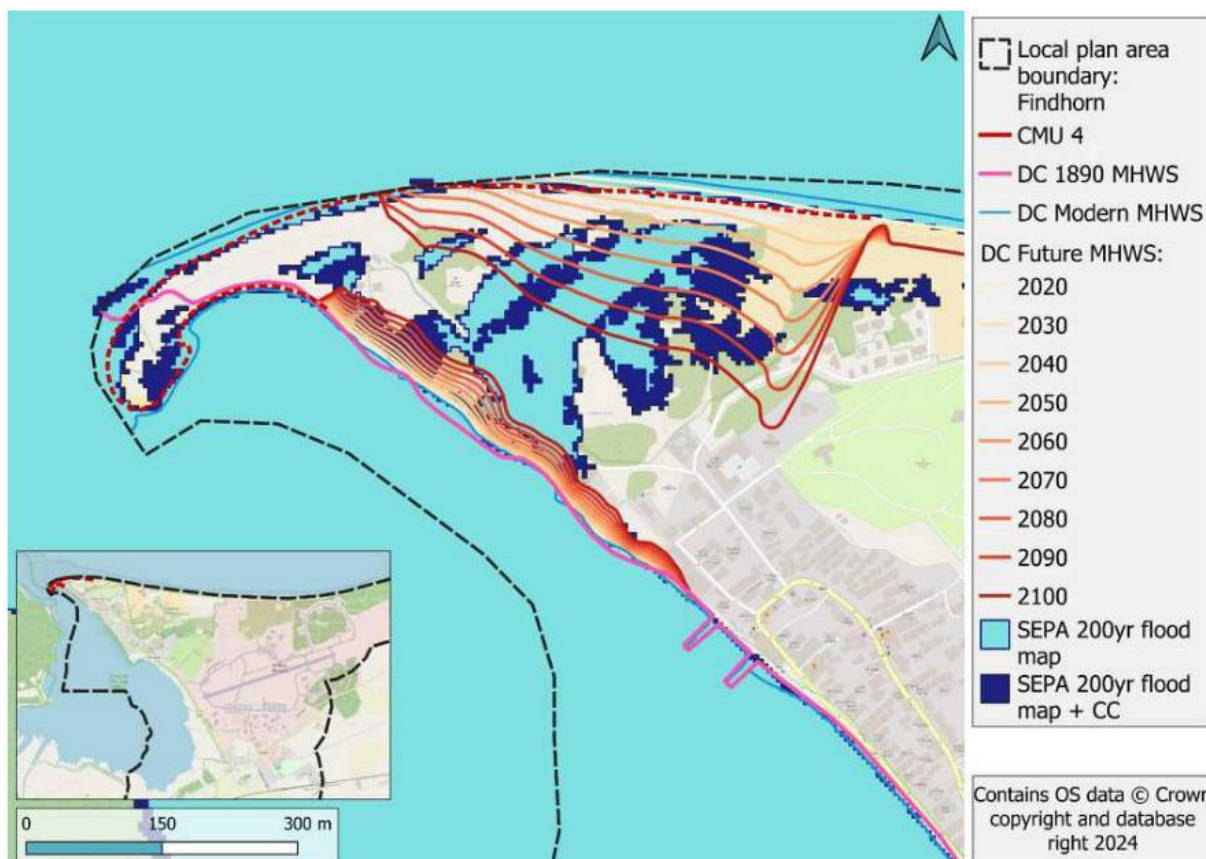


Figure A-5: CMU 4 (Findhorn Sand Spit) coastal hazards map showing SEPA flood extents and Dynamic Coast (DC) past and future erosion. Inset shows unit without coastal hazards.

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

Dynamic calculation	Coast	Results
Historical rate		1.6 m / yr Maximum
		0.8 m / yr Median
2050 rate		2.5 m / yr Maximum
		1.5 m / yr Median
2050 distance		62.7 m Maximum
		35.1 m Median
2100 rate		4.1 m / yr Maximum
		3.1 m / yr Median
2100 distance		243.2 m Maximum
		165.8 m Median

A.6 CMU 5: Findhorn Leisure Park – Hybrid

CMU 6 contains a rock armour revetment fronted by a sandy beach. Behind the rock armour revetment is an established strip of vegetated dunes in front of the Dunes Road carpark and the Findhorn Sands Leisure Park just to the south.

SEPA flood maps show there is currently no identified risk from flooding to assets. Flow paths may however exist from CMU3 as there are localised low spots.

Erosion projections from Dynamic Coast show reduced erosion extents across CMU 5. This is due to the presence of coastal defences here. However, there is uncertainty about how Dynamic Coast accounts for defences in their projections. We recommend the likely impact of the defence on erosion be reviewed locally in detail. Dynamic Coast data shows that the shoreline in CMU 5 has retreated at a maximum rate of 1.6 m/yr. Maximum future erosion rates are expected to decrease to 1.1 m/yr by 2050 and to 0.0 m/yr by 2100.

This would result in a maximum of 33.5 m of land loss caused by shoreline retreat by 2100. Table A-3 summarises Dynamic Coast data for CMU 5. Assets at risk of erosion include sections of Dunes Road and public parking spaces off Dunes Road for the Findhorn Bay Local Nature Reserve. No other assets are at risk.

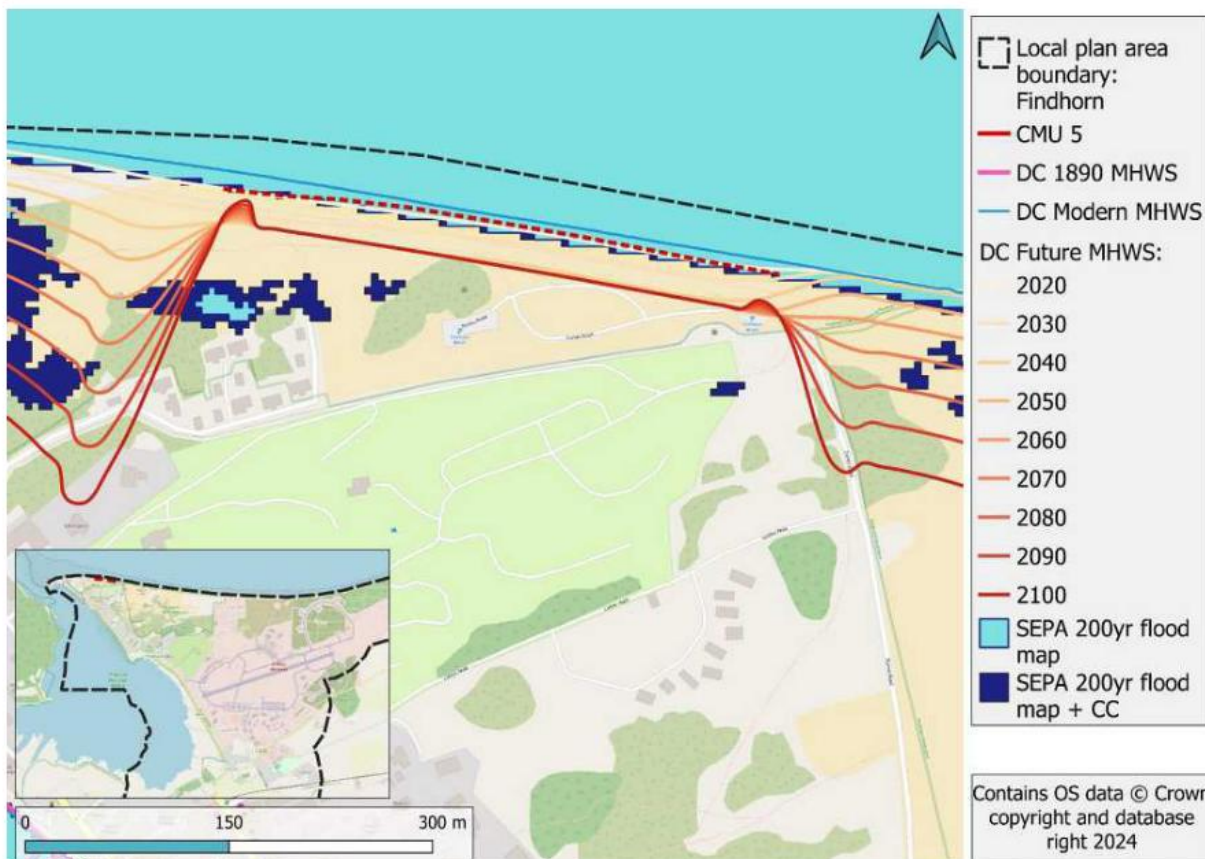


Figure A-6: CMU 5 (Findhorn Leisure Park) coastal hazards map showing SEPA flood extents and Dynamic Coast (DC) past and future erosion. Inset shows unit without coastal hazards.

Table A-3: CMU 5 Dynamic Coast erosion summary.

Dynamic calculation	Coast	Results
Historical rate		1.6 m / yr Maximum
		1.0 m / yr Median
2050 rate		1.1 m / yr Maximum
		0.2 m / yr Median
2050 distance		33.5 m Maximum
		28.5 m Median
2100 rate		0.0 m / yr Maximum
		0.0 m / yr Median
2100 distance		33.5 m Maximum
		28.5 m Median

A.7 CMU 6: Findhorn Beach East – Natural

CMU 6 has a large natural sandy beach backed by established dunes and vegetation. Kinloss Barracks spans ca. 2km of the shoreline within this CMU.

SEPA flood maps show that there is negligible flood risk from 1-in-200-year and 1-in-200-year plus climate change events.

Dynamic Coast data shows that historically the shoreline has retreated at maximum rate of 0.6 m/yr. Maximum future erosion rates are expected to increase to 2.1 m/yr by 2050 and to 4.2 m/yr by 2100. This would result in a maximum of 227.2 m of land loss caused by shoreline retreat by 2100. Table A-4 summarises Dynamic Coast data for CMU 6. The projected erosion lines under the High Emission Scenario show negligible risk to assets. However, the dunes are at risk of erosion. Land within Kinloss Barracks is at risk of erosion however MoD land has been treated separately within this assessment. Further clarification is needed between Moray Council and the MoD on risk and triggers in relation to assets within the MoD land.

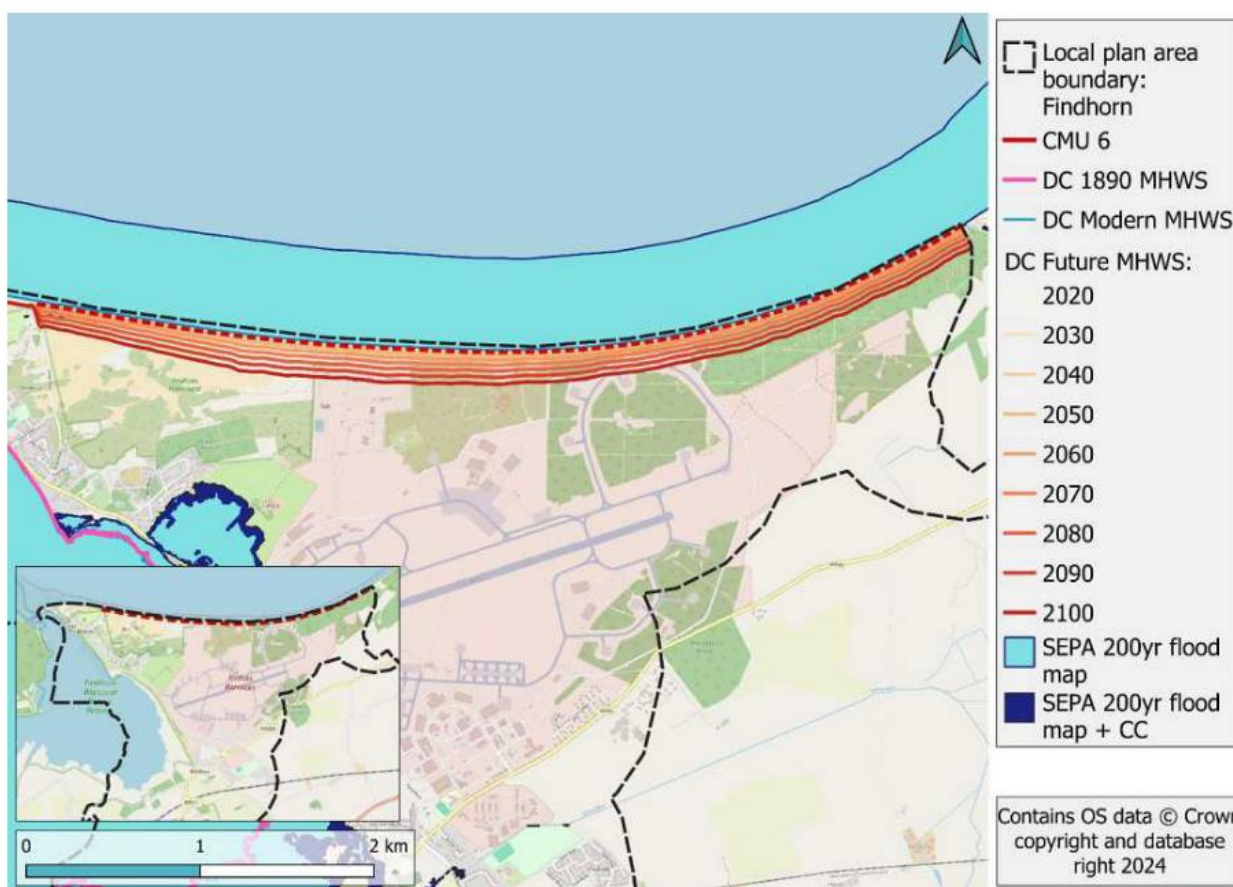


Figure A-7: CMU 6 (Findhorn Beach East) coastal hazards map showing SEPA flood extents and Dynamic Coast (DC) past and future erosion. Inset shows unit without coastal hazards.

Table A-4: CMU 6 Dynamic Coast erosion summary.

Dynamic calculation	Coast	Results
Historical rate		0.6 m / yr Maximum
		0.1 m / yr Median
2050 rate		2.1 m / yr Maximum
		1.6 m / yr Median
2050 distance		48.9 m Maximum
		35.0 m Median
2100 rate		4.2 m / yr Maximum
		3.6 m / yr Median
2100 distance		227.2 m Maximum
		185.4 m Median

B Proactive Actions

Action 1 – Investigate opportunities for natural dune enhancement.

Findhorn Beach and dune system spans the length of CMU 4, 5 and 6 and offers multiple benefits spanning flood and erosion protection, environmental and recreational. As the system retreats in response to SLR, these benefits will likely decrease and affect the character of the entire CA.

While retreat of the system is likely inevitable due to historic behaviour and baked in SLR, to delay this, and increase the resilience, opportunities for natural dune enhancement should be explored.

This should primarily involve aspects around re-profiling, vegetation enhancement, and controlling public access through the dunes. Opportunities for biodiversity and environmental enhancement should be identified within a wider programme with opportunities for delivery through community initiatives. Enhancing the level of natural protection offered by the dunes could support community engagement and may reduce ongoing maintenance burden on Moray Council



Action 2 –Establish coordinated and consistent beach monitoring plan for Natural CMUs

The requirements for monitoring the beach systems in the CA should be reviewed in the context of a wider Regional monitoring plan. Information should be collected through monitoring that is specific to support future risk assessments and compared to CMU specific erosion triggers. It should focus across the entire CA but increase in frequency and detail for CMU 3, 4, 5 and 6 where predicted risk associated with erosion and coastal change is greatest.



Action 3 – Adaptation and resilience workshop with local community and stakeholders

Adaptation to coastal change is not solely about physical interventions in coastal communities. Community and individual responsibility to increase resilience and adapt to coastal hazards is of paramount importance.

The outcomes of this initial phase should be presented to the community and stakeholders alongside consideration for wider support and education around climate awareness and flood resilience.



Further, a dialogue between Moray Council and the MoD should be developed to communicate erosion and flood risk to assets within Kinloss Barracks.

Action 4 – Identify landownership and safeguarding space.

To work with natural processes and make space for coastal change it is inevitable that existing land will be lost. To adapt effectively it is therefore important that land and asset ownership within the CA is fully understood to enable safeguarding of areas. This should feed into revisions of the wider Moray Council Local Development Plan.



Action 5 - Develop modelling framework to support future assessments of natural processes.

Implementation of effective future risk assessments will require investment in numerical (or similar) modelling tools that can effectively and efficiently quantify flood and erosion risk. Whilst this may not be achievable in the short-term, a modelling framework would be a beneficial resource in the long-term. The framework should aim to develop capability in:

- Statistical extremes – multivariate analysis for flood and erosion event
- Wave overtopping risk to Moray Defences (CMU 5)
- Morphodynamic processes and erosion
- Update flood inundation extents
- Dynamics of Findhorn Spit



C Trigger and Action Database

Table C- 1: Phase 0 Trigger and Action database for Kinloss to Hatton Coast

Community Area (CA)	CMU	Coast Type	Trigger Type	Asset Affected	Asset Description	Trigger Level	Trigger Exceeded?	Trigger Buffer Flooding (Freq/10 yr)	Trigger Buffer Erosion (m)	Action	Owner	Delivery Partners	Timescale	Cost	
Kinloss to Hatton Coast	1	Natural	Flood	Property	Private Porperty	1	Y	221.5		Increase monitoring and plan for assessment.	Moray Council	None	Short	Low	
						2	Y			Undertake assessment and plan for intervention.	Moray Council	Scot. Gov.	Medium	Medium	
				Road		1	N	0.5		None	NA	NA	NA	NA	
						2	N			None	NA	NA	NA	NA	
	2	Built Structures	Flood	Road		1	N	2.3		None	NA	NA	NA	NA	
						2	N			None	NA	NA	NA	NA	
	3	Built Structures	Flood	Property	Private Porperty	1	N	0.5		None	NA	NA	NA	NA	
						2	N			None	NA	NA	NA	NA	
				Road		1	Y	987.5		Increase monitoring and plan for assessment.	Moray Council	None	Short	Low	
						2	Y			Undertake assessment and plan for intervention.	Moray Council	Scot. Gov.	Medium	Medium	
			Erosion	Property	Residential Property	1	Y		-13.2		Increase monitoring and plan for assessment.	Moray Council	None	Short	Low
						2	Y		-3.2		Undertake assessment and plan for intervention.	Moray Council	Scot. Gov.	Medium	Medium
				Road	B9011	1	N		1.5		None	NA	NA	NA	NA
						2	N		4.5		None	NA	NA	NA	NA
	Other	Findhorn Marina Clubhouse	1	N		2		None	NA	NA	NA	NA			
			2	N		5		None	NA	NA	NA	NA			
	4	Natural	Erosion	Other	Carpark/ Motorhome layover	1	N		16		None	NA	NA	NA	NA
						2	N		20.8		None	NA	NA	NA	NA
5	Built Structures	Erosion	Other	Dune Road Carpark	1	N		6		None	NA	NA	NA	NA	
					2	N		10.8		None	NA	NA	NA	NA	
6	Natural	Erosion	Other	Kinloss Airfield MOD	1	N				None	NA	NA	NA	NA	
					2	N				None	NA	NA	NA	NA	

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