

# Moray Coastal Change Adaptation Plan

**Findochty to Portknockie**

**Final Report**

**April 2024**

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## Revision History

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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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JBA Consulting has no liability regarding the use of this report except to Moray Council.

## Acknowledgements

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Thanks also go to Prof Larissa Naylor and Dr Martin Hurst of the University of Glasgow for their valuable input throughout, and peer review of previous reports.

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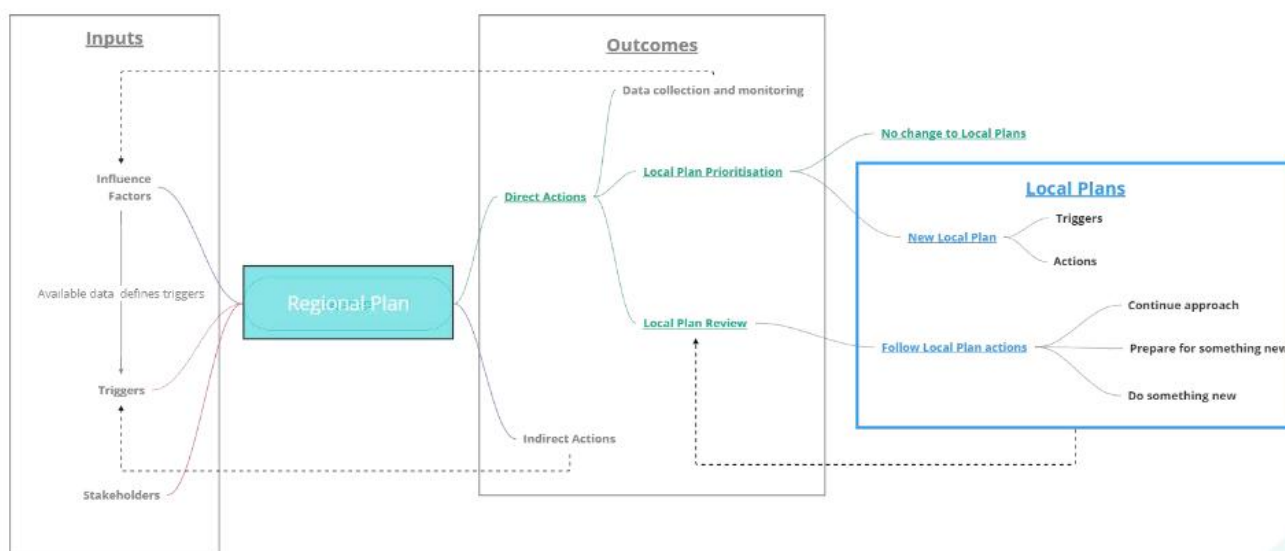
## **Carbon Footprint**

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## Executive summary

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

It aligns with the wider Regional Plan<sup>1</sup> 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 Findochty to Portknockie CA, 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.

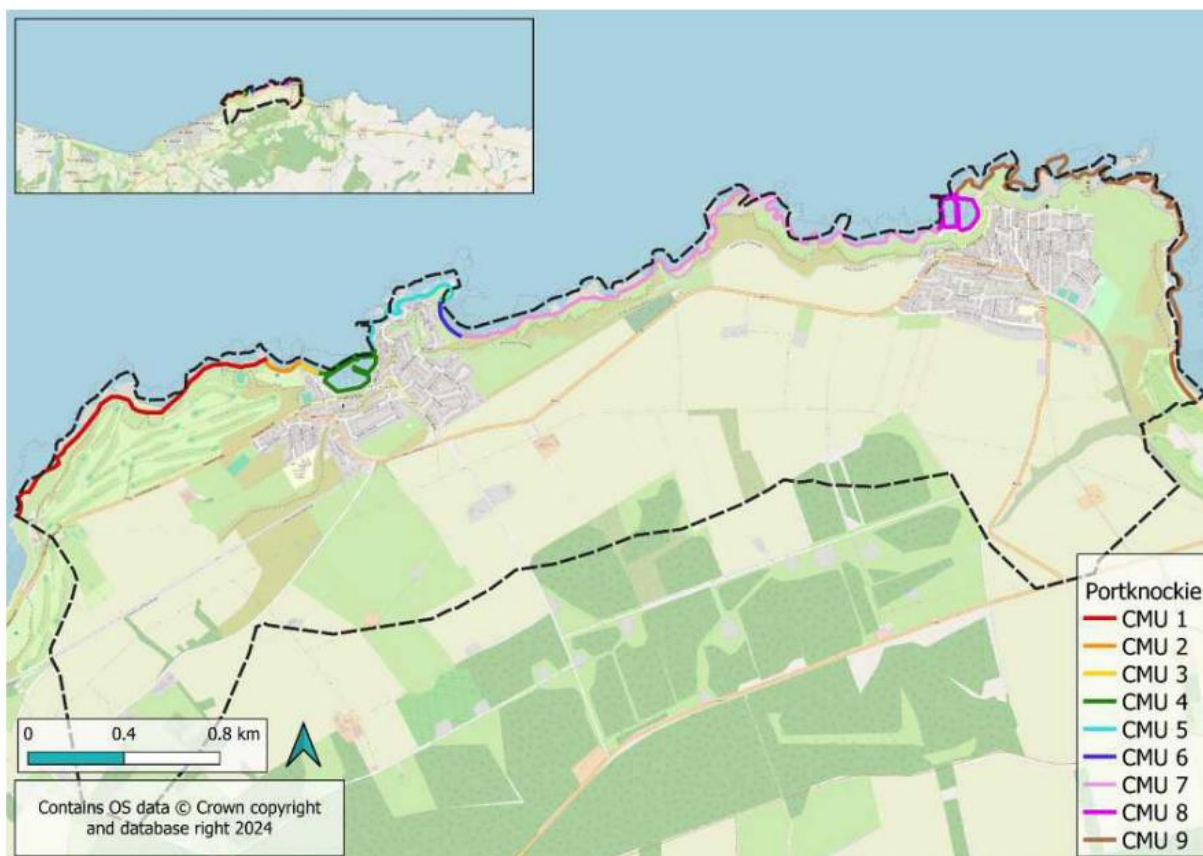
The Plan has been developed using available datasets from Moray Council, SEPA, and the Dynamic Coast Project. It aims to directly support statutory and non-statutory Moray Council policies, plans, and strategies and aligns with key coastal climate change adaptation guidance and resources within and beyond 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 ten CMUs were identified, and associated Adaptation Pathways were developed to align with each.

<sup>1</sup> 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 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 Findochty to Portknockie 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 at Findochty to Portknockie Coast.

The current iteration of the Findochty to Portknockie CA plan 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	No current Triggers	No current Actions
2	No current Triggers	No current Actions
3	No current Triggers	No current Actions
4	No current Triggers	No current Actions
5	No current Triggers	No current Actions
6	No current Triggers	No current Actions
7	No current Triggers	No current Actions
8	No current Triggers	No current Actions
9*	Erosion buffer exceeded	Undertake assessment and plan for intervention

\*Note CMU 9 of this CCAP is directly linked to CMU 1 of the Culbin to Netherton Coast CCAP and so any action applied to one, should be applied to the other.

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

- 1) Develop modelling framework to support future assessments.
- 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.

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 Guidance<sup>2</sup>

<sup>2</sup> [https://www.dynamiccoast.com/files/ccapg\\_2023feb.pdf](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 repeat, frequency 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.

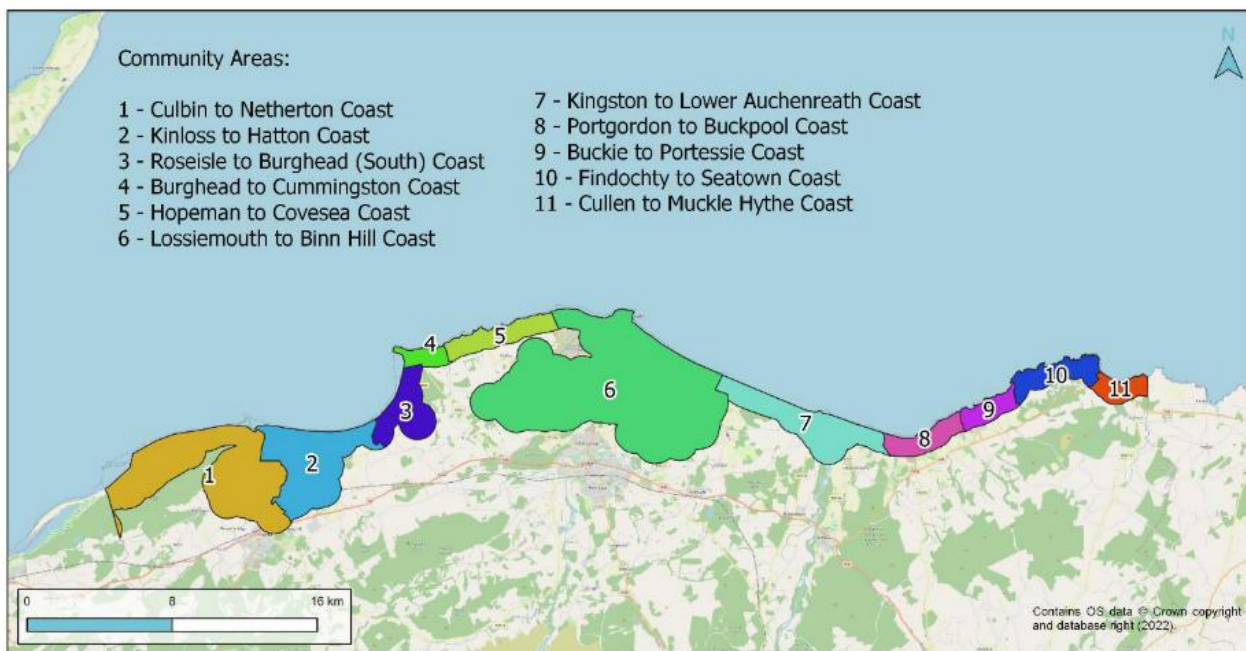
The Coastal Change Adaptation Plans (CCAPs) provide a key first step in this process; they are a practical mechanism to enable proactive engagement with and involvement of communities to co-develop a shared vision for long-term societal resilience to coastal climate change risk and impacts.

To support this adaptation journey in Moray the coast has been subdivided into Community Areas (CAs) (Figure 1-1). Findochty to Portknockie is one of eleven CAs recognised in the Regional Coastal Change Adaptation Plan (CCAP). The geology along the Findochty to Portknockie CA is made up of the Grampian Group of Quartzite, a resilient metamorphosed quartz rich sandstone. Notwithstanding the resilient geology, the Dynamic Coast has still predicted coastal retreat in the CA, for example, as much as 134 m of shoreline retreat could be realised by 2100 close to Den Burn within Cullen Links Golf Club. In addition, Findochty Harbour is already at risk from coastal flooding, which may increase in the future.

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 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 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 Findochty to Portknockie. 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 CCAPs is to:

*Guide Moray Council towards development of detailed Adaptation Pathways and associated Action Plans for the Findochty to Portknockie 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 Plan<sup>5</sup> and Local Planning Policy. These should be implemented in parallel to avoid future risk by making space for change.

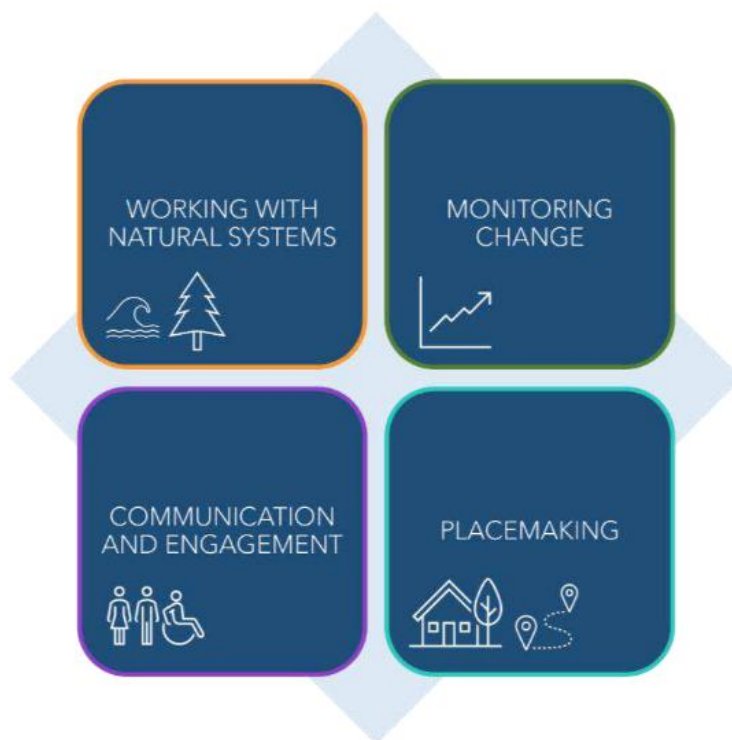
### 1.8 How has this framework been developed?

The approach to coastal change adaptation in Moray is presented in the Regional Plan which distils the Scottish Government guidance<sup>3</sup> into **four key pillars of adaptation** (Figure 1-2). Development and implementation of the CCAP Implementation Plan should align with these principles.

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<sup>3</sup> Scottish Government (2023) Coastal Change Adaptation Plan Guidance – Interim  
[https://www.dynamiccoast.com/files/ccapg\\_2023feb.pdf](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?

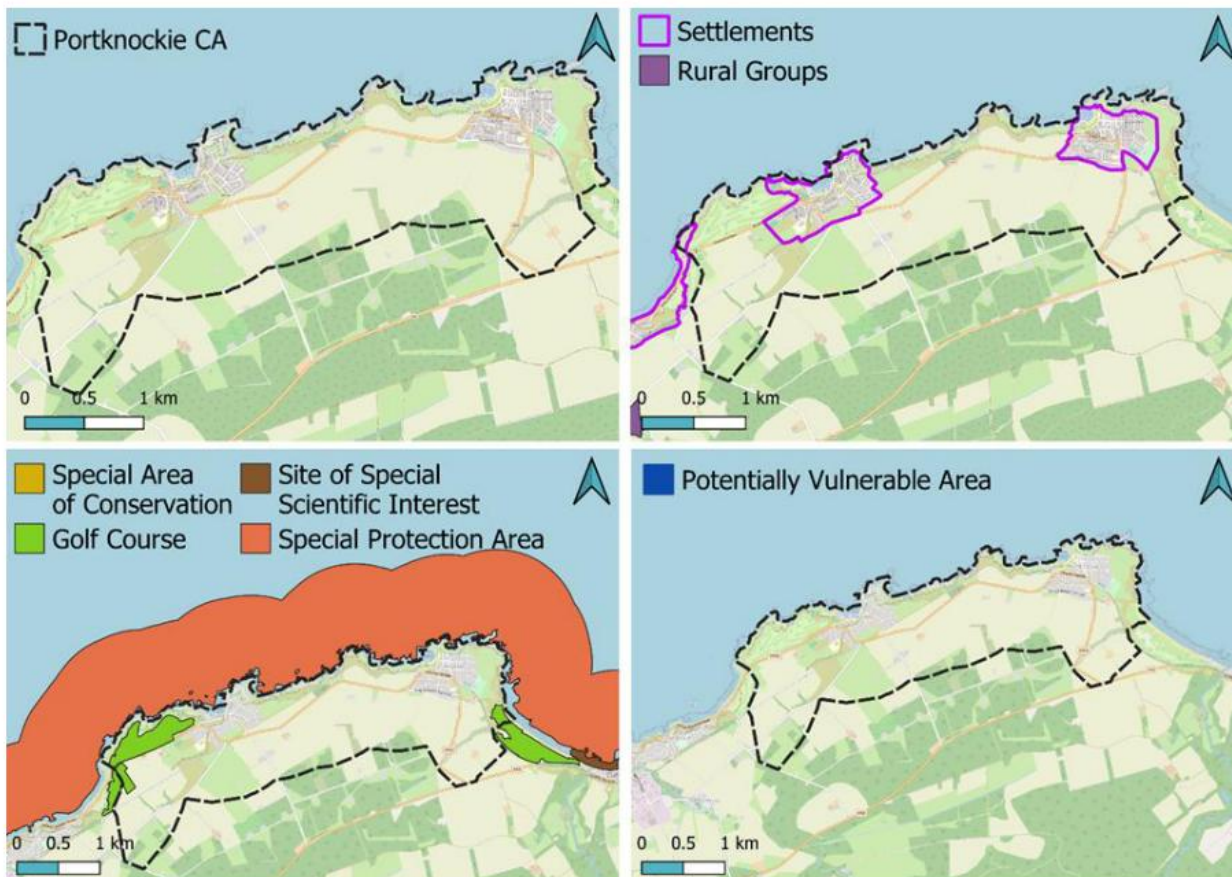
The Regional CCAP links to the Local CCAP in the following ways:

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 Findochty to Portknockie CA covers an area of ca. 6 km<sup>2</sup> and is located on the eastern edge of the Moray Coast, between the Buckie to Portessie CA and Cullen to Muckle Hythe CA (Figure 1-1). The CA includes a range of coastal environments and land use areas. The CA does not sit within a SEPA Potentially Vulnerable Area (PVA)<sup>4</sup> (Figure 2-1).



**Figure 2-1: Findochty to Portknockie CA, showing settlements, greenspace and environment and special consideration areas.**

#### Settlements:

The Findochty to Portknockie CA includes the settlements of Findochty and Portknockie. Findochty has a population of approximately 1,209 with 525 households and Portknockie approximately 1,296 with 547 households<sup>5</sup>. The Moray Council Local Development Plan<sup>6</sup> has identified designation areas for specific land use in these settlements. There are no rural groups located within the CA.

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](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:**

There is not a NatureScot designated Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC), or Special Protection Area (SPA) within this CA. There are two golf courses in the CA: Strathlene Golf Club on the west of Findochty, and Cullen Links Golf Club east of Portknockie.

### **Special consideration areas:**

The CA is not identified as having a Potentially Vulnerable Area (PVA) in the North East Local Flood Risk Management Plan (LPD6)<sup>7</sup>.

### **Habitats:**

Within this CA there is only a small area of Nature Scot designated habitat, unvegetated dunes, at the eastern extent at Cullen Links Golf Course , which also forms part of CMU 1 of the Cullen CCAP.

## **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.
  - 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, no flooding/erosion hazard.
  - d. No risk and no Hazard  
No assets present in CMU, no flooding/erosion hazard.

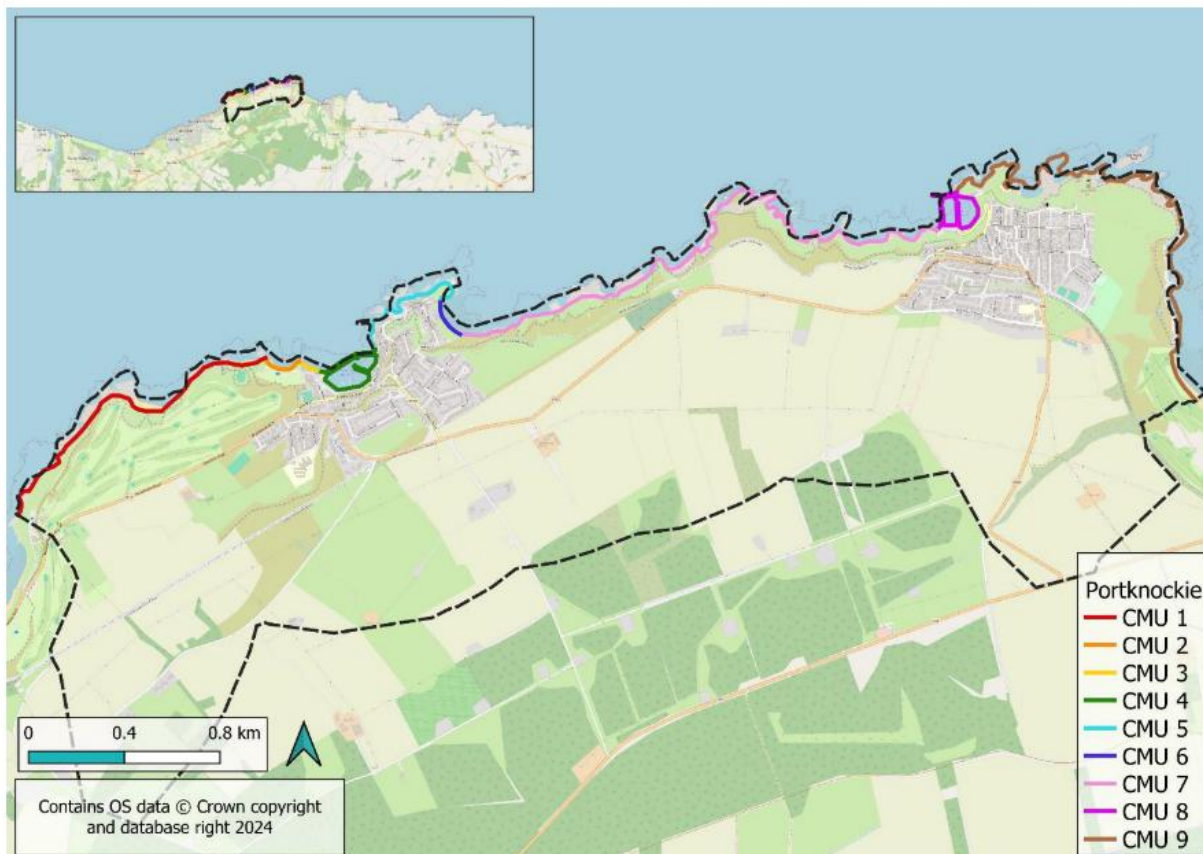
Assets referred to in the risk classification include residential properties, key roads and infrastructure.

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

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<sup>7</sup> North East Local Flood Risk Management Plan (LDP6) - <https://www.aberdeenshire.gov.uk/media/27479/local-flood-risk-management-plan-2022-2028.pdf>





**Figure 2-2: Findochty to Portknockie Coast CMU divided coastal extents.**

### 2.2.1 CMU 1: Strathlene Golf Course - Natural

This unit is classified as natural coast and spans ca. 1.5 km of north-northwest facing coastline, immediately north of the Strathlene Golf Course and west of Findochty. The coastal geomorphology is predominantly rocky, including numerous outcrops of the metamorphic Grampian Quartzite. Interspersed along the coast are a series of sandy pocket beaches backed by established dunes. The Moray Coastal Trail (MCT) runs along the cliff top.

Despite the rocky morphology, there is retreat predicted by Dynamic Coast localised at the sandy pocket beaches. The historical rate of retreat is estimated to have been 0.1 m/yr (from ca. 2003 to 2011). This rate is expected to increase up to 0.27 m/yr by 2050 and up to 0.44 m/yr by 2100. This will lead to an estimated retreat of 7 m by 2050 and 26 m by 2100. There are no assets within Dynamic Coast's projected erosion area vicinity of it up to 2100 under the High Emission Scenario.

SEPA flood maps show that there is no flood risk from 1-in-200-year and 1-in-200-year plus climate change events.

### 2.2.2 CMU 2: Findochty Caravan Park - Hybrid

This unit is classified as hybrid as it spans a natural beach enhanced by a section of rock armour. Available images support the view that construction of this revetment may have been informal (i.e. rock dump) rather than a formally designed and engineered defence. The unit spans ca. 174 m along the north facing sandy beach immediately north of Findochty Holiday Park. There is a large rocky platform at the toe of the beach, below the high tide line.

Despite the rock armour, there is substantial retreat predicted by Dynamic Coast for this unit, this may be because the Dynamic Coast projections have not considered the presence of the defence. The historical rate of retreat is estimated to have been 0.1 m/yr (from ca. 2003 to 2011). This rate is expected to increase up to 0.25 m/yr by 2050 and up to 0.44 m/yr by 2100. This will lead to an estimated retreat of 6 m by 2050 and 25 m by 2100. If the Dynamic



Coast 2100 prediction is to be realised, then the caravan park would be under threat of erosion. This level of retreat may well not be realised as it is likely that the Dynamic Coast projections did not account for the defence being present. If so, then the retreat will be contingent on the rock armour defence condition being maintained at an appropriate level and so assessment and monitoring of this is important.

No other assets are currently within Dynamic Coast's projected erosion area or in the vicinity of it up to 2100 under the High Emission Scenario.

SEPA flood maps show that there is no flood risk from 1-in-200-year and 1-in-200-year plus climate change events.

### **2.2.3 CMU 3: Findochty Beach - Natural**

This unit is classified as natural and spans 84 m along the north-northeast beach immediately west of Findochty Harbour. Running in a northerly orientation out of the centre of the beach is a large concrete drainage outfall pipe. This pipe is not currently considered in any available assessment, however its condition and performance will be important to maintain drainage for the caravan park. As with CMU 2, there is a large rocky platform at the bottom of the beach.

Dynamic Coast estimates that there will be coastal retreat on the western edge of this unit. However, towards the east of the unit, close to Findochty Harbour, there may be a small amount of accretion. The Dynamic Coast projections show that a historical rate of retreat in the unit has been 0.04 m/yr (from ca. 2003 to 2011). This rate is expected to increase up to 0.11 m/yr by 2050 and up to 0.34 m/yr by 2100. This will lead to an estimated retreat of 1.6 m by 2050 and 15 m by 2100. Other than the outfall pipe, there are no assets within Dynamic Coast's projected erosion area.

There is no apparent risk of coastal flooding predicted by SEPA for a 1-in-200-year and 1-in-200-year plus climate change events within this CMU.

### **2.2.4 CMU 4: Findochty Harbour – Built Structures**

This unit is defended by built structures and spans ca. 300 m of the vertical concrete seawalls at Findochty Harbour. The harbour has two large basins, sheltered by two large vertical seawalls. It can berth up to 100 vessels and caters for a wide range of activities, from leisure craft through to commercial fishing boats. Just offshore of there is a series of detached rocky outcrops.

There is an unknown risk of coastal erosion in this unit as there is no coastal erosion prediction provided by Dynamic Coas.

There is no apparent risk of coastal flooding predicted by SEPA for a 1-in-200-year and 1-in-200-year plus climate change events within this CMU.

### **2.2.5 CMU 5: Findochty North - Hybrid**

This unit is classified as hybrid as it comprises ca. 450 m of rocky coastline around the northeastern extent of Findochty town, with several sections of manmade coastal defences built atop the foreshore. Along the coast there are a series of small sand and shingle beaches as well as a large concrete jetty. There are numerous residential and non-residential properties and a minor road near to the coastline.

At the eastern extent of this unit is a small section of rocky coastline spanning ca. 200 m around the headland northeast of Findochty. Just offshore of the headland is a large rocky outcrop to the northeast.

SEPA flood maps show that there is risk of flooding from 1-in-200-year and 1-in-200-year plus climate change events in one location within the CMU and negligible flood risk to the remaining coast. There is one residential property at risk from a 1 in 200-year flood event and a 1 in 200-year plus climate change flood event, according to NFRA dataset.

There is an unknown hazard from coastal erosion as there is no data available from Dynamic Coast.

### **2.2.6 CMU 6: Findochty East Beach - Hybrid**

This unit is classified as hybrid and spans ca. 180 m along the east facing beach east of Findochty. At the top of the beach is an established dune system and built behind the dunes is a waist high vertical concrete seawall.

SEPA flood maps show that there is no flood risk from 1-in-200-year and 1-in-200-year plus climate change events.

There are no assets within Dynamic Coast's projected erosion area or in the vicinity of it up to 2100 under the High Emission Scenario.

The historic rate of coastal retreat given by Dynamic Coast shows accretion of 0.1 m/yr (from ca. 2003 to 2011). The predicted rate of change going forward shows a projected 0.25 m/yr of retreat by 2050 increasing to 0.8 m/yr by 2100. This will lead to an estimated retreat of 3.6 m by 2050 and 35 m by 2100.

### **2.2.7 CMU 7: Hillhead Cemetery Coast - Natural**

This unit classified as natural and comprises of an expansive stretch approximately 2.4 km in length. This coastline is dominated by rocky cliffs of Grampian Quartzite fronted by rocky platforms. Dispersed along the unit are a series of sandy pocket beaches.

The MCT runs along the cliff top in this unit as does the main link road between Findochty and Portknockie (A942), which is situated 76 m back from the cliff top at its closest. In the centre of the unit is Hillhead Cemetery and either side of the cemetery between the cliff top and the A942 is agricultural land.

SEPA flood maps show that there is no flood risk from 1-in-200-year and 1-in-200-year plus climate change events.

Dynamic Coast estimates that there will be coastal retreat within this unit at the various pocket beaches up to 2100. Dynamic Coast estimates that there has been no historic retreat from ca. 2003 to 2011. Yet, this rate is expected to increase up to 0.24 m/yr by 2050 and up to 0.47 m/yr by 2100. This will lead to an estimated retreat of 6 m by 2050 and 26 m by 2100.

There are no assets within Dynamic Coast's projected erosion area or in the vicinity of it up to 2100 under the High Emission Scenario.

### **2.2.8 CMU 8: Portknockie Harbour – Built Structures**

This unit is defended by built structures and spans approximately 300 m of the vertical concrete seawalls at Portknockie Harbour. The Harbour faces west, has two large basins, and is sheltered by two large vertical seawalls. There is berthing space for up to 50 vessels and it caters for predominantly leisure craft. Within the outer basin is an open-air swimming pool.

SEPA flood maps show that there is risk of flooding from 1-in-200-year and 1-in-200-year plus climate change events in one location within the CMU and negligible flood risk to the remaining coast. The NFRA dataset shows that ca. 25 m of the Harbour Road is at risk from a 1 in 200-year flood event and a 1 in 200-year plus climate change flood event.

As this is engineered, there are no erosion projections available from Dynamic Coast and therefore there is an unknown hazard from coastal erosion.

### **2.2.9 CMU 9: Portknockie North -Natural**

This unit classified as natural and comprises an expansive stretch approximately 2.8 km in length. The coastline is dominated by rocky cliffs of Grampian Quartzite on its northern coast and Old Red Sandstone and Conglomerates on its east facing coast. The coastline in this unit is fronted by rugged rocky platforms and Bow Fiddle rock formation just offshore to the northeast. In addition to the rocky platforms there are a series of sandy pocket beaches. The

MCT runs along the cliff top in this unit. Set back ca. 90 m from the north coast of this unit are numerous residential properties within Portknockie town.

SEPA flood maps show that there is no flood risk from 1-in-200-year and 1-in-200-year plus climate change events.

Dynamic Coast projects that there will be coastal retreat within this unit, although this is mainly centred around the Cullen Golf Course to the very east of the unit. Here, Dynamic Coast estimates that the historic retreat has been up to 1.7 m/yr (from ca. 2003 to 2011). This rate is expected to increase up to 2 m/yr by 2050 and remaining at 2 m/yr in 2100. This will lead to an estimated retreat of 57 m by 2050 and 134 m by 2100. This unit is directly linked with CMU 1 of the Cullen CCAP to the east.

Cullen Golf Course is the only recognised asset within the Dynamic Coast projected erosion area for 2100 under the High Emission Scenario.

### 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: Findochty to Portknockie CMU categorisation.**

CMU	Coastal Type Classification	Risk Classification
1	Natural	Risk and Hazard
2	Hybrid	Risk and Hazard
3	Natural	Risk and Unknown Hazard
4	Built Structures	Risk and Hazard
5	Hybrid	Risk and Hazard
6	Hybrid	Risk and Hazard
7	Natural	No Risk with Hazard
8	Built Structures	Risk and Hazard
9	Natural	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, 3, 7, and 9 are classified as natural coasts and have been assigned an adaptation pathway for natural coastlines with risk from erosion, flooding, or both (Figure 3-1):

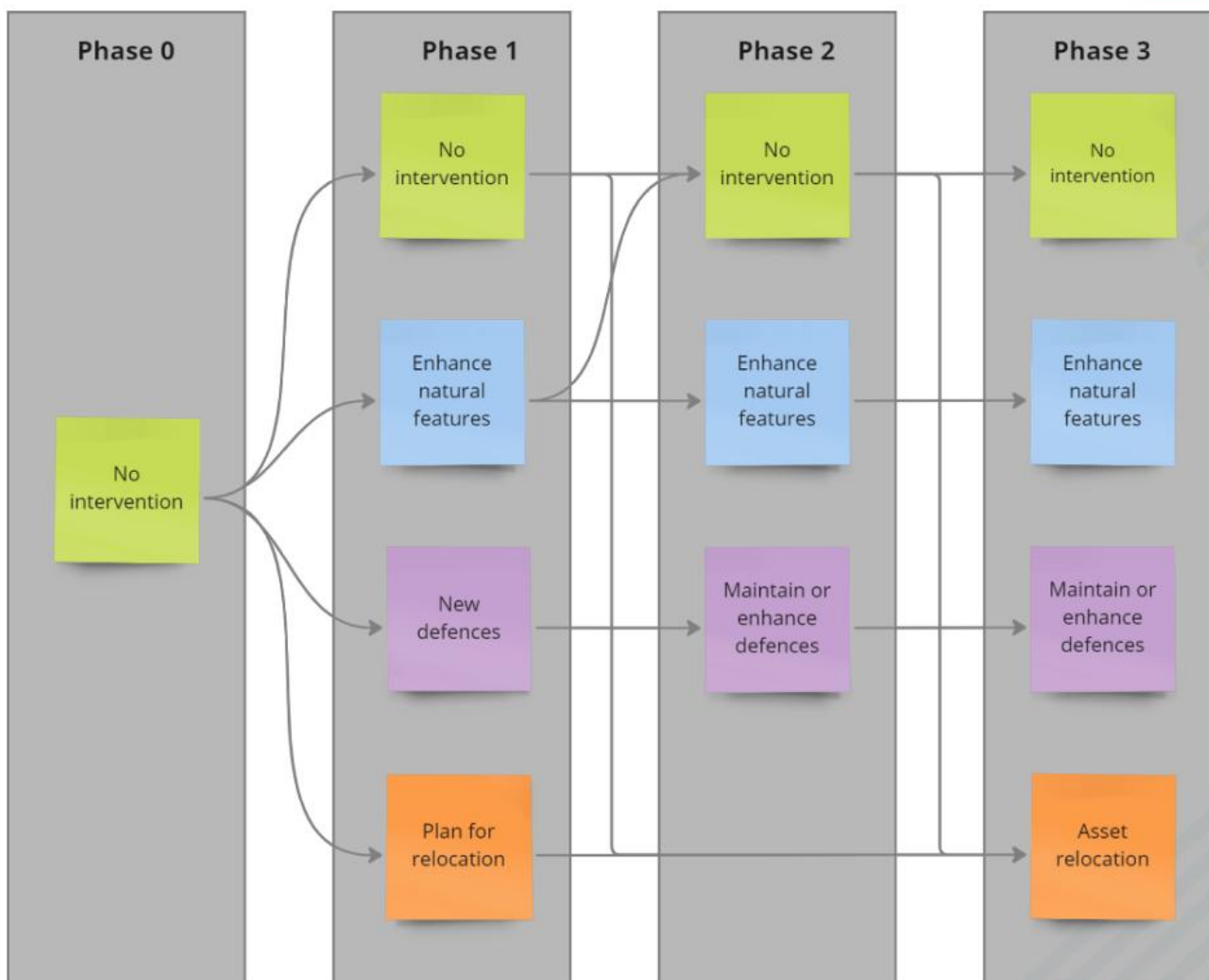
- **CMU 1 = Natural with risk and hazard**
- **CMU 3 = Natural with risk and no hazard**
- **CMU 7 = Natural with no risk and hazard**
- **CMU 9 = Natural with risk and hazard**

Phase 0 of the adaptation pathway (1<sup>st</sup> 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 (2<sup>nd</sup> 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, 3, 7 and 9 (natural coast). Grey lines represent possible future pathways.**

### 3.2 Hybrid Adaptation Pathway

CMU 2, 5, and 6 are classified as hybrid coastlines (Figure 3-2). CMU 2 is predominantly a natural beach, enhanced with rock armour, CMU 5 is a natural rocky coast with various privately owned coastal defence structures along the length, and CMU 6 is a large sandy beach backed by dunes and a vertical concrete wall. The risk and hazard at these three CMUs are summarised below:

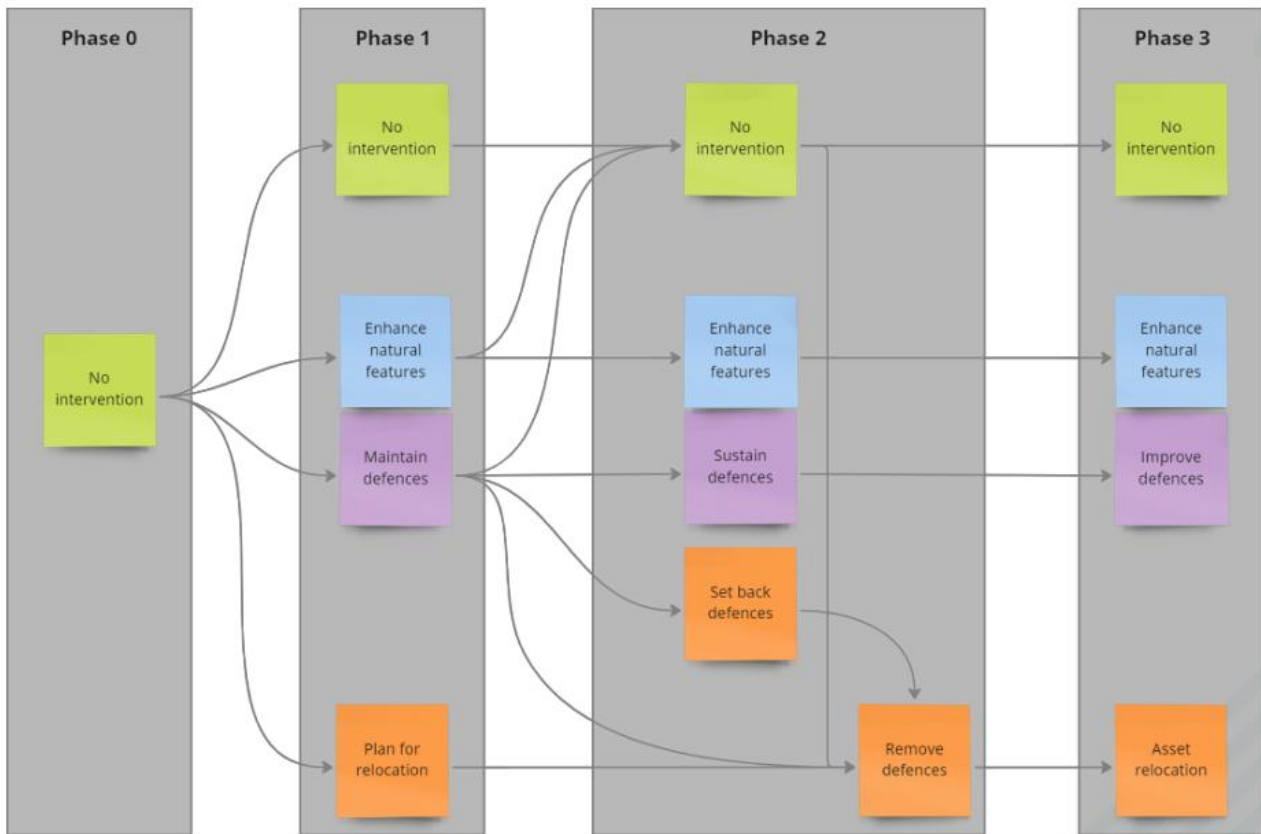
- **CMU 2 = Hybrid with risk and hazard**
- **CMU 5 = Hybrid with risk and hazard**
- **CMU 6 = Hybrid with risk and hazard**

Phase 0 of the adaptation pathway (1<sup>st</sup> column) is the current actions undertaken by Moray Council in respect of these CMUs. Here this is **No Intervention** as Moray Council are not obligated to maintain the defence structures in these CMUs. This means that there will be no coastal and/or erosion risk management interventions, nor maintenance of existing structures during this phase.

For the adaptation pathway to move to Phase 1 (2<sup>nd</sup> 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 2, 5, and 6 (hybrid coast). Grey lines represent possible future pathways.**

### 3.3 Built Structures Adaptation Pathway

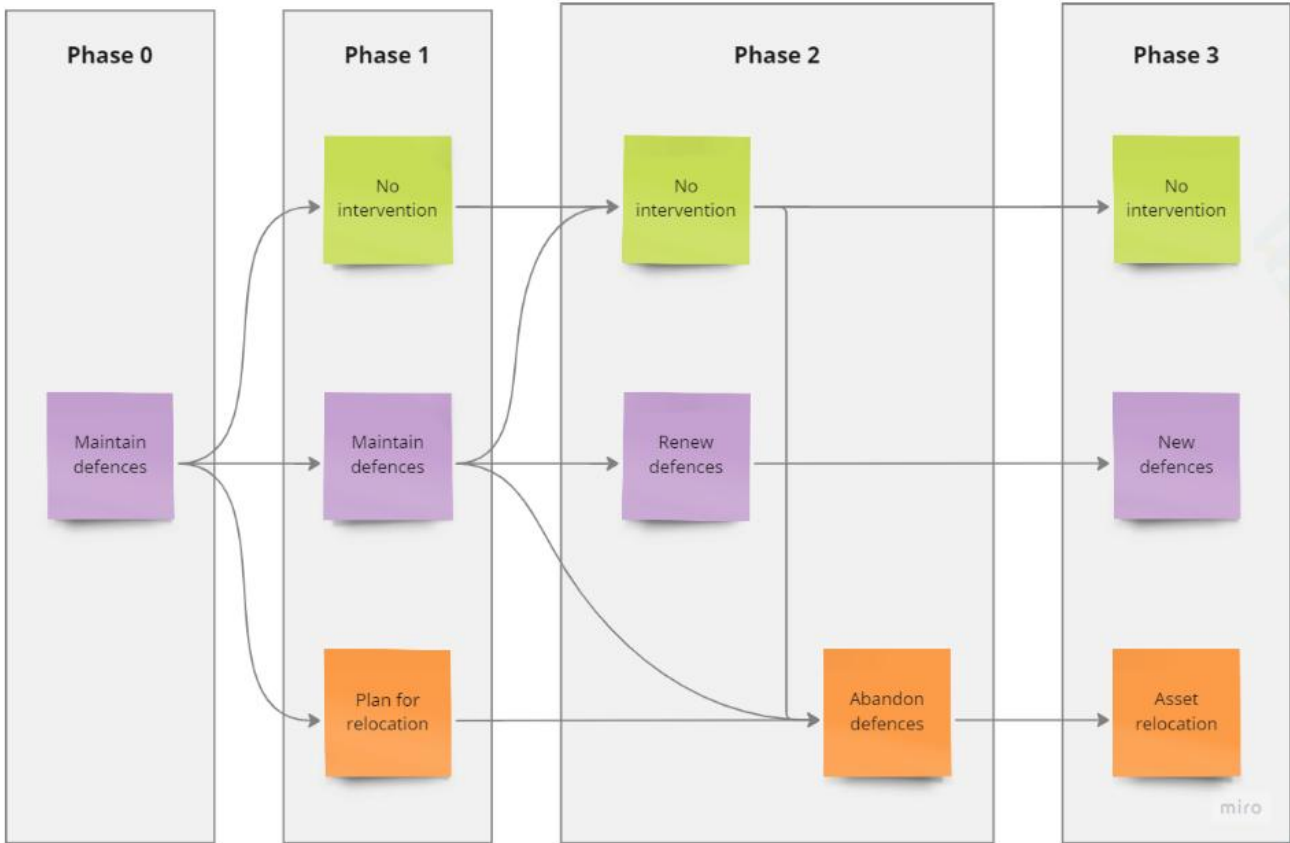
CMU 4 and 8 comprise Findochty and Portknockie harbours respectively. They have both been classified as CMUs defended by structures and have therefore been assigned adaptive pathways for Built Structures (Figure 3-3).

- **CMU 4 = Built Structures with risk and hazard**
- **CMU 8 = Built Structures with risk and hazard**

Phase 0 of the adaptation pathway (1<sup>st</sup> column) is the current actions undertaken by Moray Council in respect to these CMUs. The pathway approach for both CMUs is **Maintain Defences**. This means that there will be coastal and/or erosion risk management interventions during this phase and maintenance of existing structures should be undertaken if there is a risk to public safety and if funding is available.

For the adaptation pathway to move to Phase 1 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 4 and 8 (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 Findochty to Portknockie 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 4-2):

- 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.

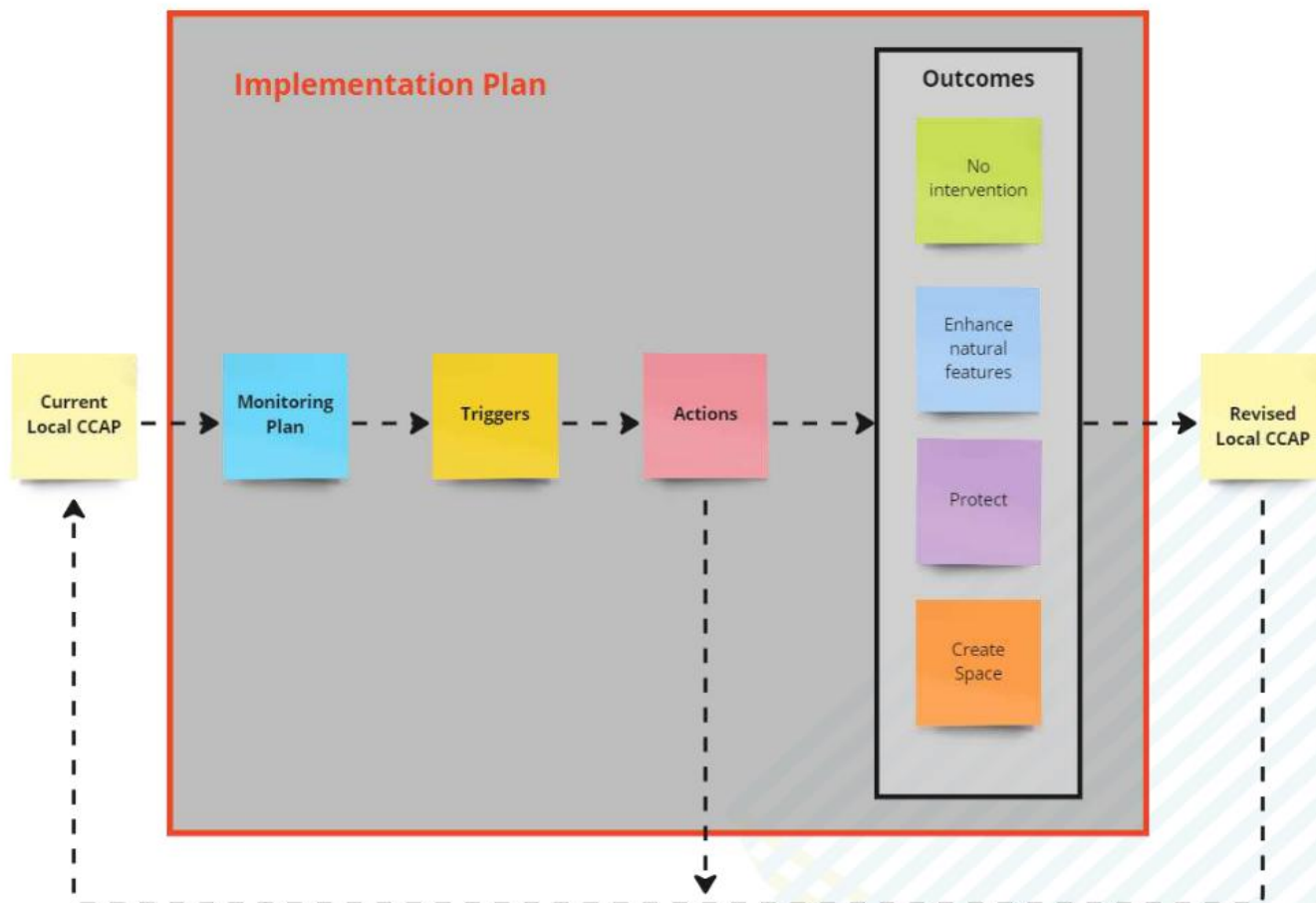


Figure 4-1: High-level Implementation Plan.



## 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, but risk exposure triggers related to physical flooding, erosion and overtopping thresholds are specific to each CMU. For the Findochty to Portknockie 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 erosion hazard
- CMU 2: Monitoring of erosion hazard
- CMU 3: Monitoring of erosion hazard
- CMU 4: Monitoring of flood and erosion hazard
- CMU 5: Monitoring of flood hazard
- CMU 6: Monitoring of erosion hazard
- CMU 7: Monitoring of erosion hazard
- CMU 8: Monitoring of flood hazard
- CMU 9: 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.
- Coastal defences.

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 the tide gauge levels (Table 4-1).

At Findochty to Portknockie Coast, current SEPA maps indicate flood risk at CMU 4, 5 and 8.

**Exceedance Frequency is the number of events that exceed the asset threshold in a 10-year period.**

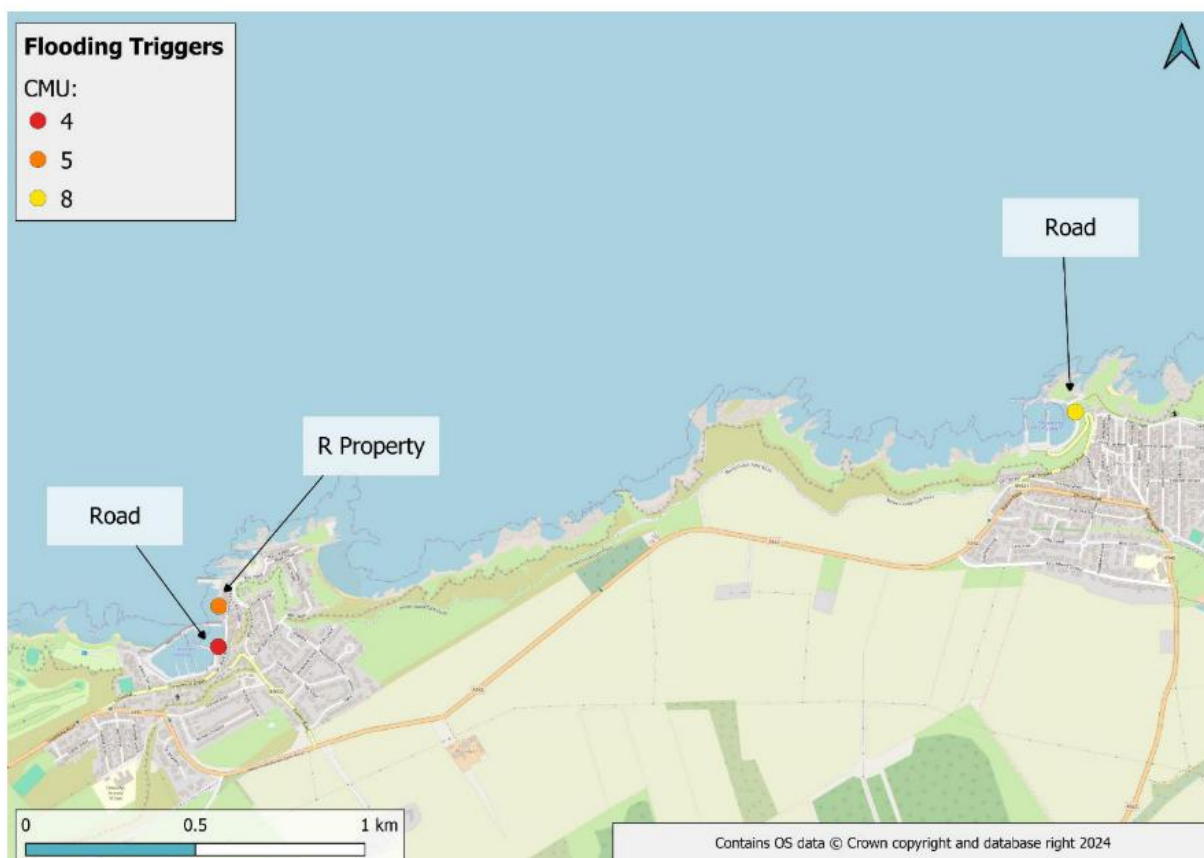
The CMU-specific flooding trigger is realised if the exceedance frequency increases beyond specified criteria. There are two levels to this Trigger realisation that result in different actions. These also vary depending on the type of asset at risk of flooding:

- **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 4-3. Currently, no flooding triggers have been met (Table 4-1).

**Table 4-1: CMU-specific flooding triggers for Findochty to Portknockie 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:
5	Property	4.3	4.0	0	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:
4	Commercial Street		3.8	0	5.0	10.0
8	Harbour Road		5.0	0	5.0	10.0



**Figure 4-2: Findochty to Portknockie 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 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:

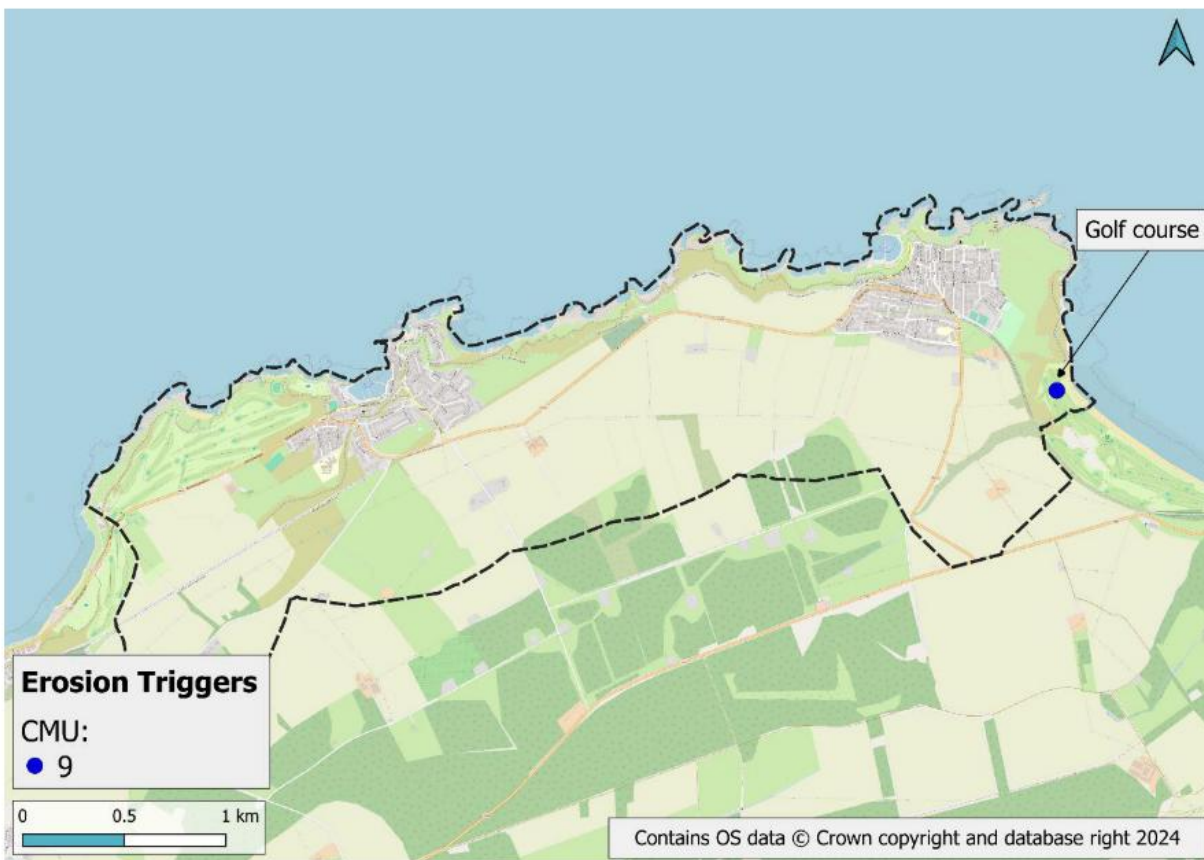
- **Residential properties**
  1. Maximum of historic erosion rate multiplied by 20 or 20m.
    - Increase monitoring and plan for assessment.
  2. Maximum of historic erosion rate multiplied by 10 or 10m.
    - Undertake assessment and plan for intervention.
- **Roads and other features**
  1. Maximum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



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 4-3.

**Table 4-2: CMU-specific erosion triggers for Findochty to Portknockie Coast 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 feature to coast (m)		Erosion trigger level 1: Coast X m from feature	Erosion trigger level 2: Coast X m from feature
9	1.7	Golf course	3	8.5	3.4



**Figure 4-3: Findochty to Portknockie Coast erosion trigger locations.**



**Table 4-3: Findochty to Portknockie Coast erosion triggers**

CMU	Asset	Trigger Met	Erosion Trigger
9	Golf course	Yes (1 and 2)	 <p>Note, extent of erosion trigger only shown up to edge of study area. Golf course continues to the southeast (into the Cullen Local Plan)</p>

### 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 all and specific CMUs in Findochty to Portknockie 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 Plan<sup>8</sup> Proactive are also required to support.

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

#### Post flood data collection:

- Involve community engagement, surveys, photographs etc.

<sup>8</sup> Moray Coastal Change Adaptation Plan: Regional Plan - IRR-JBAU-XX-XX-RP-MO-0001-S4-P03-Regional\_Plan

### 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 guidance<sup>9</sup> 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 to Findochty to Portknockie Coast CMU is 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 Findochty to Portknockie Coast CMU.**

Category	Trigger	Action	CMU
Natural Systems	Changes to habitat	Community engagement (places)	All except: CMU 4 and CMU 8
	Changes to greenspace	Community engagement (places)	All except: CMU 4 and CMU 8
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	CMU 4 CMU 5 CMU 8
Risk exposure	Defence condition	Community engagement (asset)	CMU 2 CMU 4 CMU 5 CMU 6 CMU 8
	Update to SEPA flood warning	Review risk assessment Community engagement (places, practice)	CMU 4 CMU 5 CMU 8
	Erosion buffer exceeded	Review risk assessment Community engagement (places)	CMU 1 CMU 2 CMU 3 CMU 4 CMU 6 CMU 7 CMU 9

<sup>8</sup> Scottish Government. 2016. Flood protection appraisals: guidance for SEPA and responsible authorities <https://www.gov.scot/publications/guidance-support-sepa-responsible-authorities/pages/2/>

	Flood risk threshold exceeded	Review risk assessment Community engagement (places)	CMU 4 CMU 5 CMU 8
	Update to Dynamic Coast	Review risk assessment Community engagement (practice)	All
<b>Socio-economic</b>	Changes of asset use	Community engagement (asset)	All except: CMU 7
	Changes of asset owner	Community engagement (asset)	All except: CMU 7
	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 Findochty to Portknockie Coast. These are outlined below:

- CMU 9:
  - Trigger 2: Erosion buffer exceeded (level 2)
    - **Action 2:** Undertake assessment and plan for intervention. Furthermore, if any action is taken on CMU 1 of the Cullen Plan, then the associated action would apply here.

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 four such actions have been identified. These have been developed focusing on the key pillars 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 C. These are designed to complement the wider Proactive Actions identified in the Regional CCAP.

**Table 4-5: Local Proactive Actions.**

Action	Details	Pillars
1	Develop modelling framework to support future assessments at CMU 10	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. This should link with Regional Proactive Action 6 to identify and define local opportunities.	Placemaking

#### 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.

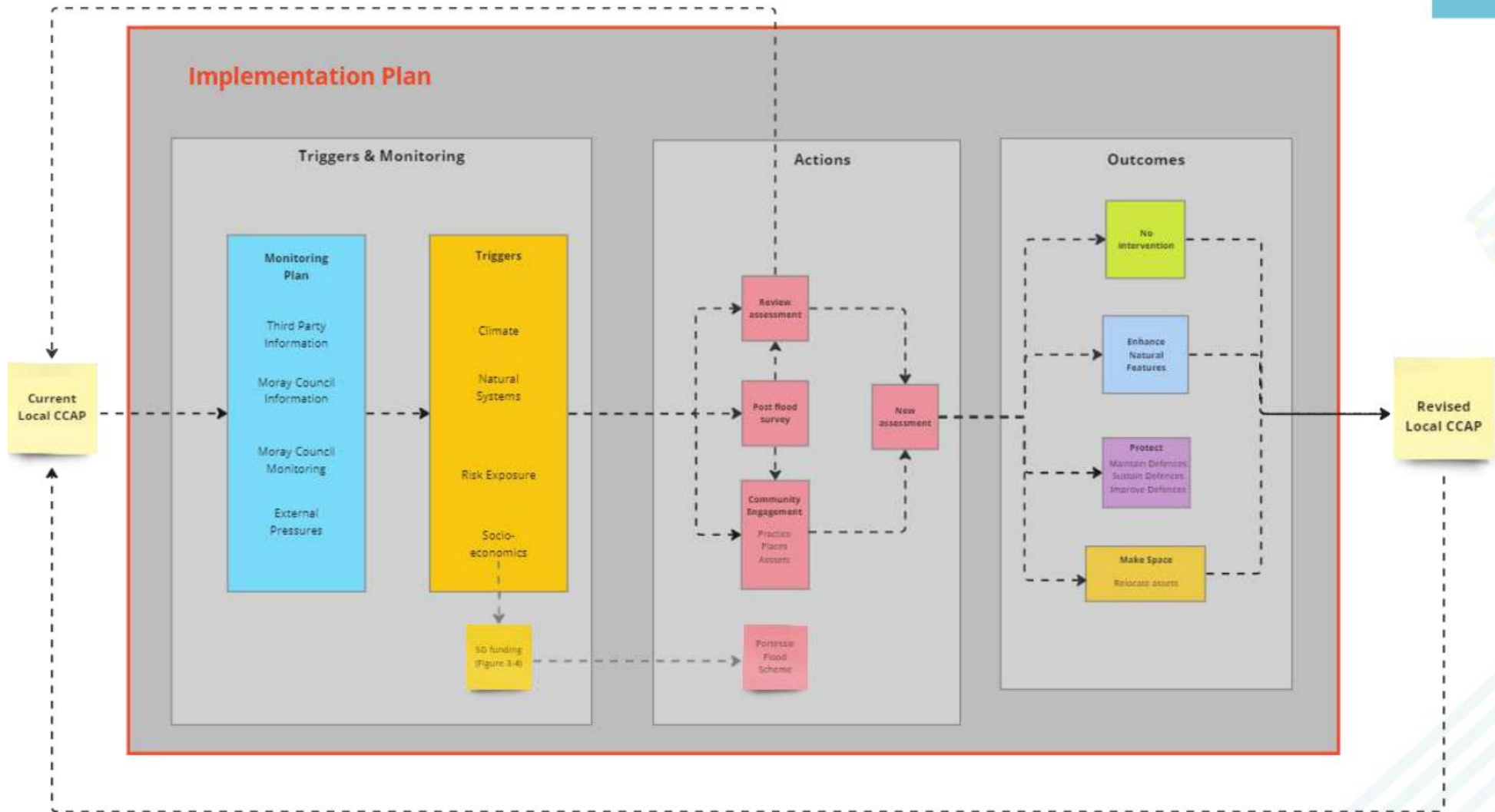
As the Implementation Plan is applied at CMU level, the ultimate outcome is dependent on the CMU and the associated Adaptation Pathway. Table 4-6 summarises the general and specific CMU outcomes for the Findochty to Portknockie Coast CA.



**Table 4-6: Findochty to Portknockie Coast CA possible outcomes.**

Category	Outcome	Findochty to Portknockie CMUs
No intervention	No intervention	CMU 1 CMU 2 CMU 3 CMU 5 CMU 6 CMU 7 CMU 9
Enhance natural features	Enhance natural features	CMU 1 CMU 2 CMU 3 CMU 5 CMU 6 CMU 7 CMU 8
Protect	Maintain defences	CMU 2 CMU 4 CMU 5 CMU 6 CMU 8
	Sustain* defences	CMU 2 CMU 4 CMU 5 CMU 6 CMU 8
	Improve** defences	All
Create space	Remove defences	CMU 2 CMU 4 CMU 5 CMU 6 CMU 8
	Set back defences	All
	Relocate assets	CMU 1 CMU 2 CMU 3 CMU 4 CMU 5 CMU 6 CMU 8 CMU 9
<p>*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</p>		

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

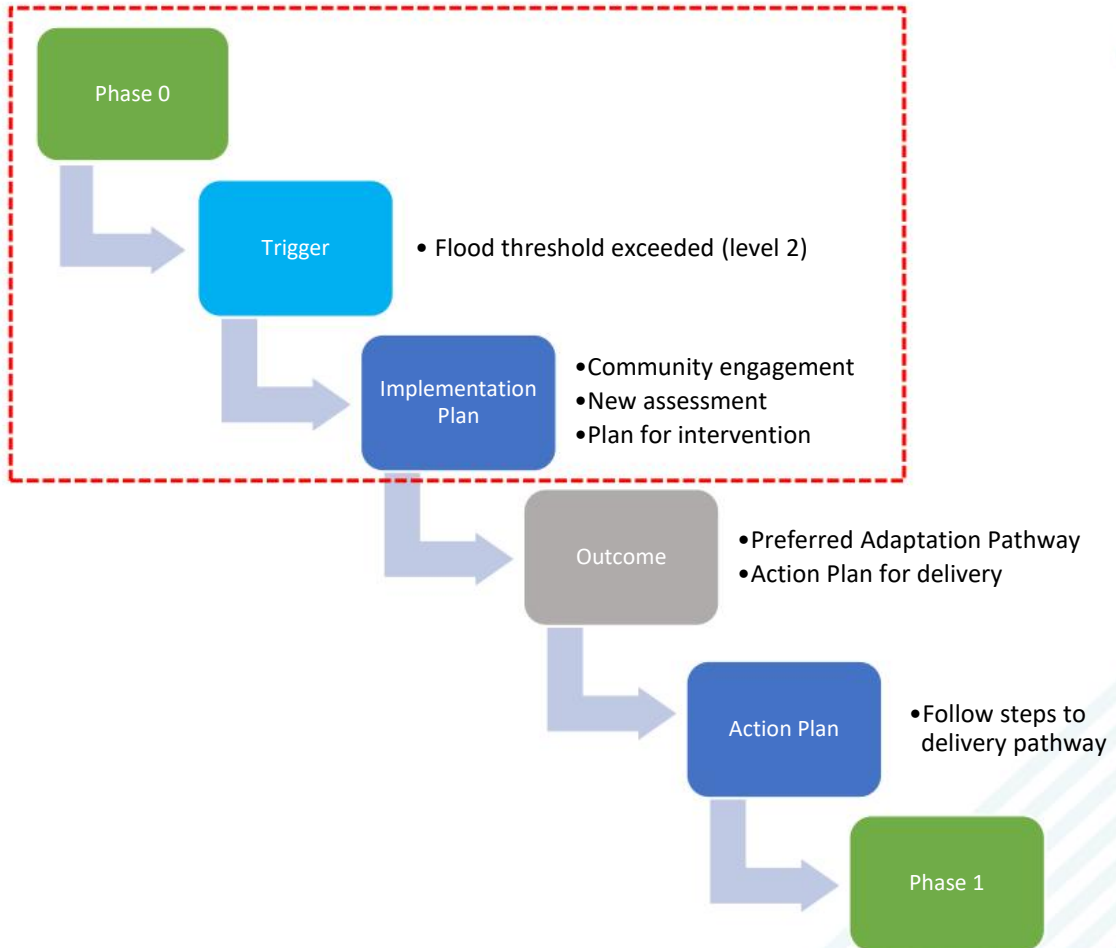


**Figure 4-4: Complete Implementation Plan for Findochty to Portknockie Coast CA.**



### 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 Findochty to Portknockie 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 Findochty to Portknockie 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 Findochty to Portknockie 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 Findochty to Portknockie Coast CA. This will happen when the process moves into Phase 1.

### 5.2 Coastal Management Units and Risks

The Findochty to Portknockie Coast CA was subdivided into ten 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 – Hybrid with Risk and Hazard
- CMU3 – Natural with Risk and Unknown Hazard
- CMU4 – Built Structures with Risk and Hazard
- CMU5 – Hybrid with Risk and Hazard
- CMU6 – Hybrid with Risk and Hazard
- CMU7 – Natural with No Risk and Hazard
- CMU8 – Built Structures with Risk and Hazard
- CMU9 – Natural with 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 Findochty to Portknockie 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. Implementation of the Plan will result in end outcomes that will ultimately influence the direction of the Adaptation Pathways in the Findochty to Portknockie 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, four Proactive Actions have been set.

## 5.5 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 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

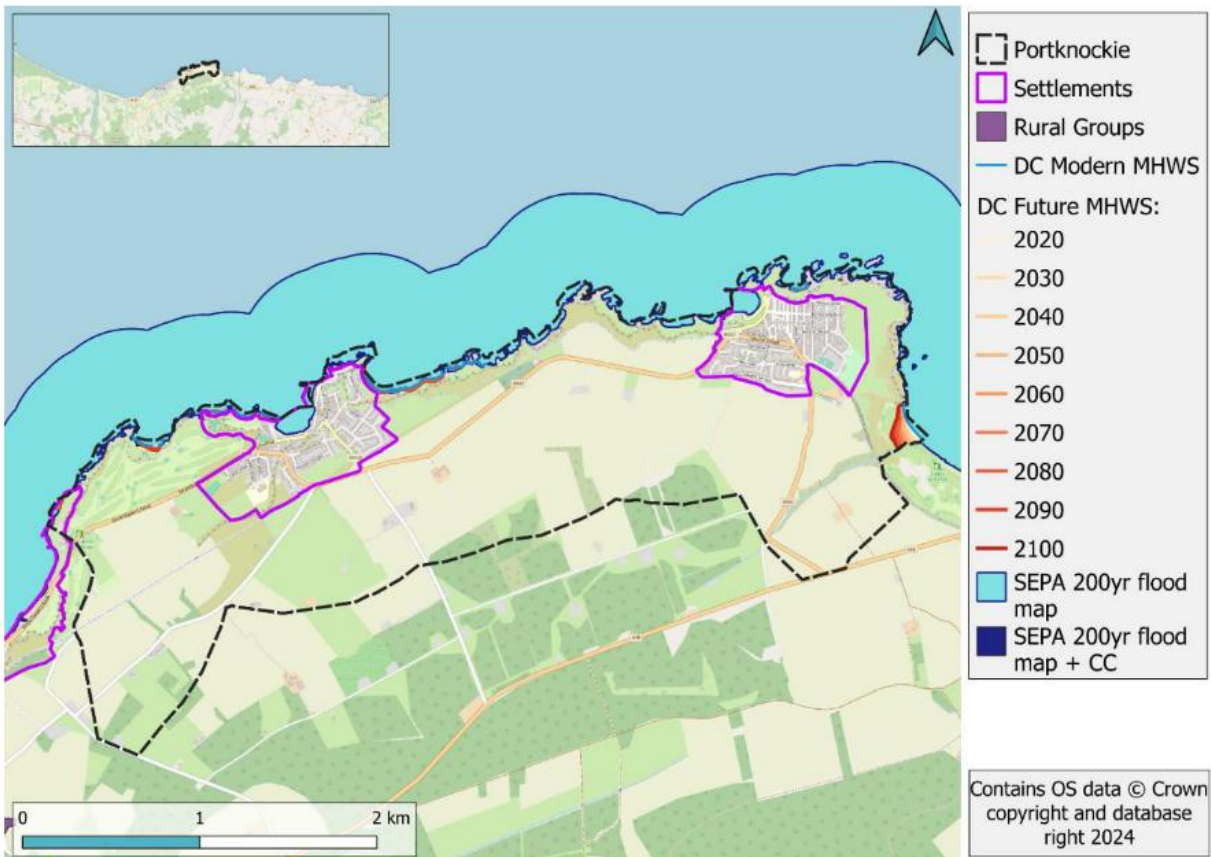
### A.1 Data and overview

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

**Table A-1: Coastal dataset summary for the Findochty to Portknockie 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	
	LAT	-2.1 mOD	
Extreme Sea Levels	2.05 m OD	MHWS	CFB (Portknockie: 3090)
	2.66 m OD	2-year	
	2.96 m OD	50-year	
	3.02 m OD	100-year	
	3.08 m OD	200-year	
	3.22 m OD	1000-year	
Sea level rise projections	0.14 m	2050 70th percentile	UKCP18
	0.19 m	2050 95th percentile	
	0.58 m	2100 70th percentile	
	0.83 m	2100 95th percentile	

An overview of coastal flood and erosion hazards is provided for Findochty to Portknockie 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.



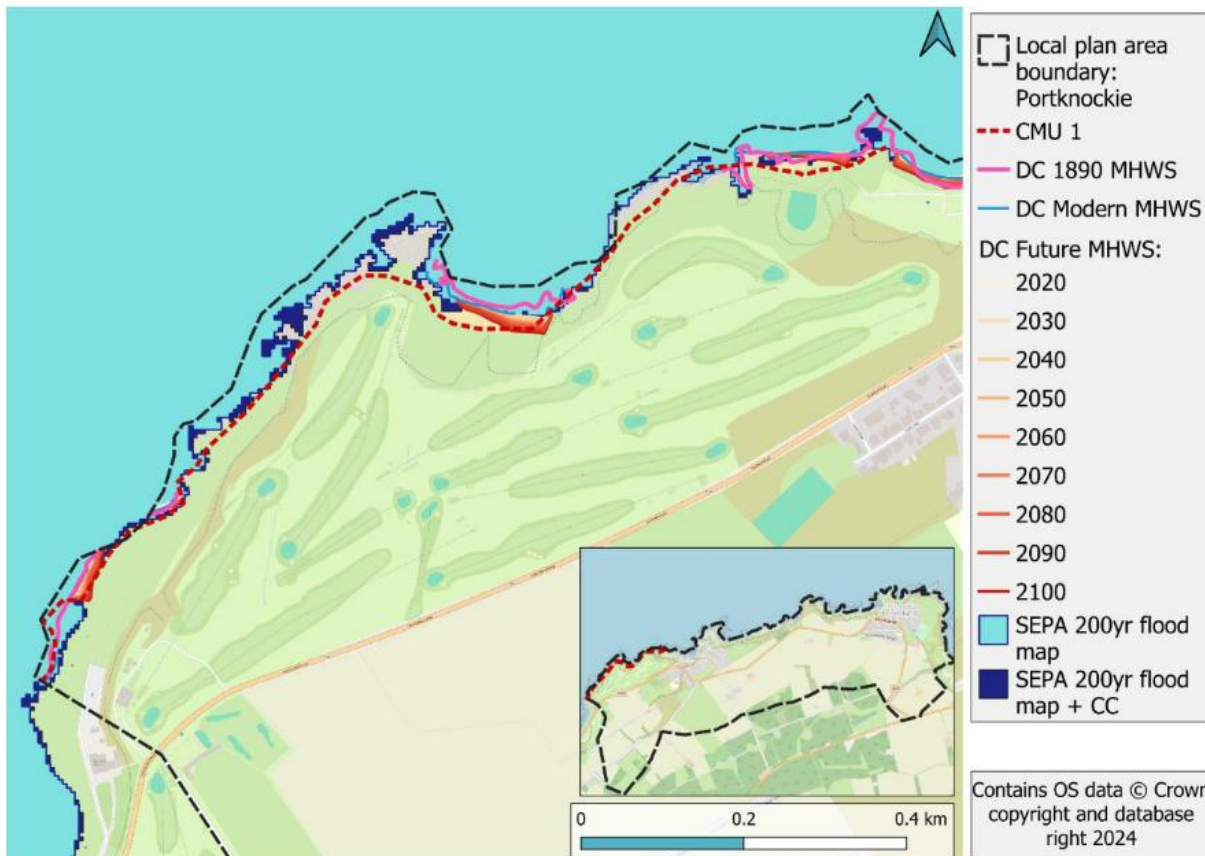
**Figure A-1: Findochty to Portknockie Coast CA coastal flood and erosion hazard overview.**

## A.2 CMU 1: Strathlene Golf Course

This unit is classified as natural coast and spans ca. 1.5 km of north-northwest facing coastline, immediately north of Strathlene Golf Course and west of Findochty. The coastal geomorphology is predominantly rocky coast, including numerous outcrops of the metamorphic Grampian Quartzite. Interspersed along the coast are a series of sandy pocket beaches backed by established dunes. The Moray Coastal Trail (MCT) runs long the cliff top.

Despite the rocky morphology, there is retreat predicted by Dynamic Coast localised at the sandy pocket beaches. The historical rate of retreat is estimated to have been 0.1 m/yr (from ca. 2003 to 2011). This rate is expected to increase up to 0.27 m/yr by 2050 and up to 0.44 m/yr by 2100. This will lead to an estimated retreat of 7 m by 2050 and 26 m by 2100. There are no assets within Dynamic Coast’s projected erosion area vicinity of it up to 2100 under the High Emission Scenario.

SEPA flood maps show that there is no flood risk from 1-in-200-year and 1-in-200-year plus climate change events.



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

**Table 5-1: CMU 1 Dynamic Coast erosion summary.**

Dynamic Coast calculation	Results	
Historical rate	0.1 m / yr	Maximum
	0.0 m / yr	Median
2050 rate	0.3 m / yr	Maximum
	0.1 m / yr	Median
2050 distance	6.6 m	Maximum
	1.5 m	Median
2100 rate	0.4 m / yr	Maximum
	0.3 m / yr	Median
2100 distance	25.6 m	Maximum
	11.7 m	Median



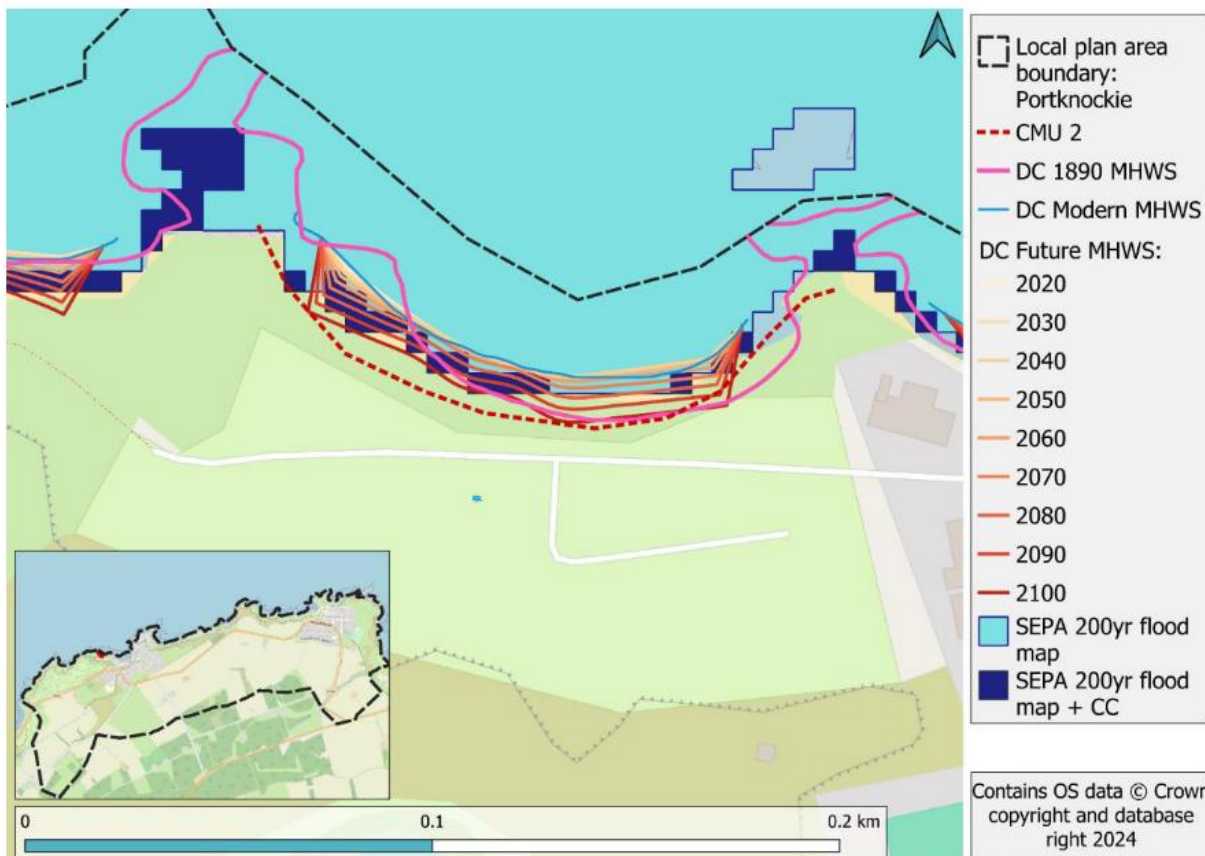
### A.3 CMU 2: Findochty Caravan Park

This unit is classified as hybrid as it spans a natural beach enhanced by a section of rock armour. Available images support the view that construction of this revetment may have been informal (i.e. rock dump) rather than a formally designed and engineered defence. The unit spans ca. 174 m along the north facing sandy beach immediately north of Findochty Holiday Park. There is a large rocky platform at the toe of the beach, below the high tide line.

Despite the rock armour at the top of the beach, there is substantial retreat predicted by Dynamic Coast for this unit, this may be because the Dynamic Coast projections have not considered the presence of the defence. The historical rate of retreat is estimated to have been 0.1 m/yr (from ca. 2003 to 2011). This rate is expected to increase up to 0.25 m/yr by 2050 and up to 0.44 m/yr by 2100. This will lead to an estimated retreat of 6 m by 2050 and 25 m by 2100. If the Dynamic Coast 2100 prediction is to be realised, then the caravan park would be under threat of erosion. This level of retreat may well not be realised as it is likely that the Dynamic Coast projections did not account for the structure being present. If so, then the retreat will be contingent on the rock armour defence condition being maintained at an appropriate level and so assessment and monitoring of this is important.

No other assets are currently within Dynamic Coast’s projected erosion area or in the vicinity of it up to 2100 under the High Emission Scenario.

SEPA flood maps show that there is no flood risk from 1-in-200-year and 1-in-200-year plus climate change events.



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

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

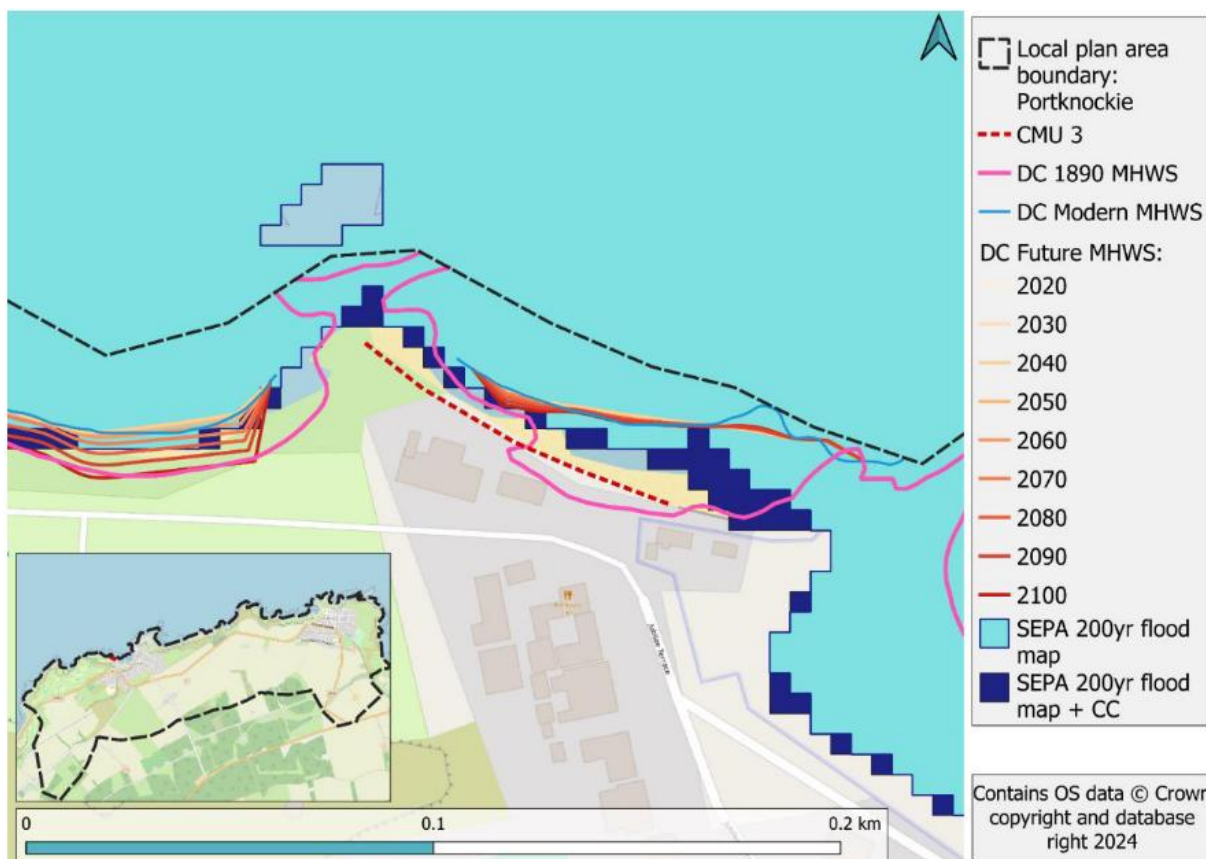
Dynamic Coast calculation	Results	
Historical rate	0.1 m / yr	Maximum
	0.0 m / yr	Median
2050 rate	0.3 m / yr	Maximum
	0.1 m / yr	Median
2050 distance	6.1 m	Maximum
	1.3 m	Median
2100 rate	0.4 m / yr	Maximum
	0.3 m / yr	Median
2100 distance	25.1 m	Maximum
	12.1 m	Median

### A.4 CMU 3: Findochty Beach

This unit is classified as natural and spans 84 m along the north-northeast beach immediately west of Findochty Harbour walls. Running in a north orientation out of the centre of the beach is a large concrete drainage outfall pipe. This condition and hydraulic performance of the pipe will be important to maintain drainage for the caravan park. This has not been assessed. As with CMU 2, there is a large rocky platform at the bottom of the beach.

Dynamic Coast estimates that there will be coastal retreat on the western edge of this unit. However, towards the east of the unit, close to Findochty Harbour, there may be a small degree of accretion. The Dynamic Coast projections show that a historical rate of retreat in the unit has been 0.04 m/yr (from ca. 2003 to 2011). This rate is expected to increase up to 0.11 m/yr by 2050 and up to 0.34 m/yr by 2100. This will lead to an estimated retreat of 1.6 m by 2050 and 15 m by 2100. Other than the outfall pipe, there are no assets within the Dynamic Coast projected erosion area.

There is no apparent risk of coastal flooding predicted by SEPA for a 1-in-200-year and 1-in-200-year plus climate change events within this CMU.



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

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

Dynamic Coast calculation	Results	
Historical rate	0.4 m / yr (accretion)	Maximum
	0.3 m / yr (accretion)	Median
2050 rate	0.1 m / yr	Maximum
	0.2 m / yr (accretion)	Median
2050 distance	1.6 m	Maximum
	7.5 m (accretion)	Median
2100 rate	0.3 m / yr	Maximum
	0.04 m / yr (accretion)	Median
2100 distance	15.0 m	Maximum
	9.3 m (accretion)	Median



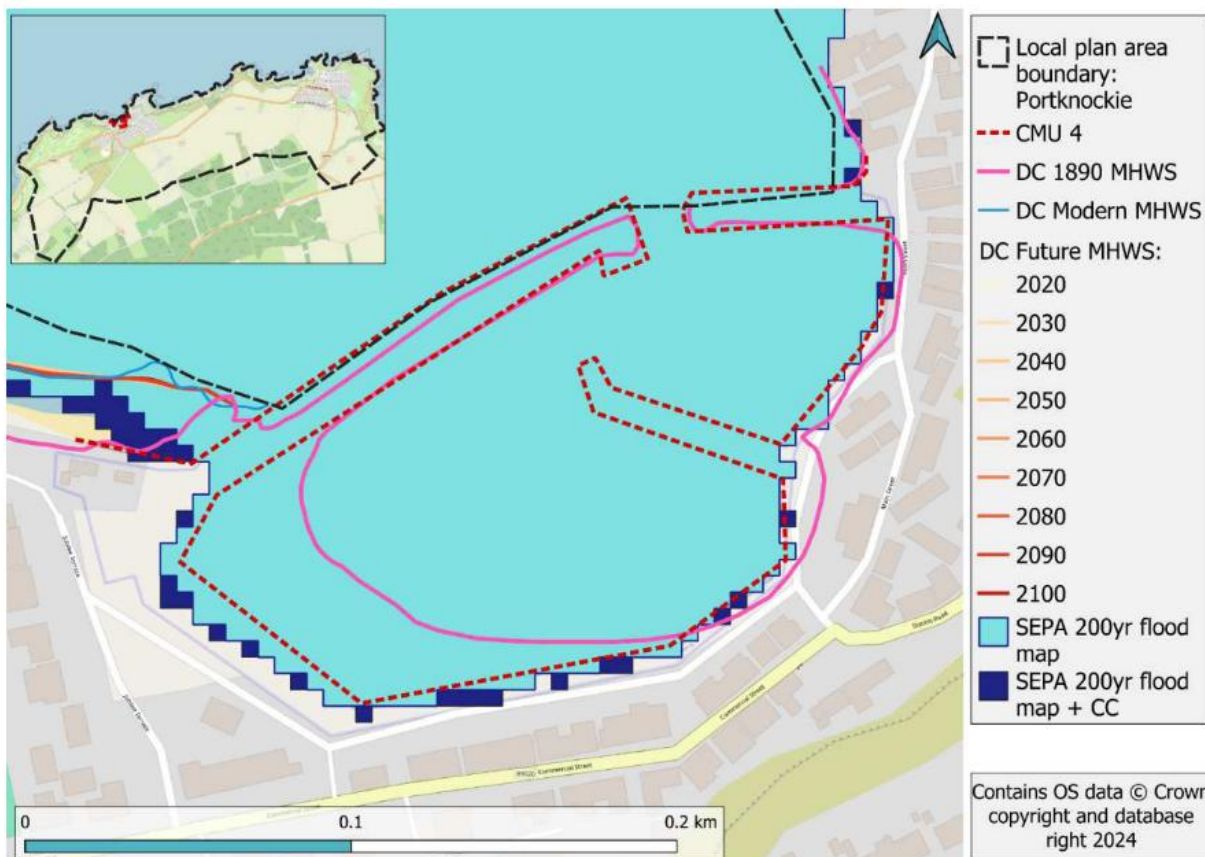
### A.5 CMU 4: Findochty Harbour

This unit consists solely of built structures and includes ca. 300 m of the vertical concrete seawalls of Findochty Harbour. The harbour has two large basins, sheltered by two large vertical seawalls. It can berth up to 100 vessels and caters for a wide range of activities, from leisure craft through to commercial fishing boats. Just offshore of there is a series of detached rocky outcrops.

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

- Commercial Street (~5 m section)

As this is an engineered coastline, there are no erosion projections available from Dynamic Coast. There is an unknown hazard from coastal erosion.



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

### A.6 CMU 5: Findochty North

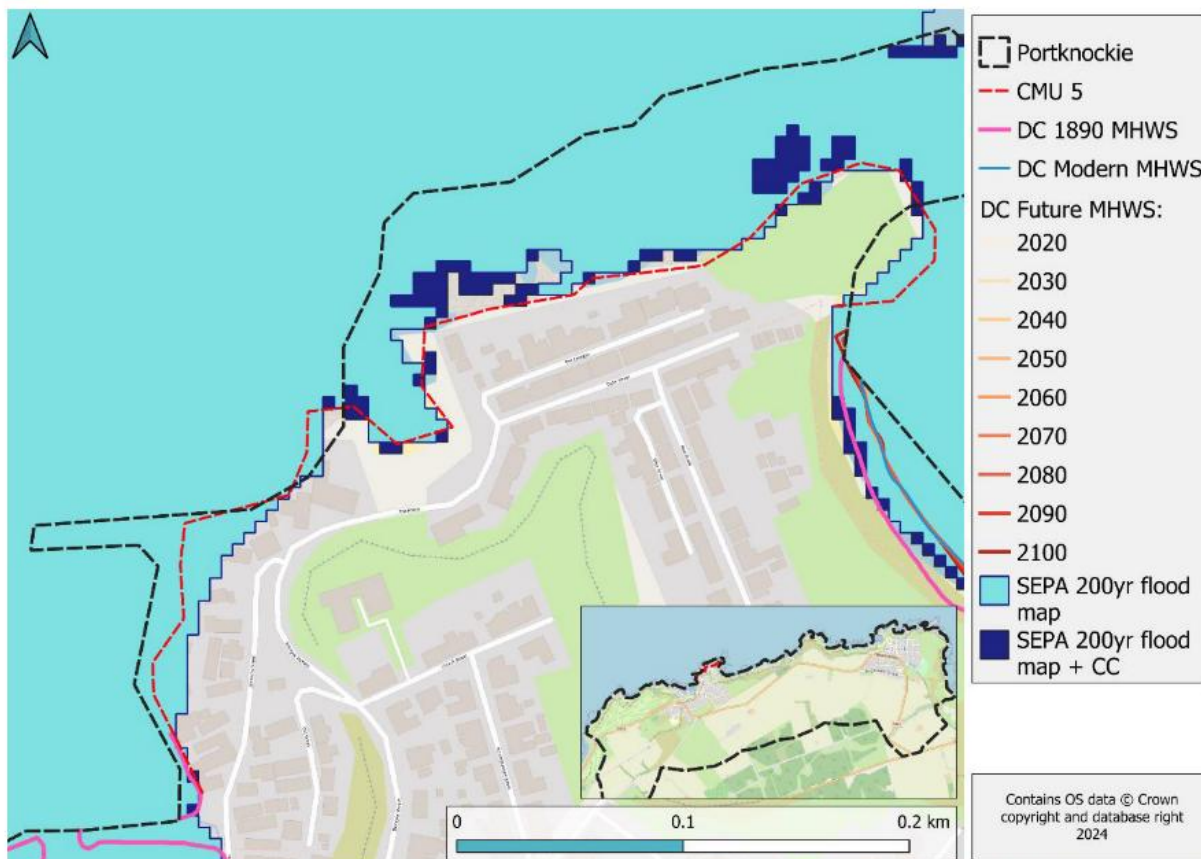
This unit is classified as hybrid as it comprises ca. 450 m of rocky coastline around the northeastern extent of Findochty, with several sections of manmade coastal defences built atop the backshore. Along the coast there are a series of small sand and shingle beaches as well as a large concrete jetty. There are numerous residential and non-residential properties and a minor road within proximity of the coastline.

On the eastern extent is a small section of rocky coastline spanning ca. 200 m around the headland northeast of Findochty. Just offshore of the headland is a large rocky outcrop to the northeast.

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

- 1 RP (residential property)

There is an unknown hazard from coastal erosion as there is no data available from Dynamic Coast.



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

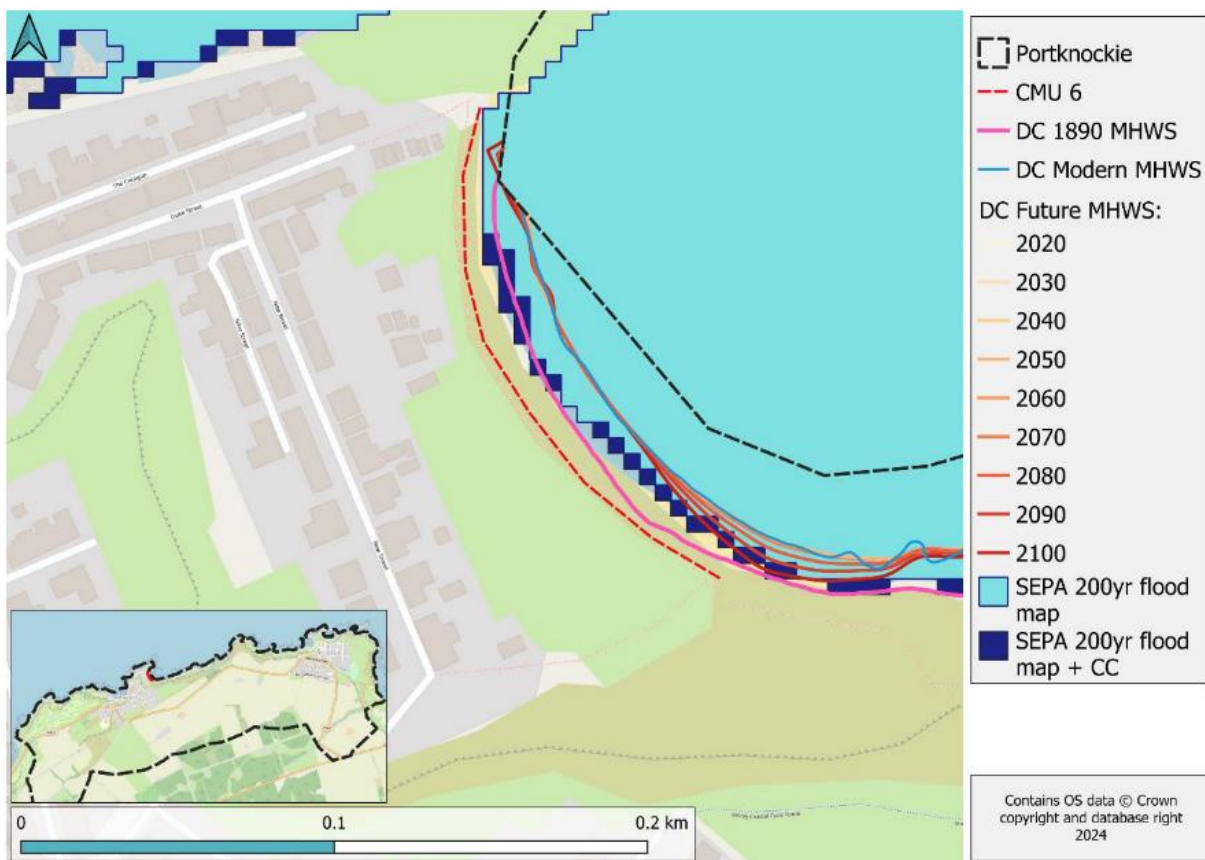
### A.7 CMU 6: Findochty East Beach

This unit is classified as a hybrid and spans ca. 180 m along the beach east of Findochty. At the top of the beach is an established dune system and built behind the dunes is a waist height vertical concrete seawall.

SEPA flood maps show that there is no flood risk from 1-in-200-year and 1-in-200-year plus climate change events.

There are no assets within the Dynamic Coast projected erosion area or in the vicinity of it up to 2100 under the High Emission Scenario.

The historic rate of coastal retreat given by Dynamic Coast shows a steady accretion of 0.1 m/yr (from ca. 2003 to 2011). The predicted rate of change in the future indicates a projected 0.25 m/yr of retreat by 2050 increasing to 0.8 m/yr by 2100. This will lead to an estimated retreat of 3.6 m by 2050 and 35 m by 2100.



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



**Table 5-4: CMU 6 Dynamic Coast erosion summary.**

Dynamic Coast calculation	Results	
Historical rate	0.34 m / yr (accretion)	Maximum
	0.29 m / yr (accretion)	Median
2050 rate	0.25 m / yr	Maximum
	0.13 m / yr (accretion)	Median
2050 distance	3.60 m	Maximum
	5.42 m (accretion)	Median
2100 rate	0.83 m / yr	Maximum
	0.11 m / yr	Median
2100 distance	35.08 m	Maximum
	3.7 m (accretion)	Median



### A.8 CMU 7: Hillhead Cemetery Coast

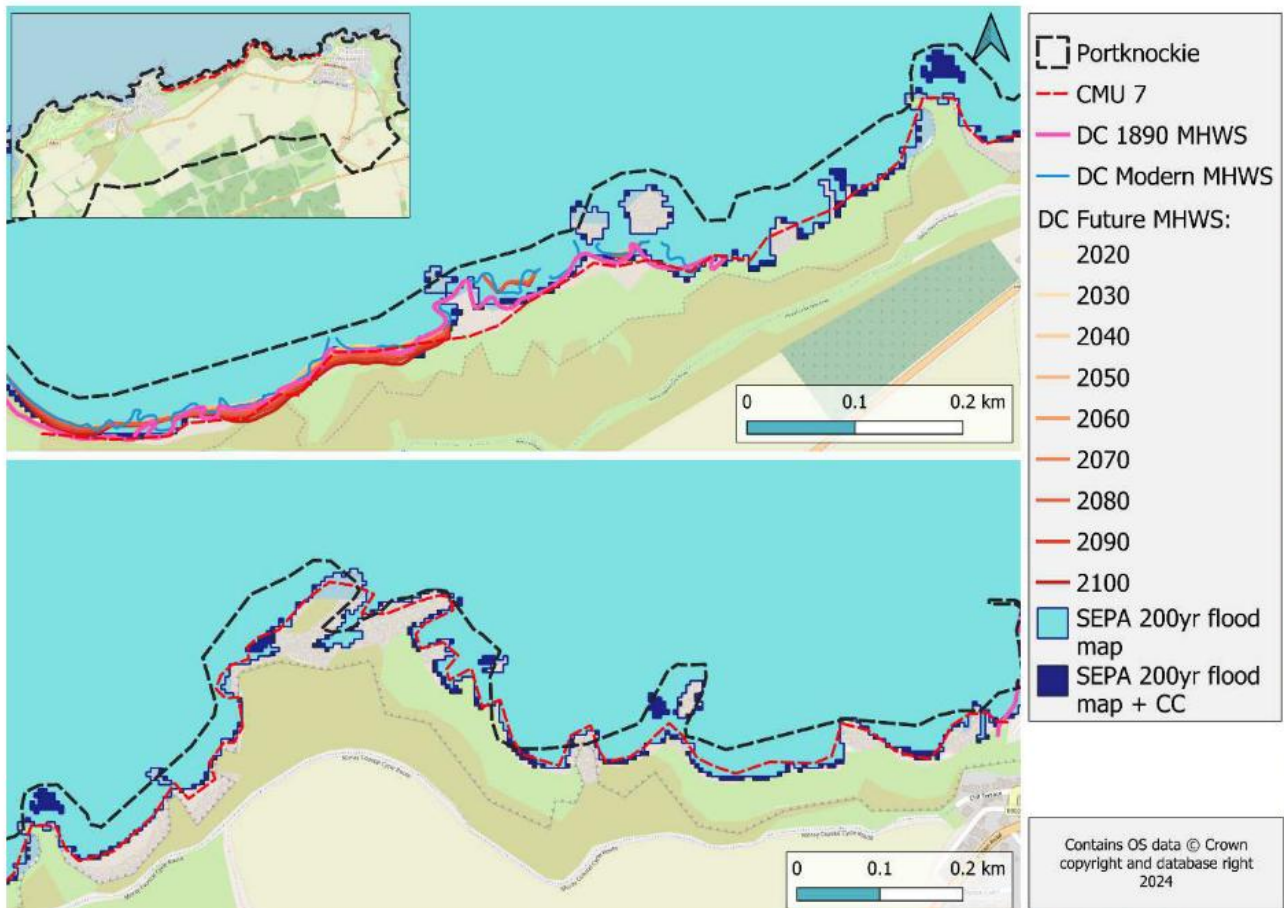
This unit classified as natural and comprises of an expansive stretch of natural coast, approximately 2.4 km in length. This coastline is dominated by rocky cliffs of Grampian Quartzite fronted by rocky platforms. Dispersed along the unit are a series of sandy pocket beaches.

The MCT runs along the cliff top in this unit as does the main link road between Findochty and Portknockie (A942), which is situated 76 m back from the clifftop at its closest. In the centre of the unit is Hillhead Cemetery and either side of the cemetery between the clifftop and the A942 is agricultural land.

SEPA flood maps show that there is no flood risk from 1-in-200-year and 1-in-200-year plus climate change events.

Dynamic Coast projects that there will be coastal retreat within this unit at the various pocket beaches up to 2100. Dynamic Coast estimates that there has been no historic retreat from ca. 2003 to 2011. Yet, this rate is expected to increase up to 0.24 m/yr by 2050 and up to 0.47 m/yr by 2100. This will lead to an estimated retreat of 6 m by 2050 and 26 m by 2100.

There are no assets within the Dynamic Coast projected erosion area or in the vicinity of it up to 2100 under the High Emission Scenario.



**Figure A-8: CMU 7 coastal hazards map showing SEPA flood extents and Dynamic Coast (DC) past and future erosion. Inset shows unit without coastal hazards.**

**Table 5-5: CMU 7 Dynamic Coast erosion summary.**

Dynamic Coast calculation	Results	
Historical rate	0.00 m / yr	Maximum
	0.10 m / yr (accretion)	Median
2050 rate	0.24 m / yr	Maximum
	0.10 m / yr	Median
2050 distance	5.59 m	Maximum
	0.59 m	Median
2100 rate	0.47 m / yr	Maximum
	0.33 m / yr	Median
2100 distance	25.61 m	Maximum
	13.00 m	Median

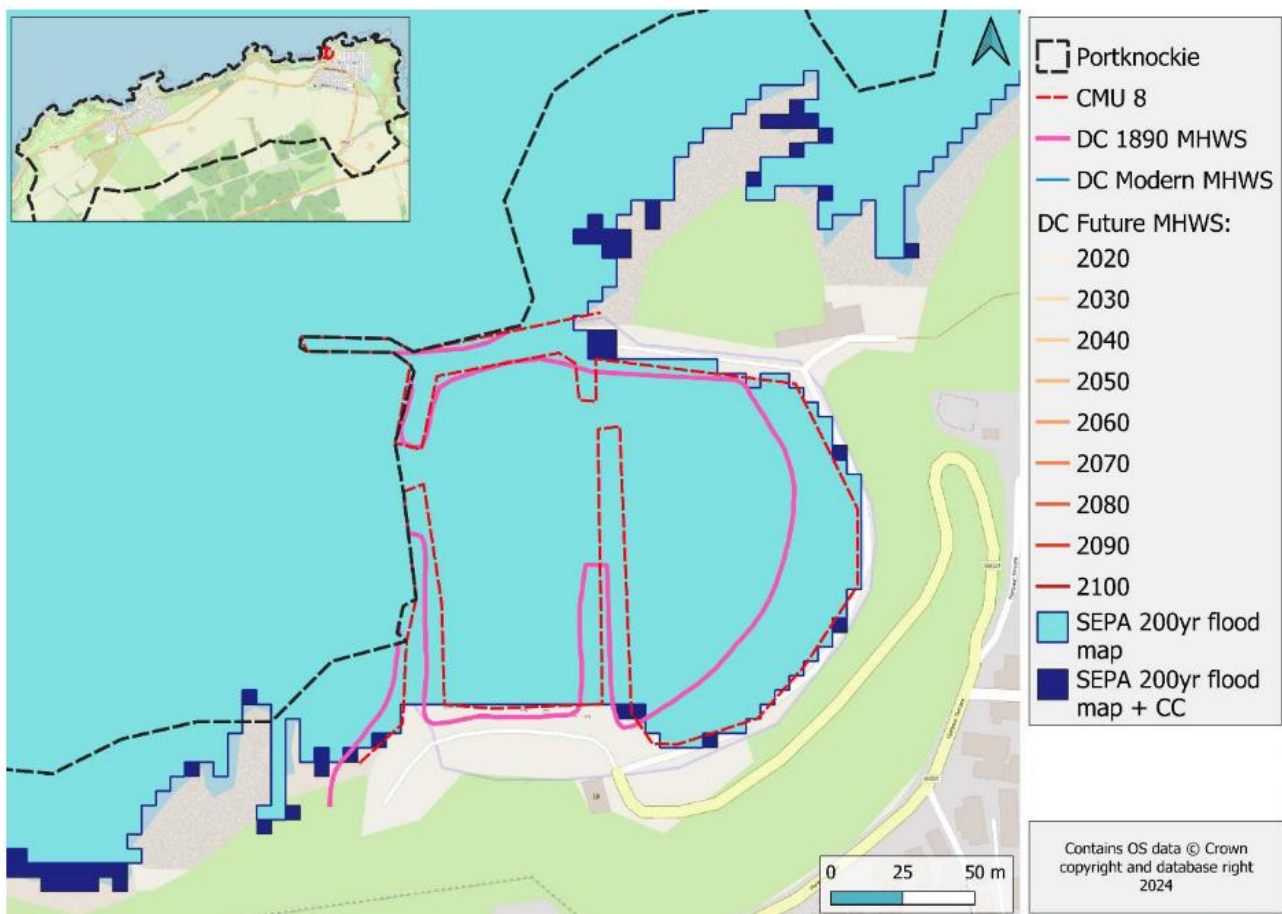
### A.9 CMU 8: Portknockie Harbour

This unit consists of built structures and spans ca. 300 m of the vertical concrete seawalls at Portknockie Harbour. The Harbour faces west, has two large basins, and is sheltered by two large vertical seawalls. There is berthing space for up to 50 vessels and it caters for predominantly leisure craft. Within the outer basin is an open-air swimming pool.

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

- Harbour Road (~25 m section)

As this is an engineered coastline, there are no erosion projections available from Dynamic Coast. There is an unknown hazard from coastal erosion.



**Figure A-9: CMU 8 coastal hazards map showing SEPA flood extents and Dynamic Coast (DC) past and future erosion. Inset shows unit without coastal hazards.**



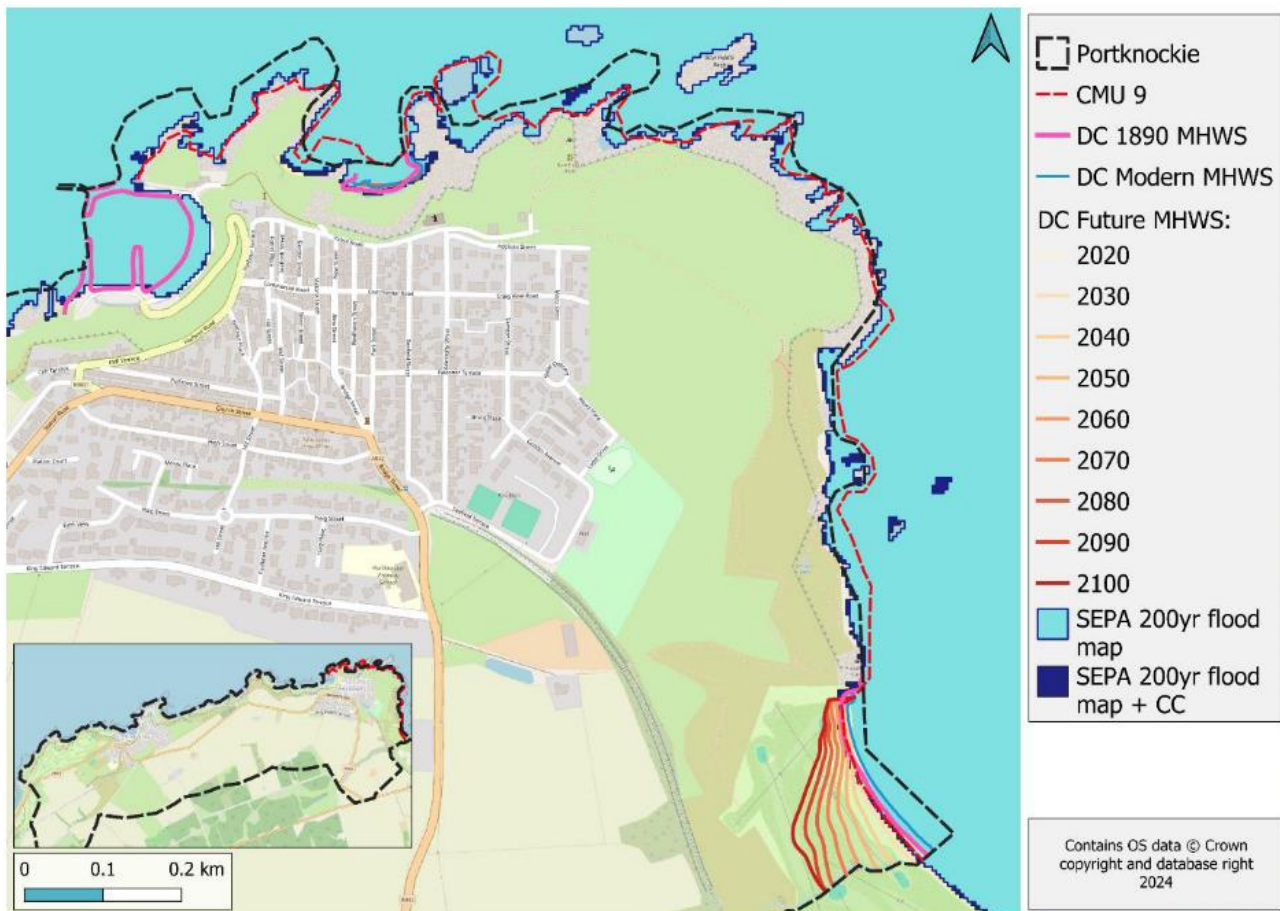
### A.10 CMU 9: Portknockie North

This unit classified as natural and comprises an expansive stretch of natural coast, approximately 2.8 km in length. The coastline is dominated by rocky cliffs of Grampian Quartzite on its northern coast and Old Red Sandstone and Conglomerates on its east facing coast. The coastline in this unit is fronted by rugged rocky platforms and the famous bow and fiddle rock formation just offshore to the northeast. In addition to the rocky platforms are a series of sandy pocket beaches. The MCT runs along the cliff top in this unit. Set back ca. 90 m from the north coast of this unit are numerous residential properties within Portknockie town.

SEPA flood maps show that there is no flood risk from 1-in-200-year and 1-in-200-year plus climate change events.

Assets within the Dynamic Coast projected erosion area or those in the vicinity of it in 2100 under the High Emission Scenario are summarised below:

- Cullen Golf Course.



**Figure A-10: CMU 9 coastal hazards map showing SEPA flood extents and Dynamic Coast (DC) past and future erosion. Inset shows unit without coastal hazards.**



**Table 5-6: CMU 9 Dynamic Coast erosion summary.**

Dynamic Coast calculation	Results	
Historical rate	1.7 m / yr	Maximum
	0.2 m / yr	Median
2050 rate	2.0 m / yr	Maximum
	0.6 m / yr	Median
2050 distance	56.6 m	Maximum
	13.2 m	Median
2100 rate	1.9 m / yr	Maximum
	0.0 m / yr	Median
2100 distance	134.2 m	Maximum
	47.3 m	Median

## B Proactive Actions

### Action 1 - Develop modelling framework to support future assessments.

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. A modelling framework should be developed alongside the one proposed in the Cullen CCAP for CMU 1, that includes:

- Statistical extremes
- Wave transformation
- Morphodynamics and erosion
- Flood inundation



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

Requirements for monitoring various beach systems within the CA should be reviewed in the context of a wider Regional plan. Information should be collected through monitoring that is specific to support future risk assessments and compared to CMU specific erosion triggers. A future monitoring plan should focus across the entire CA but increase in frequency and detail for CMU 1, 2, 3 and 9 where predicted erosion risk and coastal change is greatest. The plan should be continually reviewed and updated to account for new information becoming available, specifically related to defence condition assessments.



### 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 of the CCAP should be presented to the community and stakeholders alongside consideration for wider support and education around climate awareness and flood resilience.



**Action 4 – Identify landownership and safeguarding space. This should link with Regional Proactive Action to identify and define local opportunities.**

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.



## C Trigger and Action Database

**Table C- 1: Phase 0 Trigger and Action database for Findochty to Portknockie Coast.**

Community Area (CA)	CMU	Coast Type	Trigger Type	Asset Affected	Asset Description	Trigger Level	Trigger Buffer Flooding (Freq/10 yr)	Distance to coastline (m)	Trigger buffer erosion (m)	Trigger Exceeded?	Action	Owner	Delivery Partners	Timescale	Cost
Findochty to Seatown Coast	1	Natural	Erosion	Other	Strathlene Golf Course	1	N/A			N	None	NA	NA	NA	NA
						2	N/A			N	None	NA	NA	NA	NA
	2	Hybrid	Condition	Other	Caravan Park Rock Armour	1	N/A			N	None	NA	NA	NA	NA
						2	N/A			N	None	NA	NA	NA	NA
			Erosion	Other	Caravan Park	1	N/A			N	None	NA	NA	NA	NA
						2	N/A			N	None	NA	NA	NA	NA
	3	Natural	Erosion	Other	Caravan Drainage Outfall	1	N/A			N	None	NA	NA	NA	NA
						2	N/A			N	None	NA	NA	NA	NA
			Erosion	Property	Non-residential	1	N/A			N	None	NA	NA	NA	NA
						2	N/A			N	None	NA	NA	NA	NA
	4	Built Structures	Condition	Other	Findochty Harbour	1	N/A			N	None	NA	NA	NA	NA
						2	N/A			N	None	NA	NA	NA	NA
			Flooding	Road	Commercial Street	1	0	N/A		N	None	NA	NA	NA	NA
						2	N/A			N	None	NA	NA	NA	NA
			Erosion	Other	Findochty Western Harbour Wall	1	N/A			N	None	NA	NA	NA	NA
						2	N/A			N	None	NA	NA	NA	NA
	5	Hybrid	Condition	Other	Private coastal defences	1	N/A			N	None	NA	NA	NA	NA
						2	N/A			N	None	NA	NA	NA	NA
			Flooding	Property	Residential	1	0	N/A		N	None	NA	NA	NA	NA
						2	N/A			N	None	NA	NA	NA	NA
	6	Hybrid	Condition	Other	Seawall	1	N/A			N	None	NA	NA	NA	NA
						2	N/A			N	None	NA	NA	NA	NA
	7	Natural	Erosion			1	N/A			N	None	NA	NA	NA	NA
						2	N/A			N	None	NA	NA	NA	NA
8	Built Structures	Condition	Other	Portknockie Harbour	1	N/A			N	None	NA	NA	NA	NA	
					2	N/A			N	None	NA	NA	NA	NA	
		Flooding	Road	Portknockie Harbour Road	1	0	N/A		N	None	NA	NA	NA	NA	
					2	N/A			N	None	NA	NA	NA	NA	
9	Natural	Erosion	Other	Cullen Links Golf Course	1		3	-5.5	Y	Increase monitoring and plan for assessment.	NA	NA	NA	NA	
					2		3	-0.4	Y	Undertake assessment and plan for intervention.	NA	NA	NA	NA	



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