

Moray Coastal Change Adaptation Plan

Portgordon to Buckpool Coast

Final

October 2023

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Revision History

Revision Ref/Date	Amendments	Issued to
June 2023-P01	Draft Report	Will Burnish Leigh Moreton
October 2023 – P02	Final report after Moray Council comments	Will Burnish Leigh Moreton

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. Jenny Shadrick, Doug Pender, and Angus Pettit of JBA Consulting carried out this work.

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Purpose

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Acknowledgements

JBA and Moray Council would like to acknowledge the contributions of Steve McFarland (SEPA) and Dr Alistair Rennie (Nature Scot and Dynamic Coast) for provision of data and advice during the project planning phase.

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 the draft report.

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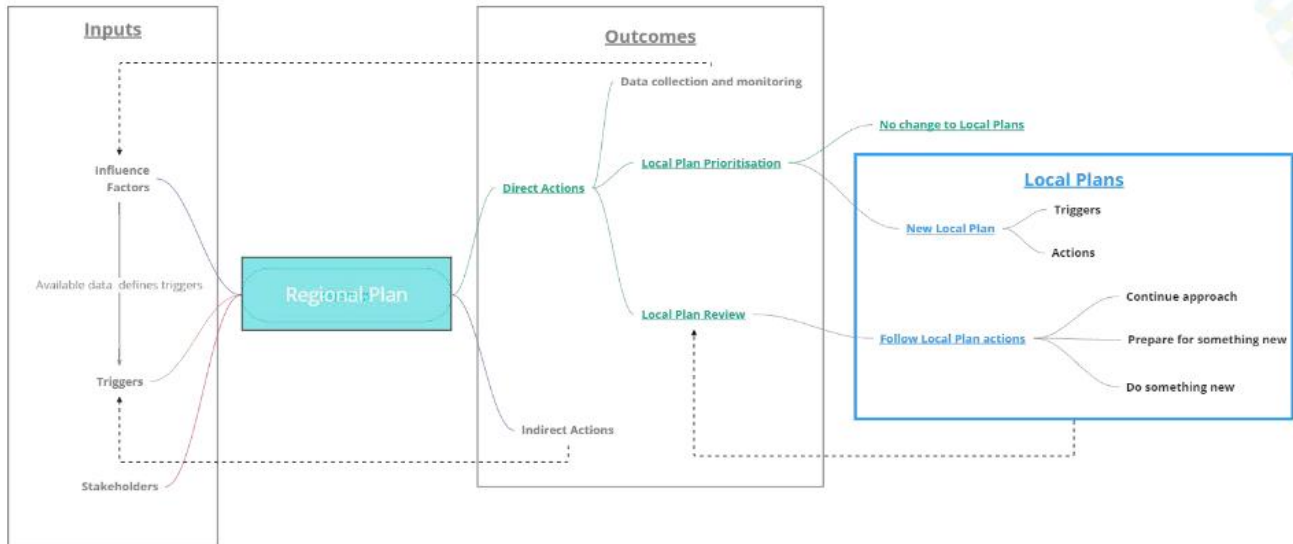
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Executive summary

The report documents the Coastal Change Adaptation Plan (CCAP) for the Portgordon to Buckpool Coast 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 which 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 Portgordon to Buckpool 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, to enable implementation of climate change adaptation actions and link with climate resilient development planning along Moray’s coast.

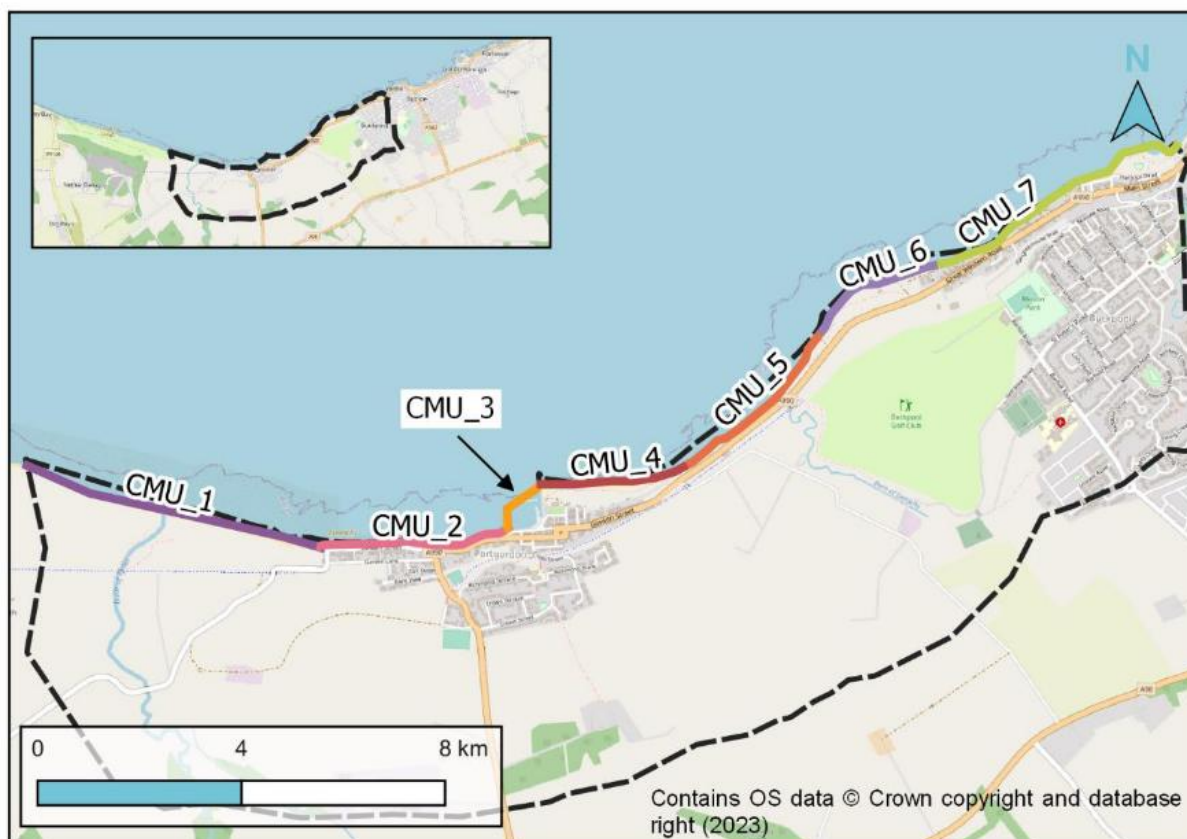
The Plan has been developed using available, datasets from Moray Council, SEPA and the Dynamic Coast Project. It aims to directly support statutory and non-statutory Moray Council policies, plans and strategies and aligns with key coastal climate change adaptation guidance and resources within and beyond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

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



The Adaptation Framework is to be delivered through the 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 Portgordon to Buckpool 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 at Portgordon to Buckpool Coast.

The current iteration of the Portgordon to Buckpool Coast CA local plan is at Phase 0. Triggers met in Phase 0 of the Adaptation Pathway 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 Phase 0 Actions.

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	Erosion buffer exceeded	Increase monitoring and plan for assessment
7	Erosion buffer exceeded	Increase monitoring and plan for assessment

As well as Triggers and Actions that correspond directly to the Adaptation Pathway and specified CMUs, Proactive Actions, which should be ongoing to support coastal change adaptation for the whole of Portgordon to Buckpool 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 the first cycle.

Contents

1	Introduction	1
1.1	Coastal Change Adaptation Planning in Moray	1
1.2	What is the Local CCAP?	2
1.3	What are adaptation pathways?	2
1.4	What do adaptation pathways do?	2
1.5	What is the focus of the Local CCAP?	2
1.6	Where are we on the adaptation journey?	3
1.7	What is the Phase 0 Adaptation Framework?	3
1.8	How has this framework been developed?	3
1.9	How does the Local CCAP link to the Regional CCAP?	4
2	Plan Overview	5
2.1	Plan Area and Characteristics	5
2.2	Coastal Management Units	6
2.2.1	CMU 1: Beach west - natural	7
2.2.2	CMU 2: West – built structures	7
2.2.3	CMU 3: Harbour – built structures	8
2.2.4	CMU 4: Beach central - natural	8
2.2.5	CMU 5: Central – built structures	8
2.2.6	CMU 6: East beach - natural	8
2.2.7	CMU 7: East – built structures	8
2.3	CMU categorisation for local adaptation plan	8
3	Adaptation Pathways	10
3.1	CMU 1, 4 and 6 Adaptation Pathways	10
3.2	CMU 3, 5 and 7 Adaptation Pathways	11
3.3	CMU 2 Adaptation Pathways	12
4	Adaptation Process	14
4.1	Implementation Plan	14
4.2	Monitoring and Triggers	14
4.2.1	Monitoring for Triggers	14
4.2.2	Trigger Classification	15
4.2.3	CMU-specific flooding trigger	15
4.2.4	CMU-specific Overtopping trigger	15
4.2.5	CMU-specific erosion trigger	17
4.2.6	CMU-specific condition triggers	22
4.2.7	New information trigger	23
4.2.8	Moray Coastal Trail	23
4.3	Actions	23
4.4	Phase 0 Actions	26
4.5	Supporting Steps and Proactive Actions	26
4.6	Outcomes	27
4.7	Example application	30
5	Summary and Next Steps	31
5.1	Approach	31
5.2	Coastal Management Units and Risks	31
5.3	Adaptation Pathways	31
5.4	Implementation Plan	32
5.5	Next Steps	32
A	CMU Risk Assessment	33
B	Proactive Actions	45
C	Trigger and Action Database	47

List of Figures

Figure 1-1: Extent and location of CAs within Moray.	2
Figure 1-2: Four pillars of coastal adaptation for Moray.	4
Figure 2-1: Portgordon to Buckpool Coast CA, showing NatureScot habitats, settlements, greenspace and environment and special consideration areas.	5
Figure 2-2: CMUs within the Portgordon to Buckpool Coast CA.	7
Figure 3-1: Adaptation Pathway for CMUs 1, 4 and 6 (natural coasts). Grey lines represent possible future pathways.	11
Figure 3-2: Adaptation Pathways for CMUs 3, 5 and 7 (built structures). Grey lines represent possible future pathways	12
Figure 3-3: Adaptation Pathway for CMU 2 (built structures). Grey lines represent possible future pathways.	13
Figure 4-1: High-level Implementation Plan.	14
Figure 4-2: Portgordon to Buckpool Coast erosion trigger locations for residential properties (R property), roads and other features including carparks.	19
Figure 4-3: Complete Implementation Plan for Portgordon to Buckpool Coast CA.	29
Figure 4-4: Example application of Phase 0 to Phase 1 of the adaptation process and how the Implementation Plan works with Adaptation Pathways and Action Plans.	30

List of Tables

Table 2-1: Portgordon to Buckpool Coast CMU categorisation for local adaptation plan.	9
Table 4-1: Overtopping triggers for coastal defence structure in CMU 2. Cells shaded red indicate that an overtopping trigger has been met.	16
Table 4-2: CMU-specific erosion triggers for Portgordon to Buckpool properties, roads and features. Cells shaded red indicate that the erosion trigger has been met.	18
Table 4-3: Portgordon to Buckpool Coast erosion triggers.	20
Table 4-4: Triggers, trigger categories and associated actions for each Portgordon to Buckpool Coast CMU.	25
Table 4-5: Local Proactive Actions	27
Table 4-6: Portgordon to Buckpool Coast CA outcomes.	28

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 determines 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 Scottish Government (2023) Coastal Change Adaptation Plan Guidance – Interim 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 coastal risk management approaches to manage and 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 Plan (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. Further background on coastal change adaptation is provided in supplementary documentary document 'What is Coastal Change Adaptation?'

To support this adaptation journey in Moray the coast has been subdivided into Community Areas (CAs) (Figure 1-1). Portgordon to Buckpool Coast is one of the CAs with the highest priority for a local adaptation plan, due to the changing coast and risk of flooding, and as recognised in the Regional Coastal Change Adaptation Plan (CCAP). The CA includes Portgordon and Buckpool settlements.

The coast of the CA is a mix of natural and defended coast, with a range of built structures, including Portgordon harbour. There are considerable assets, including properties and roads that are protected from flooding and erosion by the defences and structures in place at Portgordon. Due to the structures in place, there is no predicted risk of flooding to any assets at Portgordon, based on the information available. However, Dynamic Coast has projected as much as 230 m of shoreline retreat to 2100 at the natural sections of coast. Most assets at risk from coastal erosion are located along the coast at Buckpool, to the east of Portgordon.

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.

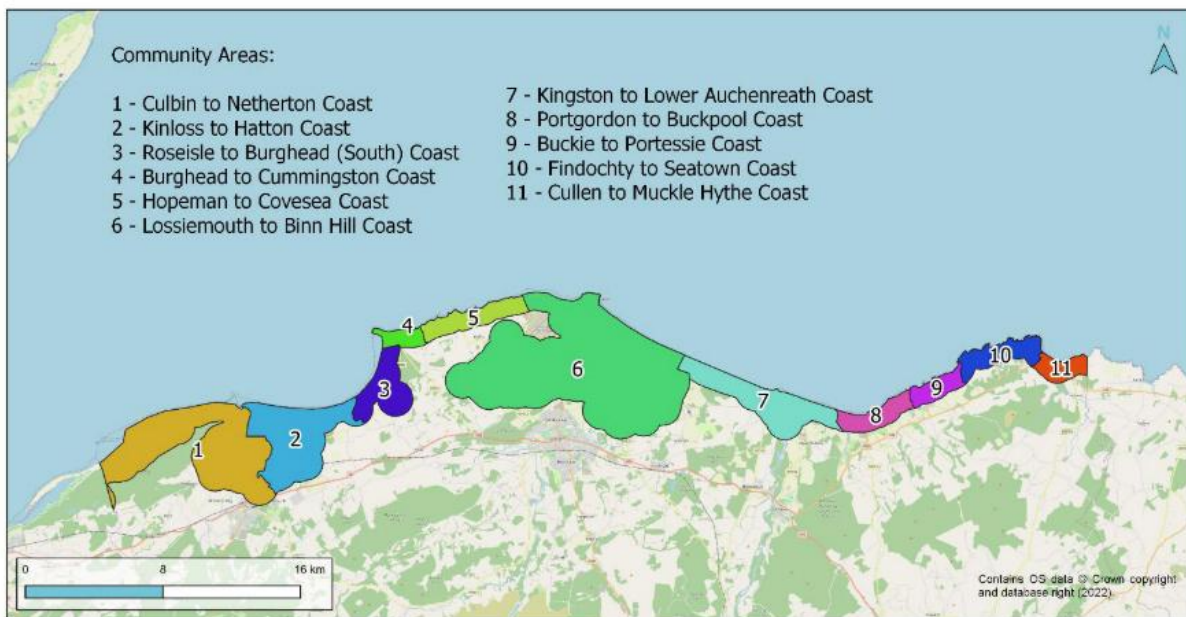


Figure 1-1: Extent and location of CAs within Moray.

1.2 What is the 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 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 Portgordon to Buckpool 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 Adaptation Framework set out in this Local CCAPs is to:

Guide Moray Council towards development of detailed Adaptation Pathways and associated Action Plans for the Portgordon to Buckpool 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 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 Proactive Actions that will support delivery of the CCAP in each CMU.
- Inform and support the Local Development Plan³ 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 guidance² into **four key pillars of adaptation** (Figure 1-2). Development and implementation of the CCAP Action Plan should align with these principles.



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 three key 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 Portgordon to Buckpool Coast Community Area (CA) covers ca. 4.9 km² and is located between the Kingston to Lower Auchenreath Coast and Buckie to Portessie Coast CAs. The CA includes a range of coastal environments and land use areas (Figure 2-1).

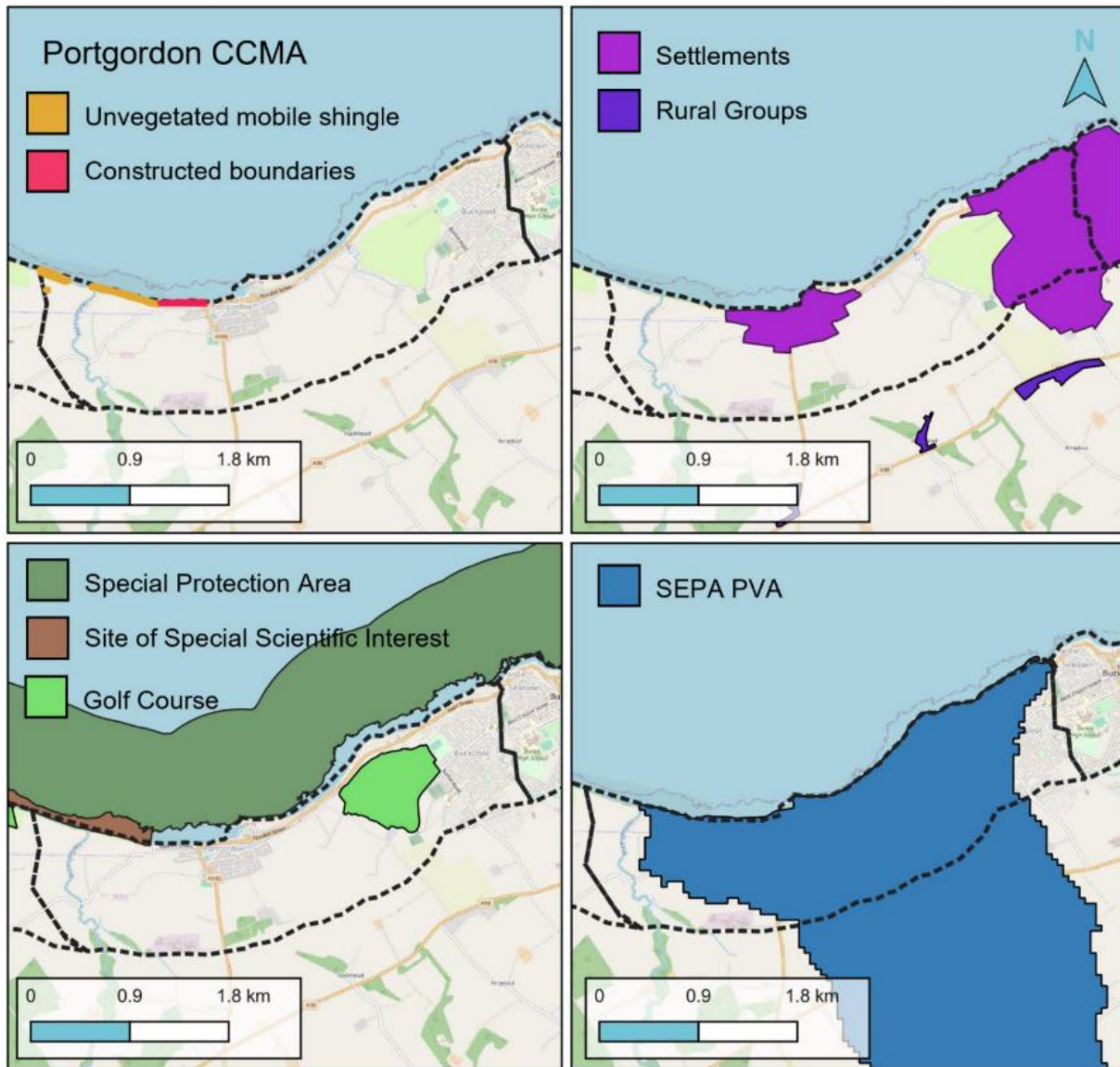


Figure 2-1: Portgordon to Buckpool Coast CA, showing NatureScot habitats, settlements, greenspace and environment and special consideration areas.

Settlements:

The CA includes the settlements Portgordon and Buckpool. Portgordon has a population of 884 with 374 households³. Buckpool is part of Buckie town, which has a population of 8,541 with 3,782 households¹. See the Buckie CCAP plan for more information about coastal adaptation and Buckie town specifically. The Moray Council LDP has identified designation areas for specific land use in settlements and rural groups.

Greenspace and Environment:

The entire coast of is a Scottish Natural Heritage designated Site of Special Scientific Interest (SSSI). The coastal waters offshore of the CA are a NatureScot designated Special Protection Area (SPA). There is one golf courses in the Portgordon to Buckpool Coast CA: Buckpool Golf Club, to the west of Buckpool. This is located landward of the A990 and on land well above sea level.

Special consideration areas:

The CA contains part of the Portgordon Potentially Vulnerable Area (PVA) as identified in the Northeast Local Plan District Area (LPD06)⁴. This PVA encompasses Portgordon entirely and part of Buckpool. A concrete sea wall with rock revetment is present, which is managed by Moray Council.

Habitats:

There are two significant habitats along the coastal extent of Portgordon to Buckpool Coast as identified by NatureScot and include unvegetated mobile shingle and constructed boundaries. (Figure 2-1).

2.2 Coastal Management Units

To facilitate the development of the Local CCAP, the coast of each 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.

³ Moray Council. 2020. Moray Local Development Plan.
http://www.moray.gov.uk/moray_standard/page_133431.html

⁴ Aberdeenshire Council. 2016. North East Local Plan District Local Flood Risk Management Plan.
<https://www.aberdeenshire.gov.uk/media/17174/north-east-local-flood-risk-management-plan-2016-2022-web-version.pdf>

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

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

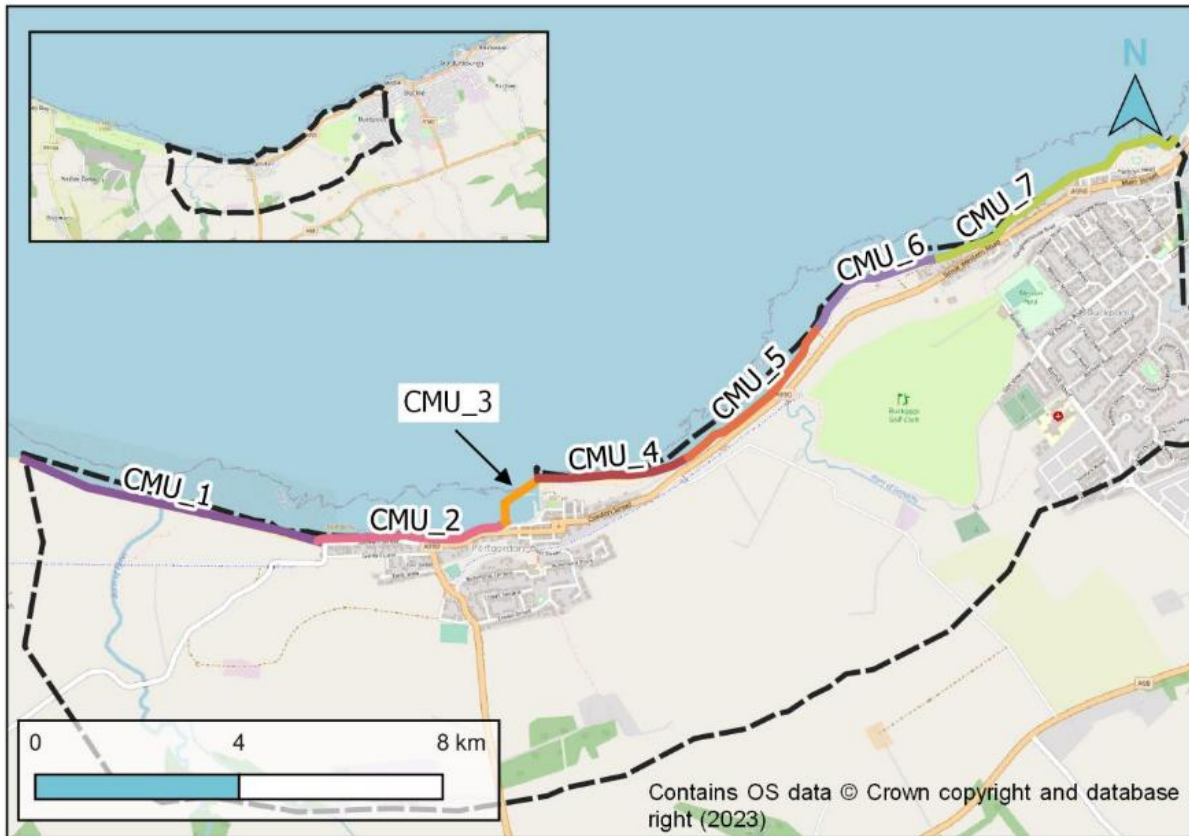


Figure 2-2: CMUs within the Portgordon to Buckpool Coast CA.

2.2.1 CMU 1: Beach west - natural

The coast along CMU 1 is fronted by a natural shingle beach and is the eastern extent of Spey Bay, connected to the Kingston to Lower Auchenreath Coast CA, CMU 6. The Burn of Tyne mouth is located centrally in CMU 1. There is one groyne (or other control structure) present in the east section of the CMU. The area inland comprises of agricultural land. Historically (from ca. 1966 to 2003), there has been considerable shoreline retreat rates of 1.5 m/yr. Erosion rates and extent is expected to increase significantly into the future. By 2100, shoreline retreat is estimated to increase to a maximum rate of 3.7 m/yr, resulting in potential erosion distance of over 230 m. Only a minor road is currently predicted to be at risk from erosion in CMU 1. There is also a risk of flooding in this CMU located at the Burn of Tyne mouth and in the agricultural land in the western extent of CMU 1, but there are no other assets predicted to be at risk.

2.2.2 CMU 2: West – built structures

The coast along CMU 2 consists of a concrete sea wall and rock revetment (hard defences) managed by Moray Council. The area inland includes properties, roads, and assets in Portgordon town. Due to these built structures, there is no data available from Dynamic Coast to understand potential future erosion risk. As a result, the hazard is unknown from coastal

erosion in this unit, to the land and to assets. The condition of these structures is therefore the fundamental control on the risk and, when these reach the end of their life, retreat of the coastline under sea level rise is inevitable. There is currently no available data on condition or residual life for these assets. SEPA flood maps show there is currently no identified risk from flooding at CMU 2.

2.2.3 CMU 3: Harbour – built structures

CMU 3 contains Portgordon harbour. The area inland includes properties, roads, and assets in Portgordon town. Due to the built structures, there is no data available from Dynamic Coast. As a result, the hazard is unknown from coastal erosion in this unit, to the land and to assets. SEPA flood maps show there is currently no identified risk of flooding at CMU 3.

2.2.4 CMU 4: Beach central - natural

The coast at CMU 4 is an undefended shingle and sand beach, with the harbour wall to the west. The area inland includes some greenspace and properties, roads, and assets in Portgordon town. Dynamic Coast results show that historically (from ca. 1983 to 1990) the beach at CMU 4 has experienced both erosion and accretion. By 2100, shoreline retreat is estimated to increase to up to 2.2 m/yr with a maximum eroded distance of over 120 m. Twelve existing residential properties, two non-residential properties and Gordon Street are within the erosion vicinity for 2100. SEPA flood maps show there is currently no identified risk from flooding at CMU 4.

2.2.5 CMU 5: Central – built structures

CMU 5 is a section of the coast consisting of a rock armour structure. There are several residential properties near the coast at CMU 5. Due to the built structures, there is no data available from Dynamic Coast as to the potential future retreat when these reach the end of their design life. As a result, the hazard is unknown from coastal erosion in this unit, to the land and to assets. SEPA flood maps show there is currently no identified risk from flooding at CMU 5.

2.2.6 CMU 6: East beach - natural

The coast along CMU 6 is a natural coast, fronted by a sand and shingle beach that provides natural protection of coastal communities and assets lying behind it. Historically (from ca. 1902 to 1986), there has been shoreline retreat rates of 0.3 m/yr. Erosion rates and extent is expected to increase significantly into the future. By 2100, shoreline retreat is estimated to increase to a maximum rate of 2.1 m/yr and maximum eroded distance of over 120 m. Nine existing residential properties and Great Western Road are within the erosion vicinity for 2100. SEPA flood maps show there is currently no identified risk from flooding at CMU 6.

2.2.7 CMU 7: East – built structures

The coast at CMU 7 is entirely defended with a mixture of rock revetment and sea walls. The area inland includes properties, roads, and assets in Buckpool. Historically (from ca. 1964 to 1986), there has been shoreline retreat rates of 0.5 m/yr. Erosion rates and extent is expected to increase into the future, with a maximum expected eroded distance of 49 m by 2100. A total of 111 Residential properties, 15 non-residential properties and Main Street are within the erosion vicinity for 2100. SEPA flood maps show there is currently no identified risk from flooding at CMU 7.

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 will be used to develop initial Adaptation Pathways, Triggers, and an associated Action Plan.

Table 2-1: Portgordon to Buckpool Coast CMU categorisation for local adaptation plan.

CMU	Coastal Type	Risk
1	Natural	Risk and Hazard
2	Built Structures	Risk and unknown Hazard
3	Built Structures	Risk and unknown Hazard
4	Natural	Risk and Hazard
5	Built Structures	Risk and unknown Hazard
6	Natural	Risk and Hazard
7	Built Structures	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 in 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.
- **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 CMU 1, 4 and 6 Adaptation Pathways

CMU 1, 4 and 6 are natural coasts and have been assigned an adaptation pathway for a natural coast (Figure 3-1). Currently the CMUs classified as natural are all at risk of erosion:

- **CMU 1 = Natural with risk and hazard**
- **CMU 4 = Natural with risk and hazard**
- **CMU 6 = Natural with risk and hazard**

Phase 0 of the adaptation pathway (1st column) is the current management approach/actions being delivered by Moray Council in respect to 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 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. Examples of changes to the management approaches in these areas are land-based adaptation measures to make space on land for the natural coasts to migrate landwards as climate change impacts accelerate. This would allow the natural coast to continue to provide benefits to nature and society, including flood resilience.

Consultation of the CCAP Implementation Plan (Section 4.6) will guide the process and ultimately the pathway to adaptation.

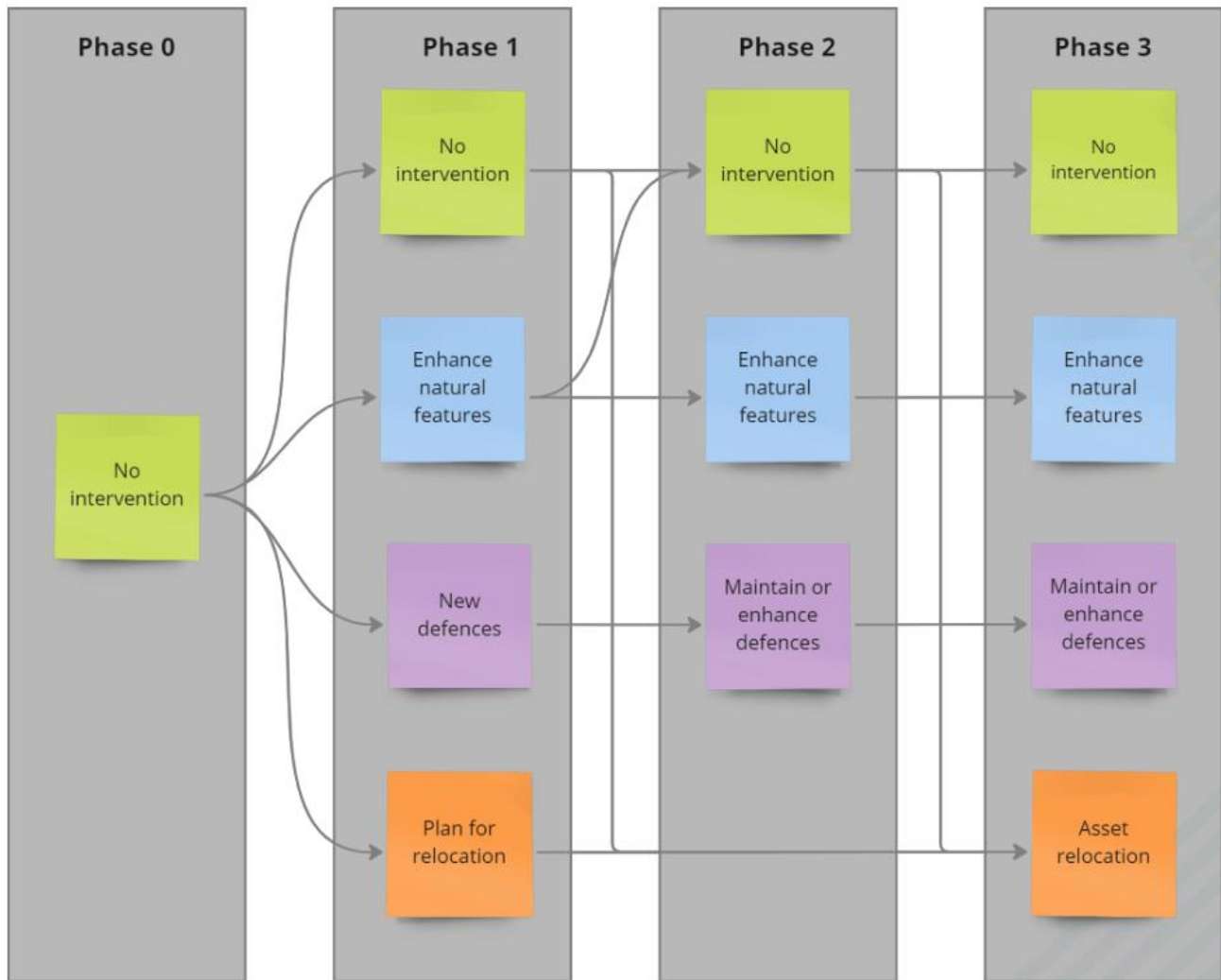


Figure 3-1: Adaptation Pathway for CMUs 1, 4 and 6 (natural coasts). Grey lines represent possible future pathways.

3.2 CMU 3, 5 and 7 Adaptation Pathways

The coasts at CMU 3, 5 and 7 have rock armour, sea walls or other concrete structures present and have been assigned an adaptation pathway for a built structures coast (Figure 3-2). Currently the CMUs classified as built structures are shown to currently have both categories of risk across them.

At CMU 5 and 7, should delivery of the Implementation Plan result in a pathway that identifies a protect outcome category in future phases, considerations should be given to enhance natural features as part of the management approach. At CMU 3, there is no pathway to **Enhance Natural Features** as these coastlines are engineered and natural features are not currently understood to form a primary control on flood or erosion risk.

- **CMU 3 = Built Structures with risk and unknown hazard**
- **CMU 5 = Built Structures with risk and unknown hazard**
- **CMU 7 = Built Structures 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. The coastal defences at CMU 3, 5 and 7 are not managed by Moray Council and so Phase 0 of the Adaptation Pathway is **No Intervention**. 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 (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 4.6) will guide the process and ultimately the pathway to adaptation.

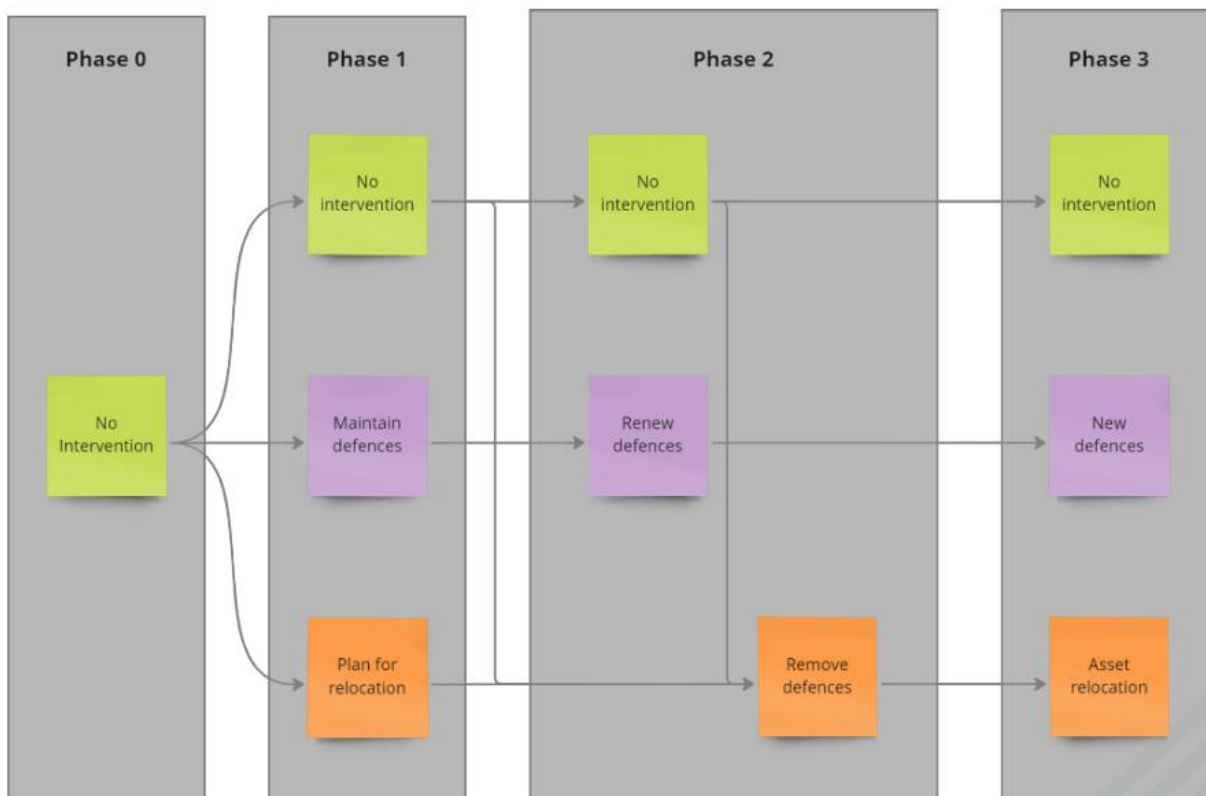


Figure 3-2: Adaptation Pathways for CMUs 3, 5 and 7 (built structures). Grey lines represent possible future pathways

3.3 CMU 2 Adaptation Pathways

CMU 2 includes the concrete sea wall and rock revetment that are managed by Moray Council, with unknown hazard Figure 3-3).

At CMU 2, should delivery of the Implementation Plan result in a pathway that promotes protection against flood and erosion risk in future phases, considerations should be given to working with natural processes or features as alternative (or hybrid) flood and/or erosion resistance measures.

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

Phase 0 of the adaptation pathway (1st column) is the current actions undertaken by Moray Council in respect of these CMUs. In CMU 2, this is **Maintain Defences** as Moray Council are responsible for the defence structures.

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 4.6) will guide the process and ultimately the pathway to adaptation.

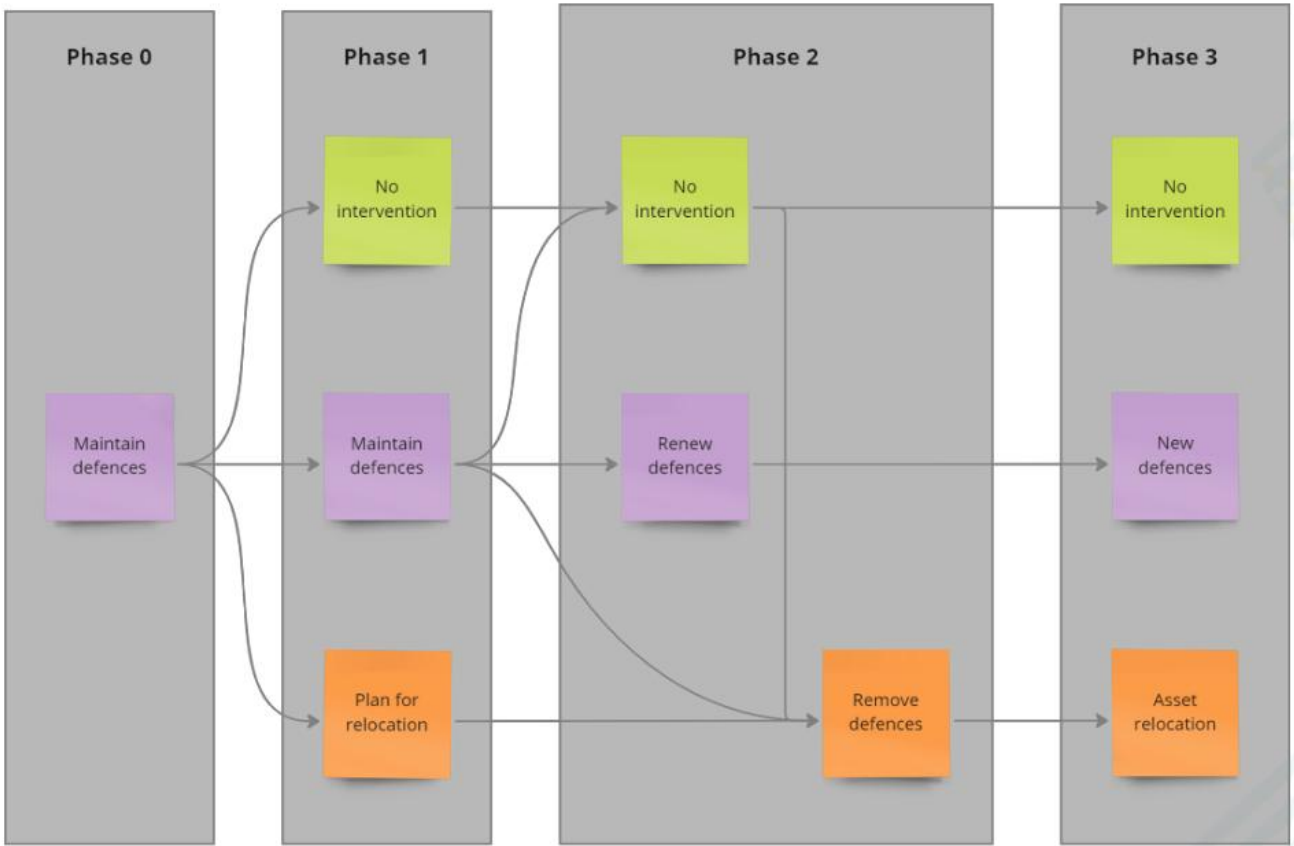


Figure 3-3: Adaptation Pathway for CMU 2 (built structures). Grey lines represent possible future pathways.

4 Adaptation Process

4.1 Implementation Plan

To support the delivery of the Adaptation Framework, a single Implementation Plan is applied to the entire Portgordon to Buckpool 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.

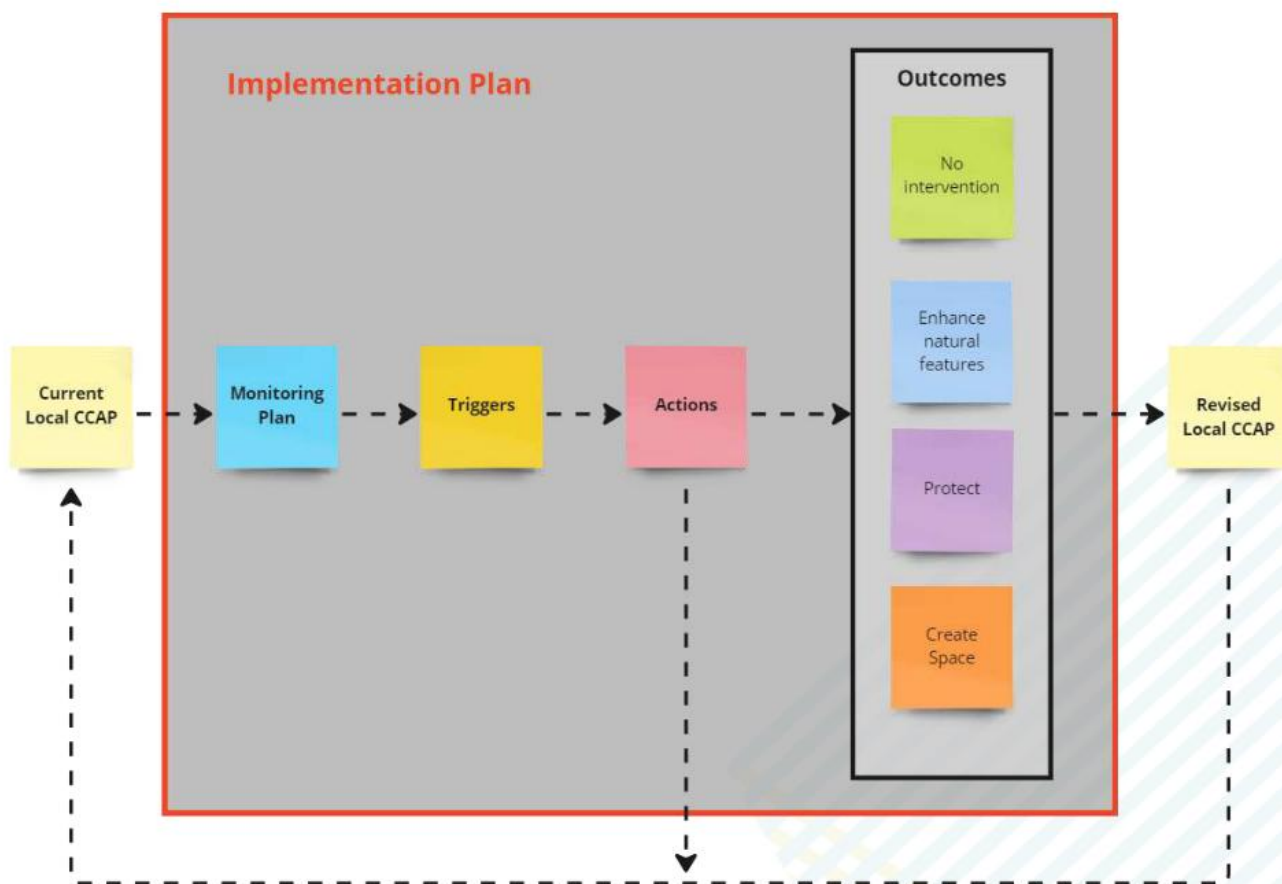


Figure 4-1: High-level Implementation Plan.

4.2 Monitoring and Triggers

4.2.1 Monitoring for Triggers

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 specific to each CMU. For the Portgordon to Buckpool Coast CA these are summarised in Table 4-4.

All trigger types considered for the Cullen to Muckle Hythe Coast CA are summarised below:

- 1) Flooding triggers (section 4.2.3)
- 2) Overtopping triggers (section 4.2.4)
- 3) Erosion triggers (section 0)
- 4) Built structure condition triggers (section 4.2.6)
- 5) New information trigger (section 4.2.7)

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

- CMU 1: monitoring of erosion risk.
- CMU 2: monitoring of overtopping risk.
- CMU 3: no monitoring currently required.
- CMU 4: monitoring of erosion risk.
- CMU 5: no monitoring currently required.
- CMU 6: monitoring of erosion risk.
- CMU 7: monitoring of erosion risk.

4.2.3 CMU-specific flooding trigger

There are currently no assets predicted to be at risk from flooding for the entire Portgordon to Buckpool Coast CA, based on the available data. Once an asset is highlighted by SEPA flood maps and NFRA data as being at risk from flooding, a CMU-specific flooding trigger will be applied. 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. It should be noted however that the currently available SEPA NFRA data does not account for flood risk associated with wave overtopping. Availability of improved flood risk information forms a third part data trigger.

4.2.4 CMU-specific Overtopping trigger

Where there is risk of flooding from wave overtopping (not currently accounted for in SEPA NFRA data), an overtopping risk assessment has been undertaken. That has been used to develop trigger levels based on return periods. To enable proactive planning, the risk assessment has been undertaken for four SLR scenarios:

- 0.0 m (present-day)

- +0.2 m
- +0.5 m
- +1.0 m

The maximum and minimum volumes have been extracted for each return period to produce an envelope of potential overtopping under each sea level rise scenario (Appendix A). This has been undertaken for the Moray Council coastal defence in CMU 2 in Portgordon, where wave overtopping will be the primary flood risk mechanism for adjacent properties.

An overtopping trigger is realised once overtopping volume during the 1 in 2-year and 1 in 30-year return period events exceed given threshold levels⁵. There are two levels to the trigger realisation that require different actions:

1. Level 1: overtopping volume exceeds 10 l/s/m during a 1 in 30-year event.
 - Increase monitoring and plan for assessment.
2. Level 2: overtopping volume exceeds 5 l/s/m during a 1 in 2-year event.
 - Undertake assessment and plan for intervention.

The overtopping rates itself does not require monitoring rather the updated overtopping calculations, should new data become available (e.g., extreme waves or sea levels, defence survey, beach levels etc). The Triggers therefore provide an indication of the performance level of the structure.

In the event of an overtopping event being realised, Moray Council should consult with SEPA to understand where the realised rates fit on the overtopping volume estimates (section A.3.1) to assess whether this represented an exceedance of these initial triggers. Depending on the outcome the value of overtopping triggers should be adjusted to reflect the outcome, if appropriate.

Overtopping results from the risk assessment (Table 4-1) show that triggers are not being met now (2023 present-day). Level 1 overtopping triggers will be met after 0.5 m of sea level rise and Level 2 will be met after 1.0 m of sea level rise. Climate change data should be monitored to understand when action is required. Current projections estimate that, by 2100, sea levels on the Moray coast could rise by up to 0.9m⁶.

Table 4-1: Overtopping triggers for coastal defence structure in CMU 2. Cells shaded red indicate that an overtopping trigger has been met.

Sea level rise	Overtopping Trigger Level 1: Maximum 1 in 30-year overtopping rate (l/s/m)	Overtopping Trigger Level 2: Maximum 1 in 2-year overtopping rate (l/s/m)
0.0 m (present-day)	0.73	0.04
0.2 m	3.24	0.28
0.5 m	14.82	2.70
1.0 m	67.67	24.59

⁵ It should be noted that thresholds are based primarily on judgement, tolerable limits in guidance and associated consequence in the immediate vicinity of the beach crest. A more detailed assessment of when overtopping volume results in flooding to properties is recommended.

⁶ <https://www.sepa.org.uk/media/594168/climate-change-guidance.pdf>

4.2.5 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. Assets considered at risk from erosion include:

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

To note, if two assets are in the same location (e.g. a road and property) only the most seaward asset will be used to define an erosion 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 action is dependent on the asset and associated consequences.

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 triggers have been met for CMUs 6 and 7 (Table 4-2). The Level 2 erosion trigger has not been met for any CMUs. . Location of all assets used for erosion triggers are shown in Figure 4-2 and Table 4-3.

Table 4-2: CMU-specific erosion triggers for Portgordon to Buckpool properties, roads and features. Cells shaded red indicate that the erosion trigger has been met.

CMU	Maximum historical change rate (m/year)	Present-day distance of Property to coast (m)		Erosion trigger level 1: Coast X m from property	Erosion trigger level 2: Coast X m from property
1	1.5	RP	47	30	15
4	0.3	RP	45	20	10
6	0.3	RP	16	20	10
7	0.5	RP	11	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
1	1.5	Minor road	72	7.5	3
4	0.3	A990	26	5	2
6	0.3	A990	55	5	2
7	0.5	A990	12	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
4	0.3	Carpark	50	5	2

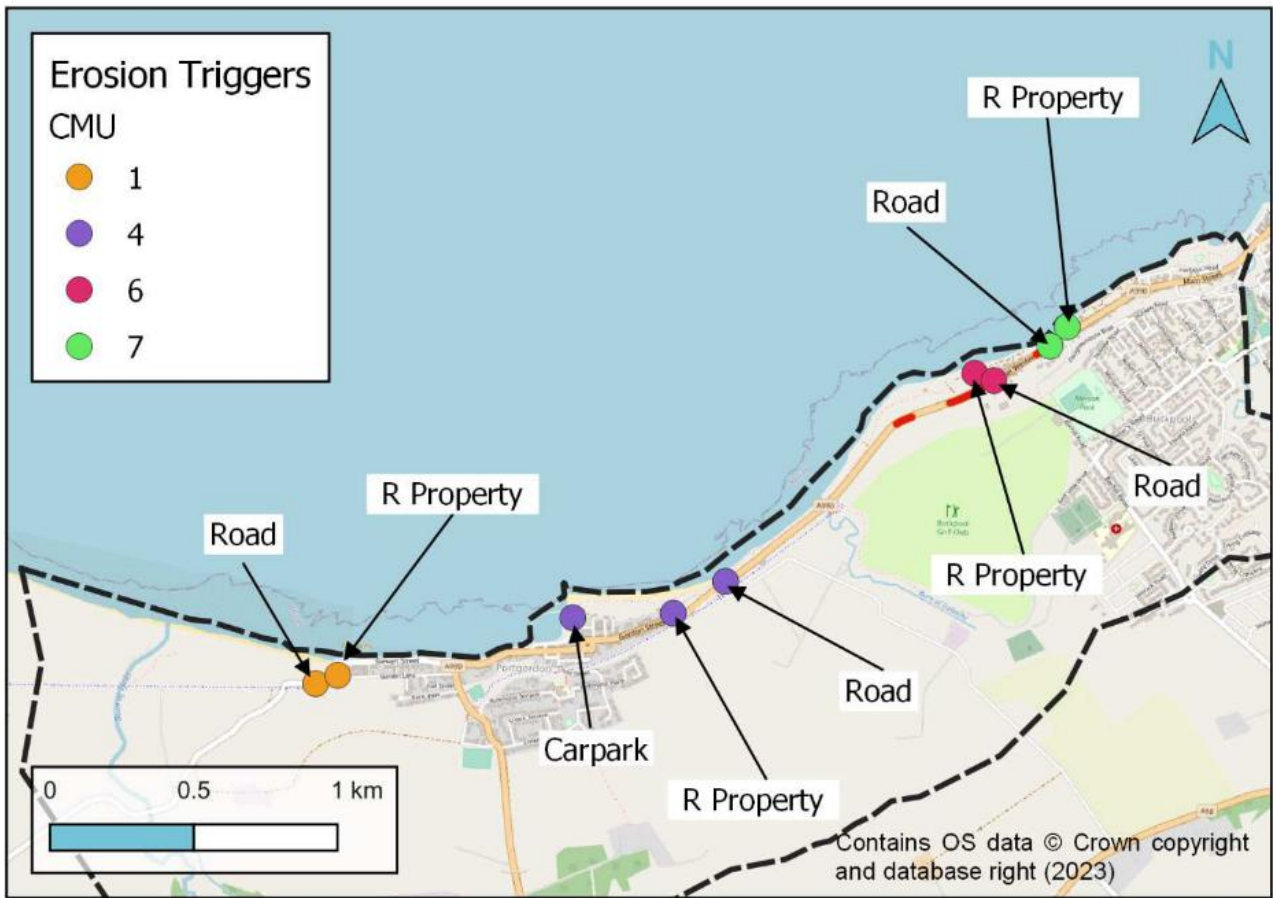


Figure 4-2: Portgordon to Buckpool Coast erosion trigger locations for residential properties (R property), roads and other features including car parks.

Table 4-3: Portgordon to Buckpool Coast erosion triggers.

CMU	Asset	Trigger Met	Erosion Trigger
1	R property	No	
	Road	No	
4	R property	No	

	Road	No	
	Carpark	No	
6	R property	Yes (level 1)	
	Road	No	

7	R Property	Yes (level 1)	
	Road	No	

4.2.6 CMU-specific condition triggers

Where a built structure is present in a CMU, a CMU-specific trigger will be applied to the condition of the built structure. Currently, built structures are present in:

- CMU 2
- CMU 3
- CMU 5
- CMU 7

As with the other CMU-specific triggers, a two-level condition trigger approach and associated action is defined using the Grades of built structure condition according to the EA and Defra condition assessments⁷:

- **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 built coastal structures are currently Grade 3 but this should be reviewed upon completion of the Regional Proactive Actions for defence condition.

⁷ Environment Agency (2013) Practical guidance on determining asset deterioration and the use of condition grade deterioration curves: Revision 1.

4.2.7 New information trigger

New information on hazards, vulnerability, built structure 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.

- **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.

4.2.8 Moray Coastal Trail

Impact of flooding and erosion on the Moray Coastal Trail⁸ (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 9). This will provide opportunities for investigation options to enhance and retain the amenity.

In this CA, it is understood that both the Speyside Way (SW) and the MCT will be affected from the long-term coastal erosion projections, particularly in CMUs 1, 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 all and specific CMUs in Portgordon to Buckpool coast 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 Plan⁹ 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 stakeholders, such as Councillors and affected community groups.
- **Practice:** Involves third party stakeholders, such as SEPA, Scottish Government, Nature Scot etc.
- **Asset:** Includes private defences, harbours, and utilities specific to built structures or hybrid CMUs.

⁸ <https://www.morayways.org.uk/routes/the-moray-coast-trail/>

⁹ Moray Coastal Change Adaptation Plan: Regional Plan - IRR-JBAU-XX-XX-RP-MO-0001-S4-P03-Regional_Plan

Post flood data collection:

- Involves citizen science, 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 guidance¹⁰ 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 Portgordon to Buckpool 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.

¹⁰ Scottish Government. 2016. Flood protection appraisals: guidance for SEPA and responsible authorities <https://www.gov.scot/publications/guidance-support-sepa-responsible-authorities/pages/2/>

Table 4-4: Triggers, trigger categories and associated actions for each Portgordon to Buckpool 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
	Update to SEPA flood warning	Review risk assessment Community engagement (places, practice)	All
	Erosion buffer exceeded	Review risk assessment Community engagement (places)	CMU 1 CMU 4 CMU 6 CMU 7
	Flood risk threshold exceeded	Review risk assessment Community engagement (places)	-
	Overtopping risk threshold exceeded	Review risk assessment Community engagement (places)	CMU 2
	Update to Dynamic Coast	Review risk assessment Community engagement (practice)	All
	Socio-economic	Changes of asset use	Community engagement (asset)
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 with associated triggers realised in the first Portgordon to Buckpool Coast CCAP.

- CMU 6:
 - Trigger 1: Erosion buffer exceeded (Level 1)
 - **Action 1:** Increase monitoring and plan for assessment.
- CMU 7:
 - Trigger 1: Erosion buffer exceeded (Level 1)
 - **Action 1:** Increase monitoring and plan for assessment.

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 is only benefit. Undertaking these can therefore only have a positive impact on supporting adaptation or increasing resilience.

Four such actions have been identified at this stage in the adaptation planning process. 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 delivery of wider aspects of the Adaptation Framework for Portgordon to Buckpool Coast.

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	Develop modelling framework to support future assessments	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	Place Making 

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 Portgordon to Buckpool Coast CA.

Table 4-6: Portgordon to Buckpool Coast CA outcomes.

Category	Outcome	CMU
No intervention	No intervention	All
Enhance natural features	Enhance natural features	CMU 1 CMU 4 CMU 6
Protect	Maintain defences	CMU 2 CMU 3 CMU 5 CMU 7
	Sustain* defences	CMU 2 CMU 3 CMU 5 CMU 7
	Improve** defences	All
	Property resilience measures	All
Create space	Remove defences	CMU 2 CMU 3 CMU 5 CMU 7
	Set back defences	CMU 2 CMU 3 CMU 5 CMU 7
	Relocate assets	All
*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 Portgordon to Buckpool Coast is shown in (Figure 4-3); structured using the three stages: 1) Monitoring and Trigger, 2) Actions, 3) Outcomes.

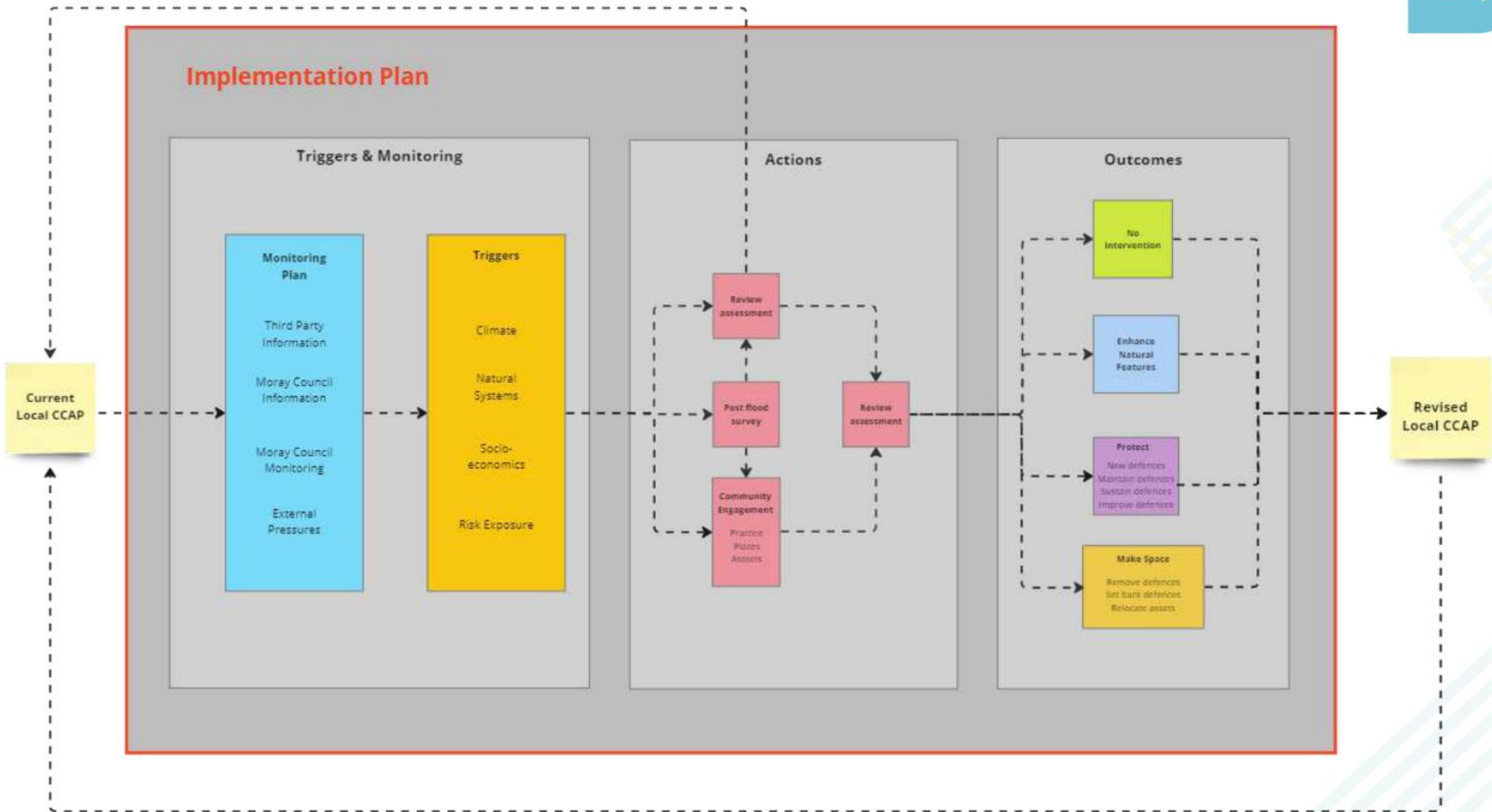


Figure 4-3: Complete Implementation Plan for Portgordon to Buckpool Coast CA.

4.7 Example application

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

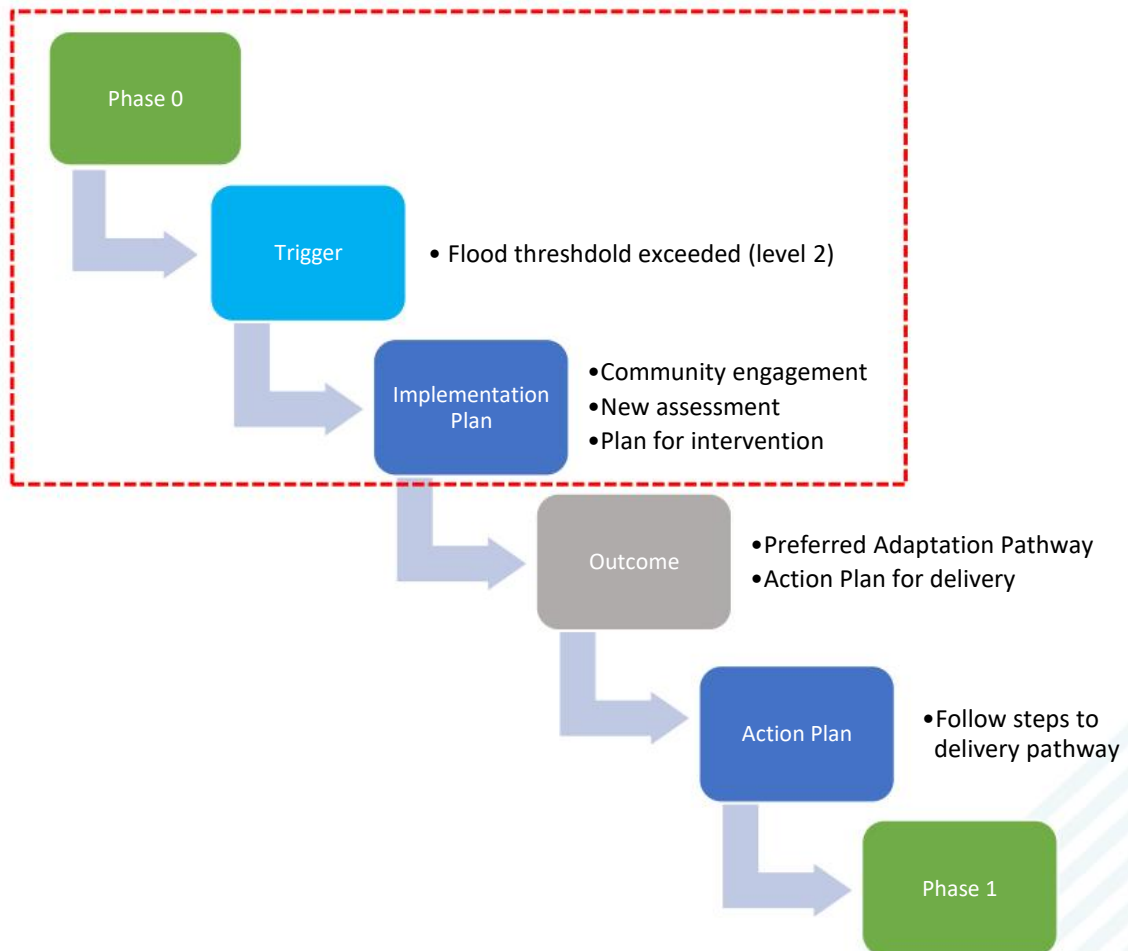


Figure 4-4: Example application of Phase 0 to Phase 1 of the adaptation process and how the Implementation Plan works with Adaptation Pathways and Action Plans.

5 Summary and Next Steps

5.1 Approach

This document presents the local CCAP for Portgordon to Buckpool 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 an overall Regional CCAP. This has been simplified into four key pillars of adaptation:

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

This local Plan builds on the Regional Plan by focusing on these pillars to develop an Adaptation Framework that can effectively prepare Portgordon to Buckpool Coast to the impact 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 Portgordon to Buckpool Coast CA.

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

5.2 Coastal Management Units and Risks

The Portgordon to Buckpool Coast CA was subdivided into seven 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 unknown hazard.
- CMU3 – Built structures with risk and unknown hazard.
- CMU4 – Natural with risk and hazard.
- CMU5 – Built structures with risk and unknown hazard.
- CMU6 – Natural with risk and hazard.
- CMU7 – Built structures 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 the CCAP across the Portgordon to Buckpool Coast CA, each CMU has been assigned an 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, which is not yet the case for any CMU at the Portgordon to Buckpool Coast (section 4.4). During Phase 1a preferred pathway and associated Action Plan will 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 Proactive Actions
3. **Phase 2+:**
 - Implementation Plan outcomes:
 - Preferred Adaptation Pathway (Continue or revise Phase 1)
 - Action Plan for delivery (Continue or revise Phase 1)
 - Delivery of Phase 2 Proactive Actions

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

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 Portgordon to Buckpool 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, 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 defined local 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 Portgordon to Buckpool Coast are summarised in Table A-1.

Table A-1: Coastal dataset summary for Portgordon to Buckpool 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	TotalTide
	MHWS	2.0	
	MHWN	1.1	
	MSL	-	
	MLWN	-0.5	
	MLWS	-1.6	
	LAT	-2.0	
Extreme Sea Levels	2.04 m	MHWS	CFB
	2.75 m	2-year	
	3.04 m	50-year	
	3.10 m	100-year	
	3.17 m	200-year	
	3.32 m	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	
	0.84 m	2100 95th percentile	

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

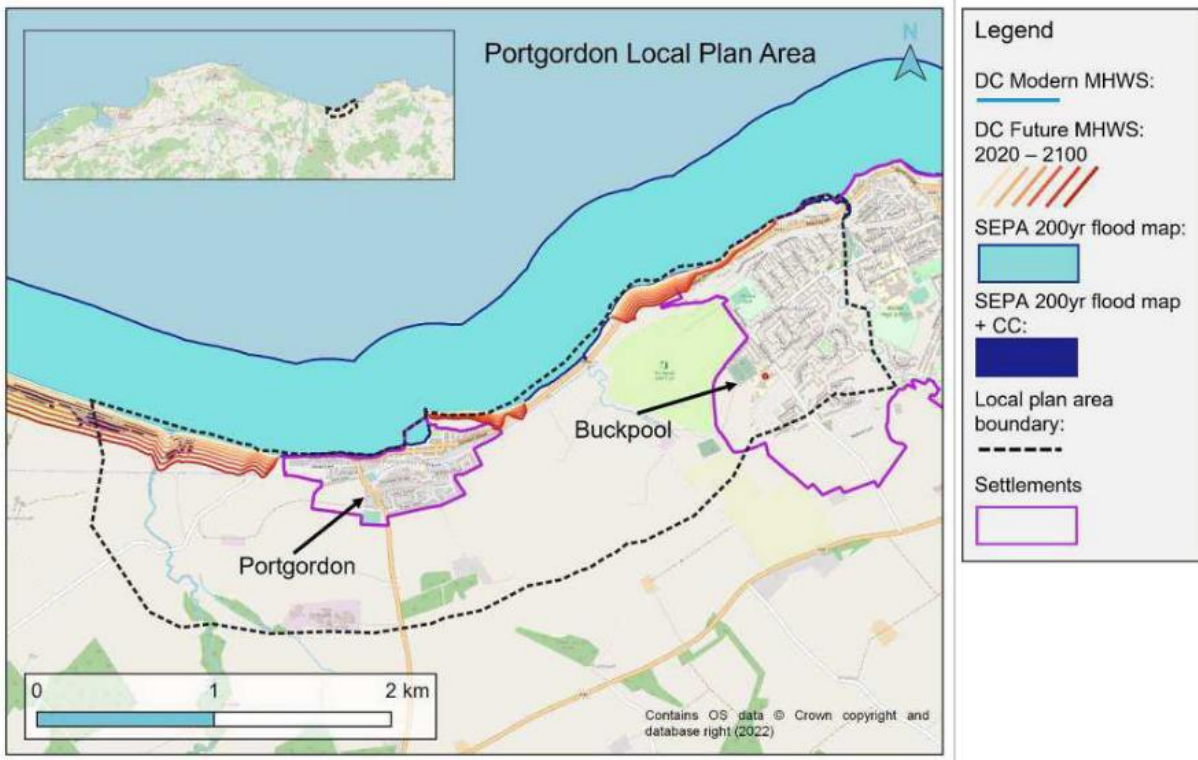


Figure A-1: Portgordon to Buckpool Coast CA coastal flood and erosion hazard overview.

A.2 CMU 1: Beach west - natural

The coast along CMU 1 is fronted by a natural shingle beach and is the eastern extent of Spey Bay, connected to The Kingston to Lower Auchenreath Coast CA, CMU 6. Historically (from ca. 1966 to 2003), there has been considerable shoreline retreat rates of 1.5 m/yr. Erosion rates and extent is expected to increase significantly into the future. By 2050, the median rate of coastal change is projected to be eroding at a rate of 1.6 m/yr, and maximum rate of 2.5 m/y. By 2100, the beach is projected to erode at a maximum rate of 3.73 m/yr and maximum eroded distance of over 230 m. Table A-2 summarises Dynamic coast 2 data for CMU 1 within Portgordon to Buckpool Coast CA.

Dynamic Coast 2 data shows that only ca. 164 m of minor road is at risk of erosion by 2100. At present-day is the road is at minimum 75 m from MHWS. No properties or other assets are at currently predicted to be at risk of erosion in CMU 1.

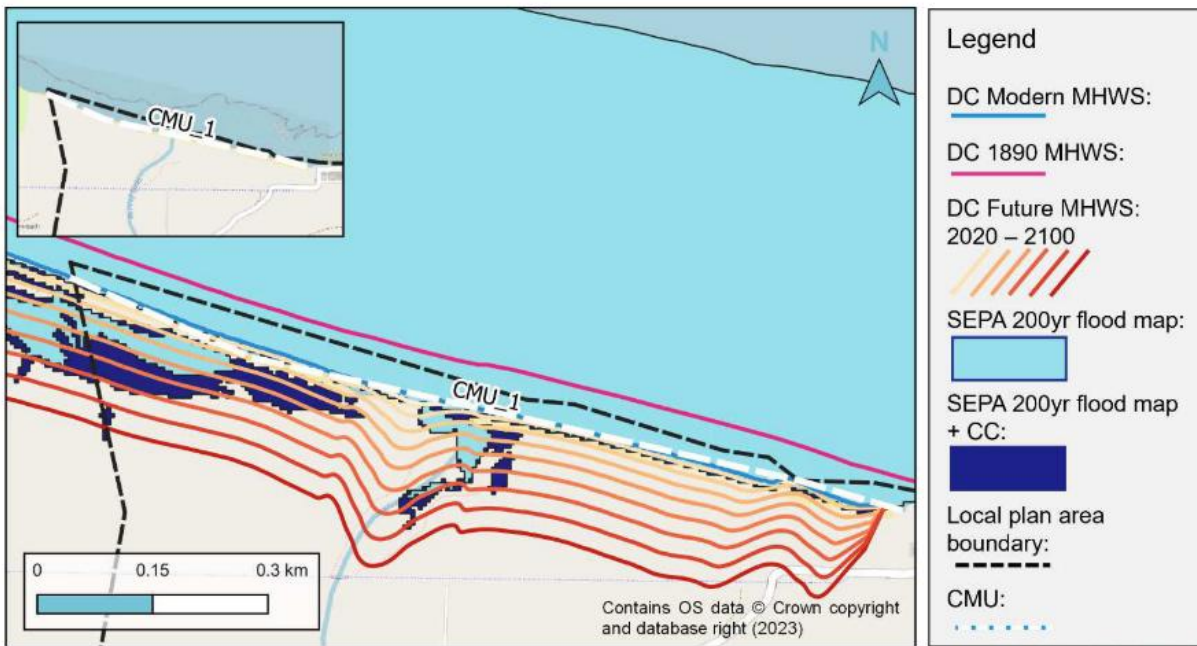


Figure A-2: CMU 1 beach west natural coastal hazards map showing SEPA flooding extents and Dynamic Coast 2 past and future erosion. Inset shows unit without coastal hazards.

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

Dynamic Coast calculation	Results	
Historical rate	1.5 m/yr	Maximum
	0.5 m/yr	Median
2050 rate	2.5 m/yr	Maximum
	1.6 m/yr	Median
2050 distance	64.6 m	Maximum
	37.8 m	Median
2100 rate	3.7 m/yr	Maximum
	2.8 m/yr	Median
2100 distance	230.9 m	Maximum
	159.4 m	Median

There is also a risk of flooding at this CMU located at the Burn of Tyne mouth and in the agricultural land in the western extent of CMU 1, but there are no other assets are at risk.

A.3 CMU 2: West - built structures

The coast along CMU 2 is defended by a concrete sea wall and rock revetment managed by Moray Council. Due to the built structures, there is no data available from Dynamic Coast. As a result, the hazard is unknown from coastal erosion in this unit, to the land and to assets. SEPA flood maps show there is currently no identified risk from flooding at CMU 2.

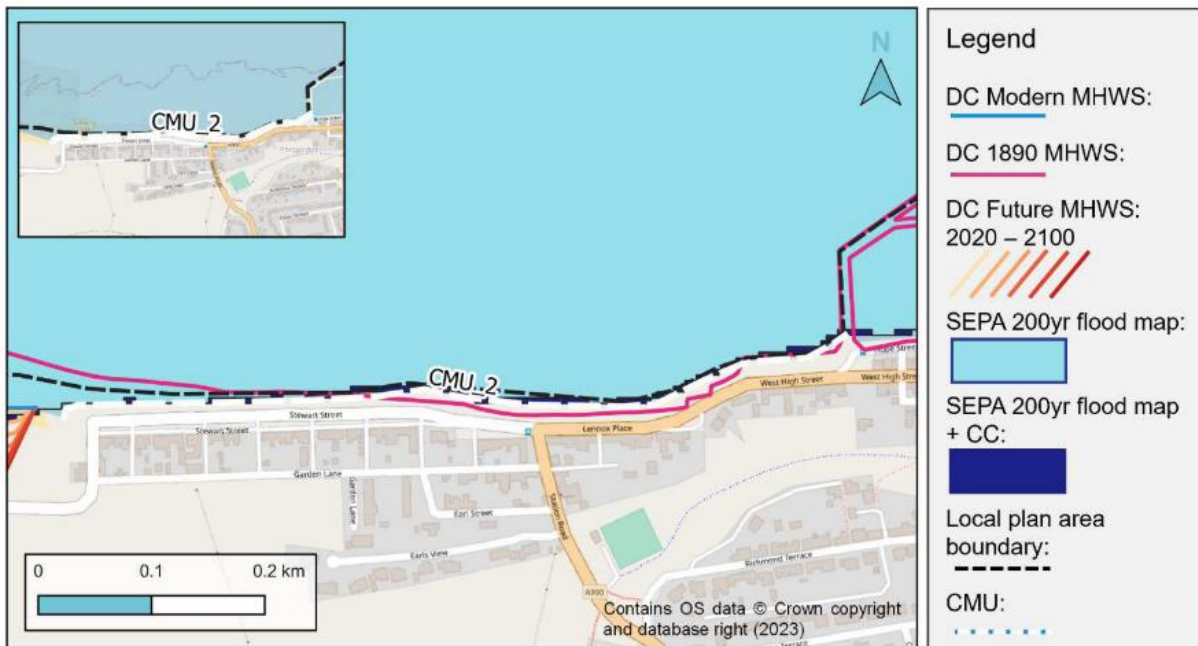


Figure A-3: CMU 2 defended west coastal hazards map showing SEPA flooding extents and Dynamic Coast 2 past and future erosion. Inset shows unit without coastal hazards.

A.3.1 Portgordon to Buckpool Coast coastal defence overtopping assessment

An overtopping assessment has been undertaken for the Moray Council coastal defence in CMU 2 in Portgordon. At this location, overtopping volumes have been calculated based on the following profile schematisation (Figure A-4):

- Structure has two crests, one at the top of near vertical embankment backed by secondary concrete slope to short vertical wall at crest of defence, from the 2013 Council survey data (4.9 mAOD crest level, 1.5 mAOD toe level).

Results from the overtopping assessment for all 4 sea level rise scenarios are shown in Figure A-5 to Figure A-8 and corresponds to Table 4-1 in the main text.

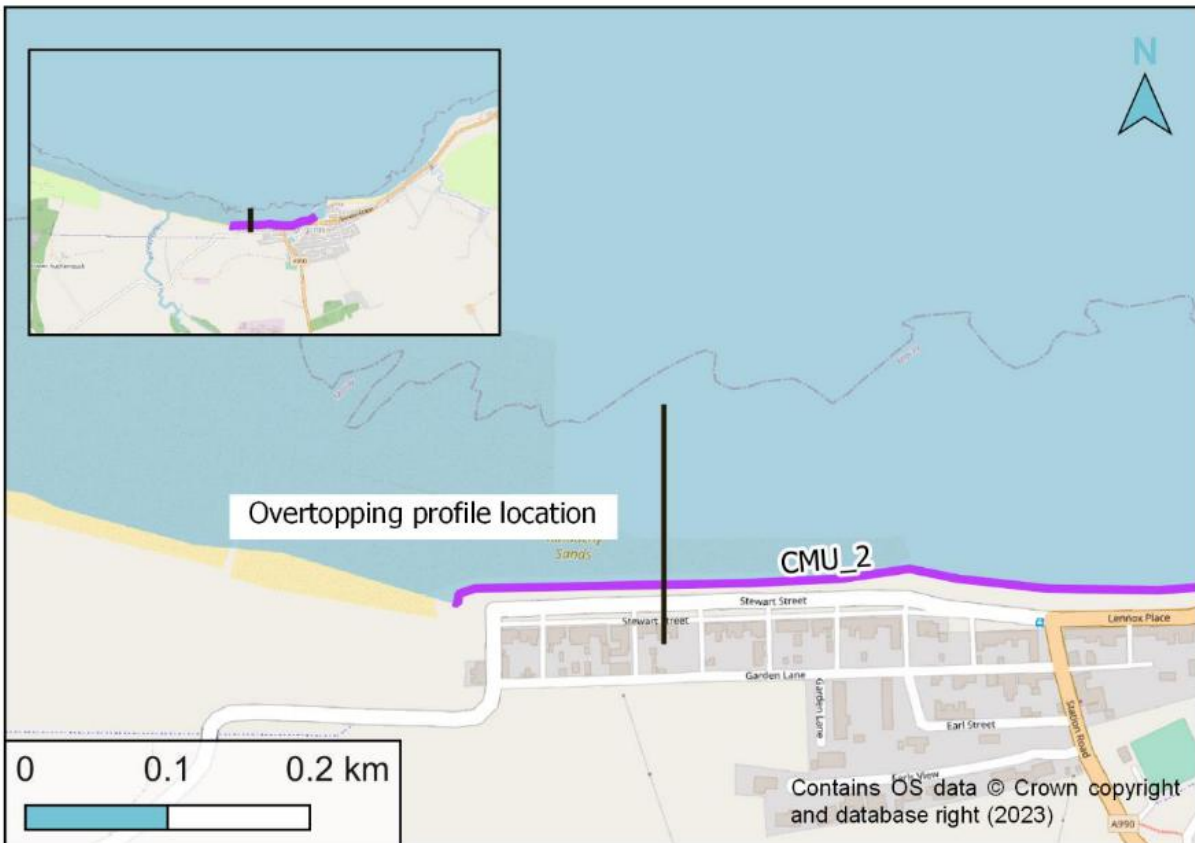


Figure A-4: Portgordon to Buckpool Coast Overtopping profile location.

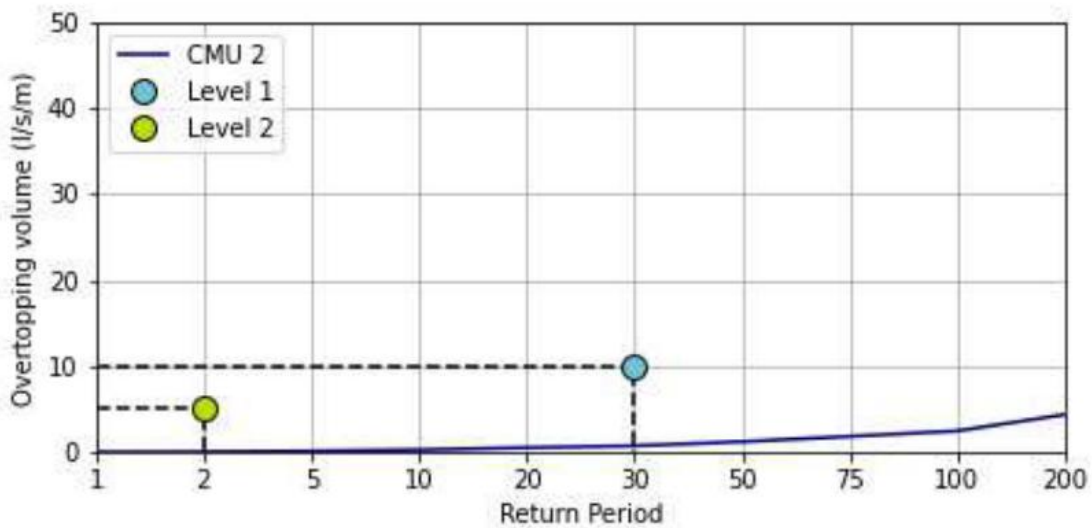


Figure A-5: Overtopping volume estimates for the rock armour defence in CMU 2 at present day (i.e. a 0.0 m sea level rise projection) . Overtopping triggers plotted for 1 in 30-year and 1 in 2-year return period events.

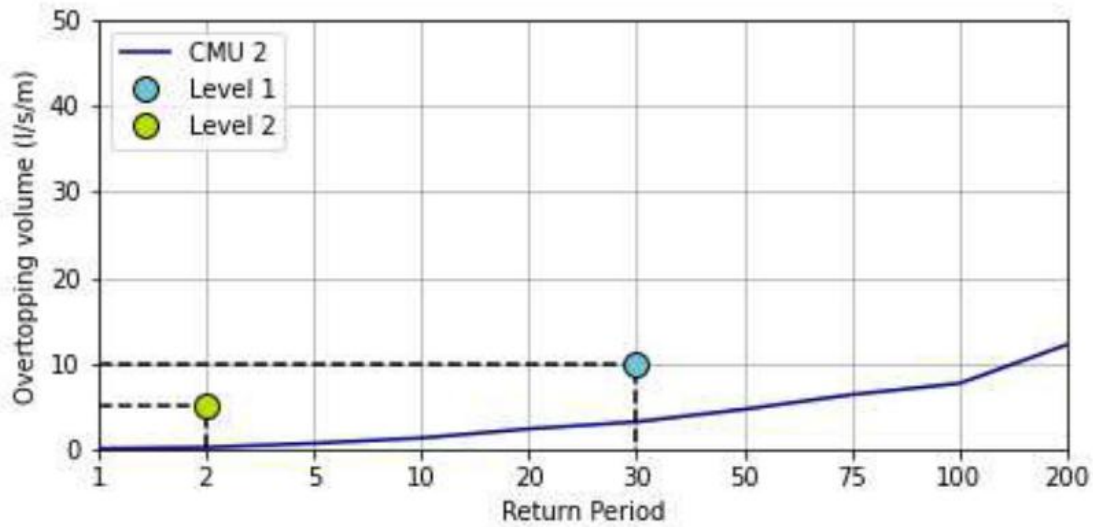


Figure A-6: Overtopping volume estimates for the rock armour defence in CMU 2 with a 0.2 m sea level rise projection. Overtopping triggers plotted for 1 in 30-year and 1 in 2-year return period events.

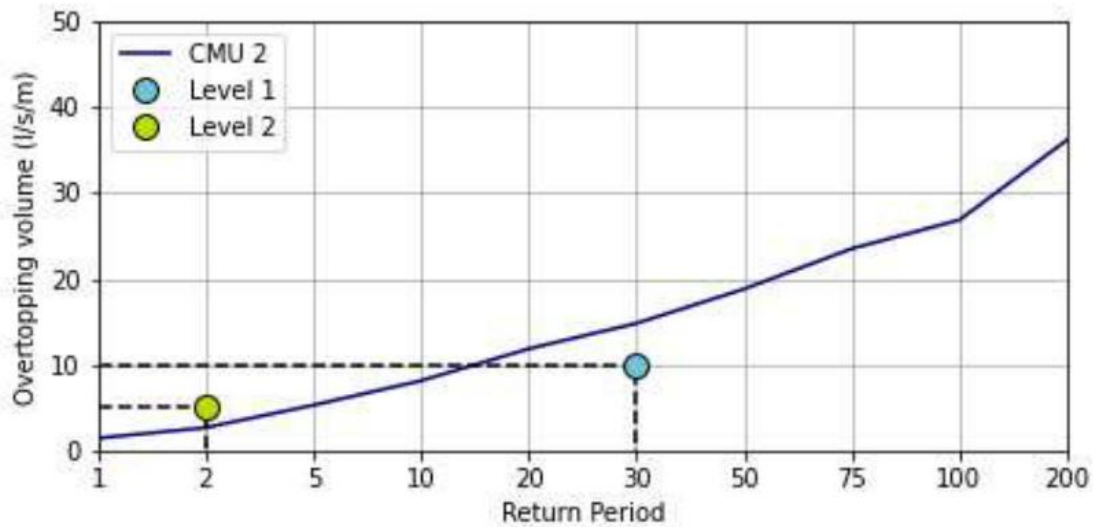


Figure A-7: Overtopping volume estimates for the rock armour defence in CMU 2 with a 0.5 m sea level rise projection. Overtopping triggers plotted for 1 in 30-year and 1 in 2-year return period events.

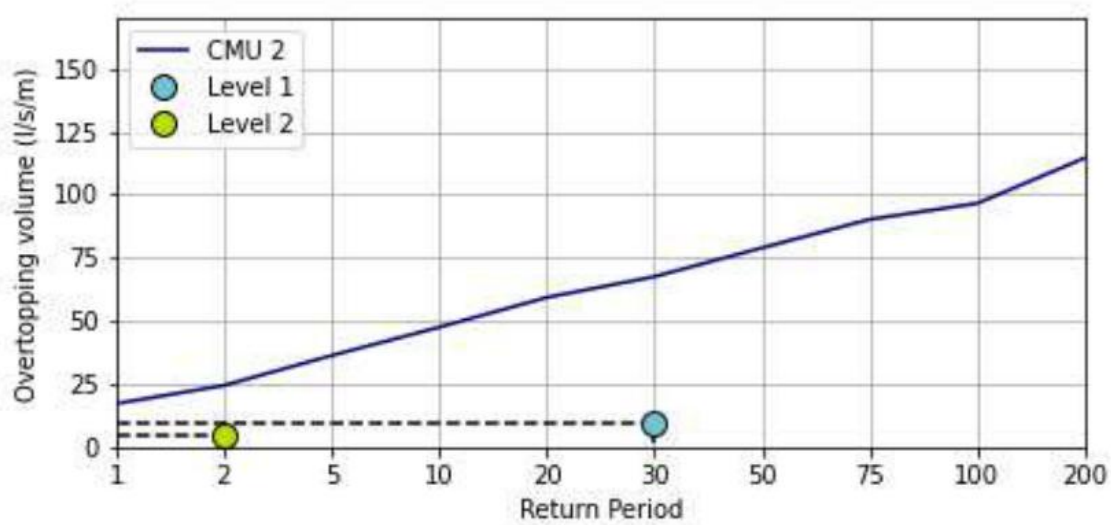


Figure A-8: Overtopping volume estimates for the rock armour defence in CMU 2 with a 1 m sea level rise projection. Overtopping triggers plotted for 1 in 30-year and 1 in 2-year return period events.

A.4 CMU 3: Harbour – built structures

CMU 3 contains Portgordon harbour. Due to the built structures, there is no data available from Dynamic Coast. As a result, the hazard is unknown from coastal erosion in this unit, to the land and to assets. SEPA flood maps show there is currently no identified risk from flooding at CMU 3.

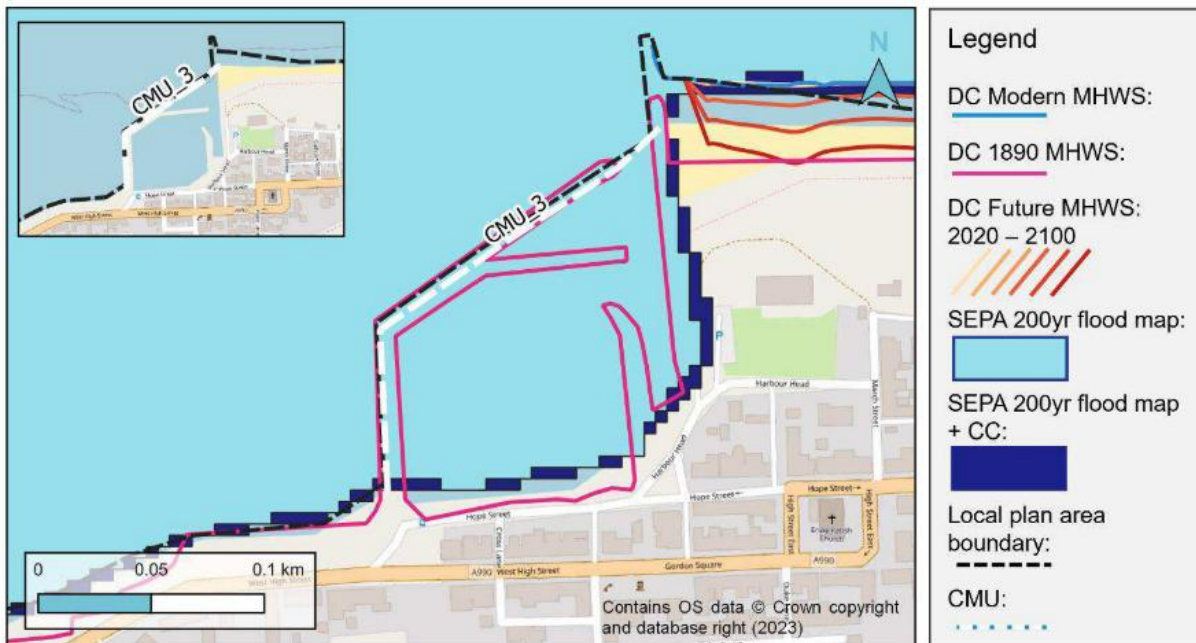


Figure A-9: CMU 3 defended harbour coastal hazards map showing SEPA flooding extents and Dynamic Coast 2 past and future erosion. Inset shows unit without coastal hazards.

A.5 CMU 4: Beach central - natural

The coast at CMU 4 is a natural shingle and sand beach, with the harbour wall to the west. The area inland includes some greenspace and properties, roads, and assets in Portgordon settlement

Dynamic Coast 2 results show that historically (from ca. 1983 to 1990), the beach at CMU 4 has experienced both erosion and accretion (Table A-3). By 2050, the median rate of coastal change is projected to be eroding at a rate of 0.4 m/yr, and maximum rate of 1.1 m/y. By 2100, the beach is projected to erode at a maximum rate of 2.2 m/yr and maximum eroded distance of over 120 m. Table A-3 summarises Dynamic coast 2 data for CMU 4 within Portgordon to Buckpool Coast CA.

Assets at risk from future coastal erosion to 2100 in CMU 4 are summarised below:

- Twelve RP: present-day minimum 53 m from MHWS
- Two NRP: present-day minimum 51 m from MHWS
- Gordon Street (A990) ca. 273 m: present day minimum 34 m from MHWS

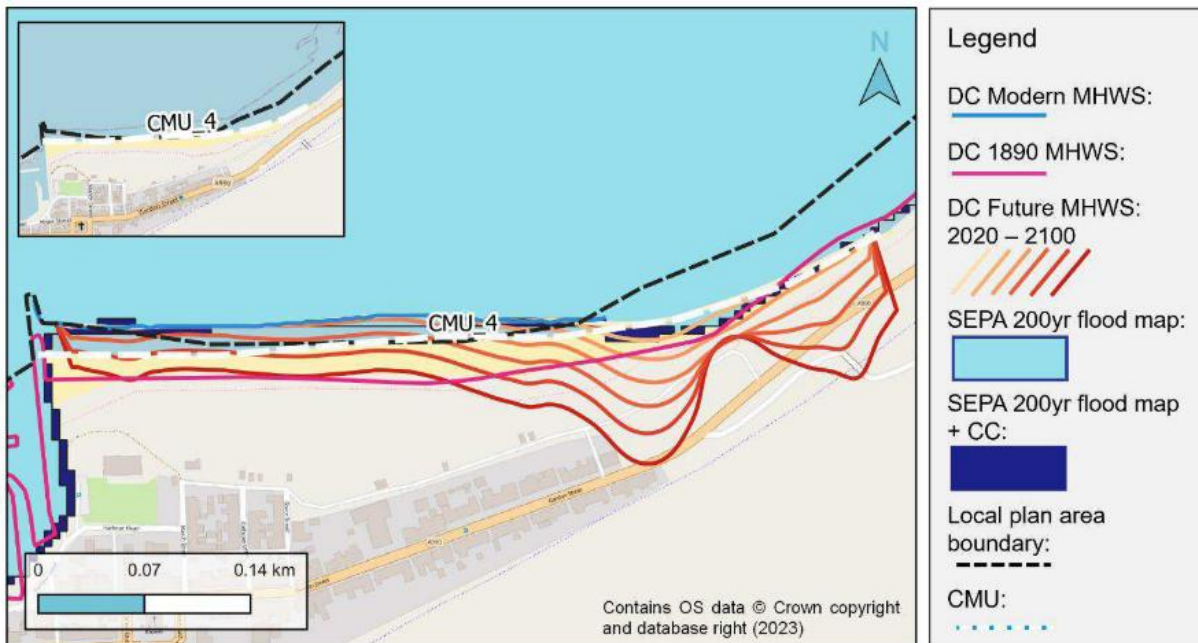


Figure A-10: CMU 4 beach central natural coastal hazards map showing SEPA flooding extents and Dynamic Coast 2 past and future erosion. Inset shows unit without coastal hazards.

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

Dynamic Coast calculation	Results	
Historical rate	0.3 m/yr	Maximum
	+ 0.4 m/yr (accretion)	Median
2050 rate	1.1 m/yr	Maximum
	0.4 m/yr	Median
2050 distance	26.5 m	Maximum
	2.8 m	Median
2100 rate	2.2 m/yr	Maximum
	1.3 m/yr	Median
2100 distance	120.7 m	Maximum
	48.3 m	Median

SEPA flood maps and NFRA datasets show negligible risk from coastal flooding in CMU 4 to the land and to assets.

A.6 CMU 5: Central – built structures

CMU 5 includes a section of the coast defended with rock armour. Due to the built structures, there is no data available from Dynamic Coast. As a result, the hazard is unknown from coastal erosion in this unit, to the land and to assets. SEPA flood maps show there is currently no identified risk from flooding at CMU 5.

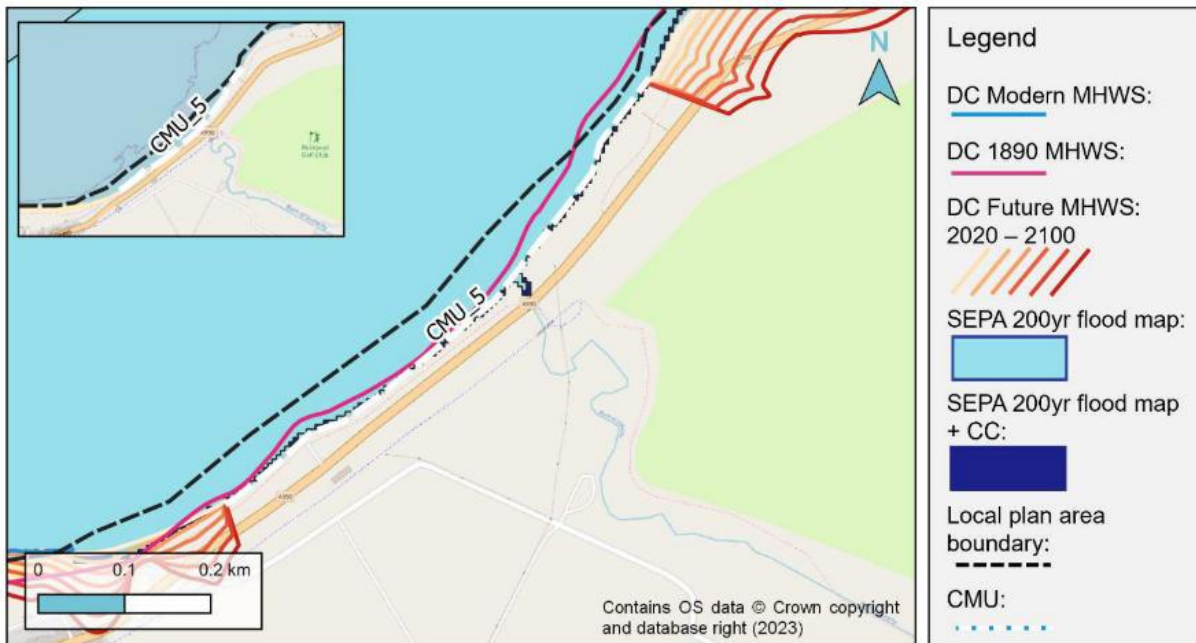


Figure A-11: CMU 5 defended central coastal hazards map showing SEPA flooding extents and Dynamic Coast 2 past and future erosion. Inset shows unit without coastal hazards.

A.7 CMU 6: East beach - natural

The coast along CMU 6 is natural and fronted by a sand and shingle beach. Historically (from ca. 1902 to 1986) there has been shoreline retreat rates of 0.3 m/yr. Erosion rates and extent is expected to increase significantly into the future. By 2050, the median rate of coastal change is projected to be eroding at a rate of 1.1 m/yr, and maximum rate of 1.3 m/y. By 2100, the beach is projected to erode at a maximum rate of 2.1 m/yr and maximum eroded distance of over 120 m. Table A-4 summarises Dynamic coast 2 data for CMU 6 within Portgordon to Buckpool Coast CA.

Assets at risk from future coastal erosion to 2100 in CMU 6 are summarised below:

- Nine RP: present-day minimum 29 m from MHWS
- Great Western Road (A990) ca. 457 m: present day minimum 67 m from MHWS

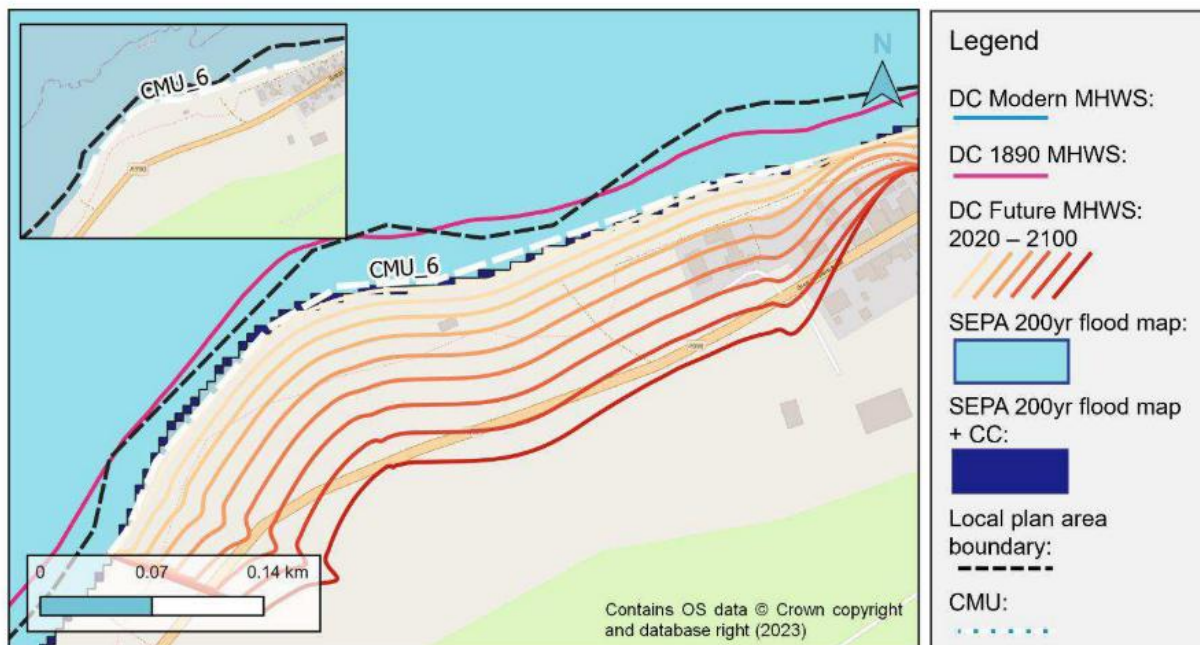


Figure A-12: CMU 6 east beach natural coastal hazards map showing SEPA flooding extents and Dynamic Coast 2 past and future erosion. Inset shows unit without coastal hazards.

Table A-4: CMU 6 Dynamic Coast 2 erosion data summary.

Dynamic Coast calculation	Results	
Historical rate	0.3 m/yr	Maximum
	0.3 m/yr	Median
2050 rate	1.3 m/yr	Maximum
	1.1 m/yr	Median
2050 distance	32.3 m	Maximum
	28.6 m	Median
2100 rate	2.1 m/yr	Maximum
	1.9 m/yr	Median
2100 distance	124.0 m	Maximum
	110.3 m	Median

SEPA flood maps and NFRA datasets show negligible risk from coastal flooding in CMU 6 to the land and to assets.

A.8 CMU 7: East – built structures

The coast at CMU 7 is entirely defended with a mixture of rock revetment and sea walls. The area inland includes properties, roads, and assets in Buckpool. Historically (from ca. 1964 to 1986), there has been shoreline retreat rates of 0.5 m/yr. Erosion rates and extent is expected to increase by 2050, but then slow to rates lower than historical erosion rates by 2100. By 2050, the median rate of coastal change is projected to be eroding at a rate of 0.7 m/yr, and maximum rate of 0.8 m/y. By 2100, the beach is projected to erode at a maximum rate of 0.1 m/yr and maximum eroded distance of over 48.9 m. Table A-5 summarises Dynamic coast 2 data for CMU 6 within Portgordon to Buckpool Coast CA.

Assets at risk from future coastal erosion to 2100 in CMU 7 are summarised below:

- 111 RP: present-day minimum 22 m from MHWS
- 15 NRP: present-day minimum 11 m from MHWS
- Main Street (A990) ca. 584 m: present day minimum 19 m from MHWS



Figure A-13: CMU 6 defended east coastal hazards map showing SEPA flooding extents and Dynamic Coast 2 past and future erosion. Inset shows unit without coastal hazards.

Table A-5: CMU 7 Dynamic Coast 2 erosion data summary.

Dynamic Coast calculation	Results	
Historical rate	0.5 m/yr	Maximum
	0.1 m/yr	Median
2050 rate	0.8 m/yr	Maximum
	0.7 m/yr	Median
2050 distance	20.2 m	Maximum
	15.4 m	Median
2100 rate	0.1 m/yr	Maximum
	0.0 m/yr	Median
2100 distance	48.9 m	Maximum
	24.2 m	Median

SEPA flood maps and NFRA datasets show negligible risk from coastal flooding in CMU 7 to the land and to assets.

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 that includes:

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



Action – 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 CMU2 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 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

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 Portgordon to Buckpool 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 Overtopping (SLR m)	Trigger Buffer Erosion (m)	Action	Owner	Delivery Partners	Timescale	Cost		
Portgordon to Buckpool Coast	1	Natural	Erosion	Property		1	N			65	None	NA	NA	NA	NA		
						2	N				None	NA	NA	NA	NA		
				Road		1	N				None	NA	NA	NA	NA		
						2	N			69	None	NA	NA	NA	NA		
	2	Built Structures	Overtopping	Defence	Sea wall	1	N		0.2		None	NA	NA	NA	NA		
						2	N		0.5		None	NA	NA	NA	NA		
			Condition			1	N				None	NA	NA	NA	NA		
						2	N				None	NA	NA	NA	NA		
	3	Built Structures	Condition	Defence		1	N				None	NA	NA	NA	NA		
						2	N				None	NA	NA	NA	NA		
	4	Natural	Erosion	Property		1	N				25	None	NA	NA	NA	NA	
						2	N				35	None	NA	NA	NA	NA	
						Road	1	N				21	None	NA	NA	NA	NA
							2	N				24	None	NA	NA	NA	NA
						Other	1	N				45	None	NA	NA	NA	NA
							2	N				48	None	NA	NA	NA	NA
	5	Built Structures	Condition	Defence		1	N				None	NA	NA	NA	NA		
						2	N				None	NA	NA	NA	NA		
	6	Natural	Erosion	Property		1	Y				-4	Increase monitoring and plan for assessment.	Moray Council	None	Short	Low	
						2	N				6	None	NA	NA	NA	NA	
						Road	1	N				50	None	NA	NA	NA	NA
2							N				53	None	NA	NA	NA	NA	
7	Built Structures	Erosion	Property		1	Y				-9	Increase monitoring and plan for assessment.	Moray Council	None	Short	Low		
					2	N				1	None	NA	NA	NA	NA		
			Road		1	N				7	None	NA	NA	NA	NA		
					2	N				10	None	NA	NA	NA	NA		
		Condition	Defence		1	N				None	NA	NA	NA	NA			
					2	N				None	NA	NA	NA	NA			

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