Moray Coastal Change Adaptation Plan

Buckie to Portessie Coast

Final

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Revision History

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May 2023 – P01	Draft Report	Will Burnish Leigh Moreton
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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. Jenny Shadrick, Doug Pender, and Angus Pettit of JBA Consulting carried out this work.

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Purpose

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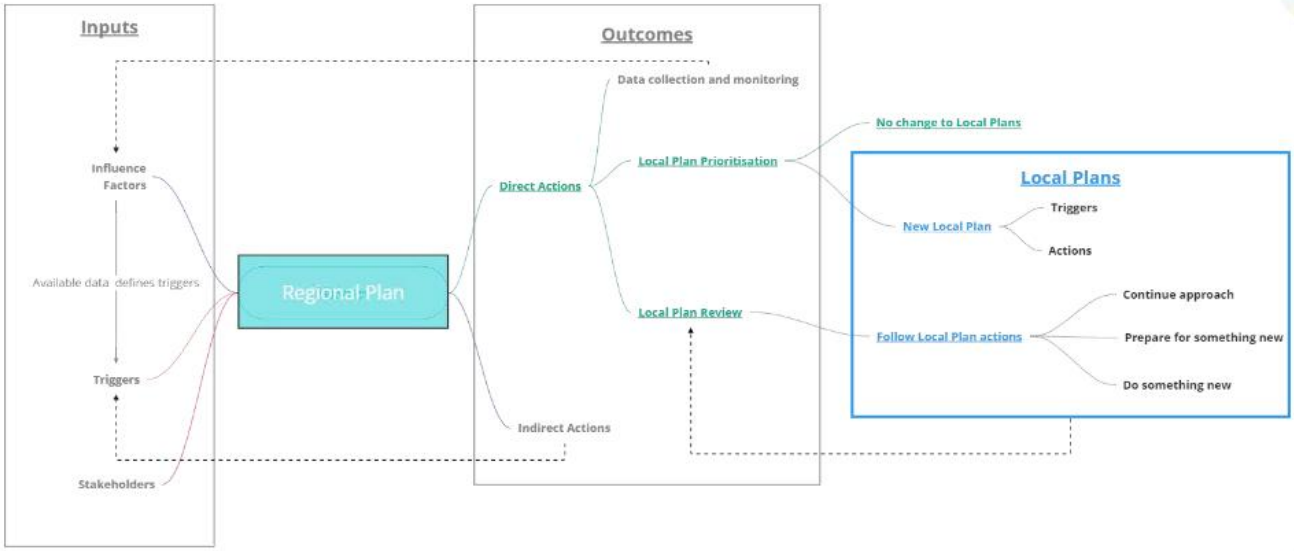
Executive summary

The report documents the Coastal Change Adaptation Plan (CCAP) for the Buckie to Portessie 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 Plan[1] 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 along the Buckie to Portessie Coast, which are used to underpin development of possible Adaptation Pathways for this CA. These are presented, along with a framework to support proactive coastal risk management, enable implementation of climate change adaptation actions and link with climate resilient development planning along Moray's coast.

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

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

To develop Adaptation Pathways, the coast of the CA was classified into Coastal Management Units (CMUs) defined by 1) classification of coastal landform type, and 2) risk associated with coastal flooding and erosion.

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

1) Monitoring and Triggers
2) Actions
3) Outcomes

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

Realisation of Triggers signal a need for review or change of the Adaptation Pathway. Actions bridge the gap between Triggers and Outcomes and define what processes need to be implemented before an appropriate Outcome is identified. Adaptation interventions are potential measures that can be applied. There are four possible categories:

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

A set of Phase 0 Actions have been identified, that require immediate attention because of Triggers being met in this iteration of the Buckie to Portessie 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 along the Buckie to Portessie Coast.

Portessie is shown to already be in the position of having a coastal flood scheme developed and submitted for Scottish Government funding. Incorporation of any future funding decision is reflected in the associated Triggers, Actions and Pathway for that CMU.

The current iteration of the Buckie to Portessie Coast local plan is at Phase 0. The 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 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	Overtopping threshold exceeded	Increase monitoring and undertake detailed assessment
5	Erosion buffer exceeded	Undertake assessment and plan for intervention

As well as Triggers and Actions that correspond directly to the Adaptation Pathway and specified CMUs, Proactive Actions that support the whole of the Buckie to Portessie 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) Portessie Coastal Flood Scheme workshop with SEPA and Scottish Government.
5) Buckie Harbour Masterplan Review.
6) 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 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 Guidance[2].

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 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, frequent flooding. More positively, a proactive approach to adaptation and climate resilient development planning now can generate wider benefits and opportunities for coastal communities and the ecosystems which sustain and support them.

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

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

Most the coastline of the Buckie to Portessie Coast CA consists of built structures, such as Buckie harbour. There are considerable assets, including properties and roads that flood and erosion risk is mitigated by these structures.

Dynamic Coast has projected as much as 42 m of shoreline retreat by 2100 at the Strathlene Caravan park and Great Eastern Road located in the Buckie to Portessie Coast CA. In addition, there is a risk of flooding of properties and roads in the vicinity of Buckie Harbour.

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

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

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

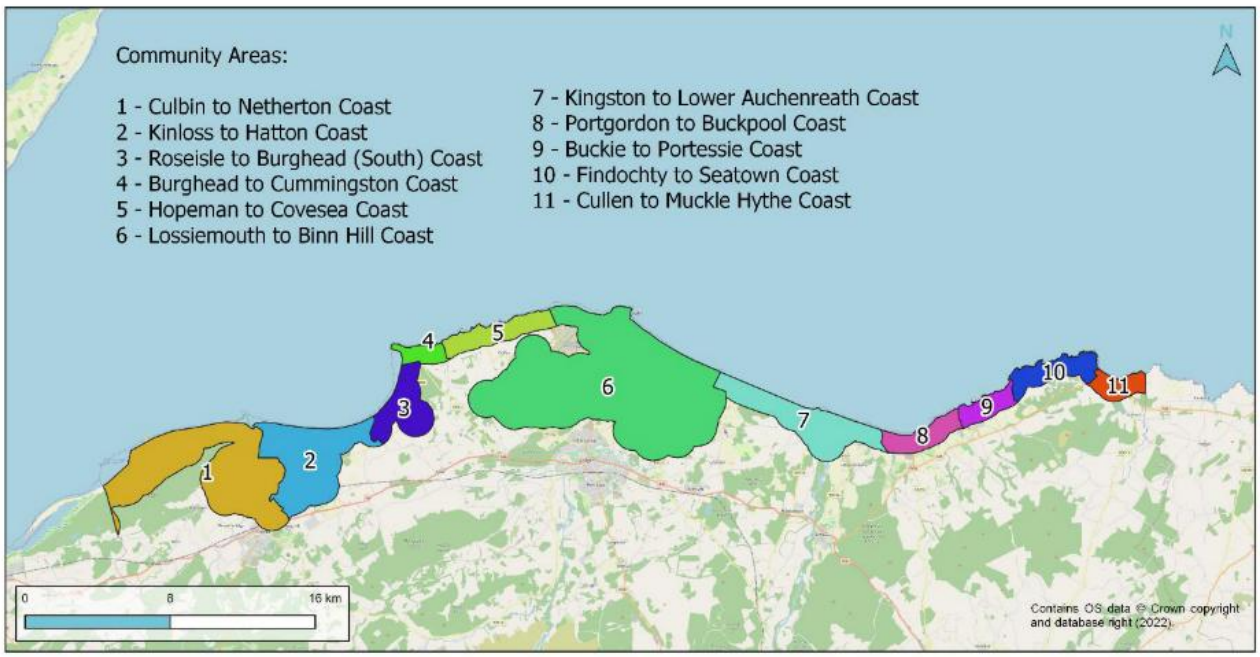


Figure 1-1: Extent and location of CAs within Moray

1.2 What is a Local CCAP?

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

1.3 What are adaptation pathways?

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

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

1.4 What do adaptation pathways do?

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

Triggers are used in Adaptation Pathways to signal when the current management approach should be reviewed, and possibly changed, in response to updated information or change of circumstance[Error! Bookmark not defined.], 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 Buckie to Portessie 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 Buckie to Portessie 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 Actions that will support delivery of the CCAP in each CMU.
- Inform and support the Local Development Plan[3] 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[2] into **four key pillars of adaptation** (Figure 1-2). Development and application of the CCAP Implementation Plan should align with these principles.

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

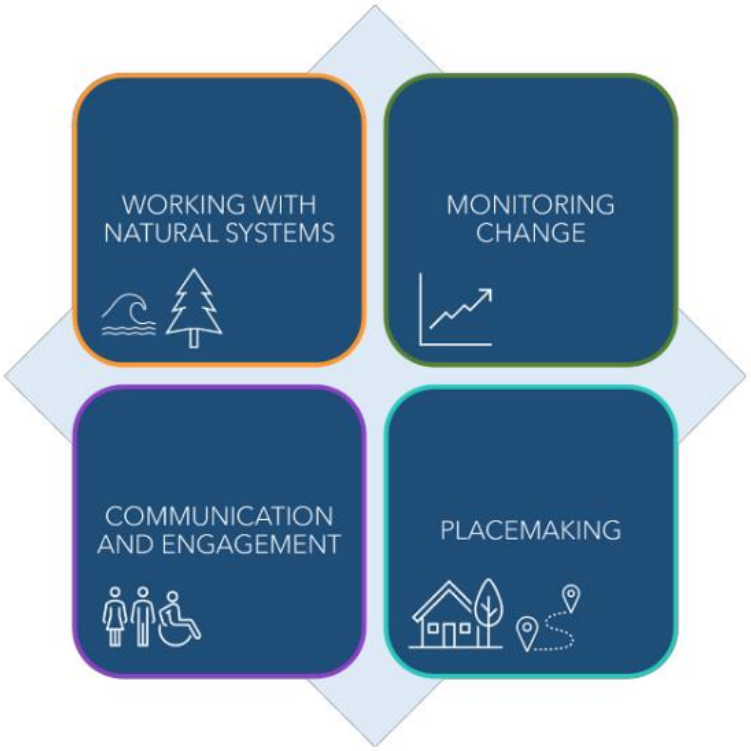


Figure 1-2: Four pillars of coastal adaptation for Moray

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

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

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

2 Plan Overview

2.1 Plan Area and Characteristics

The Buckie to Portessie Coast Community Management Area (CA) covers an area of ca. 3.7 km^2 and is located between the Portgordon to Buckpool Coast CA and the Findochty to Seatown Coast CA. The CA includes a range of coastal environments and land use areas (Figure 2-1).

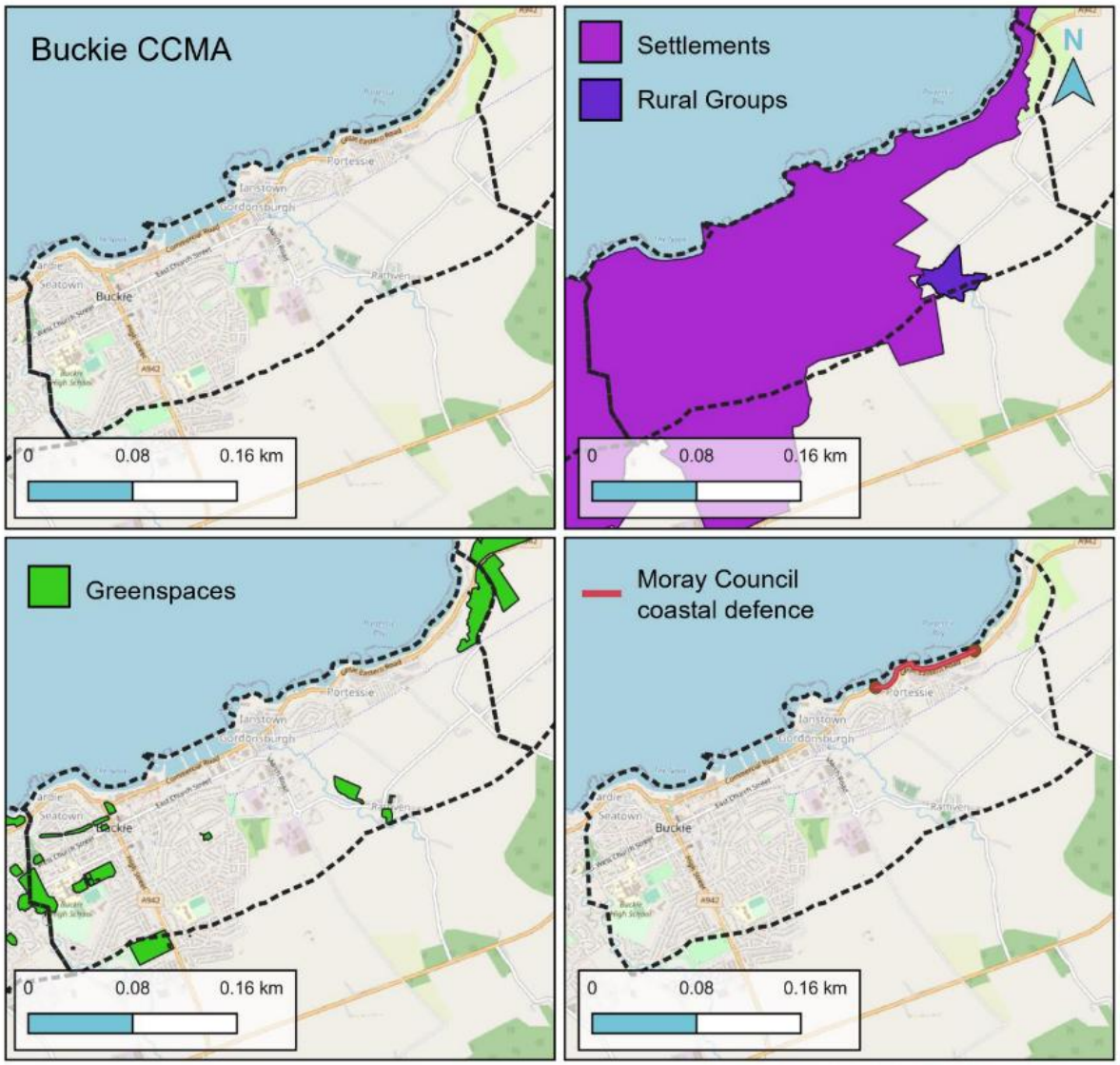


Figure 2-1: Buckie to Portessie Coast CA, showing settlements, greenspace and environment and special consideration areas.

Settlements:

The Buckie to Portessie Coast CA includes the settlements of Buckie and Portessie and rural group Rathven. Buckie has a population of 8,541 with 3,782 households[3] and the town extends across most of the CA. The Moray Council LDP has identified designation areas for specific land use in settlement and rural groups.

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

Greenspace and Environment:

There is minimal greenspace across the CA; mostly consisting of local parks within Buckie to Portessie Coast. To the east, Strathlene Golf Club extends into the CA. The coastal waters offshore of the CA coast are a NatureScot designated Special Protection Area (SPA).

Special consideration areas:

A 770 m long extent of the coast at Portessie is defended with a sea wall and rock revetment, which is managed by Moray Council. Within the CA is Buckie Harbour, which is also operated by Moray Council and structures provide protection to that part of the town.

Habitats:

There is only one key natural habitat along the coastal extent of Buckie to Portessie Coast as identified by NatureScot and includes unvegetated mobile shingle at Portessie Bay (Figure 2-2).

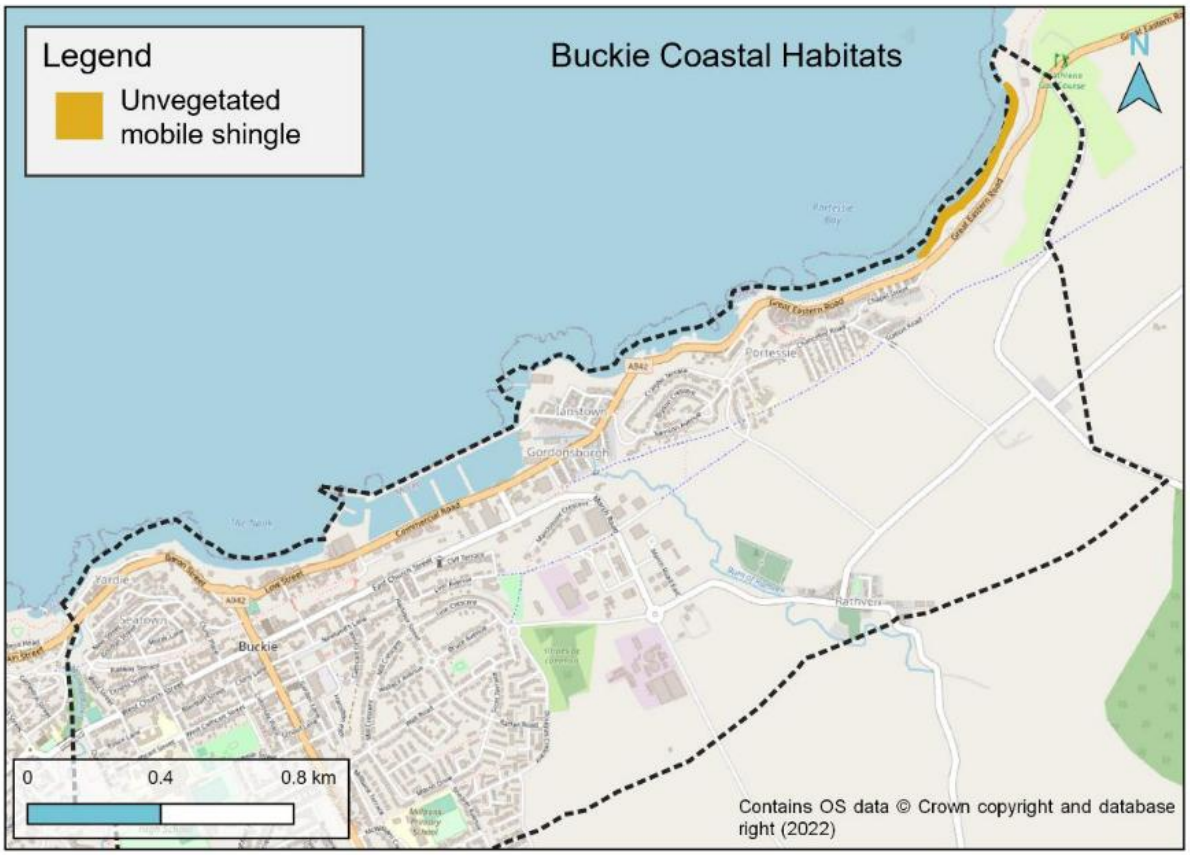


Figure 2-2: Coastal habitats at Buckie to Portessie Coast as identified by NatureScot.

2.2 Coastal Management Units

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

1. Classification of coast type.
    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 Buckie to Portessie Coast CA coast has been subdivided into five CMUs (Figure 2-3). The five CMUs are described below including a summary of the coastal change and flood risk. Full details of each CMU are provided in Appendix A.

Figure 2-3: CMUs within the Buckie to Portessie Coast CA.

2.2.1 CMU 1: West – built structures

CMU 1 is located to the west of Buckie Harbour. This section of coast is entirely defended with a range of structure types, including a concrete sea wall and rock revetment. The area inland includes Buckie town. Due to the built structures and rock coast, there is no data available from SEPA flood maps, NFRA datasets and Dynamic Coast. As a result, the hazard is unknown from both coastal flooding and erosion in this unit, to the land and to assets.

2.2.2 CMU 2: Buckie Harbour – built structures

CMU 2 contains Buckie Harbour with substantial concrete structures. The area inland includes part of Buckie town. There is an unknown hazard from coastal erosion CMU 2 as there is no data available from Dynamic Coast. In a 1 in 200-year flooding event, the east side of the harbour is at risk of flooding, ca. 88 m inland across the industrial area by the harbour and includes one non-residential property at risk.

In a 1 in 200-year return period plus climate change event, this flooding extent at the west of the harbour could extend up to 130 m inland, flooding further along the Burn of Rathven canal and into the Gordonsburgh housing estate. Under this climate change scenario, five residential properties, three non-residential properties and ca. 100 m of Rathburn Street are at risk of flooding.

2.2.3 CMU 3: Central - hybrid

CMU 3 is the central unit in the CA and comprises of a mixture of rocky shore platform and beaches with concrete sea wall and rock revetment defences in places. The area inland includes parts of Buckie and the community of Portessie. Due to the built structures and rock coast, there is no data available from SEPA flood maps, NFRA datasets and Dynamic Coast. As a result, the hazard is unknown from both coastal flooding and erosion in this unit, to the land and to assets.

2.2.4 CMU 4: East – built structures

CMU 4 contains the coast which includes the coastal defence managed by Moray Council. Rock revetment and a concrete structure protects Portessie behind. The natural coast in front of the defences mostly comprises of rocky shore platform. Due to the built structures and rock coast, there is no data available from SEPA flood maps, NFRA datasets and Dynamic Coast. As a result, the hazard is unknown from both coastal flooding and erosion in this unit, to the land and to assets.

This area, however, was subject to a detailed coastal flood study in 2016, which highlighted the flood risk associated with wave overtopping[4]. As a result, an overtopping assessment has been included here for CMU 4 to understand potential existing and future risk from this mechanism (section 4.2.4).

2.2.5 CMU 5: East beach - hybrid

The coast at CMU 5 comprises of a natural shingle and sand beach with multiple small shore platform outcrops. There are several coastal defence structures present, likely to protect individual properties.

Inland from the coast includes some residential properties, Strathlene Caravan Park, and Strathlene Golf Course. There is a risk of only erosion at this CMU. Dynamic Coast results show that historically (from ca. 1964 to 2011) the shingle beach at CMU 5 has remained stable, with no net loss or gain of sediment at the beach. By 2050, the maximum rate of coastal change is projected to be eroding at a rate of 0.4 m/yr. By 2100, the beach is projected to erode at a maximum rate of 1 m/yr and maximum eroded distance of 42 m. Assets estimated to be at risk of erosion by 2100 include six residential properties, three non-residential properties and ca. 675 m of Great Eastern Road.

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.

4 2015s2535 - Portessie Options Appraisal Final Report Jan 2016, JBA Consulting.

Table 2-1: Buckie to Portessie Coast CMU categorisation for local adaptation plan

CMU	Coastal Type	Risk
1	Built Structures	Risk and unknown Hazard
2	Built Structures	Risk and Hazard
3	Hybrid	Risk and unknown Hazard
4	Built Structures	Risk and Hazard
5	Hybrid	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.
  - 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 in asset location
  - Changes of land ownership
  - Community pressures
  - Tourism

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

3.1 CMU 1 Adaptation Pathway

The coast at CMU 1 is entirely defended, with a range of engineered coastal structures, including a concrete sea wall and rock armour, with unknown hazard (Figure 3-1). Land adjacent to the coast at CMU 1 is a mixture of residential area and industrial area, with some green space.

At CMU 1, should delivery of the Implementation Plan result in a pathway that requires protection of the coast to alleviate flooding and/or erosion risks 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 1 = Built Structures with risk and unknown hazard**

Phase 0 of the adaptation pathway (1st column) is the current action undertaken by Moray Council in respect of these CMUs. The coastal defences at CMU 1 and CMU 2 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. To develop a robust adaptation plan it is critical that Regional Proactive Actions 3 and 5* are delivered and results integrated into this Local Plan.

* **Regional Proactive Action 3** – Establish and standardise defence asset condition database
Regional Proactive Action 5 – Engagement workshop with third parties to understand ownership and responsibilities

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.

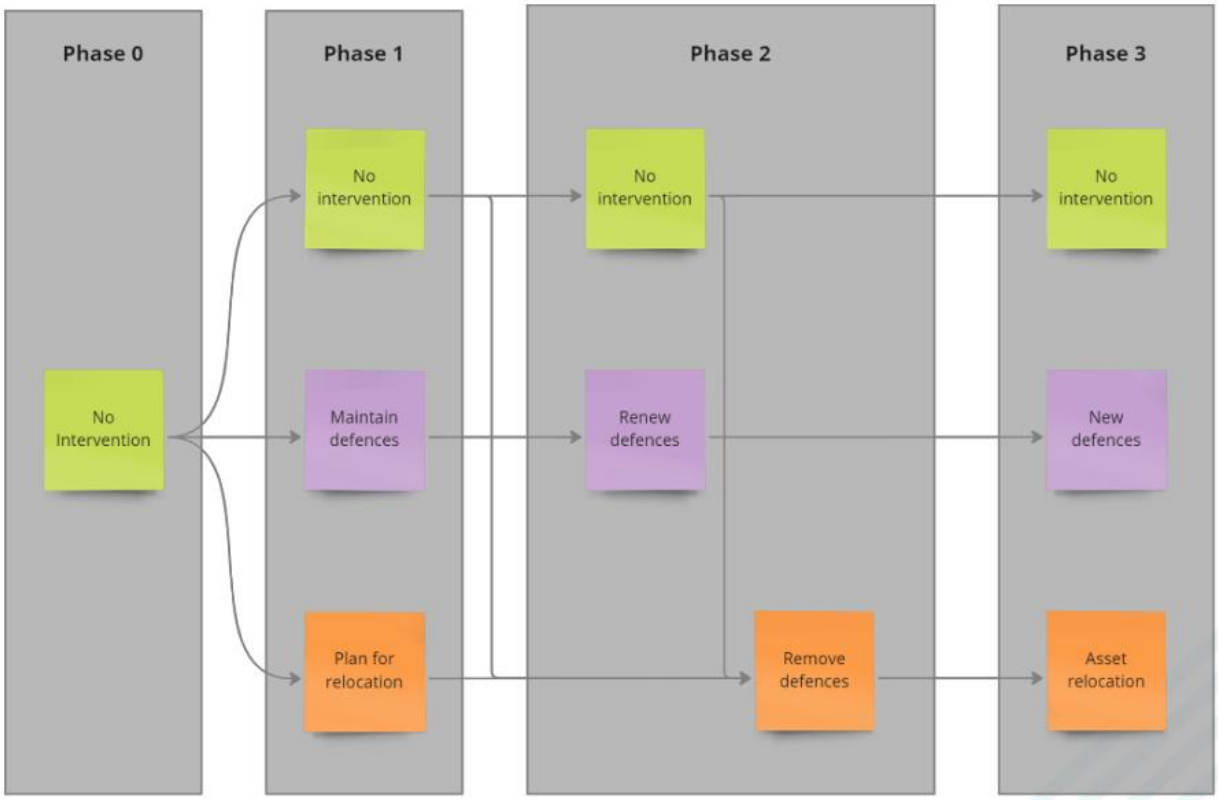


Figure 3-1: Adaptation Pathways for CMU 1 and CMU 2 (built structures). Grey lines represent possible future pathways.

3.2 CMU 2 Adaptation Pathway

CMU 2 includes Buckie Harbour with substantial concrete structures, with risk of flooding (Figure 3-2). Land adjacent to the coast at CMU 2, is mostly industrial, with small areas of residential properties. At CMU 2, there is no pathway to **Enhance Natural Features** as natural features do not contribute or provide any control on the flood risk.

- **CMU 2 = 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. In CMU 2, this is **Maintain Defences** as Moray Council are responsible.

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 coastal risk 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.

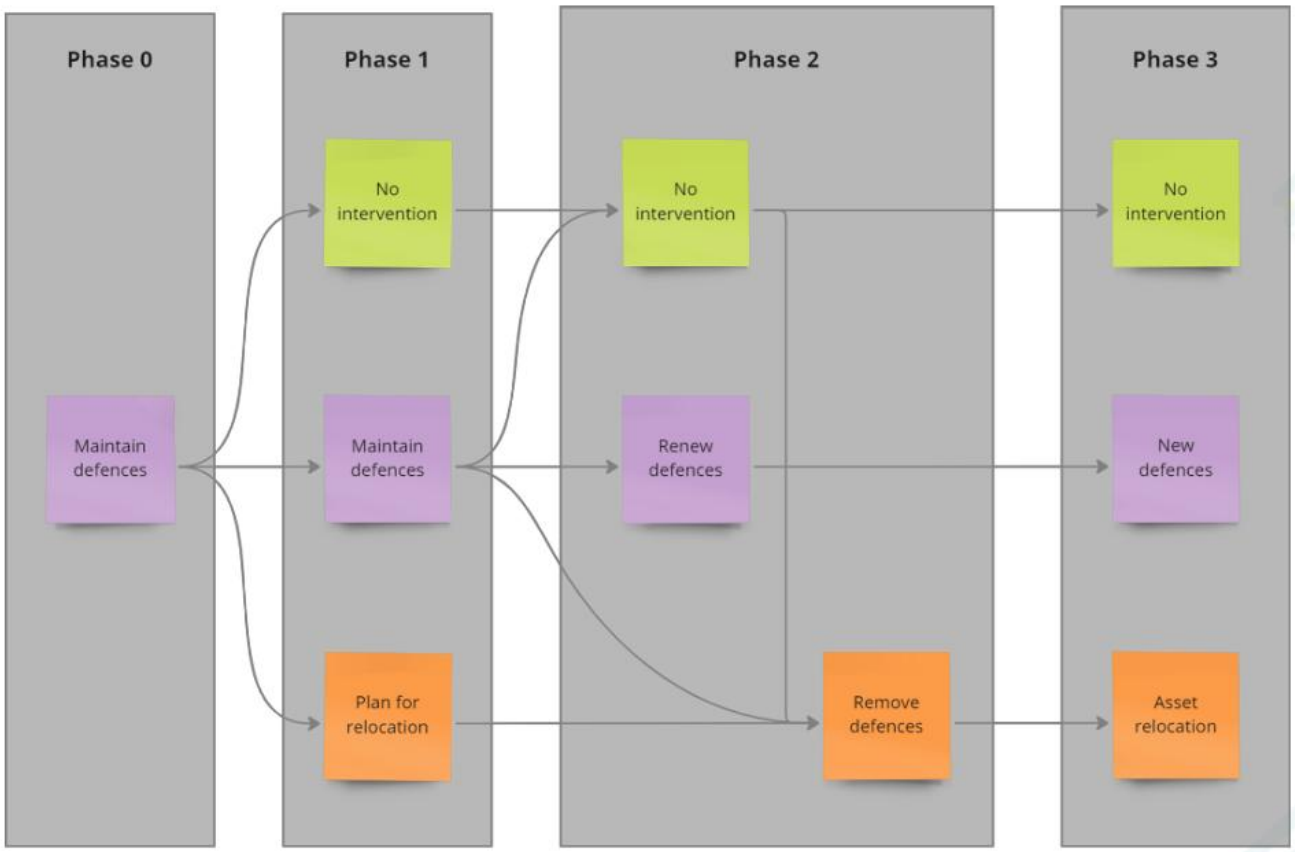


Figure 3-2: Adaptation Pathways for CMU 2 (built structures). Grey lines represent possible future pathways.

3.3 CMU 4

CMU 4 includes the rock armour and concrete structure that are managed by Moray Council, with risk of overtopping (Figure 3-3). Land adjacent to the coast at CMU 4, includes residential areas and green space.

3.3.1 Portessie Coastal Flood Study

This CMU is unique in the context of the CCAP in that a conventional hard engineering coastal flood scheme has already been assessed, developed, and proposed to Scottish Government for consideration of national prioritisation[4].

The 2016 study showed that the area of Portessie is at risk of coastal flooding from wave overtopping and that this is such that an economically viable coastal defence scheme can be justified[4]. The preferred scheme proposes to extend and increase the height of the setback wall and fill existing gaps with flap valves and flood gates to provide a reduction in flood risk up to a 1 in 200-year return period, with an allowance of climate change.

Delivery of a detailed flood study and development of a scheme should move CMU 4 from Phase 0 to Phase 1, as a long-term (100-year) plan for management of flood risk has been derived. However, at the time of writing, no decision has been made by Scottish Government as to whether funding will be available for a Portessie scheme in the current cycle (2022 – 2028). For the purposes of this CCAP it has therefore been decided that CMU 4 will continue in Phase 0 and a future for adaptation be developed according to the framework outlined in this CCAP.

3.3.2 Adaptation Pathway

At CMU 4, should delivery of the Implementation Plan result in a pathway that requires protection of the coast 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 4 = 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. In CMU 4, this is **Maintain Defences** as Moray Council are responsible.

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.

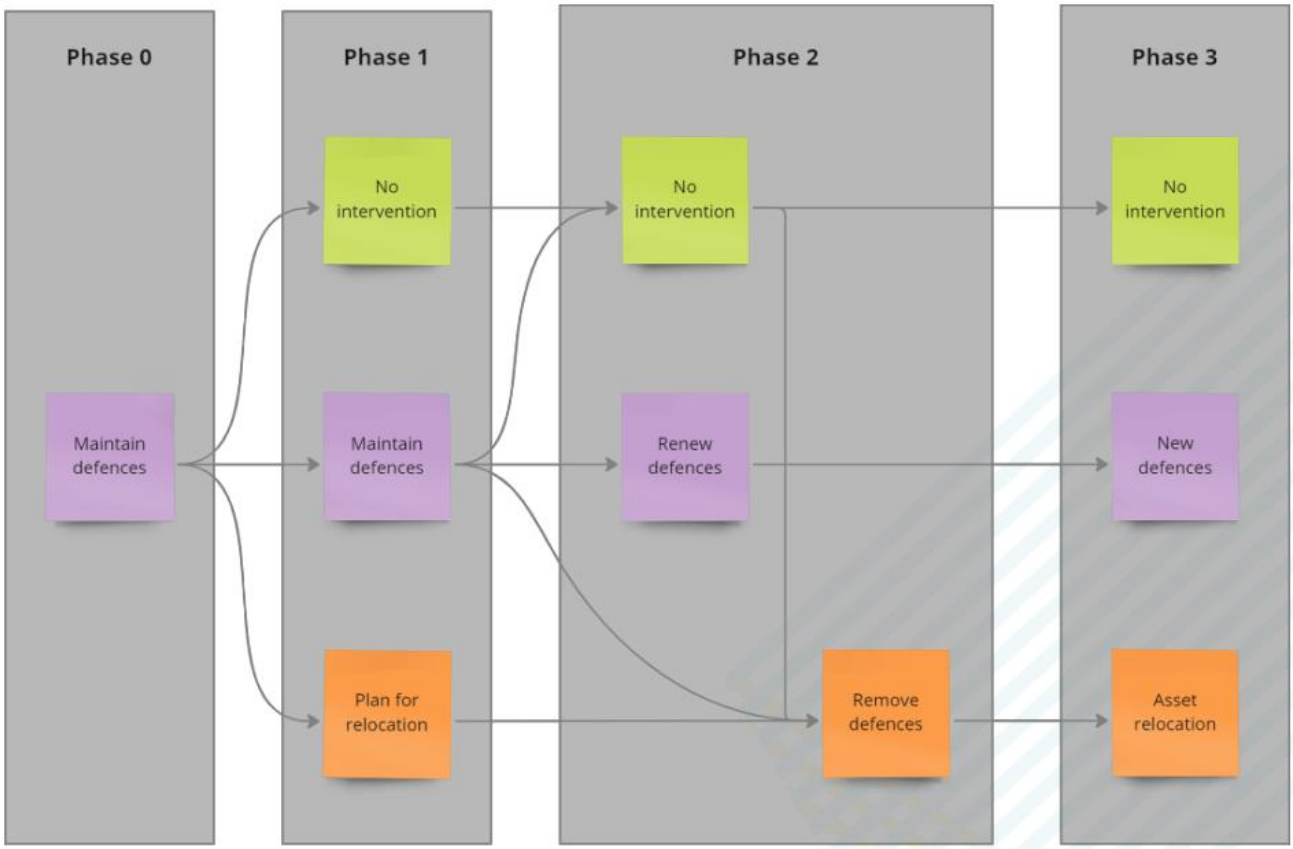


Figure 3-3: Adaptation Pathway for CMU 4 (built structures). Grey lines represent possible future pathways.

Despite the Adaptation Pathway proposed in Figure 3-3, as a coastal flood scheme has previously been developed, and proposed to Scottish Government, an alternative management approach to coastal change is possible for CMU 4. This would follow the delivery of the scheme proposed in the 2016 Portessie flood study[4] (See section 3.3.1).

For this to be realised, Moray Council requires capital funding from Scottish Government or other sources, which acts as an economic-**Trigger** in the delivery of the CMU 4 pathway (Figure 3-4). This, if realised, will lead to a long-term **Protect** outcome for CMU 4 by means of delivering the scheme. The current concept of the scheme includes a "built in" allowance for future climate change estimates including climate change induced sea level rise scenarios. When delivered this scheme therefore may or may not include future phases or wider adaptation activities. This will be reviewed during the detailed design phase, in consultation with Scottish Government.

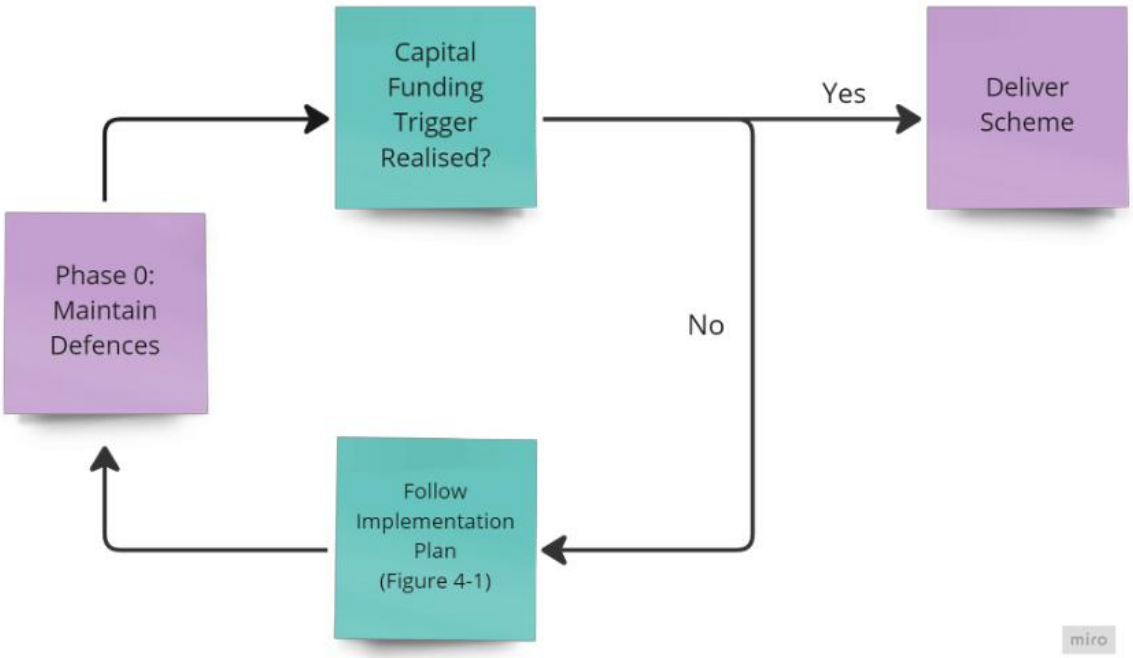


Figure 3-4: Capital funding Trigger for CMU 4.

3.4 CMU 3 and 5 Adaptation Pathways

The coast at CMU 3 is a mix of natural and defended with rock armour and hard structures, with unknown hazard. Land adjacent to the coast at CMU 3, includes residential properties and some green space (Figure 3-5).

The coast at CMU 5 is mostly natural with some private defences in place to protect individual property, with risk from erosion at CMU 5 (Figure 3-5). Land adjacent to the coast at CMU 5 includes residential properties, a caravan park and greenspace, including Strathlene Golf Course.

- **CMU 3 = Hybrid with risk and unknown hazard**
- **CMU 5 = Hybrid with risk and hazard**

Phase 0 of the adaptation pathway (1st column) is the current actions undertaken by Moray Council in respect of these CMUs. Here this is **No Intervention** as Moray Council are not obligated to maintain the structures or any privately owned defences in CMU 3 and CMU 5.

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.

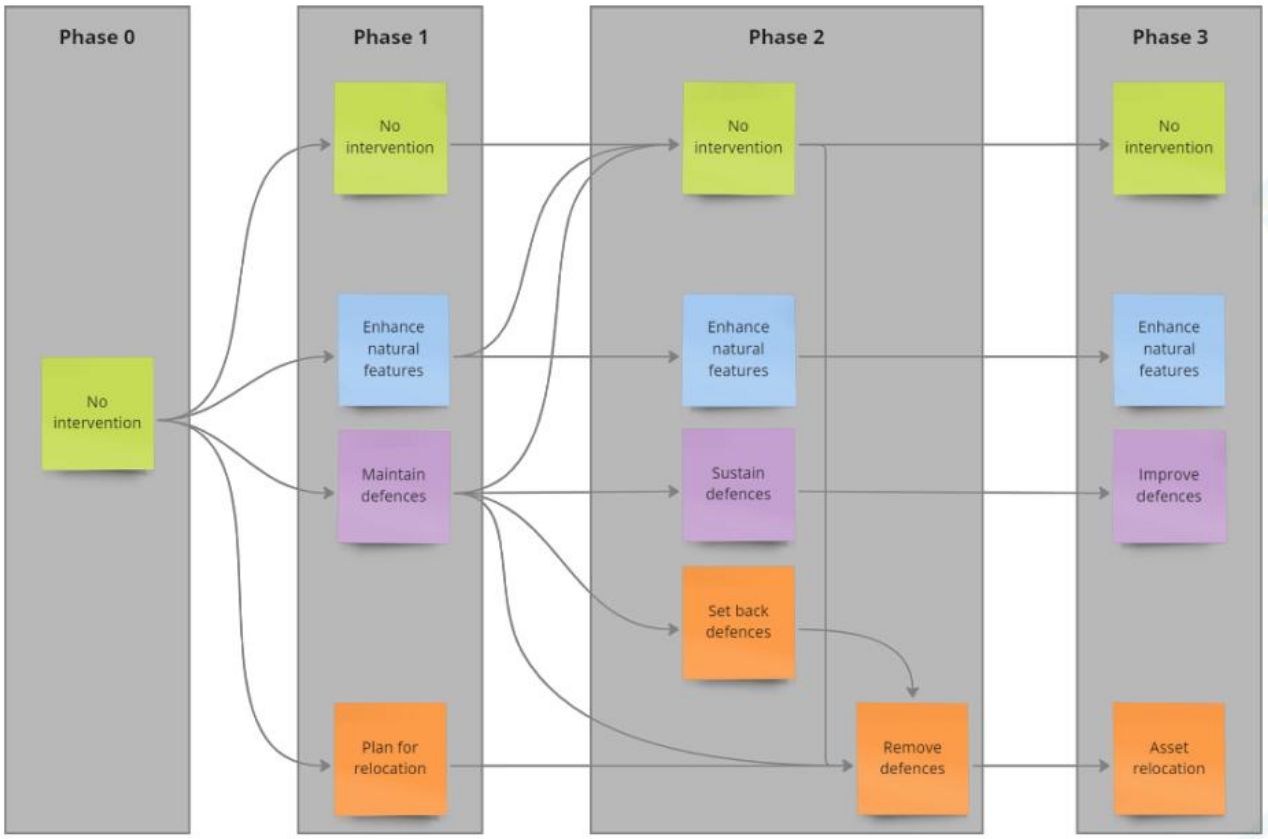


Figure 3-5: Adaptation Pathway for CMU 3 and CMU 5 (hybrid coast). Grey lines represent possible future pathways.

4 Adaptation Process

4.1 Implementation Plan

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

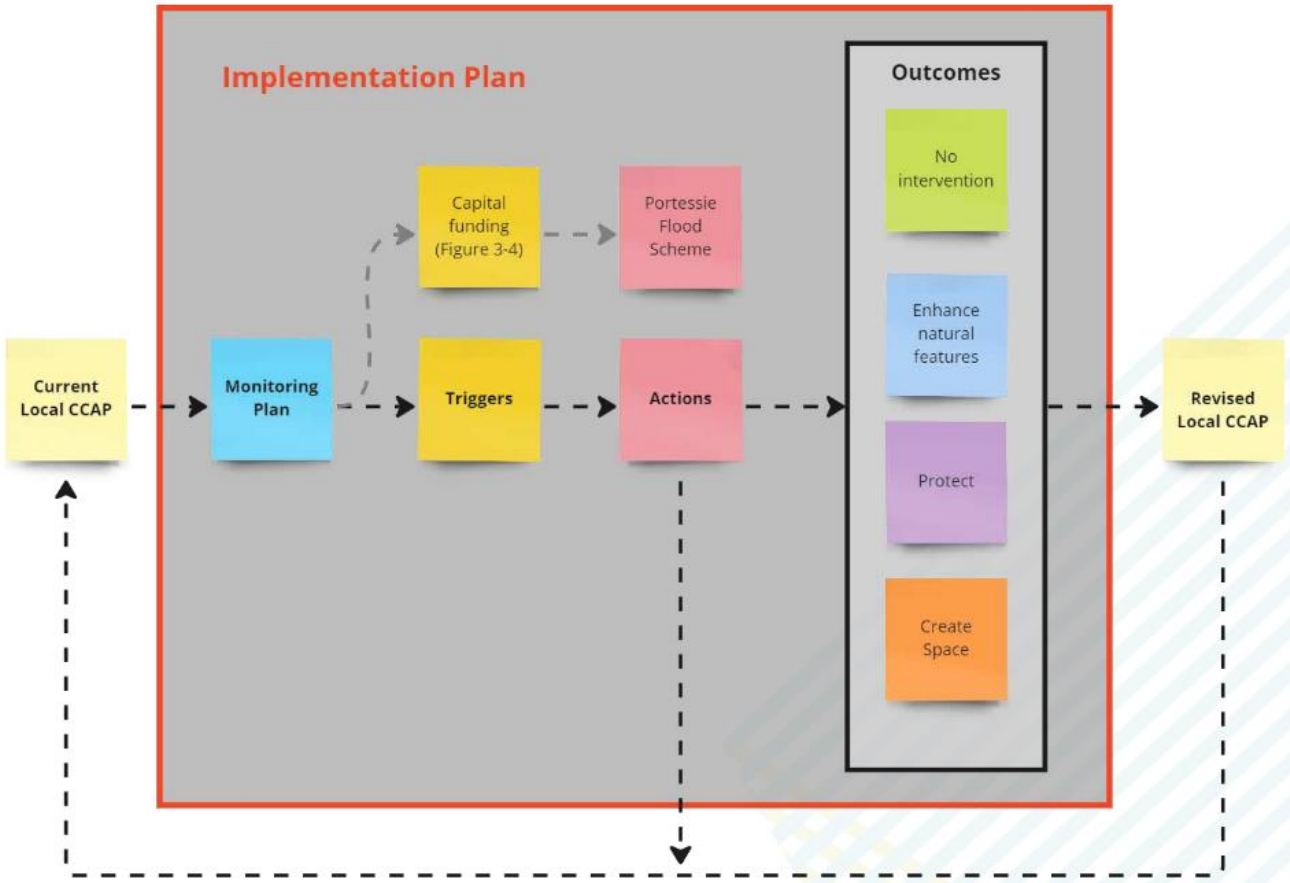


Figure 4-1: High-level Implementation Plan. Specific to Buckie to Portessie Coast CA, a flood protection scheme has already been proposed for Portessie in CMU 4. A capital funding Trigger (section 4.2.5) will action the Portessie Flood Scheme.

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 potentially change 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 Buckie to Portessie Coast CA these are summarised in Table 4-5.

All trigger types considered for the Buckie to Portessie Coast CA are summarised below:

1) Flooding triggers (section 4.2.3)
2) Overtopping triggers (section 4.2.4)
3) CMU specific funding trigger (section 4.2.5)
4) Erosion triggers (section 4.2.6)
5) Built structure condition triggers (section 4.2.7)
6) New information trigger (section 4.2.8)

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

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

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 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 the frequency of exceedance using the tide gauge levels (Table 4-1).

At the Buckie to Portessie Coast, current SEPA maps indicate a flood risk at CMU 2 only.

Exceedance Frequency is the number of events that exceed the asset threshold over 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.
- **Coastal Defences (note no MC defences at Buckie to Portessie Coast CMU 2)**
    1. Exceedance frequency of **one** or more in a **ten-year window**.
        - Increase monitoring and plan for assessment.
    2. Exceedance frequency of **two** or more in a **ten-year window**.
        - Undertake assessment and plan for intervention.

Locations of the assets used to define the flooding triggers are shown in Figure 4-2. Currently, no flooding triggers have been met at CMU 2 (Table 4-1).

Table 4-1: CMU-specific flooding triggers for Buckie to Portessie 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:
2	Property	3.2	2.9	1.4	2	5
CMU	**Lowest level of Road (mOD)**			**Current 10-year frequency**	**Flooding trigger level 1 Exceedance Frequency:**	**Flooding trigger level 2 Exceedance Frequency:**
2	Rathburn Street (A942)	3.2		0	5	10

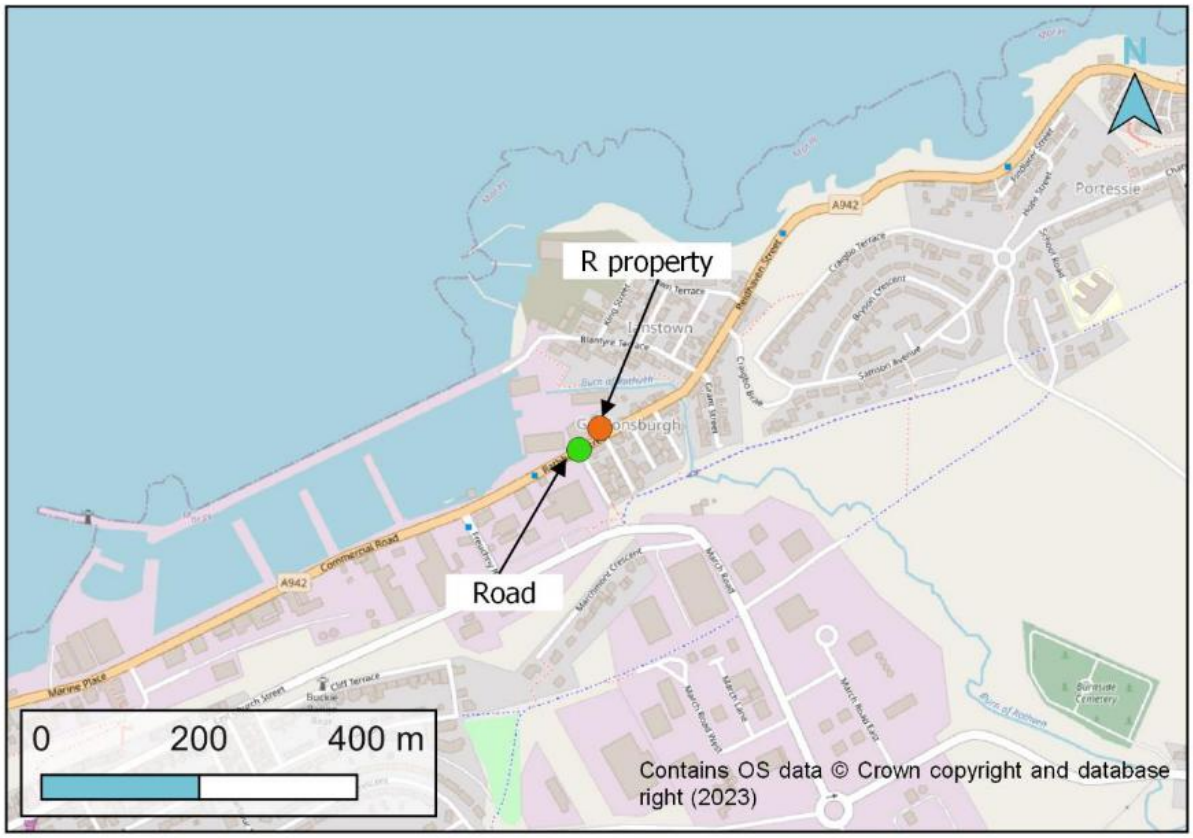


Figure 4-2: Buckie to Portessie Coast flooding trigger locations for residential property (R property) and Road.

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. This has been used to develop threshold levels based on extreme return periods. To enable proactive planning, the overtopping 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 overtopping rates 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 4 in Portessie, where the 2016 flood study demonstrated wave overtopping to be the 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 levels[5]. There are two levels to the trigger realisation that require different actions:

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.

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 are therefore 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.5.1) 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 4-2) show that Level 1 overtopping trigger is met now (2023 present-day), with 0.0 m, of sea level rise. Level 2 overtopping trigger will be met after 0.2 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 up to 0.9m[6].

Table 4-2: Overtopping triggers for the coastal defence in CMU 4. 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)	16.1	3.6
0.2 m	27.7	7.1
0.5 m	52.8	16.8
1.0 m	125.2	50.1

4.2.5 CMU-specific Funding trigger

Within the Buckie to Portessie Coast CA, CMU 4 is unique as a coastal flood scheme has already been assessed, developed, and proposed to Scottish Government for consideration of national prioritisation. As a result, an **Outcome** has already been defined as **Protect** through the chosen option to extend and increase the height of the setback wall and fill existing gaps with flap valves and flood gates.

However, at the time of writing, no decision has been made by Scottish Government as to whether funding will be available for the scheme in the current cycle. Therefore, a **Trigger** associated with available capital funding (internal or external) will be used to initiate the proposed scheme within the CCAP. If this Trigger is realised, the Adaptation Pathway proposed for CMU 4 (section 3.3) will be overridden by the flood protection scheme. This may or may not include any further supporting adaptation activities developed during the detailed design stage.

The CMU-specific funding trigger and associated action for CMU 4 is summarised as:

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

1) Capital funding available for coastal defence scheme for Portessie in CMU 4.
2) Deliver Scheme.

Here it is important the any occurrence of flooding or overtopping along CMU 4 is monitored, understood, and brought forward to support discussions on potential use of internal capital budget to support scheme delivery.

4.2.6 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 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 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 20 m.
        - Increase monitoring and plan for assessment.
    2. Maximum of historic erosion rate multiplied by 10 or 10 m.
        - Undertake assessment and plan for intervention.
- **Roads and other features**
    1. Maximum of historic erosion rate multiplied by 5 or 5 m.
        - Increase monitoring and plan for assessment.
    2. Maximum of historic erosion rate multiplied by 2 or 2 m.
        - Undertake assessment and plan for intervention.

Level 1 erosion triggers have been met for the property and carpark in CMU 5 (Table 4-3). Level 2 erosion trigger has also been met for the carpark in CMU 5 (Table 4-3). Location of all assets used for erosion triggers are shown in Table 4-3 and Table 4-4.

Table 4-3: CMU-specific erosion triggers for Buckie to Portessie 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 Property to coast (m)		Erosion trigger level 1: Coast X m from property	Erosion trigger level 2: Coast X m from property
5	0	RP	14	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**
5	0	A942	11	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**
5	0	Carpark	2	5	2

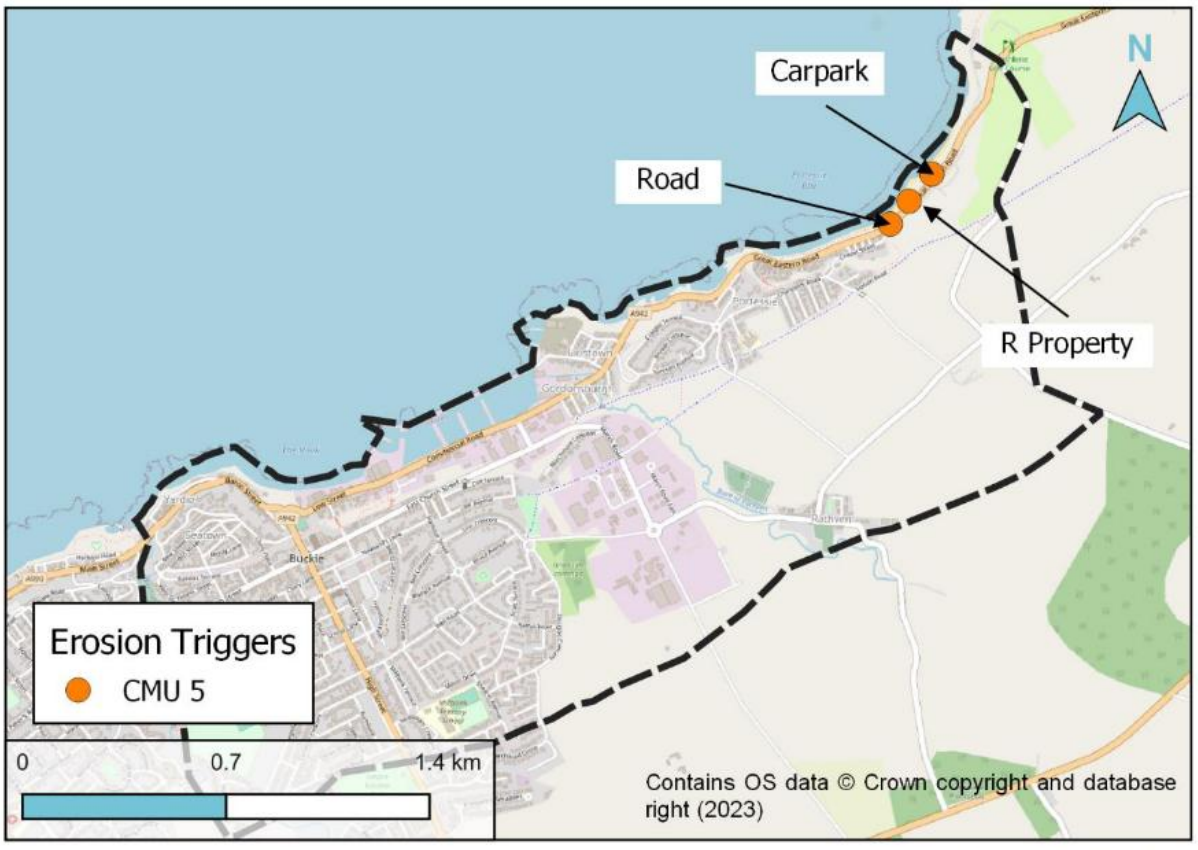
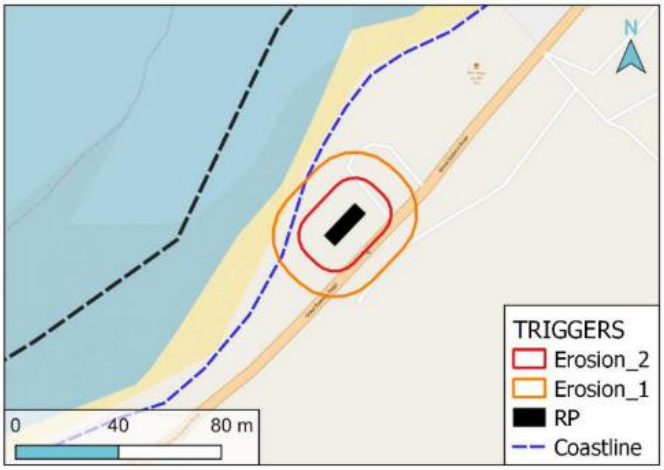
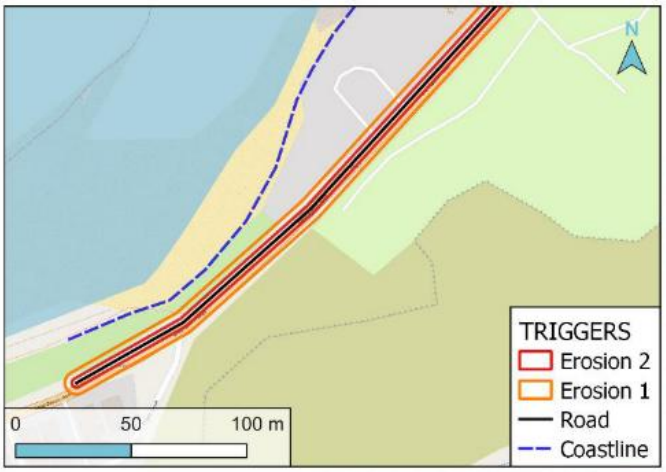
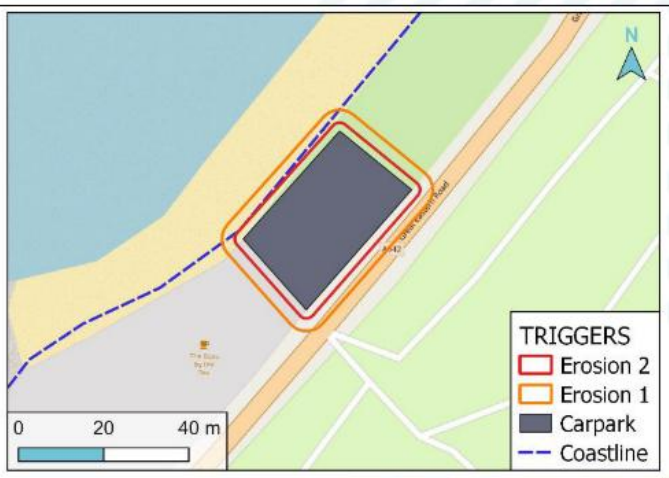


Figure 4-3: Buckie to Portessie Coast erosion trigger locations.

Table 4-4: Buckie to Portessie Coast erosion triggers

CMU	Asset	Trigger Met	Erosion Trigger
5	R Property	Yes (level 1)	
5	Road	No	
5	Carpark	Yes (level 2)	

4.2.7 CMU-specific condition triggers

Where a coastal defence is present in a CMU, a CMU-specific trigger will be applied to the condition of the coastal defence. Currently, coastal defences are present in all Buckie to Portessie Coast CMUs.

As with the other CMU-specific triggers, a two-level condition trigger approach and associated action is defined using the Grades of coastal defence condition according to the EA and Defra condition assessments[7]:

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

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

4.2.8 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.

4.2.9 Moray Coastal Trail

Impact of flooding and erosion on the Moray Coastal Trail[8] (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 at the MCT and Speyside Way (SW) are mostly along the footway of the coastal road. Any future measures to mitigate risk to the road will consider the impacts to the MCT and SW.

4.3 Actions

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

7 Environment Agency (2013) Practical guidance on determining asset deterioration and the use of condition grade deterioration curves: Revision 1.
8 https://www.morayways.org.uk/routes/the-moray-coast-trail/

Actions applicable to all and specific CMUs in Cullen CA have been identified in Table 4-5. 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[9] 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 local 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.

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, more detailed, risk assessment may be required. Should a new assessment be deemed necessary this should follow appropriate guidance[10] 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 Buckie to Portessie Coast CMU is included in Table 4-5. These highlight what may be delivered during the Phase 0 cycle and are dependent on the associated Trigger being realised.

Table 4-5: Triggers, trigger categories and associated actions for each Buckie to Portessie 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

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

	Coastal flood occurrence	Review risk assessment Community engagement (places, asset) Post flood survey	All
Risk exposure	Defence condition	Community engagement (asset)	CMU 1 CMU 2 CMU 3 CMU 4 CMU 5
	Update to SEPA flood warning	Review risk assessment Community engagement (places, practice)	All
	Erosion buffer exceeded	Review risk assessment Community engagement (places)	CMU 5
	Flood risk threshold exceeded	Review risk assessment Community engagement (places)	CMU 2
	Overtopping risk threshold exceeded	Review risk assessment Community engagement (places)	CMU 4
	Update to Dynamic Coast	Review risk assessment Community engagement (practice)	All
Socio-economic	Changes of asset use	Community engagement (asset)	All
	Changes of asset owner	Community engagement (asset)	All
	Community pressure	Review risk assessment Community engagement (places)	All
Funding	Capital funding	*	CMU 4

*Capital funding Trigger for CMU 4 to follow separate pathway (see Figure 3-4).

4.4 Phase 0 Actions

Phase 0 Actions require immediate attention and have been identified by associated triggers realised through the development process of this initial CCAP for Buckie. These are outlined below:

- CMU 4:
  - Trigger 1: Overtopping threshold exceeded (level 1)
    - **Action 1**: Increase monitoring and undertake detailed assessment.
- CMU 5:
  - Trigger 1: Erosion buffer exceeded (level 1)
    - **Action 1**: Increase monitoring and plan for assessment.
  - Trigger 2: Erosion buffer exceeded (level 2)
    - **Action 2**: Undertake assessment and plan for intervention.

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

4.5 Supporting Steps and Proactive Actions

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

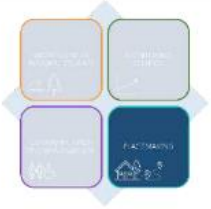
Proactive actions are defined as those whereby there should only be benefit. Undertaking these can therefore only have a positive impact on supporting adaptation or increasing resilience.

At this stage in the adaptation planning process five such actions have been identified. These have been developed focusing on the key pillar identified previously and through review and understanding of key knowledge gaps. They therefore aim to close these knowledge gaps at this stage and support alignment with wider aspects of the adaptation plan for the region.

A summary of these actions is provided in Table 4-6, with further details on each included in Appendix B. These are designed to complement the wider Proactive Actions identified in the Regional CCAP.

Table 4-6: 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	Portessie Coastal Flood Scheme workshop with SEPA and Scottish Government	Community and Engagement 

5	Buckie Harbour Masterplan Review	Community and Engagement	
6	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 three 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 4-7 summarises the general and specific CMU outcomes for the Buckie to Portessie Coast CA.

Table 4-7: Buckie to Portessie Coast CA possible outcomes.

Category	Outcome	CMU
No intervention	No intervention	All
Enhance natural features	Enhance natural features	CMU 5
Protect	Maintain defences	CMU 1 CMU 2 CMU 3 CMU 4
	Sustain defences	CMU 1 CMU 2 CMU 3 CMU 4
	Improve defences	All
	Property resilience measures	All
Create space	Remove defences	CMU 1 CMU 2 CMU 3 CMU 4
	Set back defences	CMU 1 CMU 2 CMU 3 CMU 4
	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 Buckie is shown in (Figure 4-4); structured using the three stages: 1) Monitoring and Triggers, 2) Actions, and 3) Outcomes.

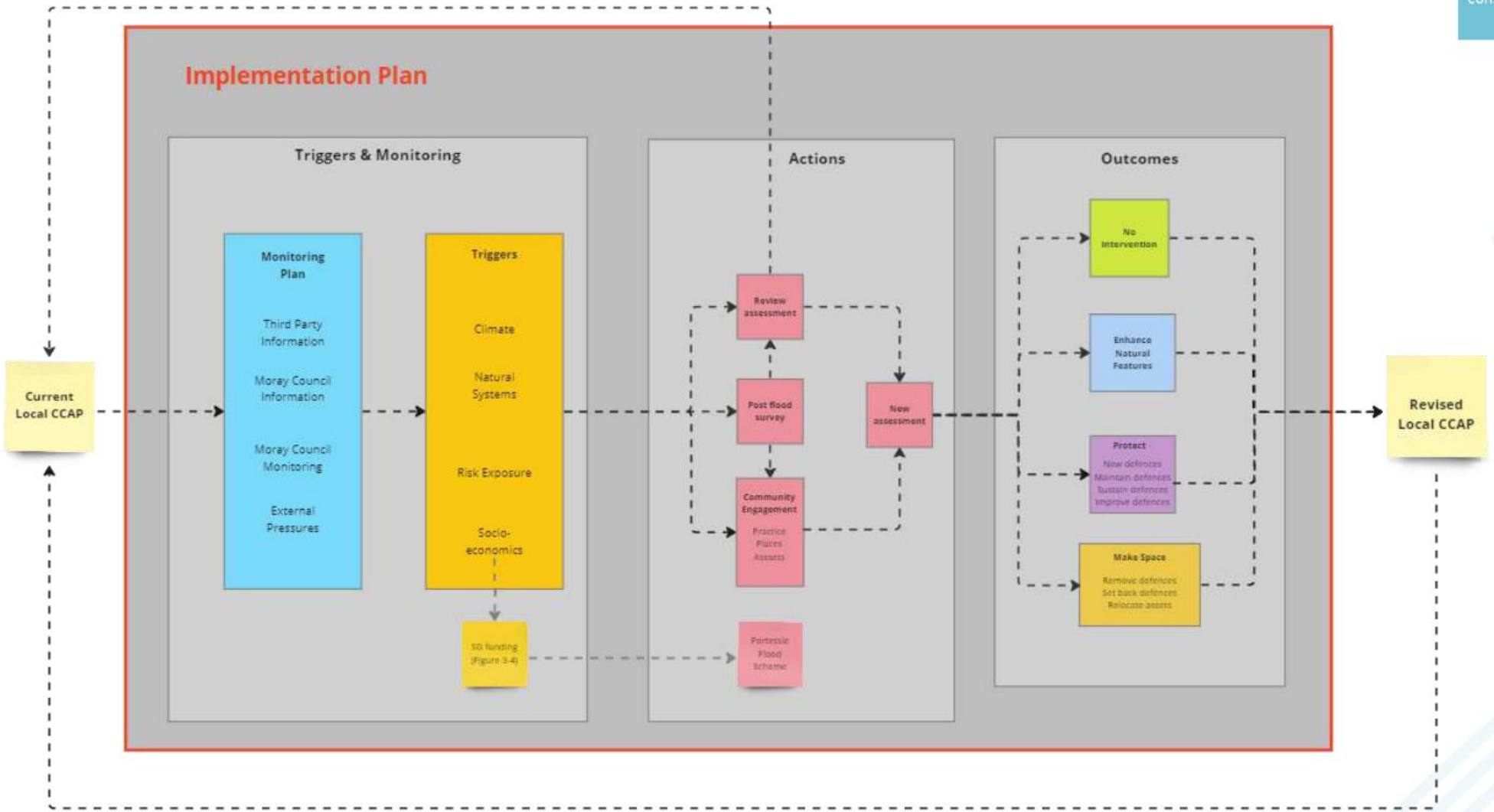


Figure 4-4: Complete Implementation Plan for Buckie to Portessie Coast CA

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 Buckie to Portessie Coast. The red box highlights the processes described in this iteration of the CCAP.

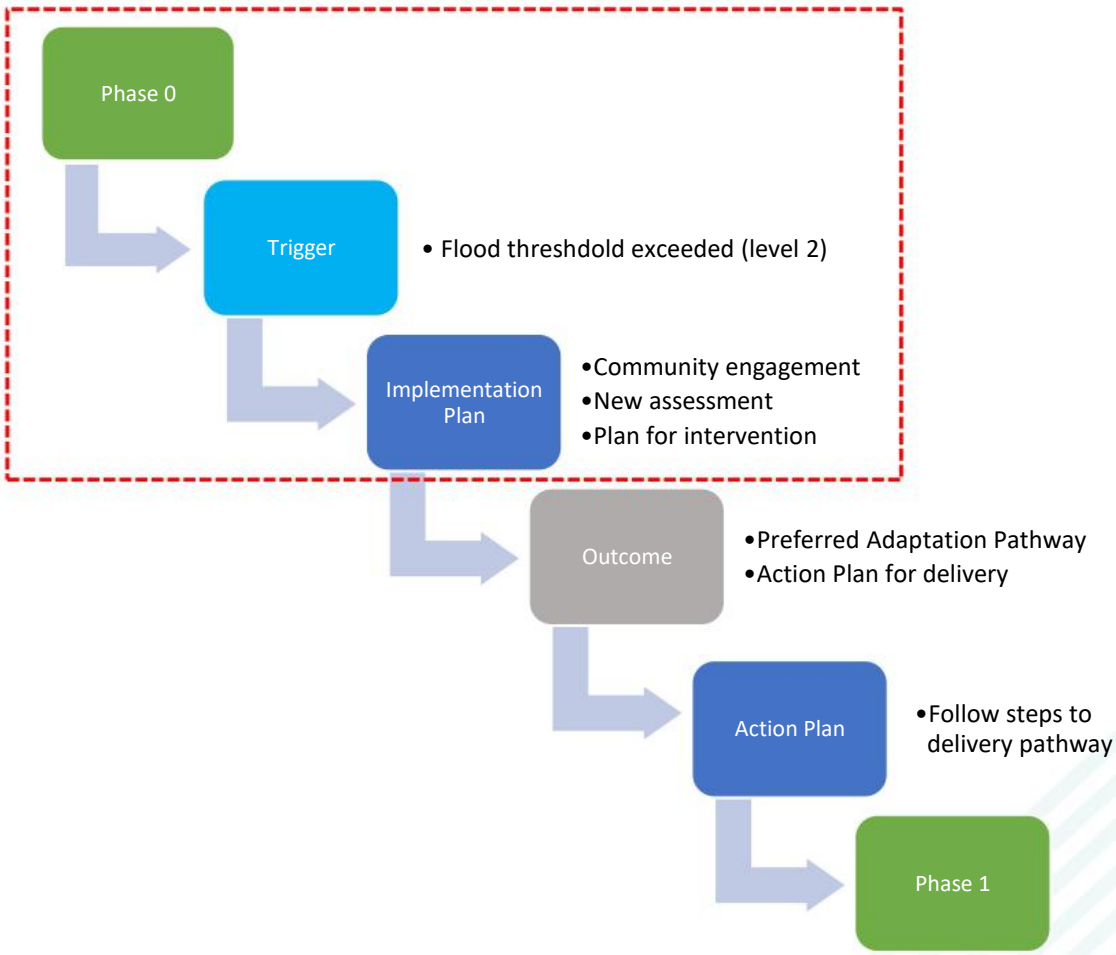


Figure 4-5: Example application of Phase 0 to Phase 1 of the adaptation process and how the Implementation Plan works with Adaptation Pathways and Action Plans.

5 Summary and Next Steps

5.1 Approach

This document presents the local CCAP for Buckie to Portessie 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 has steered by relevant published documentation and the Scottish Government's 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 Buckie to Portessie 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 Buckie to Portessie Coast CA. This will happen when the process moves into Phase 1.

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

5.2 Coastal Management Units and Risks

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

- CMU1 – Built Structures with Risk and unknown Hazard
- CMU2 – Built Structures with Risk and Hazard
- CMU3 – Hybrid with Risk and unknown Hazard
- CMU4 – Built Structures with Risk and Hazard
- CMU5 – Hybrid 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 Buckie to Portessie 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, which is the case for CMU 5 (section 4.4). During Phase 1 a preferred pathway and associated Action Plan will be identified at this CMU:

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

While ultimately the Adaptation Pathways have a desired outcome, what that looks like and how it will be reached cannot be defined at this stage. Effective monitoring against the set triggers will enable the CCAP to evolve through Phases and support 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 Buckie to Portessie 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 Implementation Plan. The Outcomes of these however, are unknown and the direction of the pathway in the future therefore cannot be defined.

This is the case for all but Portessie (CMU4). Here a coastal flood scheme has previously been developed by Moray Council and proposed to Scottish Government for funding consideration. The potential for this to be approved is reflected in a bespoke Trigger based on the national scheme prioritisation outcome. If realised this would move CMU4 beyond Phase 0 and towards a long-term Protect outcome. This may or may not include future adaptation activities.

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, six 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. 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 for Buckie to Portessie Coast are summarised in Table A-1.

Table A-1: Coastal dataset summary for Buckie to Portessie 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 Buckie to Portessie 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.

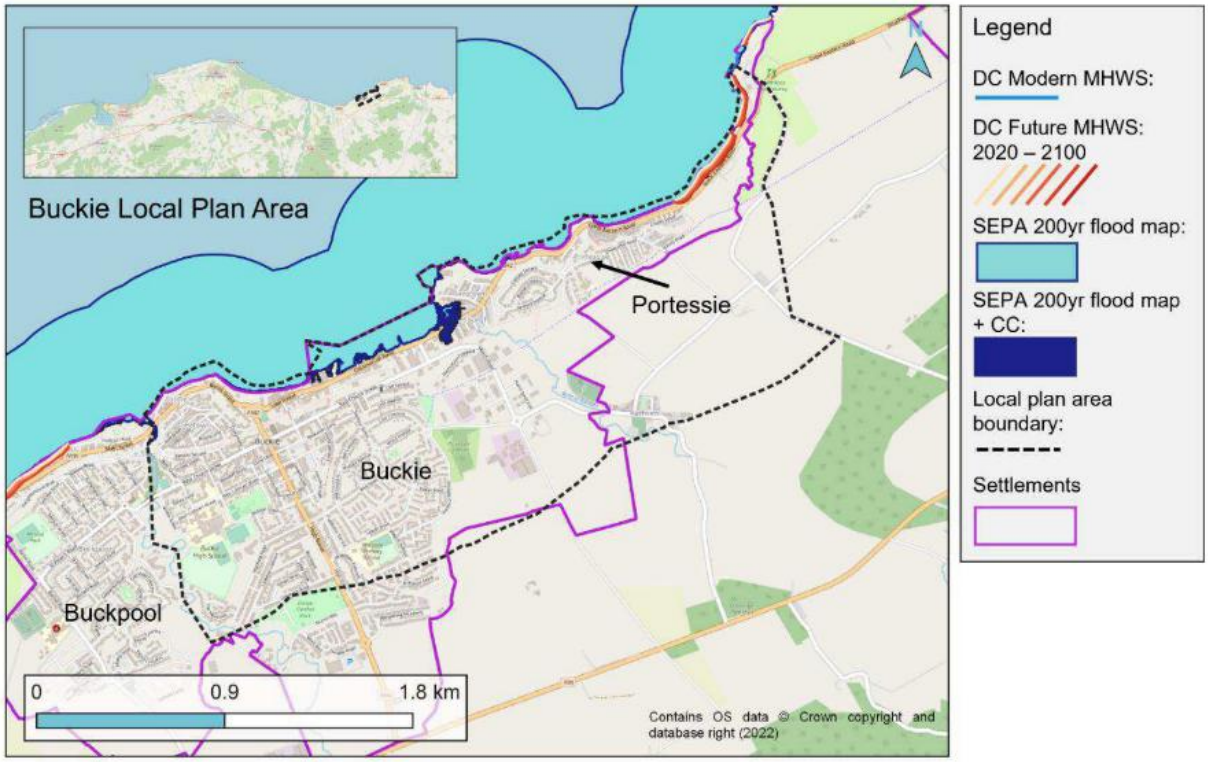


Figure A-1: Buckie to Portessie Coast CA coastal flood and erosion hazard overview.

A.2 CMU 1: West – built structures

CMU 1 is located to the west of Buckie to Portessie Coast Harbour and is fronted by a shore platform and shingle beach. There are a range of coastal defences across this length of coast, including a concrete sea wall, rock revetment and groynes. Due to the built structures and rock coast, there is no data available from SEPA flood maps, NFRA datasets and Dynamic Coast. As a result, the hazard is unknown from both coastal flooding and erosion in this unit, to the land and to assets.

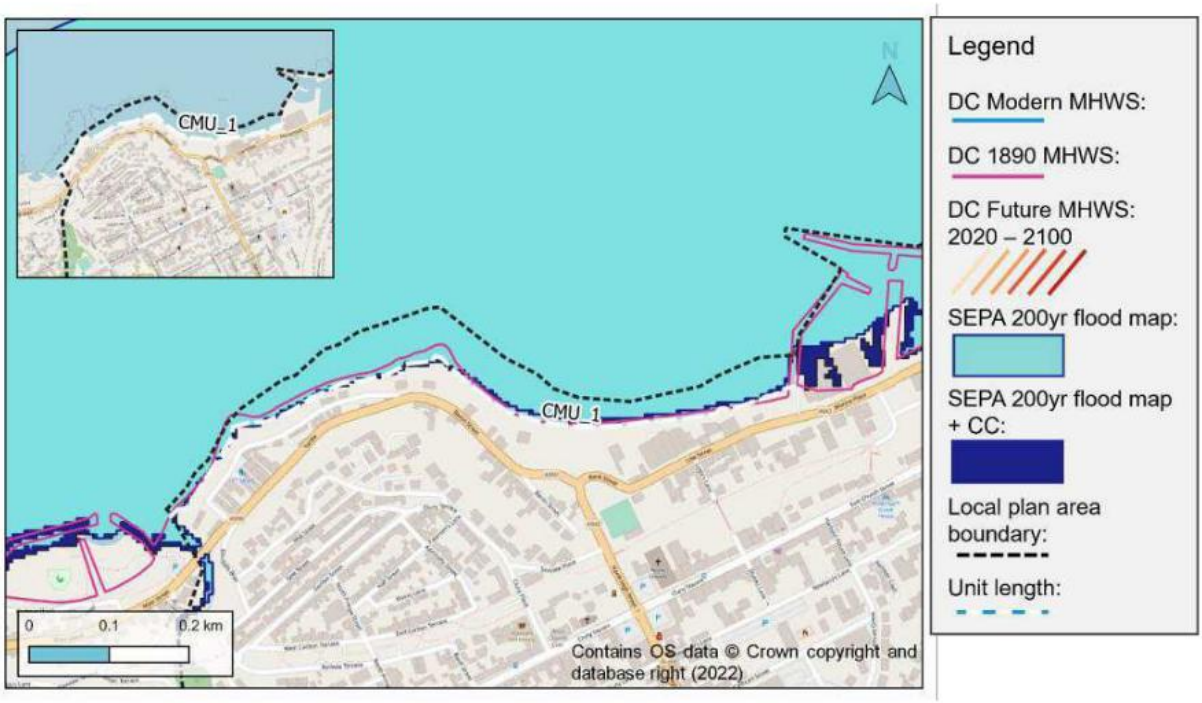


Figure A-2: CMU 1 Defended West coastal hazards map showing SEPA flooding extents and Dynamic Coast (DC) past and future erosion. Inset shows unit without coastal hazards.

A.3 CMU 2: Buckie Harbour – built structures

CMU 2 is a built-up section of the coast that contains Buckie to Portessie Coast Harbour and substantial concrete structures. There is an unknown hazard from coastal erosion CMU 2 as there is no data available from Dynamic Coast. In a 1 in 200-year event, the east side of the harbour is at risk of flooding ca. 88 m inland across the industrial area by the harbour. In a SEPA modelled 1 in 200-year flood plus climate change event, flooding extent at the west of the harbour could extend to 130 m inland, flooding further along the Burn of Rathven canal and into the Gordonsburgh housing estate.

Assets on land at risk from a 1 in 200-year flooding event, according to NFRA data, are summarised below:

- One (non-residential property) NRP

Assets at risk from a 1 in 200-year flooding plus climate change event (not including overtopping) include assets at risk from a 1 in 200-year flooding event (shown above) plus assets summarised below:

- Five (residential property) RPs
- Three NRPs
- Rathburn Street (~100 m)

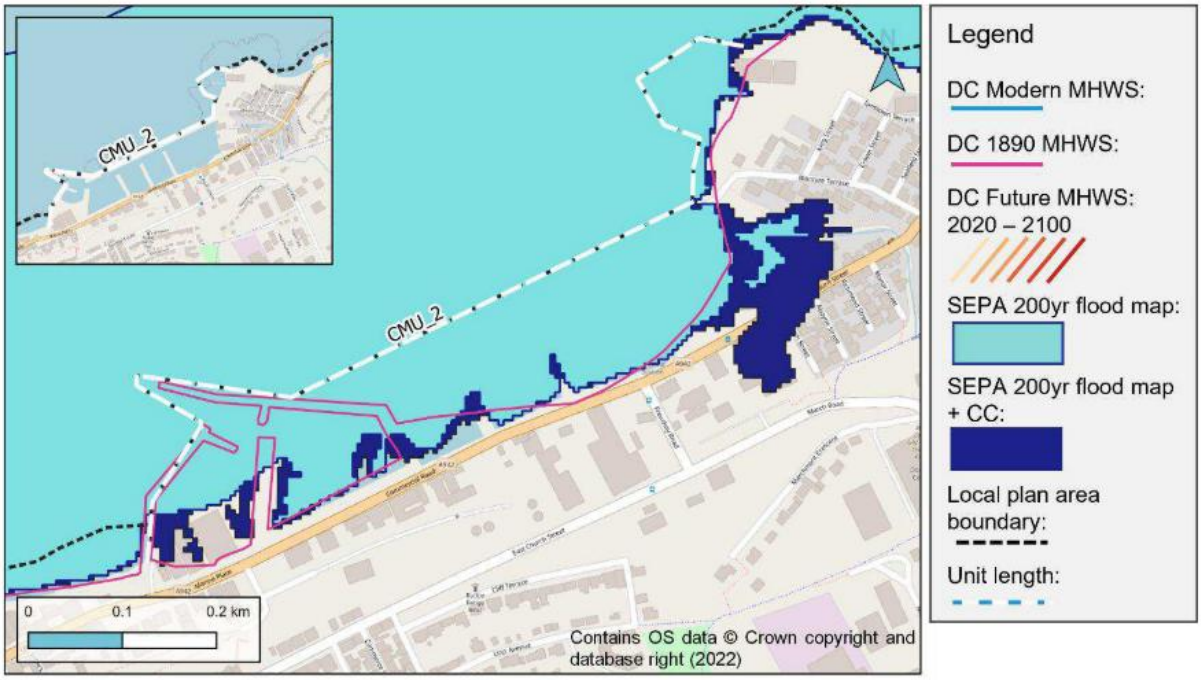


Figure A-3: CMU 2 Buckie to Portessie Coast Harbour coastal hazards map showing SEPA flooding extents and Dynamic Coast (DC) past and future erosion. Inset shows unit without coastal hazards.

A.4 CMU 3: Central –hybrid

The central unit, CMU 3, comprises of a mixture of rocky shore platform and beaches with concrete sea wall and rock revetment defences in place. Due to the built structures and rock coast, there is no data available from SEPA flood maps, NFRA datasets and Dynamic Coast. As a result, the hazard is unknown from both coastal flooding and erosion in this unit, to the land and to assets.

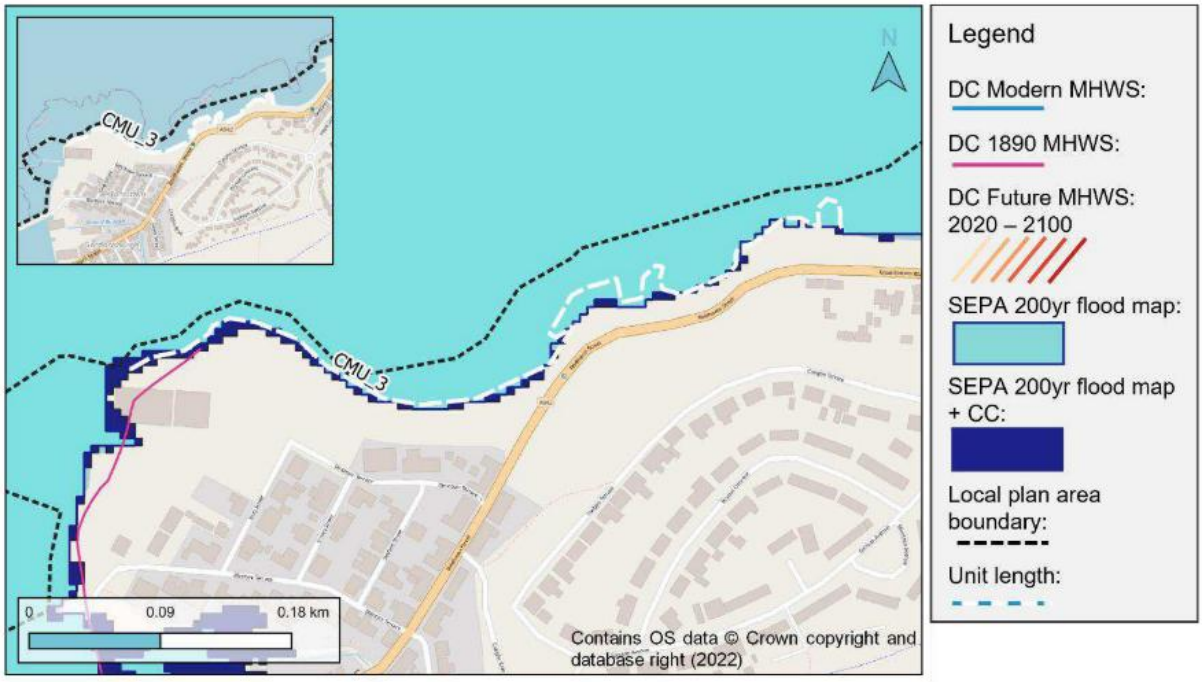


Figure A-4: CMU 3 central defended coastal hazards map showing SEPA flooding extents and Dynamic Coast (DC) past and future erosion. Inset shows unit without coastal hazards.

A.5 CMU 4: East – built structures

CMU 4 contains the extent of coastal defence managed by Moray Council. Rock armour and a concrete structure protects Portessie town behind. The natural coast in front of the defences is mostly comprised of rock shore platform. Due to the built structures and rock coast, there is no data available from SEPA flood maps, NFRA datasets and Dynamic Coast. As a result, the hazard is unknown from both coastal flooding and erosion in this unit, to the land and to assets.

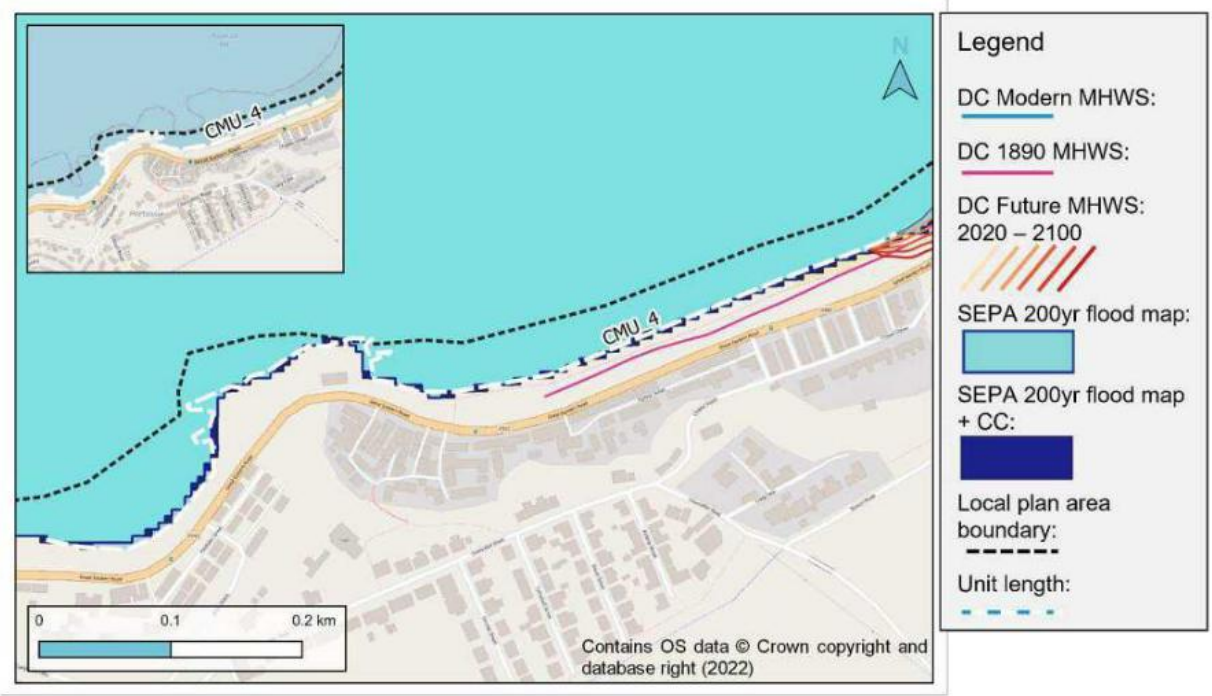


Figure A-5: CMU 4 defended east coastal hazards map showing SEPA flooding extents and Dynamic Coast (DC) past and future erosion. Inset shows unit without coastal hazards.

A.5.1 CMU 4 overtopping assessment

The findings of the 2016 flood study for Portessie found that there is risk of flooding from wave overtopping[4]. An additional wave overtopping assessment was conducted in this CCAP to understand risk and enable the setting of appropriate triggers.

This has been undertaken for the Moray Council coastal defence. At this location, overtopping rates have been calculated based on the following profile schematisations (Figure A-7):

- Cross-section of rock armour with berm in form of walkway along crest (no. 03) from the 2017 SEPA strategic coastal hazard mapping project[4] (4.9 mAOD crest level, 0.5 mAOD toe level).
- Cross-section of rock armour with no berm (no. 02) from the 2017 SEPA strategic coastal hazard mapping project (5.3 mAOD crest level, -1.4 mAOD toe level).

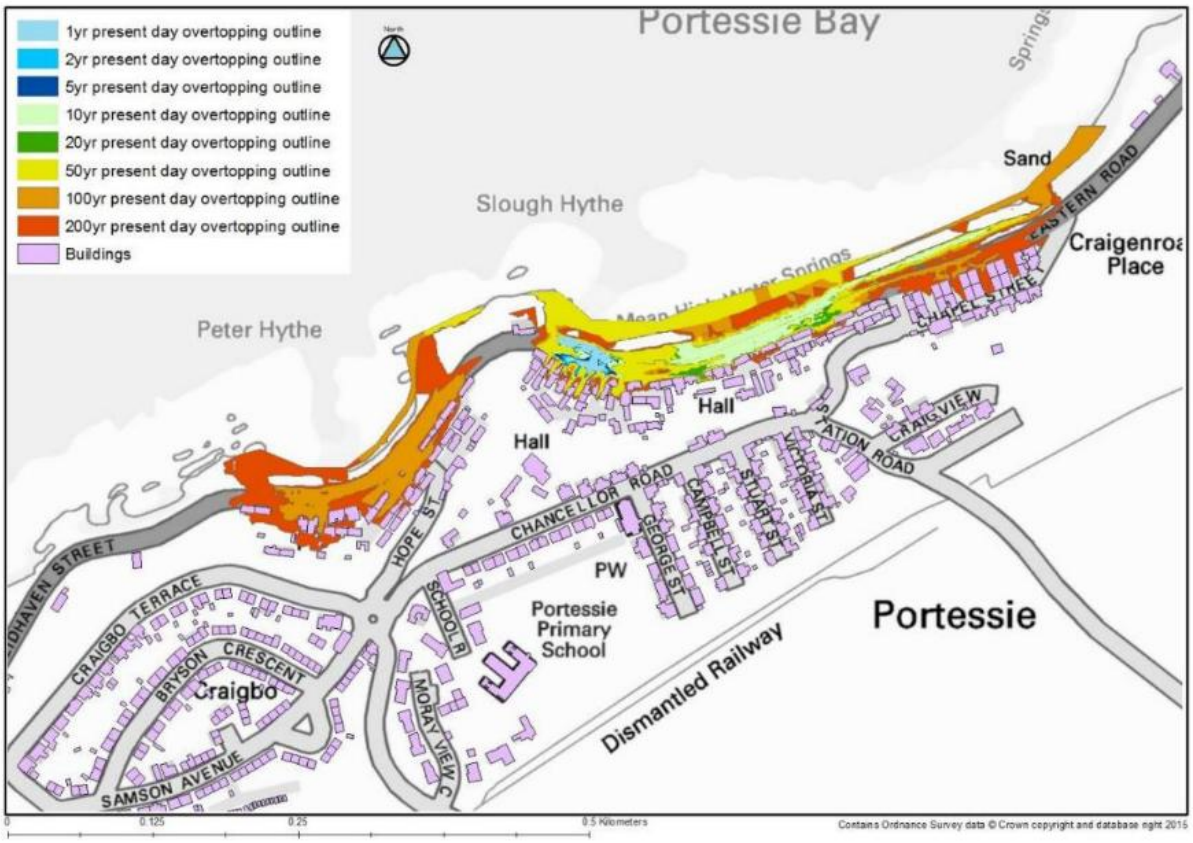


Figure A-6: Flood inundation outlines for a range of return periods – present day. From JBA consulting Portessie Options Appraisal 2016[4].

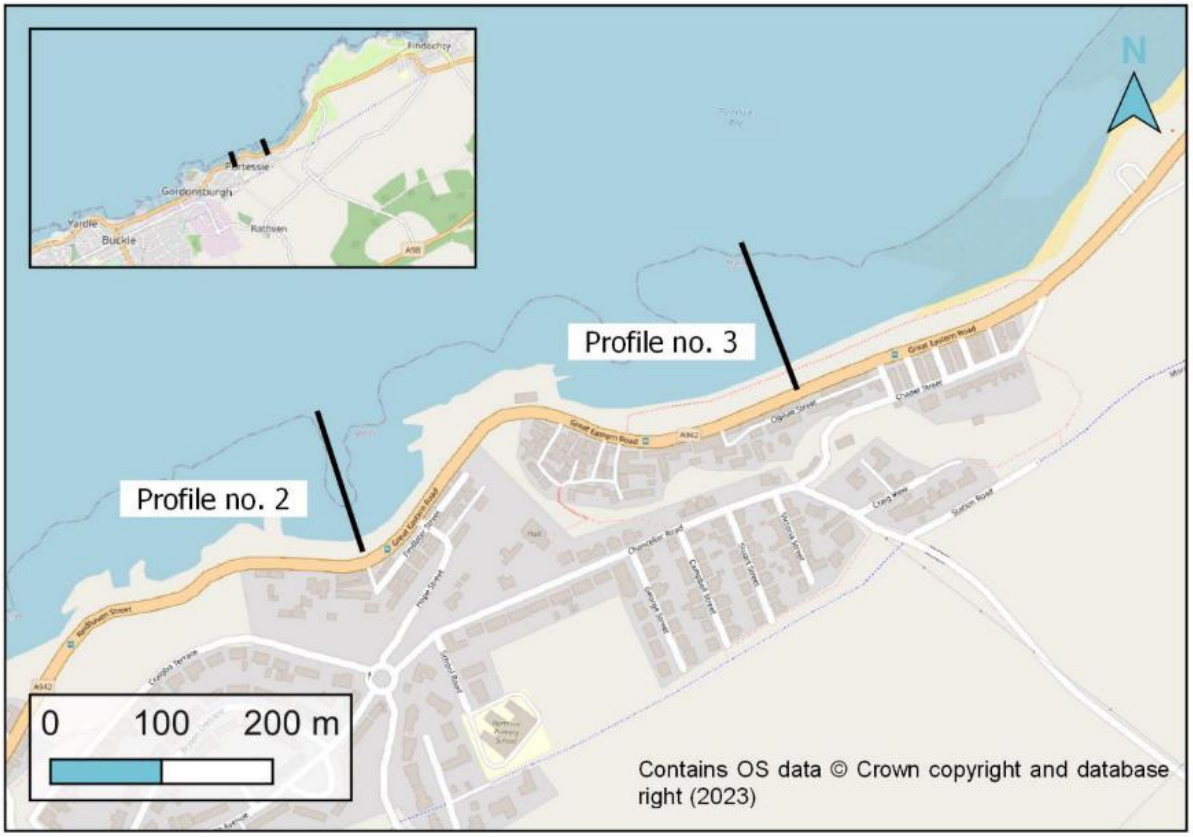


Figure A-7: Location of profiles used for overtopping assessment in Buckie to Portessie Coast CA.

Results from the overtopping assessment for all four sea level rise scenarios are shown in Figure A-8 to Figure A-11 and correspond to Table 4-2 in the main text. Level 1 Trigger is realised when overtopping volume exceeds 10 l/s/m during a 1 in 30-year event. Level 2 Trigger is realised when overtopping volume exceeds 5 l/s/m during a 1 in 2-year event. See section 4.2.4 for more details on the overtopping Triggers.

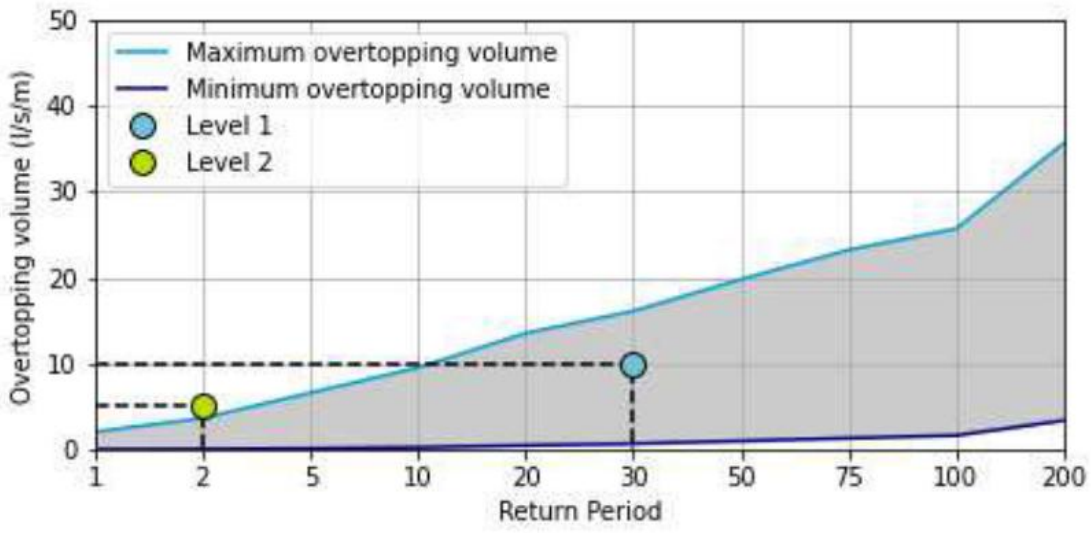


Figure A-8: Upper and lower overtopping volume estimates for the rock armour defence in CMU 4 at present day (i.e. a 0.0 m sea level rise projection). Overtopping triggers plotted for 1 in 30-year and 1 in 2-year return period events.

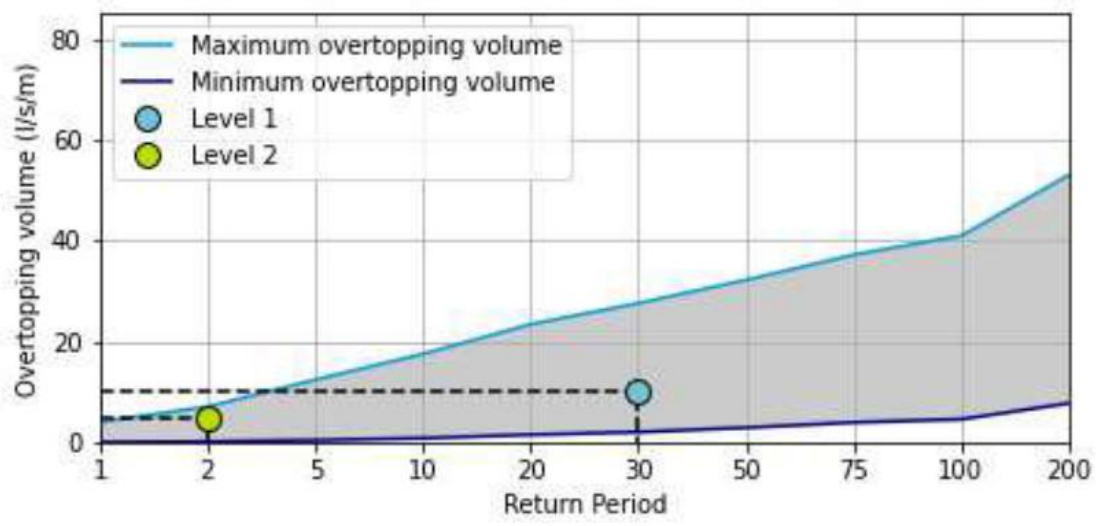


Figure A-9: Upper and lower overtopping volume estimates for the rock armour defence in CMU 4 with a 0.2 m sea level rise projection. Overtopping triggers plotted for 1 in 30-year and 1 in 2-year return period events.

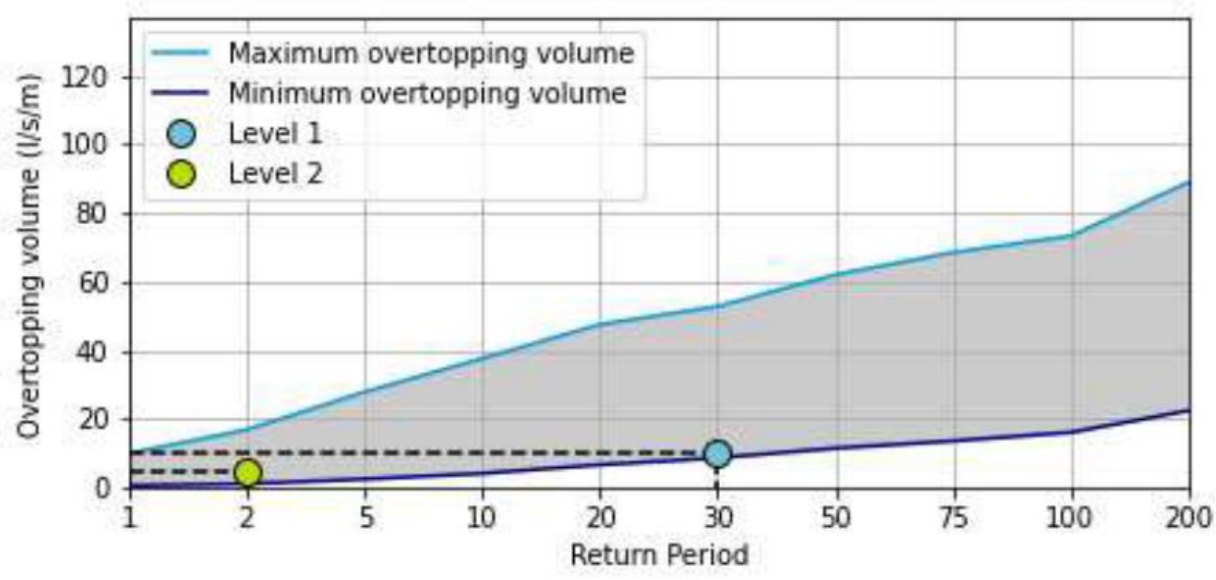


Figure A-10: Upper and lower overtopping volume estimates for the rock armour defence in CMU 4 with a 0.5 m sea level rise projection. Overtopping triggers plotted for 1 in 30-year and 1 in 2-year return period events.

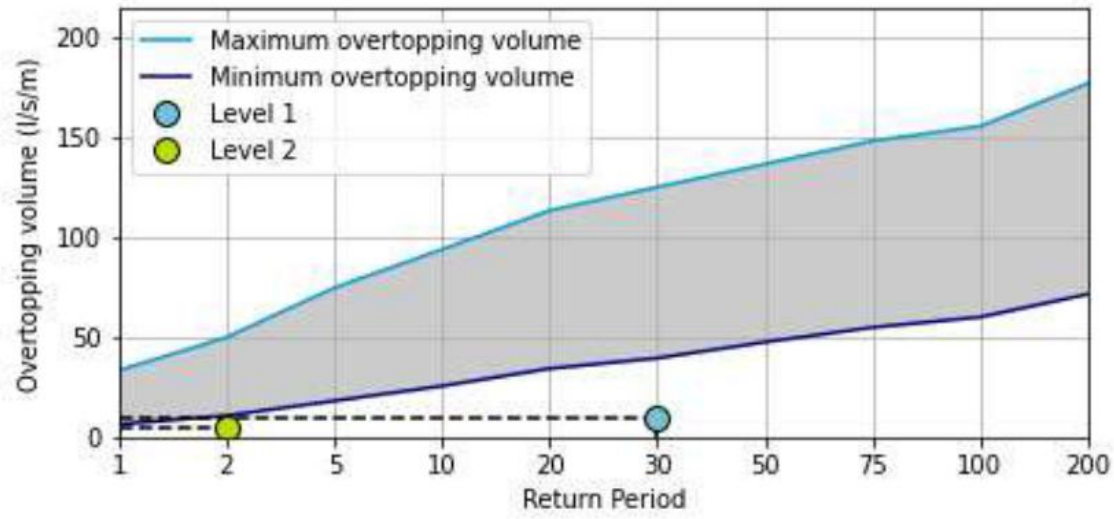


Figure A-11: Upper and lower overtopping volume estimates for the rock armour defence in CMU 4 with a 1 m sea level rise projection. Overtopping triggers plotted for 1 in 30-year and 1 in 2-year return period events.

A.6 CMU 5: East Beach - hybrid

The coast at CMU 5 comprises of natural shingle and sand beach with multiple small shore platform outcrops. There are several coastal defence structures present, likely to protect individual properties. Inland from the CMU 5 coast includes some residential properties, Strathlene Caravan Park and Strathlene Golf Course. There is only an erosion risk at this unit.

Dynamic Coast results show that historically (from ca. 1964 to 2011) the shingle beach at CMU 5 has remained stable, with no net loss or gain of sediment at the beach (

Table A-2). By 2050, the median rate of coastal change is projected to be eroding at a rate of 0.3 m/yr, and maximum rate of 0.4 m/y. By 2100, the beach is projected to erode at a maximum rate of 1 m/yr and maximum eroded distance of 42.2 m.

Table A-2 summarises Dynamic coast data for CMU 5 within Buckie to Portessie Coast CA.

Assets at risk from future coastal erosion under the RCP8.5 scenario in CMU 5 are summarised below:

- Six RP: present-day minimum 14 m from shoreline
- Three NRP: present-day minimum 10 m from shoreline
- Great Eastern Road (A942) ~675 m: present day minimum 15 m from shoreline

Figure A-12: CMU 5 Beach East defended coastal hazards map showing SEPA flooding extents and Dynamic Coast (DC) past and future erosion. Inset shows unit without coastal hazards.

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

Dynamic Coast calculation	Results	
Historical rate	0.0 m/yr	Maximum
	0.0 m/yr	Median
2050 rate	0.4 m/yr	Maximum
	0.3 m/yr	Median
2050 distance	9.0 m	Maximum
	6.1 m	Median
2100 rate	1.0 m/yr	Maximum
	0.6 m/yr	Median
2100 distance	42.2 m	Maximum
	31.1 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, including the benefits of working with natural geomorphic systems as part of the modelling process (e.g. where beaches are likely to move with climate change impacts). A modelling framework should be developed that includes:

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

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

The requirements for monitoring the beach systems in the CA should be reviewed in the context of a wider Regional monitoring plan. Information should be collected through monitoring that is specific to support future risk assessments and compared to CMU specific erosion triggers. It should focus across the entire CA but increase in frequency and detail for 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 - Portessie Coastal Flood Scheme workshop with SEPA and Scottish Government

The future direction of CMU4 (Portessie) is partly dependent on the availability of Scottish Government flood defence funding. The 2015 study determined the preferred scheme to managed coastal flood risk in the long-term. Prior to an adaptive pathway being developed the outcome of the Scottish Government funding prioritisation will be pursued through a collaborative discussion.

Action 5 - Buckie Harbour Masterplan Review

Any future adaptation pathway for CMU3 (Buckie Harbour) must incorporate plans for harbour redevelopment. The Buckie Harbour Masterplan will be reviewed collaboratively to enable alignment of objectives and identify and pursue opportunities for funding or adaptation delivery mechanisms.

Action 6 – Making space for coastal change on land: Planning, landownership and adaptation

To work with natural processes and make space for coastal change it is inevitable that existing land will be lost to make space for natural systems such as beaches to dynamically adjust to climate change impacts such as sea level rise, and to continue to alleviate risks for people. To adapt effectively it is therefore important that a) planning is used to reduce the number of new and existing assets that are increasing at risk and b) to make space for the natural adjustment of the coast in response to coastal climate change drivers (e.g sea level rise and storms). To do this, it is important that land and asset ownership within the CA is fully understood, to identify windows of opportunity to reduce impacts of coastal climate change on communities; thereby increasing the climate resilience of these communities to coastal change. 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 Buckie to Portessie 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
Buckie to Portessie Coast	1	Built Structures	Condition	Defence	Mixed	1	N				None	NA	NA	NA	NA
						2	N				None	NA	NA	NA	NA
	2	Built Structures	Flood	Property		1	N	0.6			None	NA	NA	NA	NA
						2	N	3.6			None	NA	NA	NA	NA
				Road		1	N	5			None	NA	NA	NA	NA
						2	N	10			None	NA	NA	NA	NA
			Condition	Defence	Harbour	1	N				None	NA	NA	NA	NA
						2	N				None	NA	NA	NA	NA
	3	Hybrid	Condition	Defence	Mixed	1	N				None	NA	NA	NA	NA
						2	N				None	NA	NA	NA	NA
	4	**Built Structures**	**Overtopping**	**Defence**		**1**	Y		0		Increase monitoring and plan for assessment.	**Moray Council**	**None**	**Short**	**Low**
						2	N		0.2		None	NA	NA	NA	NA
			Condition	Defence	Mixed	1	N				None	NA	NA	NA	NA
						2	N				None	NA	NA	NA	NA
	5	**Hybrid**	**Erosion**	**Property**		**1**	Y			-6	Increase monitoring and plan for assessment.	**Moray Council**	**None**	**Short**	**Low**
						2	N			4	None	NA	NA	NA	NA
				Road		1	N			6	None	NA	NA	NA	NA
						2	N			9	None	NA	NA	NA	NA
				Other	**Carpark**	**1**	Y			-3	Increase monitoring and plan for assessment.	**Moray Council**	**None**	**Short**	**Low**
						2	Y			0	Undertake assessment and plan for intervention.	**Moray Council**	**Scot. Gov.**	**Medium**	**Medium**
			Condition	Defence	Mixed	1	N				None	NA	NA	NA	NA
						2	N				None	NA	NA	NA	NA

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