

Shoreline Management Plans on PEI – Handbook

PEIshorelines.ca



Prepared by CBCL and We6 Planning Group

with contributions from:

The PEI Department of Land and Environment, the UPEI Canadian Centre for Climate Change and Adaptation, and CBWES

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Natural Resources
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Natural Resources Canada (NRCan) supports coastal regions across Canada to adapt to a changing climate through its Climate-Resilient Coastal Communities (CRCC) Program (2023-2028) under the Government of Canada Adaptation Action Plan (GOCAAP) linked to the National Adaptation Strategy (NAS).

Table of Contents

Table of Contents	<i>i</i>
1. Introduction.....	1
What is Shoreline Management Planning?.....	1
What does Shoreline Management in PEI look like?	1
Handbook outline	1
2. The PEI Shoreline Management Plan Project	2
How are shoreline management plans being prepared?	2
Who is involved in the project?	2
What are the project timelines?	3
Subject areas for Shoreline Management Plans in PEI	3
3. How to use this handbook	4
Additional tools and information.....	4
4. Coastal climate change.....	5
4.1 Exploring shorelines.....	5
What is the shoreline?.....	5
What types of shorelines do we have in PEI?	6
What is a buffer zone?	6
4.2 Exploring resources	6
What are littoral cells and what role do they play in shoreline management plans?	6
What are we modelling for the shoreline management plans and what does this tell us?	7
4.3 Exploring coastal change	7
What are coastal processes?	7
What are coastal hazards?	9
4.4 Exploring impacts	11
What are we seeing with storm surge and flood hazards in PEI	11
What is sea level rise and how will it affect PEI?.....	11
5. Climate Hazards and Adaptation Options.....	12
5.1 Adaptation Approaches.....	12
What are some actions to reduce impacts of coastal hazards?	12
How does armouring affect the coastline?	14
How do Nature-based Solutions work?	15

1. Introduction

Shorelines in Prince Edward Island (PEI) are always changing. Natural changes can be caused by flooding, waves, storms, and sea level rise. Other changes happen because of human activity like constructing retaining walls or wharves. Both natural and human changes to the shoreline can impact natural habitats and affect people, property, infrastructure and the economy.

What is Shoreline Management Planning?

Shoreline management plans (SMPs) are documents and maps that are used to help residents and public officials make informed decisions about development along shorelines or coasts.

For the purposes of this project, “shore” broadly represents areas adjacent to the water around the Island, including beaches, cliffs, bluffs, and other land areas under marine influence.

Shoreline management plans:

- present detailed information on shoreline characteristics, coastal processes, as well as current and future estimates of flooding and erosion hazards. These consider wave action, storm surges and sea level rise; and
- provide direction for the short, medium, and long term on where and how investments can or should be made to manage risks; and
- balance protection of existing structures and preservation of natural processes while integrating the likelihood of success.

Ultimately, shoreline management helps to protect shoreline function and supports local community resilience by using approaches that can evolve over time as conditions change.

What does Shoreline Management in PEI look like?

While SMPs have been prepared for other places in Canada and around the world, the Province of Prince Edward Island is now embarking on a process to develop them for the entire provincial shoreline. The development of the plans is based on recommendations from the State of the Coast and the Interim Coastal Policy Recommendations reports. Shoreline management plans were identified as a way to link local shoreline changes (current and future) to shoreline management options best suited to each section of the coast. A pilot project will start with Lennox Island and Pitumek and the southeast portion of the Island, from West River to Boughton.

In PEI, SMPs will focus on:

- Reducing risks to people and property from flooding and erosion
- Conserving natural habitats
- Preserving access along the shore and beach
- Protecting infrastructure and land uses

Handbook outline

This handbook outlines what shoreline management plans are and how they can help Islanders make the best decisions for shoreline management. Section 2 describes the SMP project, its organization, process and schedule. Section 3 describes how to use the handbook and identifies

key tools. Sections 4 and 5 explore coastal climate change, processes, hazards and risks and the ways to address them.

For additional or updated information, please visit PEIshorelines.ca.

2. The PEI Shoreline Management Plan Project

How are shoreline management plans being prepared?

The first steps include:

- Mapping of shoreline characteristics
- Mapping of coastal flood and erosion hazards
- Seeking public input to gather local knowledge, values, and areas of particular interest
- Seeking municipal planning interest, where they exist

The technical analysis, erosion and flood hazard modelling will then consider:

- Historic and projected rates of erosion
- Extreme water levels from tides, storm surges and future sea level rise
- Exposure of property and infrastructure to flood and erosion hazards
- Sediment transport rates and directions

Each of these will include the most up to date climate science. Taken together, this information will help form recommendations on appropriate shoreline management decisions for the short, medium and long term.

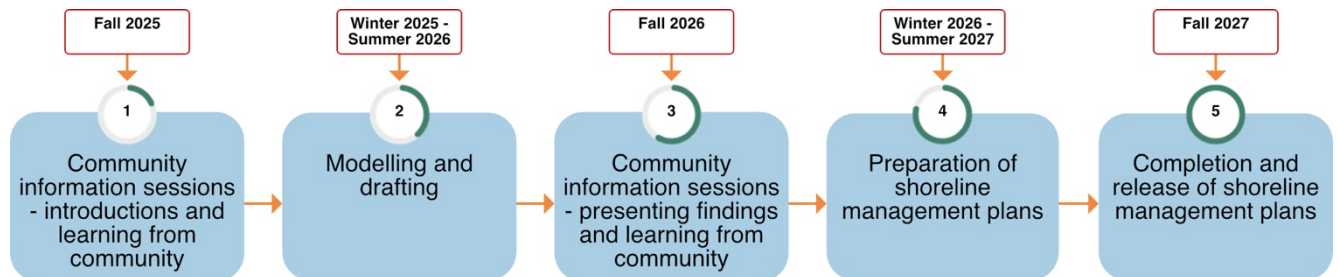
Who is involved in the project?

The Province of PEI's Department of Land and Environment is overseeing this project, which was co-funded through Natural Resources Canada's (NRCan) Climate-Resilient Coastal Communities Program. Using a collaborative process, SMPs will be developed with help from four groups that have been formed to support this project:

- *Technical Working Group and Advisory Committee*, which include representatives from Lennox Island First Nation, universities, CLIMAtlantic, the PEI Watershed Alliance, the Federal Government, and other knowledge-based organizations;
- *Interdepartmental Working Group* will provide information and perspectives from across the Government of PEI; and
- *External team* of project consultants who will lead the process and complete the shoreline management plans. Specifically, the project is led by Atlantic Canada-based engineering and scientific consulting firm CBCL, with key partners including We6 (planning and engagement), CBWES (wetlands and nature-based solutions), and DHI (shoreline mapping). The external team consultants are subject matter experts in coastal processes, land use planning, and adaptation options.

What are the project timelines?

The shoreline management planning project for the pilot areas (Lennox Island and southeastern PEI) began in the spring of 2025.



Subject areas for Shoreline Management Plans in PEI

The current study area includes two subject areas; southeastern PEI and Lennox Island (see Figure 1). Regions for shoreline management are determined based on natural characteristics and jurisdictional boundaries. Because the SMPs are focused on areas that are located along the shoreline, only municipalities with shorelines in the study area are included. However, all Island residents are welcome to provide feedback on the project. Within each region, sub-regions that share similar characteristics, known as ‘littoral cells,’ have been identified. See Section 4.2, below, to learn more about littoral cells.

The southeastern PEI pilot project area includes the Boughton, Cardigan, Murray Harbour, Southeast, and Hillsborough littoral cells. The other study area includes Lennox Island and the Pituamkek National Park Reserve.

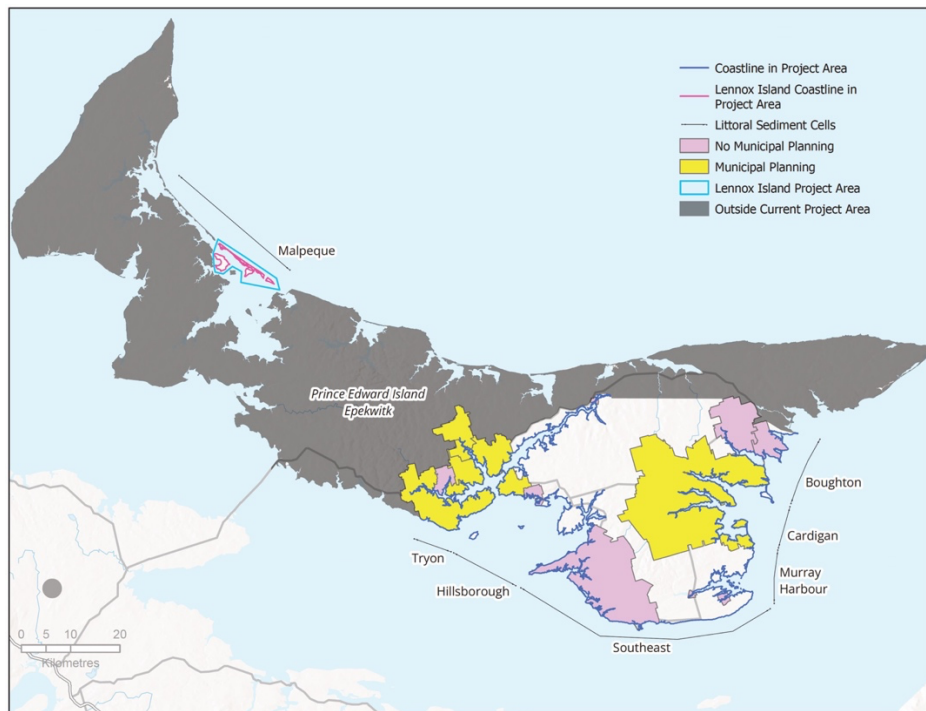


Figure 1 – Initial SMP project areas

3. How to use this handbook

Engaging with the public to share information on shoreline management questions and processes is a key part of this SMP project. This handbook is one of several tools that was developed to share information and to collect responses to survey questions. Please refer to the project website for more information: PEIshorelines.ca.

This handbook is intended to help the reader consider the coastal context and to explore options. Please read the information in the following sections and access the links to more resources or to mapping applications.

Additional tools and information

- 1) The PEI Climate Hazard & Risk Information System, or CHRIS platform, provides a comprehensive GIS- and web-based tool to allow the general public and decision makers to explore climate-related hazards and information for the Province of Prince Edward Island. CHRIS was developed by the Government of Prince Edward Island and the University of Prince Edward Island.
<https://chris.peiclimate.ca/>
- 2) CLIMAtlantic facilitates access to data and information that supports adaptation to climate change in Atlantic Canada through collaboration, networking, and partnerships.
<https://climatlantic.ca/>
- 3) The *PEI State of the Coast Report (2023)* provides an overview of the current conditions of PEI's coastline, highlighting the state of both natural and human systems along the coast.
<https://www.princeedwardisland.ca/en/publication/state-of-the-coast-report>
- 4) The *Interim Coastal Policy Recommendations Report* builds on the State of the Coast Report and identifies a number of priorities for government to consider.
<https://www.princeedwardisland.ca/en/publication/interim-coastal-policy-recommendations-report>
- 5) Several other relevant resources are available using the following links:
 - Coastal Hazards: <https://www.princeedwardisland.ca/en/information/environment-energy-and-climate-action/erosion-and-flooding>
 - PEI's Climate Adaptation Plan: <https://www.princeedwardisland.ca/en/information/environment-energy-and-climate-action/climate-adaptation-plan>
 - Climate Change Risks: <https://www.princeedwardisland.ca/en/information/environment-energy-and-climate-action/climate-change-risks-assessment>
 - Prince Edward Island Coastal Property Guide: <https://www.princeedwardisland.ca/en/publication/prince-edward-island-coastal-property-guide>

- Coastal Erosion Monitoring:
<https://www.princeedwardisland.ca/en/information/environment-energy-and-climate-action/coastal-erosion-monitoring>
 - Erosion-Mitigating Infrastructure Monitoring 2021-22 Annual Report;
<https://www.princeedwardisland.ca/en/publication/erosion-mitigating-infrastructure-monitoring-2021-22-annual-report>
 - Canadian Centre for Climate Change and Adaptation <https://cccca.upei.ca/>
UPEI Coastal Change Monitoring on PEI <https://arcg.is/0GmLWj0>
- 6) The [ClimateSense Training & Professional Development](https://www.climatesense.ca/professional-development-courses) Program is designed to provide a series of short climate-related training opportunities for local adaptation practitioners. Courses will allow practitioners to develop valuable skills in an interactive learning environment.
<https://www.climatesense.ca/professional-development-courses>

4. Coastal climate change

4.1 Exploring shorelines

What is the shoreline?

The shoreline is the point at which the sea meets land and, as such, is a constantly moving target. For mapping purposes, the shoreline usually refers to the high-water line, or the landward limit of the action of waves and tides. It typically corresponds to the vegetation line in low-lying coasts, or the top of the cliff or bank. In salt marshes, it corresponds to a change in vegetation type, which can be difficult to see without experience.

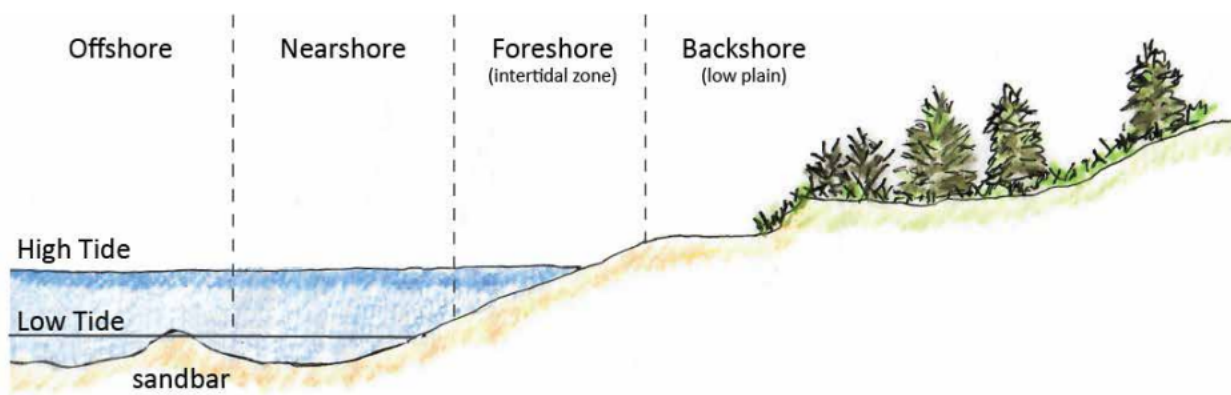


Figure 2 – Coastline cross-section. Source: PEI State of the Coast Report

What types of shorelines do we have in PEI?

Shore Type Exposure	Total Length	Percentage
Coastal	802 km	24%
Cliffs and Bluffs	421 km	53%
Low Plains	89 km	11%
Saltmarsh	42 km	5%
Dunes	250 km	31%
Estuary	2,477 km	76%
Cliffs and Bluffs	602 km	24%
Low Plains	303 km	12%
Saltmarsh	1,341 km	54%
Dunes	231 km	9%

Table 1. Summary of PEI Coastline Classification and Shore Types (Adapted from Coldwater Consulting, 2012)

Figure 3 – Types of shorelines. Source: PEI State of the Coast Report

What is a buffer zone?

In PEI, there is a 15 m wide watercourse and wetland buffer of land extending inland from the high-water mark or top of bank, including tidal areas. This buffer acts as a vegetative barrier protecting against sedimentation, erosion, and nonpoint source pollution. Tidal regions include the saltwater portion of rivers, bays and coastline.

4.2 Exploring resources

What are littoral cells and what role do they play in shoreline management plans?

Sand moves within a given area; littoral cells, also known as sediment cells, are segments of the coastline with a common sediment budget. That is, sediment (sand) transported by wave, tide and wind action is either partially or completely contained within the cell. Sediment cells are typically bound between natural boundaries such as large protruding rock headlands or wide tidal inlets, and typically have an area or areas of erosion, intermediate areas of sediment movement, and areas of deposition. These depositional areas can be on beaches, dunes, bays and estuaries, or offshore (see Figure 4).

Sediment movement within a cell ignores property boundaries. Shoreline interventions on one property such as armouring or wharves and jetties, can typically impact sediment processes down the shore within the same sediment cell. This is why littoral cells are crucial for developing effective shoreline management strategies. Considering littoral cells ensures that the potential impacts of development or the implementation of shoreline management strategies at one location within the cell are considered and understood across the entirety of the system.

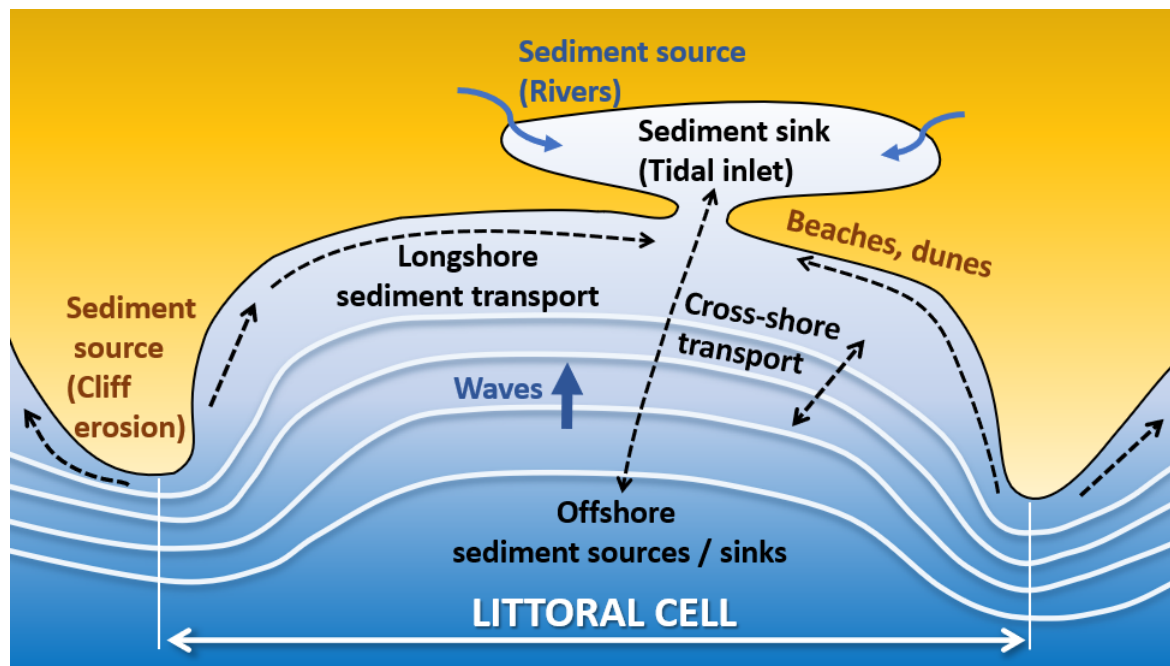


Figure 4 - Littoral Cell

What are we modelling for the shoreline management plans and what does this tell us?

The SMPs will be based on an updated set of coastal flood and erosion hazard maps as well as through updated modelling of sediment transport. These will be prepared using the latest field measurements and modelling techniques. This will include long-term historical trends and recent extreme events such as Post-Tropical Storms Dorian and Fiona.

Climate change projections - such as sea level rise and potential increased erosion due to the loss of sea-ice - will also be incorporated. The hazard maps will identify safe versus risky areas along the shores for various time horizons, whether in the short, medium, or long term. Crucial information will be used to inform decisions on managing existing and future property and infrastructure. In addition, mapping sediment transport patterns will provide critical information on how structural interventions like armouring may impact adjacent shores.

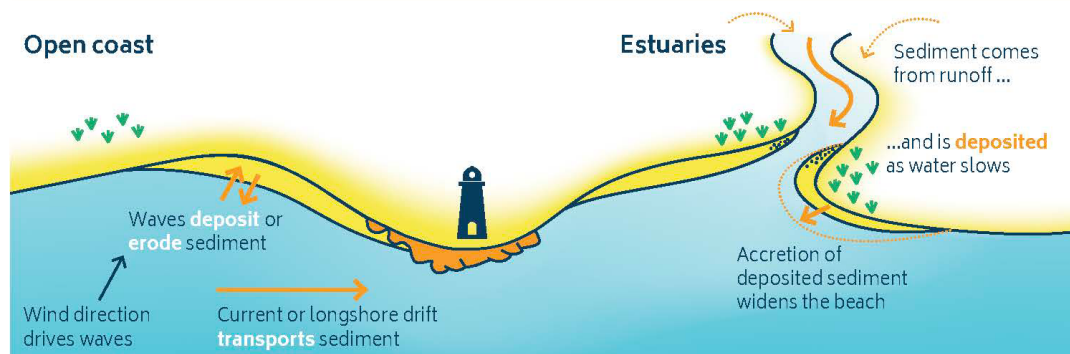
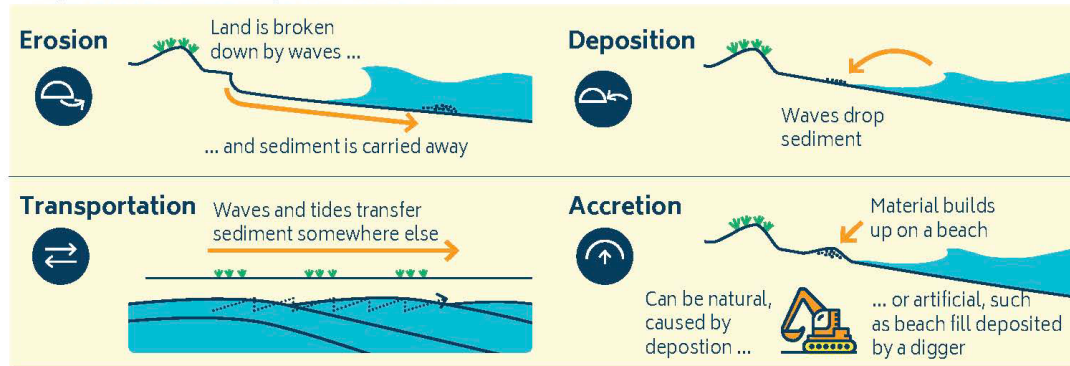
4.3 Exploring coastal change

What are coastal processes?

Figure 5 outlines the various processes that shape PEI coastlines.

What shapes our coastlines?

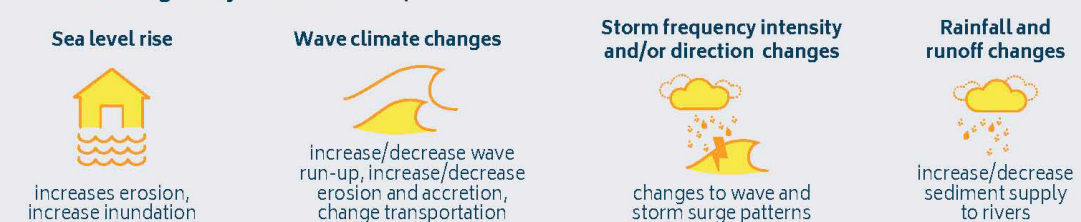
The processes that shape our coast are:



Changes in coastlines happen:



Climate change may affect coastal processes



Coastal climate change infographic series
www.coastadapt.com.au

Australian Government
Department of the Environment and Energy

CoastAdapt

NCCARF
National Climate Change Adaptation Research Facility

Figure 5 – What shapes our coastlines? Source: CoastAdapt

What are coastal hazards? ¹

Coastal hazards are natural forces that affect shorelines and can include:

- **Erosion** – gradual or event-based removal, loss, or displacement of land from waves, currents, tides, wind, ice or other impacts of storms, as well as human interventions. Erosion is primarily affected by the natural geology and composition of the land (hard bedrock vs. soft sandstone vs. soft sediment), whether the shoreline is exposed to long distance waves or within small protected bays, tidal range, bank or cliff height, and adjacent uses of the land.
- **Flooding** – the permanent or temporary movement of water onto land that is normally dry, often affecting low-lying or poorly drained areas. Coastal flooding is influenced by two main factors:
 - short-term storm surges, and
 - long-term sea level rise
- **Storm surges** are water levels that are higher than expected due to a combination of low atmospheric pressure that occurs during storms and **wave runup**. Wave runup can be described as the area that is flooded when incoming waves move up the beach or shore. Storm surge and wave runup can occur separately or together and are most noticeable during a high tide.
- **Sea level rise** is a slow increase in the global ocean levels that are linked to climate change. This increase in water level is sometimes accompanied by a local sinking of the land which results in a similar apparent rise in water level. In PEI, sea levels are projected to rise by up to 1 m by the year 2100.

These coastal hazards have always existed along shorelines. Hazards evolve into risks when they affect people, property, or nature. The Province of PEI will provide a coastal hazard assessment (CHA) on any coastal property (on request), which is a summary of potential erosion and flood hazards associated with a particular coastal property. Understanding hazards before they become risks will help residents to make informed choices going forward.

Coastal hazards only become risks when they affect people, property, or nature.

¹ Source: UPEI Coastal Conversations

EXAMPLES OF COASTAL EROSION

Erosion can be caused by more than just wave action.



◀ Frost wedging:

the seeping of water into cracks, which then freezes, expands, and breaks up rocks over time

Frost Wedging at East Point (H. Parnham, 2023)

▶ Cliff undercutting:

the slow, gradual removal of debris from the base of a sandstone cliff due to wave action, leading to eventual collapse during extreme weather events

Cliff undercutting at Lower Darnley (H. Parnham, 2023)



◀ Soil slumping:

the failure of a bank to support the weight of the soil, structures, and vegetation above due to instability or over-saturation of soil

Soil slumping at Victoria Provincial Park (H. Parnham, 2023)

▶ End-scouring:

the loss of soil and sand at the bottom and sides of armouring material, caused by wave action

End-scouring on Langley Sea Wall at West Point (D. Jardine, 2019)



◀ Overtopping:

the erosion of soil and flattening of land and vegetation from waves driven over dunes, coastal armouring, and other features by intense storm winds

Sea wall overtopping at North Rustico (H. Parnham, 2023)

▶ Stormwater gullies:

the erosion caused by stormwater runoff during heavy rain or snowmelt conditions, where stormwater is not able to be absorbed by the ground or slowed by vegetation at the edge of a bank

Stormwater gully on cliff at West Point (H. Parnham, 2023)



◀ Human activity:

the removal of soil and stabilizing vegetation due to construction of buildings, excavation, and installation of shoreline armouring

Coastal settlement at Johnston River (H. Parnham, 2023)

Figure 6 – Examples of Coastal Erosion. Source: PEI Coastal Property Guide

4.4 Exploring impacts

What are we seeing with storm surge and flood hazards in PEI ²

- What were once considered 1-in-100 year floods are now more likely to happen due to climate change³.
- Post-Tropical Storm Fiona caused storm surge of more than 2.8 m in North Rustico and up to 10 m of shoreline erosion in some parts of the north shore
- More frequent or severe storm events

What is sea level rise and how will it affect PEI?

- Sea levels are expected to rise 30-35 cm by 2050, and 75-80 cm or more by 2100, depending on emission scenarios.
- PEI is also sinking very slowly over time (subsiding -10 to -20 cm/century) which increases the impact of sea level rise.
- Over time, floodplains will expand inland, especially in low areas.

PEI coastal floodplain includes approximately 3% of PEI's land area

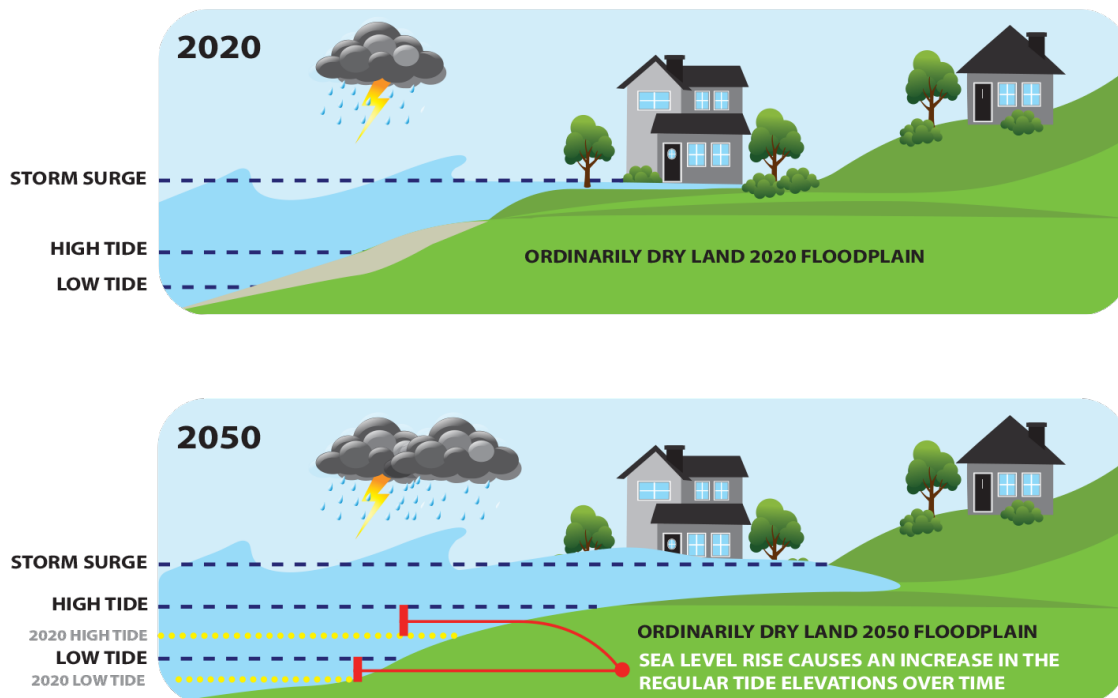


Figure 7 – Floodplain scenarios. Source: PEI Coastal Property Guide

² Source: UPEI Coastal Conversations

³ A '1-in-100-year flood' is a flood level that has a 1% chance of happening in any given year, or a likelihood of occurring once in every 100 years. Multiple such floods can happen within a few years. Due to climate change, these flood levels are being reached more frequently because sea levels are rising and large storms are occurring more often.

5. Climate Hazards and Adaptation Options

5.1 Adaptation Approaches

Under the shoreline management planning process, adaptation options have been categorized into several general approaches:

- No Active Intervention,
- Managed Realignment, and
- Resist.

Figure 8 below shows examples of the approaches; the ‘No Active Intervention’ and ‘Managed Realignment’ strategies promote long-term sustainability, while ‘Resist’ strategies promote a short-term approach. Avoidance, part of the ‘No Active Intervention’ approach, should always be the first option whenever possible to eliminate the risk before there is a chance of occurrence.

What are some actions to reduce impacts of coastal hazards?⁴

- Avoid building too close to the shoreline; build further back from the shoreline
- Support dune and wetland restoration
- Combine natural and built solutions where applicable (e.g. living shorelines)
- Monitor changes in coastal processes such as erosion

⁴ Source: UPEI Coastal Conversations

THREE COASTAL ADAPTATION STRATEGIES

Different approaches can be used in different places depending on local hazards, shoreline type, natural features, and community priorities.

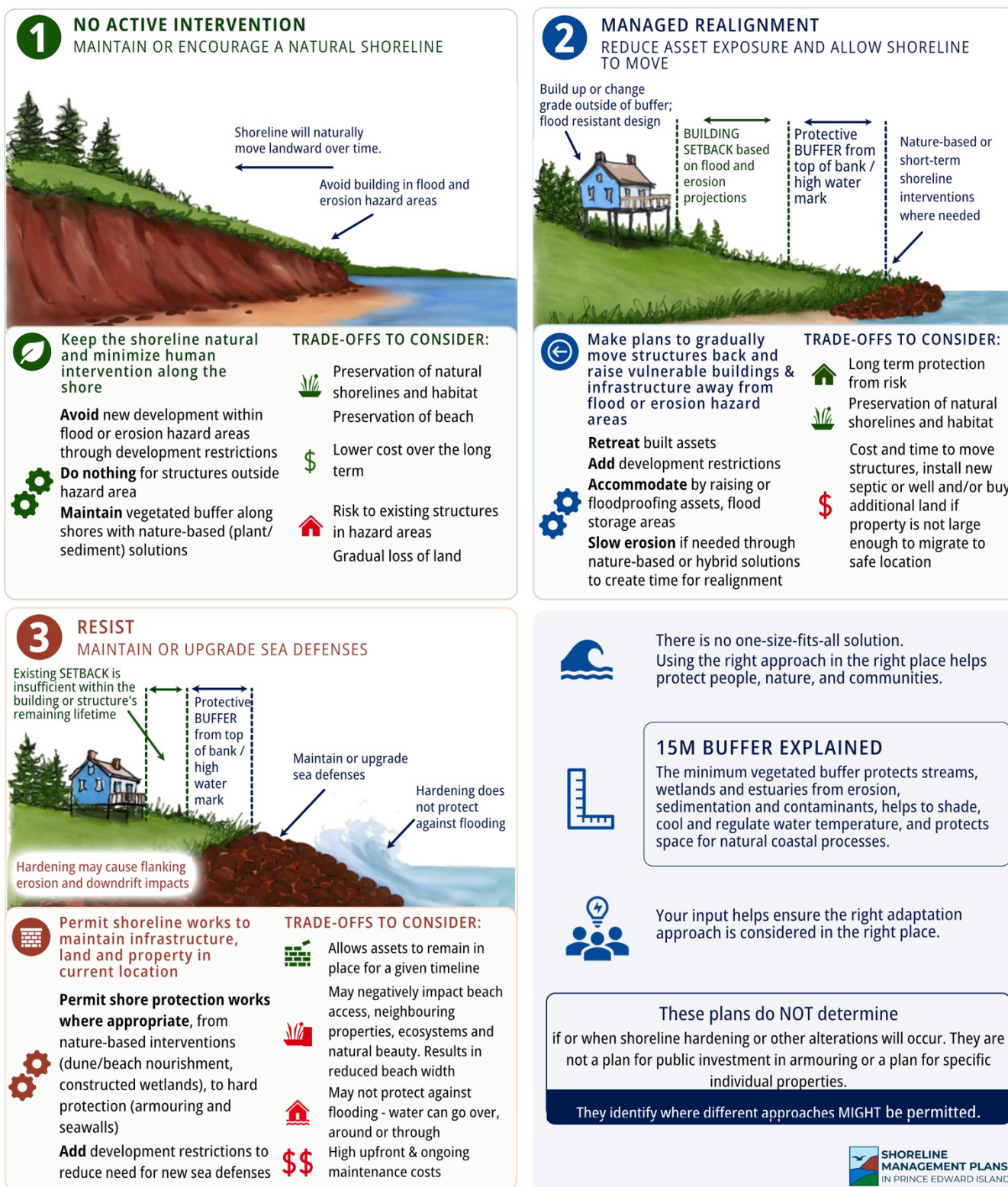


Figure 8 – Three Coastal Adaptation Strategies

How does armouring affect the coastline?⁵

- Armouring (or shoreline hardening) seeks to protect the property inland of the armouring from erosion
- Shoreline hardening installations protect property, not coastlines

Armouring typically has the following limitations:

- Flanking may cause erosion (end scouring)
- Loss of beach and access over time
- Disrupts natural coastal habitat
- Disrupts sediment transport and dune/beach rebuilding processes
- May still be overtopped with erosion to the back if low-lying
- Can have limited benefits in relation to flooding
- Can cause safety hazards to people on the beach

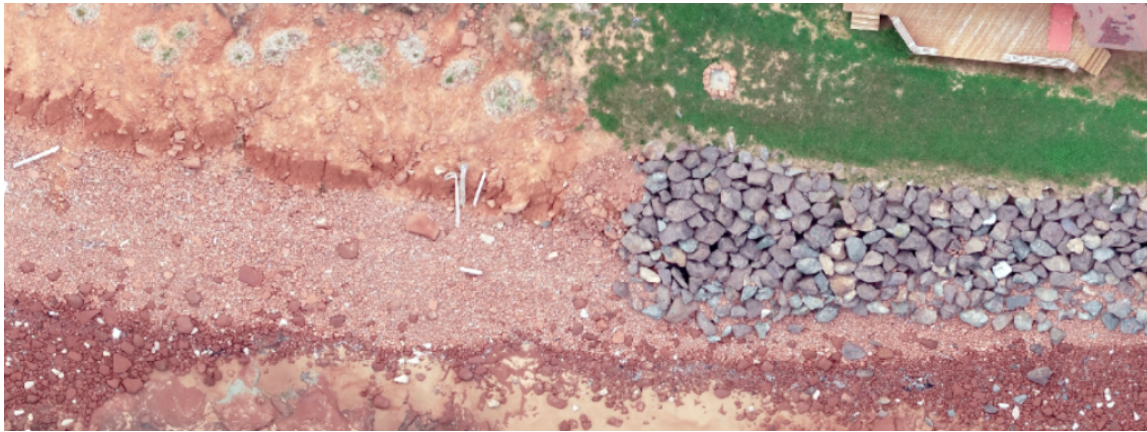


Figure 9 – Example of flanking erosion at end of armourestone revetment. Source: UPEI



Figure 10 – Example of overtopping erosion at armourestone revetment. Source: UPEI

⁵ Source: UPEI Coastal Conversations

How do Nature-based Solutions work?

Nature-based solutions are strategies that depend on, or mimic, natural system processes to reduce coastal risk, while delivering environmental and other co-benefits.

Coastal nature-based solutions are typically vegetation or sediment-based. Examples include beaches and dunes, reefs, and wetlands to provide buffers against wave action and erosion.

Nature-based solutions may include protecting existing natural systems such as floodplains and enhancing or restoring natural processes using beach nourishment or dune plantings.

These actions are typically better suited for shorelines with low to moderate wave energy. For higher energy sites, hybrid solutions can integrate hard structures with natural features.

In hybrid-based solutions, the hard structures are designed to provide stabilization to the vegetation and sediment components. The suitability of nature-based solutions depends on the shoreline characteristics, wave exposure, availability of sediment and vegetation, desired lifetime and tolerance for maintenance.