Draft Northern Bellarine Coastal Adaptation Plan

Bellarine Bayside
Coastal Management

Executive summary

PURPOSE OF THE REPORT

The Northern Bellarine Coastal Adaptation Plan (CAP) provides a strategic, place-based framework to manage current and future coastal hazard risks along the northern Bellarine coast. This CAP has been developed to align with the Victorian Government's Victoria's Resilient Coast – Adapting for 2100+ which provides a strategic approach to coastal hazard risk management and adaptation.

The CAP is intended to support the Bellarine Bayside Foreshore Committee of Management (Bellarine Bayside), partner agencies and the community to make informed, transparent and adaptive decisions that protect environmental, cultural, social and economic values while recognising uncertainty and long-term change.

STUDY AREA AND PRECINCTS

The CAP applies to the Bellarine Bayside managed coastline, which has been divided into a series of coastal precincts based on geomorphology, land use, exposure to coastal hazards and the distribution of key values. These precincts form the spatial basis for identifying risks and developing tailored adaptation responses.

A map of the study area and precinct boundaries is provided in Figure 0.1. Key values for each precinct are identified in section 4.2 of this CAP.

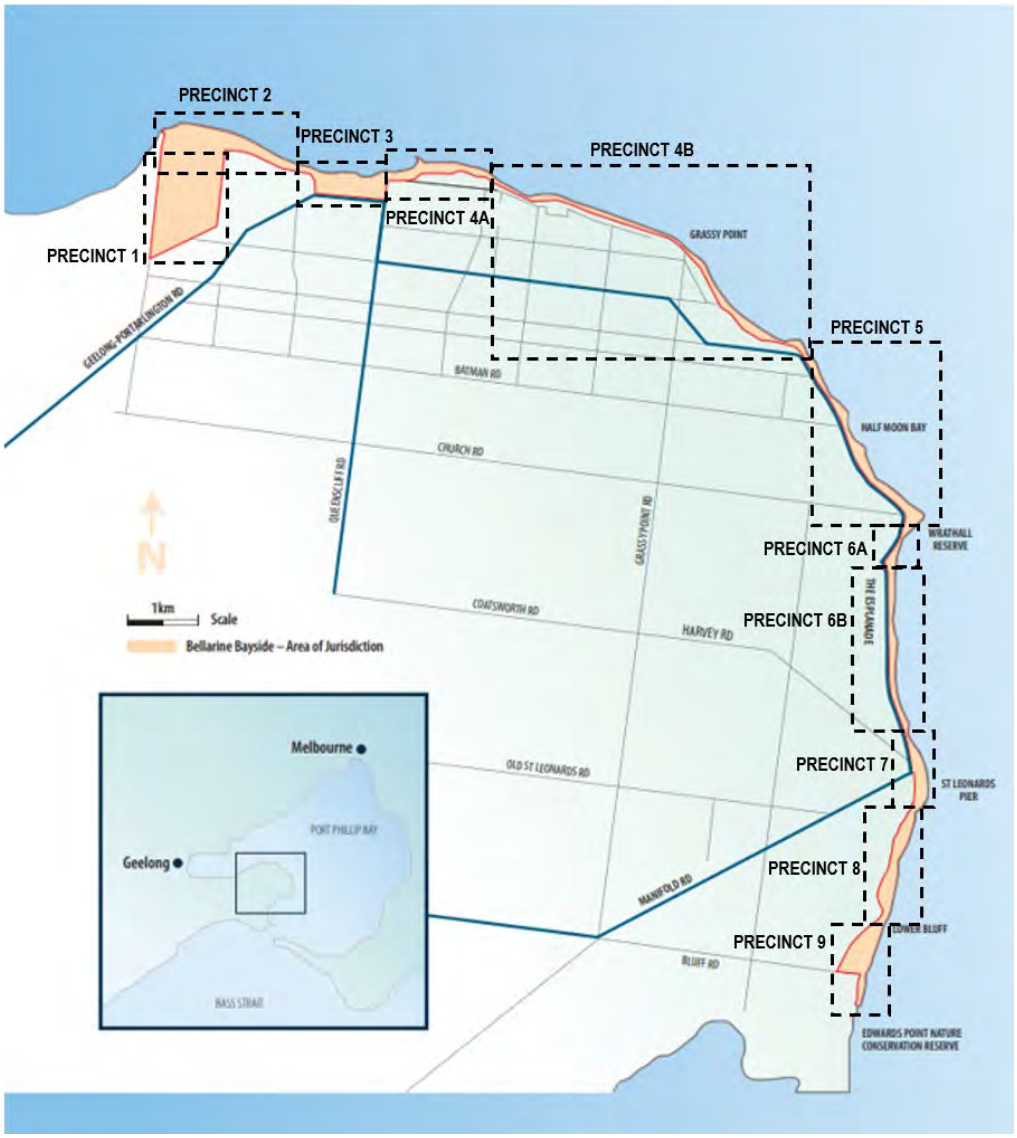

Figure 0.1 Study area and Precincts

VULNERABILITY AND RISK ASSESSMENT

This CAP focusses on the following coastal hazards:

- erosion (storm-tide erosion)
- inundation (both temporary, storm-tide inundation and permanent inundation with sea level rise)
- accretion
- saline intrusion and groundwater hazard

A vulnerability and risk assessment was undertaken to identify the values that are most at risk to be impacted by these coastal hazards at different timeframes. Risk levels vary by precinct depending on exposure, sensitivity of values and adaptive capacity, reinforcing the need for precinct-specific responses rather than a one-size-fits-all approach.

Based on the results of this assessment, the following adaptation pathways were identified:

- Wadawurrung Cultural heritage, including both tangible and intangible Cultural heritage, is ever present within the Bellarine Bayside's Responsibilities and protection of Culture is a priority for Bellarine Bayside.
- Portarlington Holiday Park (Precinct 2) has been identified as a high priority site due to risks from storm tide erosion. The projected damage to land and essential infrastructure poses both economic and social risks, impacting availability for tourism uses.
- The Bellarine Coastal Trail, within Precinct 6a and 7, is at high risk from storm tide erosion, threatening public access, safety, and infrastructure integrity.
- Dune habitats and the intertidal zone and marine habitat, (Precinct 6b), have also been identified as a priority due to their ecological sensitivity and the critical habitat they provide for species such as the Red-capped plover. Erosion poses a direct threat to nesting and breeding success.
- Indented Head boatsheds (Precinct 5), representing post-European settlement heritage, face significant risk from temporary inundation from 2040, and high risk from permanent inundation at 2070 or 0.5 Sea Level Rise, which could lead to structural damage, and inaccessibility.
- Beach and water-based activities, within Precincts 2, 3, 4a and 4b, are at high risk from storm tide erosion affecting access to the beach and impacting ability to undertake recreation activities contributing to a negative visitor experience.
- Steeles Rock boat ramp is also identified as a priority given its risk from erosion, potential safety issues associated with erosion events and access.

ADAPTATION PATHWAYS

Adaptation pathways have been developed for each Precinct to provide a flexible, staged approach to managing coastal risks over time. Adaptation pathways have been identified for values that are at a significant or high risk, based on the risk assessment. Rather than relying on a single long-term solution, pathways identify sequences of actions that can be implemented as conditions change and thresholds are reached.

Across the study area, pathways include combinations of:

- Maintain and protect actions in the short term, such as targeted maintenance, dune management and asset protection
- Nature-based and hybrid solutions to enhance coastal resilience while maintaining environmental and landscape values
- Accommodate and adapt approaches, including changes to asset design, access arrangements and land use over time
- Planned retreat or realignment in locations where long-term protection is not feasible or sustainable
- Protect using engineering solutions where other options are not viable.

The draft adaptation pathways for each precinct are presented in section 9 of this CAP.

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Acknowledgement of Traditional Owners

Bellarine Bayside acknowledges Wadawurrung people as the Traditional Owners of the Bellawiyn land, waterways and skies. We pay tribute to their Elders, past, present and emerging, and commit to walking alongside them to progress their aspirations.

We recognise the intrinsic spiritual, cultural, economic, social and environmental connection Traditional Owners share with the land and waters. We acknowledge the ongoing contribution of Traditional Owners in the management of the natural landscape and our built environments, and we value genuine partnerships with Wadawurrung to achieve effective management of our coastal regions. The northern Bellarine coast is rich with Wadawurrung cultural heritage.

We are committed to our partnership with Wadawurrung Traditional Owners Aboriginal Corporation (WTOAC) to support the protection of cultural heritage and values of Wadawurrung people. Through this partnership, we acknowledge and respect the broader aspirations of Traditional Owners for the present and future.

Contributors

Bellarine Bayside recognises the many people who contributed to developing this Coastal Adaptation Plan (CAP). We appreciate the involvement of northern Bellarine community members, including local residents, community groups, holiday-makers, campers and coastal users, who attended listening posts or provided survey feedback. We also acknowledge the support and contribution of agency partners such as the WTOAC, Department of Energy, Environment and Climate Action (DEECA), Parks Victoria and the City of Greater Geelong (CoGG), along with others who shared information or made submissions.

Special thanks go to

- Bellarine Bayside staff: Project Manager Allison Elsey and Project Director Kate McMahon.
- GHD Project Team: Project Manager Amanda Maxwell, Project Director Jane Munro, and project team members Kara Robinson, Rebecca Robertson, and Hannah Tribe.
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Acronyms and Abbreviations

Acronym / abbreviation	Definition
AAD	Annual Average Damages
AEP	Annual Exceedance Probability (see Glossary)
AHD	Australian Heigh Datum
ARI	Average Recurrence Interval
Bellarine Bayside	Bellarine Bayside Foreshore Committee of Management
BOM	Bureau of Meteorology
CAP	Coastal Adaptation Plan
CAMS	Coastal Asset Management System
CD	Chart Datum
CFA	Country Fire Authority
CMMP	Coastal and Marine Management Plan
CoGG	City of Greater Geelong
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEECA	Department of Energy, Environment and Climate Action
EPBC	*Environment Protection Biodiversity and Conservation Act 1999*
EVC	Ecological Vegetation Class
FFG	*Flora and Fauna Guarantee 1988*
GHD	GHD Pty Ltd
HAT	Highest Astronomical Tide
LAT	Lower Astronomical Tide
MHHW	Mean Higher High Water
MHLW	Mean Higher Low Water
MHWS	Mean High Water Springs - the highest water level reached by spring tides, under average meteorological conditions.
MLHW	Mean Lower High Water
MLLW	Mean Lower Low Water
RAP	Registered Aboriginal Parties (see Glossary)
RASP	Regional and Strategic Partnership (see Glossary)
SDGs	Sustainable Development Goals
SLR	Sea Level Rise (see Glossary)
VCMP	Victorian Coastal Monitoring Program
VMACC	Victorian Marine and Coastal Council
VRC	Victoria's Resilient Coast – Adapting for 2100+
WTOAC	Wadawurrung Traditional Owners Aboriginal Corporation

Glossary

Term	Definition
Adaptation	The process of adjustment to actual or expected disturbances such as coastal hazards. In human systems, adaptation seeks to proactively manage or avoid harm and make use of beneficial opportunities.
Adaptation pathway	A structured approach to managing coastal hazard risk over time. It identifies a sequence of possible actions and decision points, guided by thresholds or triggers, to respond to changing conditions such as sea-level rise. This method ensures flexibility, addresses current needs, and plans for future climate impacts by applying the most suitable measures at the right time.
AEP	Annual Exceedance Probability is the primary metric used to define likelihood. It is the probability of an event occurring in any given year. A higher AEP means it is more likely the event will occur in any one year. The 1% AEP has been modelled for the following sea level rise scenarios and indicative time periods (planning horizons): 0.0 m SLR (present), 0.2 m SLR (~2040), 0.5 m SLR (~2070), 0.8 m SLR (~2100), 1.1 m and 1.4 m SLR (2100 sensitivity scenarios).
Coastal adaptation	The process of adjustment to actual or expected disturbances for a coastal environment involving the modification of behaviour through a change in coastal land management.
Coastal erosion	The process by which winds, waves, and coastal currents shift sediment away from a localised area of the shoreline. In the Northern Bellarine Coastal Adaptation Plan (CAP), erosion is assessed based on both short-term and long-term impacts: short-term erosion involves event-based sediment loss and recovery following storm events (known as storm-bite), while long-term erosion refers to the progressive retreat of the shoreline over time due to historic changes and projected future impacts from sea level rise.
Coastal hazard	Natural physical, chemical and biological process continually drive changes in the Victorian landscape over short and long timeframes. These natural processes can have a negative impact on landscape values and uses; this is referred to as a natural hazard. Coastal hazards are a subset of natural hazards and are unique to the marine and coastal environment. Coastal hazards can include erosion and inundation (flooding), due to storm tide and sea level rise.
Coastal values	Refers to the diverse features and characteristics of a coast that holds ecological, cultural, historical, social, landscape, or recreational importance. These values may be location-specific, such as a shipwreck or midden, or intangible, like historic stories or tourism appeal. A single feature may hold significance across multiple contexts, e.g. natural ecosystems may have ecological, cultural, and recreational value.
Coastal vulnerability	The susceptibility of people and places along the coast to adverse impacts from coastal hazards. Includes the degree of exposure, and ability to cope with, respond to and adapt to coastal hazards.
Consequence	Refers to the impact or outcome of a coastal value or use being exposed to coastal hazards. Consequence ratings are informed by local stakeholder and community feedback, as well as findings from the Cultural and Community Values studies. These ratings may differ depending on the type of hazard (e.g. erosion or inundation) and take into account both short- and long-term impacts.
Community	A group of individuals who share a common sense of belonging and mutual trust: • Geographic – based around where people live, such as neighbourhood, suburb, town, or region

Term	Definition
	• Interest – based around common interests such as conservation, community connection and improvement or recreation interest • Identity – based on sharing a common identity such as age, culture, or lifestyle The Bellarine community includes all who live in, work in, visit, or care for the region.
Community engagement	Refers to the intentional and incidental ways Bellarine Bayside and consultants interact with project partners, stakeholders, and communities. Community engagement is undertaken to gather information, involve the community in decisions, actions or outcomes, build and maintain relationships and increase community capacity for planning, action and learning.
Event	Refers to a natural hazard that can cause disruption or impact to the environment, community, or infrastructure. Events may include bushfires, extreme temperatures, invasive species, water quality changes, floods, drought, storms, or other adverse weather conditions. Coastal storm events result from a combination of meteorological factors (such as wind, rainfall, and temperature) and oceanographic conditions (such as tides, currents, and waves). These events may involve high winds, elevated tides, and intense rainfall, potentially leading to inundation (flooding) and/or coastal erosion.
Leaky boundary	A leaky boundary is a coastal compartment edge where sediment can move between adjacent compartments rather than being fully contained. These boundaries allow partial sediment exchange, influencing coastal processes and management strategies
Likelihood	Likelihood of exposure to coastal hazards is determined by the probability (chance) of an event occurring. For this assessment, we have various scenarios from more frequent to rarer events, and multiple sea level rise scenarios as well as different catchment flows. Likelihood can be expressed as annual exceedance probability (AEP).
Resilience	The capacity of social, economic, and environmental systems to cope with a hazardous event, trend, or disturbance, responding or reorganising in ways that maintain their essential function, identity, and structure, while also maintaining capacity for adaptation, learning, and transformation.
Risk assessment	A systematic process of evaluating the potential risks (likelihood and consequence) of coastal hazards, helping to inform a response and adaptation actions.
Permanent inundation	Permanent inundation is regular or persistent inundation by the regular tidal cycle.
Planning horizon	An indicative timeframe by which a projected sea level rise scenario is expected to occur. Although each sea level rise projection is associated with a specific time period, these timeframes are approximate and may be revised as more local or updated projections become available. For instance, Victoria's current policy requires planning for sea level rise of at least 0.8 m by 2100, while recent global estimates suggest this could be between 1.1 m and 1.4 m by the same year.
Regional and Strategic Partnership	A tool under the *Marine and Coastal Act 2018*. RASPs bring stakeholders together on regionally significant issues. A RASP has been established for the Port Phillip Bay western shoreline that brings together Traditional Owners, three local councils and four agencies. They each have a role in managing coastal and foreshore values, assets and infrastructure around the Port Phillip Bay western shore.
Saline intrusion	Movement of saltwater into freshwater aquifers and groundwater.
Sea level rise	An increase in the average level of the ocean over time. Relative sea level rise occurs when there is a local increase in sea level relative to the land, which may result from a combination of rising ocean levels and land subsidence (sinking).

Term	Definition
Stakeholders	Individuals, group of individuals, organisation, or political entity with an interest or stake in the outcome of a decision.
Storm surge	A coastal process involving a temporary rise in sea level or elevated water levels caused by a storm, contributing to inundation and erosion.
Storm tide inundation	Storm tide inundation is a temporary event-based inundation, where flooding occurs due to an event such as storm activity.
Traditional Owners	People with traditional and customary rights in a particular part of the land. In some cases, Traditional Owner rights have been formally recognised through a Native Title determination under Commonwealth law or a Traditional Owner Settlement Agreement under Victorian legislation.

Wadawurrung Foreword

Our deep knowledge and enduring connection to dja (Country) is at the heart of building climate resilience across this region. We invite communities and partners to walk alongside Wadawurrung people – learning with us and from us. Together, our shared connection to Culture, community, and Country shapes a future that is just, sustainable, and resilient for all.

One of our key priorities is partnering with land managers to develop and deliver Coastal Adaptation Plans, ensuring we care for Country and Water. Through collaboration with Bellarine Bayside, we strengthen the resilience of biodiversity, ecosystems, and species on Wadawurrung Country as our climate changes.

Document Management

VERSION CONTROL

Revision #	Change Description	Approval Date	Author
Version 1		8/12/25	
Version 2			
Version 3			

1 Project Overview

1.1 PROJECT INTRODUCTION

In 2019, Bellarine Bayside Foreshore Committee of Management (Bellarine Bayside) published the Northern Bellarine Coastal and Marine Management Plan 2020-2025 (CMMP). A key action of the CMMP is to:

"Develop a Coastal Climate Change Adaptation Plan (CCCAP) to identify options to address potential risks to public assets, both structural and environmental. As part of the CCCAP, conduct a series of community education activities to raise awareness of coastal hazards and climate change risks and seek input into the development of the CCCAP."

This Northern Bellarine CAP has been developed to address the CMMP key action above and to align with the Victorian Government's Victoria's Resilient Coast – Adapting for 2100+ which provides a strategic approach to coastal hazard risk management and adaptation.

1.1.1 About Bellarine Bayside Committee of Management

Bellarine Bayside is a not-for-profit, Category 1 coastal Committee of Management formed by the Victorian Government in 1994 to manage the coastal Crown land reserve on the northern Bellarine Peninsula, the northern Bellarine coastal reserve (study area).

Bellarine Bayside has responsibility for the management of the foreshore reserve in accordance with the *Crown Land (Reserves) Act 1978*, the *Marine and Coastal Act 2018* and related subordinate legislation and policy set out by the Victorian Government.

The northern Bellarine coastal reserve is recognised as Wadawurrung Country, and its management is carried out with respect for the Traditional Owners who have lived on Country for tens of thousands of years. Bellarine Bayside is committed to protecting, restoring and promoting traditional cultural values in collaboration with the Wadawurrung Traditional Owners Aboriginal Corporation (WTOAC) to achieve effective management of this coast.

Bellarine Bayside also maintains strong working relationships with key stakeholders and industry partners including the Department of Energy, Environment and Climate Action (DEECA), City of Greater Geelong (CoGG), Better Boating Victoria and Parks Victoria to deliver a collaborative approach resulting in mutually beneficial outcomes.

A diverse approach to engagement and communication with the broader community enables Bellarine Bayside to understand the values and uses of the coastal reserve. This includes maintaining strong relationships with the community and providing education of residents and visitors to promote an appreciation of the coastal environment. This allows Bellarine Bayside to provide a high level of customer service and promote sustainable and shared use of the coastal reserve.

1.1.2 Study area: the northern Bellarine coast

The northern Bellarine coast is situated along 17 km of coastal Crown land reserve on the northern Bellarine Peninsula, approximately 90 km southwest of Melbourne. The study area extends from the Point Richards Flora and Fauna Reserve (Portarlington) to Lower Bluff (St Leonards) (Figure 1.1) and comprises approximately 200 hectares of coastal land. It falls within the Bellarine Peninsula declared distinctive area and landscape under section 46 of the *Planning & Environment Act 1987*, which recognises the area's outstanding environment, geography, heritage, cultural values, natural resources, strategic infrastructure and built form.

It is noted that some parts within the study area are managed by organisations other than Bellarine Bayside. For example, Parks Victoria operates Portarlington Pier and Harbour and City of Greater Geelong operates Harvey Park.

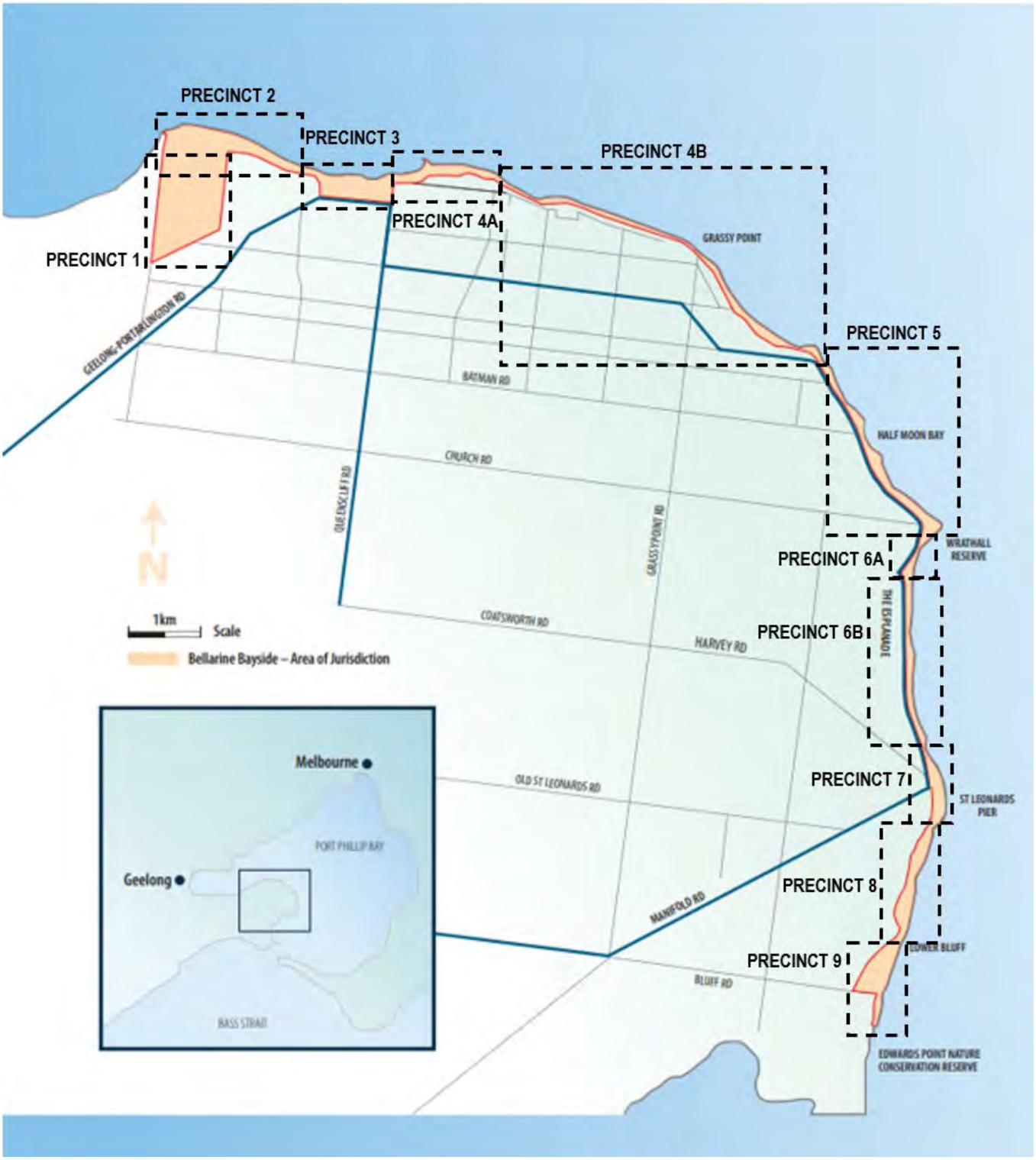


Figure 1.1 Study area and Precincts

1.1.2.1 Wadawurrung Heritage

The northern Bellarine coast study area is situated on Wadawurrung Country. The northern Bellarine coastal reserve is culturally significant, containing a number of Wadawurrung places and objects registered under the *Aboriginal Heritage Act 2006.* Wadawurrung Traditional Owners have continuing spiritual, cultural, economic, social and environmental connections to the land, sea, sky and waterways of the study area.

Significant Wadawurrung living cultural heritage sites within the study area include Moonah (*Melaleuca landeolata*) forests, stone arrangements and shell midden archaeological sites.

There are also intangible Wadawurrung cultural values in the study area, including the imprint of ancestors, felt in places that songlines pass through and in the places of Aboriginal creation stories, connecting this area to all of Country.

1.1.2.2 Natural landscapes

The study area is a landscape with a unique natural profile, not a place of discrete landforms or geological formations but instead a place of biodiverse and interconnected systems enriched by significant flora and fauna on the land and in the sea.

Visitors have been attracted to the peninsula's white sandy beaches and calm waters, which sit against the backdrop of the You Yangs, since the middle of the 1800s. Tourists continue to flock to the area today during the summer months to enjoy the cool coastal breezes and waterside fun.

Port Phillip Bay to the east, with its treacherous waters and crucial trade routes, looms as the dominant natural backdrop for the Bellarine. The skeletons of shipwrecks dotted throughout the bay are a stark reminder of the Bay's deadly potential and of failed attempts to navigate through the Heads. Looking further back into the past, the bay's geological history tells the tale of a changing landscape that has evolved over millions of years.

The coastal environment consists of sheltered beaches, saltmarsh and wetlands along the low-lying shoreline. Consequently, the coast experiences tides, wind, waves and erosion that shape the landscape and its use, and make it vulnerable to inundation and erosion during storm events.

1.1.2.3 Ecological importance

Since European settlement, the northern Bellarine coastal environment has seen significant changes, with open grassed areas and exotic trees replacing native coastal vegetation. However, areas such as Point Richards Flora and Fauna Reserve still provide valuable habitat for indigenous plants and animals. Wetlands including those at Indented Head are crucial links to the internationally significant Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site. The area is adjacent to fertile farmlands and boasts a range of native landscapes that include grassy coastal woodlands, scrublands, coastal saltmarshes and mangrove woodlands.

The study area is home to a diverse coastal environment with distinct ecological pockets and thriving populations of fauna including the Red-capped Plover (*Charadrius rubricollis*) along the Portarlington beachfront and Indented Head and Growling Grass Frog (*Litoria raniformis*) at Point Richards Flora and Fauna Reserve.

Rehabilitation efforts are revitalising areas of the Bellarine landscape, and flora species, including Moonah, Bellarine Yellow Gum and the Hairy Spinifex, are beginning to thrive again along the Bellarine foreshore from Indented Head towards Ocean Grove.

The waters of Port Phillip Bay near the Bellarine are home to rich marine life including the Australian Fur Seal and Southern Australian Bottlenose Dolphin who travel through The Heads and feed or rest in the Bay. The Southern Australian Bottlenose Dolphin (*Tursiops australis*), also known as the Burrunan dolphin has a curved dorsal fin, a stubby snout and its blubber is a mix of dark and light grey and white on its underside. Burrunan dolphins in Port Phillip Bay are one of the rarest populations in Victoria and are critically endangered. Don't forget to look up—you might even spot a majestic Wedge-tailed Eagle making slow circles high in the sky, searching for its next meal.

1.1.2.4 Coastal character

The study area is known for its unique look and feel with expansive views across Port Phillip Bay to the Melbourne city skyline and the You Yangs granite ridges. Many community members have long-established and deep connections with the foreshore landscape, some going back many generations.

The coastal foreshore provides community access to beaches, reserves, water-based activities and ferries to Melbourne. The region is home to a diverse range of wildlife, including native bird and marine species, making it a popular destination for birdwatching and dolphin spotting. In addition to the natural beauty that this region offers, the study area is a vibrant community hub that hosts numerous community events, markets and festivals, bringing both locals and tourists together. Bellarine Bayside's holiday parks and campgrounds are also a significant feature of the area as they provide recreational opportunities to locals and tourists, allowing for people to connect to the foreshore, whilst also significantly contributing to the local economy.

1.1.2.5 Post-European heritage

Post-European history includes the stories of Captain George Ward Cole, John Batman, William Buckley, the wrecking of the vessel Ozone and the development of the mussel farm industry.

A number of sites within the study area are designated heritage places, including:

- Portarlington Jetty
- Coles Jetty, St Leonards
- Indented Heads Well Site.

Other sites are protected by a Heritage Overlay under CoGG's Planning Scheme, including:

- Band Rotunda and Weighbridge, Portarlington
- Matthew Flinders Memorial
- Ozone Memorial
- Anderson Reserve
- Batman Park
- Batman Memorial.

The Portarlington War Memorial is also included on the Victorian War Heritage Inventory.

Note: As Indented Head was an important camping and meeting place for Wadawurrung People prior to the establishment of an encampment there by John Batman and representatives of the Port Phillip Association in 1835, the Batman Memorial is considered a site of contested history.

1.1.2.6 Built assets

Built assets of the northern Bellarine coast service community, recreational and commercial needs. Built assets include infrastructure such as:

- Halls and club rooms
- Piers and jetties
- Boat harbours
- Boat ramps
- Historical boat sheds
- Public toilets
- Sports courts
- Bellarine Coastal Trail
- Formal beach access ways
- Holiday park roofed accommodation and amenities.

1.1.2.7 Recreation

The northern Bellarine coast is an important recreational hub, providing coastal spaces for land-based activities such as:

- Camping
- Walking
- Running
- Dog-walking
- Cycling
- Picnics
- Sports
- Events
- Beach fishing.

And water-based activities such as:

- Swimming
- Snorkelling
- Paddle boarding
- Kayaking
- Boating
- Boat fishing (recreational and commercial).

A range of events and festivals are held in the reserve throughout the year, providing unique opportunities for locals and visitors to connect with the foreshore.

1.1.2.8 Holiday parks

There are six holiday parks in the study area that offer 484 year-round and 378 seasonal tourist sites.

The Portarlington Holiday Park is open year-round and has a range of accommodation options (self-contained cabins, powered and unpowered sites and beach front pods).

Indented Head has three seasonal campsites that offer powered sites:

- Anderson Reserve (open December to April)
- Taylor Reserve (open December to January)
- Batman Park (open October/November to April).

St Leonards has two seasonal campsites that offer powered sites:

- Bengalat Reserve (open October/November to April)
- Karrong Reserve (open December to January).

The holiday parks provide affordable camping and options for roofed accommodation for visitors.

1.1.2.9 Key management programs

Some of Bellarine Bayside's key management programs for the area include:

- Protection and enhancement of the natural environment (including vegetation)
- Rehabilitation and pest animal and weed monitoring and management
- Maintenance of open spaces (parks, playgrounds, car parks)
- Ensuring safe access and provision of safe and functional facilities (as a Child Safe Organisation and in accordance with all abilities access standards)
- Community education and engagement
- Maintenance of five boat ramps and associated jetties and facilities
- Accommodation provision related operations (Portarlington Holiday Park and five seasonal camping reserves)
- Coastal reserve use-related leases, licences and permits.

1.1.2.10 Other study area information

Additional information about the geomorphological setting, nearshore bathymetry and tides is provided in section 6.1.

2 Precincts

For the purpose of this CAP, the northern Bellarine coastal reserve has been divided into nine Precincts. Each Precinct is defined by common built and environmental assets, along with patterns of recreational and community use. The delineation also considers tertiary coastal compartments. For organisational planning, the Precinct framework incorporates four sub-Precincts: 4a, 4b, 6a, and 6b. A description of how these Precincts align with the tertiary coastal compartments and geomorphic settings in included in Section 6.1.2.

The nine (9) Precincts are listed below and mapped in Figure 1.1 above and Table 2.1 below. Planning for climate change adaptation on a Precinct scale allows for more detailed understanding of and focus on the specific values and challenges within each of these areas.

Table 2.1 Precincts of the northern Bellarine coastal reserve

Precinct	Description
Precinct 1.	Point Richards Flora and Fauna Reserve
Precinct 2.	Point Richards and Portarlington Holiday Park
Precinct 3.	Sproat Street to Fisher Street
Precinct 4a.	Fisher Street to 50 m to the left of Mercer Street/The Esplanade
Precinct 4b.	50 m to the left of Mercer Street/The Esplanade to Point George
Precinct 5.	Point George to Batman Memorial
Precinct 6a	Batman Memorial to St Leonards Foreshore Reserve (North The Bluff)
Precinct 6b.	St Leonards Foreshore Reserve (North The Bluff) to 130 m north of Second Avenue
Precinct 7.	130 m north of Second Avenue to William Buckley Labyrinth
Precinct 8.	William Buckley Labyrinth to The Bluff
Precinct 9.	The Bluff to Beach Road

3 Coastal Adaptation Planning and Management Framework

3.1 PURPOSE AND BASIS OF THE NORTHERN BELLARINE COASTAL ADAPTATION PLAN

This Northern Bellarine CAP has been developed to align with the Victorian Government's Victoria's Resilient Coast – Adapting for 2100+ which provides a strategic approach to coastal hazard risk management and adaptation, and to address the CMMP key action that is to address risks to public assets and raise awareness of coastal hazards and climate change risks.

The northern Bellarine coastline is being shaped by the effects of climate change, exacerbating coastal processes including tides, wind, waves and erosion. More frequent and more severe storm events, associated storm surges and sea level rise put the study area at risk of extensive inundation of low-lying areas and increased beach erosion. The impacts of inundation and erosion include loss of access and amenity as well as potential damage to infrastructure, facilities, native habitat and cultural sites. Human modifications to the environment and an increase in demand for open space for recreational and commercial use put further pressure on the integrity and quality of the marine and coastal environment.

Coastal adaptation planning allows land managers and their communities to enable place-based, best practice and long-term coastal hazard risk management and adaptation. It provides a framework to identify options to address potential risks to coastal values including public assets, both structural and environmental. The coastal adaptation planning process relies on engagement with community stakeholders and raises awareness of coastal hazards and climate change risks. It allows for the identification of coastal values; assessment of coastal hazard exposure, vulnerability and risk; and development of an adaptation pathways outline.

3.1.1 Victoria's Resilient Coast – Adapting for 2100+ framework and guidelines

Victoria's Resilient Coast – Adapting for 2100+(VRC) framework and guidelines provide a statewide strategic approach for local governments, land managers and communities to achieve long-term coastal hazard risk management and adaptation (refer to Figure 3.1).

Building upon directions in the *Marine and Coastal Act 2018* and Marine and Coastal Policy 2020, the VRC framework and guidelines outline a staged approach to technical, strategic planning and engagement aspects of managing and adapting to coastal hazard risks.

Figure 3.1 Victoria's Resilient Coast – Adapting for 2100+ framework seven stages (DEECA, 2024)

3.2 DEVELOPING THE NORTHERN BELLARINE COASTAL ADAPTATION PLAN

3.2.1 A collaborative approach

This CAP has been developed through a collaborative approach with internal and external stakeholders. A project control group has been established to provide governance and oversight on the project from key funding partners.

This has been supported by a project working group, which has provided key stakeholders with an opportunity to work closely with the project team and consultants to advise and comment on key stages of the project. The project working group includes Rights Holders, Wadawurrung Traditional Owners Aboriginal Corporation and representatives from Bellarine Bayside, DEECA, City of Greater Geelong, and Parks Victoria.

3.2.2 Coastal adaptation planning in Victoria

In Victoria, coastal adaptation planning is broadly managed under the *Climate Change Act 2017* and Climate Action Strategy 2021, with specific adaptation needs addressed through the *Marine and Coastal Act 2018*, Marine and Coastal Policy 2020 and Marine and Coastal Strategy 2022 (Victoria's primary management tools for the guidance of coastal management). A summary of these key coastal management tools is attached in Appendix D.

3.2.3 Stages of the Coastal Adaptation Plan project

Development of the CAP takes place over seven stages, summarised in Table 3.1.

Table 3.1 Key stages of the Northern Bellarine CAP project

Victoria's Resilient Coast – Adapting for 2100+ framework Stage and purpose	Key questions	Northern Bellarine CAP Project Key Deliverables
STAGE 1: Scoping and preparation Provide a foundation for coastal hazard risk management and adaptation planning, aligned to best practice guidance, in a place-based context	What is our study area? Do we need planning and action? Who should be involved? What's our project scope?	Project plan Community Engagement plan
STAGE 2: Values, vision and objectives Ensure coastal hazard risk management and adaptation planning is underpinned by place-based values and a shared vision and objectives.	What do we value on our coast? What do we want for the future of our coast?	Community engagement campaigns Coastal values assessment Coastal vision assessment
STAGE 3: Coastal hazard exposure Assess coastal hazard exposure, including hazard assessment to enable best practice approaches to risk assessment and adaptation planning.	What coastal processes are occurring? How might these change?	Coastal hazard assessment
STAGE 4: Vulnerability and risk Explore place-based coastal hazard vulnerability and risk, to enable a strategic approach to considering coastal hazard risk and adaptation needs.	How might coastal processes impact what we value? Which values are the highest priority for protection?	Coastal exposure assessment Risk and vulnerability assessment
STAGE 5: Adaptation actions and pathways Identify, assess, consult on and decide which adaptation options and actions are	How can we manage and adapt to these impacts?	Adaptation framework, options and preferences summary Adaptation feasibility modelling

Victoria's Resilient Coast – Adapting for 2100+ framework Stage and purpose	Key questions	Northern Bellarine CAP Project Key Deliverables
the most appropriate for managing current and future coastal hazard risks.		Economic assessment & cost benefit analysis
STAGE 6/7: Plan, implement, monitor and review Confirm plan of action and implementation, including priority actions in the adaptation pathways, shared roles and responsibilities, triggers for review and resources/ requirements. Ensure coastal hazard risk management and adaptation is accompanied by ongoing monitoring and evaluation processes to enable effective implementation, learnings and improvement.	Which options are feasible and suitable for now and in the future? How can we plan a strategic adaptation response? How will we track and implement our plan?	Northern Bellarine CAP including implementation plan/s, monitoring and evaluation

3.3 KEY EXISTING STUDIES, PLANS AND DOCUMENTS

The principal existing coastal management documents and tools applicable to the study area that this CAP has drawn from and aims to align with are summarised in Appendix C.

4 Coastal Vision and Values

4.1 VISION

> **The northern Bellarine coast is sustainably managed in partnerships with rights holders and the community to provide long-term resilience against current and future coastal hazards.**

The vision recognises the importance of Wadawurrung leadership and self-determination during collaboration with Bellarine Bayside and aims to inspire support and collaboration from the community, foreshore users, stakeholders and partner agencies.

Objectives have been developed by applying the VRC guideline objectives at a local scale, informed by Bellarine Bayside's CMMP, and shaped through rightsholder and stakeholder engagement.

Objectives:

The vision for the northern Bellarine is aligned with the CMMP and was developed with the consideration of the following:

- Support climate-ready coastal management across Bellarine Bayside.
  Provide clear, evidence-based direction for how Bellarine Bayside will respond to increasing coastal hazards, erosion, storm-tide inundation, and long-term climate change projections.
- Integrate Wadawurrung values and leadership in adaptation.
  Partner with Wadawurrung to protect cultural heritage.
- Manage risks to people, infrastructure and coastal assets.
  Identify and proactively manage risks to public assets (coastal reserves, infrastructure, values) and reduce exposure over time through staged, long-term adaptation.
- Alignment with Marine and Coastal Policy and partner agency roles.
  Align the CAP with the Marine and Coastal Policy, *Marine and Coastal Act*, Coastal Marine Management Plan (CMMP), and relevant local partner strategies to ensure integrated and coordinated coastal planning.
- Provide clear, transparent and consistent guidance for decision-making.
  Establish a transparent process for assessing adaptation options, consistent with statewide best practice to guide future investment, maintenance and planning.
- Strengthen community understanding and involvement.
  Build shared understanding of coastal change, risks and adaptation options through clear communication and inclusive engagement.
- Support long-term financially responsible adaptation planning.
  Establish realistic, cost-effective adaptation actions that guide capital works, maintenance planning, partnerships and shared responsibility.
- Provide a living, adaptive framework to guide future decisions.
  Deliver a CAP that is able to evolve as new data, climate projections, community expectations and policy updates emerge ensuring flexibility and ongoing relevance.

4.2 COASTAL VALUES

4.2.1 Coastal values framework

A key step in adaptation planning is the identification and understanding of what is recognised as being of importance on the coast and how climate change may have an impact on those important aspects.

There are a wide range of features and characteristics of the northern Bellarine coast that hold importance in one or more context(s), i.e. ecological, landscape, cultural, historical, social or recreational importance. These features and characteristics are referred to as 'coastal values'.

Coastal values can be location-specific, e.g. a wetland or midden, or less tangible, e.g. historic stories or tourism values. Coastal values may also be important in more than one context, e.g. as well as ecological value, natural ecosystems may also have cultural and recreational value.

For this CAP, coastal values were drawn from multiple sources to ensure a comprehensive and inclusive foundation for planning. The values identified in the CMMP were summarised as preliminary coastal values and used as a key input for stakeholder and community engagement. Through this engagement, additional values and refinements were identified, as detailed in Section 4.2.2.

Equally, to ensure Wadawurrung values were respectfully and meaningfully incorporated, Bellarine Bayside collaborated with WTOAC to identify coastal values specific to the northern Bellarine. This process involved both consultation and a review of WTOAC's 10-year Healthy Country Plan.

Together, these combined values—Wadawurrung, community, and stakeholder—formed the basis for the coastal hazard risk management and adaptation planning outlined in Section 7.

In developing a coastal values framework for this CAP, the coastal values identified have been grouped into broad categories that align with those of the Marine and Coastal Policy (2020). These categories are set out under 'type of value' in Table 4.1 below:

Table 4.1 Key types of coastal values used for the Northern Bellarine CAP (summarised from the Marine and Coastal Policy, 2020)

Type of value	Context (summarised from the Marine and Coastal Policy, 2020)	Links to other types of values
Ecosystem and habitats	Coastal environments contain a diverse and unique mix of plants, animals, soils, seas and waterways that function together as ecosystems. These ecosystems provide ecosystem services and associated habitats (places where organisms or populations naturally occur) and are home to an array of plant and animal species, some of which are not found elsewhere in the world.	Wadawurrung people regard Country (including ecosystems and habitats) as part of, and fundamental to, Culture. Country and Culture are inextricably linked. Ecosystem health and function are therefore critical to safeguarding and protecting Culture.
Natural features and landscapes	Coastal landscapes and seascapes are integral to the identity of the coast and its people. The unique natural features provide aesthetic value and an insight into historic landscape formation processes.	As well as containing important ecological, cultural and social values, these landscapes are a powerful magnet for eco-tourism. Many are also tied to Wadawurrung stories and customs and hold deep and ongoing meaning and roles in customs and practices.
Cultural values	Cultural values in the marine and coastal environment play an important role in creating a sense of place. Aboriginal Culture is living and inherent throughout the Victorian landscape. It includes Traditional Owners' connection to and caring of Country, their languages, Creation stories, knowledge and practices.	There are many sites of heritage significance to Aboriginal people, from both before and after the first contact with Europeans.
Heritage sites	Heritage sites are often linked to the central role of the sea in the early economic, social and physical development of Victoria by Europeans. Shipwrecks, lighthouses, piers and archaeological remains of early coastal	Sites of heritage significance from Victoria's European past exist alongside, and in many instances co-exist with, sites of cultural importance and heritage for Wadawurrung people and Aboriginal Victorians.

Type of value	Context (summarised from the Marine and Coastal Policy, 2020)	Links to other types of values
	settlements are among the sites that help provide links to this past.	
Recreation and tourism	Recreational use of the marine and coastal environment is highly valued by residents and visitors alike. Recreation and tourism are economic drivers for coastal areas. By connecting people with the marine and coastal environment, recreation and tourism also foster a sense of stewardship among users and provide community-wide health benefits from active and outdoor lifestyles.	The ways in which people enjoy the marine and coastal environment are many and varied, from the passive (staying near the water and beach walking) to the active (swimming, surfing, boating, kite surfing, fishing) and engaging with and learning about Wadawurrung Culture.
Buildings, structures and access	Buildings and structures in the marine and coastal environment support the functioning of communities and industries. They can include, docks, jetties, boat ramps, paths, toilet blocks, picnic facilities, structures to maintain public safety, and buildings to enhance recreation opportunities.	Buildings, structures and access are necessary to enable a diversity of uses in the marine and coastal environment, and to accommodate increasing demand as the population grows.

4.2.2 Coastal Adaptation Plan identified coastal values

The identification of key value themes for the CAP considered previous feedback from WTOAC, agency partners and community during the development of the CMMP, as well as feedback from specific engagement for the CAP. The themes identified were:

- Natural beauty and environment
- Passive recreational activities
- Relaxed and peaceful atmosphere
- Water activities
- Community and social aspect.

To support the vision for the Northern Bellarine CAP, Table 4.2 outlines the cultural, environmental, social, and economic values identified across the nine Precincts. These values were validated through consultation with stakeholders and the community.

Table 4.2 Coastal values identified for the Northern Bellarine CAP

Precinct	Type of Value (as per Marine and Coastal Policy, 2020)	Identified Value	Description of Value	Photos
All Precincts	Cultural Heritage Value	Wadawurrung cultural heritage – physical places	Physical places (tangible) – Lithic e.g. stone and artefacts Physical places (tangible) – Living places e.g. middens Cultural places (intangible) – Coastal dunes e.g. generational living and sharing experiences	

Precinct	Type of Value (as per Marine and Coastal Policy, 2020)	Identified Value	Description of Value	Photos
	Cultural Heritage Value	Wadawurrung Cultural Heritage – Coastal	Sea Country – rock pools, saltmarshes, seagrass beds, kelp forests Coastal bush tucker – Indigenous plants, wildlife habitats Wetlands Coastal Country – beaches, coastal scrub Native animals – key species, habitat Inland Country – grasslands, woodlands Intangible Values – Sharing of stories dance and song, generational living, access to country, engaging in cultural practices	

Precinct	Type of Value (as per Marine and Coastal Policy, 2020)	Identified Value	Description of Value	Photos
	Recreation and tourism	Bellarine Coastal Trail	A 17km coastal trail linking all Precincts offering an easy, scenic route for recreation while connecting key natural and cultural sites	 

Precinct	Type of Value (as per Marine and Coastal Policy, 2020)	Identified Value	Description of Value	Photos
		Beach and water-based activities	Sandy beaches on narrow to moderate width with low profiles, shallow backed dunes and sand banks and calm protected waters particularly in summer under predominant south and south-easterly winds Swimming Snorkelling Boating and boat hire Kayaking Paddle boarding Fishing Playing on beach (children)	
		Facilities supporting recreation activities	Public toilets Public showers Cafés Services (power, telecommunications, water)	

Precinct	Type of Value (as per Marine and Coastal Policy, 2020)	Identified Value	Description of Value	Photos
	Natural features and landscapes	Coastal amenity and views	Green open space Sea and beach views	

Precinct	Type of Value (as per Marine and Coastal Policy, 2020)	Identified Value	Description of Value	Photos
Precinct 1 **Point Richards Flora and Fauna Reserve**	Wadawurrung cultural heritage	Coastal bush tucker Medicines and resources	Native vegetation	
		Native animals	Fauna within the Point Richards Flora and Fauna Reserve	
	Ecosystem and habitats	Natural environment	Ecological Vegetation Class 3: Damp Sands Herb-rich Woodland Wetlands (permanent and ephemeral) Wildlife One of the last publicly accessible stands of remnant bushland on the Bellarine Canopy trees Biodiversity and habitat to support local fauna (including the Growling Grass Frog classified as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act 1999*) and *Flora and Fauna Guarantee Act 1988* (*FFG Act 1988*) Ecosystem services	

	Recreation and tourism	Public area	Walking tracks Picnic tables Bird watching	

Precinct	Type of Value (as per Marine and Coastal Policy, 2020)	Identified Value	Description of Value	Photos
Precinct 2 **Point Richards and Portarlington Holiday Park**	Wadawurrung cultural heritage	Coastal Country	Sandy beaches	
		Wetlands	Bush tucker Medicines Resources	
	Ecosystem and habitats	Native animals	Grass Frog classified as vulnerable under the *EPBC Act 1999* and *FFG Act 1988*	
		Natural environment	Ecological Vegetation Classes 1: Coastal Dune Scrub/Coastal Grassland Mosaic and 3: Damp Sands Herb-rich Woodland (highly degraded) Intertidal zone habitat Wetland	
	Recreation and tourism	Water-based clubs	Portarlington Sailing Club	

		Two boat ramps	Point Richards boat ramp Portarlington Holiday Park boat ramp	
		Miniature railway	Portarlington Bayside Miniature Railway	
		Portarlington Holiday Park	Camping and recreation adjacent to foreshore	

		Public area	Open space Beach access Picnic areas	

Precinct	Type of Value (as per Marine and Coastal Policy, 2020)	Identified Value	Description of Value	Photos
Precinct 3 **Sproat Street to Fisher Street**	Wadawurrung cultural heritage	Coastal Country	Sandy beaches	
		Sea Country	Seagrass Intertidal zone habitat	
	Recreation and tourism	Shaded beach	Swimming beach (including Swimming-only zone)	
		Public area	Event space Regional playground Skate park W.G. Little Reserve S.S. Nash Reserve Portarlington Bowls Club Open space Beach access Picnic areas	

	Cultural values and heritage sites	Post European settlement heritage	Cenotaph	
	Buildings, structures and access	Adjacent to town commercial area	Access for ferry terminal Parks Hall Portarlington Country Fire Authority (CFA)	
		Boating facilities	Portarlington Pier (Parks Victoria) Portarlington Harbour (Parks Victoria)	

Precinct	Type of Value (as per Marine and Coastal Policy, 2020)	Identified Value	Description of Value	Photos
Precinct 4 **Fisher Street to Point George**	Wadawurrung cultural heritage	Cultural sites and places	Living Place	
		Sea Country	Seagrass Intertidal zone habitat Saltmarshes Marine life	
		Coastal Country	Sandy beaches Coastal scrub	
		Native animals	Fauna and fauna habitat	
		Wetland	Bush Tucker Resources	
	Ecosystem and habitats	Natural environment	Ecological Vegetation Classes 161: Coastal Headland Scrub, 1: Coastal Dune Scrub/ Coastal Dune Grassland Mosaic and 9: Coastal saltmarsh (endangered in the Corangamite region) Wildlife Intertidal zone habitat Wetland Habitat for Red-capped Plovers and other beach-nesting birds Seals Reefs	

				
	Buildings, structures and access	Buildings and access	Boardwalk over Indented Head saltmarsh Steeles Rock boat ramp Public toilets	

Precinct	Type of Value (as per Marine and Coastal Policy, 2020)	Identified Value	Description of Value	Photos
Precinct 5 **Point George to Batman Memorial**	Wadawurrung cultural heritage	Coastal Country	Sandy beaches Dunes Grasslands	
		Cultural sites and places	Living places	
		Sea Country	Intertidal zone habitat Marine life	
	Heritage sites	Post-European settlement heritage	The Ozone shipwreck Historic boatsheds and Precinct	
	Ecosystem and habitats	Natural environment	Ecological Vegetation Classes 1: Coastal Dune Scrub/Coastal Dune Grassland Mosaic and 858: Coastal Alkaline Scrub Wildlife Intertidal zone habitat	

	Recreation and tourism	Seasonal campground	Anderson Reserve campground Batman Park campground Taylor Reserve campground	
		Proximity to beach	Swimming beach (including swimming only zone) Snorkelling Beach access	
		Sports courts	Tennis/basketball court	

		Water-based clubs	Indented Head Boat Club Indented Head Yacht Club	
	Buildings, structures and access	Building and access	Indented Head Community Hall Indented Head boat ramp Playgrounds Picnic area and facilities (e.g. BBQs) Public amenity blocks	

Precinct	Type of Value (as per Marine and Coastal Policy, 2020)	Identified Value	Description of Value	Photos
Precinct 6 **Batman Memorial to 460 The Esplanade (northen Beach)**	Wadawurrung cultural heritage	Coastal Country	Coastal dunes and scrub Coastal alkaline scrub Saltmarsh Moonahs	
		Cultural sites and places	Living place	
		Sea Country	Intertidal zone habitat Seagrass meadows Marine life	
	Cultural values and heritage sites	Post European settlement heritage	John Batman and Matthew Flinders monument	

	Ecosystem and habitats	Natural environment	Ecological vegetation Class 1: Coastal Dune Scrub/Coastal Grassland Mosaic and 858: Coastal Alkaline Scrub Wildlife Intertidal zone habitat Seagrass meadows 161: Coastal Headland Scrub Wetlands Moonah trees	
	Recreation and tourism	Public area	Open space Beach access Picnic areas	

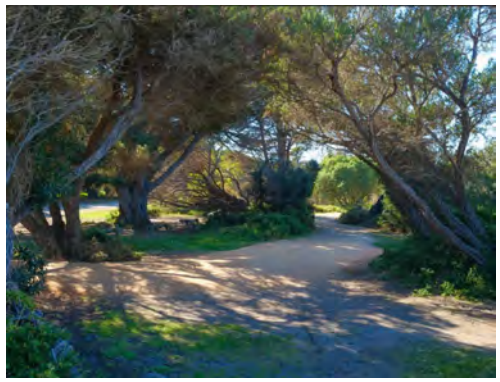
Precinct	Type of Value (as per Marine and Coastal Policy, 2020)	Identified Value	Description of Value	Photos
Precinct 7 **460 The Esplanade (northern Beach) to William Buckley Labyrinth** NOTE: CoGG-managed land in Precinct 7 includes includes Harvey Park playground, toilet block, tennis court, carpark, Buckley labyrinth	Wadawurrung cultural heritage	Cultural sites and places	Living place	
		Coastal Country	Sandy beaches Dune scrub Coastal alkaline scrub Dune habitat	
		Sea Country	Intertidal zone habitat Marine life	
	Ecosystem and habitats	Natural environment	Ecological vegetation Class 858: Coastal Alkaline Scrub Wildlife Intertidal zone habitat Dunes	
	Cultural values and heritage sites	Post-European settlement heritage	St Leonards Pier (Parks Victoria) Coles Jetty	

	Recreation and tourism	Close proximity to beach	Swimming beach (including swimming-only zone) Snorkelling	
		Public area	Picnic areas	
	Buildings, structures and access	Adjacent to town commercial area	St Leonards Hotel Restaurants and shops	

		Boating facilities	St Leonards Pier (Parks Victoria) Harbour (Parks Victoria)	

Precinct	Type of Value (as per Marine and Coastal Policy, 2020)	Identified Value	Description of Value	Photos
Precinct 8 **William Buckley Labyrinth to The Bluff**	Wadawurrung cultural heritage	Cultural sites and places	Living place	
		Coastal Country	Coastal alkaline scrub Dune scrub Coastal headlands	
		Sea Country	Intertidal zone habitat Marine life	
	Ecosystem and habitats	Natural environment	Ecological vegetation 858: Coastal Alkaline Scrub Wildlife Intertidal zone habitat Dunes 161: Coastal Headland Scrub	
	Recreation and tourism	Seasonal campgrounds	Bengalat Reserve campground Karrong Reserve campground	

		Public area	Open space Picnic areas Playgrounds	
	Buildings, structures and access	Boat ramp	St Leonards boat ramp	

Precinct	Type of Value (as per Marine and Coastal Policy, 2020)	Identified Value	Description of Value	Photos
Precinct 9 **The Bluff to Beach Road**	Wadawurrung cultural heritage	Cultural sites and places	Physical place – tangible and intangible	
		Coastal Country	Coastal alkaline scrub Coastal dune	
		Native animals	Bush Tucker Resources	
		Sea Country	Intertidal zone habitat Marine life	
	Ecosystem and habitats	Natural environment	Ecological vegetation 858: Coastal Alkaline Scrub 55: Plains Grassy Woodland 1: Coastal Dune Scrub/Coastal Dune Grassland Mosaic Wildlife Intertidal zone habitat Dunes Woodland Tree canopy	
	Recreation and Tourism	Public area	Open space Picnic areas Playgrounds	

		Beach access	Secluded beach Swimming	
		Water-based clubs	St Leonards Yacht Club and Motor Squadron	 

5 Community Engagement and Stakeholder Involvement

5.1 ENGAGEMENT PROGRAM

Community engagement was completed across a period of eight weeks from 23 November 2024 to 17 January 2025. In total, 289 people provided contributions to the engagement. Of these 289 people, 74.6% of respondents were locals to the area, 18.3% were holiday house owners, 3% were Bellarine Bayside campers, 2.4% were day visitors and 1.8% were other overnight visitors. The engagement program utilised a range of different approaches, summarised in Figure 5.1.

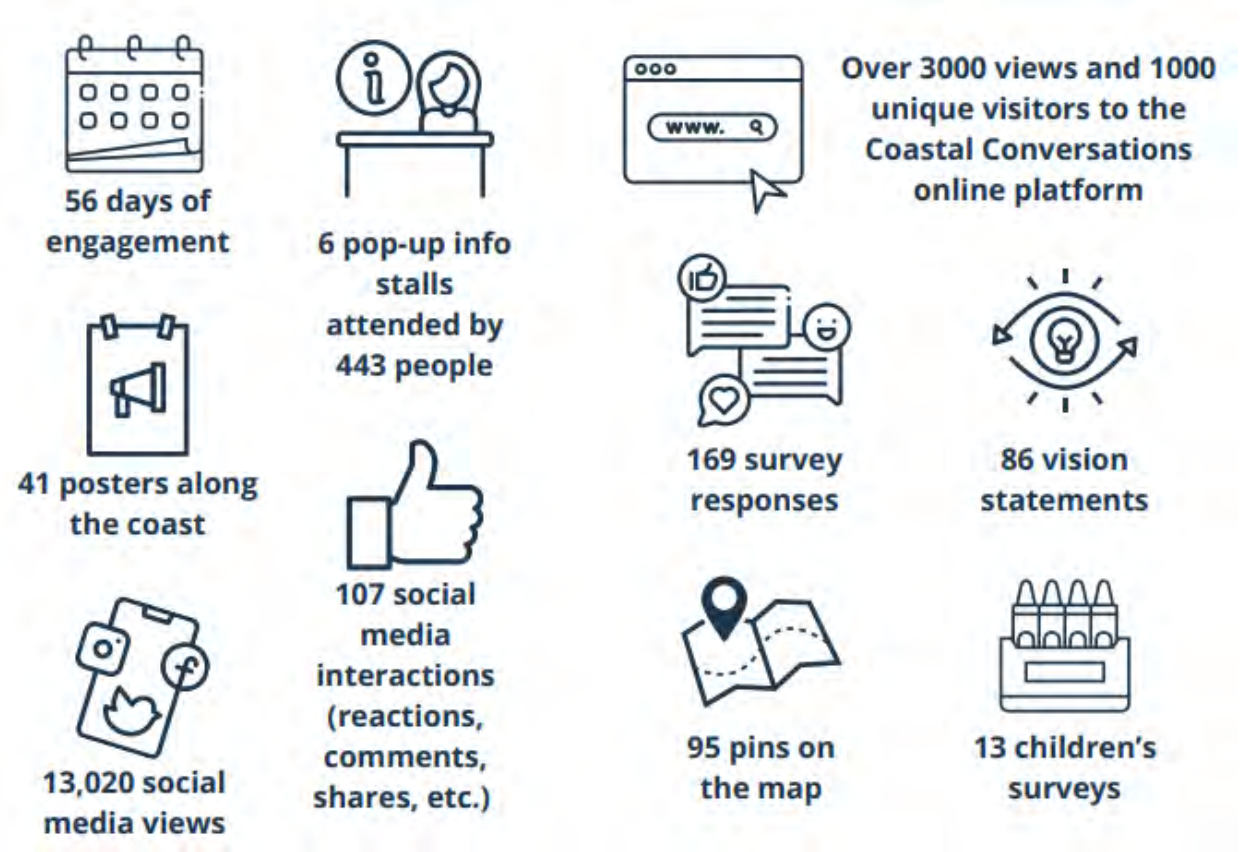


Figure 5.1 How we engaged, Bellarine Bayside Community engagement summary

Community feedback regarding the desired characteristics for the coast in 15 years' time included that they desire the coast to be a place that:

- Recognises Wadawurrung cultural values and knowledge
- Has a protected and healthy environment
- Is an accessible and safe coastline
- Provides sustainable, inclusive and well-maintained infrastructure
- Maintains the existing natural beauty
- Fosters community connections.

5.2 RIGHTS HOLDERS – WADAWURRUNG TRADITIONAL OWNERS ABORIGINAL CORPORATION

Wadawurrung values were primarily captured through direct engagement with representatives from the Wadawurrung Traditional Owners Aboriginal Corporation. Their contributions at both strategic and technical levels—through the Project Control Group and Planning Working Group—helped guide the development of the Coastal Adaptation Plan. This collaboration supported meaningful conversations about how we can work together to strengthen the resilience of the northern Bellarine coast to coastal hazards, now and into the future.

We also worked closely with Wadawurrung to ensure the Coastal Adaptation Plan aligns with their broader strategic vision, including the Wadawurrung Healthy Country Plan and the Climate Action Strategy (currently in development).

Deepening Understanding of Wadawurrung Values

As part of our commitment to embedding cultural knowledge in coastal adaptation planning, staff joined Wadawurrung Elders for a Walk on Country to explore the cultural values at two significant sites. The session provided an opportunity to share insights on local landscapes, plants, and wildlife, while listening to stories of connection and the importance of caring for Country. An image of the day and the attendees from the project team is provided in Figure 5.2.

Figure 5.2 WTOAC Corporate education day attendees (Bellarine Bayside and GHD)

5.3 VALUES AND COASTAL USE

Respondents were asked to select coastal values important to them and activities they undertake on the coast. The key values are summarised in Table 5.1. The results showed that the northern Bellarine coast is highly valued for its natural beauty, especially beaches, wildlife, and wetlands. Community members enjoy passive recreation such as walking, swimming, and cycling, as well as water activities like snorkelling, fishing, and kayaking. The region's relaxed, peaceful atmosphere and its role in supporting social connections and community participation are also important to residents and visitors.

Table 5.1 Values and Coastal Use, Bellarine Bayside Community engagement summary

Natural Beauty and Environment - beaches was the highest rated coastal value, selected by 160 survey respondents, followed by wildlife with 124 responses and wetlands with 105 responses.
Passive Recreational Activities - the most popular activities when visiting the coast are walking with 158 responses, swimming with 140 responses, dog walking with 95 responses and cycling with 78 responses.
Relaxed and Peaceful - the quiet atmosphere of the region is highly valued with 124 survey respondents enjoying the coast for relaxing and 88 saying they visit to picnic or eat a meal.
Water Activities - the coast is valued for a wide range of water activities including 72 responses saying they enjoy the coast for snorkeling/diving, 64 responses for fishing, 52 responses for kayaking/canoeing, 50 responses for boating and 49 responses for stand-up paddleboarding.

Community and Social Aspects - many responses gave a strong sense that the coast provides important community connections through shared spaces, social recreation and opportunities to participate in community activities.

5.4 CONCERNS FOR THE COAST

As part of the consultation, respondents were invited to identify their concerns from a list of 23 issues identified during previous community engagement, as well as share any additional issues. Of these, the main concerns raised were erosion, litter and pollution, loss of native vegetation and weeds, and conflict arising from different uses of the coast. There was also a strong desire to improve coastal maintenance and ensure public facilities are accessible and well maintained. The key concerns are summarised in Table 5.2.

Table 5.2 Concerns for the coast, Bellarine Bayside Community engagement summary

Erosion - selected by 114 survey respondents and mentioned frequently in open ended questions, erosion is of high concern for the northern Bellarine Peninsula.

Litter and Rubbish - 104 survey respondents selected littering and rubbish as a concern, and open-ended responses also mentioned Pollution such as stormwater run-off.

Loss of Native Vegetation and Weeds - correlating with the high value for the natural environment and wildlife, loss of native vegetation is a concern for 90 respondents, and weeds are a concern for 89 respondents.

Visitor Conflict - a key theme for concern was the differing ways in which people enjoy and use the coast, with many responses commenting on the demand this places on the coast by users.

Facilities and Maintenance - there was a strong desire to keep coastal maintenance standards high, and concern expressed about limited all-abilities facilities, as well as ageing or damaged public facilities.

5.5 IDEAS AND OPPORTUNITIES

Respondents were asked to provide their ideas for the coast, and what they thought was most important to ensure the coast is protected and enjoyed into the future. The key ideas and opportunities are summarised in Table 5.3.

Table 5.3 Ideas and opportunities, Bellarine Bayside Community engagement summary

Plant more native vegetation - selected by 100 survey respondents and mentioned frequently in open-ended questions, planting more native vegetation was recognised as highly important to help mitigate a range of concerns including erosion, replacement of ageing trees, wildlife protection and improving the natural beauty.

More weed management - 90 survey respondents selected weed management as important, with open ended responses suggesting it is considered valuable to protect the natural environment and preserve the local amenity.

Improved Facilities - there were many suggestions for facility additions and improvements, including shared trails, interpretive signage, public amenities and playgrounds. A strong desire was also expressed to incorporate all-abilities options wherever possible.

Improved rubbish management - was a key theme with ideas including more rubbish bins, more frequent litter collection, educational opportunities and switching to a take your rubbish home management practice

5.6 COASTAL HAZARDS AND ADAPTATION

84 survey respondents opted to provide further feedback on the CAP. Figure 5.3 shows how well-informed people feel about the impacts of climate change on the coast.

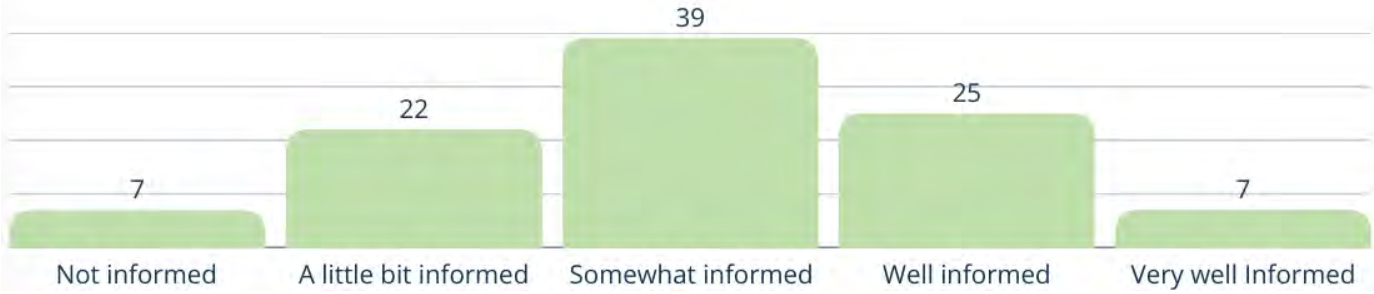


Figure 5.3 Distribution of responses to how well-informed people feel about the impacts of climate change on the coast, Bellarine Bayside Community engagement summary

6 Hazard Assessment

6.1 COASTAL PROCESSES

6.1.1 Coastal geomorphology

The northern Bellarine Peninsula is located within the southwest of the Port Phillip Sunkland. Port Phillip Sunkland is one of the two large depressions determined by north-trending faults that characterise the south-central Victorian coast, in addition to the Western Port Sunkland (Miner and Rosengren, 2017). The northern Bellarine Peninsula is classified by three tectonic fault lines, including Leopold Fault, Curlewis Monocline and Bellarine Fault (Figure 6.1). The main three terrain units that comprise the northern Bellarine Peninsula include Bellarine hill and plateau, consisting of a central area between Leopold, Portarlington and Ocean Grove, Swan Bay and eastern lownland consisting of a fringe of gently undulating sloping lowland, and the Barwon and Connewarre lowland in the west, extending south from Stingaree Bay at Geelong to the Bass Strait coast at Breamlea (Figure 6.2) (Miner and Rosengren, 2017).

The Bellarine Peninsula lies within the Ordovician and Silurian metasediments and Devonian granites beneath a cover of Mesozoic and Cainozoic sediments and volcanics (Miner and Rosengren, 2017). The geology of the northern Bellarine coastline is characterised of Pleistocene and Holocene dune and beach sands, Miocene basalt and tuff, Pleistocene Bridgewater Formation aeolian calcarenite, dune and beach sands, and Holocene and Pleistocene alluvium (Figure 6.3) (Miner and Rosengren, 2017). Backshore outcrop exist along the steep coastal slopes at Portarlington and sections of St Leonards whilst southeast of Steeles Rock in Portarlington the backshore is poorly consolidated sediments of alluvial and aeolian origin (Miner and Rosengren, 2017).

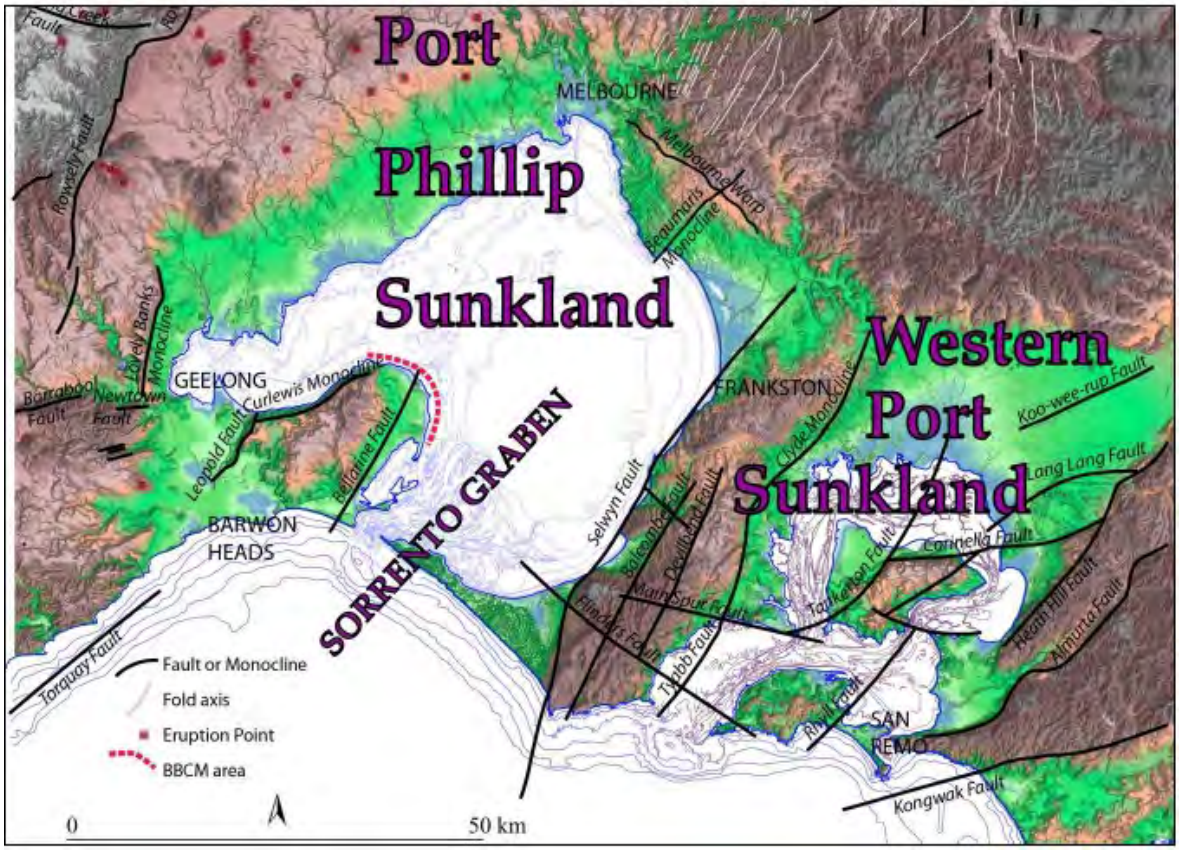


Figure 6.1 Tectonic context of the Bellarine Peninsula (Miner and Rosengren, 2017)

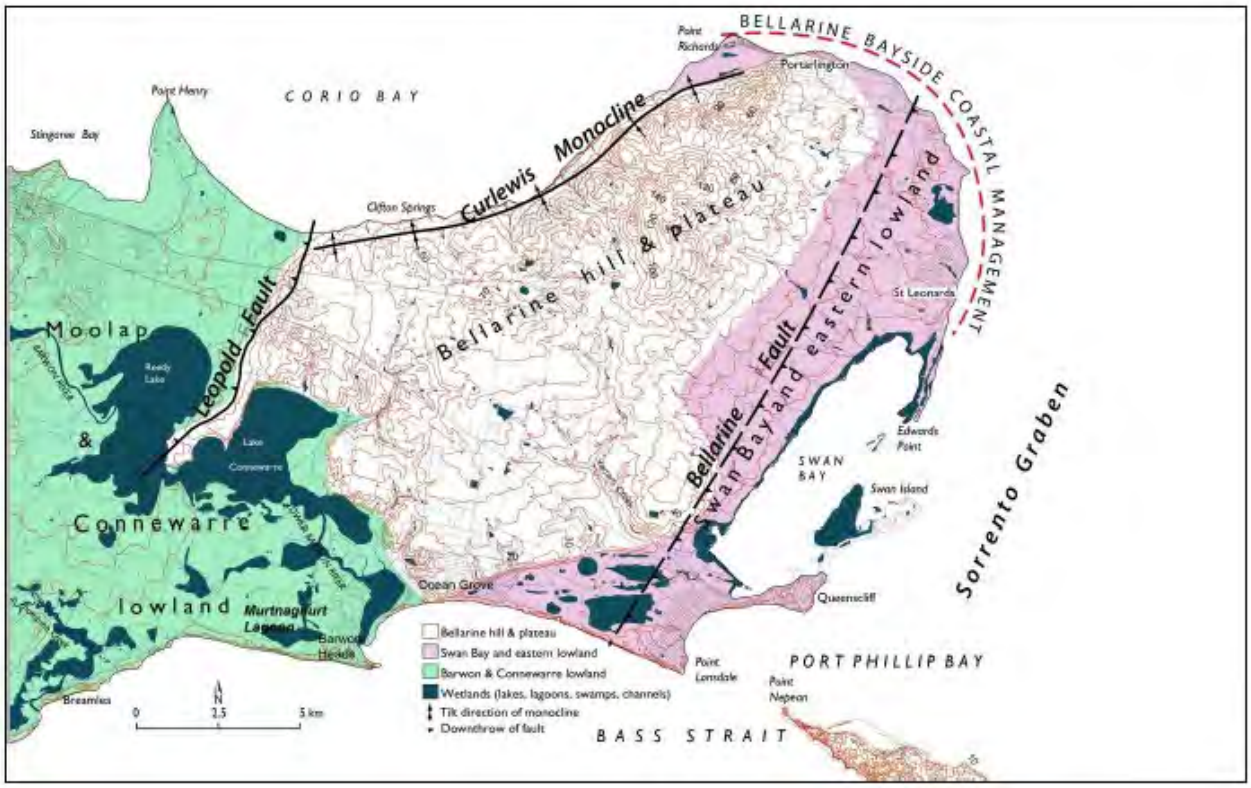


Figure 6.2 Terrain and tectonics, Bellarine Peninsula Coastal Management Area (Miner and Rosengren, 2017)

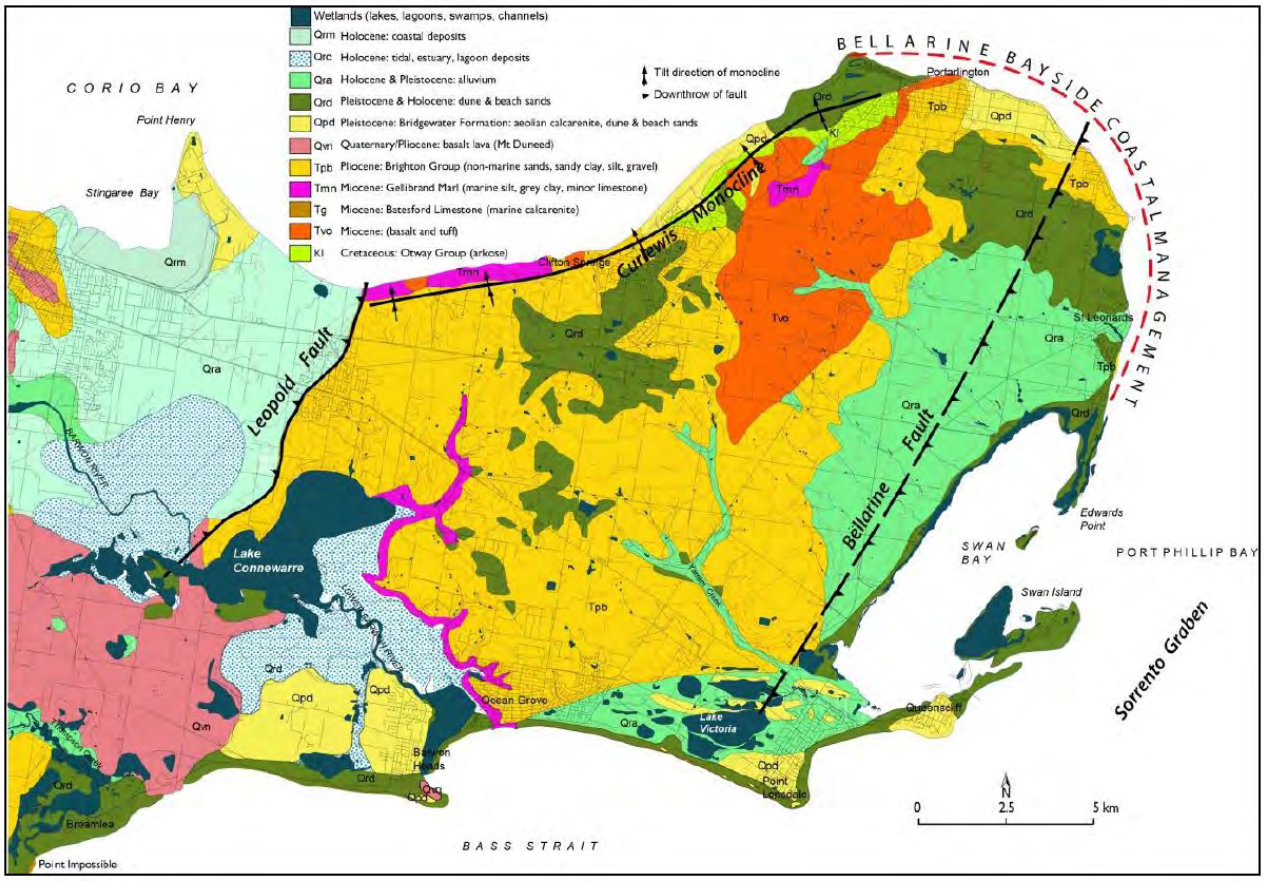


Figure 6.3 Geology of Bellarine Peninsula (Miner and Rosengren, 2017)

6.1.2 Geomorphic setting and tertiary coastal compartments

The 17 km stretch of northern Bellarine Peninsula is geologically similar, however has a diverse coastal geomorphic setting (Miner and Rosengren, 2017) as outlined in Table 6.1. The coastline is broken into six categories of shoreline geomorphic setting according to Victoria's Resilient Coast – Adapting for 2100+(VRC) framework and guidelines , which is outlined in Table 6.2. In addition, there are numerous tertiary coastal compartments along this stretch of coastline, where tertiary compartments are defined as a section of coast within which long and cross-shore movement of sediment can be expected to occur within a decade. This movement is calculated based on geomorphic features related to aeolian and hydrodynamic processes (Kennedy, 2022).

The coastal Precincts were determined based on their shoreline geomorphic setting, tertiary coastal compartments, and vulnerability to coastal hazards. Information to determine these was based on various sources such as the CoastKit (2024) online resource (including the Bellarine Geomorphic Compartments layer), NCCARF, 2024 CoastAdapt Shoreline Explorer, and information from various reports including Miner and Rosengren (2017) and Kennedy, 2022. Some Precincts feature multiple geomorphic setting characteristics and tertiary compartments, which are described below, and the length of each geomorphic setting has been estimated in Table 6.2.

The predominant beach geomorphology consists of a sandy shoreline overlying a variably exposed shore platform, with a low bluff backshore, and occasional soft or hard rock cliffs. The shoreline is intermittently modified by engineered structures and landscaping, some of which is identifiable by engineering structures mapped in CoastKit (2024), others which are informed by Miner and Rosengren (2017).

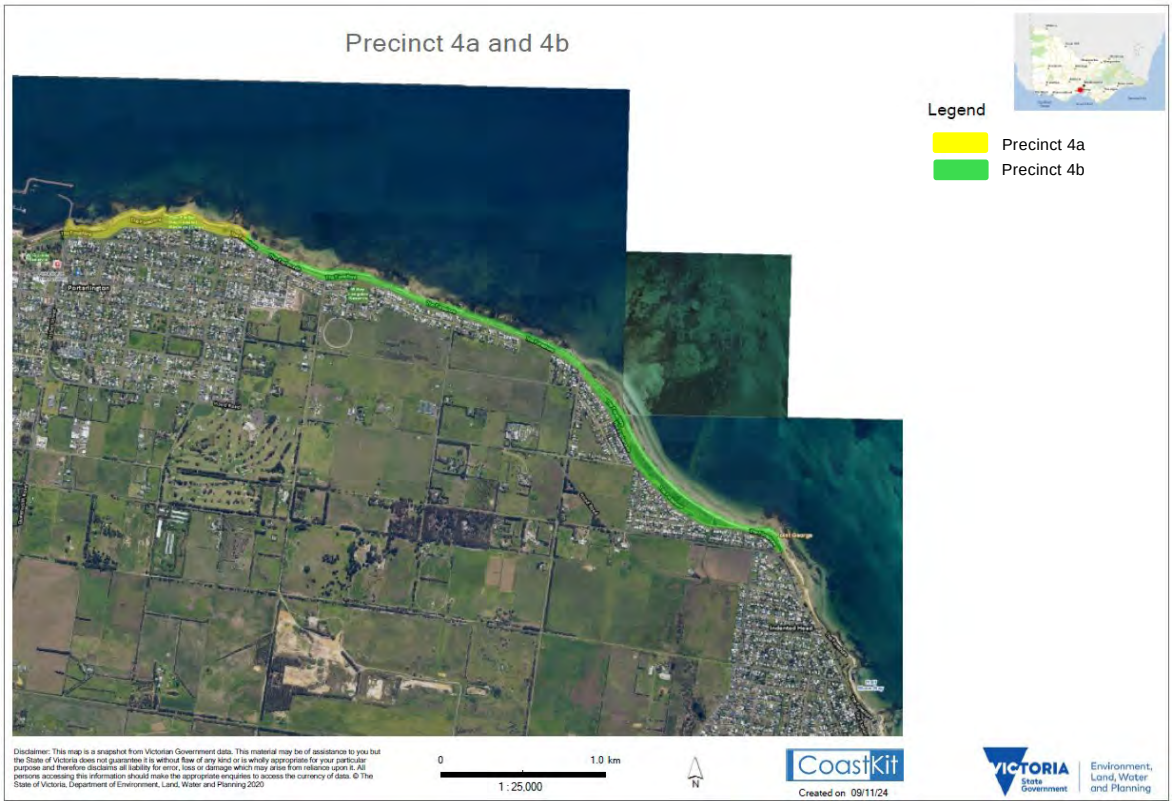
Table 6.1 Geomorphic setting for the northern Bellarine (adapted from the Victoria's Resilient Coast – Adapting for 2100+ (DEECA 2023))

Precinct	Precinct description
Precinct 1	Precinct 1 is located at the Point Richards Flora and Fauna Reserve and does not include any coastline. 

Precinct	Precinct description
Precinct 2	Precinct 2 encompasses Point Richards and Portarlington Holiday Park. The present-day coastline is dominated by a sandy shoreline with engineered structures including breakwater, revetment, groynes and artificial shorelines associated with the Point Richards boat ramp and the Portarlington Caravan Park boat ramp. It is noted by Miner and Rosengren (2017) that the entire shoreline is anthropogenic, with no pre-1750 surface morphology preserved, however the measured 'engineered coastline' is restricted to the presence of mapped engineered defensive structures. The Portarlington Holiday Park is all within one tertiary sediment compartment and has well defined boundaries. The Point Richards boat ramp is within a separate closed tertiary sediment compartment and will require ongoing sediment management (dredging). However, the Bellarine Bayside managed land adjacent to the Point Richards boat ramp (carpark / miniature railway etc) has similar coastal vulnerabilities to the Portarlington Holiday Park. As these facilities are all interlinked the Point Richards boat ramp remains within the same Precinct as the Portarlington Holiday Park. 

Precinct	Precinct description
Precinct 3	Precinct 3 encompasses the Portarlington Harbour and breakwaters, and is considered to be a highly modified landform featuring numerous breakwater, seawall, and rock revetment structures. A sandy beach coastline is present however this whole Precinct is considered to be engineered. Portarlington Harbour is within its own closed tertiary sediment compartment. Whilst the harbour is not managed by Bellarine Bayside, the shore is. Vulnerabilities and adaptation measures for this section of the shore will largely depend on management activities associated with the harbour (e.g. dredging). The shore immediately west of the harbour to the Portarlington Holiday Park is within the same tertiary sediment compartment as the Portarlington Holiday Park. Adaptation measures for this stretch of coast will therefore be linked to those for the Portarlington Holiday Park. This Precinct has unique values as described in Section 4. It also has unique management challenges such as increased demand for access. Due to this, the reserves should be considered wholistically, and within the same Precinct. 

Precinct	Precinct description
Precinct 4a	Precinct 4a extends from the Portarlington Harbour eastern breakwater to 50 m to the west of the intersection of Mercer Street and The Esplanade. The western extent of this Precinct features a cliff outcrop of Older Volcanic Basalt and Brighton Group, however, is protected by a seawall, and this portion is therefore considered to be engineered shoreline. Beyond this seawall the shoreline consists of a sandy beach with a low bluff behind it. The Precinct includes two embayments of sandy shoreline separated by Steeles Rock, a cliffed low headland of Brighton Group with no beach exposure. East of the Steeles Rock boat ramp embayment, the shoreline becomes dominated by a cliff outcrop of Brighton Group Sandstone. The majority of this Precinct has an exposed shore platform. There are two tertiary sediment compartments within this Precinct as follows: the Portarlington Harbour eastern breakwater to Steeles Rock, which has an active slope and extensive reef; and Steeles Rock to 50 m to the left of Mercer Street/The Esplanade. Steeles Rock to 46 The Esplanade is an active rockfall site with a high potential for ongoing falls expected at this site. Precinct 4a and Precinct 4b have been separated as the predicted inundation and erosion hazards do not extend landward of The Esplanade for Precinct 4a, and therefore their adaptation pathways may differ. 

Precinct	Precinct description
Precinct 4b	Precinct 4b covers a large stretch of shoreline from 50 m to the west of the intersection of Mercer Street and The Esplanade to Point George. The coastline is dominated by sandy beaches, or mixed sandy beach with variably exposed shore platform, with a generally gently sloping backshore. Minimal engineered structures are listed on CoastKit (2024) within this Precinct, with the exception of an older, informal structure located near Grassy Point and its associated modified backshore. Multiple mobile shore-parallel sand bars are present in this Precinct. The southeastern portion of this Precinct from Pike Street to 200 m west of Point George is reported by Miner and Rosengren (2017) to be a highly modified area of infilled/claimed/engineered shoreline. There are two main tertiary sediment compartments within this Precinct as follows: 50 m to the left of Mercer Street/The Esplanade to Grassy Point Road, and Grassy Point Road to Point George. 

Precinct	Precinct description
Precinct 5	Precinct 5 extends from Point George to Batman Memorial beyond the Indented Head boat ramp, and features extensive portions of engineered coastline, considered by Miner and Rosengren (2017) to be a fully engineered and managed shoreline. Engineered structures include seawalls, breakwater, rock revetments, groyne structures, and boat launching/ramps. The coastline has typically wide stretches of exposed sandy beach and some sandbars oblique to the shore. Some exposures of the natural backshore include low regolith cliffs, and active cliffs of Brighton Group. Further south beyond Half Moon Bay to Indented Head the backshore is a modified 60 m wide zone of sand beach ridges. At Indented Head the natural low cliff has exposed the Blackrock Sandstone, and the sandy beach is absent and the coastline locally protected by rock revetment. There are three open and leaky tertiary sediment compartments within this Precinct as follows: • Anderson Reserve to Taylor Reserve – This sediment compartment has been identified as an erosion hotspot, with a moderate rate of erosion occurring between approximately 1980 to 2017. Additional groynes were installed in late 2016 / early 2017 and beach nourishment has been undertaken recently. • Taylor Reserve to Helen Street / Batman Park: This compartment includes the Ozone wreck and historic boatsheds. There is an active cliff along the northern extent of this section towards Taylor Reserve, and a maintained slope towards Batman Park. Due to this increase in elevation, the long term inundation hazard is contained. However, this sediment compartment has been identified as an erosion hotspot, and beach nourishment was undertaken recently. • Batman Park to Wrathall Reserve: This is a long gently curving bay (Hood Bight) with wide shallow offshore sand bars and includes historic boatsheds. Predicted inundation and erosion hazards do not generally extend landward of The Esplanade. Since this Precinct covers most of the Indented Head coastline, and is likely to have similar vulnerabilities and adaptation measures, this Precinct remained as one Precinct. Although the small section of coast from Wrathall Reserve to the Batman Memorial is within a different tertiary sediment compartment, this was included in the same Precinct as Wrathall Reserve in order for the vulnerabilities and adaptation measures to be considered for the whole Wrathall Reserve in the same Precinct. 

Precinct	Precinct description
Precinct 6a	Precinct 6a is a small section of coastline from Batman Memorial to North The Bluff (south of Jade Tiger Abalone), with no formally mapped engineered structures, but some sand fencing. A narrow sandy beach terminates against a near vertical low cliff of Brighton Group Sandstone. Whilst this isn't a separate sediment compartment to that adjacent to the St Leonards Salt Lagoon, this area has different vulnerabilities to the stretch of coast adjacent to the Salt Lagoon, and therefore the adaptation pathways may differ. 

Precinct	Precinct description
Precinct 6b	Precinct 6b consists of a long stretch of coastline that forms a sand barrier ridge in front of Salt Lagoon, with the road being very close to the beach throughout much of this section. Minimal engineered structures are recorded on CoastKit (2024), however Miner and Rosengren (2017) illustrate a long history here of defensive structures such as earth/rock fill, geotextiles, fencing and retaining structures, implemented to maintain the road access that divides the lagoon from the beach. The coastline here is dominated by sandy beach, however it is unclear what portion of this coastline is engineered and what portion is natural. At this stage the mapped portion of seawall has been attributed to engineered coastline and the rest of the coastline as sandy shoreline, however it is noted that a larger portion of the coastline is engineered than is captured by CoastKit (2024). This Precinct is all within one tertiary coastal compartment. Although Salt Lagoon is not managed by Bellarine Bayside, adaptation measures for this stretch of coast will need to take into consideration the presence of Salt Lagoon, which could be affected by inundation in a present day 1% Annual Exceedance Probability (AEP) storm. The properties behind the road are located in a low lying area and have been inundated in the past. This stretch also includes an offshore reef adjacent to the Salt Lagoon, which will be taken into consideration when determining adaptation pathways for this area. Hence this area was designated as a separate Precinct due to its unique characteristics. 

Precinct	Precinct description
Precinct 7	Precinct 7 stretches from 460 The Esplanade, Northern Beach to William Buckley Labyrinth, and includes St Leonards Pier, featuring engineered structures such as seawall, breakwater, and numerous groynes. This Precinct includes variable geomorphology; to the north of the St Leonards Pier is exposed cliffs of weathered Brighton Group with a sandy beach foreshore. To the south of the pier Precinct is a thin sandy beach over shore platform. The pier and breakwater Precinct is reportedly altered by fill and nourishment over the natural Brighton Group. 

Precinct	Precinct description
Precinct 8	Precinct 8 extends south from William Buckley Labyrinth to The Bluff, and features significant engineering alteration including timber and concrete seawalls, groynes, and a boat ramp and jetties. The area is considered to be a former tidal lagoon with intermittent sand barrier, but is now partially modified to manage flooding. The site now features a sandy beach shoreline, with the exception of the southernmost extent of this Precinct at The Bluff where the outcropping cliffs of weathered Brighton Group are exposed with a narrow sandy beach. This coastline is considered to be all within one tertiary sediment compartment, although the St Leonards boat ramp could be considered as a leaky boundary, dividing this Precinct into two tertiary sediment compartments. The whole area has similar coastal vulnerabilities, although the predicted erosion hazard is slightly more significant at the entrance to the St Leonards Lake, and north of this to St Leonards Pier. Since the adaptation pathways are likely to be similar for this whole area, it has all been included in one Precinct. 

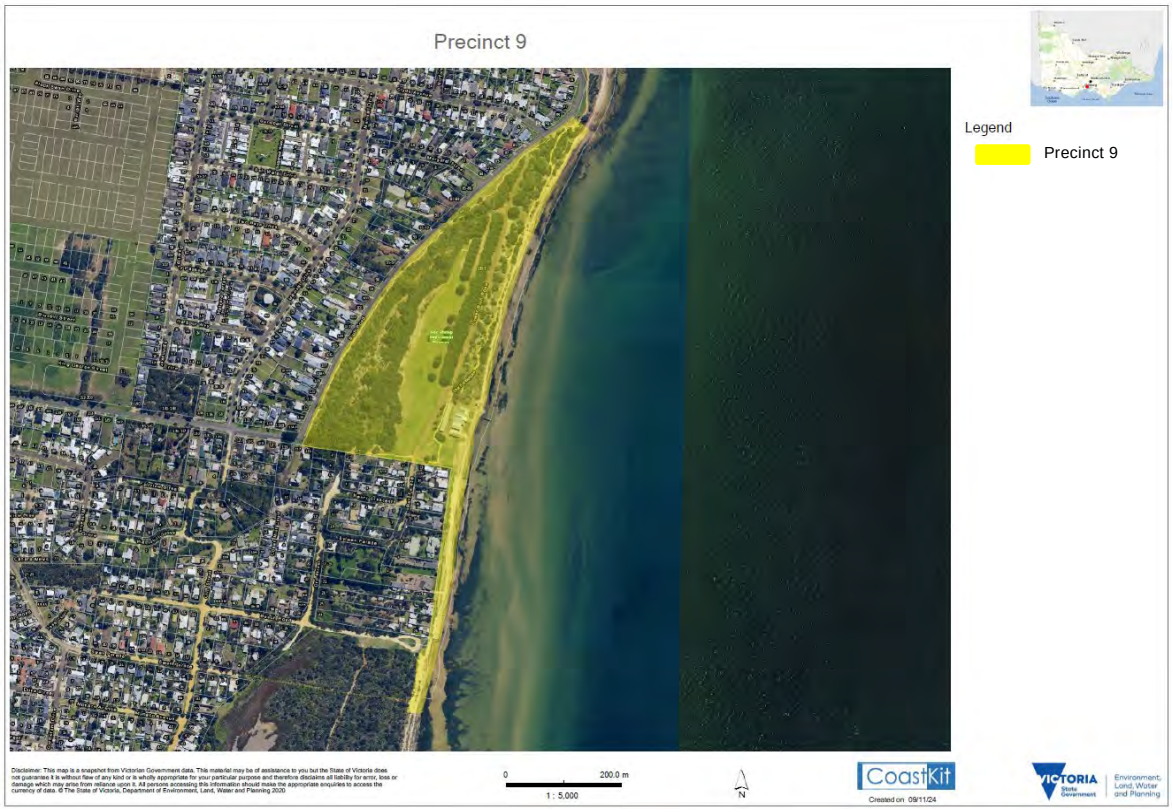
Precinct	Precinct description
Precinct 9	Precinct 9 extends from the Bluff to Beach Road, and encompasses the end of the Edwards Point spit and lagoon geomorphology. The geomorphology here is dominated by a sandy beach in front of a high bluff, and has undergone significant engineered modifications, featuring long stretches supported by seawall, breakwater, revetment, and groynes. This Precinct is all within one tertiary sediment compartment. 

Table 6.2 Geomorphic setting for the northern Bellarine (adapted from the Victoria's Resilient Coast – Adapting for 2100+ (DEECA 2023))

Setting/shoreline class	Description of geomorphic setting	Estimated Length (Precinct)	Percentage of total northern Bellarine coastline
Sandy shorelines	Beaches are formed from a combination of terrestrial and marine-derived sediments. Sandy shorelines cover extended sections of the open coast, as well as smaller pocket or compartmentalised beaches.	1,500 m (Precinct 2) 500 m (Precinct 4a) 2,700 m (Precinct 4b) 1,600 m (Precinct 6b) 400 m (Precinct 7) 600 m (Precinct 8) 500 m (Precinct 9) **7,800 m (Total, along 17 km coastline)**	8.8 % (Precinct 2) 2.9 % (Precinct 4a) 15.9 % (Precinct 4b) 9.4 % (Precinct 6b) 2.4 % (Precinct 7) 3.5 % (Precinct 8) 2.9 % (Precinct 9) **45.9 % (Total, along 17 km coastline)**
Low earth scarp shorelines	Low earth scarp shorelines or 'muddy' coasts are typically restricted to the low-energy environments of large bays and consist of low cliffs and scarps, intertidal flats consisting of silty sand or peat materials, often colonised by mangroves, seagrasses or saltmarsh vegetation.	N/A	N/A
Hard rock cliffs with and without platform and/ or beach	Rocky coasts are the result of the weathering of ancient rocks over millennia by marine and atmospheric processes such as waves, currents and winds. They comprise a range of landform types, including hard rock coasts (e.g. granite, basalt, sedimentary) and soft rock coasts (e.g. limestone, clay), and occur on open coasts and estuarine areas.	600 m (Precinct 4a) 400 m (Precinct 5) 500 m (Precinct 6) **1,500 m (Total, along 17km coastline)**	3.5 % (Precinct 4a) 2.4 % (Precinct 5) 2.9 % (Precinct 6) **8.8 % (Total, along 17km coastline)**
Soft rock cliffs with and without platform and/ or beach		300 m (Precinct 7) 200 m (Precinct 8) **500 m (Total, along 17km coastline)**	1.8 % (Precinct 7) 1.2 % (Precinct 8) **2.9 % (Total, along 17km coastline)**
Estuarine and tidal channels	Where streams enter the sea either via estuaries and tidal channels. Estuaries, intermittently open and close lakes and lagoons.	150 m (Precinct 8) **150 m (Total, along 17km coastline)**	0.9 % (Precinct 8) **0.9 % (Total, along 17km coastline)**
Engineered coastline	Some sections of the coast have been significantly modified over time with the use of infrastructure – e.g. seawalls, drains, groynes.	500 m (Precinct 2) 1,000 m (Precinct 3) 900 m (Precinct 9) 150 m (Precinct 4a) 1,200 m (Precinct 4b) 1,900 (Precinct 5) 100 m (Precinct 6b) 450 m (Precinct 7) 350 m (Precinct 8) 500 m (Precinct 9) **7,050 m (Total, along 17km coastline)**	2.9 % (Precinct 2) 5.9 % (Precinct 3) 5.3 % (Precinct 9) 0.9 % (Precinct 4a) 7.1 % (Precinct 4b) 11.2 % (Precinct 5) 0.6 % (Precinct 6b) 2.6 % (Precinct 7) 2.9 % (Precinct 8) 2.9 % (Precinct 9) **41.5 % (Total, along 17km coastline)**

6.1.3 Bathymetry and seabed conditions

Bathymetry within Port Phillip Bay varies greatly, with depths ranging from a 100 m deep canyon towards the entrance of the bay to relatively shallow banks further to the north (Cardno 2014). Water entering or leaving Port Phillip Bay flows over range of depths which results in highly turbulent flow with large eddies (Cardno 2014). Immediately inside the entrance to Port Phillip Bay is the Great Sands. Due to the size of the Great Sands and the shallow bathymetry, the sands dampen wave activity approaching through the entrance and results in any locally derived wind waves being depth limited. Bathymetry within the study area is as shown in Figure 6.4 and seabed conditions are shown in Figure 6.5.

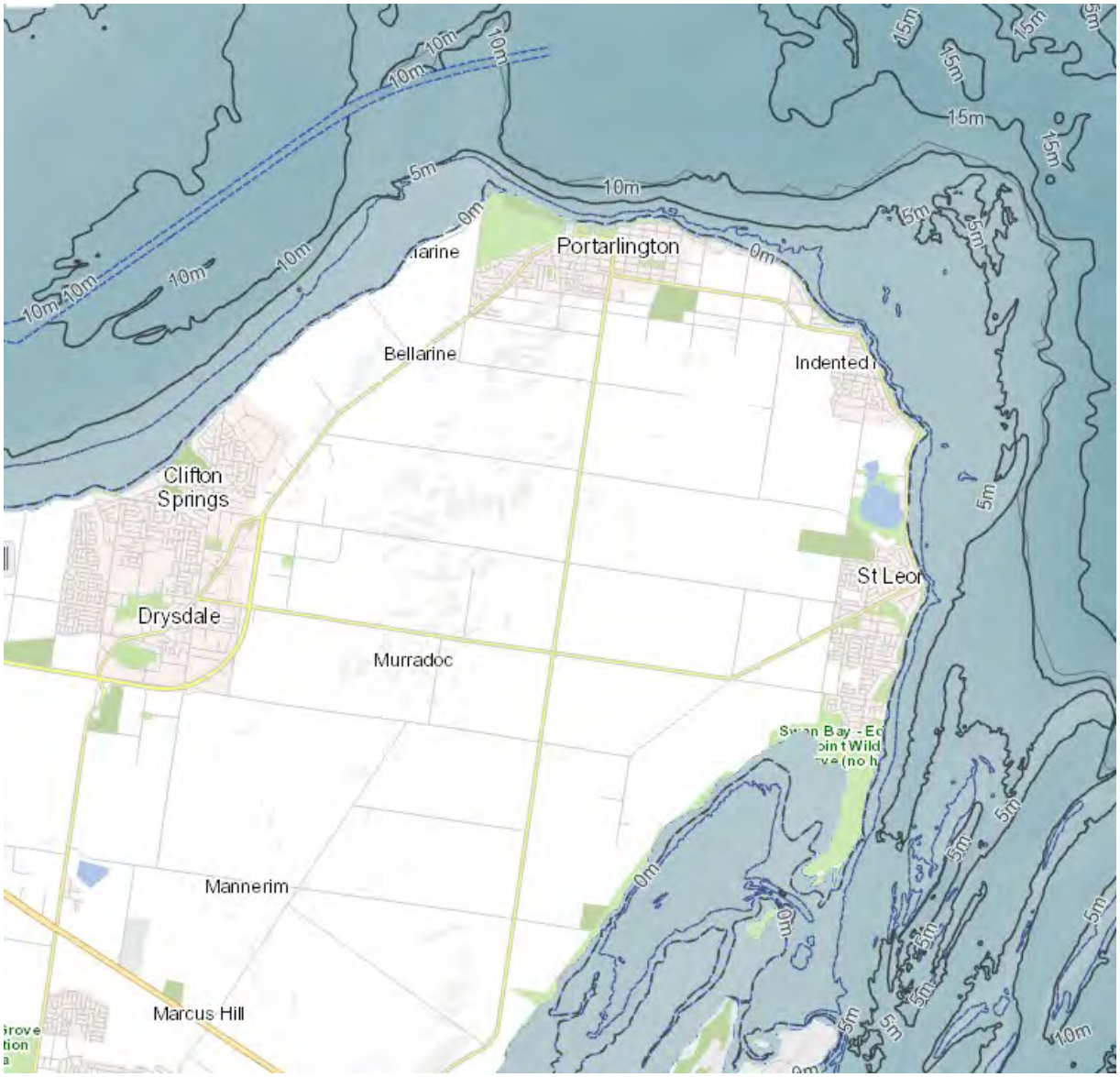


Figure 6.4 Bathymetry within the study area (CoastKit 2024)

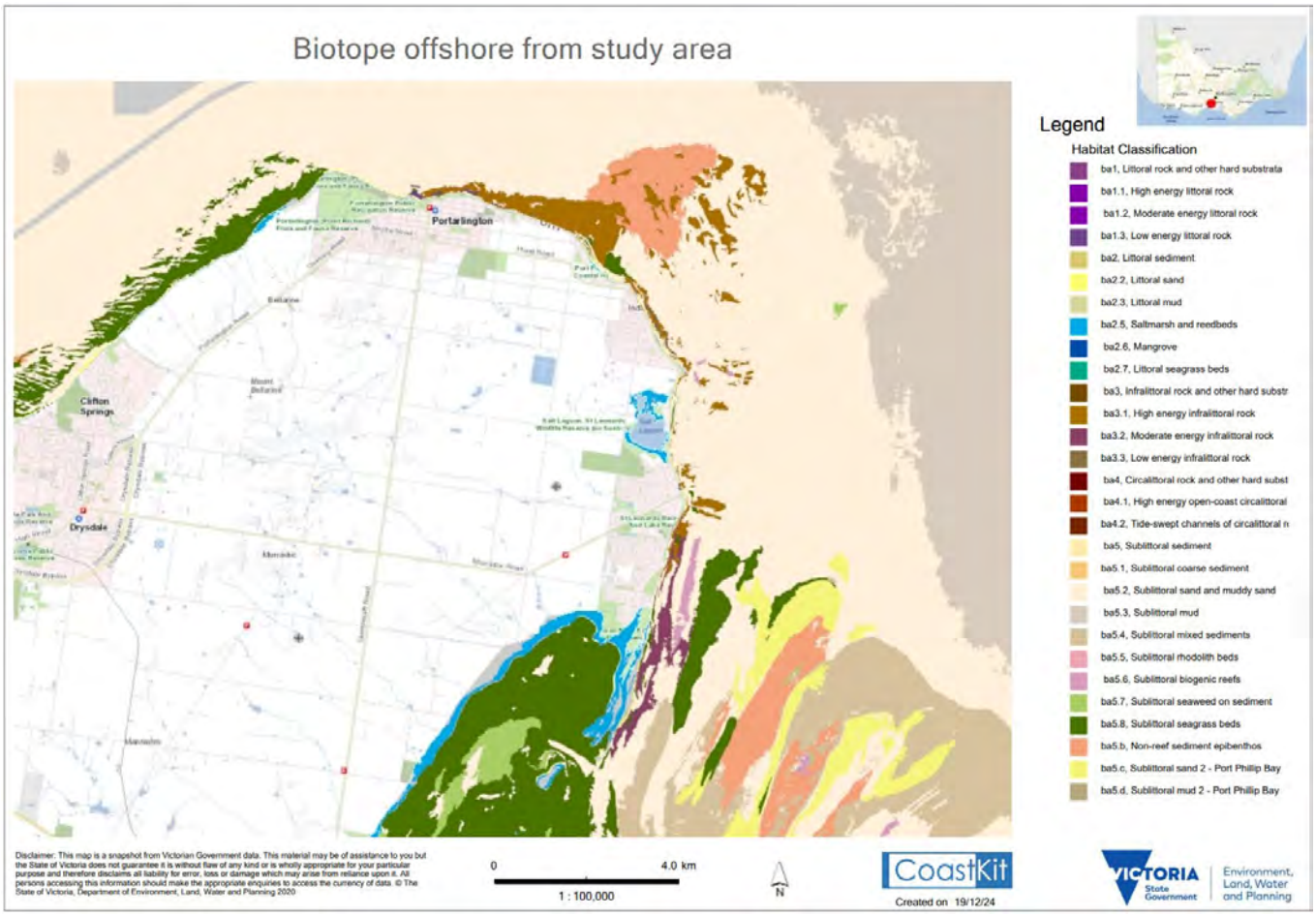


Figure 6.5 Biotope offshore from the study area (CoastKit 2024)

6.1.4 Water levels and currents

6.1.4.1 Astronomical tides

Astronomical tides are the daily rise and fall of sea levels caused by the combined effects of the rotation of the earth and the gravitational attraction between the earth, moon and the sun. Tides within Port Phillip Bay are classified as diurnal with one major tidal cycle each day. The tidal planes at Williamstown are considered representative of conditions in the study area and are provided in Table 6.3 below.

Table 6.3 Tidal planes within the study area (Williamstown, VicTides, Ports Victoria 2023)

	Astronomical tide level (m AHD)
Highest Astronomical Tide (HAT)	0.59
Mean Higher High Water (MHHW)	0.54
Mean Lower High Water (MLHW)	0.21
Mean Higher Low Water (MHLW)	0.07
Australian Height Datum (AHD)	0
Mean Lower Low Water (MLLW)	-0.26
Lower Astronomical Tide (LAT)	-0.484
Chart Datum (CD)	-0.524

6.1.4.2 Storm tide (extreme water levels)

Storm surge is an unusual rise in coastal water levels during a storm due to the barometric and wind set-up effects (CSIRO, 2022). It is measured as the water height above the usual predicted astronomical tide. Storm tide is the total elevated sea level at the coast during a storm, combining storm surge with astronomical tide. To determine adaptation pathways, coastal inundation maps were generated from CoastKit, which show the temporary inundation that can occur during a storm tide – i.e. when the sea level is elevated above regular tidal levels. The storm tide event that was used to generate the maps is a 1% AEP storm tide, where AEP is the measure of the likelihood (expressed as a probability) of an event equalling or exceeding a given magnitude in any given year.

The spatial pattern of the 1% AEP storm surge height for Port Phillip Bay, not including a tidal component or consideration of sea level rise, is shown in Figure 6.6.

Figure 6.6 Spatial pattern of the 1% AEP storm surge height, not including a tidal component, for Port Phillip Bay (McInnes et al 2009b)

6.1.4.3 Currents

Tidal currents within Port Phillip Bay show a marked variation, with speeds exceeding 3.5 m/s in Port Phillip Bay Heads, over 1 m/s in the South of the Bay channels, and generally below 0.2 m/s in the body of Port Phillip Bay north of the Sands. Consequently, tidal currents are essential to coastal processes and sediment movement in The Entrance and the Sands but less so in other areas of Port Phillip Bay (Cardno 2014).

For the section of Port Phillip Bay that is relevant to the study area and north of the Sands, tidal currents are generally weak with speeds of less than 0.2 m/s. During storms, current magnitudes of approximately 0.3 - 0.6 m/s may occur at Point Richards, Point George and south of St Leonards Pier (Cardno 2011b).

6.1.5 Wave climate

Depending on water depth and wind direction, waves within the study area can exceed 1 m in height, however this is rare. The height and direction of waves depend on the wind speed and direction as well as the fetch, which is the distance over which the wind blows. The presence of the Great Sands, as shown in Figure 6.7, limits the wave energy that reaches the shoreline of the east coast of the Bellarine Peninsula (Cardno 2014).

Figure 6.7 Great Sands within Port Phillip Bay in proximity to the study area (Cardno 2014)

During the summer months, south to southwest winds blow offshore, meaning wave conditions are generally calmer during this period. Less frequently occurring winds from the north through to the southeast will result in waves with heights typically up to 0.5 m offshore (Cardno 2014). Fresh to strong east winds could generate onshore wave heights of up to 1.0 m or more, however much of the associated wave energy is lost as it crosses sand banks (Water Technology 2005).

In winter there is a higher proportion of onshore and alongshore winds which results in more wave action when compared to the summer months. Relatively frequent fresh to strong north winds generate more frequent high waves with heights of 1.0 to 1.5 m approaching from the north (Water Technology 2005).

6.1.6 Sediment transport

Sediment is transported along the Bass Strait coast from west to east and it is estimated that approximately 400,000 m^3/yr of sand reaches Point Lonsdale from the west (Cardno 2011a) and approximately half of this sand is carried offshore by the ebb tide. It is estimated that between 50,000 and 80,000 m^3/yr are moved by wave-generated longshore currents along the beaches of Lonsdale Bight (Cardno 2014). Once sand reaches Shortland Bluff, some is carried further north past Queenscliff and moves onto the beaches within the study area via tidal streams and longshore currents (Cardno 2014).

The coastlines within the study area are known to be dynamic and highly seasonal, driven primarily by southerly winds in the summer and northerlies in winter (Murphy N.D). Longshore sediment transport is dependent on wave period, wave height, sediment size and the angle of wave break in relation to the contours of the seabed. A summary of sediment transport within the study area is provided in Table 6.4.

Table 6.4 Sediment size and transport data (Murphy N.D)

Site	Direction of movement	Quantity per year (approx.)	Grain size
St Leonards	North to south	5,000m^3	0.24 – 0.30mm
Indented Head	South to Edwards Point	2,500m^3	0.25 – 1.03mm
Portarlington	West towards Point Richards	600m^3	0.13 – 0.97mm

6.2 COASTAL HAZARDS

Coastal hazards, including erosion, accretion, inundation, and saline intrusion, pose significant challenges to coastal environments and communities. Erosion involves the loss of coastal land due to wave action, currents, or human activities, threatening infrastructure, ecosystems, and livelihoods. Conversely, accretion refers to the buildup of sediment, which can alter natural landscapes and disrupt habitats. Inundation, caused by storm surges, rising sea levels, or extreme tides, leads to the temporary or permanent flooding of low-lying areas. Saline intrusion, the movement of saltwater into freshwater systems, compromises drinking water supplies, agriculture, and ecosystems in coastal regions. Understanding and managing these interconnected hazards is critical for sustainable coastal development and resilience in the face of climate change and increasing human pressures.

6.2.1 Erosion

Discussion of erosion trends within the study area have been broken up via the Precincts outlined in Section 2 and then grouped based on similar coastal conditions as shown in Figure 6.8.

Figure 6.8 Precincts grouped based on similar coastal conditions

As part of the Victorian Coastal Monitoring Program (VCMP) (DEECA, 2023), parts of Victoria's coastline have been assessed to determine the erosion indicator score of the area. The erosion indicator score is based on five statistics that give a combined score out of 10. Higher scores indicate a higher erosion warning level. The scores equate to the following in terms of erosion potential:

- 0-2 indicate a low warning level
- 3-4 a moderate level
- 5+ a high erosion warning level.

Precinct 5 was given a score of 4 out of 10 which indicates a moderate level of erosion. The short-term shoreline trend of Precinct 5 was -0.53 m/year, however the long-term shoreline trend was +0.01 m/year (DEECA, 2023). Coastal areas within Precinct 5 have a higher exposure to wave energy, and consequently more erosion. However, previous studies have found that the shoreline in this area is generally stable, with some erosion noted towards the southern end of this area (Murphy N.D).

Precincts 6 – 9 were also assessed as part of the VCMP and were assigned an erosion indicator score of 5 which indicates a high erosion warning level for this area. The short-term shoreline trend for these Precincts was +1.95 m/year, however the long-term shoreline trend was -0.13 m/year (DEECA, 2023). The coastline along Precincts 6 – 8 are primarily shaped by longshore and cross-shore sediment transport. Longshore transport of sand along St Leonards is seasonal and driven by southerly winds in the summer and northerlies in the winter (Murphy N.D). It is noted that cross-shore transport of sand within this area has the potential to move significant quantities of sand offshore and cause erosion due to the fine sands present there (Murphy N.D).

The area within Precincts 1 – 4 was not fully assessed as part of the VCMP, with only a portion of the coastal area within Precinct 4 studied. This area was given an erosion indicator score of 0, which means there is a very low level of erosion warning level for this area. The short-term shoreline trend for these Precincts was -0.21 m/year, however the long-term shoreline trend was -0.11 m/year (DEECA, 2023). Sand transport and erosion trends for Precincts 1 – 4 are described as a net onshore transport which have resulted in the ongoing build-up of most beaches within this area during the calm conditions that occur during summer (Murphy N.D). During winter, storm events produce larger waves that result in the transport of sand offshore and erosion of beaches.

Erosion maps were generated from CoastKit, which show the erosion that could occur for each Precinct during a 1% AEP storm tide and 0.2 m, 0.8 m and 1.4 m of SLR. A 1% AEP event has a 1% chance of occurring in each year. These maps are contained within Appendix A.

Table 6.5 discusses a case study of erosion occurring at Steeles Rock, Portarlington.

Table 6.5 Case study of erosion at Steeles Rock

Case study: Steeles Rock
Steeles Rock is experiencing ongoing erosion driven by severe weather events, with both recent and historic cliff collapses (refer to Figure 6.9). When failures occur, the upper cliff layers have previously broken away as large boulders. Visitor safety is an increasing concern, as the narrow stretch of beach sits close to the actively eroding cliff face. WTOAC, DEECA, CoGG and Bellarine Bayside are working together to manage the erosion and protect the site's cultural, environmental and recreational values (Bellarine Bayside, 2025). Temporary safety measures have been installed, and short-term works include beach nourishment to act as a buffer, helping to slow the rate of erosion. Further investigations are underway to develop a comprehensive understanding of the site and identify suitable medium to long-term options. This includes conceptual modelling and evaluating long-term adaptation pathways, noting that any physical changes would be subject to future planning processes (Bellarine Bayside, 2025). 

Figure 6.9 Steeles Rock (Bellarine Bayside, 2025)

6.2.2 Accretion

Accretion can occur within the study area, with the following examples of accretion being documented in Cardno, 2011b. Accretion maps have not been generated for this study area.

- Along the Point Richards coastline, analysis of photographs from 2001 and 2009 have indicated that the vegetation line has extended seawards 30 m since 1985. Further east along Precinct 2's shoreline, there has been a series of retreats and re-builds since the 1960's (Cardno, 2011b).
- The accretion of the beach directly east of the Portarlington Pier within Precinct 3 was due to a build-up of sand at Portarlington Harbour (Cardno, 2011b).
- The majority of fluctuations of accretion and erosion along the Precinct 4a and 4b coastline was analysed to occur within the small inlets and bays that are present (Cardno, 2011b).
- The shoreline along Precinct 5 to 9 appears to be relatively stable with mild fluctuations along the coastline due to the sand movement along the shorelines originating from the east of Portarlington (Water Technology, 2021; Cardno, 2011b).

6.2.3 Coastal inundation

As discussed in Section 6.1.4.2, to determine adaptation pathways, coastal inundation maps were generated from CoastKit, which show the temporary inundation that can occur during a storm tide at different levels of sea level rise projections. The storm tide event that was used to generate the maps is a 1% AEP storm tide. The maps were produced for various sea level rise (SLR) scenarios, including the 0.8 m SLR scenario, the current Victorian benchmark for 2100, which is for a moderate emissions scenario. In addition to 0.8 m SLR, coastal inundation was also mapped for a 1% AEP storm tide under 0.0 m, 0.2 m, 1.1 m and 1.4 m SLR scenarios. The maps under 0.2 m, 0.8 m and 1.4 m SLR for each Precinct are contained within Appendix A.

The 1.1 m and 1.4 m SLR maps are generated as sensitivity scenarios, since under a higher emissions scenario or faster ice sheet melting, SLR could be greater than 0.8 m by 2100, however these scenarios are more likely for beyond 2100. These sensitivity scenarios are used to assist with determining which areas are most vulnerable, and they allow better adaptive decision making.

The coastal inundation maps show the temporary inundation that could occur during a 1% AEP storm tide if no changes are made to how we manage the study area. A 1% AEP event has a 1% chance of occurring in each year. The maps were generated in CoastKit using data from CSIRO, 2022).

The percentage of each Precinct predicted to be temporarily inundated within the study area during a 1% AEP storm tide is displayed below in Table 6.6 for the 2100 scenario (0.8m SLR) and a sensitivity scenario (1.4m SLR). Based on current projections, the 0.8m SLR scenario is predicted to occur in 2100 whereas the 1.4m SLR scenario is not likely and has been included as a sensitivity scenario. Where Precincts experience inundation under current conditions, these are summarised in Table 6.7.

Table 6.6 Percentage of area predicted to be temporarily inundated for each Precinct by 2100.

Precinct	1% AEP 0.8 m SLR storm tide 2100 scenario	Location of inundation area	1% AEP 1.4 m SLR storm tide sensitivity testing	Location of inundation area	Increase in % of inundation area
1	25%	Northern portion of the Flora and Fauna Reserve	58%	Northern portion of the Flora and Fauna Reserve	33%
2	100%	Entire Precinct	100%	Entire Precinct	0%
3	34%	Car park and cafe adjacent to Portarlington Pier and north of the Portarlington Bowls Club along Pier Street	38%	Expanded area of Bowls Club and reserve	4%
4a	46%	Immediate foreshore along the coastline	58%	Immediate foreshore along the coastline	12%
4b	100%	Entire foreshore, all of The Esplanade between Mercer Street to Andersons Reserve in Indented Head	100%	Entire foreshore, all of The Esplanade between Mercer Street to Andersons Reserve in Indented Head	0%
5	45%	Foreshore reserve along Indented Head, impacting the Anderson Reserve campground and parts of the Batman Park seasonal campground	59%	Foreshore reserve and northern section of The Esplanade near Pigdon Street	14%
6a	55%	The Esplanade located further inland	62%	The Esplanade and the Abalone Farm located further inland	7%
6b	100%	Salt Lagoon, almost reaching Ibbotson Road to the west of Precinct 6b	100%	Salt Lagoon and parts of Ibbotson Road to the west of Precinct 6b	0%
7	60%	Within the foreshore reserve. Larger extents south of St Leonards Pier	76%	Mainly within the foreshore reserve. Larger extents south of St Leonards Pier	16%
8	66%	Mainly confined to the foreshore area	88%	Inundation extent increases up through to St Leonards Lake	22%
9	66%	Mainly confined to the foreshore area and Lower Bluff Road	77%	Mainly confined to the foreshore area and Lower Bluff Road	10%
TOTAL	**58%**		**73%**		**15%**

Table 6.7 Precincts with existing inundation impacts

Precinct	Description of existing inundation conditions
Precinct 2	Large portions of the foreshore along Precinct 2, from Point Richards Road to the Boat Ramp at Beach 41B within the Portarlington Holiday Park (including the Rotary Children's Park) are below the 100 year average recurrence interval (ARI) storm tide level of 1.09 m AHD (Cardno, 2011). The area likely to be inundated under the 2030 100 year ARI storm tide level is similar to the extent of present day inundation with slightly expanded boundaries (Cardno, 2011b). Past storm events in April 2009, June 2002, February 2005 and March 2008 have temporarily inundated this area (Cardno, 2011) as well as an inundation event in June 2014. Refer to Figure 6.10 for images of the inundation at Portarlington Harbour in June 2014.  **Figure 6.10 Coastal inundation at Portarlington Holiday Park on 24 June 2014, Precinct 2** Recent coastal inundation at Portarlington Holiday Park jetty is likely associated with elevated tidal conditions and adverse weather experienced on 27 May 2025. Ports Victoria provides real-time tidal observations, with the closest monitoring station located at Queenscliff Jetty. At 3:00 pm on 27 May, the recorded tide height at Queenscliff was 1.43 m Chart Datum (CD), with the daily maximum reaching 1.53 m and the minimum 0.68 m. These observed values significantly exceeded the predicted high and low tides for that date, which were 1.09 m and 0.27 m CD, respectively. Although not a direct measurement of conditions at Portarlington, these figures represent the most relevant available tidal data for comparison. The higher-than-expected tides coincided with a Coastal Hazard Warning issued by the Bureau of Meteorology (BOM) for the entire Victorian coastline. The warning noted the likelihood of tides rising well above normal high tide levels. On the day, a low-pressure system located east of Tasmania contributed to strong south-westerly winds (15 to 25 knots), sea heights of 1 to 1.5 m, and a 70% chance of showers under partly cloudy skies, all of which may have contributed to inundation at the jetty. Refer to Figure 6.11 and Figure 6.12 for images of the inundation at Portarlington Harbour on 27 May 2025.

Precinct	Description of existing inundation conditions

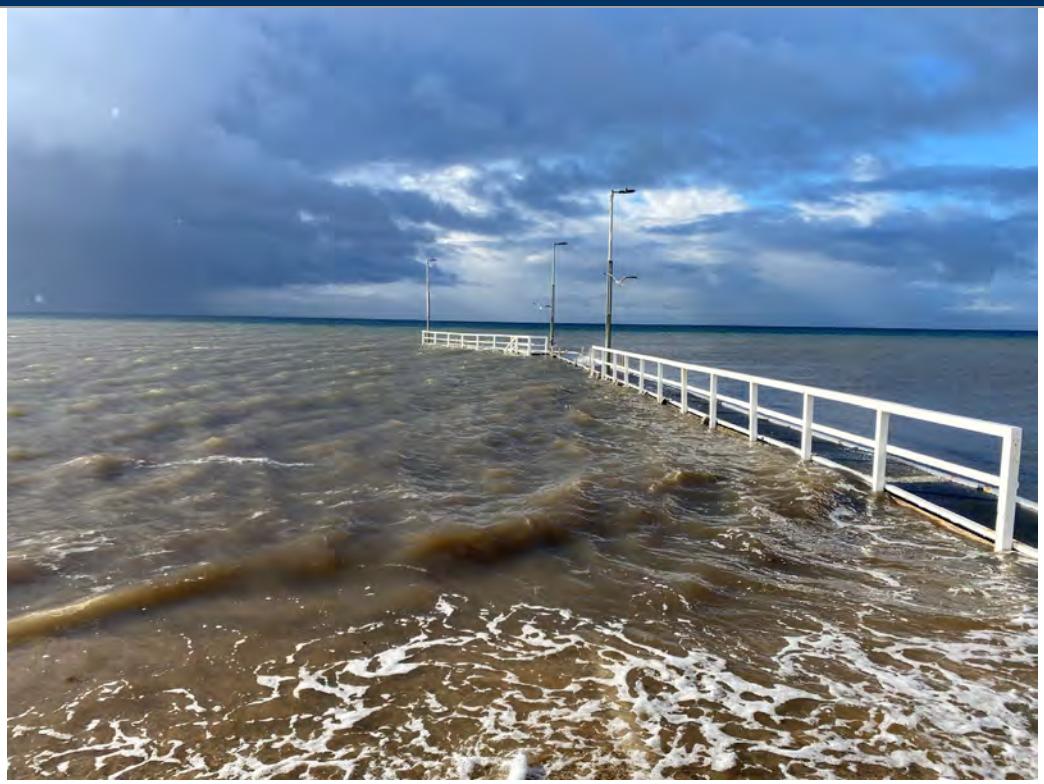


Figure 6.11 Coastal inundation at Portarlington Holiday Park jetty, on 27 May 2025, Precinct 2

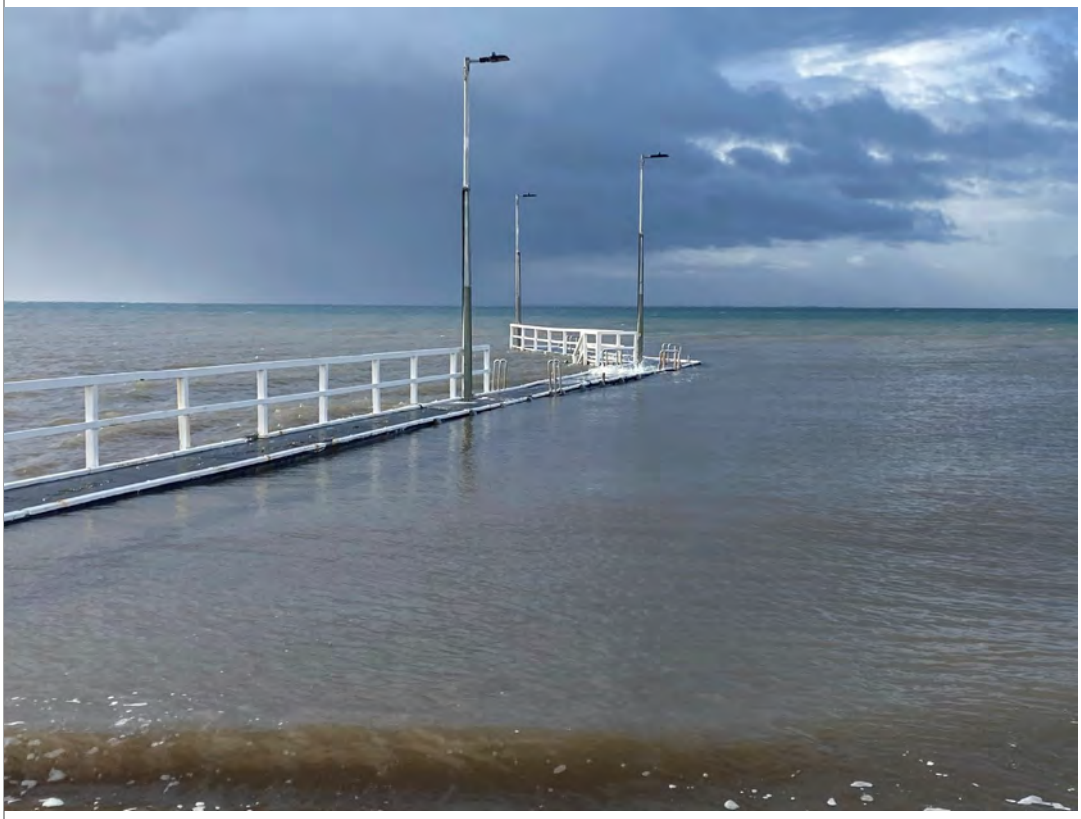


Figure 6.12 Coastal inundation at Portarlington Holiday Park jetty, on 27 May 2025, Precinct 2

Precinct	Description of existing inundation conditions
Precinct 4b	Recent storm events have highlighted the vulnerability of this Precinct along The Esplanade, particularly due to the narrow, low and flat sections of shoreline, minimal dune formation and lack of vegetation along the foreshore and the coastal trail (Bellarine Bayside, 2024; Cardno, 2014) (see Figure 6.13 and Figure 6.14).  **Figure 6.13 Coastal inundation at Levanto Street, Portarlington on 21 August to 1 September 2024 (Bellarine Bayside, 2024)**  **Figure 6.14 Coastal inundation at Pike Street, Portarlington on 21 August to 1 September 2024 (Bellarine Bayside, 2024)**
Precinct 6b	The coastline within Precinct 6b is vulnerable to inundation (Cardno, 2014). Under a present day 1% AEP storm tide event (with no SLR), the foreshore, parts of The Esplanade, and the Salt Lagoon already become temporarily inundated. This is likely due to the low-lying area around the Salt Lagoon and that the coast that separates the Lagoon from the bay is narrow (Cardno, 2014).

6.2.4 Saline intrusion / groundwater

Hazards associated with groundwater from SLR and climate change is mainly exhibited through changing depths of the water table and the migration of seawater (CSIRO, 2022). There are two types of threats associated with changes in groundwater hydrology which are the threat posed to assets as a result of changing groundwater levels, and the threat posed to groundwater itself as an asset (CSIRO, 2022).

Potential impacts to the natural and built environment include:

– Changing water tables resulting in increased flooding due to groundwater tables rising closer to the surface.

– Changes to groundwater quality (e.g. salinity, biology) of shallow water tables that are located beneath natural and built assets.
– Change in the quantity and/or quality of groundwater that provides services for social amenity, cultural heritage values and natural assets.

Within the Bellarine Peninsula, the groundwater is shallow and relatively saline meaning the area is particularly vulnerable to changes to the groundwater levels (CSIRO, 2022). Changes in groundwater levels could result in impacts to urban infrastructure, parks, waterways and wetlands. The locations where changes in groundwater is predicted were mapped using CoastKit, and output from CSIRO, 2022. These maps have not been included in this report, however will be used during the determination of adaptation pathways for each Precinct.

SLR may cause changes in groundwater levels and quality and could contribute to inundation risk (due to shallower water tables) and coastal erosion (due to changes in groundwater discharge). Sea-level rise also has the potential to cause the saline wedge, which is where discharging fresh groundwater forms a wedge with saline sea water along the coastline, to move further inland (CSIRO, 2022). However, these potential impacts are considered to be minimal and comparable to present day impacts (CSIRO, 2022).

7 Vulnerability and Risk Assessment

Risk and vulnerability were assessed for each of the coastal values identified in section 4.2, considering the coastal hazards included in Table 7.1. As requested by WTOAC during consultation, risks to Wadawurrung cultural heritage values have not been rated in the risk assessment.

Table 7.1 Risk and vulnerability assessment – hazards considered

Coastal hazard	Definition	Source
Coastal erosion	The process by which winds, waves, and coastal currents shift sediment away from a localised area of the shoreline. The total coastal erosion was calculated by adding together three erosion components (long-term erosion, short-term erosion, and SLR response, for a 1% AEP event. Short-term erosion involves event-based sediment loss and recovery following storm events (known as storm-bite), while long-term erosion refers to the progressive retreat of the shoreline over time due to historic changes and projected future impacts from sea level rise.	CoastKit (DEECA 2024)
Storm tide inundation (1% AEP event)	Temporary flooding by sea water of low-lying coastal land from a locally elevated sea level (storm tide). (DEECA 2024)	CoastKit (DEECA 2024)
Accretion	Where sand is deposited (instead of eroded) and builds up over time. Accretion typically occurs during calmer periods. For Port Phillip Bay, some accretion is quite seasonal with beaches moving and rotating at different times of the year. Its timing varies depending on where you are around the Bay. Beach accretion is generally a more gradual process than beach erosion, and may be short term, long term, or episodic. (DEECA 2024)	Cardno (2011b)
Permanent inundation	Regular flooding as part of the local tidal cycle, rather than storms and weather conditions. With sea level rise, previously dry land is becoming impacted by the tides. (DEECA 2024)	Port Phillip Bay Coastal Hazard Assessment (CSIRO 2022)
Groundwater hazard	Predominantly associated with saline intrusion, the long term / permanent movement of sea water (saltwater) into freshwater areas, including groundwater aquifers, upstream waterways or water bodies. This means higher salt levels in previously freshwater areas. (DEECA 2024)	CoastKit (DEECA 2024)

7.1 IDENTIFICATION OF KEY VULNERABILITIES

Coastal vulnerability is the susceptibility of people and places along the coast to adverse impacts from coastal hazards. To understand how an asset or value may be vulnerable to coastal hazards, a vulnerability assessment was undertaken for the overall coastal values considering the following variables:

- Exposure – the degree to which an asset or value is exposed to a given hazard.
- Sensitivity – the degree to which an asset or value stands to be impacted by the effects of a hazard.
- Adaptive capacity – the capacity for an asset or value to respond to a hazard and adjust accordingly to lessen the adverse effects or overcome the hazard.

It includes the degree of exposure, and the ability to cope with, respond to and adapt to coastal hazards.

7.1.1 Vulnerability assessment methodology

A vulnerability assessment was undertaken for each coastal value class. First, potential impact was assessed using an impact matrix (Table 7.2) based on the exposure level (using definitions in Table 7.3) and value sensitivity (using definitions in

Table 7.4).

Table 7.2 Potential impact matrix

Exposure	Sensitivity			
	Low	Medium	High	Very high
Likely	Medium	Significant	High	High
Possible	Medium	Medium	Significant	High
Unlikely	Low	Medium	Medium	Significant
Rare	Low	Low	Medium	Medium

Table 7.3 Exposure definitions

Descriptor	Inundation and erosion	Groundwater hazard	Accretion and other hazards
Likely	1% AEP storm tide with 0.0m SLR OR Permanent inundation with 0.0m SLR.	0.2m SLR	Is expected to occur most of the time.
Possible	1% AEP storm tide with 0.5m SLR OR Permanent inundation with 0.5m SLR.	0.8m SLR	Might occur.
Unlikely	1% AEP storm tide with 0.8m SLR OR Permanent inundation with 0.8m SLR.	1.1m SLR	Might occur, but not expected.
Rare	1% AEP storm tide with 1.4m SLR OR Permanent inundation with 1.4m SLR.	1.4m SLR	Only expected to occur under exceptional circumstances.

Table 7.4 Sensitivity definitions

Rating	Social and Heritage	Economic	Environment
Very High	Loss of vital social or heritage values, experiences and/or sites of both local and regional significance.	Damage to local economy, public or private infrastructure or loss of land value greater than $10 million Or Loss of >75% of annual revenue from campgrounds.	Irreversible damage to local environmental asset(s) that would compromise its viability. No alternate habitat(s) exist.
High	Loss of important social or heritage values, experiences and/or sites that would impair quality of life of coastal users.	Damage to local economy, public or private infrastructure or loss of land value $1 million to $10 million Or Loss of 30-75% of annual revenue from campgrounds.	Major damage to local environmental asset(s) that would compromise its viability. No local alternate habitat exists.

Rating	Social and Heritage	Economic	Environment
Medium	Loss of social or heritage values, experiences and/or sites that would impair quality of life of the local community.	Damage to local economy, public or private infrastructure or loss of land value $1 million to $10 million Or Loss of 30-75% of annual revenue from campgrounds.	Moderate damage to local environmental asset that could be reversed or offset. Local alternate habitats exist.
Low	Loss of social or heritage values, experiences and/or sites that would have minimal impact on the quality of life of the local community.	Damage to local economy, public or private infrastructure or loss of land value $10,000 to $50,000 Or Loss of 1-5% of annual revenue from campgrounds.	Minor environmental damage to local environmental asset(s) that could be reversed or offset. Local or regional alternate habitat exists.

Then vulnerability was assessed using a vulnerability matrix (Table 7.5) based on the combination of the potential impact and adaptive capacity (using definitions in Table 7.6).

Table 7.5 Vulnerability matrix

Potential impact	Adaptive capacity			
	Low	Medium	High	Very high
High	High	Significant	Significant	Medium
Significant	High	Significant	Medium	Low
Medium	Significant	Medium	Low	Low
Low	Medium	Medium	Low	Low

Table 7.6 Adaptive capacity definitions

Rating	Definition
Very High	Very high ability to absorb coastal hazard impacts or where capacity can be restored Capacity would be restored naturally over time.
High	Reasonable ability to absorb coastal hazard impacts, with functionality able to be restored. Natural restoration of capacity may occur slowly over time.
Medium	Small amount of ability to absorb coastal hazard impacts. Restoration of functionality would be difficult, though possible.
Low	Little to no ability to absorb impacts from coastal hazards. Functionality would be unable to be restored.

7.1.2 Vulnerability assessment results

A total of 18 values were found to have significant vulnerability, and eight have high vulnerability. These are presented in Table 7.7. Ecosystems and habitats, cultural and heritage values and recreation and tourism values tended to have higher assessed vulnerability compared to other categories.

Table 7.7 Values with significant and high vulnerability

Category	Coastal value	Coastal hazard	Exposure	Sensitivity	Adaptive capacity	Vulnerability
Ecosystems and habitats	Red-capped plover habitat	Erosion	Likely	High	Medium	Significant
Ecosystems and habitats	Wetlands and saltmarshes	Permanent inundation	Likely	Medium	Medium	Significant
Ecosystems and habitats	Wetlands and saltmarshes	Saline intrusion/groundwater	Likely	Medium	Medium	Significant
Ecosystems and habitats	Intertidal zone and marine habitat	Permanent inundation	Likely	Medium	Medium	Significant
Ecosystems and habitats	Scrub and woodland vegetation and habitat	Permanent inundation	Possible	Medium	Low	Significant
Ecosystems and habitats	Scrub and woodland vegetation and habitat	Saline intrusion/groundwater	Likely	Medium	Low	High
Natural features and landscapes	Coastal views	Erosion	Likely	Low	Low	Significant
Natural features and landscapes	Coastal views	Permanent inundation	Possible	Low	Low	Significant
Natural features and landscapes	Beaches	Erosion	Likely	High	Low	High
Natural features and landscapes	Beaches	Permanent inundation	Likely	Medium	Low	High
Cultural values and heritage sites	Post-European settlement heritage – onshore (e.g. cenotaph, boatsheds, monument)	Erosion	Likely	High	Medium	Significant
Cultural values and heritage sites	Post-European settlement heritage – onshore (e.g. cenotaph, boatsheds, monument)	Permanent inundation	Possible	Very high	Low	High
Cultural values and heritage sites	Post-European settlement heritage – offshore (e.g. jetty, shipwreck)	Permanent inundation	Possible	Medium	Low	Significant
Recreation and tourism	Bellarine Coastal Trail	Erosion	Likely	High	Medium	Significant
Recreation and tourism	Bellarine Coastal Trail	Inundation – storm tide	Likely	High	High	Significant
Recreation and tourism	Bellarine Coastal Trail	Permanent inundation	Unlikely	Very high	Low	Significant
Recreation and tourism	Camping and accommodation	Erosion	Likely	Very high	Medium	Significant
Recreation and tourism	Camping and accommodation	Inundation – storm tide	Likely	High	Medium	Significant
Recreation and tourism	Camping and accommodation	Permanent inundation	Possible	Very high	Low	High

Category	Coastal value	Coastal hazard	Exposure	Sensitivity	Adaptive capacity	Vulnerability
Recreation and tourism	Camping and accommodation	Saline intrusion/groundwater	Likely	Medium	Medium	Significant
Recreation and tourism	Water-based clubs (e.g. sailing/yacht/boat clubs)	Inundation – storm tide	Likely	Medium	Medium	Significant
Recreation and tourism	Water-based clubs (e.g. sailing/yacht/boat clubs)	Permanent inundation	Unlikely	High	Low	Significant
Buildings, structures and access	Access to ferry terminal	Erosion	Possible	Medium	Low	Significant
Buildings, structures and access	Boat ramps and boating facilities	Erosion	Likely	Medium	Medium	Significant
Buildings, structures and access	Access to Portarlington Pier	Permanent inundation	Unlikely	High	Low	Significant
Buildings, structures and access	Access to Portarlington Pier	Inundation – storm tide	Likely	Medium	Low	High

7.2 POTENTIAL RISKS AND IMPLICATIONS

7.2.1 Risk assessment methodology

A risk assessment was undertaken for each Precinct and value, considering the vulnerability of the value. Each risk was rated based on its likelihood of occurring (likelihood) and the impact to coastal values and uses if it did occur (consequence) using a tailored risk assessment matrix Table 7.8.

Table 7.8 Tailored risk assessment matrix

Likelihood	Consequence Level				
	Negligible	Minor	Moderate	Major	Extreme
Likely	Medium	Medium	Significant	High	High
Possible	Low	Medium	Significant	High	High
Unlikely	Low	Medium	Medium	Significant	High
Rare	Low	Low	Medium	Medium	Significant

The likelihood of each potential impact on coastal values was estimated using the definitions outlined in Table 7.9. These definitions were selected with regard to the available data and the approaches taken in similar assessments for coastal adaptation planning in Victoria.

Table 7.9 Likelihood definitions

Descriptor	Inundation and erosion	Groundwater hazard	Accretion and other hazards
Likely	1% AEP storm tide with 0.0m SLR OR Permanent inundation with 0.0m SLR.	0.2m SLR	Is expected to occur most of the time.
Possible	1% AEP storm tide with 0.5m SLR OR Permanent inundation with 0.5m SLR.	0.8m SLR	Might occur.
Unlikely	1% AEP storm tide with 0.8m SLR OR Permanent inundation with 0.8m SLR.	1.1m SLR	Might occur, but not expected.
Rare	1% AEP storm tide with 1.4m SLR OR Permanent inundation with 1.4m SLR.	1.4m SLR	Only expected to occur under exceptional circumstances.

The consequence level for each potential impact on coastal values was estimated using the definitions outlined in Table 7.10. These definitions were selected with regard to guidance in Victoria's Resilient Coast – Adapting for 2100+ (DEECA 2023) and the approaches taken in other similar coastal adaptation planning in Victoria.

Table 7.10 Consequence definitions

Description	Environmental values Environmental values and ecosystem services	Public safety Human health and safety	Access / lifestyle Access to key sites, services and activities underpinning community lifestyle, wellbeing and Culture	Property and infrastructure Impact on surrounding properties and infrastructure	Economy and growth Local business and economic growth opportunities
Extreme	Widespread, permanent impact on environmental values of national or regional significance.	Loss of life and/ or permanent disabilities.	Widespread, permanent impact with no viable alternatives.	Damage or loss of property and infrastructure with total value >$10million.	Widespread permanent impact; or Negative visitor experience that causes severe reputational impacts from physical climate events and chronic stressors, affecting strategic partnerships; or Loss of 75% of annual revenue.
Major	Widespread, temporary impact on environmental values of national or regional significance Full recovery expected to take several years; or Long term impact on environmental values of local significance.	Widespread serious injuries / illness.	Widespread, temporary disruption, with limited alternatives available Full recovery expected to take several years.	Damage or loss of property or infrastructure with total value >$5million.	Widespread, temporary impact. Full recovery expected to take several years; or Substantial reputational or visitor experience impacts from significant physical climate events and/or chronic stressors affecting guest experience and regional tourism; or Loss of 30-75% of annual revenue.
Moderate	Localised, temporary impact on environmental values of national or regional significance; or Long term impact on environmental values of local significance Full recovery may take <1 year.	Isolated serious injuries / illnesses Or Widespread minor injuries / illnesses.	Localised, temporary disruption, with limited alternatives available Full recovery expected in < 1 year.	Damage or loss of property or infrastructure with total value >$1million.	Localised, temporary impact Full recovery expected in < 1 year; or Expectations being unmet and/or negative guest experience due to physical climate change impacts (e.g. extended power outage); or Loss of 10-30% of annual revenue.
Minor	Isolated and temporary short-term impact on values of local significance Full recovery expected in <1 month.	Isolated minor injuries and illnesses.	Isolated and temporary short-term disruption, with some alternatives available	Damage or loss of property or infrastructure with total value >$100,000.	Isolated temporary and short-term impact Full recovery expected in < 1 month; or Minor influence on customer perceptions if customer expectations unmet; or

Description	Environmental values Environmental values and ecosystem services	Public safety Human health and safety	Access / lifestyle Access to key sites, services and activities underpinning community lifestyle, wellbeing and Culture	Property and infrastructure Impact on surrounding properties and infrastructure	Economy and growth Local business and economic growth opportunities
			Full recovery expected in < 1 month.		Loss of 1-10% of annual revenue.
Negligible	No expected environmental impact.	Negligible injuries or illnesses.	Negligible disruption.	Damage or loss of property or infrastructure with total value < $50,000.	Negligible disruption One-off, minor and temporary customer experience damage, if any; or Loss of <1% of annual revenue.

Risk tolerance was also considered for each risk level and is summarised below in Table 7.11.

Table 7.11 Risk tolerance definitions

Risk level	Risk tolerance
High	Falls outside Bellarine Bayside's risk appetite. A risk that requires actions to avoid or reduce the risk to as low as possible.
Significant	May fall outside Bellarine Bayside's risk appetite. A risk that requires action to be managed to a level that is as low as reasonably practicable.
Medium	Falls within Bellarine Bayside's risk appetite. A risk that may be managed or accepted without further treatment, with active monitoring and regular re-evaluation.
Low	Well within Bellarine Bayside's risk appetite. Business as usual is appropriate.

7.2.2 Risk assessment results

A total of 298 risks were identified and assessed. The number of risks identified, and the assessment of risk levels varied substantially by Precinct as indicated in Figure 7.1. The most risks and most high or significant risks were identified in Precinct 2.

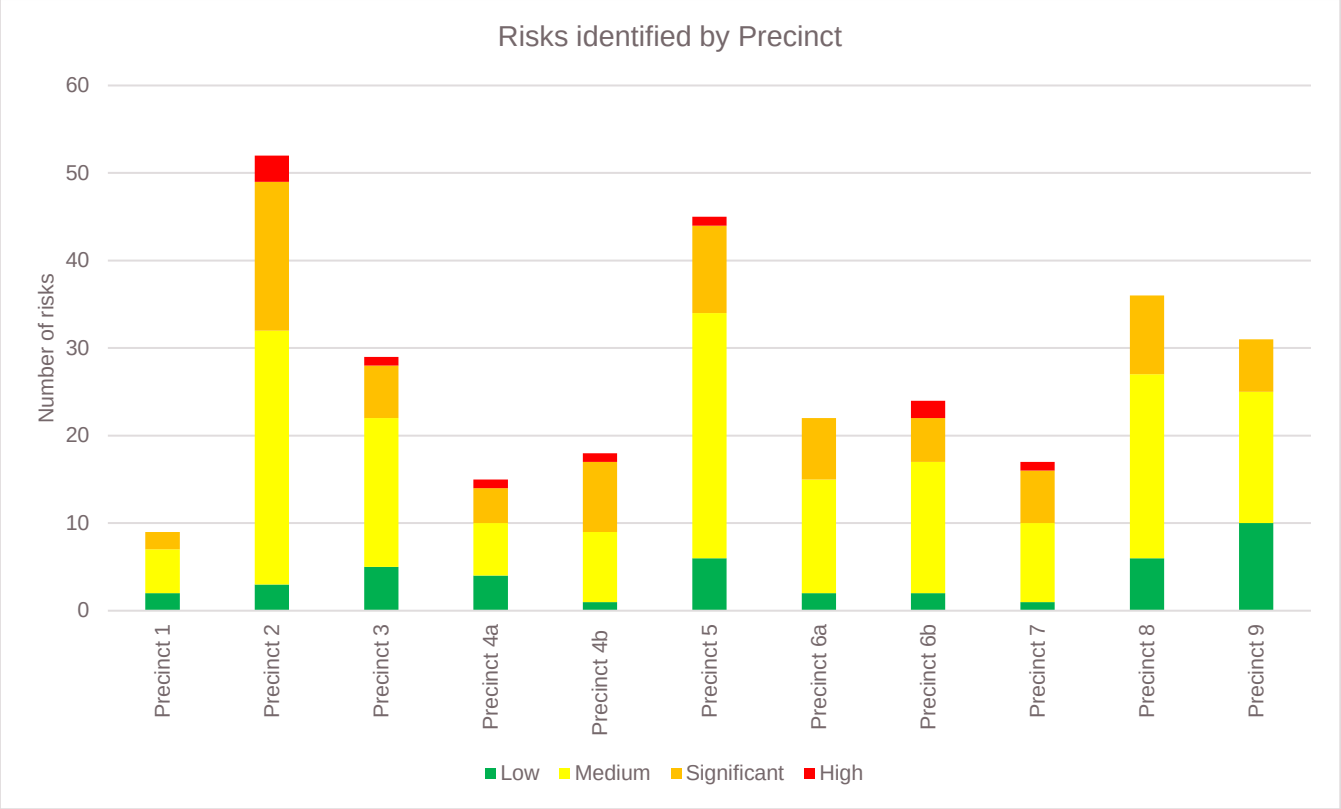


Figure 7.1 Risks identified by Precinct

A risk assessment was undertaken for each Precinct and value, considering the vulnerability of the value. Each risk was rated based on its likelihood of occurring (likelihood) and the impact to coastal values and uses if it did occur (consequence) using a tailored risk assessment matrix. The high and significant risks identified in the risk assessment are described below.

7.2.2.1 Wadawurrung Cultural heritage

Wadawurrung tangible and intangible Cultural heritage is ever present within the Bellarine Bayside land management responsibilities. Works along this area have the potential to cause harm to significant Cultural heritage and landscapes. Constant consultation should be made with a heritage advisor and the Wadawurrung Registered Aboriginal Party (RAP), when works are taking place.

7.2.2.2 Beaches, beach and water-based activities, coastal views

Erosion from storm tide events is predicted to be the most significant hazard affecting beaches, beach and water-based activities, and coastal views.

Recreational activities are at increasing risk, with loss of safe access to beaches following erosion events noted across all Precincts except in Precinct 1. This loss of access directly impacts the ability of visitors to engage in beach and water-based recreation, contributing to a negative visitor experience.

Erosion may also impact the health and stability of shade trees west of Portarlington Pier, representing a localised high risk. Further, significant beach erosion has the potential to eliminate safe beach access in some areas.

Visual amenity is also at risk. Coastal views may be permanently altered due to both storm-induced erosion and long-term sea level rise, with impacts identified in all Precincts except Precinct 1. This could substantially change the coastal landscape and visitor experience.

7.2.2.3 Bellarine coastal trail and green open space

The risk assessment identified the Bellarine Coastal Trail as at risk from erosion, storm tide inundation, permanent inundation, and saline intrusion across much of its length (which spans all Precincts except Precinct 1). Sections of the trail located in Precincts 6b and 7 are at risk of erosion during storm events, with the risk rated as high. Sections of the trail located in Precincts 2, 3, 5, 6a, 8, and 9 are at risk of erosion during storm events, with the risk rated as significant. Damage estimates range from 30% to 100% in some areas. These impacts pose major risks to safe recreational access and trail usability.

Inundation from storm tides is rated as a significant risk. It has been projected to affect up to 80% of some trail sections (Precinct 5) in a 0.8m sea level rise scenario, with water depths exceeding 1 m in areas, further limiting access.

Erosion to the west of Portarlington Pier in Precinct 3 presents a significant risk to the usability and condition of the green open space and foreshore area, which supports informal recreation and contributes to local amenity.

7.2.2.4 Boats and boating facilities, water-based clubs

The risk assessment identified the Portarlington Sailing Club, Indented Head Yacht Club, Indented Head Community Hall, and several boat ramps (Grassy Point, Portarlington Holiday Park, Point Richards and St Leonards) as being at significant risk from coastal hazards in Precincts 2, 4b, 5, and 8. These assets face combined threats from storm tide erosion, storm tide inundation, and permanent inundation.

- The Portarlington Sailing Club has a significant risk from storm tide inundation depths of up to 0.7 m, with the potential to cause substantial damage to infrastructure and equipment. Permanent inundation is a significant risk, with implications for long-term site usability.
- The Indented Head Yacht Club and Community Hall is at significant risk from permanent inundation.
- Erosion at both the clubs and the boat ramps is expected to impact safe access, cause damage to infrastructure and reduce the operational functionality of these facilities.

Steeles Rock boat ramp is also at risk from erosion, with erosion impacting safety of the access road. A previous erosion event in early September 2024 impacted the road-side beach embankment.

7.2.2.5 Camping and accommodation

The risk assessment identified the Portarlington Holiday Park as being at high risk from storm tide erosion and a significant risk from permanent inundation and storm tide inundation. Bengalat Reserve campground has been identified in the risk assessment to be at significant risk from saline intrusion.

Inundation from storm tides, if occurring during Portarlington Holiday Park's high season, could affect availability for tourism uses. In a 0.5 m sea level rise scenario, this would impact all twelve-month permit sites and approximately half of the tourist cabins, which would increase to all twelve-month permit sites and all of the tourist cabins in an 0.8 m sea level rise scenario.

Significant sections of the park are at risk of erosion during a storm event, with damage predicted to 10-40% of front sites (beach pods and twelve-month permit sites), depending on the sea level rise scenario, affecting

availability for tourism use. Additionally, damage to recreational facilities, power stations and pump stations is predicted. Temporary loss of power to some sites and facilities may occur, impacting visitor experience.

Permanent inundation is also a concern for the park, with potential for 25-30% of the park located within Precinct 2 to be permanently inundated in a 0.5 m sea level rise scenario (in 2070), increasing to 50-60% in a 0.8 m sea level rise scenario (in 2100).

Groundwater hazard was identified at Bengalat Reserve campground as having the potential for detrimental impacts on campground infrastructure due to groundwater salinity, corrosion and swelling of certain materials.

7.2.2.6 Dune habitat, intertidal zone and marine habitat, scrub and woodland vegetation and habitat, wetlands and saltmarshes

The risk assessment identified high from storm tide erosion for Precinct 6b and significant risks to vegetation and habitat types across the study area from storm tide erosion, inundation, permanent inundation, and saline intrusion/groundwater. These hazards pose ongoing threats to the health, stability, and long-term viability of both terrestrial and intertidal ecosystems.

- Scrub and woodland vegetation, including remnant Damp Sands Herb-rich Woodland and Coastal Alkaline Scrub, is at risk of:
  - Saline intrusion and storm tide inundation, leading to changes in hydrology and vegetation stress.
  - Erosion during storm events, potentially resulting in loss of vegetation, root destabilisation, and dieback (especially east of Lower Bluff Road).
- Wetlands and saltmarshes, including those supporting species such as the Growling Grass Frog, are at significant risk of permanent inundation, with many wetlands at risk of being fully inundated, leading to high impacts on biodiversity and ecosystem services.
- Intertidal zone habitats face significant risk of permanent inundation due to sea level rise, which is likely to alter tidal dynamics and reduce the suitability of these areas for marine life.
- Seagrass meadows are at significant risk from storm tide erosion, which may disrupt sediment stability, leading to decreased coverage and ecological function.
- Dune habitats are susceptible to vegetation loss through storm-related erosion, impacting dune stability and natural buffers, rated high risk within Precinct 6b and significant in Precincts 2, 3, 4b, 6a and 7.

7.2.2.7 Stormwater and drainage

Stormwater infrastructure is at significant risk of permanent inundation in Precincts 2, 4b, and 8, with rising sea levels risking compromise to drainage infrastructure, increasing the likelihood of surface water flooding in the study area.

7.2.2.8 Post-European settlement heritage – onshore

Indented Head boatsheds are at high risk from erosion and groundwater hazard, and a significant risk from storm tide inundation and permanent inundation.

- Significant risk of temporary storm tide inundation is expected to interfere with use and access.
- Significant risk of erosion threatens structural damage and usability, while high risk of permanent inundation could render the assets unusable.

7.2.2.9 Red-capped plover

Significant risk of dune erosion during storm events was identified in Precinct 4b, threatening nesting locations of Red-capped plovers and other beach-nesting birds. This could result in breeding failure and loss of important habitat for the Red-capped plover.

7.3 UNDERSTANDING ECONOMIC RISK (BASE CASE)

7.3.1 Economic base case approach

A high-level economic analysis has been undertaken with reference to guidance from *An Economic Approach to Inform Adaptation* (Natural Capital Economics & Alluvium 2022) to understand the economic base case. This is important to inform analysis of approaches to coastal hazard adaptation.

The most significant economic cost of coastal hazards in the study area is damage to the Portarlington Holiday Park affecting its availability for tourism uses. This has direct tangible impacts through damage to holiday park cabins, sites and infrastructure, indirect tangible impacts such as the loss of tourism revenue and tourism-based employment from the holiday park while sites and accommodation are unavailable and intangible impacts including the loss of social and recreational value.

Given the significant economic impact from Portarlington Holiday Park and Batman Holiday Park, these have been quantitatively assessed using an annual average damages approach, as described in section 7.3.2.

In accordance with guidance from Natural Capital Economics & Alluvium on behalf of DEECA (2022, p.7), other values have been assessed qualitatively (see section 7.3.4):

> *The base case should include estimated monetary costs that are most material. Any costs that cannot be estimated in monetary terms should be described qualitatively.*

7.3.2 Methodology for calculating annual average damages

An annual average damages (AAD) approach was adopted to calculate the costs to Bellarine Bayside of coastal hazards in a 'do nothing' scenario with no adaptation interventions and is provided below in Table 7.12. This assessment was undertaken specifically around the loss of revenue from holiday parks as a result of not being able to lease out cabins, pods and sites.

Table 7.12 Inputs, parameters and assumptions for economic base case assessment

Input data	Lost revenue from sites impacted by coastal hazards, based on Bellarine Bayside site occupancy data from select holiday parks and impacted sites from CoastKit mapping. Data was provided for: – Revenue loss due to inundation – storm tide (1% AEP event) in each time period, with separate revenue loss figures for whether the event occurs in low season or high season and whether the duration of impact is one or three months. – Revenue loss due to erosion – storm tide (1% AEP event) in each time period, with separate revenue loss figures for whether the event occurs in low season or high season and whether the duration of impact is one, six or twelve months. – Revenue loss due to permanent inundation in each time period[1]. Data provided did not include any adjustment for inflation.
Time periods considered in economic base case	Present day (representing costs for the time period of 2025–2030) 2040 (representing costs for the time period of 2031–2055) 2070 (representing costs for the time period of 2056–2080) 2100 (representing costs for the time period of 2081–2100)
Coastal hazards considered	Inundation – storm tide (1% AEP event) Erosion – storm tide (1% AEP event) Permanent inundation
Key assumptions	Inundation – storm tide (1% AEP event)

[1] It should be noted that the analysis is based only on lost revenue. There could also be a reduction in cost (minimal) as Bellarine Bayside may have reduced maintenance requirements across the lost areas. The analysis is based on present value, rather than net present value, given reductions in costs are not being offset against lost revenue to obtain a 'net' figure.

	– Loss of revenue impacts were based on the average loss of revenue for 1 and 3 month duration impacts. – Impacts were calculated based on a weighted average loss of revenue across the year, based on the number of days in high, low and shoulder season. – Given 1% AEP inundation events have a 1% chance of occurring each year, the AAD was calculated as 1% x the loss of revenue. Erosion – storm tide (1% AEP event) – Loss of revenue impacts were based on the loss of revenue for a 12 month duration impacts. – Linear interpolation was used between data points to estimate the lost revenue in years between, for example, 2040 and 2070. – For erosion, once the event occurs in a 'do nothing' case, the sites would no longer be available and not rebuilt. Therefore, the loss of revenue was assumed to continue from the year of the erosion event and each subsequent year. Lost revenue was then averaged across the impacted years to get an average annual damage value if an erosion event happened in a particular year. – Given 1% AEP inundation events have a 1% chance of occurring each year, the average annual damage for each event year was multiplied by 1%. The values of 1% x average lost revenue for each applicable year within the time period were then added to get an overall annual average damage value for the time period. Permanent inundation – Linear interpolation was used between data points to estimate the lost revenue in years between, for example, 2040 and 2070. – For permanent inundation, once an area is inundation in a 'do nothing' case, the sites would no longer be available. Therefore, the loss of revenue was assumed to continue from the year of the permanent inundation impact beginning and each subsequent year. Lost revenue was then averaged across the impacted years. When calculating adjusted average annual damages, an assumed increase in revenue loss was applied based on annual consumer price index (CPI) inflation, and a discounting rate was applied to adjust to present value.
Assumed inflation rate applied	2.5% per annum inflation
Discounting rate applied	7% per annum discounting

7.3.3 Annual average damages results

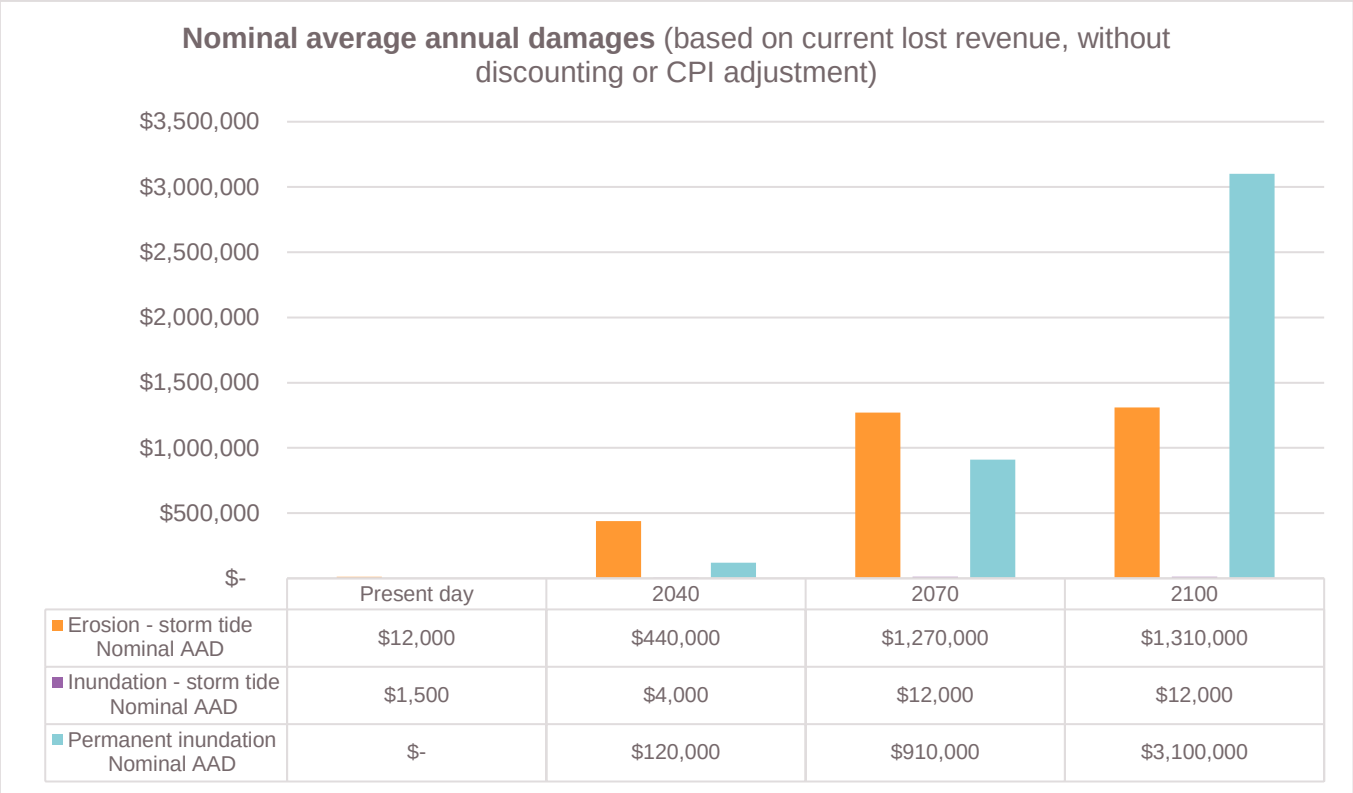
To understand the annual average damages results we need to understand two Sets of Values. Nominal values (Figure 8.2) which shows the estimated revenue loss in today's terms, without any adjustments, and the Adjusted values (Figure 8.3) which takes inflation and the time value of money into account. This converts future losses into what they're worth in today's dollars. This is a standard economic approach for long-term planning.

Because this assessment looks far into the future, the adjusted values appear much lower than the nominal values, especially for 2070 and 2100. This doesn't mean the impact will be smaller, it's just expressed differently for decision-making.

Why show adjusted values?

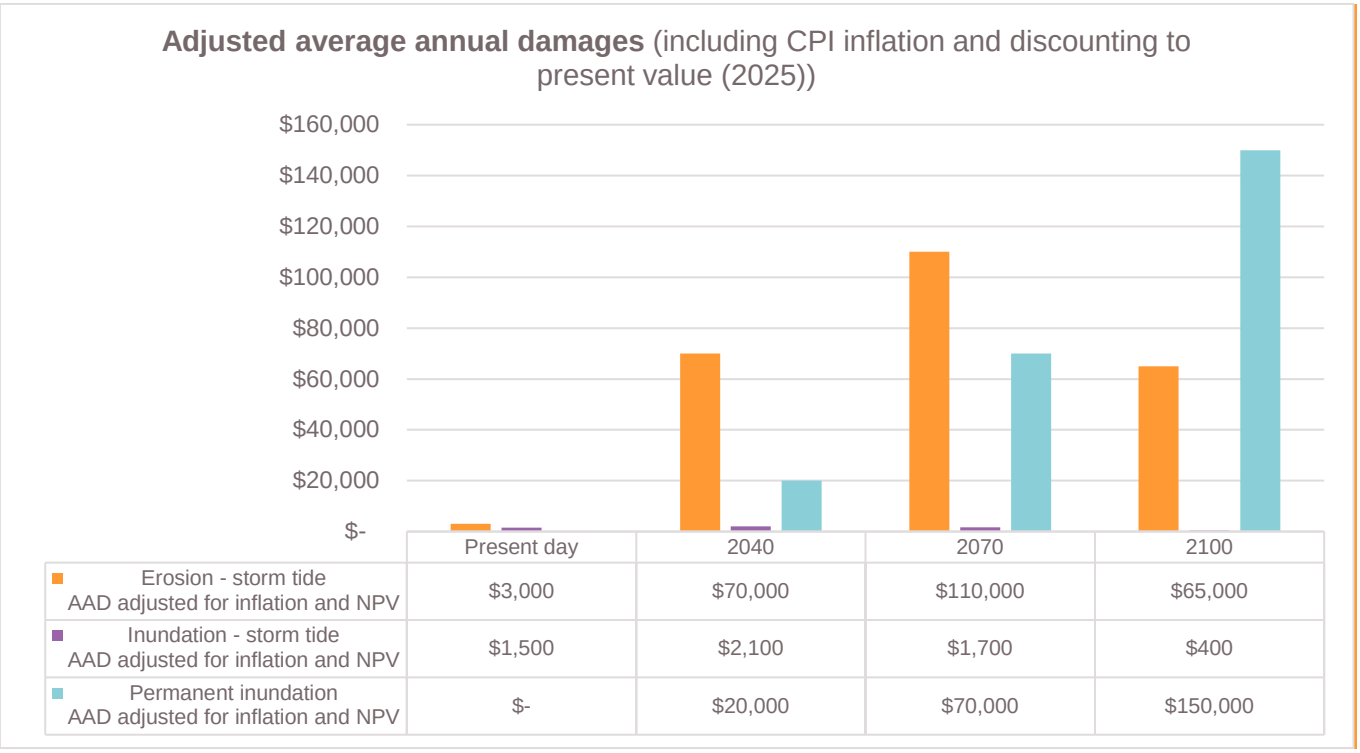
Adjusted values help decision-makers compare the cost of acting now versus the cost of doing nothing in a way that aligns with today's budgets. For example, if an adaptation measure costs $200,000 today, we compare that to the present value of future losses (adjusted) rather than the inflated nominal figure. This ensures fair and consistent economic analysis when planning investments.

Both sets of values show that the biggest revenue loss comes from permanent inundation, with losses increasing over time. Erosion is the next largest cause of lost revenue.



	Present day	2040	2070	2100
Erosion - storm tide Nominal AAD	$12,000	$440,000	$1,270,000	$1,310,000
Inundation - storm tide Nominal AAD	$1,500	$4,000	$12,000	$12,000
Permanent inundation Nominal AAD	$-	$120,000	$910,000	$3,100,000

Figure 7.2 **Nominal average annual damages**



	Present day	2040	2070	2100
Erosion - storm tide AAD adjusted for inflation and NPV	$3,000	$70,000	$110,000	$65,000
Inundation - storm tide AAD adjusted for inflation and NPV	$1,500	$2,100	$1,700	$400
Permanent inundation AAD adjusted for inflation and NPV	$-	$20,000	$70,000	$150,000

Figure 7.3 **Adjusted average annual damages**

7.3.4 Qualitative assessment of other values

As described in section 4.2, the study area contains a range of important values beyond Portarlington Holiday Park and Batman Holiday Park. The qualitative assessment of these values is provided below in Table 7.13.

Table 7.13 Qualitative assessment of economic factors and values.

Hazard impact category	Impact	Description
Direct tangible impacts	Loss of revenue to other businesses	Loss of revenue from tourism, hospitality and other local businesses due to a reduction in tourism as a result of coastal hazard damage. Includes flow-on impacts to the broader local community and economy. According to data provided in a summary of Travel to Geelong and The Bellarine, international, daytrip, and overnight visitors collectively spent $1.74 million in 2024. Overnight visitors contributed the largest portion, spending $1.001 million. This may be reduced as a result of coastal hazards if suitable adaptation measures are not adopted.
Direct tangible impacts	Damage to buildings and facilities	Public and private buildings and facilities, including facilities with local Cultural significance. The financial cost of repairing or replacing these assets.
Direct tangible impacts	Damage to other infrastructure and facilities	Electricity, gas, telecommunications, sewerage, drainage, and water supply infrastructure. Damage to this infrastructure and facilities can have flow-on impacts to visitor experience, safety, and recreational values.
Indirect tangible impacts	Clean up and rehabilitation of damage to infrastructure and assets	Coastal hazard events (e.g. storms) can have significant clean-up costs, both in terms of materials and labour (e.g. removing dangerous assets or trees) and time spent by Bellarine Bayside and potentially community and volunteers to make public assets safe.
Intangible impacts	Damage to beach and foreshore assets	Beach and foreshore assets including recreational facilities, foreshore infrastructure and local tourism assets. Impacts to public amenity and recreational values for visitors and the local community. Can have flow-on impacts to local businesses due to a loss of tourism revenue.
Intangible impacts	Natural asset damages	Land and environmental assets include natural assets such as salt marshes, dune habitat, wetlands and coastal shrubland. Damage to these values can result in a loss of ecosystem service value from a reduction in extents of these assets.
Intangible impacts	Cultural and heritage values	Cultural and heritage values include both tangible and intangible Wadawurrung Cultural heritage sites and values, as well as European heritage sites and values. Damage to these values can have significant detrimental impact to Cultural and historical values and activities.
Wider economic benefits	Geelong/Victorian economy	Impact on Supply Chain and Consumer demand as a multiplier of local direct and indirect economic activity.

7.4 PRIORITISATION FOR ADAPTATION

Adaptation priorities have been determined based on the severity and urgency of identified risks, based on both the economic risk assessment and the results of the coastal hazard risk assessment. While multiple values and assets across the study area are facing varying levels of risk, several have been identified as a priority for adaptation due to severity and urgency.

Wadawurrung Cultural heritage, including both tangible and intangible Cultural heritage, is ever present within the Bellarine Bayside land management Responsibilities and is a priority for Bellarine Bayside.

Portarlington Holiday Park (Precinct 2) has been identified as a high priority site due to risks from storm tide erosion. The projected damage to land and essential infrastructure poses both economic and social risks, impacting availability for tourism uses.

The Bellarine Coastal Trail, within Precinct 6a and 7, is at high risk from storm tide erosion, threatening public access, safety, and infrastructure integrity.

Dune habitats and the intertidal zone and marine habitat, (Precinct 6b), have also been identified as a priority due to their ecological sensitivity and the critical habitat they provide for species such as the Red-capped plover. Erosion poses a direct threat to nesting and breeding success.

Indented Head boatsheds (Precinct 5), representing post-European settlement heritage, face significant risks from permanent inundation, which could lead to long-term structural damage, and accessibility.

Beach and water-based activities, within Precincts 2, 3, 4a and 4b, are at high risk from storm tide erosion affecting access to the beach and impacting ability to undertake recreation activities contributing to a negative visitor experience.

Steeles Rock boat ramp is also identified as a priority given its risk from erosion, potential safety issues associated with erosion events and access, as evidenced by the recent erosion event in early September 2024.

While numerous assets are at risk, these locations and values have been identified as the most urgent for adaptation planning due to the combination of Cultural significance, high exposure, potential loss, and community reliance.

8 Adaptation Measures

The Marine and Coastal Policy 2020 re-framed how coastal hazards are managed in Victoria, aiming to facilitate more sustained and holistic management approaches for the long-term benefit of Victoria's coastline. Chapter 6 of the Marine and Coastal Policy 2020 requires land managers to consider strategic adaptation options and apply an adaptation pathways approach to determining actions.

8.1 ADAPTATION OPTIONS

Adaptation options under the Policy and VRC framework are defined as *different strategic approaches to managing coastal hazard risk. In Victoria, these are considered in the order of:*

1. *non-intervention*
2. *avoid*
3. *nature-based*
4. *accommodate*
5. *retreat*
6. *protect.*

Each option is a different strategic approach and have been considered in the defined Policy and VRC framework hierarchy order when planning a suitable adaptation response.

8.1.1 Non-intervention and avoid

Non-intervention allows marine and coastal processes, and the hazards they may pose, to occur. Avoid involves locating new uses, development and redevelopment away from areas that are or will be negatively impacted by coastal hazards.

8.1.2 Working with nature

Nature-based methods involve enhancing or restoring natural features that may improve the resilience of existing and new uses and development to coastal hazard risks. This can include beach and dune management. Bellarine Bayside have delivered beach nourishment programs at four top priority locations along the Bellarine Peninsula to address coastal erosion in 2021 and these beaches will be monitored and maintained for the next 10 to 15 years.

Young *et al.* (2023) developed 'Living Shorelines' a shoreline suitability model to select areas of a representative coastline that would be suitable for a soft (natural habitats alone) or hybrid (natural habitats in combination with hard structures) approaches. This model has been used to determine where these soft or hybrid approaches can be used along each Precinct's coastline.

A case study describing nature-based methods employed in the study area is provided in Table 8.1.

Table 8.1 Ramblers reef and Dell Eco Reef case study

Case study: Living Shorelines - Ramblers Road Foreshore and Dell Eco Reef
Ramblers Road foreshore, located near Portarlington is an example of nature-based adaptation methods. Built by the City of Geelong, the project as conceived in 2014 and constructed in 2018 using a mix of onshore and offshore methods (VMACC, 2020). The City of Geelong partnered with the University of Melbourne to establish a monitoring program and conduct experiments at the foreshore (Brullo, T. et al., 2024). The Ramblers Road foreshore was impacted repeatedly by severe storms, inundating the foreshore and causing the shoreline to retreat. Hard engineering structures can have adverse impacts such as loss of beach area, changes to ecological or physical processes, limiting access and impacting visual amenity. Therefore, ecological engineering principals (nature-based methods) were the preferred solution to addressing the impacts of severe weather.

Case study: Living Shorelines - Ramblers Road Foreshore and Dell Eco Reef

The offshore works involved the construction of a semi-submersible artificial reef 100 m offshore and parallel to the beach. Designed to reduce wave energy and coastal erosion, the reef is 130 m long and 8 m wide and build from modular cages filled with rock and shell (refer to Figure 8.1). These cages will naturally corrode over time, leaving behind a mostly natural reef structure. The reef was seeded with a native mussel species and is being monitored to track colonisation by shellfish and intertidal marine communities (VMACC, 2020).

Another key project, the Dell Eco Reef at Clifton Springs (refer to Figure 8.2), was constructed between 2018 and 2022 (Brullo, T. et al., 2024). Both the Dell Eco Reef and Ramblers Road foreshore were designed to reduce coastal erosion and inundation impacts, restore marine habitat and improve the resilience of shoreline ecosystems (CoGG, 2025).

The benefits of these artificial reefs include creating permeable barriers in shallow water, reducing wave impacts, and supporting the recovery of marine habitats. Ramblers Reef has already shown successful results, including increased beach and foreshore habitat, fewer inundation events, and the re-establishment of seagrass in shallow waters (VMACC, 2020).

Figure 8.1 Ramblers Reef (Brullo, T. et al., 2024)

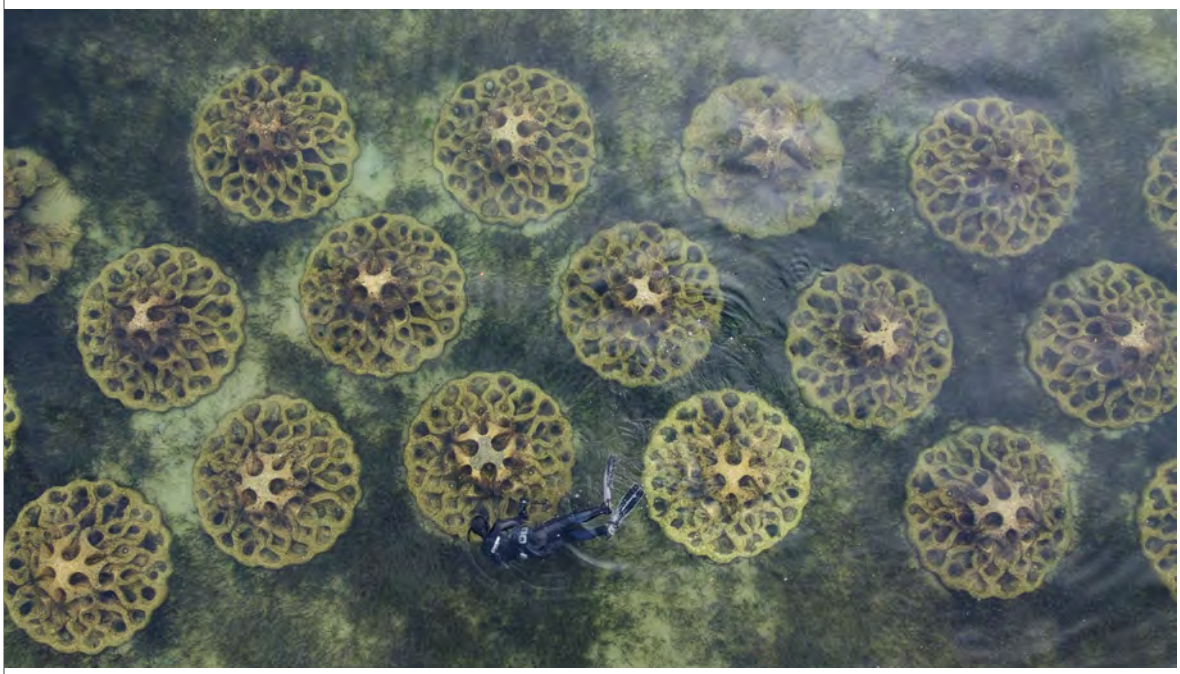


Figure 8.2 Dell Eco Reef (Brullo, T. et al., 2024)

8.1.3 Accommodate

Accommodate focusses on the ability for structures to be designed to reduce the exposure to, or decrease the impact of, coastal hazard risk, thus 'accommodating' the risk.

8.1.4 Retreat

Existing structures, assets or uses may be decommissioned or relocated away from areas that are, or will be, negatively impacted by coastal hazards. The retreat of natural systems such as saltmarsh habitat or wetlands may also be required as well as corridors of undeveloped land to allow landward movement of species and functioning habitats.

8.1.5 Protect / structural measures

This option is the last option on the hierarchy defined by the VRC framework . Protect involves the enhancement of existing physical barriers, or the construction of new ones, to mitigate the impact of coastal hazards caused by marine and coastal processes. This can include groynes, rock revetments, seawalls and offshore breakwaters.

9 Adaptation Actions and Pathways

9.1 ADAPTATION ACTIONS

Adaptation actions are defined in the VRC framework as *the range of tools, decisions and works that can be implemented to create adaptation pathways aligned to the strategic options* (as outlined in Section 8). These actions are aligned with the six strategic adaptation options and can be broadly classified under three key types:

– Land management, planning and design
– Nature-based
– Engineering.

Adaptation actions are not mutually exclusive, and often a suite of measures is required to effectively manage coastal hazard risk. Coastal hazard adaptation actions are outlined in Table 9.1 below.

Table 9.1 Coastal hazard adaptation actions. Coastal hazard adaptation actions have been refined to only include options that are viable for the northern Bellarine coastline.

Type	Category	Adaptation action
Land management, planning and design	Land use	Controlled access
		Land acquisition, swap or lease-back
	Cultural landscapes	Survey, document, salvage, other
	Resilient design/development	Development setbacks
		Use of resilient materials and design in a new and retrofitted coastal infrastructure
Nature-based	Coastal vegetation and blue carbon ecosystems	Mangrove forests
		Seagrass meadows
		Salt marsh
		Kelp forest
	Beach and dune ecosystems	Beach and dune protection/vegetation/management
		Use of on-site natural materials
		Wet sand fencing
Hybrid engineering and nature-based	Reefs	Shellfish reefs
	Nourishment	Beach nourishment
		Localised beach scraping/dune nourishment
		Sand by-passing systems
	Seawalls	Vertical seawall
		Eco engineering of hard structures
		Rock revetments
		Geobag revetment / wall
	Groynes	Groynes
	Breakwaters	Breakwaters
	Flood/tidal barriers	Levees / dykes
		Tidal / surge barriers

Type	Category	Adaptation action
		Tidal valves on stormwater system
	Drainage	Saline groundwater intrusion barrier
		Upgrade of drainage network
	Road network	Upgrade of road network

9.2 ADAPTATION PATHWAYS

Adaptation pathways have been used to examine and communicate a range of location-specific actions and make decisions on technical feasible and preferred pathways. The different action types are integrated and act together to manage emerging coastal hazard risk and increase the resilience of the northern Bellarine region.

Adaptation pathways have been identified for the risks that have been assessed as high or significant.

9.2.1 Approach

The process of assessing and selecting actions involves the following:

1. Conducting a desktop review of existing adaptation actions to understand current relevance and performance.
2. Setting up initial pathway templates on excel and confirming the significant and high risks per precinct as determined in the risk assessment (Section 7).
3. Completing an initial screening of feasible adaptation actions (in Table 9.1) for each Precinct in the context of identified coastal hazard risks and Precinct values. This process considered the present day, 0.2, 0.5, and 0.8 SLR scenarios for each coastal hazard.
4. Further screening was undertaken through a tailored multi-criteria analysis for each Precinct (the multicriteria criteria and weightings are outlined in Table 9.2). Criteria were adapted from the VRC framework, aligned with Bellarine Bayside CoM's strategic pillars. The same multicriteria analysis criteria were used for all Precincts, and the weighting was the same for Precincts 3 to 9. Precincts 1 and 2 had different weightings in recognition of the specific values and focusses of those Precincts. The multicriteria analysis process assisted with shortlisting and selecting adaptation actions.
5. The selected range of adaptation actions were included in the adaptation pathway.

In response to feedback from WTOAC during consultation, adaptation actions in relation to Wadawurrung Cultural heritage values have not been rated in the multicriteria assessment. An alternative approach has been adopted as described in section 9.2.2 of this document.

Per the requirements of the Victoria's Resilient Coasts Guidelines, adaptation pathways have been identified to 2100. However, it is noted that Bellarine Bayside intends to initially use this to inform adaptation actions for the next 20 years.

Table 9.2 Multicriteria analysis criteria and weightings

Pillar **and pillar weighting**	**Criteria**	**Description**	**Scoring guidance**	**Criteria weighting within pillar**
Feasibility Weightings by Precinct: 1: 18% 2: 18% 3-9: 22%	Effectiveness - Pathway is effective at reducing risk.	How effective is the option likely to be in reducing the hazard to an acceptable level without causing adverse impacts to other Precincts.	1 = least effective 5 = most effective	40%
	Complexity - Is aligned to overarching policies enabling approvals and reducing overall complexity.	Complexity and level of effort required to obtain necessary approvals.	1 = highly complex 5 = least complex	30%
	Adaptive ability - The pathway is adaptable and enables future pathway changes.	Does this action allow flexibility to adopt different adaptation pathways into the future.	1 = very little adaptive ability 5 = high adaptive ability	30%
Pillar 3 – visitor and social benefit Weightings by Precinct: 1: 19% 2: 19% 3-9: 26%	Community values - Protect Community values and assets. Ensure coastal environment is safe and supports needs of users.	How well does it protect Rec and Act areas (Coastal trail, Boat ramps, facilities, piers, beaches).	1 = has negative impact social values 5 = protects social values	100%
Pillar 2 – Natural environment Weightings by Precinct: 1: 45% 2: 18% 3-9: 26%	Natural environment - Protects/enhances the Natural environment.	How well does it protect native vegetation (Ecological Vegetation Class (EVC)), wildlife habitats, intertidal zone, wetlands (habitat for key species: red cap plover, growling grass frog).	1 = has negative impact on the environmental areas and habitat 5 = protects/enhances environmental values.	100%
Pillar 4 – Community and economy Weightings by Precinct: 1: 18% 2: 45% 3-9: 26%	Economic sustainability - Pathway is economically sustainable.	Revenue and Broader tourism economic loss due to loss of income from Caravan Parks.	1 = biggest loss 5 = lowest loss	35% (Precinct 2: 60%)
	Direct cost - Pathway is economically achievable.	Direct costs to Bellarine Bayside for implementing actions (including costs of supporting assessments / studies).	1 = most expensive 5 = least expensive	35% (Precinct 2: 20%)
	Ongoing cost - Pathway is economically sustainable.	Ongoing costs required to upkeep pathway.	1= highest ongoing costs 5 = least ongoing cost	30% (Precinct 2: 20%)

9.2.2 Wadawurrung heritage: aspirations for the coast

In partnership with Wadawurrung Traditional Owners, we have developed the following aspirations, grounded in their Cultural heritage values and their Paleert Tjaara Dja Wadawurrung Country Plan. Together, we aim to ensure that the Cultural heritage, stories and significance of this coastline are continuously recognised, respected and strengthened even as the coast faces increasing pressures and environmental hazards.

Aspirations:

- Restoration and rehabilitation – Restore and rehabilitate coastal ecosystems, including sand dunes, saltmarshes, and other Culturally and environmentally significant habitats (Climate Action Strategy).
- Healing Country – Support the healing of Country through revegetation, pest and weed management, and wildlife conservation activities (Climate Action Strategy).
- Recognised access to coastal Country – Ongoing recognition and support for Wadawurrung access to Coastal Country.
- Collaborative Relationships – Foster a proactive and respectful relationship with Wadawurrung Traditional Owners through close collaboration and consultation.
- Proactive consultation with a heritage advisor and Wadawurrung RAP when works are taking place or being planned for as part of the Coastal Hazard response.

Through collaboration with Wadawurrung, Bellarine Bayside will continue to embed Wadawurrung knowledge and priorities in coastal adaptation planning and foster opportunities for joint decision-making. Community engagement has also shown that the wider community deeply values the coasts' natural environment, wildlife, and ecosystems. This shared care for Country strengthens both Cultural and natural resilience, ensuring the coast's ecosystems and heritage endure into the future.

Adaptation Actions for risks to Cultural Heritage

- Revegetation - Retain, restore and expand native coastal vegetation (including species such as Moonah) to support habitat values, shade stability, dune health and Wadawurrung cultural practices.
- Sand Nourishment/Shoreline Works - consult with Wadawurrung and Heritage Advisors to undertake any works that might impact Cultural Heritage.
- Develop community education and interpretation projects to share Cultural Heritage stories, seasonal calendars, place names and ecological values thus strengthening public knowledge and respect.
- Plan for and adapt to coastal hazards (sea level rise, erosion, inundation) in a way that balances risk reduction with Cultural landscape preservation.
- Ensure decision making about planning, investment and approvals is inclusive of Wadawurrung priorities, knowledge and consent.
- Support Wadawurrung Traditional Owners Aboriginal Corporation (WTOAC) to identify physical Cultural heritage sites at risk from coastal hazards and collaborate to develop approaches for their protection and ongoing management.
- Undertake a Cultural Values Assessment to better identify and understand Cultural Heritage values along the northern Bellarine Coast.

9.2.3 Overarching adaptation pathways

The following adaptation pathways presented in ***Table** 9.3* are applicable across all Precincts.

Key							
	Preparation – Lead time required to prepare for action implementation.		Wadawurrung heritage		Nature-based methods		Protect
	Actioning – Implementation of action		Non-intervention		Accommodate		Hybrid engineering and nature-based
	Supporting action		Avoid		Retreat		Existing measures in place (partial or full)

Table 9.3 All Precincts – adaptation pathway

Adaptation option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Implement actions from Cultural Values Assessment and continual reassessment, monitoring and engagement				
(Subject to agreement with WTOAC) Undertake Wadawurrung heritage surveys so that risk to Cultural Heritage values can be understood				

9.2.4 Adaptation pathways for each Precinct

Precinct 1

Figure 9.1 Precinct 1

Values

This location includes Point Richards Flora and Fauna Reserve (Figure 9.1). Precinct 1 provides for significant biodiversity protection, habitat and passive recreation.

Risk profile

Key values assessed as having significant and high risk are in Table 9.4. The region will primarily be impacted by storm tide inundation and groundwater intrusion, with exposure and risk likely to increase into the future (Table 9.5).

Table 9.4 Summary of significant and high risks for Precinct 1

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0.8	Inundation - storm tide	Detrimental impacts on woodland vegetation and wildlife due to changed hydrology and salinity	Significant
0.8	Inundation - storm tide	Detrimental impacts to wetland vegetation and wildlife due to changed hydrology	Significant

Table 9.5 Precinct 1 - hazard risk levels

Hazard risk levels	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Erosion risk	N/A	N/A	N/A	N/A
Storm tide inundation	N/A	Medium	Medium	Significant
Permanent inundation	N/A	N/A	N/A	Medium
Groundwater hazard	Medium	Medium	Medium	Medium

Adaptation pathways

The adaptation pathway for Precinct 1 involves:

– Non-intervention actions including controlling access and monitoring the Point Richards Flora and Fauna Reserve during inundation events.
– Accommodation of risk through infrastructure (walking tracks and stormwater network) upgrades to increase resilience.

With 0.5 m SLR (by 2070), or as an alternative trigger is reached, this pathway expands to include:

– Moving infrastructure and assets out of at-risk areas over time (retreat) including redesign of walking trails, artificial wetlands, and woodland plantings.

It should be noted that some actions are associated with triggers other than the year and associated SLR levels. For example:

– Modifications to wetlands and expanded woodland planting should be triggered by changes to condition or state, as detected through monitoring. Based on available mapping, impacts are predicted to occur around 2100.

Key							
	Preparation – Lead time required to prepare for action implementation.		Wadawurrung heritage		Nature-based methods		Protect
	Actioning – Implementation of action		Non-intervention		Accommodate		Hybrid engineering and nature-based
	Supporting action		Avoid		Retreat		Existing measures in place (partial or full)

Table 9.6 Precinct 1 - adaptation pathway

Adaptation option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Control access to walking tracks in northern section of the Point Richards Flora and Fauna Reserve during inundation events.				
Monitor the condition of the wetlands and woodlands within the Point Richards Flora and Fauna Reserve, especially during and after inundation events.				
Risk avoidance				
Nature-based methods				
Advocate for the review of stormwater infrastructure to reduce impact to foreshore and improve coastal resilience.				
Modify walking trail - upgrades or raising trail in locations predicted to be impacted by inundation.				
Modify walking trail - inland or manoeuvre around hot spots along the northern section of the Precinct.				
Explore options to maintain or enhance habitat values in response to inundation of northern wetlands, including potential habitat connectivity or the development of emerging wetland areas.				

Adaptation option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Woodland planting in areas less affected by coastal hazards to reduce impacts to habitat values in the area.				
Protection				

Precinct 2

Figure 9.2 Precinct 2

Values

This location includes Point Richards to Portarlington Holiday Park (Figure 9.2). Precinct 2 provides for a variety of recreation and leisure pursuits, comprising Point Richards Boat Ramp and foreshore, Portarlington Holiday Park and foreshore as well as the miniature railway site and wetland/park areas.

In some areas, a narrow section of Bellarine Bayside-managed land sits in front of municipal or state assets. Bellarine Bayside will collaborate with these authorities to support integrated planning and actions.

Risk profile

Key values assessed as having significant and high risk are in Table 9.7. The region will primarily be impacted by erosion, storm tide inundation, and permanent inundation. Exposure and risk from these hazards are likely to increase into the future (Table 9.8).

Table 9.7 Summary of significant and high risks for Precinct 2

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0.2	Erosion - storm tide	Damage to 70-80% of coastal trail during storm events, causing damage to trail and medium- term impacts to access	Significant
0.2	Erosion - storm tide	Change to beach views following erosion events. Negative impact on visitor experience	Significant
0.2	Erosion - storm tide	Loss of safe access to beach following erosion events impacting ability to undertake recreation activities. Negative visitor experience.	High
0.8	Inundation - storm tide	Temporary inundation during low season Portarlington Holiday Park during storm event affecting availability for tourism uses. Impacts all twelve month permit sites and all tourist cabins for an assumed 1 month duration	Significant
0.2	Erosion - storm tide	Erosion of front sites (all beach pods and twelve month permit sites) during storm event, affecting availability for tourism for 6-12 months.	Significant

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0.8	Permanent inundation	Permanent inundation of approximately 50-60% of Portarlington Holiday Park	Significant
0.2	Erosion - storm tide	Erosion of vegetation during storm events affecting root stability and potentially causing die-off.	Significant
0.8	Permanent inundation	Permanent inundation of sailing club	Significant
0.2	Erosion - storm tide	Erosion of sailing club area during storm events, causing damage to boats and building, non-operation during recovery period	Significant
0	Erosion - storm tide	Erosion of boat ramp area, impacting access and safe use of the ramp	Significant

Table 9.8 Precinct 2 - hazard risk levels

Hazard risk levels	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Erosion risk	High	High	High	High
Storm tide inundation	Medium	Medium	Significant	Significant
Permanent inundation	N/A	Medium	Significant	Significant
Groundwater hazard	Medium	Medium	Medium	Medium

Adaptation pathway

The adaptation pathway for Precinct 2 (Table 9.9) involves:

– Non-intervention actions including controlling access.

– Targeted dune and vegetation enhancement at the west of Precinct 2 to improve the natural dynamics of the beach system and provide hazard buffer through sand nourishment.

– Accommodation of coastal hazards through infrastructure (for example, waterproofing underground assets including utility and stormwater system) upgrades and modifications to increase resilience in design.

With 0.2 m SLR (by 2040), or as an alternative trigger is reached, the pathway expands to include:

– Modifying the foreshore coastal trail through realignment and/or raising as appropriate.

– Investigate nature-based methods (offshore reefs) to mitigate hazards.

With 0.5 m SLR (by 2070), or as an alternative trigger is reached, the pathway expands to include:

– Plan for the staged relocation of cabins and associated infrastructure, including review of cabin suitability in hazard prone areas as coastal risks increase.

It should be noted that some actions are associated with triggers other than the year and associated SLR levels. For example:

– Modification or relocation of the coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards Based on available mapping, it is predicted that storm tide inundation begins to threaten the trail at around 2040.

– Modifications of built assets may be triggered by: any changes in condition; updated technical information that may be available; through any relevant changes in community attitude and risk tolerance; or at a time when erosion or storm time inundation begins to threaten the built asset, which is predicted to occur around 2070.

Key							
	Preparation – Lead time required to prepare for action implementation.		Wadawurrung heritage		Nature-based methods		Protect
	Actioning – Implementation of action		Non-intervention		Accommodate		Hybrid engineering and nature-based
	Supporting action		Avoid		Retreat		Existing measures in place (partial or full)

Table 9.9 Precinct 2 - adaptation pathway

Description of option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Control access to beaches and pier during inundation events and to damaged areas following erosion events for public safety				
Development of a site-specific CAP				
Beyond 2070 or .5SLR, avoid constructing new infrastructure (accommodation or services) shoreward of Anglers Road / First Avenue				
Beyond 2100 or .8 SLR, avoid constructing new infrastructure (accommodation or services) within the existing Portarlington Holiday Park boundaries				
Revegetation of dunes to stabilise beach and provide protection from hazard events				
Seek to partner with lead agencies to investigate feasibility of 'living shorelines' approaches, including potential integration of engineering structures to support shellfish reef development (hybrid approach)				
Beach nourishment to mitigate impacts of short- and long-term erosion and storm tide inundation				
Beach scraping to mitigate impacts of short-term erosion				
Advocate for review of tidal valve application on stormwater system				
Advocate for review of stormwater infrastructure to reduce impact to foreshore and improve coastal resilience				

Description of option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Protect utility networks (for example, waterproofing underground assets including utilities at Portarlington Holiday Park				
Modification of infrastructure to adopt more resilient design including new development within the holiday park. types of infrastructure for new development within the holiday park. (broaden scope in language to include cabins etc)				
Review the suitability of offering twelve-month permits for sites at risk of erosion or inundation				
Plan for the staged relocation of cabins and associated infrastructure, including review of cabin suitability in hazard prone areas as coastal risks increase.				
Consider completing a ground feature survey to establish exact heights across the park to better inform all future asset planning				
Modify the foreshore coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards				
Maintenance of existing Portarlington West Revetment (Stewart Gr) - Asset ID: S771122.				
Maintenance of existing breakwaters				
Upgrades to drainage networks within the holiday park to improve resilience to erosion and inundation				

Precinct 3

Figure 9.3 Precinct 3

Values

This location includes on Sproat Street to Fisher Street (Figure 9.3). Precinct 3 provides for a variety of recreation and leisure activities, including Portarlington Bowls Club and S.S. Nash Reserve, and W.G. Little Reserve. The Precinct is a popular tourist site where many events, festivals and markets occur.

This Precinct specifically focusses on Portarlington's main beach. The Safe Harbour and Portarlington Pier are managed by Parks Victoria.

Risk profile

Key values assessed as having significant and high risk are in Table 9.10. The region will primarily be impacted by erosion, storm tide inundation and small areas of the foreshore also likely to be impacted by groundwater intrusion (Table 9.11). Permanent inundation is predicted to impact the area from 2100.

Table 9.10 Summary of significant and high risks for Precinct 3

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0.2	Erosion - storm tide	Erosion of approx. 50% of coastal trail, concentrated to the west of Portarlington Pier during storm event, causing damage to trail and medium- term impacts to access	Significant
0.5	Erosion - storm tide	Erosion of foreshore open space west of Portarlington Pier	Significant
0.2	Erosion - storm tide	Change to beach views following erosion events. Negative impact on visitor experience	Significant
0.2	Erosion - storm tide	Loss of safe access to beach following erosion events impacting ability to undertake recreation activities. Negative visitor experience	High
0.5	Erosion - storm tide	Erosion affecting health and stability of shade trees west of Portarlington Pier	Significant

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0.8	Permanent inundation	Rise in sea level leading to regular inundation of Portarlington Pier during high tides, impacting transport options for community and visitor access and safety for recreational uses (e.g. fishing).	Significant
0.2	Erosion - storm tide	Damage to coastal vegetation during erosion event	Significant

Table 9.11 Precinct 3 - hazard risk levels

Hazard risk levels	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Erosion risk	High	High	High	High
Storm tide inundation	Medium	Medium	Medium	Medium
Permanent inundation	N/A	N/A	N/A	Significant
Groundwater hazard	Medium	Medium	Medium	Medium

Adaptation pathway

The adaptation pathway for Precinct 3 (Table 9.12) involves:

- Non-intervention actions including controlling access.
- Avoiding risk through planning of future infrastructure for consistency with coastal hazard risks.
- Targeted dune and vegetation enhancement to improve the natural dynamics of the beach and foreshore system and provide hazard buffer through sand nourishment.
- Accommodation of coastal hazards through advocating for the review of infrastructure (stormwater system) to increase resilience in design.
- Engineering to maintain or replace existing revetments in the area to protect the foreshore and advocating for the maintenance of existing breakwaters with Parks Victoria.

It should be noted that some actions are associated with triggers other than the year and associated SLR levels. For example:

- Modification or relocation of assets such as car parks should be considered at a time when erosion or storm tide inundation begins to threaten the car park, if there are any changes in community attitude and risk tolerance, or if existing structures show signs of failure or changes in condition. Based on available mapping, this is predicted to occur around 2040 and 2070.

Key							
	Preparation – Lead time required to prepare for action implementation.		Wadawurrung heritage		Nature-based methods		Protect
	Actioning – Implementation of action		Non-intervention		Accommodate		Hybrid engineering and nature-based
	Supporting action		Avoid		Retreat		Existing measures in place (partial or full)

Table 9.12 Precinct 3 - adaptation pathway

Description of option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Control access to coastal trail/beach and car park during inundation events and to damaged areas following erosion events for public safety				
Ensure any proposed foreshore development is consistent with coastal risks, including where possible avoiding new permanent infrastructure to the west of Harding Street, shoreward of the intersection between Harding Street and Pier Street				
Revegetation of dunes to stabilise beach and provide protection from hazard events				
Beach nourishment to mitigate impacts of short- and long-term erosion and storm tide inundation				
Advocate for review of stormwater infrastructure to reduce impact to foreshore and improve coastal resilience				
Modify the foreshore coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards				
If recommended, modify coastal trail through realignment and/or raising as appropriate				
Relocate car park (west of pier) to an area less threatened by erosion (to east of pier)				

Description of option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Implement a suitable engineered coastal protection option, or refurbish and enhance the existing rock revetment (Asset ID: S771122) to maintain erosion protection for the adjacent beach				
Advocate for the maintenance of existing breakwaters with Parks Victoria				

Precinct 4A

Figure 9.4 Precinct 4A (yellow polygon)

Values

The location includes the area between Fisher Street to the left of Mercer Street/The Esplanade (Figure 9.4). Precinct 4A provides natural amenity, important habitat and passive recreation. The Precinct comprises Steeles Rock boat ramp.

Risk profile

Key values assessed as having significant and high risk are in *Table 9.13*. The region will primarily be impacted by erosion and permanent inundation, with small areas impacted by groundwater intrusion (Table 9.14).

Table 9.13 Summary of significant and high risks for Precinct 4A

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0	Erosion - storm tide	Change to beach views following erosion events. Negative impact on visitor experience	Significant
0	Erosion - storm tide	Erosion of beach access ramps following large erosion event affecting access to beach and Steeles Rocks Boat Ramp. Negative impact on visitor experience	Significant
0.5	Erosion - storm tide	Erosion of beach access ramps following large erosion event affecting access to beach and Steeles Rocks Boat Ramp and major damage to boat ramp. Negative impact on visitor experience	High
0.8	Erosion - storm tide	Erosion of beach access ramps following large erosion event affecting access to beach and Steeles Rocks Boat Ramp and major damage. Negative impact on visitor experience	Significant

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0.2	Permanent inundation	Changes to intertidal dynamics (e.g. high and low tide levels) due to sea level rise impacting suitability of habitats for sealife. Given soft backing in many areas of this Precinct, there is potential for migration of intertidal zone habitat	Significant

Table 9.14 Precinct 4A - hazard risk levels

Hazard risk levels	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Erosion risk	Significant	Significant	High	Significant*
Storm tide inundation	Low	Low	Low	Low
Permanent inundation	N/A	Significant	Significant	Significant
Groundwater hazard	Medium	Medium	Medium	Medium

*Risk level decreases because, although consequence increases, likelihood of the event occurring within the study period decreases.

Adaptation pathway

The adaptation pathway for Precinct 4A (Table 9.15) involves:

- Non-intervention actions including controlling access.
- Targeted dune and vegetation enhancement to improve the natural dynamics of the beach and foreshore system and provide hazard buffer through sand nourishment.
- Accommodation of coastal hazards through infrastructure (stormwater system) review/updates to increase resilience in design.
- Engineering actions including revetments to protect Steeles Rock boat ramp and car park.

With 0.8 m SLR (by 2100), or as a trigger is reached, the pathway expands to include:

- Modifying some of the foreshore coastal trail out of at-risk areas over time (retreat).

It should be noted that some actions are associated with triggers other than the year and associated SLR levels. For example:

- Modification or relocation of the coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards when. Based on available mapping, impacts are predicted to occur around 2100 in some areas.

Key							
	Preparation – Lead time required to prepare for action implementation.		Wadawurrung heritage		Nature-based methods		Protect
	Actioning – Implementation of action		Non-intervention		Accommodate		Hybrid engineering and nature-based
	Supporting action		Avoid		Retreat		Existing measures in place (partial or full)

Table 9.15 Precinct 4A - adaptation pathway

Description of option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Control access to boat ramp and car park during inundation events and to damaged areas following erosion events for public safety				
Development of a specific Steeles Rock CAP				
Risk avoidance				
Revegetation of dunes to stabilise beach and provide protection from hazard events				
Studies into appropriate measures to protect intertidal communities				
Continue dune nourishment at Steeles Rock to mitigate impacts of short-term erosion. Noting dune nourishment has been a past practice and is ongoing at Steeles Rock.				
Advocate for review of stormwater infrastructure to reduce impact to foreshore and improve coastal resilience				
Modify the foreshore coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards				

Description of option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Review the suitability of revetment to protect the boat ramp and car park from erosion				

Precinct 4B

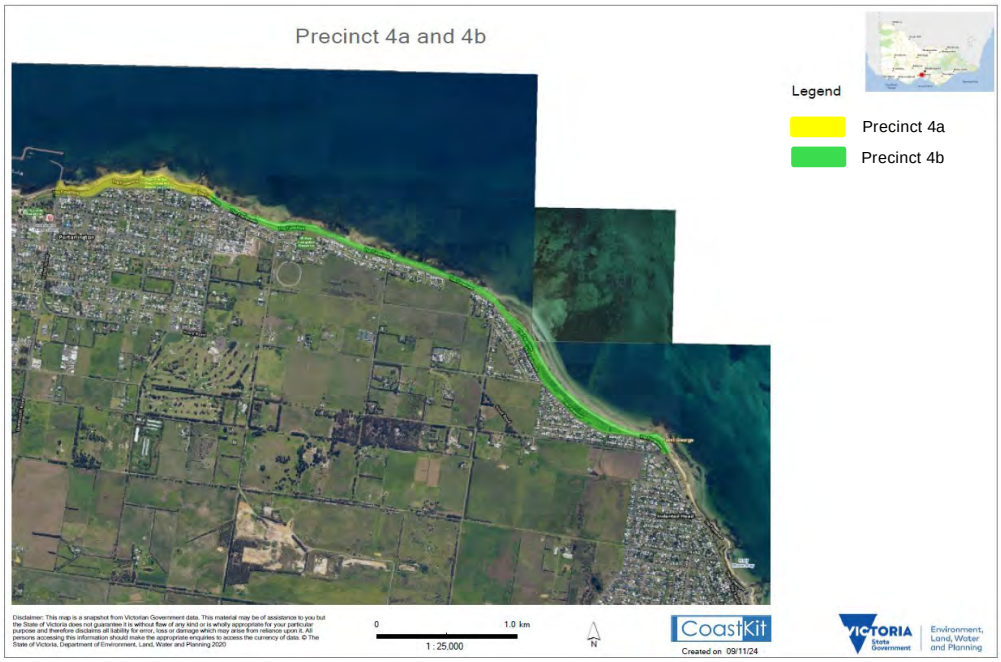


Figure 9.5 Precinct 4B (green polygon)

Values

The location includes the stretch of coast from slightly west of Mercer Street to Point George (Figure 9.5). Precinct 4B provides a range of important habitats such as seagrass, wetlands, and coastal marshland (EVC 9). These environments provide habitat for marine life including, resident bird species such as the Red-capped Plover and other beach-nesting species. The Precinct comprises Steeles Rock boat ramp.

In some areas, a narrow section of Bellarine Bayside-managed land sits in front of municipal or state assets. Bellarine Bayside will collaborate with these authorities to support integrated planning and actions.

Risk profile

Key values assessed as having significant and high risk are in Table 9.16. The region will primarily be impacted by erosion, storm tide inundation and permanent inundation with exposure and risk likely to increase into the future (Table 9.17).

Table 9.16 Summary of significant and high risks for Precinct 4B

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0	Erosion – storm tide	Change to beach views following erosion events. Negative impact on visitor experience	Significant
0	Erosion – storm tide	Erosion of Grassy Point Boat Ramp during storm events affecting safe access and use	Significant
0.2	Erosion – storm tide	Erosion of red capped plover nesting locations (dunes) during storm event. Possible breeding failure.	Significant
0.2	Erosion – storm tide	Loss of safe access to beach following erosion events impacting ability to undertake recreation activities. Negative visitor experience.	High
0.2	Inundation – storm tide	Detrimental impacts on woodland vegetation and wildlife due to changed hydrology and salinity	High

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0.2	Erosion – storm tide	Erosion of dune scrub impacting vegetation, habitat and wildlife	Significant
0.2	Inundation – storm tide	Detrimental impacts to wetland vegetation and wildlife due to changed hydrology (more frequent and deeper inundation)	Significant
0.5	Permanent inundation	Inundation of beach due to sea level rise permanently changing beach views.	Significant
0.5	Permanent inundation	Drainage compromised by rising sea levels, leading to localised surface water flooding in the study area	Significant

Table 9.17 Precinct 4B – hazard risk levels

Hazard risk levels	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Erosion risk	Significant	High	High	High
Storm tide inundation	Medium	Significant	Significant	Significant
Permanent inundation	N/A	N/A	Significant	Significant
Groundwater hazard	Medium	Medium	Medium	Medium

Adaptation pathway

The adaptation pathway for Precinct 4B (Table 9.18) involves:

– Non-intervention actions including controlling access.

– Targeted dune and vegetation enhancement to improve the natural dynamics of the beach and foreshore system and provide hazard buffer.

– Accommodation of coastal hazards through infrastructure (drainage network and stormwater system) review/updates to increase resilience in design.

With 0.2 m SLR (by 2040), or as an alternative trigger is reached, the pathway expands to possibly include:

– Seeking to partner with lead agencies to investigate feasibility of hybrid engineering and nature-based shellfish reef enhancement to protect shellfish.

– Modifying some of the foreshore coastal trail out of at-risk areas over time (retreat).

It should be noted that some actions are associated with triggers other than the year and associated SLR levels. For example:

– Modification or relocation of the coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards when. Based on available mapping, impacts are predicted to occur around 2040.

Key							
	Preparation – Lead time required to prepare for action implementation.		Wadawurrung heritage		Nature-based methods		Protect
	Actioning – Implementation of action		Non-intervention		Accommodate		Hybrid engineering and nature-based
	Supporting action		Avoid		Retreat		Existing measures in place (partial or full)

Table 9.18 Precinct 4B - adaptation pathways

Description of option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Control access to Grassy Point boat ramp during inundation events and to damaged areas along the coastal trail following erosion events for public safety				
Risk avoidance				
Revegetation and sand renourishment of dunes to stabilise beach and provide protection from hazard events				
Studies into appropriate measures to protect and restore priority biodiversity areas				
If recommended, implement sand fencesat back of beach to stabilise.				
Seek to partner with lead agencies to investigate feasibility of 'living shorelines' approaches, including potential integration of engineering structures to support shellfish reef development				
Advocate to City of Greater Geelong to monitor drainage network performance and consider whether backflow prevention may be required				

Description of option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Advocate for review of stormwater infrastructure to reduce impact to foreshore and improve coastal resilience				
Review of the alignment of the foreshore coastal trail				
According to the review, modify the foreshore coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards				
Protection				

Precinct 5

Figure 9.6 Precinct 5

Values

The location includes the area from Point George to Batman Memorial (Figure 9.6). Precinct 5 provides for a variety of recreation and leisure activities. It comprises seasonal campgrounds (Anderson Reserve campground, Batman Park campground, and Taylor Reserve campground), the Batman Memorial site, historic boat sheds and the Ozone Shipwreck, and Indented Head Boat and Yacht Clubs.

Risk profile

Key values assessed as having significant and high risk are in Table 9.19. The region will primarily be impacted by erosion, storm tide inundation, and permanent inundation, with exposure and risk likely to increase into the future (Table .9.20).

Table 9.19 Summary of significant and high risks for Precinct 5

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0	Erosion - storm tide	Erosion of approx. 30% of Bellarine Coastal Trail affecting access for community	Significant
0	Erosion - storm tide	Change to beach views following erosion events. Negative impact on visitor experience	Significant
0	Erosion - storm tide	Loss of safe access to beach following erosion events impacting ability to undertake recreation activities. Negative visitor experience.	Significant
0.2	Erosion - storm tide	Erosion of Indented Head boatsheds interrupting use and damaging infrastructure	Significant
0.5	Permanent inundation	Permanent inundation impacts to some of Indented Head boatsheds	High
0.5	Erosion - storm tide	Significant erosion of beach preventing safe access for recreation beaches following storm	Significant

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0.8	Inundation - storm tide	Inundation of approx. 80% of Bellarine Coastal Trail during storm events affecting access for community. Depth up to 1m	Significant
0.8	Permanent inundation	Permanent inundation of yacht club	Significant
0.8	Inundation - storm tide	Temporary inundation of Indented Head boat sheds during storm	Significant
0.8	Erosion - storm tide	Erosion of shore side of yacht club affecting safety of access and potentially damaging stored yachts and building structure	Significant
0.8	Permanent inundation	Permanent inundation of community hall	Significant

Table .9.20 Precinct 5 - hazard risk level

Hazard risk levels	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Erosion risk	Significant	Significant	Significant	Significant
Storm tide inundation	Medium	Medium	Medium	Significant
Permanent inundation	Medium	Medium	High	Significant*
Groundwater hazard	Medium	Medium	Medium	Medium
*Risk level decreases because, although consequence increases, likelihood of the event occurring within the study period decreases.				

Adaptation pathway

The adaptation pathway for Precinct 5 (Table 9.21) involves:

– Non-intervention actions including controlling access.
– Avoiding risk through development setbacks.
– Targeted dune and vegetation enhancement to improve the natural dynamics of the beach and foreshore system and provide hazard buffer through nature-based revegetation and hybrid engineering and nature-based sand nourishment.

With 0.2 m SLR (by 2040), or as an alternative trigger is reached, the pathway expands to include:

– Accommodation of coastal hazards through infrastructure reviews and upgrades (e.g. campground electricals) to increase resilience in design.
– Modification or relocation of the coastal trail should be considered at a time when storm tide inundation begins to threaten the trail. Based on available mapping, this is predicted to occur around 2040.
– Progressively end (or do not renew) leases on historic boat sheds as coastal hazard impacts increase

With 0.5 m SLR (by 2070), or as an alternative trigger is reached, the pathway expands to include:

– Maintain and repair existing assets (rock groyne) at Taylors Reserve to protect adjacent beach

With 0.8 m SLR (by 2100), or as an alternative trigger is reached, the pathway expands to include:

– Accommodation of coastal hazards through retrofitting-built assets, such as Indented Head boat club.

It should be noted that some actions are associated with triggers other than the year and associated SLR levels. For example:

– Modification or relocation of the coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards when. Based on available mapping, impacts are predicted to occur around 2040.
– Modifications of built assets may be triggered by: any changes in condition; available updated technical information; through any relevant changes in community attitude and risk tolerance; or at a time when erosion or storm time inundation begins to threaten the built asset.

Key							
	Preparation – Lead time required to prepare for action implementation.		Wadawurrung heritage		Nature-based methods		Protect
	Actioning – Implementation of action		Non-intervention		Accommodate		Hybrid engineering and nature-based
	Supporting action		Avoid		Retreat		Existing measures in place (partial or full)

Table 9.21 Precinct 5 - adaptation pathway

Description of option	0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Control access to Indented Head boat ramp during inundation events and to damaged areas along the shoreline following erosion events for public safety, especially around campgrounds in the Precinct				
Avoid constructing new infrastructure shoreward of the predicted erosion lines from 2070 or .5 SLR.and inundation lines.				
Avoid constructing new infrastructure shoreward of the predicted inundation lines from 2100 or .8SLR				
Revegetation of dunes to stabilise beach and provide protection from hazard events				
Studies into appropriate measures to protect and restore priority biodiversity areas				
Beach nourishment at priority hotspots to mitigate impacts of short- and long-term erosion and storm tide inundation				
Advocate for review of stormwater infrastructure to reduce impact to foreshore and improve coastal resilience				
Retrofit applicable infrastructure (if not done so already) to be more resilient to inundation and erosion - e.g.				

through raising infrastructure above predicted inundation levels				
Modification of infrastructure including adopting more resilient types of infrastructure for new development within the campgrounds				
Progressively end (or do not renew) leases on historic boat sheds as coastal hazard impacts increase				
Modify the foreshore coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards				
Maintain and repair rock revetments around Taylor Reserve (Asset ID: S761063 and Asset ID: S761244) to protect the campground and beach amenity and value and at Batman Point (Asset ID: S761061) to protect the Indented Head boat ramp and car park				
Maintain and repair rock groyne (Asset ID: S731062) at Taylors Reserve to protect the adjacent beach				
Explore opportunities to extend groyne field at Anderson Reserve to protect the adjacent beach				

Precinct 6A

Figure 9.7 Precinct 6A (yellow polygon)

Values

The location includes the area between Batman Memorial and St Leonards Foreshore Reserve (Figure 9.7). Precinct 6A is a small section of coastline which provides a sandy beach, natural environment and passive recreation.

Risk profile

Key values assessed as having significant and high risk are in Table 9.22. The region will primarily be impacted by erosion and permanent inundation, with exposure and risk likely to increase into the future (Table .9.23).

Table 9.22 Summary of significant and high risks for Precinct 6A

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0	Erosion - storm tide	Loss of safe access to beach following erosion events impacting ability to undertake recreation activities. Negative visitor experience.	Significant
0.2	Erosion - storm tide	Change to beach views following erosion events. Negative impact on visitor experience	Significant
0.2	Permanent inundation	Changes to intertidal dynamics (e.g. high and low tide levels) due to sea level rise impacting suitability of habitats for sealife. Soft backing in some areas may enable migration but areas with hard backing (e.g. revetment at Taylor's Reserve) unable to migrate	Significant
0.5	Erosion - storm tide	Erosion of about half of Bellarine Coastal Trail in this Precinct during storm events, affecting safe access	Significant
0.5	Erosion - storm tide	Erosion of approximately half of the vegetation during a storm event	Significant

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0.5	Erosion - storm tide	Erosion during storm events disrupting sediment where seagrass grows, destabilising seagrass and reducing cover	Significant
0.8	Erosion - storm tide	Erosion of all of Bellarine Coastal Trail in this Precinct during storm events, affecting safe access	Significant

Table .9.23 Precinct 6A - hazard risk levels

Hazard risk levels	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Erosion risk	Significant	Significant	Significant	Significant
Storm tide inundation	Medium	Medium	Medium	Medium
Permanent inundation	Medium	Significant	Significant	Significant
Groundwater hazard	Medium	Medium	Medium	Medium

Adaptation pathway

The adaptation pathway for Precinct 6A (Table .9.23) involves:

- Non-intervention of risk through controlling access.
- Targeted dune and vegetation enhancement to improve the natural dynamics of the beach and foreshore system and provide hazard buffer through nature-based revegetation and hybrid engineering and nature-based sand nourishment.
- Seeking to partner with lead agencies to investigate feasibility of hybrid engineering and nature-based shellfish reef enhancement.
- Accommodation of coastal hazards through infrastructure reviews (stormwater system) to increase resilience in design.

With 0.5 m SLR (by 2070), or as an alternative trigger is reached, the pathway expands to include:

- Accommodation of coastal hazards through infrastructure upgrades to coastal trail to increase resilience.
- Modifying of the foreshore coastal trail out of at-risk areas over time (retreat).

It should be noted that some actions are associated with triggers other than the year and associated SLR levels. For example:

- Modification or relocation of the coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards.
- Modifications of built assets should be triggered by any changes in condition, updated technical information that may be available, or through any relevant changes in community attitude and risk tolerance.

Key							
	Preparation – Lead time required to prepare for action implementation.		Wadawurrung heritage		Nature-based methods		Protect
	Actioning – Implementation of action		Non-intervention		Accommodate		Hybrid engineering and nature-based
	Supporting action		Avoid		Retreat		Existing measures in place (partial or full)

Table 9.24 Precinct 6A - adaptation pathway

Description of option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Control access to coastal trail during inundation events and to damaged areas along the shoreline following erosion events for public safety.				
Risk avoidance				
Revegetation of dunes to stabilise beach and provide protection from hazard events				
Studies into appropriate measures to protect and restore priority biodiversity areas				
Seek to partner with lead agencies to investigate feasibility of 'living shorelines' approaches, including potential integration of engineering structures to support shellfish reef development				
Beach nourishment to mitigate impacts of short- and long-term erosion and storm tide inundation				
Dune nourishment to mitigate impacts of short-term erosion				
Work with the relevant authority to review stormwater infrastructure to reduce impact to foreshore and improve coastal resilience				
Upgrade impacted section of coastal trail to be more resilient to inundation impacts.				

Description of option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Modify the foreshore coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards				
Monitor existing sandbags (especially Asset ID: S771119) condition and performance, and adapt, repair or redesign the structure if required Explore supporting foreshore north of this asset via additional geotextile sandbags				

Precinct 6B

Figure 9.8 Precinct 6B (green polygon)

Values

The location includes St Leonards Foreshore Reserve to north of Second Avenue (Figure 9.8). Precinct 6B provides natural environment and passive recreation experience for the community. The Precinct comprises a range of habitats for fauna including seagrass meadows, wetlands, and coastal dunes and scrub (EVC 1 and EVC 161). The coastline is dominated by sandy beach.

This Precinct has undergone major sand nourishment in 2021, with monitoring ongoing.

In some areas, a narrow section of Bellarine Bayside-managed land sits in front of municipal or state assets. Bellarine Bayside will collaborate with these authorities to support integrated planning and actions.

Risk profile

Key values assessed as having significant and high risk are in Table 9.25. The region will primarily be impacted by erosion, with exposure and risk likely to increase into the future (Table .9.26).

Table 9.25 Summary of significant and high risks for Precinct 6B

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0	Erosion - storm tide	Loss of safe access to beach following erosion events impacting ability to undertake recreation activities. Negative visitor experience.	Significant
0.2	Erosion - storm tide	Erosion of section of Bellarine Coastal Trail aligned with south end of the salt lagoon during storm event	Significant
0.2	Erosion - storm tide	Change to beach views following erosion events. Negative impact on visitor experience	Significant
0.5	Erosion - storm tide	Erosion of approx. 90-95% of Bellarine Coastal Trail in this Precinct during storm events, affecting safe access	High

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0.5	Erosion - storm tide	Erosion of majority of vegetation during significant storm event	High
0.5	Erosion - storm tide	Erosion during storm events disrupting sediment where seagrass grows, destabilising seagrass and reducing cover	Significant
0.5	Permanent inundation	"Permanent inundation of majority of wetland	

Table .9.26 Precinct 6B - hazard risk level

Hazard risk levels	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Erosion risk	Significant	Significant	High	High
Storm tide inundation	Medium	Medium	Medium	Medium
Permanent inundation	Medium	Medium	Significant	Significant
Groundwater hazard	Medium	Medium	Medium	Medium

Adaptation pathway

The adaptation pathway for Precinct 6B (Table 9.27) involves:

- Non-intervention actions including controlling access.
- Targeted dune and vegetation enhancement to improve the natural dynamics of the beach and foreshore system.
- Nature-based revegetation and saltmarsh enhancement.
- Accommodation of coastal hazards through infrastructure reviews (stormwater system) to increase resilience in design.

With 0.5 m SLR (by 2070), or as an alternative trigger is reached, the pathway expands to include:

- Accommodation of coastal hazards through infrastructure upgrades to coastal trail to increase resilience.
- Modifying of the foreshore coastal trail out of at-risk areas over time (retreat).

It should be noted that some actions are associated with triggers other than the year and associated SLR levels. For example:

- Modification or relocation of the coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards when. Based on available mapping, impacts are predicted to occur around 2070.
- Modifications of built assets should be triggered by any changes in condition, updated technical information that may be available, or through any relevant changes in community attitude and risk tolerance.

Key							
	Preparation – Lead time required to prepare for action implementation.		Wadawurrung heritage		Nature-based methods		Protect
	Actioning – Implementation of action		Non-intervention		Accommodate		Hybrid engineering and nature-based
	Supporting action		Avoid		Retreat		Existing measures in place (partial or full)

Table 9.27 Precinct 6B - adaptation plan

Description of option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Control access to coastal trail during inundation events and to damaged areas along the shoreline following erosion events for public safety.				
Risk avoidance				
Seek to partner with lead agencies to investigate feasibility of 'living shorelines' (refer Section 8.1.2) approaches, including potential integration of engineering structures to assist with salt marsh protection and growth				
Revegetation of dunes to stabilise beach and provide protection from hazard events				
Studies into appropriate measures to protect and restore priority biodiversity areas				
Seek to partner with lead agencies to investigate feasibility of living shorelines' approaches, including potential integration of shellfish reef enhancement particularly along the narrow coast near the Salt Lagoon				
Work with the relevant authority to review stormwater infrastructure to reduce impact to foreshore and improve coastal resilience				

Description of option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Upgrade impacted section of coastal trail to be more resilient to inundation impacts, including raising where required which may include raising the frontal dune.				
Advocate for review and investigation of future inundation levels of The Esplanade and with VicRoads				
Modify the foreshore coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards				
Work with relevant agencies/stakeholders in decision-making for coastal engineering structures in this Precinct, particularly where they interface with assets outside Bellarine Bayside's jurisdiction. Ongoing management, design and maintenance will be coordinated with the responsible asset managers to ensure structures remain fit-for-purpose.				

Precinct 7

Figure 9.9 Precinct 7

Values

The location includes the area between north of Second Avenue to William Buckley Labyrinth (Figure 9.9). Precinct 7 provides a variety of active recreation and natural environment including Coastal Alkaline Scrub (EVC 858). The Precinct comprises St Leonards Pier.

(Note: The planned redevelopment of St Leonards Pier in late 2026 will require monitoring for any changes to coastal processes)

Risk profile

Key values assessed as having significant and high risk are in Table 9.28. The region will primarily be impacted by erosion and permanent inundation, with exposure and risk likely to increase into the future (Table 9.29).

Table 9.28 Summary of significant and high risks for Precinct 7

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0	Erosion - storm tide	Loss of safe access to beach following erosion events impacting ability to undertake recreation activities. Negative visitor experience.	Significant
0.2	Erosion - storm tide	Change to beach views following erosion events. Negative impact on visitor experience	Significant
0.2	Permanent inundation	Changes to intertidal dynamics (e.g. high and low tide levels) due to sea level rise impacting suitability of habitats for sea life. Soft backing in some areas may enable migration but areas with hard backing (e.g. in front of St Leonards Pier) unable to migrate	Significant
0.2	Erosion - storm tide	Erosion during storm temporarily affecting safety for swimmers, including safety of access to beach.	Significant
0.5	Erosion - storm tide	Erosion of 90% of coastal trail during storm event, affecting safe access	High

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0.8	Erosion - storm tide	Erosion of entirety of coastal trail in this Precinct during storm event, affecting safe access	Significant
0.8	Erosion - storm tide	Erosion of dune scrub areas during storm event, affecting root stability and vegetation health. Possible die back and loss of vegetation	Significant

Table 9.29 Precinct 7 - hazard risk levels

Hazard risk levels	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Erosion risk	Significant	Significant	High	High
Storm tide inundation	Medium	Medium	Medium	Medium
Permanent inundation	Medium	Significant	Significant	Significant
Groundwater hazard	Medium	Medium	Medium	Medium

Adaptation pathway

The adaptation pathway for Precinct 7 (Table 9.30) involves:

- Non-intervention actions including controlling access.
- Hybrid engineering and nature-based beach enhancement through nourishment.
- Accommodation of coastal hazards through infrastructure reviews (stormwater system) to increase resilience in design.

With 0.5 m SLR (by 2070), or as an alternative trigger is reached, the pathway expands to possibly include:

- Targeted dune and vegetation enhancement to improve the natural dynamics of the beach and foreshore system and provide hazard buffer through nature-based revegetation and shellfish reef.
- Accommodation of coastal hazards through infrastructure upgrades to coastal trail to increase resilience.
- Modifying of the foreshore coastal trail out of at-risk areas over time (retreat).

It should be noted that some actions are associated with triggers other than the year and associated SLR levels. For example:

- Modification or relocation of the coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards when. Based on available mapping, impacts are predicted to occur around 2070.

Key							
	Preparation – Lead time required to prepare for action implementation.		Wadawurrung heritage		Nature-based methods		Protect
	Actioning – Implementation of action		Non-intervention		Accommodate		Hybrid engineering and nature-based
	Supporting action		Avoid		Retreat		Existing measures in place (partial or full)

Table 9.30 Precinct 7 - adaptation pathway

Description of option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Control access to coastal trail during inundation events and to damaged areas along the shoreline following erosion events for public safety.				
Avoid constructing new onshore infrastructure (e.g. toilet blocks) shoreward of the predicted erosion and inundation lines, unless it is coastal dependent (e.g. piers) which can be continued to be built.				
Revegetation of dunes to stabilise beach and provide protection from hazard events				
Studies into appropriate measures to protect and restore priority biodiversity areas				
Monitor existing sand fencing condition and performance, and adapt, repair or redesign if required				
Seek to partner with lead agencies to investigate feasibility of 'living shorelines' approaches, including potential integration of engineering structures to support shellfish reef development				
Beach nourishment to mitigate impacts of short- and long-term erosion of the cliffs.				
Collaborate with relevant authorities to monitor and respond to any changed conditions associated with				

Description of option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
sediment transport or shoreline response associated with new pier installation				
Advocate for review of stormwater infrastructure to reduce impact to foreshore and improve coastal resilience				
Upgrade impacted section of coastal trail to be more resilient to erosion impacts. (Includes assessment of cliff to identify risk to the trail).				
Modify the foreshore coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards				
Monitor existing seawall (Asset ID: S771116) condition and performance, and adapt, repair or redesign the structure if required				
Monitor existing timber groyne (Asset ID: S731034) condition and performance, and adapt, repair or redesign the structure if required				

Precinct 8

Figure 9.10 Precinct 8

Values

The location includes Wiliam Buckley Labyrinth to The Bluff (Figure 9.10). Precinct 8 provides a variety of active recreation and leisure including camping. It comprises seasonal campgrounds including Bengalat Reserve and Karrong Reserve campground, and St Leonards boat ramp.

Risk profile

Key values assessed as having significant and high risk are in Table 9.31. The region will primarily be impacted by erosion and groundwater intrusion (Table 9.32).

Table 9.31 Summary of significant and high risks for Precinct 8

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0	Erosion - storm tide	Loss of safe access to beach following erosion events impacting ability to undertake recreation activities. Negative visitor experience.	Significant
0	Saline intrusion / groundwater	Detrimental impacts on scrub vegetation and wildlife due to salinity and groundwater	Significant
0	Saline intrusion / groundwater	Detrimental impacts on campground infrastructure due to groundwater salinity, corrosion and swelling of certain materials	Significant
0.2	Erosion - storm tide	Change to beach views following erosion events. Negative impact on visitor experience	Significant
0.2	Erosion - storm tide	Erosion of scrub areas during storm event, affecting root stability and vegetation health. Possible die back and loss of vegetation	Significant
0.2	Erosion - storm tide	Erosion of boat ramp area, impacting access and safe use of the ramp	Significant
0.2	Permanent inundation	Changes to intertidal dynamics (e.g. high and low tide levels) due to sea level rise impacting suitability of habitats for sea life. Soft backing in some areas	Significant

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
		may enable migration but areas with hard backing (e.g. in front of Bengalat Reserve) unable to migrate	
0.5	Erosion - storm tide	Erosion of approx. 80% of coastal trail during storm event, affecting safe access	Significant
0.5	Permanent inundation	Drainage compromised by rising sea levels, leading to localised surface water flooding in the study area	Significant

Table 9.32 Precinct 8 - hazard risk level

Hazard risk levels	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Erosion risk	Significant	Significant	Significant	Medium*
Storm tide inundation	Medium	Medium	Medium	Medium
Permanent inundation	Low	Significant	Significant	Significant
Groundwater hazard	Significant	Significant	Significant	Significant
*Risk level decreases because, although consequence increases, likelihood of the event occurring within the study period decreases.				

Adaptation pathway

The adaptation pathway for Precinct 8 (Table 9.33) involves:

- Non-intervention actions including controlling access.
- Avoiding risk through development setbacks.
- Targeted dune and vegetation enhancement to improve the natural dynamics of the beach and foreshore system and provide hazard buffer through nature-based revegetation.
- Accommodation of coastal hazards through infrastructure review (stormwater system) to increase resilience in design.

With 0.2 m SLR (by 2040), or as an alternative trigger is reached, the pathway expands to include:

- Nature-based dune enhancement to improve natural dune dynamics and create a hazard buffer, through beach scraping and dune nourishment.
- Accommodation of coastal hazards through coastal infrastructure modification and resilient design.

With 0.5 m SLR (by 2070), or as an alternative trigger is reached, the pathway expands to include:

- Accommodation of coastal hazards through infrastructure upgrades (stormwater system and drainage network) to increase resilience in design.
- Accommodation of coastal hazards through infrastructure upgrades to coastal trail to increase resilience.
- Modifying of the foreshore coastal trail out of at-risk areas over time (retreat).

With 0.8 m SLR (by 2100), or as an alternative trigger is reached, the pathway expands to include:

- Engineering works to upgrade the St Leonards boat ramp car park to protect from erosion.

It should be noted that some actions are associated with triggers other than the year and associated SLR levels. For example:

- Modification or relocation of the coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards when. Based on available mapping, impacts are predicted to occur around 2070.

Key							
	Preparation – Lead time required to prepare for action implementation.		Wadawurrung heritage		Nature-based methods		Protect
	Actioning – Implementation of action		Non-intervention		Accommodate		Hybrid engineering and nature-based
	Supporting action		Avoid		Retreat		Existing measures in place (partial or full)

Table 9.33 Precinct 8 - adaptation pathway

Description of option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Control access to coastal trail and boat ramp following erosion events and to damaged areas along the shoreline following erosion events for public safety.				
Avoid constructing new infrastructure shoreward of the predicted erosion and inundation lines.				
Revegetation of dunes to stabilise beach and provide protection from hazard events				
Studies into appropriate measures to protect and restore priority biodiversity areas				
Dune nourishment to mitigate impacts of short-term erosion				
Drainage network upgrades at campgrounds and boat club area				
Work with the relevant authority to review tidal valve application on stormwater system				
Advocate for review of stormwater infrastructure to reduce impact to foreshore and improve coastal resilience				
Upgrade impacted section of coastal trail to be more resilient to inundation impacts.				

Description of option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Modification of infrastructure including adopting more resilient types of infrastructure for beach access				
Modify the foreshore coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards				
Upgrade the car park to increase resilience to erosion				
Monitor the condition and performance of existing coastal protection assets and adapt, repair or redesign if required				

Precinct 9

Figure 9.11 Precinct 9

Values

The location includes the area from The Bluff to Beach Road (Figure 9.11). Precinct 9 provides natural amenity and passive recreation experience for the community. It comprises the St Leonards Yacht Club and Moto Squadron. The natural environment includes Coastal Alkaline Scrub (EVC 858), Plains Grassy Woodland (EVC 55), and Coastal Dune Scrub/Coastal Dune Grassland Mosaic (EVC 1).

Risk profile

Key values assessed as having significant and high risk are in Table 9.34. The region will primarily be impacted by erosion and permanent inundation, with exposure and risk likely to increase into the future (Table .9.35).

Table 9.34 Summary of significant and high risks for Precinct 9

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0	Saline intrusion / groundwater	Detrimental impacts on scrub vegetation and wildlife due to salinity and groundwater	Significant
0.2	Erosion - storm tide	Change to beach views following erosion events. Negative impact on visitor experience	Significant
0.5	Erosion - storm tide	Erosion of part of area of Coastal Headland Scrub east of Lower Bluff Road during storm	Significant
0.5	Erosion - storm tide	Erosion of approx. half of coastal trail section in Port Phillip Bay Coastal Reserve, affecting community access and recreational use	Significant
0.2	Permanent inundation	Changes to intertidal dynamics (e.g. high and low tide levels) due to sea level rise impacting suitability of habitats for sealife. Given significant amount of hard backing (seawalls between St Leonards Yacht Club and Beach Road and revetment Beach Road), capacity for migration would be low.	Significant

Relevant sea level rise scenario	Coastal hazard	Impact	Risk rating
0	Erosion - storm tide	Loss of safe access to beach following erosion events impacting ability to undertake recreation activities. Negative visitor experience.	Significant

Table .9.35 Precinct 9 - hazard risk levels

Hazard risk levels	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Erosion risk	Significant	Significant	Significant	Significant
Storm tide inundation	Low	Low	Medium	Medium
Permanent inundation	Low	Significant	Significant	Significant
Groundwater hazard	Significant	Significant	Significant	Significant

Adaptation pathway

The adaptation pathway for Precinct 9 (Table 9.36) involves:

– Non-intervention actions including controlling access.
– Avoiding risk through planning of development to avoid areas prone to coastal hazards.
– Targeted dune and vegetation enhancement to improve the natural dynamics of the beach and foreshore system and provide hazard buffer through nature-based revegetation and hybrid engineering and nature-based sand nourishment.
– Accommodation of coastal hazards through infrastructure reviews (stormwater system) to increase resilience in design.

With 0.5 m SLR (by 2070), or as an alternative trigger is reached, the pathway expands to include:

– Accommodation of coastal hazards through infrastructure upgrades to coastal trail to increase resilience.
– Modifying of the foreshore coastal trail out of at-risk areas over time (retreat).

With 0.8 m SLR (by 2100), or as an alternative trigger is reached, the pathway expands to include:

– Major engineering to protect some lengths of the Lower Bluff Road.

It should be noted that some actions are associated with triggers other than the year and associated SLR levels. For example:

– Modification or relocation of the coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards when. Based on available mapping, impacts are predicted to occur around 2070

Key							
	Preparation – Lead time required to prepare for action implementation.		Wadawurrung heritage		Nature-based methods		Protect
	Actioning – Implementation of action		Non-intervention		Accommodate		Hybrid engineering and nature-based
	Supporting action		Avoid		Retreat		Existing measures in place (partial or full)

Table 9.36 Precinct 9 - adaptation pathway

Description of option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Control access to coastal trail following erosion events and to damaged areas along the shoreline following erosion events for public safety.				
Avoid constructing new infrastructure shoreward of the predicted erosion and inundation lines.				
Revegetation of dunes to stabilise beach and provide protection from hazard events				
Studies into appropriate measures to protect and restore priority biodiversity areas				
Dune nourishment to mitigate impacts of short-term erosion				
Work with the relevant authority to review stormwater infrastructure to reduce impact to foreshore and improve coastal resilience				
Upgrade impacted section of coastal trail to be more resilient to inundation impacts.				
Modify the foreshore coastal trail through realignment and/or raising as appropriate to mitigate impacts of coastal hazards				
Monitor existing seawalls condition and performance, and adapt, repair or redesign the structure if required				

Description of option	0.0m SLR (Present day)	0.2m SLR (2040)	0.5m SLR (2070)	0.8m SLR (2100)
Maintain and repair rock revetments to protect the beach amenity and value.				
Monitor existing timber groynes condition and performance, and adapt, repair or redesign the structure if required				
Upgrades to the Lower Bluff Road				

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Appendices

Appendix A

Coastal inundation and erosion maps

Insert posters generated for community engagement.

Appendix B

Principal existing coastal management documents and tools

The principal existing coastal management documents and tools applicable to the study area that this CAP has drawn from and aims to align with are summarised below. These documents provided valuable context around the coastal processes, hazard, assets, values, and adaptation measures previously investigated and implemented

Document/Tool Title	Description
Bellarine Bayside Coastal & Marine Management Plan Bellarine Bayside, 2019	A strategic framework used to translate marine and coastal policy and strategy into action, including guiding the future protection, enhancement, development and management of the northern Bellarine coastal Crown land reserve in accordance with the decision pathway and guiding principles of the *Marine and Coastal Act 2018*.
Bellarine Bayside Interpretation Plan SHP for Bellarine Bayside, 2023	An Interpretation Plan that provides a strategic framework for communicating the unique values and stories of the section of northern Bellarine Peninsula foreshore managed by Bellarine Bayside, including the Bellarine Bayside Coastal Trail.
Bellarine Coastal Processes Study Cardno Victoria, 2011	A coastal processes and waterways study for the Bellarine coastline commissioned by the Bellarine Bayside Foreshore Committee of Management, on behalf of the Department of Sustainability and Environment. This involved detailing potential impacts of climate change and undertaking coastal modelling to examine major coastal processes such as inundation and erosion of the coastline. This study involved a Technical Report which provided basis for the Mitigation Strategies report.
St Leonards Coastal Study AW Maritime for DELWP, 2018	A condition assessment of coastal assets within an approximately 200 m long study area at St Leonards, including a number of coastal assets such as a timber seawall, two geotextile sandbag walls, and timber sand trap fencing.
Dredge Management Plan Water Technology, 2021	A dredging management plan used to document the strategy for managing natural sediment accumulation at the Point Richards boat ramp.
Site Inspection Note and Assessment at Steeles Rock, Portarlington A.S.Miner Geotechnical, 2017	A letter report used to guide recommendations for site management. Including site observations, historical assessment and preliminary risk assessment of a coastal cliff collapse at Steeles Rock, Portarlington.
Geotechnical Assessment Report St Quentin Consulting for Water Technicalogy, 2021	A existing conditions geotechnical assessment of an area proposed to be re-developed adjacent to the Point Richards Boat Ramp..
St Leonards Sand Fencing Condition Report AW Maritime for Bellarine Bayside, 2019	A condition assessment of approximately 470 m of sand fencing at St Leonards.
Point Richards Boat Ramp Coastal Processes Study Water Technology for Department of Transport, 2019	A coastal processes study that provides practical solutions to manage seagrass and sedimentation, including site investigations, sediment sampling and modelling and laboratory analysis to improve boating operations at Point Richard Boat Ramp.
Northern Bellarine Beach Nourishment Water Technology for DELWP, 2021	A design report of beach nourishment works at six beaches along approximately 6 km of the Bellarine Peninsula shoreline. Including a strategy to manage the sand supply, and monitoring, maintenance and renewal of the beach assets for the next 10 – 15 years.

Document/Tool Title	Description
Artificial Reefs for Ecosystem Restoration and Coastal Erosion Protection with Aquaculture and Recreational Amenities Harris, L.E., 2009	A paper identifies the use of artificial reefs for ecosystem restoration and coastal erosion protection, with the added amenities of aquaculture and recreation.
Point Richards – Coastal Protection Options AW Maritime for Bellarine Bayside, 2017	A desktop analysis report of options suitable to treat foreshore erosion at Point Richards Boat Ramp
Storm event Report Bellarine Bayside, 2024	A storm event report providing snapshots of the impacts in response to the August-September 2024 storm event that caused considerable damage to the foreshore areas along the northern Bellarine Coastline.
Beach monitoring at Point Richards Department of Environment and Primary Industries for Bellarine Bayside, 2013	Preliminary notes and advice for Bellarine Bayside Foreshore Committee of Management regarding the implementation of a basic beach monitoring program at Point Richards to determine longshore sediment transport.
Background Data and Gap Analysis Water Technology for Department of Sustainability and Environment, 2011	A gap analysis report that compiles existing data sources relevant to the Bellarine Peninsula and surrounds to provide baseline data in preparation for a coastal climate change assessment.
CAMS Asset Condition and Risk Report DEECA, 2024	A Coastal Asset Management System asset condition and risk report of coastal protection structures at sites within Indented Head, Portarlington, and St Leonards. The report includes maps of the coastal protection structures identified.
Local Coastal Hazard Assessment Keanet, J & Kirsch, M., 2017	An investigation into ways to implement the findings of the Bellarine Peninsula and Corio Bay local coastal hazard assessment into the Greater Geelong and Queenscliffe Planning Schemes, including recommendations to assist this.
Bellarine Peninsula Corio Bay Local Coastal Hazard Assessment Cardno Victoria for City of Greater Geelong & Stakeholders, 2014	A local coastal hazard assessment of the extent of coastal hazards and the impacts on the coastal environments within the entire Bellarine Peninsula and the northern side of Corio Bay (Point Wilson to Breamlea).
Harvey Estate - Coastal Processes Assessment Water Technology for Roadcon Group, 2005	A coastal processes assessment to provide coastal engineering advice regarding the relationship of an infiltration basin with local coastal processes such as potential coastal erosion at Harvey Estate, Indented Head.
Coastal Protection Works Cardno Victoria for Jade Tiger Abalone, 2015	A concept design for foreshore protection at an area of significant foreshore erosion adjacent to the Jade Tiger Abalone Farm at Indented Head, specifically using wooden groynes and a geotextile sand container revetment.
City of Greater Geelong & Borough of Queenscliffe Flood Adaptation Effectiveness Study	A flood adaptation study to determine the effectiveness of adaptation measures used at high-risk flood inundation sites around the Bellarine Peninsula, including primary engineering adaptation options such as

Document/Tool Title	Description
CSIRO, 2016	levees, seawalls, tidal gates and drainage network modifications, and supportive engineering structures include artificial reefs, detached breakwaters and artificial headlands.
Draft – Portarlington Safe Harbour – Sand Management Plan Parks Victoria, 2016	A sand management plan that provides an approach to mitigate the effects on sand movement along Portarlington's foreshore as a result of the Portarlington Safe Harbour development.
Geelong Coastal Processes Study Lawson and Treloar for City of Greater Geelong, 2004	A coastal processes study of coastal and geomorphic processes that shape the coastal environment along the northern edge of the Bellarine Peninsula from Edwards Point to Limeburners Point to provide a basis for the management of the coastal zone.
The Great Sands and Adjacent Coast and Beaches Cardno Victoria for Port of Melbourne Corporation, 2011	A report used to translate the requirements identified by the Project Delivery Standards from the Environmental Management Plan of the Channel Deepening Project that Port of Melbourne Corporation undertook in 2009.
Sediment Transport Modelling Cardno Victoria for Port of Melbourne Corporation, 2011	A study that re-assesses the modelling undertaken in the Supplementary Environment Effects Statement produced for the Channel Deepening Project, Port of Melbourne Corporation undertook in 2009. Prepared to satisfy the requirements of the Project Delivery Standards of the Environmental Management Plan.
Erosion and Coastal Processes in the BBCM Management Area Murphy, G.M., N.D.	A literature review of coastal processes and erosion within BBCCM management area to define the effects of erosion along the northern Bellarine and identify potential management actions.
Northern Bellarine Coastal Geomorphology A.S.Miner Geotechnical & Environmental GeoSurveys for Bellarine Bayside, 2017	A coastal geomorphology study of the geomorphology of the coastal area managed by Bellarine Bayside.
Offshore reef structures as viable management alternatives for eroding coastal regions Oza, T., 2018	A pilot study of beach dynamics at St Leonards focussing on the natural reef in the embayment. This study is a pilot for the current larger project funded through the Victorian Climate Change funding from the Department of Environment, Land, Water & Planning.
Our Coast Coastal Inundation Options Report GHD for City of Greater Geelong, N.D.	A options report of the potential inundation adaptation options considered to be relevant for implementation within Geelong and the Bellarine Peninsula coastline.
Point Richards Boat Ramp Siltation Investigations Oldfield Consulting Australasia, 2012	A detailed investigation of the likely causes of sedimentation and accumulation of seagrass wrack at the Point Richards Boat Ramp and providing mitigation strategies.
Portarlington Beach Renourishment Beach Monitoring Final Report Oldfield Consulting Australasia for Bellarine Bayside, 2014	A final monitoring report of renourishment works at Portarlington Beach along approximately 2,000 m between the Portarlington Harbour and Point Richards. The final report provides comparative analysis of the first, second, third, and fourth and fifth monitoring surveys undertaken.

Document/Tool Title	Description
Portarlington Beach Renourishment Sand Study WorleyParsons for Department of Sustainability and Environment, 2011	A study to provide support for the renourishment of Portarlington Beach based on the 2011 beach renourishment design report by Aurecon. Including assessments of sand samples, inspection of intertidal and subtidal habitat on respective renourishment sites, and possible impacts on coastal processes and assets.
Portarlington Safe Harbour Coastal Processes and MetOcean Design Conditions Water Technology for Meinhardt Infrastructure and Environment, 2008	Coastal process and metocean design condition studies to complete the gap studies and confirm baseline conditions at Portarlington to support the development of the Portarlington Safe Harbour Master Plan.
Portarlington Safe Harbour Coastal Processes Investigation Water Technology for Maunsell Australia, 2007	A coastal processes study at Portarlington to inform the development of options for the safe harbour development on the Bellarine Peninsula.
Portarlington Beach Design Report – Beach Renourishment Aurecon, 2011	A preliminary design for beach nourishment and associated works to support the long term management of erosion at Portarlington Beach.
Portarlington Safe Harbour Option Assessment for Western Wave Protection AW Maritime, 2020	An option and technical assessment for coastal infrastructure along the inshore boundary of Portarlington Safe Harbour.
Scoping for Coastal Protection Works – Taylor Reserve, Indented Head Cardno Victoria for Bellarine Bayside, 2015	A scoping document of possible options and recommendations to stabilise the shoreline around Taylor Reserve, Indented Head.
Remotely Piloted Aircraft Survey Plan Port Phillip Bay Beach Nourishment Project Cardno Victoria for DELWP, 2018	A survey plan to capture aerial survey data across 16 beaches in 2018 to assist with beach nourishment planning.
CoastKit Web-map DEECA, 2024	Victoria's marine and coastal interactive web-mapping portal for managers, researchers, consultants and community.
NatureKit Web-map DEECA, 2024	An online mapping and data exploration tool for Victoria's biodiversity values and investment prospects.

Appendix C

Coastal adaptation planning in Victoria

Marine and Coastal Act 2018

The *Marine and Coastal Act 2018* states that the marine and coastal environment includes all private and public land and waters between the outer limit of Victorian coastal water and five km inland of the high- water mark of the sea, including:

a. The land (whether or not covered by water) to a depth of 200 m below the surface of that land
b. Any water covering the land referred to in paragraph (a) above from time to time
c. The biodiversity associated with the land and water referred to in paragraphs (a) and (b).

The *Marine and Coastal Act 2018* contains the following nine objectives:

1. Protect and enhance the marine and coastal environment
2. Promote the resilience of marine and coastal ecosystems, communities and assets to climate change
3. Respect natural processes in planning for and managing current and future risks to people and assets from coastal hazards and climate change
4. Acknowledge traditional owner groups' knowledge, rights and aspirations for land and sea country
5. Promote a diversity of experiences in the marine and coastal environment
6. Promote the ecologically sustainable use and development of the marine and coastal environment and its resources in appropriate areas
7. Improve community, user group and industry stewardship and understanding of the marine and coastal environment
8. Engage with specified Aboriginal parties, the community, user groups and industry in marine and coastal planning, management and protection
9. Build scientific understanding of the marine and coastal environment

Marine and Coastal Policy 2020

The Marine and Coastal Policy (March 2020) guides marine and coastal planning and land management in Victoria. The policy applies to the planning and management of matters relating to and affecting the marine and coastal environment, linking them to Sustainable Development Goals (SDG's) and implementing the goals through decision making. The policy is centred around a key vision for *…a healthy, dynamic and biodiverse marine and coastal environment that is valued in its own right, and that benefits the Victorian community, now and in the future.*

The Marine and Coastal Policy (March 2020) contains a 'Planning and Decision Pathway' that has been developed to set out how the objectives and guiding principles of the *Marine and Coastal Act 2018* are to be used in decision making for the marine and coastal environment. This Pathway is guided by the principles of:

– Integrated coastal zone management
– Ecologically sustainable development
– The principle of proportionate and risk-based decision making
– Evidence based decision making
– Ecosystem based management
– Adaptive management
– The precautionary principle

Marine and Coastal Strategy 2022

The Marine and Coastal Strategy 2022 identifies actions to achieve the Marine and Coastal Policy's vision. It outlines six priority action areas for the five-year life of the Marine and Coastal Strategy:

- Action 1: Supporting Traditional Owners to embed their rights and obligations into planning and management of the marine and coastal environment.
- Action 2: Improving the condition and ecological connectivity of habitats and respecting and caring for marine and coastal areas.
- Action 3: Adapting to impacts of climate change.
- Action 4: Supporting sustainable use and development of the marine and coastal environment.
- Action 5: Implementing the Marine Spatial Planning Framework to integrate long-term planning for different uses in the marine environment.
- Action 6: Identifying the resource needs and funding for sustainable marine and coastal management.