



# Port Fairy Coastal Climate Change Adaptation Plan

## Discussion Paper

Moyne Shire - a safe, vibrant, liveable, and prosperous community





## **Aim of Discussion**

*To develop a common understanding within the community of coastal threats, what causes them and possible options for implementation.*

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## 1. Introduction

The township of Port Fairy within the Moyne Shire is part of the spectacular coastline of South West Victoria. The natural and cultural values of Port Fairy underpin a strong local economy driven by tourism. Aside from the 3,000 permanent residents and business owners, the outstanding beaches and annual array of festivals and events attracts more than 10,000 visitors every summer to the historic township.

Climate change and associated sea level rise is and will continue to influence the dynamic nature of the coastal environment at Port Fairy, potentially threatening the attraction of residents and tourists to the region.

This paper summarises several research studies and papers that explore the Port Fairy coast and incorporates community input.

This discussion paper aims to provide the community with a summary of the coastal threats facing Port Fairy, particularly with respect to a changing climate and possible adaptation options.

## 2. Rationale for Adaptation

Moyne Shire Council has a significant role and responsibility to 'Defend Port Fairy', making it safer from sea level rise and extreme weather events. Adaptation requires decision makers to not only acknowledge the need to act but also to commence action to minimise the risks.

Considering the high level of confidence in climate change science information and that the current warming trend is accelerating, delaying actions to reduce immediate and intensifying future risks may exacerbate the potential impacts (Ku-ring-gai Council, 2016).

The Port Fairy coastline is already subject to erosion and inundation. When the coastal environment is threatened by storm events and as sea level rise and climate change continue to impact the coast, the community will expect Council to take action and show leadership to protect Port Fairy's natural, social and built values. Council's decisions may be subject to legal challenge on the basis of climate change impacts particularly in relation to policy frameworks such as the planning scheme, land zonings, town planning policies, building approval regimes, major construction plans and environmental protection policies.

There is an increased requirement for Council to consider climate change and incorporate it into policy and decision making frameworks. When adaptation options are timely and based on scientific studies and reports, Council's legal risk is reduced. Councils need to:

- be well informed on the science of climate change;
- understand the emerging risks from changing weather patterns;
- ensure that vulnerability and resilience assessments relate to risks and consequences; and
- implement adaptation options to reduce risk and minimise environmental, social and financial impacts.

### 3. Climate Modelling

The Intergovernmental Panel on Climate Change (IPCC) is the international body for assessing the science related to climate change, its impacts and future risks, and options for adaptation and mitigation. Comprehensive and objective IPCC assessment reports written and reviewed by leading scientists, advise that:

*“Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased” (Intergovernmental Panel on Climate Change, 2013)*

The rate of sea level rise since the mid-19th century has been larger than the average rate during the previous two millennia. Over the period 1901 to 2010, the global average sea level rose by 0.19 metres. (Intergovernmental Panel on Climate Change, 2013). By the end of the 21st century, it is very likely that sea level will rise in more than 95 per cent of the ocean area. Approximately 70 per cent of the coastlines worldwide are projected to experience sea level change (Intergovernmental Panel on Climate Change, 2013)

Global average sea level will continue to rise during the 21st century (Figure 1) (CSIRO, 2016). The rate of sea level rise will very likely exceed that observed during 1971 to 2010 due to increased ocean warming and increased loss of mass from glaciers and ice sheets. (Intergovernmental Panel on Climate Change, 2013)

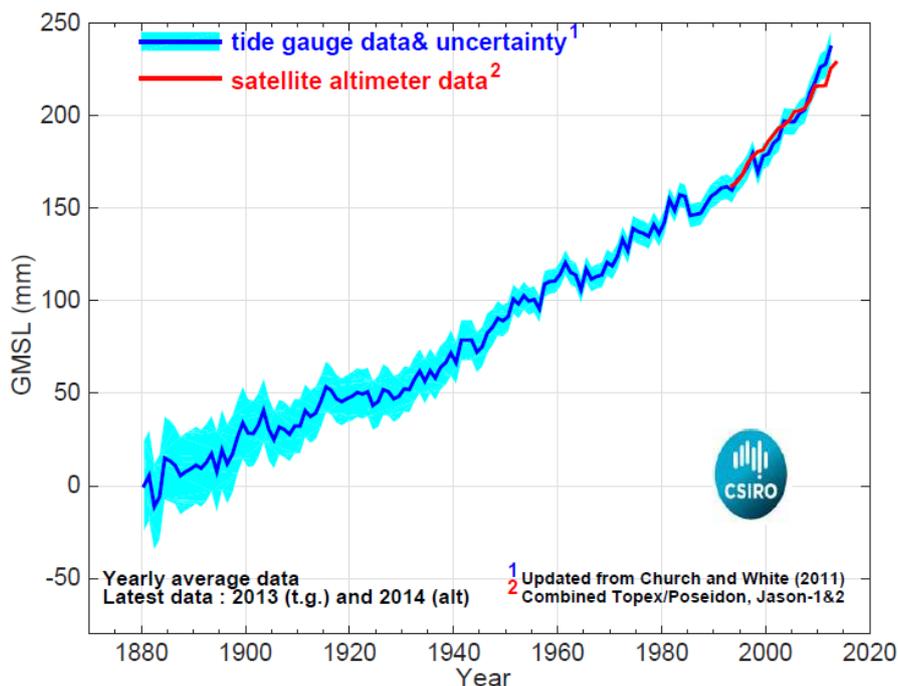


Figure 1 Global average sea level rise

To determine the potential weather related changes and the implications for the Port Fairy coastline, regional modelling was undertaken.

The 2010 'East Beach Coastal Erosion Engineering and Feasibility Study – Peer Review' explains that climate change is likely to cause:

- Sea level rise;
- Increased average and storm wind speeds;
- Potentially small but important changes to dominant wind directions; and
- Increases in storm severity and frequency (Aurecon, 2010).

The maximum sea level rise scenario as adopted by the State Government and Moyne Shire Council for the Port Fairy Coastal Hazard modelling and reporting, over the period to 2100 is 1.2 metres, as shown in Table 1 (Water Research Laboratory, 2013).

**Table 1 Sea Level Rise Projections based on Hazard Modelling, Port Fairy**

<b>Year</b>	<b>Sea Level Rise Projection (m)</b>
2050	0.40
2080	0.80
2100	1.20

## 4. Coastal Processes

Beach erosion is a natural process. The interaction of wind, waves, tides, currents, rainfall and runoff affects coastal and estuarine processes. Under normal average sea level, the water levels in the coastal zone vary with tides. These tides and levels are influenced by wind blowing the water surface and air pressure variations which in the right combination can cause a storm surge which may flood (inundate) low lying coastal land areas and also erode coastal dunes. (NCCOE, 2012)

Construction of houses, buildings, landfills and other infrastructure within the coastal zone are vulnerable to coastal processes. These coastal assets are at risk of damage from the direct impact of waves, erosion of dunes, or inundation during storms.

Scientific research has indicated that climate change is likely to increase the frequency and intensity of storms, putting local coastal assets under increased pressure from **erosion** and **inundation**.

Human interventions such as breakwaters, groynes, rock seawalls and jetties can alter natural sand transportation processes that may result in a higher rate of dune recession.

**Wind erosion** of poorly vegetated dunes caused substantial losses of sand from the Port Fairy beach. The sand may be blown inland and excluded from of the active dune system.

Wind erosion of the dune systems is occurring today, however significant losses from wind occurred in the early 1900's when cattle grazing led to loss of protective vegetation cover and extensive dune instability. Figure 2 shows marram grass being planted to prevent further sand loss due to wind (WBM Pty Ltd, 2007).



Figure 2 Planting of marram grass to prevent further loss of sand

**Increased frequency and intensity of storms** caused substantial losses of sand from Port Fairy beaches. Waves moving sand from offshore sand banks onto the beach formed sandy coastlines such as those at Port Fairy. The action of waves also transports sand back offshore from the beach and dunes. During storms, higher waves move sand from the beach to offshore sand banks. During calmer periods wave action helps to deposit sand build up back onto the beach. This cross-shore sand movement is a slow process of sand transport back to the beach over many months or several years; and beach recovery following storm erosion is slow.

Figure 3 shows recent coastal erosion on the East Beach sand dunes.



*Figure 3 Erosion of an East Beach sand dune*

**Coastal Inundation** is predominantly the result of wave run-up, created by tide, storm surge and riverine catchment influence (Water Research Laboratory, 2013). Figure 4 depicts recent coastal inundation on South Beach.



*Figure 4 Inundation Ocean Drive, South Beach Port Fairy, June 2014*

## Port of Port Fairy

The Port of Port Fairy was developed over time and continues to be maintained and protected as an important community asset. The Port has had significant impact on Port Fairy coastal processes as summarised in the timeline, Table 2 below.

**Table 2**      **Timeline - Port of Port Fairy** (WBM Pty Ltd, 2007)

Timeframe	
Early 1800s	A whaling port.
1850s	A trading port for local produce, second only to Sydney.
1854	All cargo transferred to larger vessels in small boats, due to lack of harbour facilities. Construction of training walls (breakwater) proposed to allow safe passage in the Moyne River.
1855	Lighthouse erected on Griffiths Island.
1870	Construction of training walls (entrance breakwater) (Figure 5). <ul style="list-style-type: none"> <li>• Removal of rock reefs to smooth river flow.</li> <li>• Channel dredged through the sandbar at the mouth of the river and to the wharves upstream on the west bank.</li> </ul>
1879	Modification of entrance works including: <ul style="list-style-type: none"> <li>• widening and deepening of the channel and swing basin; and</li> <li>• changing the alignment of the walls at the former Goat Island (now Griffiths Island) so that the Southwest Passage currents flow more smoothly into the main river arm.</li> </ul>
1912 – 1916	Closure of the Southwest Passage to reduce wave-induced currents and assist the navigation of unpowered boats in the river.
1920	East Beach erosion begins soon after closure of the Southwest Passage (Figures 6a, 6b).
1946	Southwest Passage temporarily re-opened. Sand on East Beach began to build up, only to erode again after closure of the Passage.
Present Day	<ul style="list-style-type: none"> <li>• Moyne River is continually dredged. The dredged material placed on southern end of East Beach.</li> <li>• Research suggests reopening of the Southwest Passage is unlikely to restore sand supply to East Beach sufficient to prevent or reverse the recession observed over the past 150 years.</li> </ul>



*Figure 5 East Beach: Painting of training walls, 1904*

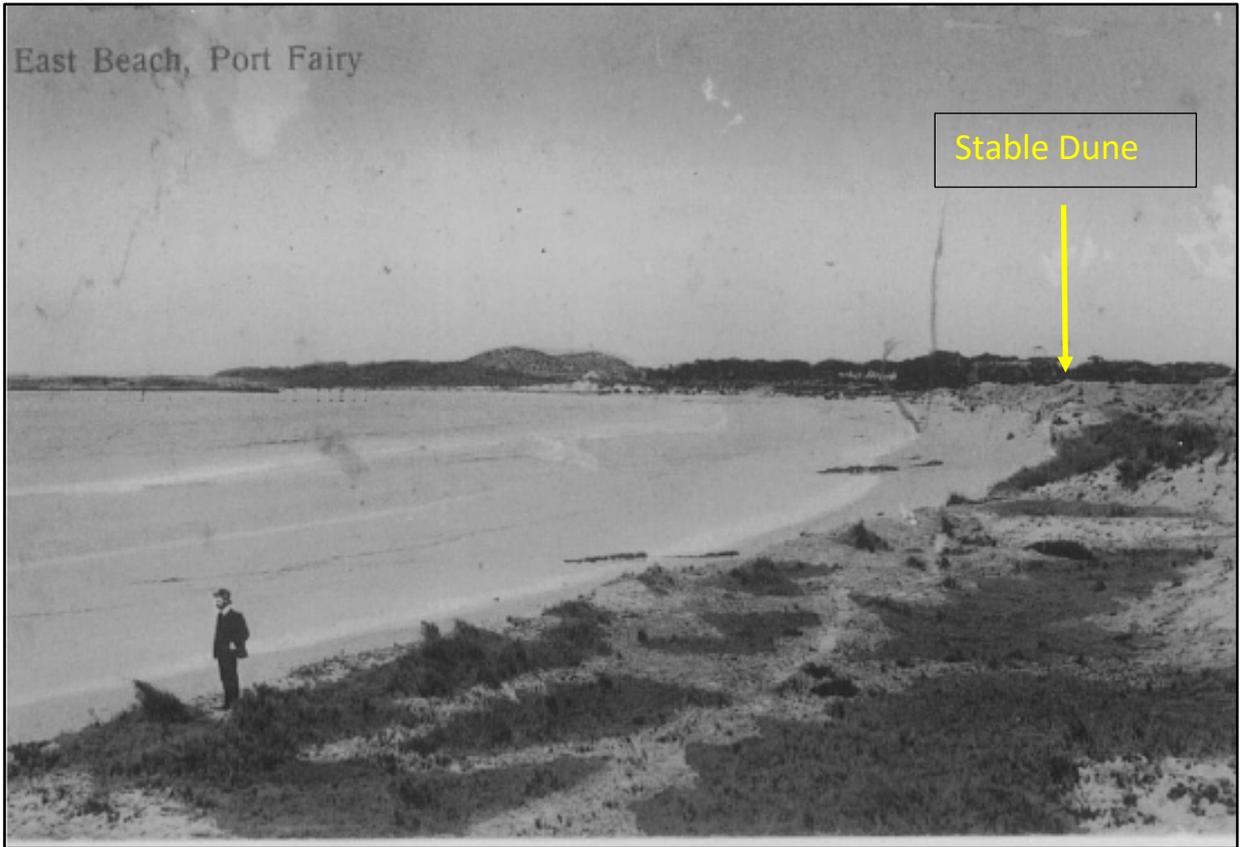


Figure 6a East Beach 1915, around time of closure of Southwest Passage



Figure 6b East Beach 1920, five years following closure of Southwest Passage, erosion begins

Figure 7 depicts the approximate location of key features as described throughout the discussion paper.

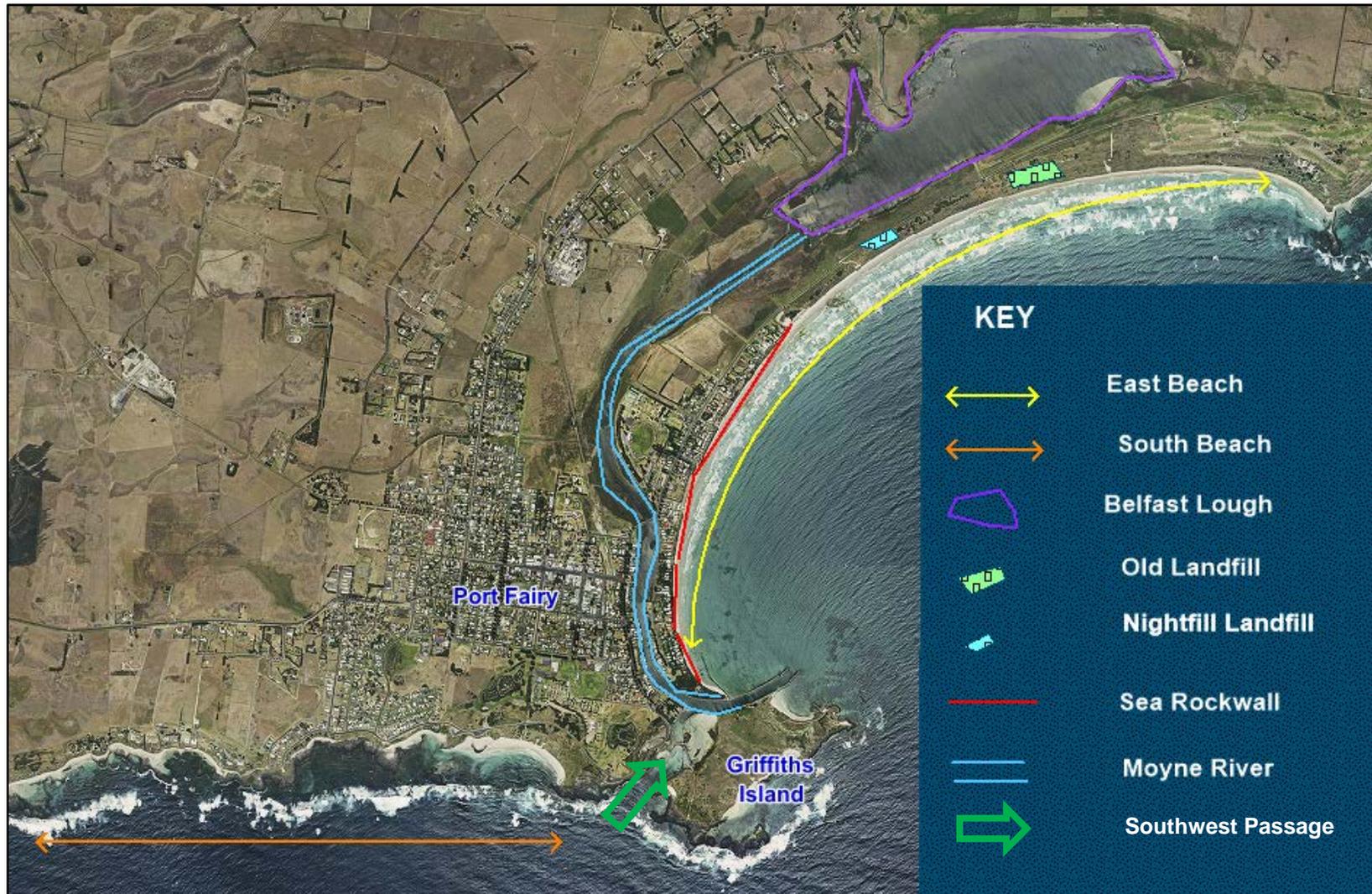


Figure 7 Key Coastal Features Port Fairy

## Moyne River Training Walls and the Southwest Passage

East Beach has experienced considerable change over the past 100 years in response to the Moyne River training walls and blockage of the Southwest Passage (Figure 8). The rationale for the construction of these features was to maintain the navigable entrance channel to the Port.

Studies undertaken in 1997 suggest the installation of the training walls and blockage of the Southwest Passage (Australia, 1997) resulted in:

- The re-distribution of pre-existing natural entrance bar sand with at least some of that sand moving on to East Beach;
- The effective blocking of any pre-existing transfer of sand across the entrance to East Beach;
- Local, long-shore redistribution of the sand on East Beach, causing build-up of the beach and dune near the training walls, with potentially some net loss of sand from the beach further east; and
- The joining of Griffiths and Rabbit Islands circa 1925 through accumulation and placement of sand.

In the absence of the training walls, much of the accumulated sand between the south training wall and the lighthouse, Puddney Ground, Sandy Cove, within the Southwest Passage itself and other areas, would have been supplied to East Beach. The sand lost from the beach system over the last century is approximately 500,000 m<sup>3</sup>.

Technical experts agree that after a long period of readjustment since building the training walls, the natural process of sand transfer past the headland and river mouth has been permanently altered.

In 1997, WBM Oceanics Australia's modelling of a southwest wind case study of the reopening of the Southwest Passage was undertaken to determine if sand would move easterly through The Passage into the river and eventually onto East Beach. The results showed that there was the potential for a strong current and associated sand transport through The Passage, if it were open. However, removing the causeway would require an assessment of impacts on waves and currents for navigation, siltation and dredging of the Port of Port Fairy. (Australia, 1997)

More recent modelling suggested that the opening of the Southwest Passage is unlikely to restore sand supply to East Beach in sufficient quantities to prevent or reverse the recession observed over the past 150 years (Water Research Laboratory, 2013).



Figure 8 View of Griffiths Island showing key features and former separate islands

## Erosion Monitoring East Beach

### Long-term Erosion Trends pre 2013

A substantial fore-dune existed in 1993, along most of East Beach, as depicted in Figure 9.



*Figure 9 East Beach Foredune 1993*

A 2006 report on East Beach shoreline stability showed a very similar image of the foredune. However, since 2007 there has been progressive erosion of the foredune without the dune re-establishing itself. (Coastal Engineering Solutions, 2006)

Historically erosion trends at East Beach can be summarised as follows:

- Prior to settlement of Port Fairy, sand was supplied at the southern end of East Beach, and transported along the beach at a relatively uniform rate (long-shore sand drift);
- The Moyne River training walls restricted the supply of sand to East Beach causing permanent erosion of the beach and dune, including loss of fore-dune;
- A rock seawall was constructed to protect infrastructure built on the dunes;
- A comparison between 1870 and 2007 maps indicated limited shoreline recession in the north-eastern section of the East Beach towards the golf course, but significant recession of up to 40 metres along East Beach further to the southwest; and
- Documentation shows loss of sand in the 1910's and again in the 1950's.

## Erosion monitoring post 2012

The Port Fairy Coastal Group (PFCG) has been monitoring East Beach monthly since January 2013. Concerned about erosion of beaches and dunes around Port Fairy and wanting to be a part of the solution, the PFCG facilitates community participation in coastal management decisions. PFCG's beach monitoring team uses a survey level each month to accurately measure beach profiles at fourteen posts located at intervals along four kilometres of East Beach in Port Fairy. Post 1 is at the southern end of East Beach and Post 12 is at the northern end of East Beach.

Figure 10 East Beach Sand height

Information acquired from the PFCG monitoring of East Beach as depicted in Figure 10 includes:

- Several areas along East Beach show differing seasonal responses with sand return taking several months. Annual sand loss tends to occur almost simultaneously over the whole of the beach.
- Areas of East Beach between the rock seawall and the 'Nightsoil Landfill' (Post 4) have excellent sand build up.
- The area in front of the 'Old Landfill' (Posts 7.5 – 8.5) that is now protected by the Wave Energy Dissipation Structure (WEDS) continues to demonstrate the capacity for active sea erosion. As indicated at Post 8 in Figure 11, the WEDS appears to be preventing high-energy waves from reaching the dune toe.
- Evidence of sand height movement is first detected at a point 30m seaward from the reference Post. Data from this area is most likely to yield information on the influence of various weather and tidal factors.

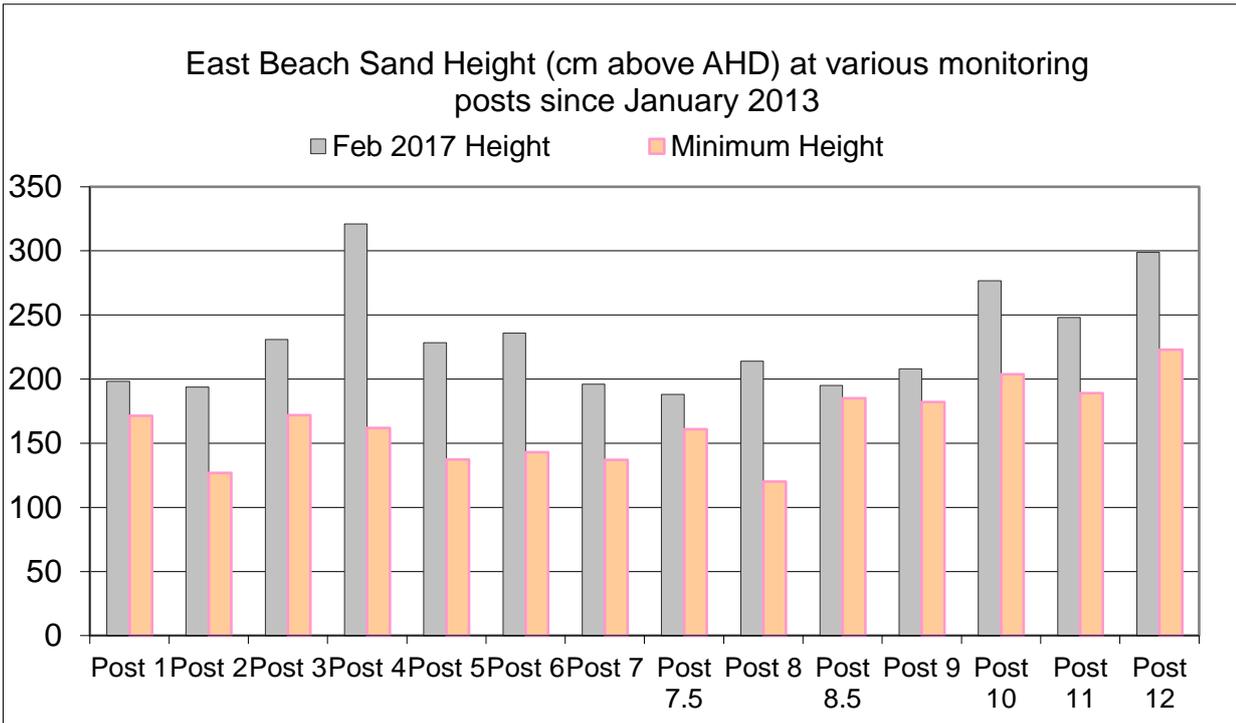
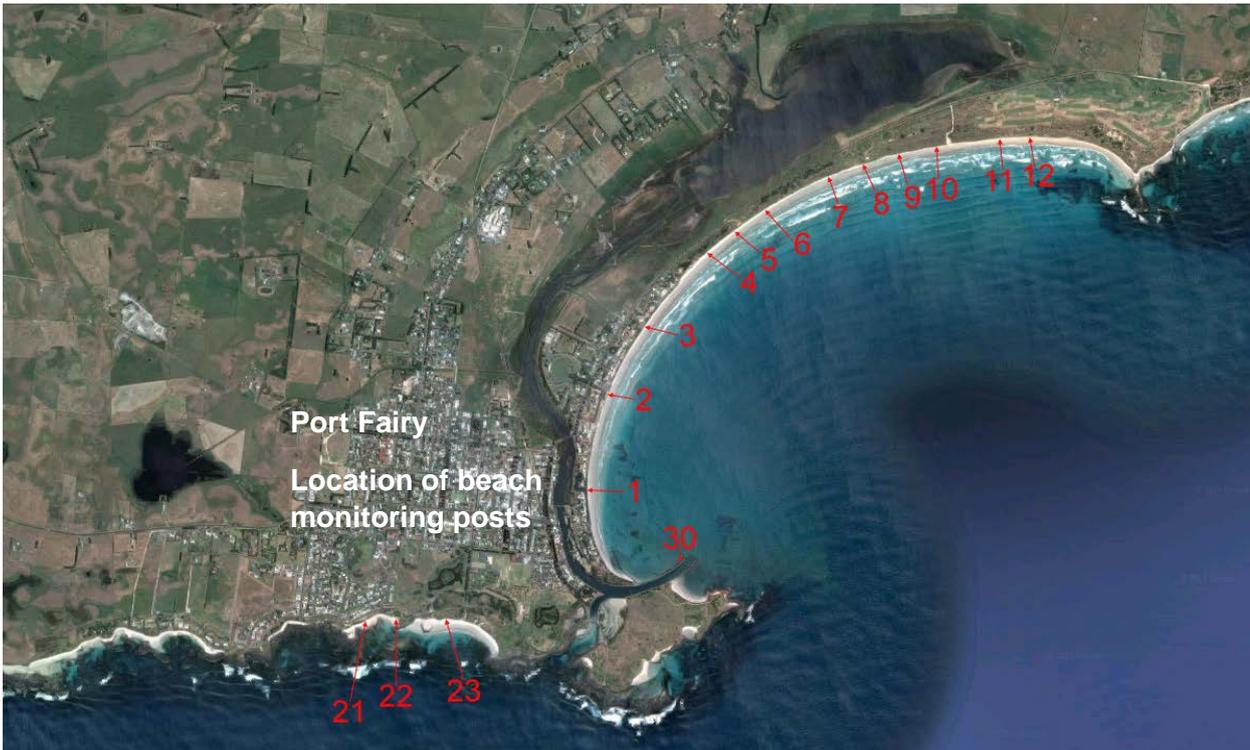


Figure 10 East Beach sand height and location plan of monitoring posts (Port Fairy Coastal Group, 2017)

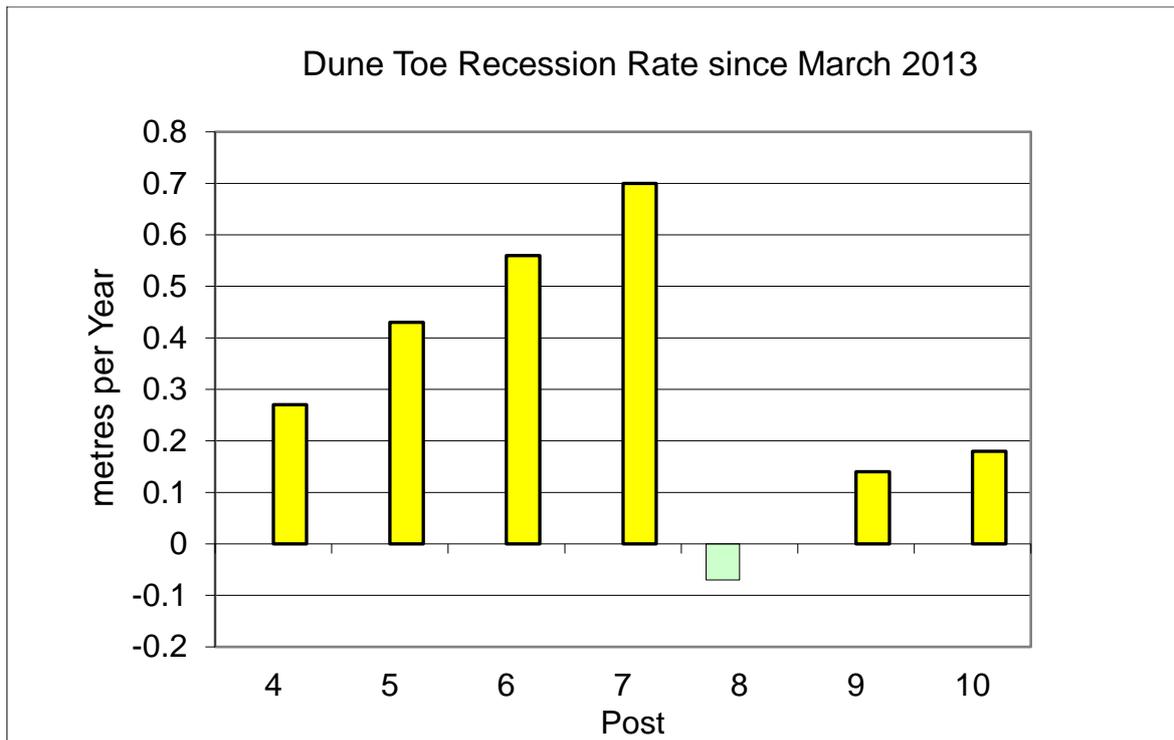


Figure 11 East Beach dune toe recession rate (Port Fairy Coastal Group, 2017)

Overall, the north-eastern section of East Beach is stable in terms of net sand height (volume), but since 2013, the dunes are receding at a rate of at least one meter per year where no rock seawall is present.

The Port Fairy Coastal Hazard Assessment (PFLCHA) states that the unprotected section of East Beach has been receding at an underlying rate of between 0.1 and 0.3 metres per year, equivalent to 3,300m<sup>3</sup> to 4,600 m<sup>3</sup> per year, measured over 150 years. (Water Research Laboratory, 2013)

The post 2012 beach monitoring at East Beach suggests that erosion is currently occurring at a faster rate than the long term average. The monitoring, has shown that present day erosion of the dune is exceeding predictions made in the 2013 PFLCHA and the dune has not re-established itself. This is a considerable change since 2007.

### Erosion Monitoring South Beach

The Port Fairy Coastal Group (PFCG) has been monitoring South Beach and Pea Soup since January 2016. Beach profiles are measured monthly at three posts. Port Fairy Consolidated and St Patricks School's Year 6 science program have collaborated with the PFCG to undertake the monitoring.

The Pea Soup Beaches Posts 21 and 22 indicate less variation in sand height levels than at Post 23 at James Street South Beach due to its greater exposure.

## 5. Existing Vulnerability and Resilience

Land management is an important consideration in assessing responsibility for climate change adaptation. While Moyne Shire is considered a community leader in climate change adaptation, responsibility for protection of assets ultimately lies with the relevant land manager. There are multiple land managers involved in Moyne Shire's coastline.

Moyne Shire is committed to working collaboratively to ensure land management boundaries do not impede our community resilience. The Shire also requires assistance from other land managers with resources and funding for projects that are beyond the Council's existing capital budget.

### Planning

Land-use planning decisions often have long-term implications because of the long life span and permanency of use and development such as residential growth areas, buildings, roads or utilities. A precautionary approach to planning new development, infrastructure and services to avoid coastal hazards over their intended lifespan is required. To avoid and be resilient to impacts of climate change, new developments should seek to respond appropriately through, siting, design and other measures.

The *Coastal Management Act 1995* requires the Victorian Coastal Strategy to provide for the long-term planning of the Victorian coast, The Act establishes the legislative framework for planning and managing the coast of Victoria, enabling a four-tiered approach with policies, plans and tools at a state, regional, local and site level. The relationship between these policies and plans is through:

- the State Planning Policy Framework via the Victorian Planning Provisions of the Planning and Environment Act 1987 requires coastal planning to be consistent with the Victorian Coastal Strategy and any relevant Regional Coastal Plans;
- sections of local planning schemes through Municipal Strategic Statements and Local Planning Policy Frameworks. Strategic long term planning for the coast should consider sea level rise. Coastal climate change impacts should be considered when reviewing Municipal Strategic Statements and in the development of land use planning strategies; and
- approvals for land use, development, and management on private and Crown land on the coast, as required under legislation. Development proposals must address future risks posed by coastal climate change impacts.

A number of adaptation measures to provide certainty for planning controls in areas affected by coastal inundation or flooding are implemented such as capacity building to improve decision-makers' understanding of climate change and amendment of local planning schemes to include specific provisions for treatment of sea level rise and storm surge projections for land use protection and development.

Moyne Shire is currently developing the Port Fairy Coastal and Structure Plan that will provide a long-term future land use and development plan for the township of Port Fairy to 2041. The Coastal and Structure Plan will recognise the future vulnerability of the township to coastal climate change and provide growth opportunities that recognises significant economic and community role together with its lands, environmental and heritage features.

## Landfills

Two closed landfills exist within the north-eastern section of the East Beach sand dunes (Figure 12).



Figure 12 Approximate location of landfills, Port Fairy East Beach sand dunes

Landfill 1, Moyne Shire Council own and manage the 'Old Landfill', located opposite the Port Fairy airstrip on Skenes Road. Whilst the surface area of the landfill is 115,000m<sup>2</sup> it is estimated that waste covers a maximum of 30,000m<sup>2</sup>. Operating between 1970's and 1990's, the compacted waste cells contain putrescible waste and recyclable materials including plastics, glass and aluminium bottles, building materials and scrap metals

A Wave Energy Dissipation Structure (WEDS) was constructed seaward of the Old Landfill in 2014 and extended in 2015 to a total length of 280 metres (Figure 13). The WEDS is considered to be a temporary structure with a limited lifespan.



*Figure 13 Wave Energy Dissipation Structure (WEDS) at the Old Landfill East Beach*

Landfill 2, The State Government, Department of Environment, Land, Water and Planning own and manage the 'Nightsoil Landfill', located approximately 700m northeast of Connolly Street. The site is significantly smaller than the Old Landfill and the waste predominantly consists of scrap metal, nightsoil pans and glass bottles.

## 6. Identification and Prioritisation of Adaptation Strategies

### Research

Significant research has identified the best ways to ‘Defend Port Fairy’. This research is the basis for the science behind, and risks of, the effects of climate change on Port Fairy. Table 3 summarises the aims and recommendations of each of the key research undertaken to date.

**Table 3 Summary of Key Research Undertaken to Date**

Year	Author	Study Title	Aim	Recommendations
2014	Coastal Engineering Solutions	Review of Wave Energy Dissipation Structures (WEDS) and Wattle and Wire Fencing Concept designs for WEDS upgrade and seawall	To provide an overview of the coastal systems at Each Beach.  To review the performance of the WEDS at the Old Landfill, and the wattle and wire fencing at the Nightfill Soil Landfill.  To describe alternative foreshore protection works for the Old Landfill including concept design and materials.	Options for foreshore protection works including: <ul style="list-style-type: none"> <li>• constructing an engineered full seawall (minimal risk over 50 years);</li> <li>• upgrading of the existing WEDS (risk of overtopping during some extreme storms, with a lifespan up to 25 years); and</li> <li>• extending the length of the WEDS.</li> </ul>
2014	Coastal Engineering Solutions	Ocean Drive – Foreshore Protection, including for Sea Level Rise	To provide an engineering solution to prevent wave impact, wave run-up and water inundation of Ocean Drive between Anna Catherine Drive and Powling Street, Port Fairy.	Suitable protection can be designed to prevent wave run-up impacting on Ocean Drive and nearby dwellings by building an onshore natural rockwall defence system from onshore sourced rock, seaward of the road. Further investigation is required to develop the concept.

Year	Author	Study Title	Aim	Recommendations
2014	Senversa	Groundwater Assessment Report – Old East Beach Landfill	To undertake groundwater monitoring on all existing groundwater monitoring bores to assess trends in groundwater quality and any risks to the Belfast Lough and East Beach.	<p>The risk to maintenance of ecosystems by potential impact migrating north towards Belfast Lough is considered to be low.</p> <p>It is unlikely for contaminants to discharge in significant concentrations to East Beach.</p> <p>Groundwater conditions should be periodically assessed for a period of up to three years, annually, to confirm the low risk to the environment.</p>
2013	Evers Consult	Port Fairy Bypassing System Upgrade	Assessment of the capacity of the existing Port of Port Fairy dredge, <i>The Cormorant</i> , to operate in open waters in order to supply offshore sand to East Beach	<i>The Cormorant</i> is too small to work in oceanic conditions outside the sheltered area of the Moyne River.
2013	Coastal Engineering Solutions	East Beach Seawall works preparation – Seawall Assessment and Design Concepts	<p>To undertake a structural assessment of rock seawall constructed in 1950's on East Beach.</p> <p>To provide a concept design for recommended remediation works, prioritisation strategy and cost estimate.</p>	<p>There is a clear need to upgrade the East Beach seawall to an appropriate structural standard of foreshore protection.</p> <p>Prioritisation of section of the seawall for urgency for repair, based on a combined assessment of the condition of the existing wall and the vulnerability of private and public infrastructure behind the wall staged over 20 years.</p> <p>The highest priority was that the length of seawall between Bourne Avenue and Ritchie Street be upgraded as soon as possible due to the close proximity of road and car parking areas.</p>
2013	Coastal Engineering Solutions	Port Fairy Sand Sourcing Study	To investigate where 100,000m <sup>3</sup> of sand could be sourced from to renourish East Beach including the evaluation of sand sources, their suitability, extraction method and cost.	Includes a summary of five options, their environmental aspects and approvals. Of the five options considered, only three of them could supply the 100,000m <sup>3</sup> of sand with minimal environmental impact. The cost of the remaining three options varied from \$1.77 million to \$2.25 million. Additionally, \$200,000 would be required to undertake external environmental assessments and gain relevant approvals.

Year	Author	Study Title	Aim	Recommendations
2013	Water Research Laboratory (University of New South Wales)	Future Coasts – Port Fairy Coastal Hazard Assessment	To identify potential climate change impacts and vulnerable areas of risk across the Shire.	Identifies areas of the Shire that are low lying and coastal areas exposed to the hazards of erosion, river catchment influences, and inundation from rising sea levels or storm surges causing wave run-up and wave impact. The affects are increased when combined with high tide, wind and predicted sea level rise.  Opening of the Southwest Passage is unlikely to restore a full sand supply to East Beach sufficient to prevent or reverse the recession observed over the past 150 years.
2012	Senversa	Landfill Site Investigation	A requirement of the Pollution Abatement Notice as required by the Environmental Protection Authority for the Old Landfill site at East Beach. The aim of study was to design and implement a monitoring program to assess the risk of harm to the environment.	No high level risks were identified. A site management plan was required to be developed.  Further assessment of the nature and extent groundwater impacts and pending the outcome of this a groundwater quality management plan.
2010	Aurecon	East Beach Coastal Erosion Engineering and Feasibility Study Peer Review (of 2007 BMT WBM report)	A Department of Sustainability and Environmental report, to provide clear and independent advice on the immediate coastal risk issues, identify appropriate options for management, and to assist with the prioritisation of government investment.	To focus effort on the central activity node, from the Surf Club through to Ritchie Street including: <ul style="list-style-type: none"> <li>- Upgrade of seawall;</li> <li>- Undertake beach renourishment with sand sourced from Griffiths Island; and</li> <li>- Monitoring of sand levels.</li> </ul>
2007	BMT WBM	Port Fairy East Beach Coastal Erosion Engineering and Feasibility Study	To further outline coastal process, the causes of erosion of East Beach, and assessment of the feasibility of engineering works and management options to overcome the erosion problems.	To implement beach improvement and seawall upgrade works with associated management and maintenance actions.  Identification of several stages of works at a cost of \$7 million over five years including: <ul style="list-style-type: none"> <li>- Repair the 1950s/60s East Beach rock seawall;</li> <li>- Remove east beach groynes and Southwest passage causeway;</li> <li>- Beach renourishment;</li> <li>- Install permanent crossing over Southwest passage; and</li> <li>- Seal leaks in training walls</li> </ul>

Year	Author	Study Title	Aim	Recommendations
2006	Coastal Engineering Solutions	Port Fairy Shoreline Stability Study	To determine historical changes to the coast in the East Beach area northeast of the existing houses along Griffiths Street, and to make predictions as to how the coast might change in the future.	Analysis of photographs since 1947 indicated negligible erosion of the last 30 years. A 20 metre buffer between the existing scarp and buildings would be adequate.
1996	WBM Oceanics Australia	Coastal Study of East Beach Port Fairy	<p>To provide a broad description of the geomorphology of the area</p> <p>To assess the dominant coastal processes influencing East Beach</p> <p>To describe changes made to the Port Fairy coastline and assess their relevance to the loss of sand at East Beach</p> <p>To present a range of management options to address the issue of sand loss.</p>	<p>Options to restore and maintain the beach sand to address erosion including:</p> <ul style="list-style-type: none"> <li>- Immediate placement of dredged sand;</li> <li>- Assessment of emergency protective options;</li> <li>- A beach monitoring program;</li> <li>- Regulation of activities and use of public land in coastal zone; and</li> <li>- A program of further investigation for long term management.</li> </ul>

## Climate Change Adaptation Planning

In order to prepare for the future and build a resilient community, a risk based approach was used to assist with the identification of potential hazards and the prioritisation of projects/works to minimise the risks. The process as depicted in Figure 14 underpins the process used to define and minimise the risks.

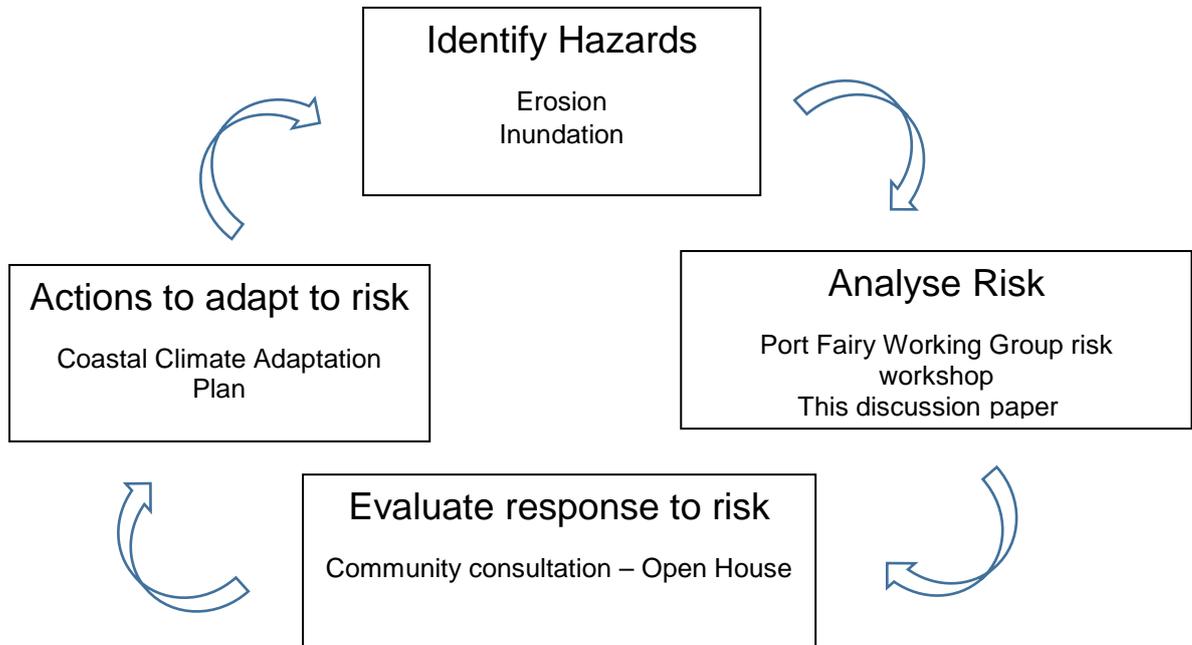


Figure 14 Summary of risk assessment steps

## Risk Assessment

A Coastal Hazard Assessment of Port Fairy undertaken in 2013 identified potential climate change impacts and confirmed that both coastal **erosion** and **inundation** pose significant risk to our assets.

A risk assessment undertaken by the Port Fairy Working Group in 2015 identified six distinct areas within Port Fairy that are at risk from coastal hazards, Figure 15. The preliminary risk assessment included community feedback on specific, high-risk areas.

The Port Fairy Working Group consists of representatives from Department of Environment, Land, Water and Planning, Parks Victoria, Glenelg-Hopkins Catchment Management Authority and Moyne Shire Council.

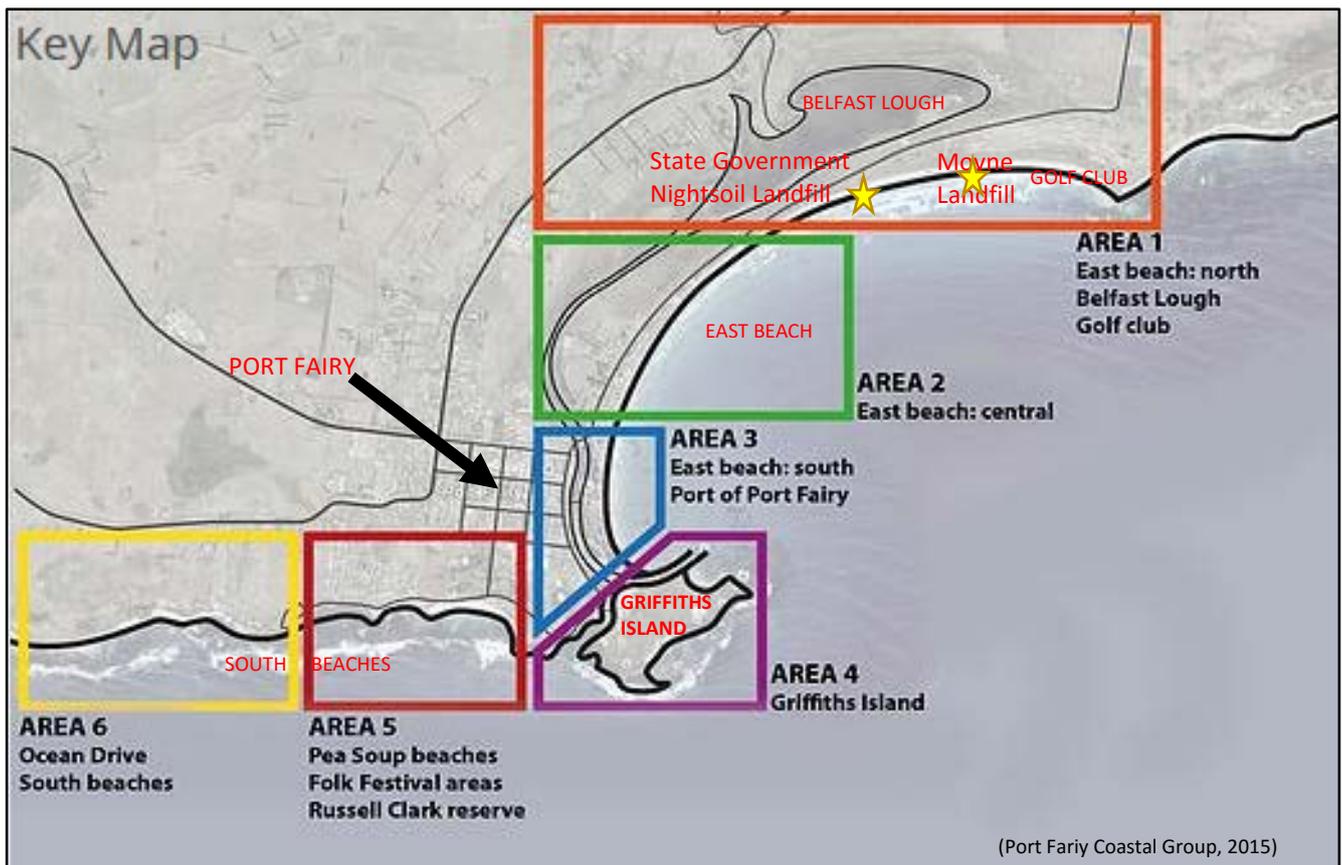


Figure 15 Areas of Moyne Shire at risk from coastal hazards

## Risk Assessment Process

As part of the risk assessment process, the **likelihood of a hazard (event) occurring** is firstly considered. Refer to Appendix A for definitions of 'likelihood of occurrence'. Some examples of using the risk assessment process to determine the likelihood of a hazard (event) occurring are as follows:

- The likelihood that dunes along East Beach North will experience erosion is 'almost certain', (studies have shown that areas without a rock seawall are most at risk of erosion).
- The likelihood that areas located along Ocean Drive, the Moyne River Channel and the south of the Belfast Lough will experience inundation is 'almost certain', (studies have shown that these areas are most at risk of coastal inundation).
- The likelihood of inundation of the Port Fairy airstrip and Belfast Lough Area in the next 20 years in the event of dune breakthrough at East Beach is 'unlikely' to occur.
- The likelihood that inundation because of wave run-up or wave impact in areas where there is no rock seawall (such as a beach access ramp) has been rated as 'likely' to occur.

The likelihood of a hazard (event) occurring is then considered in conjunction with **measure of consequence of impact**. Refer to Appendix A for definitions of ‘consequence of impact’. The consequence of the impact of an event occurring takes into account the following impacts: financial, public health, safety, council service delivery, legal compliance, environmental damage, council image, and public support.

The **level of risk** is then determined by using the following matrix provided - Table 4. For example, if an event is ‘Likely’ to occur and the consequence of the event is considered ‘Major’, the risk will be rated as ‘Extreme’. If the event is ‘Likely’ to occur but the consequence is ‘Insignificant’, the risk rating will be ‘Medium’.

**Table 4 Risk Analysis Matrix - Level of Risk**

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	High	High	Extreme	Extreme	Extreme
Likely	Medium	High	High	Extreme	Extreme
Possible	Low	Medium	High	Extreme	Extreme
Unlikely	Low	Low	Medium	High	Extreme
Rare	Low	Low	Medium	High	High



## Risk Assessment Results

The detailed results of the preliminary risk assessment are shown in Appendix B.

The assets identified as extreme and high risks in the preliminary risk assessment are summarised in Table 5.

**Table 5 Extreme and High Risk Assets**

ASSET	MANAGED BY	RISK	HAZARD
<b>AREA 1 – East Beach north, Belfast Lough, Golf Club</b>			
Mills Reef Carpark	Parks Victoria	<b>Extreme</b>	Erosion
Nightsoil Landfill	State Government	<b>Extreme</b>	Erosion
East Beach (northeast) dune	State Government	<b>Extreme</b>	Erosion; Wave run up
Old Municipal Landfill	Moyne Shire Council	High	Erosion
Golf Course	Private	High	Erosion; Wave run up
<b>AREA 2 – East Beach central</b>			
East Beach foreshore	State Government	<b>Extreme</b>	Erosion
Botanical Gardens	Moyne Shire Council	<b>Extreme</b>	Inundation
Bourne Avenue	Moyne Shire Council	<b>Extreme</b>	Inundation; Wave run up
East Beach 1950s rock seawalls	Moyne Shire Council	<b>Extreme</b>	Wave run up
Surf Life Saving Club	Moyne Shire Council	<b>Extreme</b>	Erosion; Inundation; Wave run up
Griffiths Street Residential houses	Private	<b>Extreme</b>	Inundation
Football ground, grandstand and netball courts	Moyne Shire Council	High	Inundation
Gardens Caravan Park	Moyne Shire Council	High	Inundation
<b>AREA 3 – East Beach south, Port of Port Fairy</b>			
Community Services Centre	Moyne Shire Council	High	Inundation
Gipps Street bridge	Moyne Shire Council	High	Inundation
Gipps Street Residential houses	Private	High	Inundation

ASSET	MANAGED BY	RISK	HAZARD
<b>AREA 5 – Pea Soup, The Passage at Ocean Drive, Folk Festival Cricket Ground</b>			
Reardon Street residential houses	Private	<b>Extreme</b>	Inundation
Singleton Street residential houses	Private	<b>Extreme</b>	Inundation
Cricket ground & folk festival buildings	Moyne Shire Council	High	Inundation
Pea Soup dunes	Moyne Shire Council	High	Erosion; Inundation; Wave run up
Southcombe Park	Moyne Shire Council	High	Erosion; Inundation; Wave run up
Ocean Drive residential houses	Private	High	Erosion
<b>AREA 6 – Ocean Drive, South Beaches</b>			
Ocean Drive residential houses	Private	<b>Extreme</b>	Erosion; Wave run up
Anna Catherine Drive residential houses	Private	<b>Extreme</b>	Inundation
Port Fairy West residential houses on dune	Private	<b>Extreme</b>	Erosion
Thistle Place (part) residential houses	Private	High	Inundation
Biowave	Private	High	Erosion; Inundation; Wave run up

Four assets managed by Moyne Shire Council are at ‘extreme’ risk of erosion or inundation and eight assets are at ‘high’ risk erosion or inundation.

### Measures taken to date to reduce risk

Aside from the significant research undertaken as outlined previously, a number of adaptation measures have been completed or are underway within Port Fairy including:

- Training wall;
- Groynes;
- Permanent and temporary rock seawalls, including wave energy dissipation structure;
- Dune rebuilding;
- Sand fencing;
- Revegetation of dunes;
- Planning scheme amendments;
- Engineering planning, design and cost estimating for future project options;
- Beach Monitoring (Port Fairy Coastal Group);
- 2015 Community Survey of residents and visitors (Port Fairy Coastal Group); and
- Repair and maintenance of stormwater outlets to sea, roads, bridge, river training walls and jetties following storm damage.



The 2015 community survey by the Port Fairy Coastal Group received 755 responses on how we use and value the coast, prioritising areas for investment and protection. Almost everyone surveyed think the risks to the coast are real and that the natural environment and habitat as well as beach access and car parks are priority areas for investment. Walking, water sports, fishing and beach/sun games account for 80% of coastal activity.

Appendix C provides more details on these measures undertaken to protect Moyne Shire Assets.

No solution for coastal erosion is final and any projects undertaken are treated as a trial, with careful, ongoing monitoring. Moyne Shire considers combining hard defences, such as rock sea walls, with softer treatments such as sand renourishment, as important strategies to counteract the impacts of coastal erosion.



## 7. Possible Solutions - Adaptation Options

In order for houses, buildings, dunes and other infrastructure to be resilient, adaptation to the effects of climate change and sea level rise is required. Adaptation to coastal hazards can be categorised into three main areas.

1. Structural measures – relocation, raising structures and roads, retrofit or ‘retreat, elevate and armour’.
2. Non-structural measures – policy changes, operational modifications, asset-specific measures.
3. Regional measures – benefit multiple assets and or multiple stakeholders.

Table 6 describes, compares, and provides examples of some possible structural adaptation measures.

Non-structural measures and regional measures have not been detailed in this discussion paper, however they will be included in the final Port Fairy Coastal Climate Change Adaptation Plan.

**Table 6 Structural Measures for Consideration (Mariani, 2011)**

Positives	Negatives
<b>Hard engineering structures</b>	
Seawalls, Groynes, Breakwaters	
<ul style="list-style-type: none"> <li>• Used in Australia and worldwide for hundreds of years</li> <li>• Detailed and documented engineering design criteria – providing predictable outcomes of use</li> </ul>	<ul style="list-style-type: none"> <li>• Has the potential to intensify the erosion processes</li> <li>• Can result in adverse environmental impacts</li> </ul>
Elevation of road levels and buildings	
<ul style="list-style-type: none"> <li>• Minimise need to retreat from risk of inundation</li> <li>• Properties and roads in the coastal zone may retain views of beach without risk of wave run-up or inundation</li> </ul>	<ul style="list-style-type: none"> <li>• High cost</li> <li>• No protection during storm</li> <li>• Only suitable for low energy wave areas</li> </ul>
<b>Soft engineering solutions</b>	
Artificial reefs	
<ul style="list-style-type: none"> <li>• Not visible from the beach</li> <li>• Marine Habitat enhancement</li> <li>• Coastal Protection*</li> <li>• Surfing Enhancement*</li> <li>• Recreational amenity</li> <li>• Simple to construct*</li> <li>• Removability (in some cases)</li> </ul>	<ul style="list-style-type: none"> <li>• Only suitable for beaches with small tidal range</li> <li>• Sensitive to sea level rise</li> <li>• Limited design criteria</li> <li>• Limited protection during storms</li> <li>• Subject to base scouring</li> <li>• Subject to settlement</li> <li>• Swimmer and navigational safety</li> </ul>

Positives	Negatives
Groundwater defence i.e. De-watering, beach drainage	
<ul style="list-style-type: none"> <li>No visual impact once installed</li> <li>Beach stabilisation</li> <li>Simplicity of constructability</li> <li>Removability</li> <li>Relatively low cost</li> <li>Drying effect on beach for increased recreation</li> </ul>	<ul style="list-style-type: none"> <li>Only suitable for low energy wave areas.</li> <li>No protection during storms.</li> <li>Susceptible to storm damage. Durability</li> <li>Maintenance costs for pumps</li> <li>Lack of design criteria</li> </ul>
Artificial dunes	
<ul style="list-style-type: none"> <li>Buffer against wave impacts and inundation</li> <li>Sand supply for beach</li> <li>Creation of natural habitat</li> <li>Prevents sand moving inland</li> </ul>	<ul style="list-style-type: none"> <li>Sensitivity to sea level rise</li> <li>Performance in the field of dune armouring</li> <li>Durability of reinforcement materials</li> </ul>
Natural defences, e.g. coastal vegetation, including seagrasses, salt marshes and mangroves	
<ul style="list-style-type: none"> <li>Wave attenuation</li> <li>Soil stabilisation</li> <li>Enhances ecological habitat</li> <li>Natural, non-structural protection</li> </ul>	<ul style="list-style-type: none"> <li>Only suitable for low wave energy areas</li> <li>Only suitable for shallow slopes</li> <li>Difficulties in planting and growth</li> <li>Ecological impacts</li> <li>Limited knowledge of wave attenuation characteristics</li> </ul>
Wave Energy Device	
<ul style="list-style-type: none"> <li>Harvesting of wave energy</li> <li>Coastal protection (however, this needs to be verified through laboratory experiments and field trials)</li> </ul>	<ul style="list-style-type: none"> <li>Limited field application</li> <li>Limited laboratory experience</li> <li>Environmental impact</li> </ul>
Beach nourishment	
<ul style="list-style-type: none"> <li>Protection from storm and inundation</li> <li>Promotion of recreational use</li> <li>Promotion of natural habitat</li> <li>Add value to seafront properties</li> </ul>	<ul style="list-style-type: none"> <li>Costs and approvals</li> <li>Sand sourcing (grain size, colour, transportation)</li> <li>Ecological impacts of dredging</li> <li>Requires long-term maintenance (cost)</li> </ul>

## 8. Proposed Actions

The following summarises the key actions proposed by Moyne Shire Council. The details of these will be included in the final Port Fairy Coastal Climate Change Adaptation Plan following community consultation on this discussion paper.

Note that defensive adaptation structures such as those that may be required to protect private dwellings along Port Fairy West need to be privately funded and are not detailed in this document.

**Table 7 Proposed Actions**

Key Action Proposed	Expected costs (structural works)
Extension and upgrade of the <b>rock seawall</b> along East Beach, prioritising those areas at extreme or high risk.	\$4 million
Implement a <b>beach renourishment</b> program along the southern end of East Beach, with sand sourced from other nearby sources.	\$2 million
Investigate <b>wave run-up mitigation</b> along South Beach followed by restructuring the shoreline to lessen impacts.	\$2 million
Investigate appropriate long-term management options for the <b>Old and Nightsoil Landfills</b> at East Beach.	\$125,000 (funded by state government)
Ongoing <b>repairs and maintenance</b> of roads, bridges, river training walls and other associated public infrastructure following storm damage.	Funded by state/federal governments
Continuation of support for the Port Fairy Coastal Group to accurately <b>monitor and record</b> beach profiles along East Beach.	No structural works
Development of the <b>Port Fairy Coastal and Structure Plan</b> , providing a long-term future land use and development plan for the township.	No structural works

## 9. References

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## 10. Acknowledgments

Moyne Shire Council acknowledges the significant effort and contribution by the Port Fairy Coastal Group including but not limited to the Coastal Hazards Community Survey and the Coastal Beach Monitoring.



*Figure 16 Port Fairy Coastal Group - beach monitoring team (Port Fairy Coastal Group, 2015)*

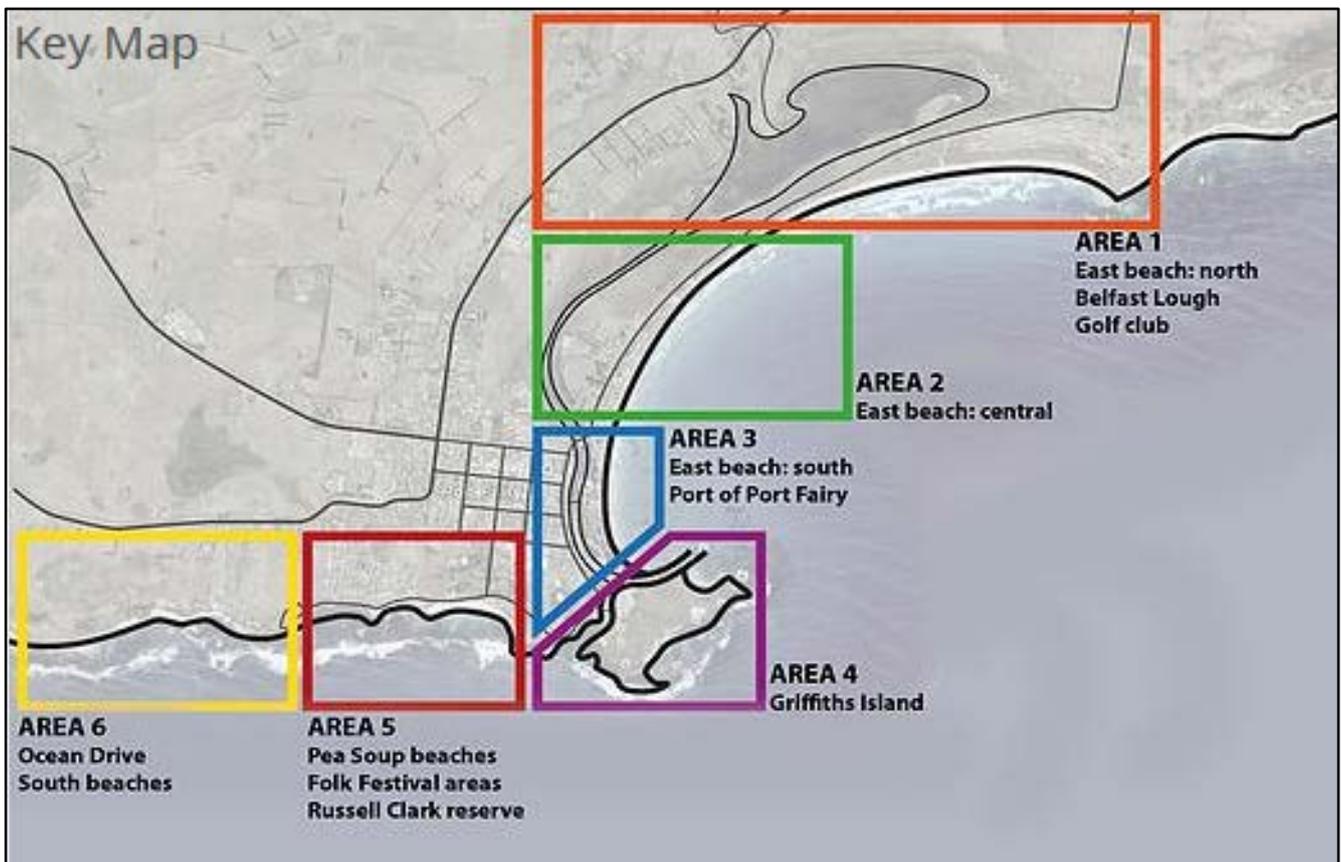
## 11. Community Feedback

Coastal hazards in areas 1 to 6 below, were rated as 'low', 'medium', 'high' or 'extreme' risk to our community assets.

After consideration of the research outlined in this discussion paper, Moyne Shire Council is asking for your feedback on the actions proposed in Table 7.

The "Port Fairy Coastal Climate Change Adaptation Plan" to be adopted by Council will consider all comments received by the community.

It is proposed that a community consultation drop-in session will be held in October 2017. We invite you to attend and discuss the risks and their actions with the panel. Advertisement of this session will be two weeks prior to the event.



# 12. Appendices



## Appendix A

### Risk Assessment Definitions: Likelihood of a hazard (event) occurring

Descriptor	Likelihood of Occurrence
<b>Almost Certain</b>	Event may occur only in exceptional circumstances
<b>Likely</b>	Will probably occur in most circumstances
<b>Possible</b>	Might occur at some time
<b>Unlikely</b>	Could occur at some time
<b>Rare</b>	May occur only in exceptional circumstances

Appendix A Risk Assessment Definitions: Consequence of Impact

Consequence of Impact						
CONSEQUENCE OF IMPACT	Financial Impact	Impacts on Public health and safety	Service Delivery Impact on Customers and Community	Environmental and Legal Compliance	Environmental damage	Image, Reputation and Public Support
<b>Insignificant</b>	< \$10,000	No health or safety impact. Injury managed with 1 <sup>st</sup> Aid	< 20 Customer-hours. Very localised-little disruptive effect.	No breaches.	Small, reversible environmental harm, permitted by terms of a resource consent.	No media attention or damage to reputation.
<b>Minor</b>	\$10,000 to \$50,000	Minor health or safety impact on small number of people. Injury dealt with by doctor. No Hospitalisation	20 – 500 Customer hours. Inconvenience to small group of residents.	Minor breaches affecting very small part of the system or service.	Localised non persisting contamination which dissipates/disperses. Death of flora /fauna where propagules are available locally for regeneration	Minimal media attention, but minor damage to image to a small group of people. May be some local coverage-not front page.
<b>Moderate</b>	\$50,000 to 200,000	Serious health or safety impact on small number (injuries require hospitalisation) or minor impact on large number of people.	500 to 20,000 Customer-hours. Some disruption to a wider group.	One-off major breach, affecting a small part of the network or service	Serious damage or loss to a locally important habitat or ecosystem. Loss of a population of a locally uncommon species.	Negative local media coverage, community concerned about Council performance.

Appendix A Risk Assessment Definitions: Consequence of Impact

Consequence of Impact						
CONSEQUENCE OF IMPACT	Financial Impact	Impacts on Public health and safety	Service Delivery Impact on Customers and Community	Environmental and Legal Compliance	Environmental damage	Image, Reputation and Public Support
Major	\$200,000 to 1,000,000	Extensive injuries or significant health or safety impacts, single fatality.	20,000 to 500,000 Customer-hours. Significant effect on large group. Political involvement.	Several major breaches affecting a significant part of the network or service.	Damage or loss of regionally or nationally important habitat. Local loss of a species. Habitat reduced below 20% of former (1840) extent. Establishment of significant new pest.	Negative national media coverage, major decrease in community support. Loss of key staff.
Catastrophic	> \$1,000,000	Widespread health or safety impacts, multiple fatalities.	More than 500,000 Customer hours. Significant effect to community at large. Community alienation.	Widespread and major breaches of standards, failure to meet legislative requirements over most of system area / network.	Loss of a nationally significant habitat or ecosystem.	Negative international media coverage, loss of community support. External enquiry. Appointment of Commissioner.



## Appendix B Detailed results of the preliminary risk assessment

The Hazards are sorted by 'Area', then 'Risk', then by 'Who asset managed by'.

ASSET	MANAGED BY	HAZARD	Likelihood	Consequence	Risk
<b>AREA 1 - East Beach north, Belfast Lough, Golf Club</b>					
Mills Reef Carpark	Parks Victoria	Erosion	ALMOST CERTAIN No rock seawall	MODERATE Loss of car parking for community, in particular to surfers and fisherman. Safety of people and vehicles needs to be considered.	EXTREME
Nightsoil Landfill	State Government Department Environment Land Water Planning (DELWP)	Erosion	POSSIBLE No rock seawall, however sand fencing is in place and beach monitoring results show sand retention. Further protection is likely to be required to protect against major storm events.	MAJOR Coastal erosion has exposed hazardous material including rusty nightsoil cans, asbestos, plastic, polystyrene, shattered glass and miscellaneous forms of rubbish to the sea, land and air in the past. Long-term solution is required to prevent waste exposure.	EXTREME
East Beach (north-east) dune	State Government Department Environment Land Water Planning (DELWP)	Erosion Wave Run Up	ALMOST CERTAIN No rock seawall to protect dune. Beach monitoring results show that dune is eroding at an average recession of between one and four metres per year. The dune width is 70-metres at some locations.	MAJOR Dune breakthrough could occur in 20 years for the current worst case rate of erosion. The sand dune is currently experiencing loss of biodiversity. A breach has the potential to flood Port Fairy including Belfast Lough, Moyne River, airstrip, homes on Griffiths Street and damage public assets such roads and drainage.	EXTREME
Old Municipal Landfill	Moyne Shire Council	Erosion	UNLIKELY Extensive armoring is predicted to protect the sand dunes covering the waste until 2040. Additional works to place jute matting and revegetate dune scheduled for late 2015.	MAJOR Coastal erosion has exposed hazardous material to the sea, land and air in the past. Long-term solution is required to prevent waste exposure past 2040.	HIGH

ASSET	MANAGED BY	HAZARD	Likelihood	Consequence	Risk
Golf Course	Port Fairy Golf Club	Erosion Wave Run Up	ALMOST CERTAIN No rock seawall	MODERATE Loss of Fairway and possible future loss of tourism and recreational drawcard	HIGH
Belfast Lough	Glenelg Hopkins CMA	Inundation	UNLIKELY Requires dune breakthrough. Present day risk is low.	MODERATE Flooding of the lough and subsequent properties. Salt water intrusion could affect biodiversity.	MEDIUM
Moyne River	Glenelg Hopkins CMA	Inundation	UNLIKELY Requires dune breakthrough. Present day risk is low.	MODERATE Elevated water levels could cause flooding of semi-rural properties. Salt water intrusion could affect biodiversity.	MEDIUM
Port Fairy Airstrip	Moyne Shire Council	Inundation	UNLIKELY Requires dune breakthrough. Present day risk is low.	MINOR Asset would require relocation inland. Community survey results showed this would be acceptable.	LOW
<b>AREA 2 - East Beach central</b>					
East Beach foreshore	Moyne Shire Council and State Government Department Environment Land Water Planning (DELWP)	Erosion	ALMOST CERTAIN Rock seawall is present, affecting the natural long-term, cross-shore replenishment of sand to the beach from sand bars	MAJOR Loss of sand from East Beach in front of rock seawalls is leaving holiday makers with a reduced width of beach to enjoy	EXTREME
Botanical Gardens	Moyne Shire Council	Inundation	ALMOST CERTAIN Inundation as a result of wave run-up at surf lifesaving club beach access ramp	MODERATE Safety of people and vehicles; damage to gardens	EXTREME
Bourne Avenue	Moyne Shire Council	Wave Run Up Inundation	ALMOST CERTAIN Inundation as a result of wave run-up if 1950s rock wall was to fail	MODERATE Safety of people and vehicles; damage to road	EXTREME
East Beach 1950s rock seawalls	Moyne Shire Council	Wave Run Up	ALMOST CERTAIN Short-term risk is low at present time. Likelihood of obtaining funding to upgrade the rockwalls before failure is low and this presents very high future risk.	MAJOR Increased pressure on existing defence structures means the rock seawall constructed in the 1950s to protect the dunes from erosion is failing.	EXTREME

ASSET	MANAGED BY	HAZARD	Likelihood	Consequence	Risk
			Other assets have been assessed assuming this wall will not fail	This rock seawall protects the surf lifesaving club, public car park, public toilets and millions of dollars' worth of homes built on dunes.	
Surf Life Saving Club	Moyne Shire Council	Erosion Wave Run Up Inundation	ALMOST CERTAIN No rock wall. Inundation as a result of wave run-up at surf lifesaving club beach access ramp	MODERATE Damage to building and assets; safety of people and vehicles	EXTREME
Griffiths Street Residential houses	Private	Inundation	ALMOST CERTAIN Inundation as a result of Bourne Avenue wave-run up if 1950s rock wall was to fail	MODERATE Safety of people and private property; drop in value of properties	EXTREME
Football ground, grandstand and netball courts	Moyne Shire Council	Inundation	UNLIKELY Inundation as a result of Bourne Avenue wave run-up – unlikely in short term due to presence of 1950s rock wall.	MAJOR Damage to buildings and infrastructure. Loss of sporting ground and revenue from visitors would be a big loss for the Port Fairy community.	HIGH
Gardens Caravan Park	Moyne Shire Council	Inundation	UNLIKELY Inundation as a result of Bourne Avenue wave run-up – unlikely in short term due to presence of 1950s rock wall	MAJOR Damage to infrastructure and loss of income from caravan park and tourism revenue	HIGH

ASSET	MANAGED BY	HAZARD	Likelihood	Consequence	Risk
<b>AREA 3 – East Beach south, Port of Port Fairy</b>					
Community Services Centre	Moyne Shire Council	Inundation	RARE	MAJOR	HIGH
Gipps Street bridge	Moyne Shire Council	Inundation	RARE	MAJOR	HIGH
Gipps Street residential houses	Private	Inundation	RARE	MAJOR	HIGH
Port of Port Fairy, piers, walkways, rock training walls	Moyne Shire Council	Inundation	POSSIBLE	MINOR	MEDIUM
Yacht Club	Moyne Shire Council	Inundation	RARE	MODERATE	MEDIUM
Battery Lane	Moyne Shire Council	Wave Run Up	RARE	MINOR	LOW
Rogers Place	Moyne Shire Council	Wave Run Up	RARE	MINOR	LOW
Battery Hill car park	Moyne Shire Council	Inundation	RARE	MINOR	LOW
Railway Place	Moyne Shire Council	Inundation	RARE	MINOR Safety of people and private property; drop in value of properties	LOW
<b>AREA 4 – Griffiths Island</b>					
Griffiths Island	Moyne Shire Council	Erosion Inundation	UNLIKELY	MODERATE	MEDIUM
Battery Hill	Moyne Shire Council	Inundation	RARE	INSIGNIFICANT	LOW
Martins Point playground	Moyne Shire Council	Inundation	RARE	MINOR	LOW
Training Walls	Moyne Shire Council	Wave Run Up	UNLIKELY	MINOR	LOW
<b>AREA 5 – Pea Soup, The Passage at Ocean Drive, Folk Festival Cricket Ground</b>					
Reardon Street residential houses	Private	Inundation	LIKELY	MAJOR	EXTREME
Singleton Street residential houses	Private	Inundation	LIKELLY	MAJOR	EXTREME
Cricket ground and folk festival temporary buildings	?	Inundation	RARE	MAJOR	HIGH
Pea Soup dunes	Moyne Shire Council	Erosion Inundation Wave Run Up	LIKELY	MINOR	HIGH
Southcombe Park	Moyne Shire Council	Erosion Inundation Wave Run Up	RARE	MAJOR	HIGH

ASSET	MANAGED BY	HAZARD	Likelihood	Consequence	Risk
Ocean Drive residential houses	Private	Erosion	RARE	MAJOR	HIGH
South Beach dunes	Moyne Shire Council	Erosion Inundation Wave Run Up	LIKELY	INSIGNIFICANT	MEDIUM
<b>AREA 5 – Pea Soup, The Passage at Ocean Drive, Folk Festival Cricket Ground</b>					
Ocean Drive	Moyne Shire Council	Erosion Inundation Wave Run Up	POSSIBLE	MINOR	MEDIUM
The Passage carpark	Moyne Shire Council	Wave Run Up	UNLIKELY	MINOR	LOW
Russell Clark Reserve	Moyne Shire Council	Inundation	RARE	MINOR	LOW
<b>AREA 6 - Ocean Drive, South Beaches</b>					
Ocean Drive residential houses	Private	Erosion Inundation Wave Run Up	LIKELY	MAJOR	EXTREME
Anna Catherine Drive residential houses	Private		LIKELY	MAJOR Homes flooded. Damage to people and property.	EXTREME
Port Fairy West residential houses on dune	Private	Erosion	LIKELY	MAJOR	EXTREME
Thistle Place (part) residential houses	Private	Inundation	RARE	MAJOR	HIGH
Biowave	Private	Erosion Inundation Wave Run Up	RARE	MAJOR	HIGH
Abalone Farm	Private	Erosion Inundation Wave Run Up	POSSIBLE /MODERA TE	INSIGNIFICANT	LOW
Port Fairy West Dune	DELWP	Erosion	RARE	MINOR	LOW
Port Fairy West Farmland	Private	Inundation	RARE	MINOR	LOW

**Appendix C Coastal Adaptation Work Completed to Date** (sorted by 'Asset Managed by')

Assets	Asset Managed by	Moyne Shire Climate Adaptation Measures	Completed by/ ongoing
<b>AREA 1 East Beach north, Belfast Lough, Golf Club</b>			
		Site fenced	December 2013
		Groundwater testing	April 2014
		Site Management Plan	June 2014
		Wave Energy Dissipation Structure (WEDS) Stage 1	May 2014
		WEDS Stage 2	June 2015
		Dune face renourished, contoured, and revegetated	May 2015
		Wattle and Wire fencing installed at both ends of WEDS to protect against seawall end effects (scour)	November 2015
		Dune face renourished, contoured, and revegetated (opposite WEDS Stage 2)	2016
Golf Course	Private	Sand fencing Fencing installed, damaged by storm	Ongoing
Nightsoil Landfill	State Government	Installation of sand fencing. Jute matting installation at top of dune face.	June 2014
		Beach Monitoring by Port Fairy Coastal Group	Ongoing - monthly
		Revegetation with Jute matting and dune rebuilding north of Stage 1 rock wall (Connelly Street).	
Belfast Lough	State Government GHCMA	Planning Amendments	In Progress
Moyne River	State Government GHCMA	Planning Amendments	In Progress
Mills Reef Carpark	State Government Parks Victoria	Reinstatement of access road and carpark with crushed rock	May 2015

Assets	Asset Managed by	Moyne Shire Climate Adaptation Measures	Completed by/ ongoing
<b>AREA 2 - East Beach central</b>			
		Stage 2 Rock seawall upgrade. Surf club to Beach Street toilet block	March 2014
		Beach Monitoring by Port Fairy Coastal Group	Ongoing - monthly
		Sand Renourishment Program: <ul style="list-style-type: none"> <li>- Implementation of "Sand Sourcing Study" 2013 by CES</li> <li>- Permit received from state Government with conditions</li> <li>- Environment Impact Study underway, considering the Environment Protection Authority (EPA) best practice environmental management – Guidelines for dredging and the National Assessment Guidelines for Dredging</li> <li>- In negotiations with Gippsland Port Authority to share the New Zealand-based dredge <i>Pelican</i></li> <li>- Considerations of 23 shipwrecks – 11 located.</li> </ul>	February 2014  Ongoing
Botanical Gardens	Moyne Shire Council		
Bourne Avenue	Moyne Shire Council		
Surf Life Saving Club	Moyne Shire Council		
Football ground, grandstand and netball courts	Moyne Shire Council		
Gardens Caravan Park	Moyne Shire Council		
East Beach 1950s rock seawalls	Moyne Shire Council	Stage 1 Rock Seawall upgrade north of Connelly Street	March 2013
Griffiths Street residential houses	Private Land	Planning scheme revision Inundation overlay.	

Assets	Asset Managed by	Moyne Shire Climate Adaptation Measures	Completed by/ ongoing
<b>AREA 3 – East Beach south, Port of Port Fairy</b>			
Railway Place	Moyne Shire Council	Planning Amendments	
Gipps Street bridge	Moyne Shire Council	Maintenance due to damage from storms and vehicles	
Port of Port Fairy, piers, walkways, rock training walls	Moyne Shire Council	Repair following June 2014 storm included rebuilding jetties on Moyne River training walls on Griffith Island and other areas of damage to historic river training walls	August 2014
Rogers Place and Apex Park	Moyne Shire Council	Stage 3 rock seawall upgrade	June 2015
Battery Hill	Moyne Shire Council	Vegetation Management Plan	Ongoing
Martins Point	Moyne Shire Council	Disaster Relief works	
Griffiths Island	Moyne Shire Council Friends of Griffiths Island Parks Victoria	Vegetation Management Plan	Ongoing
Gipps Street residential houses	Private landowners	Planning Amendments - VCAT	
The Passage Carpark	Moyne Shire Council	Repair following June 2014 Storm	August 2014
		Repair following June 2014 Storm included replacement of offshore rocks to dissipate energy from waves	August 2014
		Preliminary Design for Ocean Drive Foreshore Protection works to prevent wave run-up (2014 CES)	February 2014
Southcombe Park	Moyne Shire Council		
		Sand retention fencing, rockwall, revegetation (washed away in storm June 2014)	
		Repair following June 2014 storm included replacement of ramp and rock barrier	August 2014
		Dune rebuilding, sand fencing installation and vegetation works following damage from June 2014 storm and human activity on the dune	October 2015
		Beach Monitoring Project by local primary schools	Ongoing
		Repair and ongoing maintenance of beach accesses	Ongoing

Assets	Asset Managed by	Moyne Shire Climate Adaptation Measures	Completed by/ ongoing
Russell Clark Reserve	Moyne Shire Council	Preparation of Beach Access Asset maintenance schedule	Ongoing
		Vegetation Management Plan	Ongoing
		Preliminary Design for Ocean Drive Foreshore Protection Works (2014 CES) to prevent wave run-up and subsequent inundation of Reardon Street	February 2014
<b>AREA 6 – Ocean Drive, South Beaches</b>			
Ocean Drive (west), Anna Catherine Drive, Thistle Place and other residential houses on dunes in Port Fairy West	Private land	Preliminary design for Ocean Drive Foreshore Protection Works (2014 CES) to prevent wave run-up and subsequent inundation of residential areas	February 2014
Port Fairy West farmland	Private Land	Structure Planning for new development – James Carley VCAT	



**Website** ➤ [www.moyne.vic.gov.au](http://www.moyne.vic.gov.au)

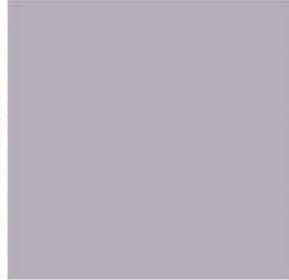
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