MAUNSELL AECOM

Bellarine Safe Harbour - Baseline Assessment Summary Report

Final

Parks Victoria

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Bellarine Safe Harbour - Baseline Assessment Summary Report

Prepared for

Parks Victoria

Prepared by

Maunsell Australia Pty Ltd
Level 9, 8 Exhibition Street, Melbourne VIC 3000, Australia
T +61 3 9653 1234 F +61 3 9654 7117 www.maunsell.com
ABN 20 093 846 925

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Table of Contents

List of Tables

List of Figures

1.0 Introduction

There is a recognised need within government and the community for improved boating facilities and infrastructure at key sites within Port Phillip Bay to improve the appeal of the area as a cruising destination, to service the expansion of the marine aquaculture industry in the region and to provide adequate berthing for recreational vessels on the Bellarine Peninsula. These objectives are addressed in a series of government framework and policy documents including the Victorian Coastal Strategy, the Central Coastal Region's Boating Coastal Action Plan and Parks Victoria's Strategic Directions for the Bays.

An assessment of the suitability of a site for the construction of a safe harbour on the Bellarine Peninsula was undertaken by Stratcorp Consulting in 2005. The results of this assessment are presented as "Bellarine Peninsula Safe Harbour – Business Development Case, 2005". The result of this assessment was the identification of Portarlington as the preferred site for development of a safe harbour.

The harbour is at the entrance to the Geelong arm of Port Phillip, Victoria. The existing facility consists of a pier extending 200m from shore, an outer jetty at right angles to the main pier and a shorter internal finger jetty, both jetties protected behind an outer breakwater (Figure 1). The Study Area for the current project was identified from these 2005 concepts for a re-developed harbour, which provide the basis for the potential future development area.

Development of a safe harbour at the Portarlington site will provide commercial infrastructure to facilitate the anticipated increase in aquaculture production which is expected to attract both national and international investment into the industry and employment to the Portarlington, Bellarine Peninsula and Greater Geelong regions. The expansion of the marine aquaculture industry in Port Phillip through the release of new aquaculture areas at the Pinnacle Channel, Grassy Point, Bates Point and Kirk Point Werribee aquaculture fisheries reserves (AFR's) will require associated land based infrastructure and facilities to support this industry. The mussel farmers who hold aquaculture leases at Grassy Point and Clifton Springs AFR's operate from Portarlington. The proposed development also has the potential to attract tourism and recreational activity to regional Victoria.

Building on these previous assessments and concept design phases, the objectives of the current project were to identify engineering constraints and environmental values associated with harbour redevelopment works, as well as the likely environmental approvals that may be required. The Baseline Assessment studies were based on existing information and data as well as being augmented by a series of field investigations. Key government agencies provided input to the Project through their involvement in the Steering Committee and review of the technical investigations.

The outcomes of the detailed review and site-specific environmental data, was applied in a risk assessment framework to categorise any potential impacts associated with redevelopment works. Key management actions have been developed, with the aim of reducing these risks and addressing engineering constraints through the Masterplanning and design phases of the Project.

1.1 Project Rationale

The current rates of growth in recreational boating across Victoria, and the forecast increase in marine-based aquaculture activity in the area are the key drivers behind the proposed development. The development of a safe harbour at Portarlington will increase the appeal of Port Phillip as a cruising destination and address the lack of infrastructure and berths for recreational and commercial vessels. The outcome will be the establishment of a modern harbour that caters for a diverse range of recreational and commercial uses that supports the aquaculture, tourism and recreational economies as well as providing important community infrastructure in the region.

The Market and Demand Analysis (Stratcorp 2007) identifies that:

- In terms of marine-based aquaculture, the industry is growing at approximately 10% per year, which is expected to increase significantly with the release of new aquaculture reserves. In 2004/2005 the Victorian mussel aquaculture industry, including Port Phillip Bay and Western Port, produced over 1,200 tonnes of mussels worth more than $2.8M and was the largest mussel production industry in Australia.
- Over the next few years the Department of Primary Industries plans to release a further 467ha of water in Port Phillip Bay which will represent an increase of approximately 300% in aquaculture production in Port Phillip Bay.
- The safe harbour recreational boating demand is for up to 50 wet berths with services such as refuelling and sewerage pump out and to allow future provision for ferry berthing, (minimum 35 commercial berths should be developed to cater for existing and future lease holders).
- There is potential for a re-developed harbour and foreshore precinct to generate tourism products and services such as galleries and cafés, with links to the existing town commercial centre, and to integrate with regional tourism initiatives such as the Seafood and Wine Trail.

The primary objectives for the proposed Bellarine Safe Harbour at Portarlington are:

- To provide necessary land based infrastructure associated with the future increase in aquaculture activity in the area;
- To provide facilities for other commercial operators such as fishing charters, tour operators and passenger ferries; and
- To address the current lack of infrastructure and berths for recreational and commercial vessels.

The management of the baseline assessment studies was conducted in parallel with the additional market analysis and industry consultation undertaken by Stratcorp (2007).

1.2 Project Study Area

Portarlington is located approximately 30km east of Geelong on the northern side of the Bellarine Peninsula overlooking the Geelong Arm of Port Phillip Bay. The town serves as a tourist destination for day trips and longer term visitors, and in particular is a location for retirees and a centre for commercial fishing.

The study area itself comprises the Portarlington Pier and Harbour precinct, and the surrounding inshore waters and adjacent land which contains a carpark and toilet block. The southern edge of the study area is defined by a rising basalt slope ranging from 15^{o} to 35^{o}, while vegetation cover across the site is predominately grass and low shrubs, with occasional trees and patches of exposed soil.

The marine environment is typified by sandy substrates and a shallow rocky reef with communities typical of the shallow waters of the Geelong Arm of Port Phillip Bay, with isolated patches of remnant seagrass. The project study area is shown in Figure 1.

Figure 1: Study Area

1.3 Study Parameters

Building on the 2002 Concept Plan (Figure 2), the redevelopment of the Portarlington Pier involves a number of components to create an almost fully enclosed harbour, designed to protect the vessels from adverse ocean conditions, particularly from the north-west.

The principles on which the redevelopment works should be designed are:

- Separate commercial and recreational areas, with the overall facility to have capacity for expansion.
- Scale of development should be sympathetic and consider existing township of Portarlington.
- Avoid or minimise the environmental impacts of the proposed development
- Upgrade the existing facilities to overcome engineering and access constraints.

In particular, the works associated with the existing facilities would involve:

- Upgrade of the existing jetty structure, and extending the existing breakwater at the end of the pier at both ends
- Installation of a sheet pile wall adjacent to the western side of the jetty to protect the harbour from waves coming from the west.
- Extension of the shorter internal finger jetty to provide 53 berths for 10m vessels.
- Addition of floating and fixed landings to the inside of the breakwater.

New land side infrastructure that would be required as part of the development includes the following:

- Additional carparking and access routes to new berths.
- Installation of power supply, as well as facilities for refuelling, bilge, sullage and sewerage pump-out.
- A sand trap breakwater to be constructed off the new breakwater to prevent sand movement into the mouth of the safe harbour.

- Onshore storage and processing facilities for commercial users, as well as trailer parking and amenities such as toilets, showers and lighting.

Figure 2: Concept plan for the proposed development

1.4 Project methodology

The baseline assessment for the proposed Safe Harbour involved a number of technical investigations and qualitative risk assessment process as detailed in the following sections of this report:

- *Section 2: Legislation and Policy* provides an overview of the legislative and policy requirements which are relevant to the proposed development
- *Section 3: Baseline Assessment* provides a summary of a range of environmental considerations within the study area:
  - Geology and Geomorphology.
  - Coastal processes.
  - Marine ecology.
  - Terrestrial ecology
  - Indigenous cultural heritage.
  - European cultural heritage.
  - Landscape.
- *Section 4: Condition Assessment* presents the results of the engineering investigation into the current condition and load capacity of the exiting pier infrastructure, based on detailed testing procedures for the concrete and timber piles.
- *Section 5*: *Impact Assessment* provides an overview of the risk assessment methodology adopted for the project, identifies the potential environmental and social impacts of the proposed development, and proposed measures for reducing environmental impacts through the Master planning and design phases of the project.
- *Sections 6 and 7*: *Approvals Pathway and Masterplanning Process* outlines the likely approvals pathway, key agency requirements and issues to be considered in the Master planning Phase of the Bellarine Safe Harbour Project.

2.0 Legislation and Policy Framework

2.1 Commonwealth legislation

2.1.1 *Environment Protection and Biodiversity Conservation Act* 1999

The *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) provides a high level of protection for seven matters of national environmental significance. Two of these matters, listed below, are relevant for the proposed development, and were investigated to determine their presence in the project area:

- Threatened species and ecological communities
- Migratory species

Threatened species listed under the EPBC Act are listed as being 'vulnerable', 'endangered', 'critically endangered' or 'extinct in the wild'. These are afforded an increasing level of protection under the Act. Migratory species are listed in recognition of their inclusion under international treaties such as the China Australia Migratory Bird Agreement and the Japan Australia Migratory Bird Agreement.

2.2 State legislation and policy

2.2.1 *Environment Effects Act 1978*

The *Environment Effects Act 1978* applies to works 'reasonably considered to have or be capable of having a significant effect on the environment'. The new Ministerial Guidelines for an EES have been reviewed to determine whether an EES is likely to be required for the harbour redevelopment works.

2.2.2 *Flora and Fauna Guarantee Act* 1988

The *Flora and Fauna Guarantee Act 1988* (FFG Act) highlights Victoria's commitment to biodiversity conservation and the sustainable use of native flora and fauna. The Act provides a level of protection for all threatened flora and fauna species and ecological communities, which under the Act, are considered to be of State significance. The Act also identifies a number of potentially threatening processes and prevents any action which may lead to an increase in their likelihood to effect threatened species or communities.

2.2.3 Heritage Act 1995

The main objective of the *Heritage Act* 1995 is to provide for the protection and conservation of places and objects of cultural significance, and registering such objects and places. The Victorian Heritage Register has been established by the Victorian Heritage Council, which lists all known heritage sites in Victoria.

2.2.4 Aboriginal Heritage Act 2006

The *Aboriginal Heritage Act* 2006 aims to protect Aboriginal cultural heritage sites and objects, recognise Aboriginal people as the guardians of Aboriginal cultural heritage and to promote public awareness and appropriate management of Aboriginal cultural heritage in Victoria. The new Act replaces the previous State and Federal laws governing the protection and management of Aboriginal cultural heritage across Victoria.

2.2.5 *Planning and Environment Act* 1987

The *Planning and Environment Act* 1987 (P&E Act) governs land use across Victoria through the application of municipal planning schemes and the designation of zones and overlays which regulate the use and activities allowed within each zone. The purpose of this Act is to establish a framework for

planning the use, development and protection of land in Victoria in the present and long-term interests of all Victorians

The City of Greater Geelong Planning Scheme applies within the project area, which is zoned Public Park and Recreation Zone (PPRZ). The PPRZ provides for the implementation of objectives, including recognising the area for public recreation and open space, protecting and conserving areas of significance and providing for commercial uses where appropriate.

The uses allowed under the provisions of the PPRZ are closely tied to activities conducted by or on behalf of the public land manager and uses associated with a public land use. Thorough consideration needs to be given to the scope of proposed uses and whether the existing zoning is the most appropriate in the context of a safe harbour that may support activities not directly associated with a public land use or conducted by or on behalf of a public land manager.

For example, the safe harbour will provide a boating facility such as a marina, which will provide for recreation and pleasure boats, including jetties and pontoons, these uses are currently permitted under the existing PPRZ. However, the use of the harbour as a ferry terminal for the purpose of transporting people other than a commercial operation that is for pleasure and recreation is prohibited under the existing zone.

Similarly, retail activities that are not conducted by or on behalf of the public land manager or associated with a public use would also be prohibited. However, there may be some retail premises, for example, a tackle and bait shop that could be linked to an associated public use, like recreational fishing and therefore would be allowed subject to permit requirements.

It is highly likely that in order to facilitate the use and redevelopment of a harbour which extends beyond the operation of a pleasure and recreation marina, there would be a need to revisit the type of zoning that is applied. This will need to be further assessed as the types of uses associated with the harbour redevelopment are further defined.

There are no overlays which apply to the study area.

2.2.6 *Coastal Management Act* 1995

The *Coastal Management Act* 1995 established the Victorian Coastal Council and three Regional Coastal Boards to provide coordinated strategic planning and management for Victoria's coastline, and to provide for the preparation and implementation of management plans for coastal Crown land. The Act sets out the structure and functions of the Victorian Coastal Council and the Coastal Boards.

A major requirement of the Coastal Management Act is the preparation and implementation through the State Planning Policy Framework of the Victorian Coastal Strategy every five years, and the subsidiary Coastal Actions Plans. The strategy is discussed below in Section 2.2.9.
The study area is within an area of Crown land and as such, consent from the Minister is required under this Act prior to any works taking place. Any proposed works within coastal Crown land is required to be consistent with the Victorian Coastal Strategy.

2.2.7 Native Vegetation Management – A Framework for Action

In 2002, the Victorian Department of Natural Resources and Environment (now known as the Department of Sustainability and Environment) released *Victoria's Native Vegetation Management – A Framework for Action*. The document establishes a framework for the protection, enhancement and revegetation of native vegetation across the State. Significantly, the document explains a reporting framework that enables accounting for native vegetation, allowing the State government to progress towards a Net Gain result (i.e. achieve an overall net gain in the amount and quality of native vegetation in Victoria).

A Framework for Action sets out the following vision for native vegetation in the state:

> *Management of native vegetation provides a sustainable landscape and protects the long-term productive capacity and environmental values of our land and water resources. The unique beauty and diversity of Victoria's landscapes and the importance of the underlying complex ecosystems are recognised internationally.*

The primary goal for native vegetation management in Victoria (as set out in the document) is to achieve:

> *A reversal, across the entire landscape, of the long-term decline in the extent and quality of native vegetation, leading to a Net Gain.*

Ecological Vegetation Classes (EVCs) are the primary level of classification of vegetation communities within Victoria. An EVC contains one or more plant (floristic) community and represents a grouping of vegetation communities with broadly similar ecological attributes. Conservation significance ratings are also assigned to each EVC to ensure the appropriate level of protection. The assessment has considered development options that seek to avoid potential impacts on native vegetation and avoid clearing.

2.2.8 Corangamite Native Vegetation Plan 2003-2008

The Corangamite Native Vegetation Plan has been prepared by the Corangamite Catchment Management Authority and is consistent with the *Framework for Action* discussed above. The Plan develops a strategic and co-ordinated approach to protecting, enhancing and restoring native vegetation throughout the region. While the Plan does not present any actions specific to Portarlington, the goals of the Plan should be considered as part of the proposal. The goals are as follows:

- **Protect** – To maintain the extent of all native vegetation types to at least 2002 levels.
- **Enhance** – To enhance the quality of existing native vegetation by managing 90% of native vegetation cover on both public and private land to Best Management Practices by 2010.
- **Restore** – To strategically increase overall cover of each Ecological Vegetation Class (EVC) to at least 10% of pre- 1750 levels by 2020.

2.2.9 Victorian Coastal Strategy

As discussed above, the *Victorian Coastal Strategy 2002* is required under the *Coastal Management Act* 1995 to provide for long-term planning and directions for management of the Victorian coast. It is prepared and reviewed every five years by the Victorian Coastal Council. Application of the Strategy is a requirement within the State Planning Policy Framework for all coastal municipalities. The objectives of the Strategy as listed in the Act are to:

- Ensure protection of significant environmental features;
- Provide clear direction for the future use of the coast, including the marine environment;
- Identify suitable development areas and opportunities on the coast; and
- Ensure the sustainable use of natural resources.

The Strategy outlines a framework for ecologically sustainable development which integrates the environmental, social and economic importance of the coast to underpin decision making to protect the long term environmental values and broad public interest. The Strategy also requires that decisions are made on an integrated basis, with due consideration of the potential consequences and other interests. It applies across six main themes, identifying values and challenges, objectives and actions for each theme:

- Marine & estuarine environments

- Natural onshore environment
- People on the coast
- Access
- Built environment & coastal infrastructure
- Coastal dependent industry

Within the Strategy, decision makers are assisted by a hierarchy of principles for coastal planning and management. The principles, which align with the overall objective and are listed below in order of priority, guide the decision makers to triple bottom line outcomes:

1) To provide for the protection of significant environmental features;
2) To ensure the sustainable use of natural coastal resources;
3) To undertake integrated planning and provide direction for the future; and
4) When the above principles have been met, facilitate suitable development on the coast within existing modified and resilient environments where the demand for services is evident and requires management.

2.2.10 Corio Bay Coastal Action Plan 2005

Corio Bay is unique to Victoria with its diverse range of environmental features and economic and social opportunities. Its deep water port access has established Geelong as the second largest city in Victoria and an important regional port facility. The Corio Bay Coastal Action Plan (CBCAP) enables the broad principles of the Victorian Coastal Strategy to be further developed and applied within a local context.

The CBCAP outlines the following vision for Portarlington:

> *Portarlington is a vibrant seaside township focused on the harbour, which is a major regional boating destination providing for recreational and commercial uses. Development is contained within the township's boundaries and complements the coastal environs. The town park is a popular place for active and passive recreation while the foreshore reserve east of Steels Rock provides for passive pursuits and nature conservation.*

The objectives of the CBCAP for the Portarlington precinct in relation to the proposed development are:

- To enhance foreshore areas, recognising the Portarlington Pier area as a Safe Boating Harbour.
- To provide for recreational and commercial boating opportunities.
- To promote aquaculture development.

The Key Directions and Actions of the CBCAP relevant to a Safe Harbour on the Bellarine Peninsula are:

- Promote and implement the establishment of the Portarlington Safe Harbour as directed by Parks Victoria.
- Provide opportunities for commercial aquaculture activities and ensure that the management of these activities is responsive to the environment.
- Built form along the foreshore reserve should be minimised, (particularly outside the town centre) with buildings where necessary kept to small, discreet structures fitting within the existing landscape or screened with new landscaping.

Specific to Portarlington, the key actions of the CAP are:

- Implement the recommendations the Geelong Development Board: Seafood Industry Strategy in relation to improvements to capacity and facilities at Portarlington for commercial fishing subject to environmental considerations.
- Complete the investigation of the development of a safe harbour at Portarlington and pursue implementation of the investigation's recommendations.
- Implement the recommendations of the Geelong Development Board: Seafood Industry Strategy in relation to establishing appropriate locations for land based servicing or processing of seafood (eg. improving services to the Portarlington industrial estate.)
- As improvements are made to adjacent boating facilities, close the single ramp access point at Grassy Point and direct boat traffic to improved facilities at Indented Head and Pt Richards. Should a new facility be constructed within the town harbour consideration should also be given to the removal of Pt Richards and Steeles Rock ramps.

2.2.11 Boating Coastal Action Plan – Central Coastal Board

Victoria is one of the largest recreational boating markets in Australia, and at present, the rate of increase in boat registrations is higher than the rate of population growth (Stratcorp 2007). The need for more berthing facilities is evidenced by the planning permit applications for berthing facilities at strategic locations around the bay, and the pressure being applied on existing marinas to keep up with demand for berths.

The Boating Coastal Action Plan (CAP) outlines strategic directives for the future planning, management and funding of the network of recreational boating facilities within the central coastal region of Victoria. The CAP provides specific recommendations in relation to the Bellarine Peninsula (Area 2), recognizing that potential growth in and around Geelong may result in significant new demand along this section of coastline.

The CAP recommends that future development along this coastline is focused on the current proposal to upgrade facilities at Portarlington to cater for this projected increase in visiting boaters. The following local policies are of specific relevance to this project:

- **A2.1** In this Boating Area, the strategic focus for investment to significantly upgrade facilities will be at Portarlington. This will be encouraged to provide a mix of activities, opportunities and facilities for visiting and local boaters.
- **A2.2** Any new boat moorings will be concentrated within the vicinity of the existing harbours – Portarlington in the first instance.

2.2.12 Bellarine Peninsula Strategic Plan

The *Bellarine Peninsula Strategic Plan 2006-2016*, prepared by the City of Greater Geelong is a comprehensive vision for future development on the Bellarine Peninsula. The Plan identifies designated urban growth areas, proposes improved management practices for protected non-urban breaks, and articulates community visions and actions for achieving these to 2016.

The Plan is designed to build on the directions outlined in a number of state and local policies for townships around the Peninsula, and in particular will inform future planning policies within the City of Greater Geelong, and the development of Structure Plans for Ocean Grove, Portarlington, Intended Head, St Leonards, Drysdale, Clifton Springs and Barwon Heads.

The key objectives for Portarlington identified in the Plan and which are relevant to the proposed development include:

- Economic and business development - Sustaining a viable, growing economy and population growth across all ages

- Environmental management - Sustaining, respecting and continually enhancing the 'green' infrastructure and coastal amenities
- Planning - Sympathetic development embracing heritage values whilst allowing for urban renewal
- Tourism - develop a point of difference to attract tourism all year round

Within the actions identified for each of these objectives, the proposed safe harbour is identified as a hub for tourism in the local area.

2.2.13 Coastal Spaces Landscape Assessment Study 2006

The *Coastal Spaces Landscape Assessment Study 2006* provides an assessment of the landscape characteristics along the Victorian coastline, and identifies areas of high visual significance. The Study assesses the entire coastline, except in Melbourne, and based on the criteria identified below, classifies areas of coastline as being of local, regional or state significance. The criteria upon which the assessments are based are:

- Landform features
- Views, viewpoints and public accessibility
- Contrast (ie land/sea boundary)
- Natural or undeveloped character.

The Study identifies the stretch of coastline around Portarlington as being of local landscape significance, and recommends a series of management guidelines at best practice level to enable a 'whole-of-coast' approach for the management and protection of landscape character.

2.2.14 Bellarine Bayside Foreshore Committee Of Management – Landscape Management Plan, 1998

As the public managers of Portarlington foreshore areas, the Bellarine Bayside Foreshore Committee of Management (BBFCoM) identifies key actions within the Landscape Management Plan to meet its adopted principles for managing the foreshore including the need to sustain, protect, direct and develop. Although the Landscape Plan is to be reviewed there is strong direction with regards to the development objectives for the coastal area of the Portarlington Township and Beach Zone, which specifically recognises the Portarlington Pier and Safe Harbour as being a key asset for this precinct. The uses that are envisioned for this area include:

- Beach and water based uses – swimming, fishing;
- Commercial boating;
- Recreational boating, moorings and safe harbour;
- Recreation generally including picnicking;
- Children's playground;
- Events, festivals and entertainment;
- Bowling Club facilities;
- Car parking;
- Bellarine Bayside Foreshore Recreation Trail; and
- Foreshore Promenade.

2.2.15 Portarlington/Indented Head Structure Plan, December 2006

The *Portarlington/Indented Head Structure Plan*, prepared by the City of Greater Geelong, identifies key strategic planning issues affecting the township and provides a strategic framework which guides preferred future use and development through the application of local planning policies,

zones and overlays. The Structure Plan is a tool through which future investment, development and provision of services and infrastructure will be directed.

Relevant strategic directions emerging from the Structure Plan relevant to the proposed Safe Harbour development include:

- Limiting urban development to defined settlement boundaries to protect the small coastal village character of Portarlington and to ensure that residential expansion does not impact on sensitive environmental areas.
- Providing adequate levels of open space by supporting the actions of public land managers to undertake improvements to existing open space, leisure and recreational areas including the provision of pedestrian/bicycle linkages.
- Protecting the landscape character of the township and sensitive environmental values of the surrounding environment, through protecting Aboriginal cultural heritage values, retaining and enhancing existing vegetation and planting of indigenous vegetation on private land, reserves and roadsides, ensuring that development complements adjacent areas of significant landscape, environmental and recreational values, protecting and enhancing key vistas and view lines to the coast and environmental features.
- Creating a vibrant Town Centre of consolidated commercial activity which avoids the fragmentation of land uses through encouraging contemporary and a mix of commercial, community and entertainment uses, integrating the town centre with the Portarlington pier and foreshore area, implementing streetscape improvement works and supporting aquaculture activities of Port Phillip Bay.

Specifically the Structure Plan recognises that feasibility studies have been undertaken to date on the proposed Portarlington Pier and Harbour redevelopment and supports further investigation of the Safe Harbour proposal.

As articulated by the community and defined in the Structure Plan, improving the relationship between the pier and the foreshore area is an essential component to meet the objective of Portarlington being the “jewel of the Bellarine Peninsula”.

3.0 Baseline Assessment

3.1 Geology and Geomorphology

Summary

The geology in the project area comprises three general classes: Holocene Beach sand, Tertiary aged Moorabool Viaduct Sands (sands and clays) and Tertiary Older Volcanics Group (basalts). The site is generally flat backed by a basalt slope to the rear of the study area which shows some evidence of erosion. Some areas of the study area may have been backfilled for previous reclamation projects.

The section of coast stretching from Portarlington to Point Henry is slowly eroding. Erosion and scouring was observed at a number of locations within the study area with the major scouring occurring adjacent to the stormwater pipe outfall. The degraded coastal cliff, basalt and tuff and overlying sediments are classified as an area of regional geological significance. However, the relatively stable geological conditions at the site mean that there are unlikely to be any effects on the local geological and geomorphological environment. A landslide risk assessment should be undertaken to determine whether observed localised slumping of some slopes is indicative of further potential impacts, particularly if further development is proposed for these cliff sections.

The dredging which will be required to maintain the navigability into the harbour, may be impeded by the presence of basalt within the required depth. This may affect the dredgeability for the initial dredge campaign, and alternate dredge methods may need to be considered. A preliminary geotechnical site investigation is required to determine the depth and dredgeability of the basalt.

The primary aim of the geology and geomorphology study is to identify any constraints, including potential geohazards which may affect the proposed harbour re-development. The information presented in the following sections is sourced from Maunsell (2007a). The methodology adopted for the study included the following key steps:

- Desktop review of geological survey information, sites of geological and geomorphological significance, aerial photographs other relevant published literature.
- Site appraisal to gain a better understanding of the local conditions and potential geohazards.
- Preparation of a report on the geological and geomorphological conditions relevant to the proposed development.
- Preparation of a cost estimate and geotechnical investigations plan for further testing of the geological conditions of the site.

3.1.1 Regional Geomorphology

The regional geomorphology and landscape evolution has been described by Robinson *et al* (2003) in detail and, in general, the '*region has formed through landscape-building episodes of the past 500 million years in a variety of environments from the deep sea to explosive volcanoes*'.

The main events that shaped the geomorphology of the study area are the Pliocene volcanism and today's processes, in particular, the climate changes over the last 150 thousand years which has caused relatively dramatic changes in sea level. Present day geological formations within the study area include slope colluvium, beach dunes and anthropogenic fill.

The study area is within the Corangamite Catchment Management Area (CCMA). Robinson *et al* (2003) have prepared a Geomorphological framework for Corangamite and the CCMA geomorphic unit within the study area provided in Table 3-1.. A copy of the description provided by Robinson *et al*

(2003) for each soil-landfall unit is provided in Appendix A of the Geological and Geomorphological Baseline Assessment.

Table 3-1: Soil-landfall unit

Soil-landfall unit	Geology	Comments	Main CCMA Geomorphic Unit
77	Neogene fluvial-marine sediments, Recent clay, sand and gravel and coastal sand dunes	Susceptible to sheet and rill erosion, and wind erosion	Dissected low hills plateaux of the main Southern Uplands
80	Paleogene tholeiite and pyroclastics, Neogene fluvio-marine sand	Susceptibility to sheet erosion on slopes and minor waterlogging in depressions.	
82	Quaternary coastal sand dunes and minor alluvium, Neogene fluvio-marine sand	Susceptible to sheet and wind erosion	

In simple terms, the geomorphology of the study area consists of a flat sandy beach that backs onto low cliffs.

3.1.2 Regional Geology

Based on the Geological Survey of Victoria, 1:63,360 'Portarlington' sheet, the regional geology comprises of (in order of youngest to oldest geological units):

- Holocene Beach sand and raised beach deposits.
- Tertiary aged Moorabool Viaduct Sand; sand, clay, and sandy clay.
- Tertiary Older Volcanics Group; basalt, tuff and agglomerates.

A snapshot of the regional geology has been generated from the Department of Primary Industries (DPI) webpage site 'GeoVic' and is shown below in Figure 3.

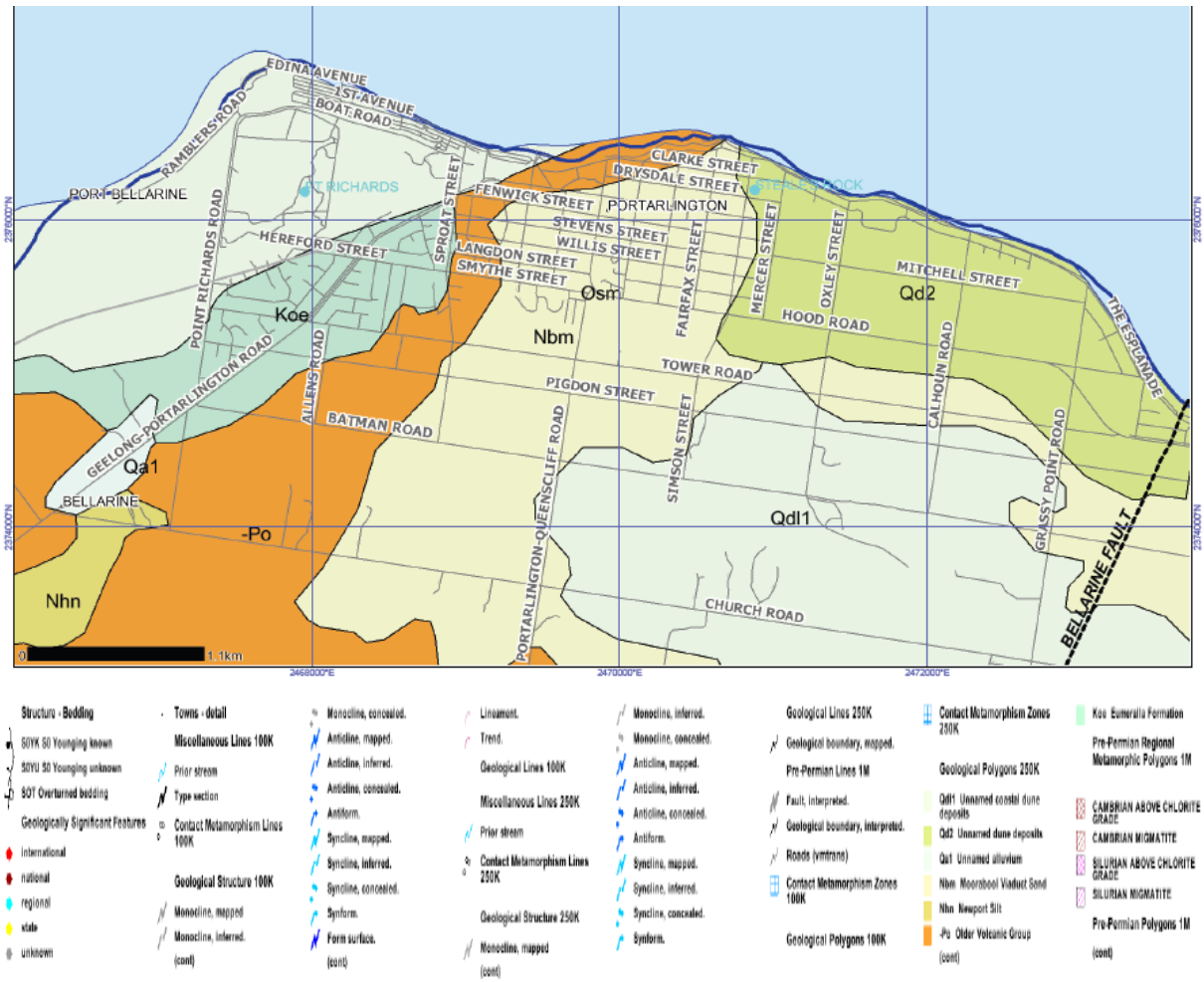

Figure 3: Regional geological formations

(Note: Historically, the Cenozoic has been divided up into the Quaternary and Tertiary sub-eras, as well as the Neogene and Paleogene periods. However, the International Commission on Stratigraphy has recently decided to stop endorsing the terms Quaternary and Tertiary as part of the formal nomenclature. This may cause some confusion in the literature, as Tertiary and Quaternary are still commonly used).

3.1.3 Sites of Geological and Geomorphologic Significance

The DPI provides the following definition for sites of geological and geomorphological significance:

"Sites of geological and geomorphological significance have been selected on the basis either that they represent a specific characteristic of the region, or that they include an outstanding, rare, or possibly unique geological or geomorphological feature. As such, these sites are of interest to people engaged in research and teaching in earth sciences and to others who wish to understand the composition, origin and dynamics of the physical landscape in this area".

Site of geological and geomorphological significance in the vicinity of the study area are listed in Table 3-2.

Table 3-2: Sites of geological and geomorphological significance

Site No.[1]	Description	Significance Rating[2]
18	Site 18 Portarlington East	Regional
19	Site 19 Steeles Rock, Portarlington	State
20	Site 20 Portarlington Pier – Geological Section and Platform	Regional
21	Site 21 Point Richards – Cuspate Foreland	Regional
22	Site 22 Point Richards South – Lobate Foreland	Regional

1. Based on Rosengren 1988
2. As provided by DPI

Sites 18, 19, 21 and 22 are outside of the study area (actual location of site 18 is not known at the time of preparing this report but appears to be well outside the study area). Site 20 Portarlington Pier is within the study area but outside of Parks Victoria Committee of Management area. This site is described on the DPI website as follows:

> *A degraded coastal cliff, partly covered by slump deposits, exposes Older Volcanics basalt and tuff and overlying sediments. The volcanics are best exposed nearer to the Portarlington Jetty where they form a wide, smooth gently sloping shore platform with variable gravel cover. In the platform, the basalts have a regular joint system which in places is infilled with secondary calcite plates. The cliff sections are higher than at Steeles Rock (Site 19) but slumping has obscured most of the significant exposures and makes access and study of the sections difficult* (DPI 2007)

3.1.4 Surface and Sub-Surface Conditions

The site is located on flat sandy beach at the Portarlington pier. The topography can be divided into two distinct domains: the relatively flat beach and bar sand, and the variably sloping basalt at the rear of the site and along the coast to the east of the study area. The relatively flat beach sand slopes gently to the north at about 3°. This area is grassed with some mature trees.

The underlying geology of the study area consists of beach sand overlying Older Volcanics. The Older Volcanics can be observed in the cliffs at the rear of the study area, as well as along the coast to the east of the Parks Victoria Committee of Management area. Additionally, it is expected that some sections of the study area contain fill materials, in particular in built up areas and car parks.

The variably sloping basalt facing the north has a slope angle ranging from 15° to 35°, with the steeper parts typically 30° to 35°. The basalt slopes, as shown in Figure 4 are typically covered in grass and some small shrubs, with the occasional soil exposure in eroded areas. No seepage was observed along these slopes.

Figure 4: Basalt slope at rear of study area

Erosion and scouring was observed at a number of locations with the major scouring occurring adjacent to the stormwater outfall. Significant scour was observed on the slopes to the east of the study area, visible in Figure 5. It is considered that the paved road along the crest of the basalt slopes diverts a significant portion of the surface water runoff. It appears that the channelised movement of people up and down the basalt slope has contributed to poor vegetation growth and encouraged surface erosion.

Figure 5 Significant scour near stormwater outfall.

3.2 Coastal Processes

Summary

The transport of sediment along the coast of Port Phillip Bay is largely driven by the oblique approach of waves on the coast. The coastal processes around Portarlington result in a net movement of sand to the west along the coastline in the order of 5-10,000m^3 per year. Erosion of the coastline directly east of the harbour appears to have increased post 1984, and overall has reduced the natural renourishment of the beach to the west of the pier. Soon after the construction of the breakwater, approximately 350,000m^3 of sand was used to renourish 1300m of beach in the Portarlington area.

The existing harbour provides a major disruption to the alongshore transport of sand in the area. This is due not only to the presence of the offshore breakwater, but also to the groyne along the shoreward end of the jetty. In combination, these provide an almost complete barrier to the alongshore transport of sand in the area.

This physical barrier to sand transport has also resulted in the additional accumulation of sand behind the harbour. The harbour would require dredging to accommodate the increased number of berths and vessels provided for by redevelopment works. Preliminary dredge volumes are presented in Water Technology's (2007) Coastal Processes investigation.

Much of the material to be dredged from the harbour would be sand and silty sand associated with the build up of the cuspate spit. However, further sediment testing and geotechnical investigation of the extent of the basalt contour is required prior to confirming the type and extent of dredging required.

The 2002 Concept Plan provided the basis for the risk assessment of the proposed redevelopment works. This risk assessment was applied to the key functional design elements of the 2002 Concept Plan being the breakwater, groyne and and wave screen.

The key objectives of Water Technology's engineering investigation were to define the coastal processes and wave climate at Portarlington Harbour to inform the preparation of options for the safe harbour redevelopment works.

The study was commissioned with the following scope of works:

- A review of previous studies relating to coastal processes in the area;
- Examination of historical aerial photos of the immediate coastline to identify coastal evolution and dynamics;
- Review of coastal processes occurring in the area based on previous work and additional analysis undertaken as part of this study;
- Assessment of the likely impact of the proposed harbour development, and of possible mitigation options
- Assessment of the implications of climate change and sea level rise

3.2.1 Review of Previous Studies

Geelong Coastal Processes

The City of Greater Geelong commissioned Lawson & Treloar to undertake a coastal processes study along the northern edge of the Bellarine Peninsula between Edwards Point and Limeburners Point. The aim of the study was to define the coastal processes shaping the coastal environment to provide a basis for management of the coastal zone in the future. The scope of the study included analysis of historical aerial photography to identify areas of significant coastline evolution, review of historical literature describing the events of coastal and marine significance such as the construction of ports, groynes, channel dredging and coastal erosion events, beach profile survey and development of wave climates and subsequent modelling to estimate longshore sediment transport rates.

With respect to the Portarlington area, the following major coastal processes were identified:

- Point Richards is a meeting place of sand drift, with sand travelling from Portarlington to Point Richards in a westward direction and sand travelling from Clifton Springs to Point Richards in an eastward direction.
- The offshore sand bars at Point Richards are considered to have generally increased since the 1960's, however they are subject to periodic fluctuations in size.
- The net longshore transport at Portarlington is westward. This was based on the observations of the build up of sand on the eastern side of the pier and accumulation of sand on the eastern side of the Pt Richards boat ramp.
- A large deposit of sand is locked up behind the breakwater that would otherwise move westward and renourish the beach to the west.

Port of Geelong Channel Improvement Program EES

The Port of Geelong Channel Improvement Program EES was completed in 1993, and incorporated a report on the hydrodynamic and coastal processes which presented the results of wave modelling littoral transport modelling and aerial photography comparisons for Portarlington and the coastline westward to Point Richards.

The results showed a net westerly sand transport rate of about 600 m^3/year along the coastline between Portarlington and Point Richards. Comparisons of aerial photography from 1947 and 1990 showed a gradual build up of sand against the east side of the jetty at Portarlington, a tendency for erosion of the beach in front of the caravan park to the west, and a build up of sand to the west of Point Richards.

Beaches at Risk

The Department of Natural Resources and Environment (DNRE) commissioned Vantree Pty Ltd to undertake a review of the beaches which had undergone renourishment in the past 20 to 25 years. Of relevance to Portarlington, the report found that:

- 350,000m^3 of sand was delivered over approximately 1300m of beach in 1986
- Wave action west of the harbour is transporting sand alongshore towards Point Richards. The coast west of the harbour is prone to erosion due to the accretion of sand in the lee of the harbour breakwater that would have naturally nourished the beaches further west along Portarlington.
- The option to bypass sand past the harbour was recognised as a means to nourish the beaches to the west of the harbour and improve their condition.

Port Bellarine Coastal Processes

Port Bellarine was a proposed canal estate and marina development on the west coast of Point Richards, between Spray Farm Road and Point Richards Road. Coastal process investigations for the development proposal included a review of aerial photography from the area and a wave climate analysis. As discussed above, the wave analysis showed waves coming predominantly from the west, north and southwest during summer, and from the west-northwest and north during winter. The west and southwest waves would be expected to generate an easterly transport.

The coastline visible in aerial photography from 1952, 1962, 1969, 1974, 1984, 1990 and 2000 showed that there had been a build up of sand along the central section of this coastline between 1952 and 1974. This build up was to the east, and is consistent with a net eastward longshore transport of sand in this area. This is discussed further in Section 3.2.6 below.

There has been little change to the coastline since 1974. This was thought to have been due to the on-going removal of sand from Point Richards to maintain access to the boat ramp. At Point Richards

there was a build up of sand to the west, from 1952 to 1974. Apart from some transient build-up in 1984, there has been little net change at Point Richards since 1974.

3.2.2 Tides and Circulation

Within Bass Strait, there are two tides per day with one tide typically having a larger range than the other. Within Port Phillip Bay, the mean spring tidal range is approximately 0.8m. Tidal currents are generally low throughout the bay.

The hydraulic model of Port Phillip Bay was simulated using typical summer and winter wind conditions and spring/neap tidal cycles. The resulting circulation patterns at Portarlington produced by the model have then been analysed. The current information has been extracted at an approximate depth of 5.5 metres.

The results of the hydraulic model indicate that circulation at Portarlington is dominated by the influence of tidal currents associated with the flood and ebb of the tide in Corio Bay. Wind driven currents related to seasonal wind patterns are considered to have a relatively minor impact on both the magnitude and direction of the prevailing tidal current driven circulation at Portarlington.

Under typical flood tide conditions at Port Phillip Heads, a generally westerly flow is generated at Portarlington as the tide rounds the Bellarine Peninsula and enters Corio Bay. Typical current speeds at Portarlington during a flood tide range between 0.1 to 0.2 m/s. Under typical ebb tide conditions at Port Phillip Heads, a generally easterly flow is generated at Portarlington as the tide drains from Corio Bay and rounds the Bellarine Peninsula towards the heads. Typical current speeds at Portarlington during an ebb tide range between 0.08 to 0.15 m/s.

3.2.3 Sea Level

Water levels at Williamstown are considered to adequately represent those at Portarlington as there is little spatial tide variation across Port Phillip Bay. The extreme high tide levels recorded at Williamstown represent a combination of high tide and storm surges. Although these levels are unlikely to occur at Portarlington due to the reduced wind fetch, they are considered by Water Technology (2007) as an appropriately conservative estimate of extreme levels at Portarlington. Table 3-3 shows the tidal variations for Williamstown.

Table 3-3: Tide levels for Williamstown

Tidal Elevation	Height (m AHD)
Highest Recorded Tide 30/11/1934 (1874-2004)	1.33
1 Year Design Water Level	0.9 – 1.0
Highest Astronomical Tide (HAT)	0.52
Mean Higher High Water (MHHW)	0.42
Mean Lower High Water (MLHW)	0.12

The highest recorded tide has been adopted as the 100 year design water level.

Predictions have also been made in relation to climate change induced sea level rise. The technical report predicts the sea level increase for a 50 year horizon (2060) from 0.05 to 0.40m. However, it is noted that since the original drafting of this report, the IPCC has revised the estimates of the degree of sea level change that may occur by 2100. Current estimates of sea level rise (for a range of emission scenarios) vary from 0.18m to 0.58m, with a mean of about 0.3m by 2100 (IPCC, 2007).

3.2.4 Wave Climate – Wind & Waves

Historical wind climate data for Portarlington was sourced from Point Wilson. In broad terms, summer tends to be windier than winter, with less occurrence of calm periods (average wind speed <2.5m/s)

and a slightly higher mean wind speed. During winter, winds come predominantly from the western and northern quarters, while in summer, a greater occurrence of winds from the south and easterly quarters are experienced.

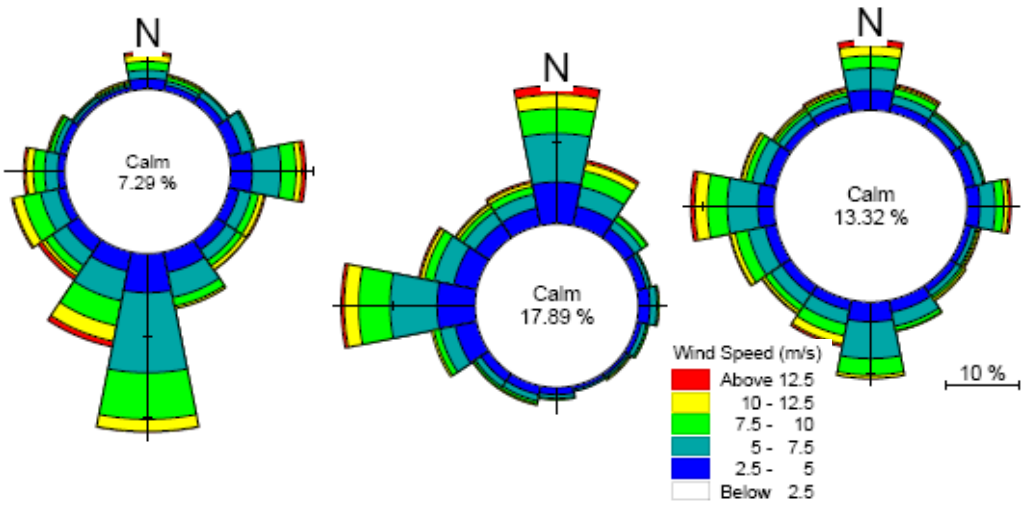

Figure 6: Wind roses for Point Wilson: (l-r) summer, winter, annual (1990 to 1998 data)

This wind data was used in a modelling package (Water Technology, 2007) to determine the wave climate at Portarlington. As the foreshore faces north, and is relatively sheltered from westerly winds, Portarlington is largely protected from waves generated from the dominant southerly summer winds and winter westerly winds. For these reasons the wave climate at Portarlington is considered rather subdued when compared with other locations on western and south facing locations around Port Philip Bay.

The modelled wave climate based on the wind data presented above is shown in Figure 7. The limited westerly fetch results in generally small waves (<0.5m) from the west and north-west with short mean wave periods (T_m) of between 1-3 seconds. Portarlington is exposed to larger waves (>0.5m) generated by north through to north easterly winds. These larger waves generally have mean wave periods of between 2-4 seconds.

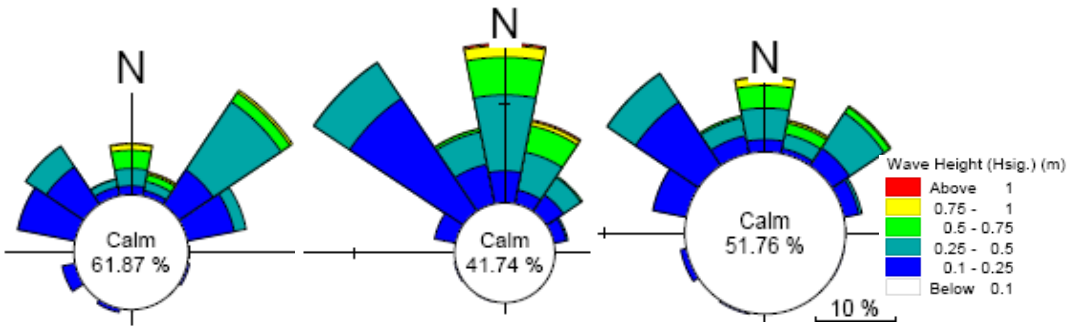

Figure 7: Modelled wave climate for Portarlington: (l-r) summer, winter, annual

Analysis of the wave climate developed for Portarlington reveals that on an annual basis, waves approach Portarlington with an almost equal percentage of easterly and westerly direction components. Waves from the east are generally larger than those arriving from the west.

3.2.5 Sediment Transport

The direction and magnitude of sediment transport is closely related to the seasonal wave climate within Port Phillip Bay. As discussed above, on an annual basis, the larger waves come from east, which would imply a general net westward sediment transport. Although there is potential for west to east sediment transport during periods of northwest waves, there is little opportunity for this to occur in practice. This is because sediment that is transported westward along the coast by the net transport in the area will become trapped within the harbour. This material will then be unavailable to the littoral regime.

Parks Victoria undertake maintenance dredging within the harbour, and have estimated that up to approximately 21,000 m^3 of material is required to be removed every 2 to 4 years. This would imply an average gross transport of between 5-10,000 m^3 a year. This is considered consistent with transport rates observed in other locations within Port Phillip Bay.

Dredged material is reported by Parks Victoria to comprise clean fine sand, and is used for renourishing the beach to the west of Portarlington Harbour. It is reported by the Bellarine Bayside Foreshore Committee of Management that the dredged sand is transported westward over a period of one to two months. While the rapid transport of the dredged sand is considered partly due to the small grain size, it illustrates that the potential transport rate is in excess of the local littoral supply.

3.2.6 Coastline Changes

Copies of historical aerial photographs were obtained from the Victorian Land Information Centre. The coastlines as of 1962, 1984 and 2001 are shown in the technical report (Water Technology, 2007). The key observations highlighted are:

- The coastline in the immediate lee of the breakwater has in general been gradually advancing
- The construction of the wave barrier/groyne along the Portarlington pier post 1984 has noticeably intercepted the longshore transport resulting in additional accumulation of sand behind the harbour
- Erosion of the coastline directly east of the harbour appears to have increased post 1984
- The coastline at Point Richards is dynamic with accretion and erosional features apparent throughout the photographic record.
- The width of the beach between Portarlington Harbour and Point Richards appears to have reduced and there is some evidence to suggest a small but gradual retreat of the coastline has also occurred.

3.2.7 Water Quality

Whilst water quality was not included in the scope of works, a desktop assessment was conducted to determine the current water quality at Portarlington and predict impacts associated with harbour re-development. Background data was sourced from the Port Phillip Bay Environmental Study (Harris *et al*, 1996) which concluded that water quality in the Bay was generally good. This conclusion was based from the analysis of Bay wide water quality monitoring results, including monitoring of a location offshore from Portarlington. Additionally, toxicants measured Bay wide during the study were found to be well below trigger levels which are considered hazardous. Considering the lack of industry and modest levels of development in the area, it is expected that the water quality in the general vicinity of Portarlington will be similar to, or better than, the Bay wide averages (Water Technology, 2007).

3.3 Marine Ecology

Summary

The habitats and ecology within the Portarlington study area are broadly representative of the northern coastline of the Bellarine Peninsula, displaying a range of habitats from sandy substrates to both natural and artificial reefs.

The key outcomes of the marine ecological field assessment undertaken by Marine, Science and Ecology (2007) are as follows:

- No species or communities were listed for protection under the FFG Act or the EPBC Act.
- Abundant algal flora were recorded on the breakwater.
- Seagrasses in the study area are probably a relict community from a previously much larger bed. This small patch is considered unlikely to survive.
- Several introduced species were recorded in the survey. Those on pier pilings include the brown alga *Undaria pinnatifida,* the polychaete *Sabella spallanzanii*, ascidians *Ciona intestinalis* and *Styela clava*. The infaunal bivalve *Corbula gibba* occurred in soft sediment. These introduced species are established and widely spread in Port Phillip.

The key risks identified predominantly relate to dredging activities and on-going operation of a Safe Harbour.

The key objectives of the Marine Ecological Assessment were to:

- Characterise the existing marine environment in the existing harbour area, including marine communities and any past disturbance in the area.
- Map the marine habitats in a study area.
- Discuss the risk and potential impacts to environmental values from the safe harbour development.

MSE (2007) surveyed the intertidal and offshore habitats around the proposed safe harbour site. In general the marine habitats and communities were similar to those along much of the northern coastline of the Bellarine Peninsula.

Due to time limitations, fish and fishing were not examined in the survey. Observations indicated the breakwater is a favoured fishing venue, summer catches being predominantly squid and flathead.

3.3.1 Intertidal Habitats

The intertidal habitats included the sandy beach and rock platform (Figure 5). The Portarlington beach infauna was both relatively populous and patchy in distribution. The two predominant species, isopods (or small crustaceans, *Mesanthura* sp) and bivalves (*Soletellina alba*) are common temperate water species occurring in beaches in Port Phillip Bay. High numbers of these species were recorded probably as a result of the surveys occurring over summer when reproduction and settlement is high.

The rock platform is a flat featureless north facing platform ranging from 20m to 50m width at the eastern end of the study area. Because of exposure to high temperatures and potential for desiccation at low tides, the biota is depauperate as the habitat is unfavourable for many species. Highest densities of biota are present at around the mid-tide mark, comprising primarily of invertebrate species, in particular the gastropod *Bembicim melanostomum*. The diversity of biota at Portarlington is less than that at Altona which has a comparable, but more sheltered, reef structure. None of the species or species groups present is rare or of high conservation value.

Figure 8: Intertidal Rocky Platform

3.3.2 Offshore Habitats

The offshore habitats include:

- Sandy beds (Figure 9);
- Sparse patches of seagrass (Figure 10);
- Offshore rocky reef (Figure 11);
- Pier pilings and the breakwater (Figure 12 and 13).

Figure 9: Sandy beds

The infaunal species in the sandy beds close to the pier comprised of species common in sheltered sandy habitats in Port Phillip Bay. Populations of infaunal species varied substantially across the three sample sites (east, west and underneath the pier) with the highest population being east of the pier, which is due to the more sheltered environment and the organic food shed from the mussel boats. The infauna was dominated by burrowing polychaete worms and several groups of crustaceans and bivalve molluscs. None of the species found are listed under either the FFG Act or the EPBC Act.

Seagrass beds of *Heterozostera nigricaulis* occur close to the beach in sheltered waters up to 2m deep. Although moderately abundant in the Geelong Arm, seagrass beds in the study area now comprise two small patches at a depth of 1m below low tide. The largest of the two is approximately $10m^2$. The plants in the patches were covered with epiphytic algae and the patches were considered too small to sample so no survey of this habitat was undertaken. The patches were small and trampled by swimmers.

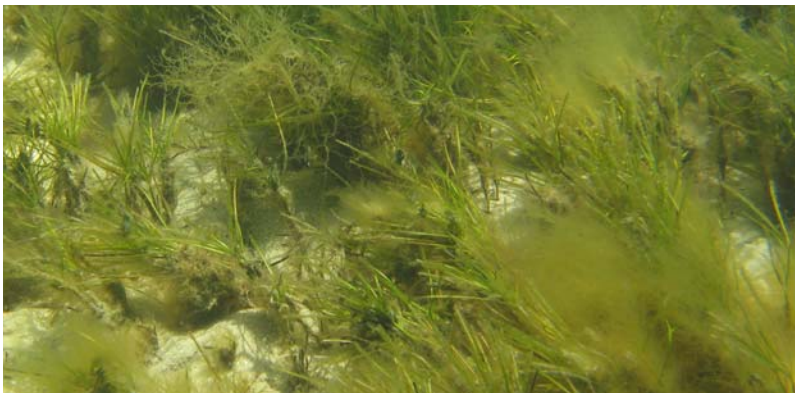

Figure 10: Seagrass Patches

The offshore rocky reef covered 3ha and extended seaward from the rock platform. It is part of the low-lying reef system that occurs in patches along the Bellarine coastline eastwards to Grassy Point. The reef is dominated by algae, sponges, sea stars and sea urchins, all commonly found on shallow reefs along the northern Bellarine coastline. Although the biota was similar to that of a reef 1km east of the area, the species were less diverse and abundant.

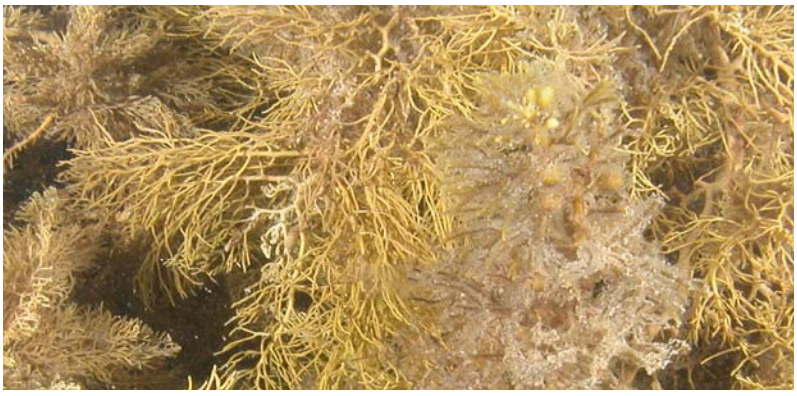

Figure 11: Offshore Rocky Reef

Five pier pilings were surveyed for biota during the baseline study. The dominant species were kelp, filamentous algae, pyura and sponges. These species were common to natural reefs and man made structures around Port Phillip Bay. In addition to the dominant species, other species such as cryptic invertebrates, small fish and other species of algae were present. None of the species were rare or listed under the FFG Act. Several introduced species were found including small plants of *Undaria pinnatifida*, numerous tubes of the polychete *Sabella spallanzanii* and the ascidians *Ciona intestinalis* and *Styela clava*.

Figure 12: Pier Piling

The breakwater is an artificial habitat of large basalt boulders on a sandy seabed at a depth of 4m rising to 2m above low water mark. This habitat is quite distinct from other artificial habitats in the existing harbour. The breakwater is heavily colonised by the green algae *Ulva* sp, kelp *Ecklonia* and several other species of brown algae. These algae are common on local shallow water reefs in Port Phillip Bay. Seagrass occurred in discrete clumps on the inner side of the breakwater and the seaward side of the breakwater provide an excellent example of shallow water reef habitats.

Figure 13: Breakwater

3.3.3 Habitat Mapping

Field surveys were carried out in the intertidal and subtidal zones in the study area from January 3 to January 20, 2007. Seven distinct habitats were defined and three of these mapped (Figure 14). The biota of the habitats was examined and dominant communities and species identified. Species lists are provided in MSE's Marine Ecological Investigation report. The habitat classifications adopted were based on Blake and Ball, 2001.

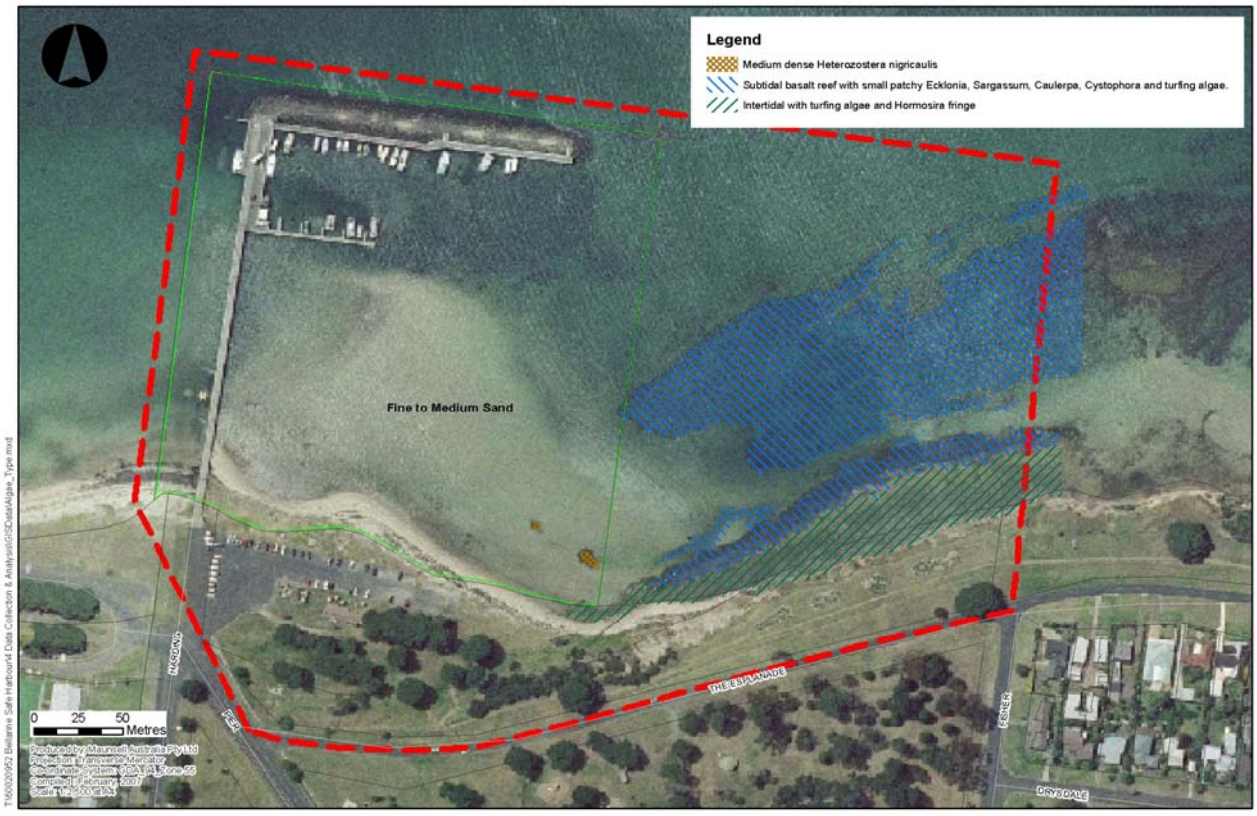

Figure 14: Key habitat types

3.4 Terrestrial Ecology

Summary

The terrestrial ecology of the study area has been substantially modified and minimal native vegetation or habitat remains. While both State and Nationally significant species have been recorded or are considered to potentially occur within 1km of Portarlington, the desktop assessment determined that no species of conservation significance are known to utilise the area.

The desktop assessment concluded that there are no significant terrestrial flora or fauna values that would constrain the redevelopmentof the harbour, however a field survey would be required to confirm areas of native vegetation and the presence of listed species prior to construction.

The flora and fauna values of the local environment around the study area have been identified through a desktop assessment of key databases and a review of the *Baseline Assessment Study of Landscape Values* (EDAW 2007). The terrestrial environment within and adjacent to the study area has been heavily modified by human activity and is dominated by introduced species. This report describes the habitat values and likelihood of occurrence of significant terrestrial flora and fauna species.

3.4.1 Desktop Assessment

Results of the desktop assessment indicate that the terrestrial environment within and adjacent to the study area has been heavily modified by human activity and is dominated by introduced grass species and Cyprus and Pine trees. A number of scattered Eucalypts and Cyprus trees are present along the Portarlington foreshore.

An Ecological Vegetation Class (EVC) – Grassy Woodland – is present in the southeastern half of the WG Little Reserve, and overlaps with a small portion of the defined study area at the corner of Geelong-Portarlington Road and Fisher Street. A site walkover confirmed the presence of scattered plantings at this location (Figure 15). This EVC is also scattered throughout Portarlington and along the foreshore to the east of Fisher Street. Grassy Woodland is considered to be endangered in the Otway Plains bioregion, and is characterised by a variable eucalypt cover up to 15m over a diverse ground layer of grasses and herbs.

Figure 15: Looking west towards the harbour from Fisher Street, Portarlington (Jan 2006)

The Flora Information System has records of species identified within one kilometre of Portarlington (Adamson's Blown-grass *Lachnagrostis adamsonii* and Purple Blown-grass *Lachnagrostis punicea subsp. filifolia*). Both of these species are listed under the EPBC Act. A further four species may occur

but have not been recorded within 1km of the study area. Given the highly modified nature of the foreshore reserve, it is unlikely that any of these flora species occur within the immediate vicinity of the study area and would therefore be disturbed by proposed harbour redevelopment works. Without a detailed flora survey having been undertaken, these species are considered more likely to occur in the Point Richards Flora and Fauna Reserve some distance to the west, or along the foreshore to the east (Maunsell, 2007b).

The fauna species listed in Table 3-4 and Table 3-5 are recorded in the Atlas of Victorian Wildlife (AVW) as having occurred within 1km of Portarlington. Additionally, a search of the EPBC online database revealed a further thirteen species which may occur, or whose habitat may occur, within 1km of the study area.

Table 3-4: Listed terrestrial bird species which have been recorded, or which may occur, within 1km of study area

Common name	Scientific name	Protection status		
		EPBC Act	FFG Act	Treaty
Species recorded within 1km of Portarlington (AVW)				
Latham's Snipe	*Gallinago hardwickii*	Mi	-	CAMBA/JAMBA
Australasian Bittern	*Botaurus poiciloptilus*	-	Listed	-
Fairy Tern	*Sterna nereis*	-	Listed	-
Little Tern	*Sterna albifrons*	-	Listed	CAMBA/JAMBA
Cattle Egret	*Ardea ibis*	-	-	CAMBA/JAMBA
Fork-tailed Swift	*Apus pacificus*	-	-	CAMBA/JAMBA
Sharp-tailed Sandpiper	*Calidris acuminata*	-	-	CAMBA/JAMBA
Species which may occur, or whose habitat may occur in the study area (EPBC database)				
Swift Parrot	*Lathamus discolor*	E	Listed	-
Northern Royal Albatross	*Diomedea sanfordi*	E, Mi	-	-
Regent Honeyeater	*Xanthomyza phrygia*	E, Mi	Listed	-
Southern Giant-Petrel	*Macronectes giganteus*	E, Mi	Listed	-
Australian Painted Snipe	*Rostratula australis*	V	-	CAMBA
Buller's Albatross	*Thalassarche bulleri*	V, Mi	Listed	-
Campbell Albatross	*Thalassarche impavida*	V, Mi	Listed	-
Gibson's Albatross	*Diomedea gibsoni*	V, Mi	-	-
Northern Giant-Petrel	*Macronectes halli*	V, Mi	Listed	-
Salvin's Albatross	*Thalassarche salvini*	V, Mi	Listed	-
Shy Albatross	*Thalassarche cauta*	V, Mi	Listed	-
Southern Royal Albatross	*Diomedea epomophora*	V, Mi	Listed	-
Rufous Fantail	*Rhipidura rufufrons*	Mi	-	-
Satin Flycatcher	*Myiagra cyanoleuca*	Mi	-	-
Painted Snipe	*Rostratula benghalensis spp lat.*	Mi	Listed	CAMBA
Rainbow Bee-eater	*Merops ornatus*	Mi	-	-
White-bellied Sea-eagle	*Haliaeetus leucogaster*	Mi	Listed	-
White-throated Needletail	*Hirundapus caudacutus*	Mi	-	CAMBA
Species for which migration routes may occur in within 1km of the study area (EPBC database)				
Orange-bellied Parrot	*Neophema chrysogaster*	CE, Mi	Listed	-

E – Endangered; CE – Critically Endangered; *V – Vulnerable; Mi – Migratory*

Table 3-5: EPBC listed terrestrial species which have been recorded within 1km of study area (AVW)

Common name	Scientific name	Protection status	
		EPBC Act	FFG Act
Growling Grass Frog	*Litoria raniformis*	V	Listed
Southern Brown Bandicoot	*Isoodon obesulus obesulus*	E	-

E – Endangered; V – Vulnerable

The likelihood of occurrence of the three key species identified is discussed below.

Orange-bellied Parrot (*Neophema chrysogaster*)

Although the EPBC Act listed Orange-bellied Parrot is listed under the EPBC Act as migrating through the area, there is no suitable habitat (coastal saltmarsh) in or adjacent to the study area for the species to utilise for breeding or foraging activity. It is therefore highly unlikely that the species will occur or be affected by the redevelopmentof the harbour.

Growling Grass Frog (*Litoria raniformis*)

The EPBC Act listed Growling Grass Frog (*Litoria raniformis*) has been recorded within 1km of the study area, however the status of this species in the local area is uncertain. The species is found in wet environments in woodlands, shrublands and open or disturbed areas. Although the species may occur in areas near Portarlington, there is no suitable habitat within the study area, and it is therefore unlikely that the species will be affected.

Southern Brown Bandicoot (*Isoodon obesulus obesulus*)

The EPBC Act listed Southern Brown Bandicoot (*Isoodon obesulus obesulus*) is known to occur in dry heath, shrubland and heathy forest and woodland usually associated with well-drained soils. Although it has been recorded within 1km of the study area, the site does not support suitable habitat for this species. No characteristic signs of this species were noted such as scats, scratchings etc. Therefore it is unlikely that the Southern Brown Bandicoot occurs within the study area.

Whilst the occurrence of remnant native vegetation in the study area is sparse, it is possible that harbour related construction or designation of access routes on the coastal cliffs has the potential to result in the clearing of remnant trees and/or native vegetation. If removal of native vegetation is proposed, these areas should be subject to both a spring flora survey and a net gain assessment particularly the areas of native vegetation in the eastern section of the study area (near Fisher Street).

3.5 Cultural Heritage

Summary

A desktop assessment of the Aboriginal and non-Aboriginal historical archaeological sites within the study area was undertaken to define areas of archaeological sensitivity and identify landforms of archaeological potential. A meeting was also held with the Wathaurong Aboriginal Co-operative to discuss culturally significant areas and to inform the development of management recommendations for their future preservation.

Three of ten Aboriginal archaeological sites along the Portarlington foreshore have been recorded near the edge of the study area. In addition, there is potential for currently unknown sites to be discovered during works as the land-side area of the study site is considered to be of high sensitivity.

The original jetty was constructed in 1859 and provided a significant focal point for the town. Surveys of the broader Portarlington area identified a number of European heritage sites, although none have been recorded within the study area.

On the basis of the results of the desktop assessment, it is recommended that the study area should be subject to a field assessment to re-identify and map previously registered sites and coupled with further historical research to identify any new archaeological sites and areas of archaeological sensitivity within the study area. Further consultation with the Wathaurong Aboriginal Co-operative is also recommended to ensure that management actions and mitigation measures are appropriate.

The *Aboriginal Heritage Act 2006* has been enacted since the completion of this technical report. The implications of this Act including the status of relevant Aboriginal stakeholder groups, any additional consultation requirements, necessary permits required for undertaking further investigation and development works, are currently being determined by the Cultural heritage consultant.

The key objectives of the archaeological assessment were to:

- Identify both Aboriginal and non-Aboriginal historical archaeological sites within the study area.
- Define areas of archaeological sensitivity and identify landforms of high archaeological potential.
- Establish the scientific and cultural significance of any archaeological sites, areas and landforms of archaeological potential found, using criteria normally applied to the assessment of cultural heritage resources.
- Establish the implications which the presence of any archaeological resources may have for the proposed harbour development and/or future management of the study area, and to develop appropriate management recommendations for both archaeological sites and areas of high archaeological potential.
- Establish the views of Aboriginal people, and of any other groups with a special interest in the archaeology of the project area, on matters such as the significance of recorded sites, the impact of the proposed harbour development and on appropriate management procedures.

The assessment was undertaken through:

- A desktop audit of known and predicted heritage listings and associations with the study area (both Aboriginal and non-indigenous), including but not limited to Victorian Aboriginal Heritage Inventory System (VAHIS) listings Victorian Aboriginal Places Register, Victorian Heritage Register and the City of Greater Geelong Planning Scheme.
- A consultative meeting with the Wathaurong Aboriginal Co-operative (WAC) regarding the significance of any Aboriginal heritage values in the study area, and appropriate management procedures.
- Development of recommendations for management of cultural material and further investigation of areas of cultural significance.

3.5.1 Ethnohistory

The study area is located within the *Wada wurrung* language group, which occupied the south central area of Victoria, broadly between Beaufort and Port Phillip Bay. Within the *Wada wurrung* language group, the *Bengalat balug* clan occupied the Indented Head area on the Bellarine Peninsula. The occupation of the area was largely seasonal, as it was noted by George Armytage, an early landholder in the Geelong area that the Wada wurrung depended on fishing in the summer and autumn, and hunting and plant food during winter and spring. The camps were regularly shifted to take advantage of foods and resources for tool making, and evidence of these camps is likely to remain.

3.5.2 Previous Archaeological Studies

Aboriginal Cultural Heritage

Two regional archaeological studies have been conducted on the Bellarine Peninsula (Stockton 1983; Rhoads 1986). Both of these studies included an inspection of the current study area and resulted in the registering of ten sites and one place along the wider Portarlington foreshore:

- Sites AAV 7821-359 to 362

- Sites AAV 7821-366 to 371
- Place AAV 9.1-3

Six of these sites (AAV 7821-366 to 371) are collectively known as the Steele Rocks Midden Complex. Two of the ten sites and one place identified along the foreshore, were recorded within the current study area.

- Sites AAV 7821-360 and AAV 7821-361
- Place AAV 9.1-3

The sites will be protected if any works are required nearby.

In addition, two zones of potential Aboriginal archaeological sensitivity within the study area have been identified in reference to the existing archaeological record, landscape disturbance and landforms of high archaeological potential. These sites, described below, are shown in Figure 16.

- The first area of sensitivity is located along the foreshore and comprises beach sands and shell beds at the western end of the study area. The sites identified above are located within this area, and there is potential for additional sites to occur, albeit disturbed. This area is considered to be of high sensitivity.
- The second area comprises the remainder of the study area that encompasses the marine environment. No known sites occur in this zone, however there have only been limited attempts to assess the potential for submerged archaeological sites. This area is considered to be of low significance.

Figure 16: Areas of Aboriginal archaeological sensitivity

Source: Andrew Long and Associates, 2007

European Cultural Heritage

3.5.3 Historical Background

The construction of the public jetty in 1859 and its later extension provided a significant driving force behind the development of the town through the later 19th century. Portarlington was sufficiently removed from the course of the Geelong-Queenscliff railway that the pier continued to serve an important function for the local community. In the mid 1870s an estimated 300 tons of produce was being shipped from the jetty. The presence of this jetty and the provision of a fast and reliable shipping connection between Portarlington and Melbourne cemented the town's position as an important local port and focal point for the surrounding agricultural area (Andrew Long & Associates 2007).

3.5.4 Previous Historical Studies

Previous archaeological studies that have been undertaken within 5km of the study area fall into two categories – localised studies concentrating on specific, discrete properties and regional studies of the local government area. Of the localised studies undertaken none have resulted in the registration of historical archaeological sites or places. However, a study undertaken by Cekalovic (2003), on a 100ha property to the west of Portarlington identified, through documentary research, a number of sites of historical archaeological potential (Cekalovic 2003). Most of these sites are likely to relate to the pastoral occupation of the property. However, none of these areas were registered as archaeological sites or identified as areas of archaeological potential/sensitivity requiring further investigation.

One regional study has been undertaken, which encompasses the present study area and the wider region. In 1996 the Bellarine Heritage Study was undertaken by Cultural Heritage Consultants with a view to 'identifying, evaluating and documenting post-contact places of cultural significance, and to make recommendations for the conservation and management of these places' (Howe & Lewis 1996). A total of 290 culturally significant places were documented as a result of the study including 258 new places (Howe and Lewis 1996). No previously recorded heritage sites are located within the study area.

As a component of the study a historical archaeological survey was undertaken by Weaver (1996). The archaeological survey identified 32 historical archaeological sites throughout the study area including, racecourses, railway infrastructure, schools, homesteads and other rural site types (Weaver 1996). No sites were identified within 5km of the present study area, supported by a search of the online Victorian Heritage Register which revealed no sites in the study area.

3.6 Landscape Values

Summary

The coastal landscape around Portarlington has a relatively undeveloped feel, although further inland the area has been extensively cleared and little remnant vegetation remains. The cliff and the dense rows of cypress trees are the dominant visual feature of the foreshore, while the simple appearance of the pier is an important contributor to the local scenic quality.

The impact of a redeveloped harbour on the landscape values of the setting will depend on its extent and visual character. Given the presence of, and public familiarity with the Portarlington Pier, new forms that maintain the simplicity and horizontality of the existing element will be consistent and visually compatible. The introduction of elements of a heavier appearance, such as breakwalls, and of greater verticality, such as boat storage facilities, will be less compatible.

The potential impacts of coastal development on the landscape setting of the coastal zone within the broader study area would need to be managed through careful layout, design and material selection.

A *Baseline Assessment Study of Landscape Values* was undertaken by EDAW (2007), the aims of which were to:

- Assess the landscape context of the study area in relation to the surrounding coastline and any significant features.
- Assess the existing harbour conditions and how a redeveloped harbour would impact on values.
- Assess scenic qualities and identifies significant landscape features.

The assessment of impact on landscape and visual values was determined through the following key tasks:

- Identification of study area viewshed. The viewshed of the study area is the area from which the site can be seen and is generally defined by landform, vegetation and distance.
- Viewer sensitivity determination. From the viewshed analysis, a series of key viewpoints were identified. Offshore viewsheds were considered from the recreational boating and tourism perspective. Viewer sensitivity is determined by the number of viewers, the duration of view and the importance of visual amenity to viewers.

3.6.1 Results of Desktop Assessment

Corio Bay Coastal Action Plan 2002

The Corio Bay Coastal Action Plan 2002 was reviewed by EDAW (2007). The key findings of the CAP in relation to landscape values around Portarlington are as follows:

- A Significant Landscape Overlay (SLO) should be applied to areas of the Bellarine Peninsula between Clifton Springs and Portarlington and the hill directly south of Portarlington. This area does not encompass the study area.
- Promote land uses that provide for revegetation and protection of the landscape qualities of the foreshore.
- Promote linear trails along the foreshore where possible and appropriate to increase public access to the Bay.
- Promote retention and remediation of coastal landscapes with indigenous vegetation. Where appropriate, remove exotic plants and replace with indigenous species.

Coastal Spaces Landscape Assessment

The core study area is located within Landscape Character Area 4.1 – Bellarine Hill (Murradoc Hill). The attributes of this area discussed in the assessment and identified by EDAW (2007) are:

"This hilly to gently undulating Character Area covers much of the central and northern Bellarine Peninsula. As the major topographic feature of the peninsula, this Character Area forms a significant landscape backdrop to many towns and viewing locations, and offers expansive outviews. While it is largely open and cleared, cultural vegetation patterns of windbreaks, vineyards and established exotic trees around homesteads are important landscape features."

Adjacent to the east and west of Landscape Character Area 4.1, and located within the broader study area, is Landscape Character Area 1.1 – Bay Slopes and Flats. The attributes of this area are:

"This Character Area is low-sloping and occasionally gently undulating, with open expansive views east to Port Phillip Bay and Swan Bay. Open paddocks are dissected by exotic conifer windbreaks and native vegetation in roadside reserves which contain views in parts. At the coastal edge, the landform is very flat with low-energy beaches, salt lakes and some minor cliffs no more than five metres high at Indented Head. Swan Bay is a significant natural feature on the eastern edge of approximately half the Character Area, while to the north, coastal townships including St Leonards and Indented Head extend inland for some distance on the flats. Further inland there is a low density of built elements with homesteads and farm sheds often exposed in large paddocks."

The study determined that at least every part of the coastline should be designated as being of at least local significance and that individual Council's should undertake local studies to determine the requirement for a SLO. However, the study did identify the following landscapes in the broader study area for SLO coverage. These are:

- Clifton Springs to Portarlington Coast
- Murradoc Hill

3.6.2 Viewshed Analysis

The report identified that landscape values of the broader Portarlington study area are characterised by coastal planes with gently undulating farmland, and that it has been heavily modified by agricultural activities, typified by farmland with linear windbreaks and some remnant native vegetation. Closer to the study area, the foreshore in the immediate vicinity of the pier comprises a low cliff which separates the coastline from the parkland adjacent to the township. The visual setting of the existing harbour is highlighted by the working nature of the existing jetty and wharf structure. Although relatively understated, these features provide a maritime character and elements of visual focus to the coastal edge.

The township, parklands and the foreshore are relatively undeveloped and modest in appearance, which gives the area a modified but relatively undeveloped feel in contrast to the more extensively developed Mornington Peninsula. The key contributors to the scenic quality of the coastline identified by EDAW (2007) are:

- The coastal edge (i.e. the land / water interface);
- The section of cliff at the shoreline near the pier that is the northern extent of the Bellarine / Murradoc Hill;
- The rudimentary, simple appearance of the Pier and its associated water craft.
- The parklands between the Pier and the township that are located on rising land and afford views over the bay.
- The dense rows of Cypress to the west of the pier that provide a cultural influence; and
- The relatively intact main street buildings and streetscape.

Although the area has a relatively undeveloped appearance, the random and mixed vegetation in the township parkland, and the relative lack of vegetation in other areas of the coastal reserve detract from the scenic values of the setting.

The City of Greater Geelong Planning Scheme does not contain any Significant Landscape Overlay controls for the area, although the Coastal Spaces Landscape Assessment Study (discussed in Section 2.2.13) indicates that the coastal and broader area would be of at least local significance.

EDAW (2007) undertook a viewshed analysis to identify locations in the surrounding area from which the proposed development could be observed. The viewing areas are generally confined to the coastline, along a three kilometre stretch between Point Richards in the west and the boat ramp at the end of Fairfax Street one kilometre to the east. Further inland, the extent of the viewshed varies significantly depending on the topography and the screening effect of the buildings and vegetation. To the east of the WG Little Reserve, the foreshore reserve is devoid of vegetation, and the adjacent residences have direct views over the study area.

The existing Pier structure is relatively simple and the attendant recreational and commercial boat traffic is relatively low volume and of visual interest to residents, tourists and land and water based recreational users. As such, EDAW (2007) note that users of the setting will be sensitive to significant changes to the landscape, given that they would either be residents and sensitive to development in the local area, or visitors expecting to visit a modified but relatively undeveloped setting.

4.0 Condition Assessment of Current Jetty Structure

An assessment of the condition of the Portarlington Pier was undertaken by Maunsell (2007c). Visual assessment and detailed testing of the pier was undertaken to assess the extent of deterioration on the pier. The condition assessment included assessments of the following features, which are discussed in detail below:

- The concrete approach
- The timber fingers
- Breakwater
- The structure

The assessment found that the concrete approach to the pier is in poor condition and requires significant remedial works. The handrails and inner leg of the outer finger also require significant upgrades.

4.1 Assessment of the concrete approach

The key findings of the concrete assessment were:

- The overall condition of the guard railing was good; however some rails and connections were corroded and need to be replaced. The separation between each of the rails does not comply with the Australian Standard.
- The top surface of the deck was in a fair condition with stress cracking throughout.
- There is significant deterioration of the deck U beams (Figure 17). Of beams at the first 37 bays, 32 were rated in a poor or very poor condition with the remaining beams in a fair to good condition. Because of the deteriorated condition of these beams the current loads on the deck exceed design capacities. The very high chloride levels within the concrete means that the remediation options are limited and the costs would be uneconomic. Options include replacing sections or all of the deck or installing a deck overlay to provide additional strength to the deck.
- The deterioration of the concrete crossheads varied from minor to significant. Of the 51 crossheads approximately 6 will require significant remediation and 20 will require some remediation. Test results confirm that crossheads are expected to continue to corrode and the very high chloride levels limited the options for remediation. Costs to maintain these structures are expected to rise significantly over the next 20 years.
- The piles were generally in a fair condition with minor deterioration. Very high chloride levels within the concrete will limit remediation options over the long term although no remediation works are required in the short term.

An additional engineering assessment was undertaken to supplement the Portarlington Jetty Condition Assessment prepared by Maunsell in February 2007 (Maunsell, 2007d). The objective was to qualify the extent of deterioration of U-Slab units by measuring the amount of residual steel of reinforcement in the lower webs of the units. The pier was inspected by boat with the objectives of confirming the previous condition assessment, to observe any further deterioration, and to verify the degree of deterioration attributed in the rating scale.

Additional cored samples were taken to supplement the February detailed investigation. Compressive strength testing of these samples was undertaken to confirm the residual capacity of units.

Alternatives for repair of the structure were then assessed with the aim of providing an 8t dual (6t single axle) vehicle load capacity of the pier over a design life of 5 years.

Figure 17: Typical cracking and deterioration under U beams

4.2 Timber condition assessment

Overall, the timber in the fingers of the jetty is generally in good condition, although a small number of piles were badly deteriorated and require maintenance. The old section of the outer finger will require significant upgrade works within 5 years. While there is some splitting of timbers in the deck support substructure, these are still in good condition, as is the timber decking on the main approach and inner finger of the jetty, which has experienced some minor splitting and weathering.

The decking of the old section of the outer finger is in fair to poor condition due to weathering of the timber planks, while the decking of the new section of the outer finger is in good to very good condition. The older timber substructure is generally in fair condition, but some of the intertidal timbers and fasteners are in poor condition displaying significant deterioration. Corrosion protection on the fasteners should be reviewed and reapplied where appropriate.

The vertical planks and some bracing of wave wall attached to the outer finger is in poor condition at around the low tide water level through a combination of weathering, marine borers and rot. All fasteners have no protective galvanising left and are corroding, and depending on whether the wave wall is still required, the fasteners and vertical timbers should be replaced.

4.3 Breakwater

The breakwater is generally in good condition and is not experiencing any movement which is demonstrated by the condition of the pavement. The only recorded damage was to the seaward face where secondary armour has been exposed through the dislodgement of approximately 5% of rocks.

4.4 Structural Assessment

The structure has deteriorated substantially since 2001 and this has resulted in capacity restrictions being recommended for the jetty. The timber section of the jetty was designed with significantly lower capacity when compared with the concrete deck. If the concrete section of the jetty is upgraded then load restrictions and traffic management measures would be required for the timber section. Maunsell (2007c) determined that although there is evidence of deterioration, the piles have sufficient capacity to carry the design loads.

The design loads of the concrete section of the timber jetty were 9 tonnes (single axle), 16.5 tonnes (double axle) and 20 tonnes (triple axle). Maunsell (2007d) determined that the timber piles still have sufficient capacity to carry the initial design loads, which are 3 tonnes and 6 tonnes for single and double axle vehicles, respectively.

Based on the results of the detailed structural analysis, the maximum permissible loading on the concrete approach structure in its current condition has been revised to 3.37t single axle (1.69t dual axle).

5.0 Risk Management Framework

A risk assessment approach provides a framework to evaluate and communicate the impacts and the risks posed by redevelopment of the harbour. The outputs of the risk assessment have raised issues that will require further mitigation and management as the project is implemented.

The risk assessment presented below is informed by the Baseline Studies and the footprint of the 2002 Concept Plan for the Safe Harbour development (refer to Figure 2). The key functional design elements associated with the Concept Plan are:

- Breakwater extension
- Eastern /groyne reclamation (secondary breakwater)
- Western wave screen

The risk assessment criteria below have been applied to these design elements in order to identify key risk categories associated with the proposed redevelopment works. Risk ratings (ie. low, medium, high, extreme) have been allocated to each risk category in order to identify priority management actions.

As the redevelopment works are yet to be designed, the results of the risk assessment are indicative only and can only be used for the purposes of identifying key risk categories and factors that will need to be considered in the Masterplanning and implementation phases of the Project.

5.1 Risk Assessment Framework

Risk is a condition resulting from the prospect of an event occurring and the magnitude of its consequences. The level of risk can be defined as a combination of:

- The likelihood of an event occurring; and
- The magnitude of potential consequences if the event were to occur.

An aim of the risk assessment process is to ensure a consistent assessment across all study areas. To achieve this, qualitative measures of likelihood and consequence were developed as shown in Table 5-1 and Table 5-2. The qualitative description of likelihood provided a measure of likelihood from almost certain to rare that could be assigned to an event (Table 5-1).

Table 5-1: Qualitative Measures of Likelihood

Measure of Likelihood	Description
Rare	May occur only in exceptional circumstances
Unlikely	Could occur at some time
Likely	Might occur at some time
Probable	Will probably occur in most circumstances
Almost certain	Is expected to occur in most circumstances

For estimating consequence, qualitative descriptions were developed using different consequence types and levels. The descriptions of consequence were divided into qualitative descriptions for ecological and socio-economic effects (Table 5-2).

Table 5-2: Qualitative Measures of Consequences

Consequence Category	Qualitative Description of Ecological Effects	Qualitative Description of Socio-Economic Effects
A: Catastrophic	Irreversible and irrecoverable changes to abundance or biomass in the affected environmental setting. Loss of biodiversity on a regional scale. Loss of ecological functioning with little prospect of recovery to pre-incident conditions.	Irreversible and irrecoverable changes to social, cultural, economic, recreational and/or aesthetic values of region. Significant impacts felt at state and national levels. Limited impacts felt at an international level.
B: Major	Major reduction of abundance or biomass in the affected environmental setting. Significant impact to biodiversity and ecological functioning. Eventual recovery of ecological systems possible, but not necessarily to the same pre-incident conditions.	Major change in quality of social, cultural, economic, recreational and/or aesthetic values in local area. Significant impacts felt at regional and state levels. Limited impacts felt at national level.
C: Moderate	Reduction of abundance or biomass in the affected environmental setting. Limited impact to local biodiversity without loss of pre-incident conditions.	Change in quality of social, cultural, economic, recreational and/or aesthetic values in local area. Limited impacts felt at regional level.
D: Minor	Small reduction of the abundance or biomass of flora and fauna in the affected environmental setting. No changes to biodiversity or ecological system.	Small change in quality of local social, cultural, economic, recreational and/or aesthetic values at local level. No impacts at regional level.
E: Negligible	Possible incidental impacts to flora and fauna in a locally affected environmental setting.	Possible incidental impacts to social, cultural, economic, recreational and/or aesthetic values in local area.

Table 5-3: Risk Rating Matrix

	Consequence				
Likelihood	Negligible	Minor	Moderate	Major	Catastrophic
Almost certain					
Probable					Extreme
Likely				High	
Unlikely			Medium		
Rare		Low			

The objectives of the risk analysis were to separate the minor acceptable risks from the major risks, and to provide data to assist in the evaluation and treatment of risks. Development of management actions has focussed on the risks identified as posing a high or extreme risk to the environment, cultural values, social considerations or engineering constraints.

In some instances further investigation is required to appropriately characterise the level of risk posed by redevelopment works. This is particularly relevant for the geotechnical conditions, being the regionally significant coastal cliffs, and the dredgability of the basalt contour.

It is recognised that the most effective risk control is risk avoidance. It is intended that many of the management actions can be applied during Materplanning and design phases in order to prevent the risk from occurring. Some management measures however, will require ongoing monitoring during the implementation phases of the project, particularly those associated with ongoing maintenance and operation of the redeveloped harbour.

5.2 Geology and Geomorphology

The predicted effects of the proposed harbour redevelopment works on the geology and geotechnical conditions within the study area were identified and assessed.

5.2.1 Risk Analysis

The results of the risk assessment are presented in Table 5-4 and discussed in further detail below.

Table 5-4: Risk assessment for the geology and geotechnical conditions

Aspect	Identified Risk	Likelihood	Consequence	Risk Rating	Management Measures /Further investigation
Management of landscape/ geotechnical hazards	Land-based works may increase the potential for landslide.	Probable	Moderate	High	Engineering works required to stabilise cliffs. The coastal cliffs should also be avoided during the design phase.
	Works may increase coastal erosion rates.	Rare	Negligible	Low	Establishment of groynes to improve sand accretion. Altered wave climate and reduced rate of coastal erosion predicted. Cliff erosion and stability issues can be managed through drainage control and revegetation works.
	Dredgability - Basalt may be present within dredge areas.	Probable	Moderate (economic impacts)	High	Further field testing is recommended (refer to Geotechnical Investigations Plan).
	Redevelopment works may impact on Regional Geological Feature (coastal cliffs and offshore basalt platform)	Probable	Moderate	High	Sites that have been identified as geologically significant should be managed in such a way that those features that contribute to its geological value are retained or enhanced and not obscured, damaged or destroyed. Engineering works required to stabilise cliffs. The coastal cliffs should also be avoided during the design phase. Extent of works to offshore platform to be determined during the Masterplanning phase.

5.2.2 Management Measures & Further Investigation

The relatively stable geological conditions at the site mean that there are unlikely to be any effects on the local geological and geomorphological environment. Whilst a landslide risk assessment was not undertaken, observations by Maunsell (2007a), minor slumping of the slopes at the south of the study area has occurred, indicating that the slopes are susceptible to landslide if sufficiently disturbed. A landslide risk assessment should be undertaken to determine whether observed localised slumping of some slopes is indicative of further potential impacts, particularly if final project design requires any development within 10m of the toe of the slope.

The dredging which will be required to maintain the navigability into the harbour may be impeded by the presence of basalt within the required depth. This may affect the dredgeability for the initial dredge campaign, and alternate dredge methods may need to be considered. A preliminary geotechnical site investigation is required to determine the depth and dredgeability of the basalt.

5.3 Coastal Processes and Dredging Requirements

The coastal processes and dredging requirements were assessed in regard to the 2002 concept design for the proposed development.

5.3.1 Risk Analysis

The results of the risk assessment are presented in Table 5-5 and discussed in further detail below in relation to the separate components of the proposed design.

Table 5-5: Risk assessment for coastal processes and dredging requirements

Aspect	Identified Risk	Likelihood	Consequence	Risk Rating	Management Measures /Further investigation
Coastal Management	Potential for harbour to impede sediment transport.	Probable	Minor	High	Combination of proposed groynes and breakwater would reduce the current level of sedimentation in the harbour area. Introduction of sand by-passing system or trucking of sand required.

The proposed development will further disrupt the natural longshore transport of sand. The present rate of accumulation of sand within the harbour will be increased, and as such, the overall quantity of sand available to replenish the beaches to the west will be significantly reduced. This is expected to result in narrow, denuded beaches which are prone to erosion.

Subsequently, this may lead to increased localised erosion of the cliffs directly to the east of the offshore breakwater. Following its construction, the resulting diffraction of waves around the breakwater will potentially intensify the wave energy reaching the coast at this location, and therefore exacerbate the rate of erosion in localised areas.

Water Technology (2007) modelled the effects of each of the major components of the proposal, as follows:

Breakwater Extension

The extension of the breakwater will increase the length of sheltered shoreline in the lee of the breakwater. This will in turn increase the width over which the cuspate spit can develop and will increase the quantity of sand locked up that would otherwise be available for the littoral regime. The increased sheltering of the shoreline is also likely to further reduce the small net westward sediment transport that may be occurring past the breakwater during large north-easterly wave episodes. The increased sheltering will also protect the beach to the immediate west of the jetty from north-easterly wave action and would be expected to also result in a build up of the beach in this area.

The approximate doubling of the length of the breakwater could be expected to trap almost the entire gross transport rate of 5-10,000 m^3/year.

Eastern Groyne

The construction of a groyne to the immediate east of the harbour as indicated in Figure 4-1 would be expected to interrupt the entire net westward sediment transport regime. Accretion of sand on the eastern side of the groyne would be expected to occur at the net alongshore transport rate, which may be of the order of 1-2,000 m^3/s. Given time, a small beach may be reinstated to the east of the harbour, and could provide a degree of protection to the coastal cliffs in the area, which appear to be undergoing locally increased rates of erosion. Accretion in the lee of the breakwater would still be expected to occur, although at a reduced rate equal to the eastward sediment transport rate.

Western Wave Screen

The construction of a wave screen to the immediate west of the harbour as indicated in Figure 4-1 would be expected, in combination with the breakwater, to trap any westward sediment transport which passes the eastern groyne.

The wave screen would also interrupt the eastward sediment transport. In this respect, the wave screen and extended breakwater would shelter the beach area to the west of the existing jetty from east and northeast wave action. As such, some localised accretion would be expected to occur in this area during periods of west and northwest wave action. This volume of sand would be removed from the system and would be prevented from migrating in a net westward direction due to the sheltering from north east waves.

Cumulative Effects

In practice, all coastal process effects are interrelated, however the overall impact of a particular combination of components is not necessarily the sum of the individual component – the combined effect could be more or less. In this case where the proposed development comprises each of these components, Water Technology (2007) expect that the proposed development will have less impact on the coastal processes in the area, and will require less maintenance dredging than the existing harbour as the structures will prevent sedimentation within the harbour.

Response to Climate Change

The IPCC has revised the estimates of the degree of sea level change that may occur by 2100. Current estimates of sea level rise (for a range of emission scenarios) vary from 0.18m to 0.58m, with a mean of about 0.3m by 2100 (IPCC, 2007). Considerable uncertainty exists in predicting the impact of climate induced sea level rises on coastal processes.

In terms of shoreline evolution however, two major effects have been generally postulated: landward retreat due to the direct result of inundation associated with increased sea levels; and landward retreat due to possible greater storminess, resulting in larger waves and changes to the direction of wave attack.

With respect to the Portarlington Harbour development, the National Committee on Coastal and Ocean Engineering (Engineers Australia, 2004 Update) provides the following adaptive options to climate change threats to coasts and coastal infrastructure:

1. Retreat
- Prevent development in areas near threatened coastlines
- Conditional approvals and phasing-out of developments

2. Accomodate
- Advanced planning to avoid worst impacts
- Modification of land use, building codes

3. Protect
- Hard structural options including, dykes, sea walls, revetments and groynes
- Soft structural options including beach nourishment, wetland creation and littoral drift make-up.

Any development of the Portarlington Harbour should be designed with an adaptive approach in mind. This approach can exploit the fact that coastal infrastructure such as Portarlington Harbour is rarely static and is likely to undergo major refurbishment or replacement on times scales of 25 to 30 years. This provides a number of opportunities to phase the structural adaption of coastal infrastructure to accommodate any impacts of climate change. Measures that could be used to mitigate the effects of sea-level rise or increased storminess that may occur, could include:

- Design the breakwater and associated infrastructure to allow for a mean sea level rise of up to 0.4m (the current median estimate for the year 2100).
- Incorporate contingency plans for protection works along the adjacent sections of coast, which in the short to medium-term may include beach renourishment and groyne construction.

5.3.2 Management Measures & Further Investigation

Regular by-passing of approximately 1-2,000 m^3 per year of sand from the east of the harbour to the beaches in the west would help reinstate the natural westward sediment transport rates in the area. This could be achieved by periodically trucking sand from one side of the harbour to the other, or by the installation of more permanent by-passing plant.

Construction of a series of groynes along the coast between the harbour and Point Richards would be expected to help stabilise the beach in this area. However, without additional sand, the beaches would remain relatively narrow and prone to erosion. Such a groyne approximately 300-500 metres west of the harbour may prevent the migration of littoral sediment eastward into the wave sheltered zone immediately west of the proposed harbour.

It is likely that a combination of sand by-passing, beach re-nourishment and groyne construction will provide the most cost-effective long-term strategy for maintaining the beaches in the area.

A number of key additional studies in relation to coastal processes and hydrodynamics include:

- A more detailed wave climate analysis to provide a more reliable assessment of design wave conditions.
- More detailed sediment transport calculations to provide a more reliable estimate of the net westward sediment transport rate at Portarlington.
- Boussinesq wave modelling to assess the degree of protection provided by the breakwater and wave screen, and to optimise the dimensions of these structures.
- Sediment sampling and analysis to determine the contamination status of the sediments.

5.3.3 Dredging Requirements

A preliminary assessment of the volume of material to be dredged from the harbour has been made using the limited hydrographic survey undertaken by Parks Victoria and interpreted depths from navigation charts. In order to achieve depths of -3.0m AHD in the navigable harbour area, the estimated dredge volume is approximately 48,000 m^3. An additional 0.5m depth would require a total

dredged volume of approximately 69,000 m^3. More detailed hydrographic survey data of the entire harbour area is required to inform a more accurate estimate of the dredge volumes.

It is clear that much of the material to be dredged from the harbour will be sand and silty sand associated with the build up of the cuspate spit discussed above. There is, however, no information available regarding the nature of the remaining sediments to be dredged. It is likely that a significant proportion of the underlying sediments will comprise silts and clays, and that rock similar to that which is exposed in the adjacent inter-tidal reef areas may also be encountered.

The dredging method to be used will be very dependent upon the properties of the material to be dredged. For sand, silty sand, silts and clays, a cutter suction dredge is likely to be the most effective plant. This type of plant generates relatively little turbidity at the dredge site, but has the problem of dealing with large volumes of turbid water at the disposal site. Silt screens and/or detention basins may be required to control turbidity at the disposal site. The excavation of harder rock may require a pneumatic/hammer type system to break up the rock, with subsequent removal by grab or excavator.

Although relatively fine, the sand and silty sand could be used for beach nourishment, or may be suitable for the reclamation work. Silt and clay material may also be suitable for reclamation works, but is likely to require a significant period of time (of the order of years) for dewatering and consolidation, before it can be built on. Alternatively, dredged material could be placed in a dredged material ground within the bay.

Following construction, a minimal volume of material will need to be removed as part of ongoing maintenance dredging. This has been estimated to be approximately 1-2,000m^3 per year, and will occur at the eastern entrance to the harbour.

Detailed hydrographic survey of the entire harbour area is required to allow a more reliable determination of the volume of material to be dredged. In addition, dredging requirements and dredging methodology will need to be informed by more reliable sediment data.

5.4 Environment

5.4.1 Marine Ecology

The predicted effects of the proposed harbour redevelopment works on the marine ecological values within the study area were identified and assessed.

5.4.2 Risk Analysis

The results of the risk assessment are presented in Table 5-6 and discussed in further detail below.

Table 5-6: Risk assessment for marine ecology

Aspect	Identified Risk	Likelihood	Consequence	Risk Rating	Management Measures /Further investigation
Protection of Flora and Fauna Values	Construction of offshore components (breakwater, groynes) will result in the loss of soft seabed habitat within footprint of works	Probable	Negligible	Medium	Marine ecology assessment identified minimal habitat values. This loss is not significant in comparison with the large area of sandy bed in the harbour precinct. Construction guidelines would be implemented. Mitigation measures not deemed necessary at this stage.

Aspect	Identified Risk	Likelihood	Consequence	Risk Rating	Management Measures /Further investigation
	Dredging will remove infaunal soft seabed assemblages	Likely	Negligible	Medium	Existing habitat is highly modified. Dredging protocols to be applied.
	Beach renourishment programs will smother beach infauna species	Unlikely	Negligible	Low	MSE reports minimal faunal values and species in beach area.
	Turbidity plumes will smother seagrass habitat.	Unlikely	Negligible	Low	MSE reports that seagrass remnants offer negligible habitat value. Given current rate of degradation, the presence of these seagrass remnants should be confirmed prior to construction works. Dredging controls to be adopted.
Public amenity	Accumulation of drift algae in new harbour area (may result in noxious odours and an increase in amount washed onto beaches).	Unlikely	Negligible	Low	Mitigation measures not deemed necessary at this stage. Management measures to be reassessed during operational phase.
Management of exotic species	Increase in number of marine pest incursions	Likely	Negligible	Medium	Existing environment characterised by introduced species, minimal habitat values within study area. Hull fouling guidelines to be implemented.

The extension of the breakwater will considerably increase the subtidal area on the seaward side available for colonisation by algae and small invertebrates. Assuming that the new breakwater will be of similar boulder construction to the present structure, the suite of algae colonising the new substrate will be the same as that on the existing breakwater.

Soft bed habitat will be permanently lost beneath the footprint of the extended breakwater. This loss is not significant in comparison with the large area of sandy bed in the harbour precinct. The footprint of the proposed hard stand area at the eastern boundary of the harbour will impact the patch of seagrass nearest the shore, and the western end of the offshore shallow reef system as following:

- The seagrass is a very small relict of what may have formerly been a much larger bed. Because of its size it is of low value to the present local ecosystem.
- The western end of the natural shore platform will be lost beneath the proposed new hardstand area, breakwater and adjacent sand trap. The area lost is not ecologically significant. The loss of this part of the shore platform will be offset to some degree by an increase in rock habitat on the rock protection (MSE, 2007).

Dredging the entrance to the harbour will result in the removal of soft seabed assemblages, which, as they are widely represented in the study area, will recolonise within a year following the completion of dredging, assuming the exposed seabed is similar to the existing conditions. A similar effect and recovery is expected for the placement of dredged material.
The installation of the sheet piling along the western side of the harbour will alter the circulation of water and result in a reduction in biota in the vicinity of berths. The altered water circulation may also increase the amount of drift algae accumulation in the vicinity of the proposed new commercial berths.

5.4.3 Management Measures & Further Investigation

MSE (2007) identified that mitigation measures for construction and for the operation of facilities will be developed during the detailed design phase for the project. Further determination of marine ecological impacts would also need to be informed by more detailed hydrodynamic and water quality assessments. Key aspects of the proposed facilities for which mitigation measures will be developed include dredging, rubbish collection, refuelling and pump-out facilities. These measures will be developed in consultation with the relevant regulatory authorities to ensure legislative and policy requirements.

5.4.4 Water Quality

The predicted effects of the construction and operation of harbour redevelopment works on the water quality within the study area were identified and assessed. The results of the risk assessment are presented in Table 5-7 and discussed in further detail below.

Table 5-7: Risk assessment for water quality

Aspect	Identified Risk	Likelihood	Consequence	Risk Rating	Management Measures /Further Investigation
Litter management	Litter as a result of increased boating activity and access causing environmental and public health issues.	Likely	Minor	Medium	Harbour redevelopment offers opportunities for installation of waste management facilities.
Stormwater management	Enclosed harbour may trap poor water quality inputs from stormwater outfall resulting in reduction in water quality.	Likely	Moderate	High	The water quality within the harbour requires assessment to determine current compliance with SEPP. The current quality of stormwater inputs has not been determined.
Fuel and oil waste management	Fuel spills to the marine environment and Port Phillip Bay.	Likely	Minor	Medium	Spill kits and emergency response procedures to be developed for new harbour facilities.
Sewage disposal	Contamination of harbour waters and Port Phillip Bay through sewage discharges.	Likely	Minor	Medium	SEPP compliance issue. Pump-out facilities to be constructed for new harbour. Further consultation with EPA Victoria recommended.

Water quality within the harbour will largely be determined by the effectiveness of the tidal exchange of harbour water with that of the Bay, and tidal and wind-driven circulations maintaining adequate mixing within the harbour. With respect to the latter, it is noted that variations in the proposed harbour depths associated within the internal beach will assist in developing wind driven currents within the harbour and will assist in mixing. Residence times within the proposed harbour development are estimated conservatively at less than 14 days (Water Technology, 2007). Residence times of this magnitude are considered adequate to maintain good water quality conditions within the harbour over the long term.

Copper concentrations within the harbour will be a function of the number and size of the vessels moored within the harbour and the rate at which harbour waters are exchanged with the Bay. Based on comparisons with similar harbour developments and in the approximate residence times estimated above, it is considered that, although copper concentrations may exceed water quality guidelines locally within the harbour, they are unlikely to have a significant impact on the surrounding Bay water (Water Technology, 2007).

5.4.5 Management Measures & Further Investigation

The collection of water quality data was outside of the scope of the current baseline assessment studies. However it would beneficial in the next stage of development, to collect some site specific baseline data to determine current compliance with SEPP criteria. The following additional studies are also recommended:

- Water sampling during both dry and wet weather conditions
- An assessment of the likely effects of relocating the stormwater outfall to deeper water out along eastern reclamation.
- Hydrodynamic and water quality modelling to confirm residence times, and to assess the degree and extent of any impact of copper leaching from antifouling paints.

Fuel and sewage systems would be designed to minimise the risk of spills within the harbour, however appropriate operation and clean-up procedures will be implemented to manage these risks.

Further discussions with EPA Victoria and DSE are also recommended to discuss any requirements for ongoing monitoring and waste management (ie. pump-out) facilities.

5.4.6 Terrestrial Ecology

The predicted effects of harbour redevelopment works on the terrestrial ecology within the study area were identified and assessed. Although significant flora or fauna species, or their preferred habitat, have not been recorded within the study area, there is potential for impacts on these values to occur.

5.4.7 Risk Analysis

The results of the risk assessment are presented in Table 5-8.

Table 5-8: Risk assessment for terrestrial ecology

Aspect	Identified Risk	Likelihood	Consequence	Risk Rating	Management Measures /Further Investigation
Protection of Flora and Fauna Values	Land-based works may require removal of significant vegetation/ habitat.	Rare	Negligible	Low	If removal of native vegetation is proposed, these areas should be subject to both a spring flora survey and a net gain assessment particularly the areas of native vegetation in the eastern section of the study area (near Fisher Street).
	Land-based works may impact EPBC Act or FFG Act listed flora species.	Unlikely	Negligible	Low	Impacts on listed species unlikely to occur.

The proposed development is unlikely to affect any significant terrestrial ecology species. As a result, no specific management measures are recommended, however a spring survey would be beneficial particularly if any removal of native vegetation is proposed.

5.5 Cultural Heritage

The predicted effects of the construction and operation of a safe harbour on areas of cultural significance were identified and assessed.

5.5.1 Risk Analysis

The results of the risk assessment are presented in Table 5-9 and discussed in further detail below.

Table 5-9: Risk assessment for the cultural heritage values of the study area

Aspect	Identified Risk	Likelihood	Consequence	Risk Rating	Management Measures /Further Investigation
Management of Aboriginal Heritage values	Land-based works may potentially disturb previously unrecorded sites ie. shell middens, located in terrestrial zone of the study area.	Likely	Minor	Medium	Additional archaeological survey recommended to adequately characterise cultural values of terrestrial environment, particularly coastal cliffs.
	Land-based works may disturb previously registered Aboriginal archaeological sites: AAV 7821-360, AAV 7821-361, AAV 9.1-3	Probable	Moderate	High	These recorded sites should be avoided during the design phase. If this is not possible, a consent to disturb process would be triggered.
	Offshore works have the potential to disturb unrecorded submerged sites	Rare	Minor	Low	Dependent on the extent of dredging of approach channels however no mitigation measures are required at this stage.
Management of Non-Aboriginal Heritage values	Earthworks have the potential to disturb post-European sites associated with the development and use of pier precinct.	Rare	Minor	Low	Highly modified on-shore environment. Further historical research proposed.
	Offshore works have the potential to disturb post-European sites associated with harbour development.	Unlikely	Moderate	Medium	Dependent on the extent of dredging. There may be submerged structures associated with historical pier use.

Three sites of Aboriginal heritage significance have been recorded within the study area for the proposed development. These sites are on the edge of the area, and as such it is recommended that these areas are avoided during the design of the proposed works. Information on Aboriginal site distribution in the wider region suggests that there is potential for additional sites to occur in the terrestrial section of the study area.

As no european heritage sites have been recorded in the study area, it is unlikely that the project will affect any heritage sites.

5.5.2 Management Measures & Further Investigation

The detailed design of the proposed development should ensure that no works will disturb the identified heritage sites within the study area, and Andrew Long & Associates (2007) recommend that additional studies, in the form of detailed field assessments be undertaken to better characterise the potential for aboriginal heritage sites to be present across the terrestrial component of the study area.

The development of concept plans for construction would assist in the formulation of a field survey strategy to target areas potentially affected by development. The field assessment would involve a thorough survey, which would seek to re-identify and map previously registered sites, identify any new archaeological sites, areas of archaeological sensitivity, involve the Aboriginal stakeholders and establish their opinion regarding the proposed development, the potential risk to Aboriginal sites, and their views regarding appropriate site mitigation measures. As stated previously, obligations under the recently enacted *Aboriginal Heritage Act 2006*, including any requirements for the development of a Cultural Heritage Management Plan, are currently being assessed.

The report would be lodged with AAV documenting the results of the investigation, the views of Aboriginal stakeholders, mitigation measures for Aboriginal sites and areas of archaeological sensitivity, and recommendations for any additional investigation (e.g. a sub-surface testing programme).

Whilst no European heritage sites have been recorded in the study area, there is the potential for buried or submerged structural remains of historical buildings to be affected during any excavation.

The cultural heritage consultant has recommended further field investigation in order to determine the likelihood of archaeological remains associated with late 19th and early 20th century structures being present within the study area. The field assessment would involve a thorough survey (N.B. the Aboriginal investigation and the historical investigation could be undertaken concurrently), which would seek to identify any historical archaeological sites and areas of archaeological sensitivity. The development of a Masterplan would assist in the formulation of a field survey strategy to target areas affected by development.

Further discussion is also required with Wathaurong Aboriginal Co-op (WAC), Aboriginal Affairs Victoria (AAV) and Heritage Victoria (HV) to discuss identified sites of archaeological significance and potential sensitivity of the study area.

Native Title

This study was confined to the impact that the project would have on the cultural heritage values of the study area. If the study area contains Crown land where native title might not have been extinguished, and native title interests are known to exist, the provisions of the Commonwealth *Native Title* Act 1993 may apply. Specialist advice should be sought on potential risks and legal obligations associated with native title legislation prior to developmental works commencing.

5.6 Landscape Character

The predicted effects of the proposed harbour redevelopment works on the landscape character of the Portarlington area were identified and assessed.

5.6.1 Risk Analysis

The results of the risk assessment are presented in

Table 5-10 and discussed in further detail below.

Table 5-10: Risk assessment for the landscape character

Aspect	Identified Risk	Likelihood	Consequence	Risk Rating	Management Measures /Further Investigation
Public amenity	Construction works may impact local visual amenity.	Rare	Negligible	Low	Only short term, low level impacts envisaged. Traffic management measures and heavy vehicle access to be considered in Masterplanning phase.
	New harbour may change local visual amenity (permanent change to visual landscape)	Rare	Negligible	Low	The potential long term impact will be dependent on the compatibility of future development options with the existing landscape. At this stage no boat storage or dry dock areas are proposed. The visual impacts will need to be further discussed at the Masterplanning stage.

The relatively gentle topography, that reduces opportunities for significant overlooking, combined with vegetation and structures in the landscape that filter or block views, contributes to an inland landscape setting that is able to absorb change effectively. The openness of the coastal edge and the location of the study area at the head of a shallow bay with direct views over water to the core study area, result in a coastal setting that is able to accommodate change that is visually similar in form, colour and scale to the existing elements, but not able to not able to easily absorb change that results in significant contrast or the introduction of elements of a heavier appearance, such as boat storage facilities.

5.6.2 Management Measures & Further Investigation

The potential impacts of coastal development on the landscape setting of the coastal zone within the broader study area would need to be managed through careful layout, design and material selection. Potential visual impacts will be further assessed through the development of the Master Plan for the site, and will include issues such as traffic management during construction, allocation of open space, verticality of harbour structures, layout, design and material selection.

A community consultation program involving local residents is currently being developed by Parks Victoria.

5.7 Structural Conditions

The condition of the concrete and timber components of the structure was assessed against the key design elements of the 2002 concept design. The results of the risk assessment are presented in Table 5-11 and discussed in further detail below.

Table 5-11: Risk assessment for the structural conditions of the Portarlington Pier

Aspect	Identified Risk	Likelihood	Consequence	Risk Rating	Management Measures /Further Investigation
Load capacity/ Public safety	Reduction in load capacity of concrete approach may cause safety risk to users .	Almost certain	Major	Extreme	Remedial option has been designed to achieve an 8t dual (6t single axle) vehicle load capacity of the pier over a design life of 5 years.
	Reduction in load capacity of timber jetty may cause safety risk to users .	Unlikely	Major	High	Maunsell has determined that the piles have sufficient residual capacity to carry the design loads (3 tonnes and 6 tonnes for single and double axle vehicles, respectively). However, If the concrete section of the jetty is upgraded then load restrictions and traffic management measures would be required for the timber section. Upgrade recommended.

5.7.1 Concrete Pier Structure

The condition assessment of the concrete structure undertaken by Maunsell (2007c) revealed that since the previous assessment undertaken in 2001, the capacity of the concrete structure has decreased significantly due to deterioration of the reinforcement in the deck beams, which has now compromised the ultimate capacity of the structure. Maunsell (2007d) determined that the maximum loading on the current structure is 3.37t single axle (1.69t double axle).

Maunsell (2007d) recommended remedial measures which will provide for a load of 6 tonnes and 8 tonnes for single and double axle vehicles respectively at 5 years.

5.7.2 Timber Jetty

The condition assessment of the timber jetty determined that the residual capacity is now less that half of the design capacity, Maunsell (2007c) determined that the timber piles still have sufficient capacity to carry the initial design loads, which are 3 tonnes and 6 tonnes for single and double axle vehicles, respectively.

5.7.3 Pier Replacement / Redevelopment

Three options have been investigated and a description of the scope, estimated cost and load capacity at 5 years for each option is outlined in the detailed engineering assessment report (Maunsell, 2007d). The alternatives considered limitations to construction and fishing operations

during construction, as well as functionality once the repair treatment is completed, addressing these limitations as best as is practicable.

The preferred remediation option is to install steel plates to make the pier continuous over four bays. Making the structure continuous over four spans reduces the magnitude of sagging moments at the mid span of the U-Slab units, where deterioration is prevalent, and re-distributes forces to the crosshead locations. The chemically anchored steel plates would provide the required tensile capacity over the crossheads to carry the hogging moments induced, and further deterioration of the bottom reinforcement in the U-Slabs would not influence the overall capacity of the structure. This solution achieves the nominated 8t dual (6t single axle) vehicle load capacity requirement.

This option is also the most cost effective solution to achieve the 5 year design criteria of an 8t dual axle rating, and it is highly practical from a construction point of view. Furthermore, the solution would allow flexibility during construction so that the commercial fishing operations may not be significantly impeded.

6.0 Approvals Pathway

There are a number of local strategies that have been prepared to guide the future use and development of Portarlington township and its surrounds. Discussions with the City of Greater Geelong are required to firstly ensure that the strategic objectives of recent studies are aligned with the Master Planning process, and to identify the most appropriate planning tool to support the implementation of the Master Plan and the redevelopment of Portarlington Harbour.

Given that the proposed works are yet to be designed, the full suite of environmental legislative requirements and approvals pathway is yet to be confirmed. The key next step in the environmental approvals process is to determine the most appropriate environmental and planning approvals pathway and whether the Project is likely to trigger requirements under the *Environment Effects Act 1978*, and what other legislation may be applicable, such as the *Coastal Management Act 1995*.

Assessment of the proposal to determine whether an EES is required will then be undertaken against the *Ministerial guidelines for assessment of environmental effects under the Environment Effects Act 1978* (DSE 2006, seventh edition). A referral to the Minister in accordance with these guidelines will be required once the scale of development and key design features has been determined.

A referral to the Commonwealth Department of Environment and Water Resources (DEWR) will also be required, although based on the development footprint of the 2002 Concept Design, it is unlikely to trigger the controlling provisions of the *EPBC Act 1999*. The technical studies undertaken to date suggest that the project activities will not affect any matters of national environmental significance.

Consultation with EPA is also recommended to discuss potential water and sediment quality impacts arising from the proposed development. Confirmation is needed as to whether there are any licensing or approval requirements, and whether they can be mitigated through any features incorporated into the design. The EPA also need to confirm whether a Works Approval is required as there is the potential for 5,000 litres per day of sewage to be deposited or discharged from the site. Parks Victoria will also need to demonstrate compliance with the EPA's Best Practice Guidelines for Environmental Management – Dredging.

Furthermore, the current baseline assessment studies and the detailed investigations proposed, should be revisited if further amendments to the study area boundaries are made through the Masterplanning phase. Although the conclusions are unlikely to change significantly, it will enable a more accurate understanding of the potential project effects and assist in implementing key management actions and mitigation measures.

7.0 Inputs to Master planning

To progress the Master Planning process, the broad parameters of the concept plan need to be refined. In addition to the existing baseline studies and further technical studies, there are a number of additional inputs which will contribute to an integrated land use planning approach to deliver a Safe Harbour proposal for Portarlington that meets the key commercial, recreation and tourism objectives.

The Master Plan should be informed by:

- Types of infrastructure elements; including wave attenuation structures (wave screens, breakwaters), harbour design and layout, treatment of harbour entrance, location of hardstand areas and maintenance dredging requirements;
- The distribution of built development; including maximum building heights or building envelopes, design objectives for new buildings (external appearance, access to daylight, materials and finishes), signage, walking and cycle paths;
- The distribution of open space and recreation opportunities; including open and landscaped areas to be provided, landscape features, hard and soft landscaping; boundary screening security structures, beach access, landside fishing;
- The access and movement arrangements; including vehicular and pedestrian access, capacity of surrounding network, public transport, vehicle and pedestrian movement about and to and from the site, car and boat parking provisions, linkages to other activities;
- Retention and development of existing features; including buildings and features on the site, any historic or cultural assets and how they can be accommodated, and significant landscape vegetation;
- Social and community inputs; including facilities and features of benefit to the general public, new public facilities required, identity of township, strengthening relationship between town centre, foreshore and harbour;
- Tourism and commercial opportunities: including tourist accommodation and tourism retail (outside study area), streetscape improvements and connectivity between township and coastal areas;
- Likely zoning and development controls to support the implementation of the Master Plan;
- Community and stakeholder consultation plan; and
- Relevant local studies including:

  Portarlington/Indented Head Structure Plan April 2007
  Siting and Deigns Guidelines for the Victorian Coast, May 1998.
  Bellarine Peninsula Leisure and Recreational Needs Study 2005.

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