Draft Western Port Ramsar Site Management Plan

Department of Environment, Land, Water & Planning

State Government Victoria

DRAFT FOR COMMENT

Printed by (insert printing company name, suburb)

ISBN XXXXXXXXXXXXXXX

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Citation: xxxxx.
Cover Image: Seagrass beds and Black Swans in Yaringa Marine National Park - M. Rodrigue / Parks Victoria.

Contents

Acronyms

CAMBA	China Australia Migratory Bird Agreement
CPS	Components, Processes and Services
DEDJTR	Department of Economic Development, Jobs, Transport and Resources
DELWP	Department of Environment, Land, Water and Planning, *formerly* Department of Environment and Primary Industries
DoE	Department of Environment (Australian Government)
ECD	Ecological Character Description
EPA	Environment Protection Authority, Victoria
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
IUCN	International Union for Conservation of Nature
LAC	Limits of Acceptable Change
JAMBA	Japan Australia Migratory Bird Agreement
MER	Monitoring, evaluation and reporting
PPWCMA	Port Phillip and Western Port Catchment Management Authority
RIS	Ramsar Information Sheet
RCT	Resource Condition Target
ROKAMBA	Republic of Korea Australia Migratory Bird Agreement
SAG	Stakeholder Advisory Group
SC	Steering Committee
VWMS	*Victorian Waterway Management Strategy*

Western Port Ramsar Site Management Plan

1. Introduction

The current Western Port Ramsar Site Strategic Management Plan (Parks Victoria 2003) established the framework for the maintenance of for the maintenance of this site's unique ecological character at the site through conservation and wise use. The plan is now over a decade old and there has been significant progress in both our understanding of the ecological character of Western Port and strategic direction in management of the site and Ramsar wetlands in Australia. A consultative and collaborative process was undertaken to review and update the Ramsar site management plan. The outputs of this review process are documented in two products:

1. A revised Draft Western Port Ramsar Site Management Plan (**this document**), including a full description of the plan's development and technical appendices, and
2. A Draft Western Port Ramsar Site Management Plan summary document for a general audience that briefly outlines the process, and details the management strategies and responsibilities.

This Ramsar site management plan sits within a framework for the management of aquatic ecosystems within Australia and the State of Victoria. At the national level, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) establishes the basis for managing Ramsar sites. In Victoria the *Victorian Waterway Management Strategy* (VWMS; DEPI 2013) guides the management of rivers, estuaries and wetlands, and the renewal of the *Western Port Ramsar Site Management Plan* addresses Action no. 12.3 of the VWMS. There are 11 Ramsar sites in Victoria and management planning for seven of these are embedded within Regional Waterway Strategies that were developed in 2015. The Western Port Ramsar Site however, does not fall into one of the Regional Waterway Strategy areas and as such was considered to require a standalone management plan.

1.1 Purpose of the management plan

1.1.1 Ecological character

The *Convention on Wetlands of International Importance Especially as Waterfowl Habitat* (Ramsar [Iran] 2 February 1971) encourages the designation of sites containing representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity, to the List of Wetlands of International Importance (Ramsar List). These sites are commonly known as Ramsar sites. The Ramsar Convention, as it is commonly known, is an international intergovernmental treaty with the broad aims of halting and, where possible, reversing, the worldwide loss of wetlands and to conserve those that remain through wise use and management (DSEWPAC 2012).

Under the terms of the Convention contracting parties nominate wetlands to be designated as Wetlands of International Importance, with nominated sites required to meet at least one of nine listing criteria. The act of designating a wetland as a Ramsar site carries with it certain obligations, including managing the site to maintain its 'ecological character' and to have procedures in place to detect if any threatening processes are likely to, or have altered, the 'ecological character'. The Ramsar Convention has defined "ecological character" and "change in ecological character" as (Ramsar Convention 2005):

"*Ecological character is the combination of the ecosystem components, processes and benefits/services [CPS] that characterise the wetlands at a given point in time*" and

"…change in ecological character is the human induced adverse alteration of any ecosystem component, process and or ecosystem benefit/service."

Ramsar: A network of sites

There is a network of over 2000 Ramsar wetlands across the globe that is dedicated to sustaining biodiversity and wise use. One of the important functions, and a primary purpose for the establishment of the Convention, is to protect sites in different countries that are important for migratory birds.

The migratory birds that visit Australia are part of the East Asian-Australasian Flyway and most of them migrate from breeding grounds in North-east Asia and Alaska to non-breeding grounds in Australia and New Zealand, covering the journey of 10 000 kilometres twice in a single year.

The lifecycle of most international migratory shorebirds involves (Bamford et al. 2008):

- breeding in May to August (northern hemisphere);
- southward migration to the southern hemisphere (August to November);
- feeding and foraging in the southern hemisphere (August to April); and
- northward migration to breeding grounds (March to May).

During both northward and southward migration, birds may stop at areas on route to rest and feed. These stopovers are referred to as "staging" areas and are important for the birds' survival. In addition, birds on their first southward migration that have not yet reached breeding maturity may remain in Australia over the southern winter period.

Other migratory species that are supported by the Western Port Ramsar Site include species such as the double-banded plover, which migrate between New Zealand and Australia spending the non-breeding (winter) season on Australian shores.

The Western Port Ramsar Site supports over 30 species that are international migrants and listed under migratory agreements with China, Japan and the Republic of Korea. Important habitats within the site include the extensive intertidal mudflats and saltmarsh where migratory waders feed. High tide roosting sites, where waders can rest are also important.

Migratory waders in Australia need to build up their energy reserves for the homeward journey. This means that they not only require abundant food sources, but they need to minimise their activity. Disturbance of waders when roosting or feeding may result in a significant loss of energy. This may even compromise their ability to build up enough reserves to complete the return journey to breeding grounds. Disturbance of migratory shorebirds may occur as a result of four wheel driving on beaches or in saltmarsh and intertidal areas, unleashed dogs, recreational fishing (in some instances); boating and jet skiing and any activity in the intertidal zone that causes significant noise or light. Migratory waders are also susceptible to predation by foxes and cats.

Populations of many migratory wader species are in decline, primarily through loss of habitat in breeding and staging areas outside Australia. This makes them more vulnerable while in Australia and increases the importance of maintaining habitat and conditions at overwintering sites. Residents and visitors to Western Port need to work together to help protect and conserve these important species.

Under Article 3.2 of the Ramsar Convention a notification of change is required if the ecological character of a site has changed, is changing, or *is likely* to change as the result of human activities. The Australian Government has established a number of principles to guide notifications in Australia (Department of the Environment, Water Heritage and the Arts 2009):

- Assessment of change will be undertaken with respect to *critical* components, processes and benefits/services of the ecological character of the site.
- An assessment of change to support a notification must be based on best available science.
- The fact that a site was undergoing human-induced ecological character change at the time of listing does not preclude the need for an assessment, and possible notification of change, if there is evidence of significant ongoing adverse ecological change.
- Where the natural variability of a site cannot reasonably be established for the critical component process, benefit or service against which change is being assessed, a notification, if made, will only be on the basis of *'is likely to'* change.
- A notification will not be made where the apparent character change has been identified as arising from the use of inadequate data sets at the time of listing.
- A notification will not be made where climate change is the principal cause of identified ecological character change.

1.1.2 Objectives of the draft management plan

The primary purpose of the Western Port Ramsar Site Management Plan is to maintain ecological character and promote wise use of the site. Wise use is defined by the Convention as (Ramsar Convention 2005):

"*the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development*".

The Western Port Ramsar Site supports a number of ecological, socio-economic and cultural values (see section 2.4.2). Socio-economic and cultural values of the site (e.g. tourism, recreation) result from maintaining the condition of the Ramsar site. This plan has adopted the principle that by maintaining (or improving) ecological character, the socio-economic and cultural values associated with the Ramsar site will also be conserved, within the concept of wise use. Therefore, the primary objective of the Western Port Ramsar Site Management Plan is:

"***To maintain, and where necessary improve, the ecological character of the Western Port Ramsar Site and promote wise and sustainable use***".

1.1.3 Ramsar documentation

Ramsar site management to maintain ecological character is reliant on a number of key documents and processes as illustrated in Figure 1. The three key documents are:

Ramsar Information Sheet (RIS) - compiled for each site it documents the essential information related to the site and its management. The Administrative Authority of each Contracting Party submits the RIS to the Ramsar Secretariat. In the case of Australia this is the Australian Government Department of the Environment (DoE). The Parties have committed to providing updated RIS information for their Ramsar sites every six years, or on the occasion of any significant change in a site's ecological character. The most recent RIS for Western Port was compiled in 1999 and can be obtained from the DoE website (http://www.environment.gov.au/cgi-bin/wetlands/ramsardetails.pl?refcode=19#). This RIS is currently being updated with a revised RIS due in mid-2016.

Ecological Character Description (ECD) – provides a more detailed and quantitative description of ecological character for a Ramsar site. The ECD establishes a benchmark, at the time of listing, which in the

case of Western Port is 1982. The ECD identifies the critical components, processes and services of the site (critical CPS) and sets limits of acceptable change (LAC). The Australia Government has developed a standard method for describing ecological character (Department of the Environment, Water, Heritage and the Arts 2008). The ECD for Western Port was completed in 2011 and can be accessed from the DoE website (http://www.environment.gov.au/cgi-bin/wetlands/ramsardetails.pl?refcode=19#).

Management plan – documents the management strategies required to protect and restore the ecological character of a Ramsar site. In Australia, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) establishes the framework for management of Australian Ramsar sites, and Schedule 6 of *Environment Protection and Biodiversity Conservation Regulations 2000* outlines the principles relevant to the preparation of Ramsar site management plans (Text Box 1).

Ramsar Rolling Review – The Department of Environment has developed a three-year Ramsar Rolling Review program for reporting the status of the ecological character of Australia's Ramsar sites. The broad aims of the Ramsar Rolling Review program are to:

- Review and report the on status of the ecological character of Australia's Ramsar sites.
- Be a tool to assist managing sites in order to maintain their ecological character, improving links between ecological character, site management plans and monitoring programs for critical components, processes and services and associated threats.
- Provide input to a database of baseline and threat data.
- Record updates as knowledge gaps are addressed and refinement of Limits of Acceptable Change.
- Highlight issues and facilitate assessment of a potential change of character, focussing on proactive management before the situation requires notification.
- Identify broad trends or common threats across site and jurisdiction boundaries.

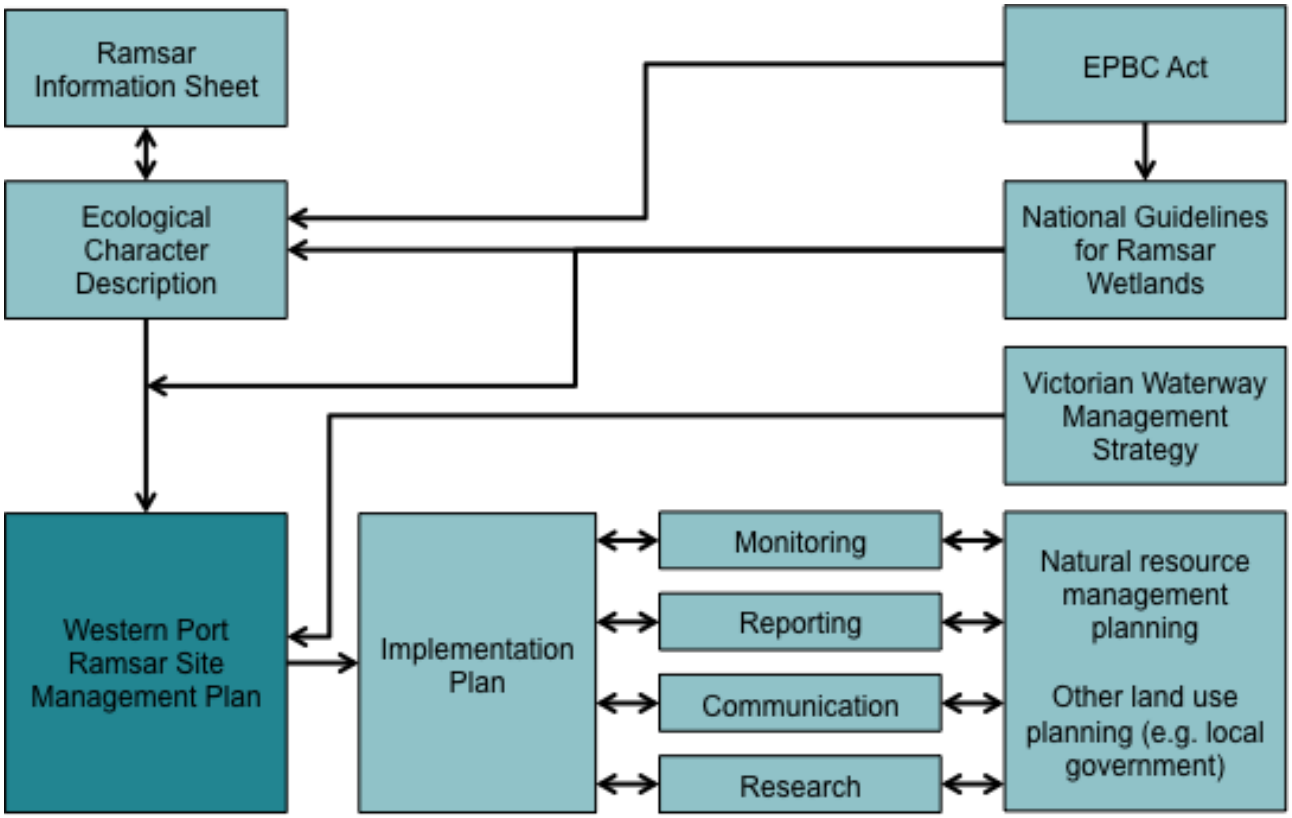


Figure 1: The Western Port Ramsar Site Management Plan in context of other requirements for the management of Ramsar sites (adapted from DEWHA 2008).

1 General principles

1.01 The primary purpose of management of a declared Ramsar wetland must be, in accordance with the Ramsar Convention:

(a) to describe and maintain the ecological character of the wetland; and

(b) to formulate and implement planning that promotes:

(i) conservation of the wetland; and

(ii) wise and sustainable use of the wetland for the benefit of humanity in a way that is compatible with maintenance of the natural properties of the ecosystem.

1.02 Wetland management should provide for public consultation on decisions and actions that may have a significant impact on the wetland.

1.03 Wetland management should make special provision, if appropriate, for the involvement of people who:

(a) have a particular interest in the wetland; and

(b) may be affected by the management of the wetland.

1.04 Wetland management should provide for continuing community and technical input.

2 Management planning

2.01 At least one management plan should be prepared for each declared Ramsar wetland.

2.02 A management plan for a declared Ramsar wetland should:

(a) describe its ecological character; and

(b) state the characteristics that make it a wetland of international importance under the Ramsar Convention; and

(c) state what must be done to maintain its ecological character; and

(d) promote its conservation and sustainable use for the benefit of humanity in a way that is compatible with maintenance of the natural properties of the ecosystem; and

(e) state mechanisms to deal with the impacts of actions that individually or cumulatively endanger its ecological character, including risks arising from:

(i) physical loss, modification or encroachment on the wetland; or

(ii) loss of biodiversity; or

(iii) pollution and nutrient input; or

(iv) changes to water regimes; or

(v) utilisation of resources; or

(vi) introduction of invasive species; and

(f) state whether the wetland needs restoration or rehabilitation; and

(g) if restoration or rehabilitation is needed--explain how the plan provides for restoration or rehabilitation; and

(h) provide for continuing monitoring and reporting on the state of its ecological character; and

(i) be based on an integrated catchment management approach; and

(j) include adequate processes for public consultation on the elements of the plan; and

(k) be reviewed at intervals of not more than 7 years.

3 Environmental impact assessment and approval

3.01 This principle applies to the assessment of an action that is likely to have a significant impact on the ecological character of a Ramsar wetland (whether the action is to occur inside the wetland or not).

3.02 Before the action is taken, the likely environmental impact of the action on the wetland's ecological character should be assessed under a statutory environmental impact assessment and approval process.

3.03 The assessment process should:

(a) identify any part of the ecological character of the wetland that is likely to be affected by the action; and

(b) examine how the ecological character of the wetland might be affected; and

(c) provide adequate opportunity for public consultation.

3.04 An action should not be approved if it would be inconsistent with:

(a) maintaining the ecological character of the wetland; or

(b) providing for the conservation and sustainable use of the wetland.

3.05 Approval of the action should be subject to conditions, if necessary, to ensure that the ecological character of the wetland is maintained.

3.06 The action should be monitored by the authority responsible for giving the approval (or another appropriate authority) and, if necessary, enforcement action should be taken to ensure compliance with the conditions.

Text Box 1: Australian Ramsar Management Principles (*Environment Protection and Biodiversity Conservation Regulations 2000*).

1.2 Relevant policy and legislation

1.2.1 International

Ramsar Convention

The Convention on Wetlands of International Importance, otherwise known as the Ramsar Convention, was signed in Ramsar Iran in 1971 and came into force in 1975. It provides the framework for local, regional and national actions, and international cooperation, for the conservation and wise use of wetlands. Wetlands of International Importance are selected on the basis of their international significance in terms of ecology, botany, zoology, limnology and/or hydrology.

Migratory bird bilateral agreements and conventions

Australia is party to a number of bilateral agreements, initiatives and conventions for the conservation of migratory birds, which are relevant to the Western Port Ramsar Site. The bilateral agreements are:

- *Japan-Australia Migratory Bird Agreement (JAMBA)* – The agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment, 1974;
- *China-Australia Migratory Bird Agreement (CAMBA)* - The Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment 1986;
- *Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA)* - The Agreement between the Government of Australia and the Republic of Korea for the Protection of Migratory Birds and their Environment, 2006; and
- *The Bonn Convention on Migratory Species (CMS)* - The Bonn Convention adopts a framework in which countries with jurisdiction over any part of the range of a particular species co-operate to prevent migratory species becoming endangered. For Australian purposes, many of the species are migratory birds.

East Asian-Australasian Flyway Partnership

The East Asian-Australasian Flyway Partnership (EAAFP) was launched in November 2006 and is an informal and voluntary initiative that aims to protect migratory waterbirds, their habitat and the livelihoods of people dependent upon them. The partnership covers the East Asia-Australasia flyway which covers 22 countries and extends from the Arctic Circle, through East and South-east Asia, to Australia and New Zealand.

Partners include governments, site managers, academic institutions, UN agencies, development agencies, industrial and private sector, non-government organisations and local people. The partnership provides a platform for dialogue and cooperation, supports the listing and maintenance of internationally recognised wetlands and supports a range of community education programs and activities.

Biosphere reserves

In 1971 the United Nations Educational, Scientific and Cultural Organisation (UNESCO) launched its Man and Biosphere Programme (MAB) with the aim of establishing a scientific basis for the improvement of relationships between people and their environments. Under the MAB, 651 World Biospheres have been designated in 120 participating countries; including Western Port. Biosphere Reserves act as a keystone of MAB by providing a global network of sites for cooperative research.

The EPBC Act includes provisions for the development of cooperative arrangements between the Commonwealth, states and territories in the development of biosphere reserves. Parks Australia, DoE, acts as the national focal point for biosphere reserves in Australia while the Australian National Commission for UNESCO has overall responsibility for UNESCO activities in Australia.

1.2.2 National

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The EPBC Act regulates actions that will have or are likely to have a significant impact on any matter of national environmental significance, which includes the ecological character of a Ramsar wetland (EPBC Act 1999 s16(1)). An action that will have or is likely to have a significant impact on a Ramsar wetland will require an environmental assessment and approval under the EPBC Act. An 'action' includes a project, a development, an undertaking or an activity or series of activities (http://www.environment.gov.au/epbc/index.html).

The EPBC Act establishes a framework for managing Ramsar wetlands, through the Australian Ramsar Management Principles (EPBC Act 1999 s335), which are set out in Schedule 6 of the *Environment Protection and Biodiversity Conservation Regulations 2000*. These principles are intended to promote national standards of management, planning, environmental impact assessment, community involvement, and monitoring, for all of Australia's Ramsar wetlands in a way that is consistent with Australia's obligations under the Ramsar Convention. Some matters protected under the EPBC Act are not protected under local or state/territory legislation, for example, many migratory birds are not specifically protected under State legislation. Species listed under international treaties JAMBA, CAMBA and CMS have been included in the List of Migratory species under the Act. Threatened species and communities listed under the EPBC Act may also occur, or have habitat in the Ramsar site; some species listed under State legislation as threatened are not listed under the EPBC Act as threatened, usually because they are not threatened at the national (often equivalent to whole-of-population) level. The Regulations also cover matters relevant to the preparation of management plans, environmental assessment of actions that may affect the site, and the community consultation process.

Native Title Act 1993

This Act provides for the recognition and protection of native title. It establishes ways in which future dealings affecting native title may proceed and sets standards for such dealing. It establishes a mechanism for determining claims to native title. It provides for, or permits, the validation of past acts, and intermediate period acts, invalidated because of the existence of native title. The *Native Title Act* 1993 applies to the management of the Ramsar site and the Marine National Parks within the site.

1.2.3 Victorian state policy and legislation

The Environment Protection Act 1970

This Act establishes the Environment Protection Authority and makes provision for the Authority's powers, duties and functions. These relate to improving the air, land and water environments by managing waters, control of noise and control of pollution. State Environment Protection Policies (SEPPs) are subordinate legislation made under the provisions of the Act. SEPP (Waters of Victoria) sets water quality objectives to protect the beneficial uses of waters and covers wetlands in a general nature. It includes a specific schedule (F8) that covers Western Port Bay, including the Ramsar site. SEPP (Waters of Victoria) is currently under review.

National Parks Act 1975

This Act makes provision for the preservation and protection of the natural environment including wilderness areas and remote and natural areas. This includes the protection and preservation of indigenous flora and fauna and of features of scenic or archaeological, ecological, geological, historic or other scientific interest in those parks. It allows for the study of ecology, geology, botany, zoology and other sciences relating to the conservation of the natural environment in those parks; and for the responsible management of the land in those parks. . Within areas managed under the National Parks Act managers must ensure that the park is controlled and managed, in accordance with the objects of this Act, in a manner that will preserve and protect the park in its natural condition for the use, enjoyment and education of the public, preserve and protect indigenous flora and fauna in the park, and exterminate or control exotic fauna and fauna in the park.

The Western Port Ramsar Site contains three marine national parks: Churchill Island Marine National Park, French Island Marine National Park and Yaringa Marine National Park, and a portion of the French Island National Park.

Environment Effects Act 1978

This Act establishes the processes for assessment of proposed projects (works) that are capable of having a significant effect on the environment. The Act establishes the role of the Minister for Planning to decide whether an Environmental Effects Statement (EES) is required. The roles and responsibilities of the EES process are described in the Ministerial guidelines for Assessment of Environmental Effects under the Environment Effects Act 1978 (DSE 2006). The guidelines specify the criteria for referring a project to the Minister for decision on the requirement for an EES. These include effects of potential long term change to the ecological character of a Ramsar site.

Crown Land (Reserves) Act 1978

This Act provides the framework for the administration and management of Crown land reserves. Wetlands in many Ramsar sites are reserved under the Act in reserves such as nature conservation reserves, wildlife reserves, coastal reserves and water supply reserves. The Act also deals with the making of regulations, committees of management and leasing and licensing. Within the Ramsar site areas reserved under this Act include the Western Port Intertidal Coastal Reserve and the North Western Port Nature Conservation Reserve.

Fisheries Act 1995

This Act provides a framework for the regulation, management and conservation of Victorian fisheries. It deals with commercial and recreational licences, fish culture, noxious aquatic species, research and development, the declaration and management of fisheries reserves; and the preparation of management plans for individual fisheries, declared noxious aquatic species and fisheries reserves.

Flora and Fauna Guarantee Act 1988

This Act provides a legislative and administrative framework for the conservation of biodiversity in Victoria. The Act provides for the listing of threatened taxa, communities and potentially threatening processes. It requires the preparation of action statements for listed species, communities and potentially threatening processes and sets out the process for implementing interim conservation orders to protect critical habitats. The Act also seeks to provide programs for community education in the conservation of flora and fauna and to encourage co-operative management of flora and fauna. Ramsar sites provide habitat for many of Victoria's threatened species and support threatened communities.

Water Act 1989

This Act establishes rights and obligations in relation to water resources and provides mechanisms for the allocation of water resources. This includes the consideration of environmental water needs of rivers and wetlands as well as for human uses such as urban water supply and irrigation.

Catchment and Land Protection Act 1994

This Act Provides for the coordinated strategic planning of Victoria's coastal resources. The Act established the Victorian Coastal Council and three Regional Coastal Boards to facilitate this process. The Act requires the written consent of the Minister for Environment and Climate Change to use, develop or change the use of coastal Crown land. When considering an application, the Minister must consider the consistency of proposals with the Victorian Coastal Strategy, relevant Land Conservation Council and Environment Conservation Council recommendations and, relevant Management Plans and Coastal Action Plans.

Coastal Management Act 1995

This Act sets up a framework for the integrated management and protection of catchments. It establishes processes to encourage and support community participation in the management of land and water resources and provides for a system of controls on noxious weeds and pest animals.

Aboriginal Heritage Act 2006

This Act provides for the protection and management of Victoria's Aboriginal heritage. It establishes the Victorian Aboriginal Heritage Council to advise the Minister in the management of cultural heritage and

registered Aboriginal parties. The Act also deals with cultural heritage management plans, cultural heritage permits and agreements. The Act also includes enforcement provisions and processes for handling dispute resolution. This includes the review of certain decisions through the Victorian Civil and Administrative Tribunal (VCAT).

Port Management Act 1995

This Act provides for the establishment, management and operation of commercial trading and local ports in Victoria and appointed Port of Hastings Corporation The Act to provides for the establishment, management and operation of commercial trading and local ports in Victoria and appointed Port of Hastings Corporation as manager of the Port of Hastings.

Parks Victoria is appointed as the local Port Manager for Western Port and has responsibilities for development of the Safety and Environmental Management Plan, as well as primary responsibilities for recreation and navigation outside of the Port of Hastings, including recreational navigational aids, dredging, moorings and management of port infrastructure catering for recreational and commercial activities including tour operators, ferry services, fishing fleets and aquaculture operations.

Victorian Waterway Management Strategy

The 2013 Victorian Waterway Management Strategy (VWMS) provides the framework for government – in partnership with the community - to maintain or improve the condition of rivers, estuaries and wetlands so that they can continue to provide environmental, social, cultural and economic values for all Victorians. The framework is based on regional planning processes and decision-making, within the broader system of integrated catchment management in Victoria.

1.2.4 Victorian and local plans and policy

Port Phillip and Western Port Regional Catchment Strategy

The Port Phillip and Western Port Regional Catchment Strategy is a statutory documents under the CaLP Act that provides the overarching framework for land, water and biodiversity management in the region.

Better Bays and Waterways

Better Bays and Waterways was developed by EPA Victoria and Melbourne Water to achieve water quality improvement for the Port Phillip and Western Port region. The plan was aimed at reducing the amount of pollutants entering waterways and bays from rural, urban and coastal areas, including priority actions for reducing sediments, nutrients and toxicants into Western Port Bay.

Healthy Waterways Strategy

The Healthy Waterways Strategy outlines Melbourne Water's role in managing rivers, estuaries and wetlands in the Port Phillip and Westernport region. This strategy focuses on investing in areas that the community values and that will protect and improve environmental values and increase liveability.

1.3 Development of the draft plan

The Department of Environment, Land, Water and Planning (DEWLP) commissioned the project to renew the 2003 Western Port Ramsar Site Strategic Management Plan. The project was based on a robust and transparent method to analyse and prioritise values and locations within the Western Port Ramsar Site. The overall aim of the prioritisation of values and threats was to maintain and where possible, restore the ecological character of the site, within a coordinated and collaborative framework for management.

A work plan was developed (see Appendix A) to guide the project. Further detail on the methods used is provided in the sections below:

- Risk assessment – section 3.1
- Identification of priority values – section 3.2
- Identification of priority threats – section 3.3
- Management strategies – section 4.1.

1.3.1 Principles of the planning process

Throughout the development of the Western Port Ramsar Site Management Plan, a number of principles were adopted and underpinned the planning process, consistent with the guiding principles of the VWMS (Department of Environment and Primary Industries 2013):

Stakeholder involvement – this plan has been developed with the input of a broad range of stakeholders through every phase (see section 1.3.2).

Evidence-based approach – best available knowledge has been used to underpin the development of this plan including the risk assessment and prioritisation of values and threats.

Precautionary principle – lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation.

Building on existing activities – there are a large number of activities already being implemented within the catchment and the Western Port Ramsar Site to maintain and improve condition and ecosystem services. This plan seeks to build on these existing activities rather than duplicate effort.

Adaptive management – the plan life is for seven years, with a mid-term review after three years. A monitoring program has been included and the principles of monitor, evaluate, report and improve have been adopted.

1.3.2 Stakeholder involvement

The importance of stakeholder engagement in the development of management plans for Ramsar sites is recognised by the Convention and in the Australian Ramsar Management Principles (Text Box 1). In terms of the development of this management plan, stakeholders were involved in every step of the process. A communications and engagement strategy was developed prior to the commencement of the project and refined as necessary (see Appendix B).

The major groups involved in the development of this project were:

Steering Committee (SC): Representatives of agencies primarily responsible for the management of the Ramsar site (Port Phillip and Western Port CMA, DELWP, Parks Victoria, Melbourne Water, EPA Victoria and DoE).

Stakeholder Advisory Group (SAG): Representatives of State Government agencies, local government and Non-Government Organisations with an interest and responsibility in managing aspects of Western Port were engaged and invited to participate in workshops related to identifying priority values and threats and strategic management actions (see Appendix B).

Community: Broader community and stakeholder engagement through the Western Port Ramsar Management Plan webpage (http://www.delwp.vic.gov.au/water/rivers,-estuaries-and-wetlands/western-port-ramsar-site-management-plan).

2 Western Port Ramsar Site

A complete description of the ecological character of the Western Port Ramsar Site is contained in the ecological character description (ECD) (Kellogg Brown and Root 2010). A summary of this information relevant to the management plan for the site is provided below.

2.1 Location

Western Port Ramsar Site is located 60 kilometres southeast of Melbourne and comprises a large proportion of the Western Port embayment to the north of Phillip Island (Figure 2). The site consists of large shallow intertidal areas, dissected by deeper channels and covers approximately 60,000 hectares. It includes a number of small islands such as includes Quail, Elizabeth and Ram Islands and the southern tip of French Island known as Tortoise Head. The main body of French Island lies in the centre of Western Port, but is excluded from the Ramsar Site.

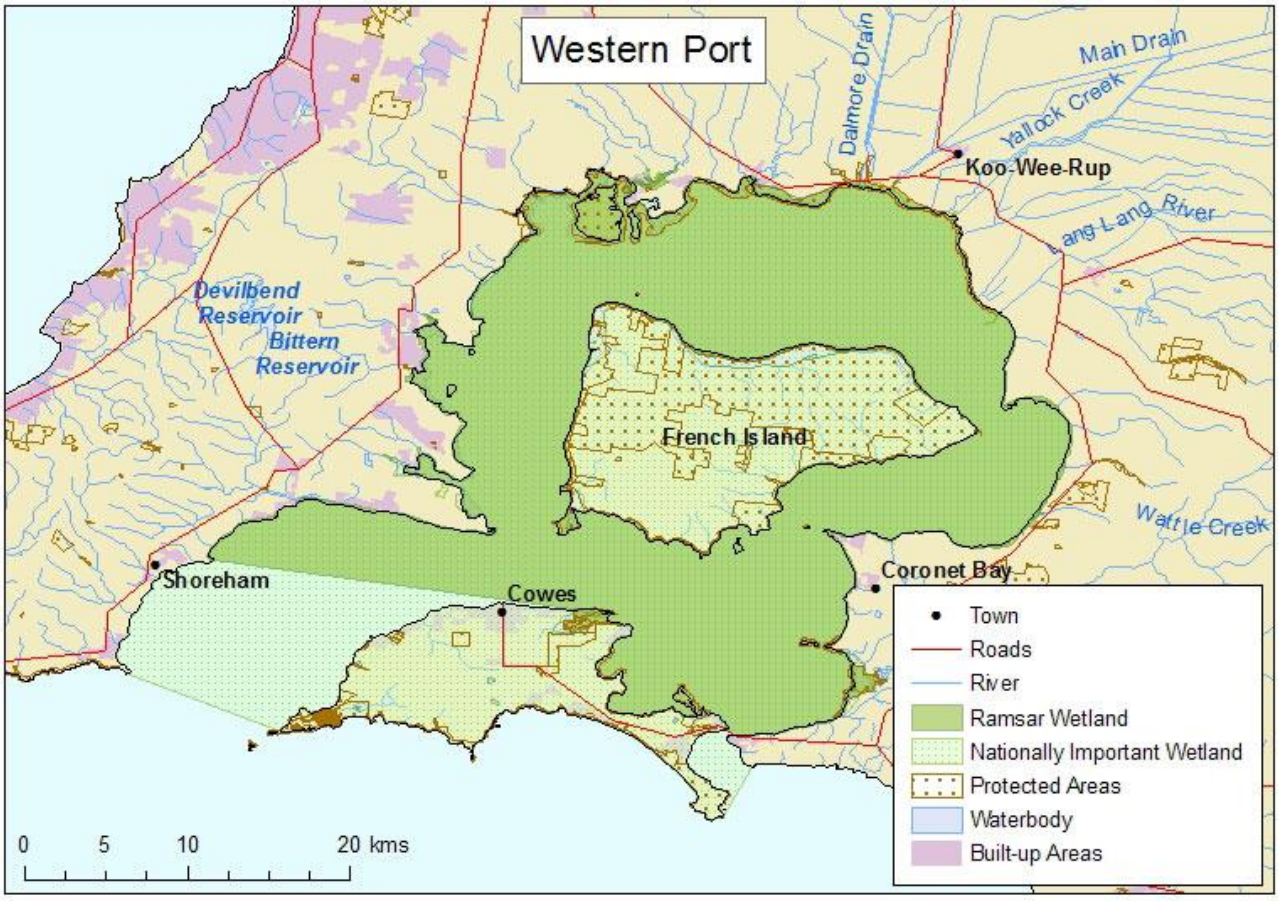


Figure 2: Map of the Western Port Ramsar Site (http://www.environment.gov.au/cgi-bin/wetlands/ramsardetails.pl?refcode=19#).

2.2 Land status and site managers

The Western Port catchment extends from the Strzelecki Ranges in the east to the Yarra Ranges in the north and the Mornington Peninsula in the west, covering over 3,700 square kilometres. Most of the catchment is modified to support rural and peri-urban land uses (Melbourne Water 2009):

- Primary industries include dairying, beef production, poultry, horticulture and quarrying;
- Urban, industrial and tourist areas and lifestyle and hobby farms make up a smaller proportion; and

- Some forested areas remain in the upper catchment, French Island and the Mornington Peninsula.

There are a variety of tenures associated with the lands and waters of the Western Port Ramsar Site, and these are detailed in (Table 1). There are also a number of different agencies with responsibilities associated with managing aspects of the site, and these are summarised in Table 2.

Table 1: Land tenure within the Western Port Ramsar Site and the associated land managers.

Area	Land tenure	Legal status	Management
Yaringa, French Island and Churchill Island Marine National Parks	Marine National Park	National Parks Act 1975	Parks Victoria
Waters and Sea bed	Unreserved Crown Land	Land Act 1958	DELWP
Waters – Recreation and Navigation	Unreserved Crown Land	Marine Act 1988	Parks Victoria
Port Waters of the Port of Hastings – commercial shipping channels	Unreserved Crown Land	Port Management Act Act 1995	Victorian Channels Authority (Toll Western Port)
150 metres seawards of high water mark around French Island	French Island National Park	National Parks Act 1975	Parks Victoria
Hanns Inlet	Declared naval waters	Control of Naval Waters Act 1918	Department of Defence
Shoreline near Somers	Coastal Reserve	Crown Land (Reserves) Act 1978	Parks Victoria
	Public Purpose Reserves	Crown Land (Reserves) Act 1978	DELWP
Shoreline from Stony Point to Jacks Beach	Coastal Reserve	Crown Land (Reserves) Act 1978	Stony Point – Crib Point Committee of Management
Jacks Beach to Hastings (Bittern Wetlands)	Unreserved Crown Land	Land Act 1958	Currently under discussion
Shoreline from east of Tyabb to Tooradin	Coastal Reserve	Crown Land (Reserves) Act 1978	Parks Victoria
	Nature Conservation Reserve	Wildlife Act 1975 and Land Act 1958	Parks Victoria
North-eastern Shoreline	Coastal Reserve	Crown Land (Reserves) Act 1978	Parks Victoria
	Nature Conservation Reserve	Land Act 1958	Parks Victoria
Shoreline near Corinella	Coastal Reserve	Crown Land (Reserves) Act 1978	Parks Victoria
Shoreline near Bass River	Nature Conservation Reserve	Land Act 1958	Parks Victoria
Churchill Island	Nature Park	Crown Land (Reserves) Act 1978	Phillip Island Nature Park
Shoreline near Rhyll	Coastal Reserve	Crown Land (Reserves) Act 1978	Parks Victoria
	Nature Park	Crown Land (Reserves) Act 1978	Phillip Island Nature Park
French Island Shoreline	National Park	National Parks Act 1975	Parks Victoria
Elizabeth & Sandstone Islands	Freehold	Private Land	Private
Adjacent to Quail Island Nature Conservation Reserve	Yaringa Marine National Park	National Parks Act 1975	Parks Victoria
Waters adjacent to the northern shore of French Island National Park	French Island Marine National Park	National Parks Act 1975	Parks Victoria
South of Rhyll, on the eastern shore of Phillip Island	Churchill Island Marine National Park	National Parks Act 1975	Parks Victoria

Table 2: Lead management agencies and their key responsibilities (Parks Victoria 2003).

Agency	Overarching responsibility	Responsibility in Western Port
Parks Victoria	Manages parks and conservation reserves and the local port of Western Port including the safety and environmental management plan for water outside the Port of Hastings.	Manage many high value conservation areas including three marine national parks, French Island National Park, coastal crown land reserves. Parks Victoria is the Local Port manager of Western Port.
Department of Environment, Land Water and Planning (DELWP)	Strategic direction for park and reserve management; flora and fauna management and implementation of the Ramsar Convention in Victoria; catchment and water management, forest management, coastal and port management; leasing, licensing and management of public land, strategic and statutory land use planning including the administration of the Victorian Planning Provisions.	Policy advice for the management of the Western Port Ramsar Site. Appointment and oversee Committees of Management on Crown foreshore reserves, including assist in the preparation of Coastal Management Plans. Administer *Coastal Management Act 1995* for use and development of coastal Crown land.
Department of Economic Development, Jobs, Transport and Resources	Provides strategic direction for fisheries management and research, agricultural services and sustainable development of Victoria's energy and mineral resources.	Manage recreational fishing for the Ramsar site in accordance with Fisheries Act 1995. Strategic and operational catchment management services e.g. soil conservation, vegetation management and water quality monitoring and management.
Environment Protection Authority Victoria	Responsibility for and coordination of all activities relating to the discharge of waste into the environment and the generation, storage, treatment, transport and disposal of industrial waste and the emission of noise and for preventing or controlling pollution and noise and protecting and improving the quality of the environment.	Licence sewage and other discharges. Report on environmental quality as required under SEPP (Waters of Victoria).
Port of Hastings Corporation	Responsible for the effective management and development of local ports and the safe use of waterways.	Operation of local port of Hastings as per overarching responsibilities including specifically maintenance of port and waterway access.
Department of Defence	Management of Commonwealth land	Manage the HMAS Cerberus naval base.
Victorian Coastal Council	Strategic statewide coastal planning; preparation and implementation of the Victorian Coastal Strategy; advise the Minister on coastal issues.	Develop the regional coastal action plans and guidelines for coastal planning and management within the region; provide advice to Minister and Council on coastal development within the region; and implementation of, and facilitating public awareness of the Victorian Coastal Strategy, and coastal action plans.
Melbourne Water	Provision of water and sewerage services and the management of water supply storages and catchments. Caretaker of river health? Environmental Water delivery with Victorian Environment Water Holder in Tarago/Bunyip.	Supply drinking and recycled water and manage Melbourne's water supply catchments, sewage treatment and rivers, creeks and major drainage systems.
Shire of Bass Coast Mornington Peninsula Shire Council Shire of Cardinia City of Casey	Manage foreshores adjoining urban areas. Ensure orderly, sustainable development within the catchment to and within the boundary of the Ramsar site, through strategic land-use planning, improvement to the Planning Scheme and administration of the Planning Scheme.	Administer the planning scheme.
Port Phillip and Western Port CMA	Advise State Government on catchment management, and land and water resource issues and priorities. Encourage cooperation between land and water managers. Promote community awareness on catchment management issues.	Develop and implement Regional Catchment Management Strategies. Prepare and implement Action Plans. Manage surrounding catchment and inflowing streams and drainage.

2.3 Ramsar criteria met

At the time that Western Port was first nominated as a Wetland of International Importance, the criteria for identifying wetlands of international importance were the "Cagliari criteria", adopted at the first conference of contracting parties in Cagliari, Italy in 1980. The original nomination documentation for the Ramsar site considered that the site met three of these criteria as shown in (Table 3). However, no specific justification for these criteria was provided.

Table 3: Criteria for Identifying Wetlands of International Importance as at listing date, 1982. Criteria for which Western Port was listed are highlighted (Forests Commission 1983).

Basis	Number	Description
Criteria for waterfowl	1a	It regularly supports 10,000 ducks, geese and swans; or 10,000 coots or 20,000 shorebirds
	1b	It regularly supports 1% of the individuals in a population of one species or subspecies of waterfowl
	1c	It regularly supports 1% of the breeding pairs in a population of one species or subspecies of waterfowl
Criteria based on plants and animals	2a	It supports an appreciable number of rare, vulnerable or endangered species or subspecies of plant or animal
	2b	It is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna
	2c	It is of special value as the habitat of plants or animals at a critical stage of their biological cycle
	2d	It is of special value for one or more endemic plant or animal species or communities.
Criterion based on representative wetlands	3	It is a particularly good example of a specific type of wetland characteristic of its region.

The criteria under which a Ramsar site can be designated have gone through a series of changes, with the most recent major revisions occurring at the 9th Ramsar Conference in Kampala, Uganda 2005, when a ninth criterion was added. The most recent assessment of the site against Ramsar criteria indicated that at the time of listing in 1982, the site would have met six of the nine criteria as follows (DELWP in prep.):

Criterion 1: A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.

The appropriate bioregion for the site is the south-east coast drainage division which includes all of the coastline of Victoria and NSW and a small portion of the South Australian coast (Department of the Environment, Water, Heritage and the Arts 2008). Although there is not a complete inventory of wetlands and coastal ecosystems across the drainage division, there is evidence to suggest that Western Port contains good representatives of Ramsar wetland types: G (intertidal mud, sand or salt flats); H (intertidal marshes) and I (intertidal forested wetlands).

Western Port contains a very large expanse of intertidal sand and mudflats and the extensive areas of saltmarsh and mangroves within the Ramsar site (wetland types H and I) are considered to be in good condition (Boon et al. 2011).

Criterion 2: A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.

This criterion is only applied to wetland dependent flora and fauna, and the site regularly supports one ecological community and four fauna species listed under the EPBC Act and or IUCN Red List:

- Coastal saltmarsh – Vulnerable ecological community
- Australian fairy tern (*Sternula nereis nereis*) – Vulnerable
- Curlew sandpiper (*Calidris ferruginea*) – Critically endangered
- Eastern curlew (*Numenius madagascariensis*) – Critically endangered
- Australian grayling (*Prototroctes maraena*) – Vulnerable

While there are historic records of orange-bellied parrot (*Neophema chrysogaster*) from the saltmarshes of the site, the species is in serious decline and has not be recorded in the Western Port for over two decades (BirdLife Australia unpublished data). Similarly there is a single record of an Australian painted snipe (*Rostratula australis*) from Pyramid Rock in 1979, which is insufficient to indicate that the site regularly supports this species. There are isolated records of the hooded plover (*Thinornis rubricollis rubricollis*) from beaches within the Ramsar site. However, habitat requirements and records for this species indicate that the open coast beaches on the southern shore of Phillip Island are important for hooded plover (Weston 2003, Maguire et al. 2014), which are outside the boundary of the Ramsar site.

Criterion 3: A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region

Guidance from the Convention indicates that this criterion should be applied to "hotspots" of biological diversity and centres of endemism within a biogeographically region. As with criterion 1, the relevant bioregion is the expansive south-east coast drainage division, for which an inventory of wetland dependent species and biodiversity hotspots is not available.

There is evidence, however, to indicate that the Western Port Ramsar Site meets this criterion, particularly with respect to marine invertebrates. The soft sediments of Western Port support a high diversity of ghost shrimps, including *Michelea microphylla*, a local endemic species known only from Crib Point (Wilson et al. 2011). The intertidal and subtidal reefs at San Remo, which support a high diversity of one invertebrate group — opisthobranchs (sea-slugs and sea-hares) and Crawfish Rock, although small is considered especially diverse: 600 species have been documented at this site: 130 algae, 150 sponges, 50 hydroids, 180 bryozoans and 80 ascidians (Shapiro 1975). In addition, the rare hydroid *Ralpharia coccinea* found at Crawfish Rock, and may be endemic to Western Port (Edmunds et al. 2010).

Criterion 4: A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their lifecycles, or provides refuge during adverse conditions.

The basic description of this criterion implies a number of common functions/roles that wetlands provide including supporting fauna during migration and breeding. The Western Port Ramsar Site regularly supports over 35 species of migratory shorebird listed under international migratory bird treaties (DELWP Flora and Fauna Database). The site provides both feeding and high tide roost sites for these species (Hansen et al. 2011). In addition over 20 species of wetland dependent bird species have been recorded breeding within the site, with breeding of beach nesting birds on French Island and the north shore of Phillip Island identified as being particularly significant (Dann 2011).

Criterion 5: A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.

Data presented in Hansen et al. (2011) indicate that for the two decades around the time of listing (1974 to 1994) the Western Port Ramsar Site supported > 20,000 waterbirds in 15 years (annual maximum count). This satisfies the Convention requirements of "at least two thirds of seasons" to meet this criterion.

Criterion 6: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

Assessment of this criterion must be made using the most recent official population estimates (Wetlands International 2012). Data presented in Hansen et al. (2011) indicate that six species meet this criterion:

- Australian fairy tern (*Sternula nereis nereis*)
- Australian pied oystercatcher (*Haematopus longirostris*)
- Curlew sandpiper (*Calidris ferruginea*)
- Eastern curlew (*Numenius madagascariensis*)
- Pacific gull (*Larus pacificus*)
- Red-necked stint (*Calidris ruficollis*)

Criterion 8: A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

At the time of listing Western Port was an important commercial fishery and remains significant for recreational fishing. The seagrass and other habitats within the embayment act as important nursery habitat for a range of fish and crustacean species (MacDonald 1992, Jenkins et al. 2013).

2.4 Ecological character and values

2.4.1 Critical components, process and services

The Australian Government has developed and implemented a framework for describing the ecological character of Ramsar sites (Department of the Environment, Water, Heritage and the Arts 2008). This framework requires the identification and description of critical components, processes and services. These are defined as characteristics of the Ramsar site (Department of the Environment, Water, Heritage and the Arts 2008):

1. that are important determinants of the sites unique character;
2. that are important for supporting the Ramsar criteria under which the site was listed;
3. for which change is reasonably likely to occur over short to medium time scales (less than 100 years); and / or
4. that will cause significant negative consequences if change occurs.

The Western Port Ramsar Site ECD (Kellogg Brown and Root 2010) identifies ten components, processes services that are critical to the ecological character of the Ramsar site. These are described briefly below, more detail on each can be found in the ECD for the site.

Wetland bathymetry

This critical component is related to the depth profile or morphology of the Western Port Ramsar Site. The site comprises extensive areas of intertidal sand and mudflat, which cover an area of approximately 27,000 hectares. At low tide, approximately 40% of the Ramsar site is exposed (Edgar et al. 1994), and this forms important feeding habitat for shorebirds, including internationally migratory waders. These soft sediments are dissected by deep (> 15 metre) channels, which extend up the north and eastern arms of the site (Figure 3).

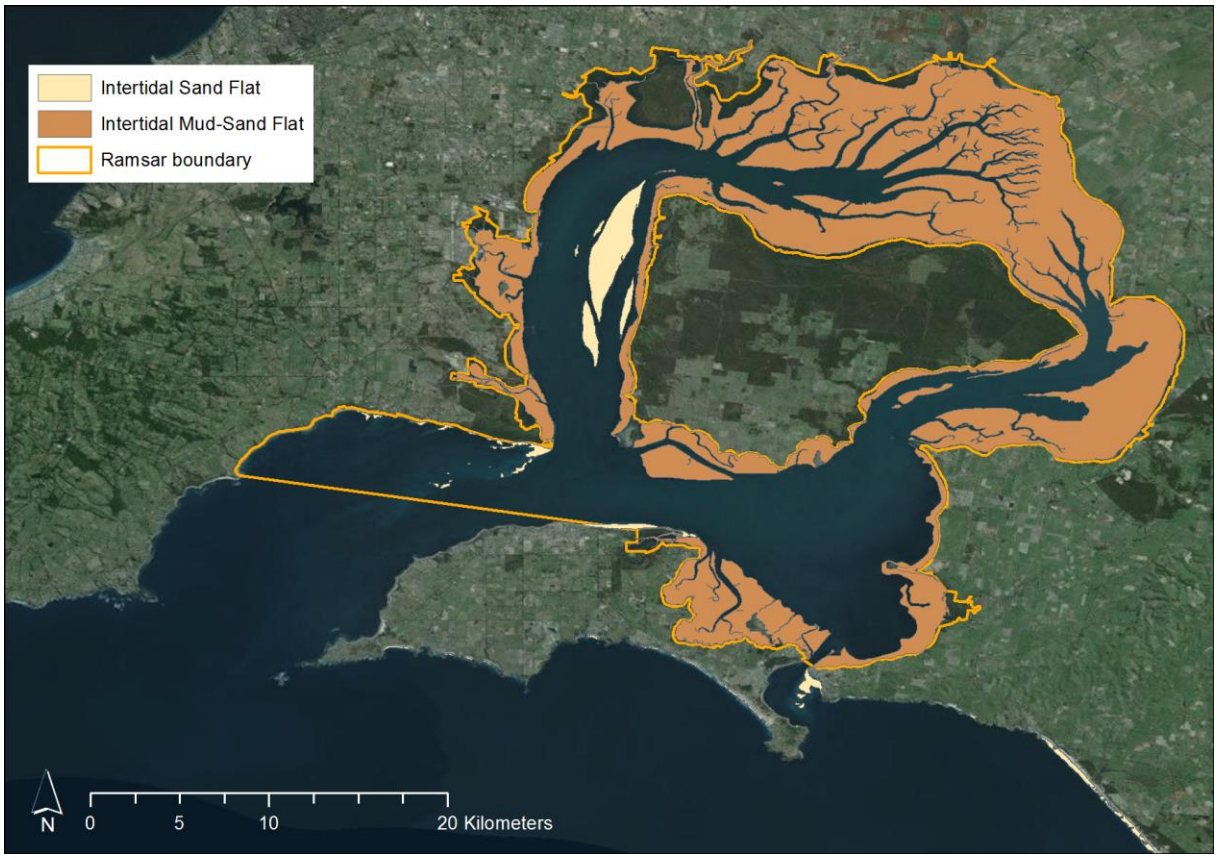


Figure 3: Bathymetry of the Western Port Ramsar Site, showing the extensive intertidal mudflats and deep channels (AMSA 2014).

Geomorphology and sedimentation

Western Port is characterised by the high sediment loads from the catchment, which are deposited in the river mouths and intertidal areas within the site. Resuspension of sediments by wind and wave action in the predominantly shallow embayment is also an important process (Kellogg Brown and Root 2010).

Seagrass

There are four species of seagrass[1] within Western Port Bay (Walker 2011):

- *Zostera tasmanica* is the dominant species comprising almost half the seagrass in the Ramsar site and occurring in the muddy intertidal banks and channels.
- *Zostera capricornii* occupies a smaller area and occurs at higher elevations.
- *Amphibolis antarctica* occurs mostly in the areas of sandy sediments with underlying rock in south of Western Port, with only small patches within the Ramsar site boundary.
- *Halophila australis* occurs in small, sparse patches in deeper waters.

The extent and condition of seagrass in Western Port is highly variable over time. At the time the site was listed under the Ramsar Convention, there was only 7,200 hectares of seagrass, this has increased to over 15,000 hectares in more recent times (Holland et al. 2013). Seagrass occurs mostly in the north and western arms of the Ramsar site (Figure 4).

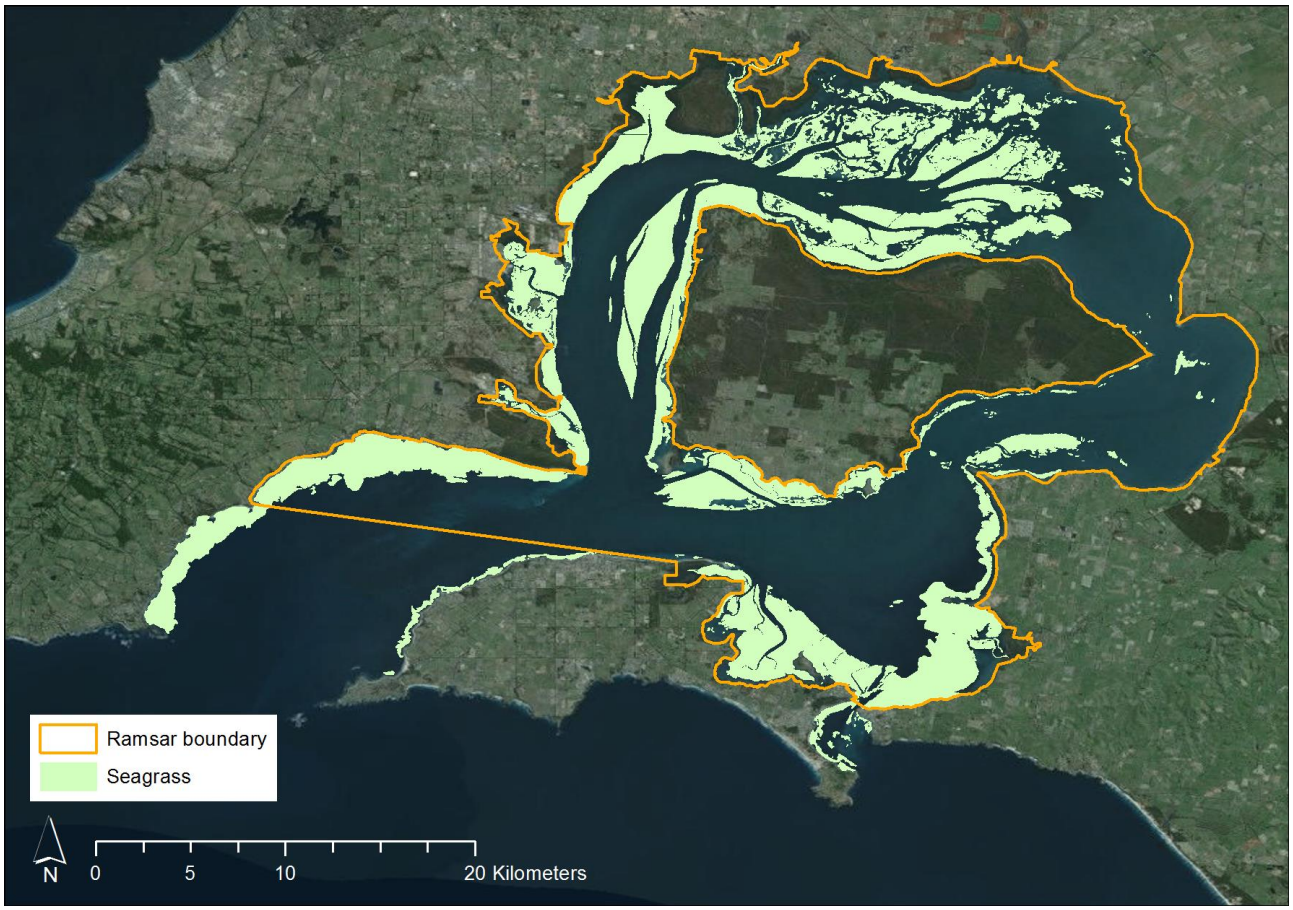


Figure 4: Western Port seagrass distribution (Melbourne Water Corporation. 2011).

Saltmarsh

The Western Port Ramsar Site contains one of the largest expanses of saltmarsh in Victoria, covering an area of just over 1,100 hectares (Boon et al. 2011)[2]. Saltmarsh occupies the area of the site between mangroves, in deeper waters and terrestrial vegetation at higher elevation. The saltmarsh of Western Port

[1] Note that there have been revisions in the taxonomy of seagrasses since early descriptions and mapping. This description reflects current taxonomy.

[2] Note that much of the saltmarsh within the Western Port Bay area lies outside the Ramsar site boundary.

is diverse (Boon 2011) and in variable condition, with areas of intact high quality saltmarsh in some areas such as Yaringa Marine National Park, and other areas in poor condition with large areas of bare ground, low diversity and weeds (Mark Rodrigue, Parks Victoria, personal communication). Coastal saltmarsh is listed as a vulnerable ecological community under the EPBC Act and is important habitat for fish, when inundated and feeding and roosting waterbirds, when tides are low.

Mangrove

The mangrove areas of Western Port comprise a single species *Avicennia marina* and represent some of the most southerly extents of the species globally (Dittman 2011). The inundated roots and pneumatophores of mangroves provide good habitat for fish and invertebrates and play a role in stabilizing the soft sediments in the site.

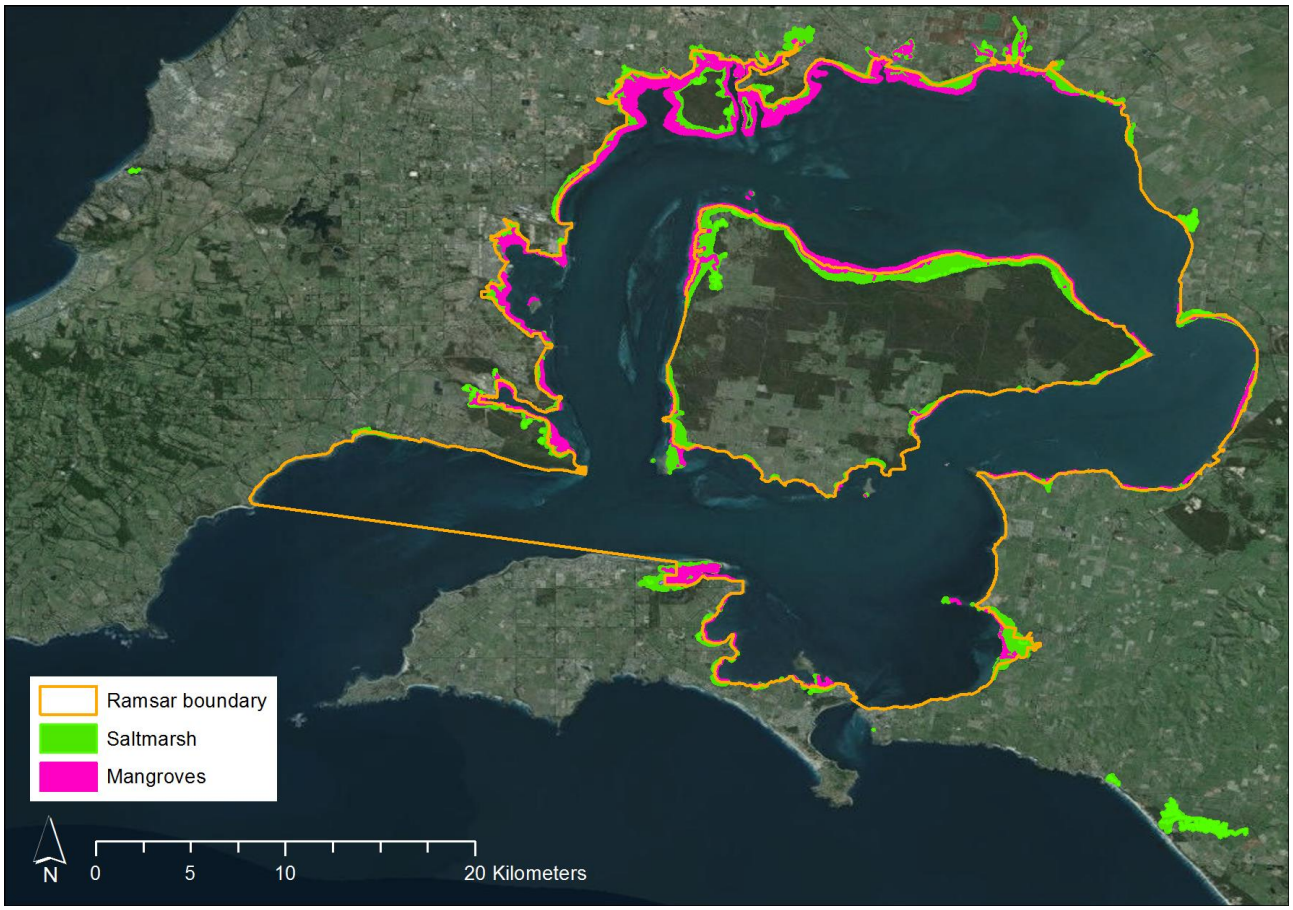


Figure 5: Western Port Mangrove and saltmarsh distribution (Boon et al. 2011). Note that much of the saltmarsh lays outside the Ramsar site boundary, in particular the majority of the saltmarsh on the northern shore of French Island is outside the Ramsar site.

Fish

The Western Port Ramsar Site supports a diversity and abundance of fish and supports an important recreational fishery. At the time of listing the site was also important for commercial fishing, but this was closed in 2007. Fish diversity and abundance is highly linked to habitat (Jenkins 2011):

- Seagrass – small resident species with gobies and pipefish / sea dragons common, juveniles of recreationally important species such as King George whiting (*Sillaginodes punctatus*).
- Mangroves – small resident gobies (but not pipefish and seadragons found in seagrass), juvenile fish seasonally, including recreationally important species.
- Open water – large species such as Australian salmon (*Arripis trutta*), snook (*Sphyraena novaehollandiae*) and barracouta (*Thysites atun*).

- Reef – not well documented, but likely to include species such as wrasse (*Notolabrus* spp.) and zebra fish (*Girella zebra*).

Invertebrates

The soft sediment and reef habitats of the Western Port Ramsar Site support a diversity and abundance of marine invertebrates. One of the outstanding characteristics of the soft-sediment fauna of Western Port is the high diversity of ghost shrimps, which includes the rare species *Paraglypturus (Eucalliax) tooradin*, and a local endemic known only from Crib Point, *Michelea microphylla*. Soft sediments in intertidal areas are important foraging ground for shorebirds (Wilson et al. 2011).

Waterbirds

A total of 115[3] waterbird[4] species have been recorded within the Western Port Ramsar Site, including over 30 species listed under the international migratory bird agreements JAMBA, CAMBA and ROKAMBA. The Western Port Ramsar Site provides significant foraging area for a variety of shorebird species as well as important roosting (resting) sites (Figure 6).

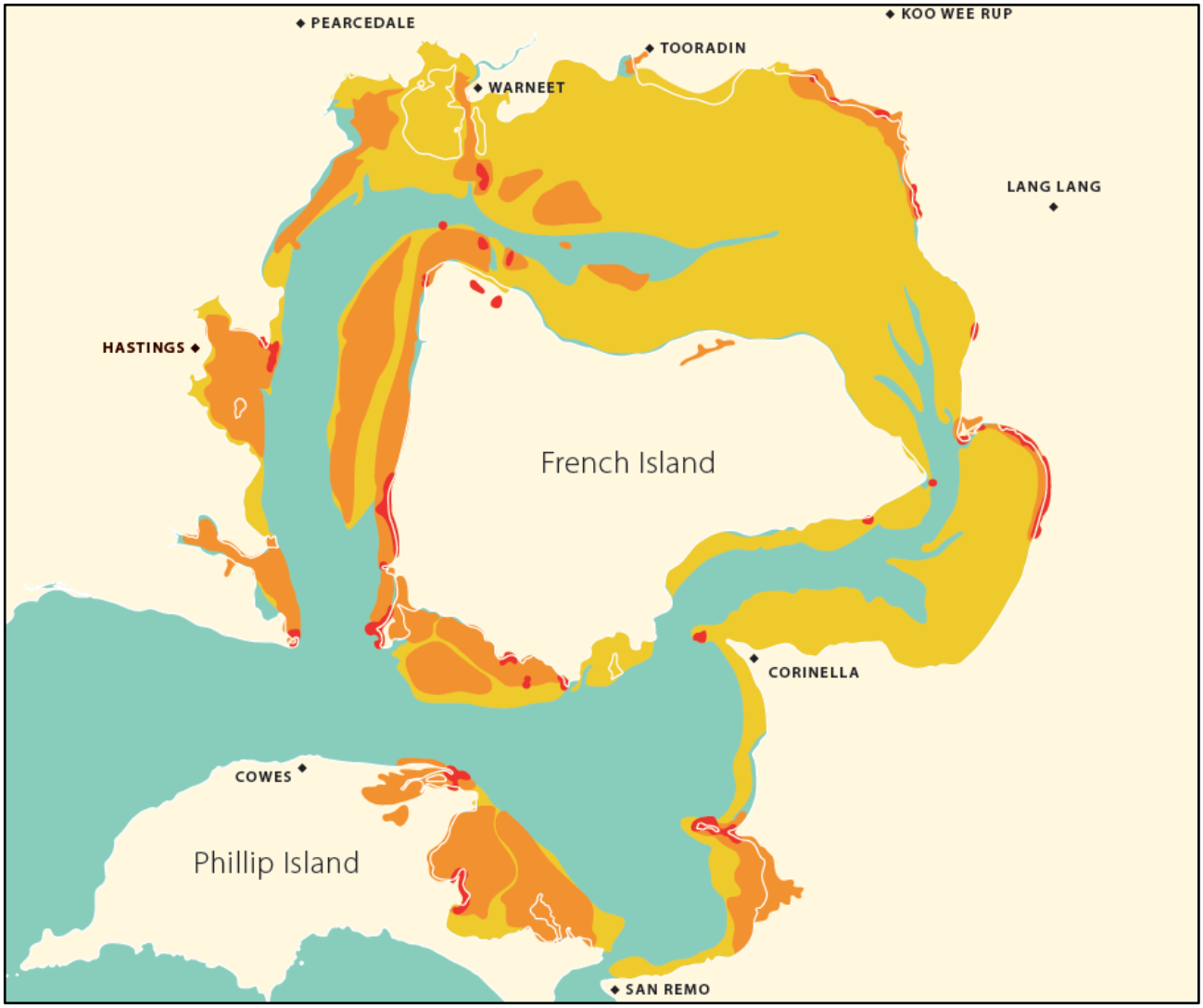


Figure 6: Shorebird habitat in Western Port showing primary foraging areas (orange); secondary foraging habitat (yellow) and high tide roost sites (red) (Central Coastal Board (Vic.) 2011, Hansen et al. 2011).

[3] Note that this number includes several pelagic seabirds such as albatross, which are not regularly supported by the site.

[4] Waterbirds are defined under the Ramsar Convention as species of birds that are ecologically dependent on wetlands.

In addition to shorebirds, the Western Port Ramsar Site provides habitat for a variety of waterbird groups or guilds including ducks and swans; grebes; large wading birds such as herons, ibis and spoonbills; gulls and fish eating birds such as cormorants pelicans and terns (Hansen et al. 2011).

Western Port supports breeding waterbird species and is particularly important for beach nesting birds. Australian fairy tern (*Sternula nereis nereis*) and Caspian tern (*Hydroprogne caspia*) breed semi-regularly on Rams Island (Lacey and O'Brien 2015). Australian pied oystercatchers (*Haematopus longirostris*) breed regularly in the sandy beaches (and even saltmarsh) of French Island. Noting that many species of waterbird such as ibis, spoonbills and cormorants, breed in swamps and wetlands outside the Ramsar site boundary, but may rely on feeding grounds in the Ramsar site during nesting.

Threatened species

Threatened species regularly supported by the Western Port Ramsar Site include three species of bird and one fish species.

Eastern curlew (*Numenius madagascariensis*) and curlew sandpiper (*Calidris ferruginea*) are international migratory species that spend the non-breeding season in the southern hemisphere. They arrive in late spring, spend the summer feeding on invertebrates in intertidal mudflats and depart for the northern hemisphere in February to March. Juveniles of both species spend their first one or two winters at the site before heading to the northern hemisphere to breed. Although the two species have similar life histories, they are physically very different. The eastern curlew is the largest of the shorebirds with a wingspan of over one metre and a weight of nearly one kilogram. In contrast the curlew sandpiper is a small bird, with a weight of just 60 grams (Higgins and Davies 1996).

Australian fairy tern (*Sternula nereis nereis*) is an Australian resident, fish eating bird species. They feed close inshore upon small schooling fish and in the Ramsar site, anchovies and pilchards are likely to comprise the majority of their diet. They breed on sand beaches within the Ramsar site in a scrape in the ground, suitable habitat devoid of dense vegetation is essential (Higgins and Davies 1996).

Australian grayling (*Prototroctes maraena*) reside in the rivers of the catchment of Western Port (Koster and Dawson 2010). This diadromous species migrates to and from marine environments as part of its lifecycle (Crook et al. 2006, Schmidt et al. 2011). It is likely that larvae of the Australian grayling drift downstream into the Western Port Ramsar Site, with return upstream migration in spring of juveniles (Jenkins 2011).

2.4.2 Additional values

Rocky reefs

Rocky reefs comprises a small area within the Ramsar site, but includes the intertidal and subtidal reefs at San Remo, which support a high diversity of one invertebrate group, opisthobranchs (sea-slugs and sea-hares) and are listed as a threatened community under the Flora and Fauna Guarantee Act. Crawfish Rock, although small is considered especially diverse: 600 species have been documented at this site: 130 algae, 150 sponges, 50 hydroids, 180 bryozoans and 80 ascidians (Shapiro 1975). In addition, the rare hydroid *Ralpharia coccinea* is found at Crawfish Rock, and may be endemic to Western Port (Edmunds et al. 2009).

Socio-economic and cultural values

The Western Port Ramsar Site has three Marine National Parks within its boundaries as well as French Island National Park. Western Port Ramsar Site and adjoining areas and its surrounds have also been designated as a Biosphere Reserve under the UNESCO's Man and the Biosphere program. The Ramsar site is within the traditional lands of the Boonwurrung, who maintain strong connections to the land and waters. The site contains the commercial Port of Hastings that services around 50 ships per year and contributes around $67 million annually to the region's economy.

Western Port has a long history of recreational fishing and was declared a 'Recreational Fishing Haven' in December 2007 by the Department of Primary Industries after imposing a ban on commercial fishing. Sailing and boating are popular past-times, and the Ramsar site contains several yacht clubs. Tourist expenditure for Western Port (excluding Phillip Island) is valued at $285 million per year (Worley Parsons

2013). Based on figures presented in Carnell (2015) and the total area of saltmarsh and seagrass within the Ramsar site, the blue carbon value of the Western Port Ramsar Site is in the order of $11.5 million.

2.5 Status of ecological character and Limits of Acceptable Change (LAC)

The mechanism against which change in ecological character is assessed is via comparison with Limits of Acceptable Change (LAC). LAC are defined by Phillips (2006) as:

"…the variation that is considered acceptable in a particular measure or feature of the ecological character of the wetland. This may include population measures, hectares covered by a particular wetland type, the range of certain water quality parameter, etc. The inference is that if the particular measure or parameter moves outside the 'limits of acceptable change' this may indicate a change in ecological character that could lead to a reduction or loss of the values for which the site was Ramsar listed. In most cases, change is considered in a negative context, leading to a reduction in the values for which a site was listed".

The following should be considered when developing and assessing LAC:

- LAC are a tool by which ecological change can be measured. However, LAC do not constitute a management regime for the Ramsar site.
- Exceeding or not meeting LAC does not necessarily indicate that there has been a change in ecological character within the meaning of the Ramsar Convention. However, exceeding or not meeting LAC may require investigation to determine whether there has been a change in ecological character.
- While the best available information was used to prepare the ECD and define LAC for the site, a comprehensive understanding of site character may not be possible as in many cases only limited information and data is available for these purposes. The LAC may not accurately represent the variability of the critical components, processes, benefits or services under the management regime and natural conditions that prevailed at the time the site was listed as a Ramsar wetland.
- LAC can be updated as new information becomes available to ensure they more accurately reflect the natural variability (or normal range for artificial sites) of critical components, processes, benefits or services of the Ramsar wetland. The formal process for this is via the Ramsar Rolling Review, which is a three yearly assessment of ecological character at each Ramsar site (Butcher et al. 2011).

The LAC for Western Port Ramsar Site were established in the ECD for critical components, processes and services (Kellogg Brown and Root 2010). These are described briefly below together with the most recent assessment through the Ramsar Rolling Review (DELWP in prep. Table 4). It should be noted that the ecological character description and LAC for Western Port (together with all Victorian Ramsar Sites) are currently under review.

Establishing the benchmark: "At the time of listing"

The Ramsar Convention establishes the benchmark for the ecological character of listed wetlands as: *"at the time of designation as a Ramsar Wetland of International Importance"* (Resolution VI.1 Annex Para 2.1).

This is an important concept for understanding the goal of maintaining ecological character and assessing change in character. Aquatic ecosystems are rarely static and stable, and Western Port is no exception. There are ongoing changes, many of which commenced prior to designation, with a continuing trajectory of change. Establishing a benchmark, against which change in ecological character can be assessed, is a task for the Ecological Character Description, using Limits of Acceptable Change. Maintaining the site's ecological character in a changing environment is a challenge for Ramsar site management.

An example of these challenges is the extent of seagrass within the site. At the time of listing there was just 7,200 hectares of seagrass in Western Port. This fell further in 1983-94 to just 5,900 hectares and follows a decline from over 23,000 hectares in the 1970s (Blake and Ball 2001). There was a large loss of intertidal seagrass (*Zostera tasmanica*) in the late 1970s / early 1980s from the northern and eastern parts of Western Port attributed to smothering by sediments. By the mid-1990s, there was evidence of recovery of seagrass extent and condition in Western Port, which continues to this day. The most recent mapping suggests that there is now over 15,000 hectares of seagrass (Holland et al. 2013).

What does this mean for setting a benchmark for ecological character and managing seagrass at the site? It means that the administrative reporting of a potential change in character to the Convention would only occur if seagrass were to decline *below* what it was at the time of listing (7,200 hectares). Management of seagrass at the site, however, is aimed at continuing to improve the extent and condition of seagrass beyond current levels and continuing the trajectory of recovery.

Image: Pebble crab amongst narrow leaf seagrass (*Zostera muelleri*). Photo: M. Rodrigue, Parks Victoria.

Table 4: Assessment of current condition of the ecological character of the Ramsar site for critical components, processes and services (CPS) for which Limits of Acceptable Change are provided in the Kellogg Brown and Root (2011) ECD (from DELWP in prep.).

Critical CPS	Limit of Acceptable Change	2015 Assessment
Wetland bathymetry	No loss of intertidal mudflat area (270 km^2)	Although there has been work on coastal erosion, there is no current information on the extent of intertidal mudflat area. There has been a decrease in the extent of bare soft sediment (due to an increase in seagrass cover) since the 1980s, but whether this is intertidal or sub-tidal is not known. There is insufficient data to assess this LAC.
Saltmarsh	15% change from extent at the time of listing (approximately 1,100 hectares)	The most recent assessment of saltmarsh extent in Western Port (Boon et al. 2011) indicates 11.4 km^2 (1,144 hectares). There is no evidence of a significant decline in saltmarsh extent and the LAC is met.
Mangrove	10% change from extent at the time of listing (approximately 1,200 hectares)	The most recent assessment of mangrove extent in Western Port indicates 17.0 km^2 (1,700 hectares). This represents an increase of 40% since the time of listing. It is unclear whether the LAC is related to only a decline or any change. If the latter, then the increase in extent since the time of listing equates to approximately 40%, which would be a breach of the LAC.
Waterbirds	A drop in mean maximum values of ≥ 20% over a five year period for the following guilds (figure in brackets equates the LAC for the five year annual mean maximum count): Total waterbirds (12,000) Migratory waders (5,300) Ducks (500) Fishers (550) Gulls (1600) Large wading birds (980) Swans (1,600).	An assessment of data presented in Hansen at al. (2011), indicate that the LAC is met for all groups with the exception of fishers, which had a mean maximum count of just 330, well below the LAC of 550. This is consistent with the decline in fish eating bird species reported by Menkhorst et al. (2015). Noting that statistics were calculated from 2005-2009 (drought years) and more recent count data were not available.

3 Threats

Priority threats and values for management in the next seven years were identified through a process that included a risk assessment.

3.1 Risk assessment method

The risk assessment process adopted for this project is consistent with the Australian/New Zealand Standard: Risk Management (AS/NZS 4360:2004; Standards Australia and Standards New Zealand 2004) and the Standards Australia Handbook: Environmental risk management - principles and process (HB 203-2000; Standards Australia and Standards New Zealand 2006). The risk assessment approach follows a structured and iterative process, with the following steps:

1. Establish the context – existing values and environmental conditions;
2. Identify risks – threats and associated potential impacts; and
3. Analyse risks – assign likelihoods and consequences to determine level of risk

3.1.1 Establishing the context

A review of existing published and unpublished information relevant to the Western Port Ramsar Site was undertaken to identify and summarise the important environmental, social and economic values; current condition and potential threats to ecological character. The spatial scale of the risk assessment was established as the entire Ramsar site.

The purpose of the risk assessment was to identify priority values and threats as the basis for identifying strategic actions in the Western Port Ramsar Site Management Plan. The ECD (Kellogg Brown and Root 2010) provided a benchmark for values and threats, which was augmented by local knowledge. The risk assessment was underpinned by both local knowledge and expert opinion. The process of prioritising values and threats and how the risk assessment contributed to this is illustrated in Figure 7.

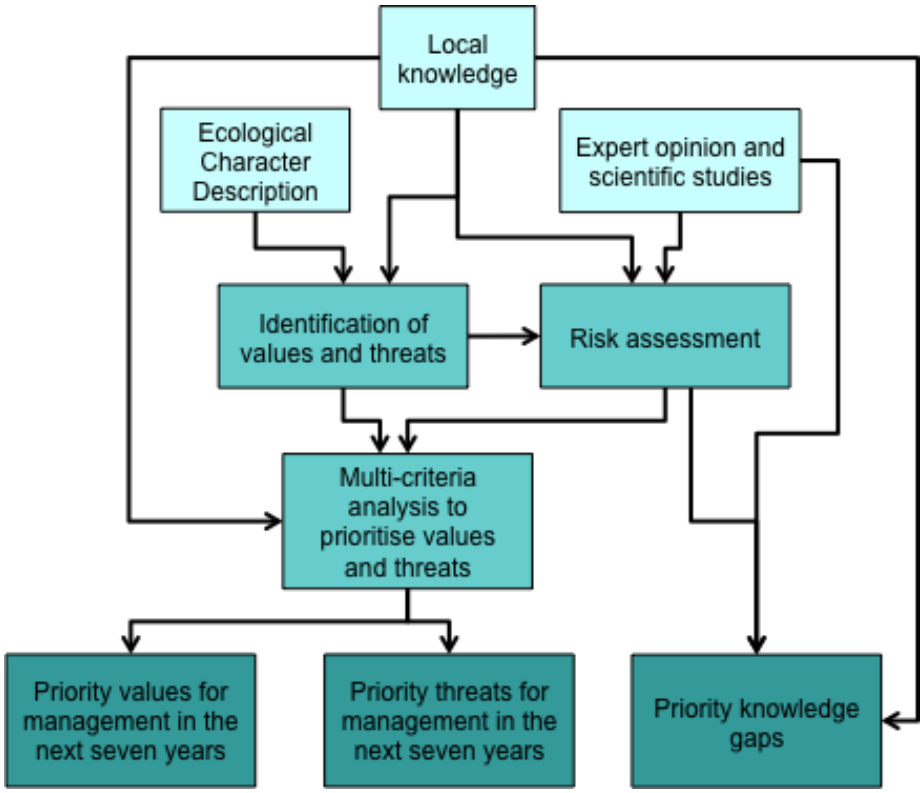


Figure 7: Process of prioritising values and threats and the role of the risk assessment.

The risk assessment was based on a desktop review of existing information, supplemented by expert scientific and broader stakeholder knowledge. The review has drawn, where appropriate, on existing relevant risk assessments that have been undertaken recently within Port Phillip Bay. The risk assessment undertaken in the current project drew heavily on three previous assessments:

- Risks identified and assessed through the Melbourne Water funded Understanding Western Port program;
- The Better Bays and Waterways program (Melbourne Water 2009) which assessed risks to water quality both in the catchments and in the Bay; and
- A series of reports assessing the risk of climate change to some of Victoria's marine environments (Klemke and Arundel 2013).

3.1.2 Identifying risks

The risk assessment process is consistent with the Australian/New Zealand Standard: Risk Management (AS/NZS 4360:2004; Standards Australia and Standards New Zealand 2004) and the Standards Australia Handbook: Environmental risk management - principles and process (HB 203-2000; Standards Australia and Standards New Zealand 2006).

The approach uses a hierarchical process to identify potential risks as follows:

- Pressures – activities in Western Port or catchment that could affect ecological character
- Stressors – the physical or chemical changes that could arise as a result of an activity
- Effects – the potential responses caused by the stressors.

This allows for clear identification of the underlying causes of risks and threats to ecological character of the Ramsar site, separating the threat from the impact.

3.1.3 Analyse risks

Impact pathways were developed that integrated each level of the hierarchy and these formed the basis of a formal risk analysis process. Likelihood and consequence were assigned to each **impact pathway** in its entirety. See below for an example for an impact pathway:

Pressures	Stressors	Impact
Pollution: Agricultural run-off	Increased nutrients	Results in increased algal growth and a decline in seagrass health

Questions were put to SAG members and experts in a workshop setting to estimate the likelihood and consequence, for example: what is the likelihood that agricultural practices in the catchment will result in increased nutrients, increased algal growth and that this will result in a decline in seagrass health? What are the consequences of this with respect to the ecological character of the Ramsar site?

Likelihood and consequence descriptions used in this assessment are provided in Table 5 and Table 6, respectively, with the risk matrix (Table 7) showing how they combine to score the overall risk. A number of ground rules for the risk assessment were established:

- The risk assessment was focussed on assessing risks to ecological character over the next 15 years.
- In assessing each impact pathway all likely future changes (population, land use, climate change) were considered.
- Where possible all decisions were based on multiple lines of evidence.

Table 5: Likelihood

Almost certain	Likely	Possible	Unlikely	Rare
Is expected to occur in most circumstances	Will probably occur in most circumstances	Could occur	Could occur but not expected	Occurs only in exceptional circumstances

Table 6: Consequence

Category	Insignificant	Minor	Moderate	Major	Extreme
Ecosystem Function (need to consider resilience and resistance)	Alteration or disturbance to ecosystem within natural variability. Ecosystem interactions may have changed but it is unlikely that there would be any detectable change outside natural variation / occurrence.	Localised measurable changes to the ecosystem components without a major change in function (no loss of components or introduction of new species that affects ecosystem function). Recovery (if relevant) in less than 1 year.	Widespread measurable changes to the ecosystem components without a major change in function (no loss of components or introduction of new species that affects ecosystem function). Recovery (if relevant) in 1 to 2 years.	Widespread measureable changes to the ecosystem components with a major change in function. Recovery (i.e. within historic natural variability) in 3 to 10.	Long term and possibly irreversible damage to one or more ecosystem function. Recovery, if at all, greater than 10 years.
Habitat, communities and / or assemblages	Alteration or disturbance to habitat within natural variability. Less than 1% of the area of habitat affected or removed.	1 to 5% of the area of habitat affected in a major way or removed.	5 to 30% of the area of habitat affected in a major way or removed.	30 to 90% of the area of habitat affected in a major way or removed.	Greater than 90% of the area of habitat affected in a major way or removed.
Species and / or groups of species (including protected species)	Population size or behaviour may have changed but it is unlikely that there would be any detectable change outside natural variation / occurrence.	Detectable change to population size and / or behaviour, with no detectable impact on population viability (recruitment, breeding, recovery) or dynamics.	Detectable change to population size and / or behaviour, with no impact on population viability (recruitment, breeding, recovery) or dynamics.	Detectable change to population size and / or behaviour, with an impact on population viability and or dynamics.	Local extinctions are imminent / immediate or population no longer viable.
Social	Short-term interruptions in recreational use (days) and perception as a high amenity place to live unaltered.	Recreational activities restricted and perceptions of amenity altered in a localised area for short-term (< 1 year)	Recreational activities restricted and perceptions of amenity altered in a localised area for > 1 year.	Long-term disruption to recreational activities and perceptions of amenity altered at a regional scale for 1 to 5 years.	Long-term disruption to recreational activities and perceptions of amenity altered for a regional scale for > 10 years.

Table 7: Risk matrix

Likelihood	Consequence					
		Insignificant	**Minor**	**Moderate**	**Major**	**Extreme**
	Almost certain	Negligible	Medium	High	Extreme	Extreme
	Likely	Negligible	Medium	Medium	High	Extreme
	Possible	Negligible	Low	Medium	High	High
	Unlikely	Negligible	Low	Low	Medium	Medium
	Rare	Negligible	Negligible	Negligible	Low	Medium

3.1.4 Cumulative risk assessment

The impact pathway approach to assessing risks allows for clear identification of the causes and impacts to values for each identified pathway. The problem remains, however, of how to deal with cumulative threats. Traditional ecological risk assessment processes are often incapable of dealing with cumulative and synergistic effects. A cumulative risk assessment is defined as an analysis, characterisation, and possible quantification of the combined risks to human health or the environment from multiple agents or stressors (Callahan and Sexton 2007). It is recognised that cumulative effects of multiple stressors on values are most often not simply additive (Crain et al. 2008). Rather, they may be synergistic, where the consequences of individual stressors are magnified to produce a greater risk than the sum; or they may be compensatory, where the total consequence is less than the sum. However, in the absence of information regarding the accumulation of effects from multiple stressors on a value, a sum of multiple risks is assumed as a reasonable first approximation for estimating cumulative risk (Bartolo et al. 2012, O et al. 2015).

There are a number of different methods for calculating the sum of risks, but the most common is based on assigning scores to likelihood and consequence, with risk = likelihood x consequence (Cox 2008). Cumulative risk was therefore calculated as: Total risk = Σ (likelihood x consequence) for each pressure, stressor and value, with individual risks scored as per Table 8.

Table 8: Scoring for cumulative risk calculations (O et al. 2015).

	Consequence				
	Insignificant (1)	**Minor (2)**	**Moderate (3)**	**Major (4)**	**Extreme (5)**
Almost certain (5)	5	10	15	20	25
Likely (4)	4	8	12	16	20
Possible (3)	3	6	9	12	15
Unlikely (2)	2	4	6	8	10
Rare (1)	1	2	3	4	5

3.1.5 Stakeholder involvement

A draft risk assessment was developed based on best available information by a team of wetland scientists in consultation with experts on various aspects of Western Port. This draft risk assessment was provided to the Steering Committee (SC) and Stakeholder Advisory Group (SAG) members for review. A one day workshop was held in Hastings on July 14, 2015. Workshop participants were asked to review the impact pathways, likelihood and consequence ratings for each impact pathway in their area of interest or expertise. At the workshop, the risk assessment was systematically worked through with discussion on the rankings and identified pathways until agreement was reached. Critical knowledge gaps were identified and documented for inclusion in the management plan. A number of risk rankings were deferred at the workshop for consultation with relevant scientific experts.

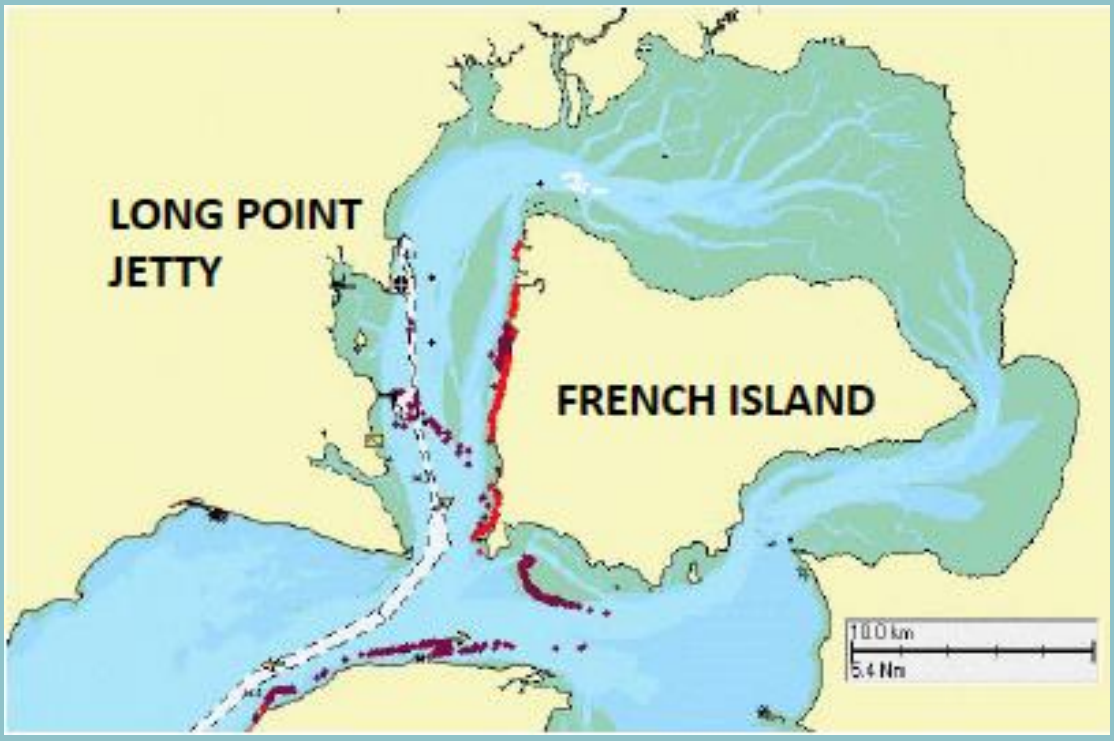
Following the workshop, relevant experts from universities and research organisations were contacted to provide input to the risk assessment in their respective fields. The results of these conversations, together with the outputs of the workshop were used to produce a revised risk assessment. The revised risk assessment was circulated to SC and SAG members for any further comments, prior to finalisation. The full risk assessment can be found in Appendix C.

Using an evidence-based approach to inform the risk assessment: Oil spills

The Westernport and Peninsula Protection Council and the Victorian National Parks Association commissioned an oil spill study for Western Port (http://vnpa.org.au/admin/library/attachments/PDFs/media%20backgrounders/bgr-wport-shipping-spill.pdf). Six oil spill scenarios were modelled using a SIMAP three-dimensional spill trajectory and weathering model. The model simulates the transport, spreading and weathering of specific oil types under the influence of changing weather conditions and ocean movements. The outputs were used to assess exposure and potential impacts to the values of Western Port, including the Ramsar site.

The main findings of the modelling were:

- Oil spilled under any of the six scenarios has a high probability of spreading widely across the bay.
- Oil spills disperse rapidly and could reach shorelines and seagrass meadows within minutes and sensitive marine national parks within hours.



Example of a model output (modelling a diesel spill from Long Point Jetty). Red indicates oil spill reaching the shoreline, burgundy oil movement within channels and open water areas.

Impacts of oil spills on marine biota and shorelines are well documented (e.g. Gundlach and Hayes 1978, Swan et al. 1994, Islam and Tanaka 2004) and effects are both acute and chronic, with recovery in many instances taking decades (e.g. Peterson et al. 2003). Boon et al. (2011) provide a literature review of the impacts of hydrocarbon pollution on Victorian coastal wetlands. This review found that few cases of pollution were recorded, but impacts can be prolonged.

All this combined evidence was used to inform the "consequence" aspect of the risk assessment. The consequence of oil spills on values in the Western Port Ramsar Site was assessed as "extreme".

The assessment of the likelihood of an oil spill was informed by a number of facts:

- The number of ships that enter Western Port each year is small (around 50) and there are no proposed plans to increase this number in the next 15 years (period of the risk assessment).
- The number of oil spills that have occurred in the past in Victorian waters is small. There have been no significant spills in Western Port and there have only been 20 spills of > 100 tonnes in Australia in the last 100 years (AMSA https://www.amsa.gov.au/environment/major-historical-incidents/).
- Mitigation measures such as oil spill contingency plans that are already in place.

Overall the risk was assessed as "medium".

3.2 Ranking priority values for management

A multi-criteria analysis was used to prioritise values for the Western Port Ramsar Site management plan. The objective of the prioritisation was to identify the highest priorities for management for the next seven years (i.e. the life of the plan). Therefore criteria for prioritising values are related to (Table 9):

- Meeting Ramsar site management obligations to maintain ecological character (criterion 1);
- Importance to the broader community (criterion 2);
- Values that have been identified as being at high risk from multiple threats (criteria 3); and
- Values that are currently in decline (criterion 4).

Values were identified based on those acknowledged as being critical to the ecological character of the Ramsar site in the ECD (Kellogg Brown and Root 2010); together with additional values identified through a search of recent literature and research; consistent with the methods described in the Victorian Waterway Management Strategy (Department of Environment and Primary Industries 2013).

Table 9: Criteria for prioritisation of values (and descriptions of low (1), medium (2) and high (3) rankings).

Criteria	Description	Score
1. Critical to the ecological character of the Western Port Ramsar Site	**Low priority:** Not an identified critical CPS, nor related to priority species / ecological communities.	1
	Medium priority: Value relates to one or more state listed and/or one or more items listed under international agreements; regional management priorities included in regional planning frameworks, management plans etc., but were not identified as a critical CPS in the ECD.	2
	High priority: Value is a critical component, process or service	3
2. Community priority	**Low priority:** Not identified of concern by general community.	1
	Medium priority: Value identified as of moderate interest/concern for the community.	2
	High priority: Value identified as a high priority by the community	3
3. Risk (from risk assessment)	**Low priority:** Classified as “low” or “very low” in the cumulative risk assessment.	1
	Medium priority: Classified as “medium” in the cumulative risk assessment.	2
	High priority: Classified as “high” or “very high” in the cumulative risk assessment.	3
4. Current condition	**Low priority:** No qualitative or quantitative evidence of a decline in condition (against 1982 benchmark)	1
	Medium priority: Qualitative evidence of a decline in condition and / or a localised or non-sustained change in condition reported for the value.	2
	High priority: Quantitative evidence of a sustained decline in condition associated with the value.	3

A draft prioritisation of values was developed based on best available information by a team of wetland scientists in consultation with experts on various aspects of Western Port. This draft prioritisation of values was provided to the SC and SAG for review. A one day workshop was held in Hastings on August 18, 2015 to review the application of criteria and scoring for each value in their area of interest or expertise. At the workshop, the prioritisation was systematically worked through with discussion on scoring until agreement was reached. The process concluded that all of the identified critical components, processes and services at the site were high priorities for management. The final ranked list of priority values for management in the next seven years was:

1. Seagrass
2. Fish
3. Waterbird abundance and diversity
4. Waterbird breeding
5. Threatened species (fish and birds)
6. Saltmarsh
7. Intertidal sand and mud flats
8. Rocky reefs
9. Mangroves

It is anticipated that this prioritisation of values could be used in annual action planning to afford higher priority to actions that directly protect high priority values. The relationships between identified high priority threats and these values are illustrated in the stressor model (Figure 8).

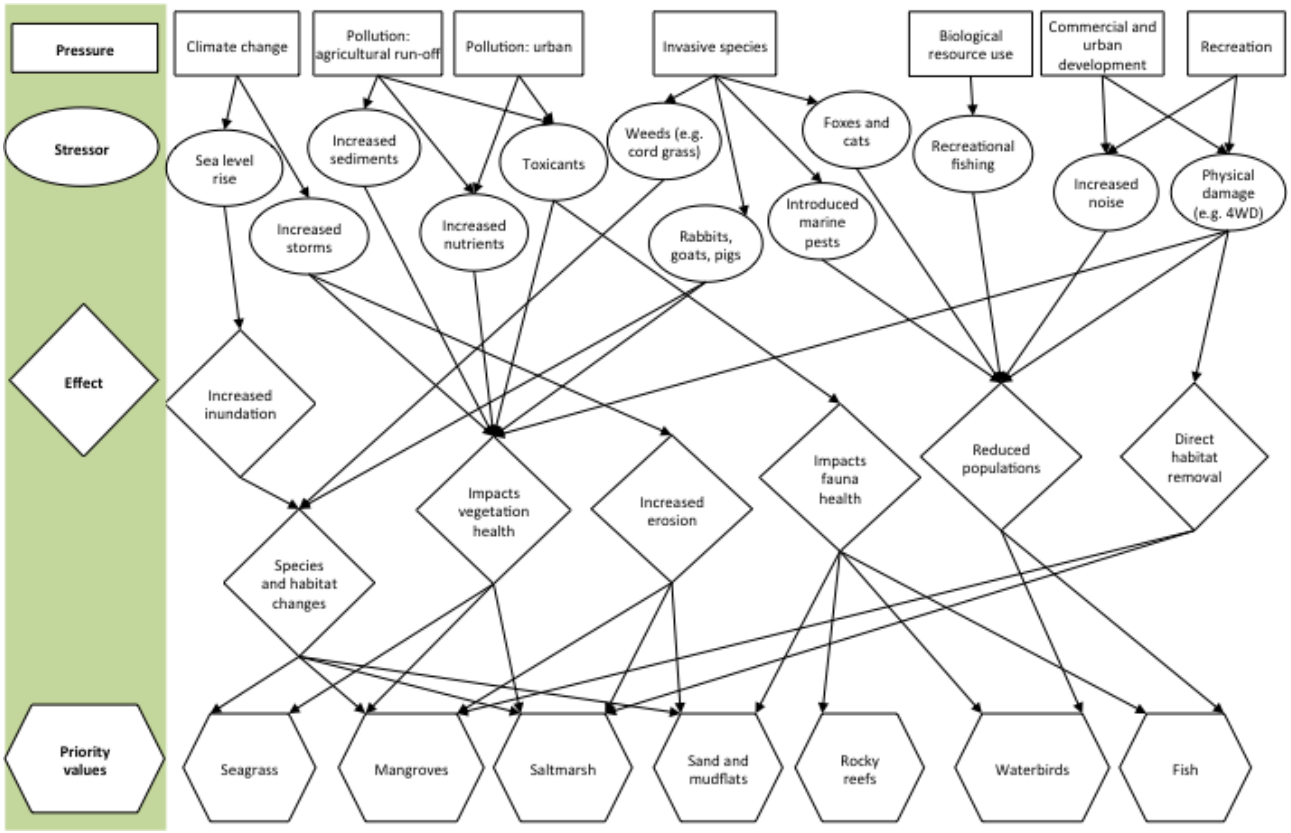


Figure 8: Stressor model illustrating the major linkages between high priority threats (pressures and stressors) and high priority values.

3.3 High priority threats for management

The outputs of the risk assessment were used to identify the highest priority threats for management in the next seven years in two ways. Firstly all identified individual risk pathways that were above a level of "tolerable risk" (risk score of 12 or more) as determined by the SC and SAG were considered a priority for management in the life of the plan (Table 10). Secondly, a cumulative risk assessment looked at the pressures and stressors across all risk pathways and was used to ensure that risks that may individually be medium or low level, but combined have a significant cumulative impact, were considered. The highest ranking cumulative pressures and stressors were as follows:

- Pressures
    - Climate change
    - Pollution: agriculture and rural
    - Pollution: urban
    - Invasive species
    - Urban and commercial development[5]
- Stressors
    - Increased sediments
    - Toxicants

The workshop held in Hastings on August 18, 2015 in addition to considering the thresholds for threats that should be considered a priority for management in the next seven years, sought to map priority locations

[5] This term relates to the physical aspects of the built environment, noting that discharge and water quality impacts are covered by "pollution".

for each of these threats. These maps are provided in Appendix D. A brief description of each of the priority threats is provided below.

Table 10: Priority threats and associated values, with numbers indicating the risk score (likelihood x consequence) for risk pathways (see Appendix C for full risk assessment and scoring). Note that higher numbers equate to high risk.

Priority threats		Priority values affected						
		Waterbirds	Fish	Sand/mud flats	Rocky reefs	Seagrass	Saltmarsh	Mangroves
1.	Invasive species: Cord-grass (*Spartina* spp.)	15					20	15
2.	Invasive species: new and emerging salt-tolerant weeds	15					15	
3.	Invasive species: foxes and cats predating on shorebirds and beach nesting birds	20						
4.	Invasive species: introduced marine pests (current and potential new invasions)		12	12	12	12		
5.	Invasive species: pigs, goats, rabbits in intertidal areas	15					15	
6.	Climate change: sea level rise	12				16	20	
7.	Climate change: increased frequency and intensity of storms leading to shoreline erosion	16		20		20	16	16
8.	Climate change: increased frequency and intensity of storms leading to increased sediments	16	16	16		15		
9.	Recreation: Vehicles in the intertidal zone	15		15			15	
10.	Recreation: Disturbance of shorebirds and beach nesting birds	15						
11.	Recreational fishing (including bait pumping)		20	15				
12.	Nutrients from rural and agricultural areas					12		
13.	Sediments from rural and agricultural areas		12	12	12	12		
14.	Toxicants from rural and agricultural areas		12	12	12	12		
15.	Nutrients from urban areas					12		
16.	Toxicants from urban areas		12	12	12	12		
17.	Urban, commercial and industrial development (direct habitat removal and associated impacts)						12	12

3.3.1 Invasive species

Five different groups of invasive species have been identified as a high priority threat to the ecological character of the Western Port Ramsar Site:

- **Cord-grass (*Spartina* spp.)**: There are two species of Spartina known from Victoria (*Spartina anglica* and *Spartina* x *townsedii*) both of which have been deliberately introduced to coastal areas, most often as erosion control or alternative fodder crops in salt affected areas (Williamson 1995). Spartina is known from two locations in Western Port and intertidal and saltmarsh habitats are vulnerable to invasion and expansion of this species. It is tolerant of inundation and salinity, resistant to many herbicides and can rapidly outcompete native vegetation (Boon et al. 2011).
- **New and emerging salt-tolerant weeds:** There are a large number of exotic species that can invade - and have invaded at higher elevations at the edge of the saltmarsh range (e.g. tall wheatgrass; *Thinopyrum ponticum,* and Sicilian sea lavender*; Limonium hyblaeum*). Impacts are mostly to saltmarsh, rather than mangroves, due to the lower degree of tidal inundation. However, some species can also affect habitat for waterbirds. For example, sea spurge (*Euphorbia paralias*) is a known threat to beach nesting birds, displacing the sandy habitat that beach nesting birds such as little tern, fairy tern and oystercatchers require for nesting (Mead et al. 2012).

- **Foxes and cats:** The Port Phillip and Westernport CMA Invasive Plants and Animals Strategy (Port Phillip and Westernport CMA 2011) identifies predation by foxes and cats as a significant threat to shorebirds and beach nesting birds, with foxes remaining widespread throughout the Ramsar site. There is also evidence that black rats are a significant threat to nesting birds, with predation on eggs.
- **Introduced marine pests:** There are several known introduced marine pest species in Western Port, although the size and number of infestations is comparatively low. However, the adjacent Port Phillip Bay has over 100 exotic species established with a number of these recognised as marine pests, and is recognised as one of the most highly invaded marine ecosystems globally (Hewitt et al. 1999). Given the proximity of Western Port to Port Phillip Bay and prevailing currents, it is highly likely that larvae could be transported from Port Phillip Bay to Western Port. High priority marine pest species include Pacific oysters (*Crassostrea gigas*) and the Asian date mussel (*Musculista senhousia*) with confirmed sighting and control activities for Japanese kelp (*Undaria pinnatifida*) and Northern Pacific seastar (*Asterias amurensis)* in Western Port.
- **Grazing animals (pigs, rabbits, goats):** Rabbits are widespread through the coastal areas of Western Port and damage native vegetation by grazing and digging. Pigs have been deliberately released on Quail Island where they are causing extensive damage to saltmarsh areas.

3.3.2 Climate change

Climate change risks were informed by the most recent climate projections for Australia (Grose et al. 2015; Table 11), the recent assessment of climate change vulnerabilities to the Victorian marine environment (Klemke and Arundel 2013) and climate change hazard mapping for Western Port Bay (Arrowsmith and Womersley 2014). It is important to note that while the assessment looked at the future risks, there is strong evidence of changes to climate variables under current conditions. For example, the 2014 State of the Climate Report (CSIRO and Bureau of Meteorology 2014) provides the following climate trends globally and for Australia:

- Atmospheric carbon dioxide is increasing and has increased in recent decades; recently exceeding 400 ppm;
- Sea-surface temperatures in the Australian region have warmed by 0.9°C since 1900;
- Global mean sea level increased throughout the 20th century and in 2012 was 225 mm higher than in 1880;
- Autumn and early winter rainfall has mostly been below average in the south-east since 1990;
- The duration, frequency and intensity of heatwaves have increased across large parts of Australia since 1950; and
- There has been an increase in extreme fire weather, and a longer fire season, across large parts of Australia since the 1970s.

Table 11: Climate change projection summaries for the southern slopes Victoria west sub-cluster (Grose et al. 2015).

Climate variable	Predicted change (relative to 1986-2005)		Confidence in predictions
	2030	2090	
Air temperature (degrees Celsius)	0.4 to 1.1	1.1 to 4.0	Very high
Sea surface temperature (degrees Celsius)	0.5	0.6 to 2.2	Very high
Rainfall	Decrease	Decrease by 25% in winter and 45% in summer	High
Evaporation	Increase	Increase	High
Sea level rise (m)	0.08 to 0.18	0.29 to 0.64	Very high
Ocean pH	-0.07 to -0.08	-0.07 to -0.3	Medium

There were three stressors associated with climate change that were considered to represent high priority threats to the ecological character of the Western Port Ramsar Site:

- **Sea level rise:** Impacts from sea level rise were considered to be greatest for saltmarsh, waterbirds and seagrass.
    - Saltmarsh community composition and extent is largely determined by the frequency and depth of tidal inundation (Boon et al. 2011). Sea level rise in areas such as Western Port that has significant barriers to landward migration (roads, walls, etc.) could have severe impacts on the EPBC Act listed ecological community *Subtropical and Temperate Coastal Saltmarsh* (Saintilan and Rogers 2013). It is likely that under future sea level, saltmarsh will be further displaced by mangroves in Western Port Bay (Rogers et al. 2005a).
    - Shorebirds and beach nesting seabirds are highly vulnerable to sea level rise, with loss of habitat predicted to be extensive (Robinson et al. 2009).
    - Intertidal seagrass is highly vulnerable to sea level rise and has a low adaptive capacity (Morris 2013).
- **Increased frequency and intensity of storms leading to increased sediments:** Extreme events (storms and high rainfall events) are predicted to occur with high confidence (Grose et al. 2015). The soft sediments in the shallow waters over much of Western Port are highly vulnerable to resuspension. While there have been no long term changes in suspended sediment concentrations in Western Port from the time of listing, modelling based on 2030 global climate change predictions indicate significant increases in suspended material throughout the system, most likely with heightened concentrations in the Eastern Arm (EPA Victoria 2011a). Greatest risks are associated with seagrass, which is already light limited (Holland et al. 2013) and fish that relay on seagrass habitat.
- **Increased frequency and intensity of storms leading to increased erosion:** Erosion of shorelines in Western Port is currently occurring, particularly in the Eastern Arm near Lang Lang due to the combined actions of waves and tidal cycles. The Western Port Local Coastal Hazard Assessment indicates widespread and significant impacts by 2100 (Water Technology 2014). Seagrass and intertidal mud and sandflats were considered to be at greatest risk from eroding shorelines, with high risks identified for saltmarsh, mangroves and feeding, nesting and roosting waterbirds (Figure 9).

3.3.3 Recreational activities

Western Port is close to the City of Melbourne and a number of regional towns, making it a popular destination for recreational activities. The population of Greater Melbourne is predicted to increase from 4.3 million in 2013 to 7.8 million in 2051 (Department of Transport, Planning and Local Infrastructure 2014). This is likely to increase recreational pressure on beaches and coastal areas. There are three identified priority threats related to recreational activities in the Western Port Ramsar Site:

- **Vehicles in the intertidal zone:** Vehicle damage to coastal saltmarsh communities has been reported from many areas in Western Port Bay (Boon et al. 2011). Saltmarsh communities are slow to recover from disturbance and damage can be subtle (stem breakage) to long lasting and severe (e.g. wheel ruts). Parks Victoria has reported that the extent of vehicle access to intertidal areas has been largely controlled in the parks of Western Port. However, damage continues at sites outside of Parks Victoria control.
- **Disturbance of shorebirds and beach nesting birds**: Increased noise from shore based or nearshore boating activities (including jet skis, kite surfing, kayaking and other water based activities) and the presence of domestic dogs on beaches have all been identified as high risks to waterbirds both in Western Port Bay and elsewhere. Impacts on shorebirds from the presence of humans and their pets is well documented with reduced feeding and unnecessary energy use likely to impact the ability of birds to successfully make return journey to the northern hemisphere to breed (Glover et

al. 2011). Similarly disturbance of nesting birds can be direct (predation or destruction of eggs by people and dogs) or indirect (harassment causing nest abandonment).

- **Recreational fishing (including bait pumping)**: A survey of recreational fishers in Victoria indicates that for some species, the recreational catch is many times higher than the commercial catch (Ford and Gilmour 2013). There are policies and rules in place (size and bag limits) to limit the impact of recreational fishing on fish stocks, but an increasing population is likely to place increasing pressure on fisheries resources. Studies of bait pumping for ghost shrimp in Western Port indicated that changes are not just to target species, but to the ecosystem function of the entire habitat, with potential for slow recovery (Contessa and Bird 2004). Ghost shrimp are a primary food source for long beaked waders such as Eastern Curlew.

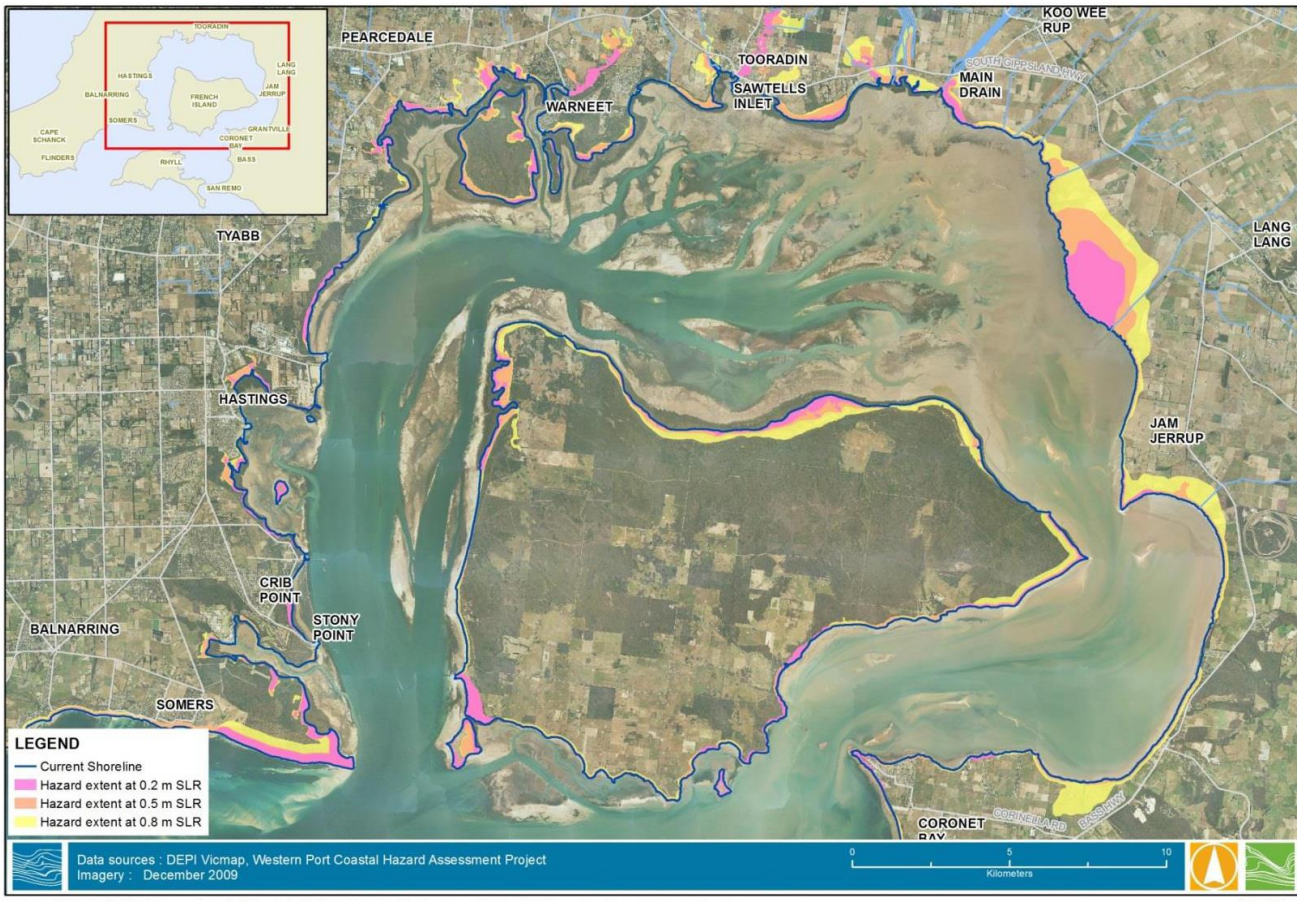


Figure 9: Erosion hazards under climate change scenarios of increased storms and sea level (Water Technology 2014).

3.3.4 Nutrients

Run-off from agricultural land (which includes stream erosion in rural areas) contributes the largest loads of nitrogen and phosphorus to Western Port (approximately 60%), with urban run-off contributing the remainder. Total nitrogen loads range from 400 tonnes per year in an average year to over 1,000 tonnes in a wet year (Melbourne Water 2009). However, there is little evidence of increasing nutrient concentrations in Western Port (1990 - 2009), with a decline in concentrations (and loads) during the Millennium drought (EPA Victoria 2011b); but no long-term change in nutrient concentrations from the 1970s to today (Holland et al. 2013). Under future climate, time spent in drought is projected (with medium confidence) to increase over the course of the century, with more rain falling in large storm events (Grose et al. 2015). This may lead to a decrease in nutrient discharges during drought, but periodic large loads during flood events. A recent study of nutrient cycling in Western Port indicates that the majority of dissolved nitrogen (over 80%) is flushed from the system into Bass Strait, although localised, less well-flushed areas, such as Corinella, may experience water quality impacts (Evrard et al. 2013). Changes in agricultural land use have occurred

since 1982, with a move to more intensive land use practices, this trend is likely to continue into the future. This may lead to increased nutrient concentrations in water reaching the bay.

Urban areas in the Western Port catchment contribute approximately 14 % of the total nutrient loads to the site (Melbourne Water 2009). Under future population scenarios, it is predicted that there will be a 13 - 14 % increase in nitrogen and phosphorus loads from urban development by 2030 (Melbourne Water 2009). More recent advice from Melbourne Water indicates that the loads will be higher than this due to an increase in urban growth over 2009 predictions and less than expected control on water volumes discharged.

3.3.5 Sediments

There are a number of sources of sediments to Western Port Bay, including catchment derived sediments (approximately 70% of total discharge) and erosion of clay banks, particularly around the Lang Lang area (Tomkins et al. 2014). The vast majority of catchment derived sediment loads come from rural lands (85%); with agriculture (cropping and dairy) accounting for the largest loads (Melbourne Water 2009). The dominant catchment source for fine sediment is channel and gully erosion of Lang Lang River and, to a lesser extent, Bunyip River.

There are no clear trends in the concentration of suspended solids in Western Port, which have remained stable since monitoring commenced in 1984 (EPA Victoria 2011b, Holland et al. 2013). As with nutrients (described above) the run-off of sediments under future climate predictions may be lower during periods of drought, but very high during storm and flood events.

The greatest risks from sediments are to seagrass and species that rely on seagrass habitats. Seagrass loss in Western Port between 1970 and 1990s has been attributed to decreased light and increased suspended sediments (Walker 2011). A recent study concluded that sediments are a strong influence on seagrass distribution and health (Holland et al. 2011). While seagrass extent has increased since 1999 in the north and west (Holland et al. 2011), the seagrass in the northeast has not recovered and loss has been associated with increased erosion and turbidity.

3.3.6 Toxicants

The types of chemicals thought to be of most concern for Western Port are heavy metals, pesticides from agricultural runoff (Sharp et al. 2013) and veterinary pharmaceuticals and oestrogens from dairying (Fisher and Scott 2008). A recent survey indicated that, in general, toxicants in Western Port sediments are not at levels likely to be causing effects to resident fauna and flora. However, in some estuarine areas several metals including arsenic, nickel, mercury and organotins, were detected at levels exceeding sediment quality guidelines and pose a moderate risk to ecosystem health. In addition pesticides were detected in a number of estuarine areas, but not in Western Port sediments (Sharp et al. 2013). A study of toxicants in Watson's estuary found evidence of oestrogen impacts on biota (Sharley et al. 2013). Herbicides and oestrogen concentrations and risks in the rest of Western Port remain a knowledge gap. Changing land use to more intensive agriculture may result in an increased risk over the next 15 years.

3.3.7 Urban, commercial and industrial development

As stated above, the population of Greater Melbourne is predicted to increase from 4.3 million in 2013 to 7.8 million in 2051 (DTPLI 2014). There has already been an expansion of residential and commercial land uses in the Western Port catchment and increasing populations are likely to add to the extent of new housing and associated commercial zones. A portion of the Western Port catchment is declared a “green wedge”, which protects public open space, prescribes minimum parcel sizes and prohibits certain land uses. The urban growth boundary has expanded in recent times (2005 and 2010) with extensive areas of commenced and proposed residential development in the catchment. The impacts are primarily related to direct habitat removal, increasing stormwater run-off (and associated pollutants) and a loss of vegetation buffers for the Ramsar site.

3.3.8 Additional threats

In addition to the threats identified through the risk assessment process, the Steering Committee and Stakeholder Advisory Group considered that there were a number of non-physical threats that were critical to the management of the Western Port Ramsar Site. These included:

- A lack of awareness of the values and Ramsar status of Western Port, by broad sections of the community.
- Poor integration of agency and non-governmental organisation (NGO) efforts.
- Inadequate and variable resourcing for management actions to maintain the ecological character of the Western Port Ramsar Site.

These were considered in the development of management strategies and the approach to governance at the site.

3.4 Identified knowledge gaps

Throughout the risk assessment and process for identifying priority values and threats for management, a number of key knowledge gaps were identified:

1. Distribution, community composition, abundance and condition of benthic infauna communities.
2. Status of phytoplankton in Western Port, including toxic species.
3. Chemicals of emerging concern (oestrogens, pharmaceuticals) - concentrations and potential impacts.
4. Impact of current and future recreational fishing on fish populations.
5. Community understanding and valuing of the Western Port Ramsar Site.
6. Beach nesting bird breeding and recruitment success.
7. Impact of cattle from unfenced properties (e.g. fencing and unlicensed grazing of saltmarsh).
8. Extent and location of illegal removal of saltmarsh and mangrove vegetation.
9. Impact of climate change on fire regimes in saltmarsh and mangrove vegetation.
10. New and emerging recreational activities and impacts on Ramsar values.
11. Opportunities for investment from carbon stored in Western Port habitats.

4 Site management strategies

4.1 Method

4.1.1 Developing targets

There are three different measures commonly used in assessing condition:

Benchmark - the state against which condition is assessed. This is condition at the time of listing and is described in the Ecological Character Description.

Target - the value an indicator is expected to achieve if management objectives have been met. These are the *Resource Condition Targets* established in this management plan (see below).

Trigger - the value of an indicator that, if it were to occur, would signal to managers that intervention is required. There are a variety of management triggers that are relevant to the Western Port Ramsar Site Management Plan, including those set for stormwater quality and quantity and those set by the State Environmental Protection Policy (SEPP) for water quality and other biota (see Text Box below).

Resource Condition Targets (RCTs) were developed to guide the development of appropriate management strategies. RCTs are statements of aspirational condition for each of the identified priority values. How they fit into the planning and development process is illustrated in Figure 10. As part of Ramsar management planning, Limits of Acceptable Change (LAC) have been developed previously for the site. These are formal instruments against which change in ecological character is assessed and reported to the Convention every three years.

Figure 10: Relationships between the different instruments of the plan and their development process.

Management triggers: Review of the SEPP (Waters of Victoria)

State environment protection policies (SEPPs) are part of a legal framework to protect and improve Victoria's environments and the environmental, social and economic values they support. The SEPP (Waters of Victoria) use indicators and objectives to describe the level of environmental quality required to protect different beneficial uses (values). These include specific chemical parameters such as nitrogen and phosphorus concentrations, turbidity and total dissolved solids, as well as biological measures such as the presence or abundance of macroinvertebrates. If an objective is not attained, the beneficial uses are likely to be at risk. The non-attainment of an objective will trigger further investigation to assess risks to beneficial uses.

There is currently a set of objectives for water quality parameters within the Western Port Ramsar Site and biological objectives for invertebrates and fish in the catchments (SEPP Schedule F8). These were established in 2001 and together with all the SEPP water related objectives are currently under review. The review will examine the different approaches to setting environmental indicators and objectives, which include:

- water quality data versus biological data;
- monitoring data versus cause – effect data; and
- locally derived data versus national standards.

In order to ensure consistency between different programs, the Ramsar Site Management Plan for Western Port will adopt the objectives developed by EPA Victoria as trigger values for maintaining ecological condition of Western Port.

Algal growth on seagrass in Yaringa Marine National Park (M. Rodrigue / Parks Victoria).

4.1.2 Review of the 2003 plan

The 2003 Western Port Ramsar Site Strategic Management Plan contained 10 management objectives and 66 associated site management strategies. These were reviewed with respect to progress towards implementation and / or achieving the stated strategy, and relevance to current priority values and threats at the site (Appendix E). Strategies in the 2003 management plan that were relevant to identified priority values and threats were used to inform the development of management strategies for this current management plan.

4.1.3 Stakeholder involvement

Resource Condition Targets were developed and refined by the Steering Committee. Management strategies to address priority values, threats and knowledge gaps were developed by the Steering Committee and Stakeholder Advisory Group in a one day workshop held in Warneet on October 20, 2015. The outputs of the workshop were used to assign management strategies to one of five themes:

- Theme 1: Managing water quality
- Theme 2: Living with climate change
- Theme 3: Protecting flora and fauna
- Theme 4: Improving our knowledge
- Theme 5: Communication, Education, Participation and Awareness (CEPA)

Where possible, integration with existing programs was sought, with relevant programs identified. Responsibilities for each management strategy were identified.

4.2 Achievements from the 2003 plan

A large amount of on-ground work and research has been undertaken within the Western Port Ramsar Site since the release of the 2003 Ramsar site management plan. A summary of this work, highlighting significant achievements related to maintaining ecological character is provided here for each management agency. It should be noted that a large amount of collaborative work is undertaken in Western Port through multi-agency programs. These are described below under the relevant lead agency, with key partner organisations identified.

4.2.1 Central Coastal Board

The Central Coast Board has developed a Coastal Action Plan for the coast of the Port Phillip & Western Port region, released in 2015. The plan may make progress towards the development of an 'Index of Coastal Condition' or similar that could better describe and assess the environmental value of coastal areas. If implemented this may lead to monitoring arrangements being revised. The Victorian Coastal Strategy (2104) is the overarching planning instrument under which the Regional Coastal Plan sits. As such it addresses the five main statewide coastal issues and 16 regional issues. The five statewide issues are:

- Managing for population growth
- Adapting to climate change
- Managing coast land and infrastructure
- Valuing the natural environment
- Integrating marine planning

4.2.2 EPA Victoria

EPA Victoria together with Melbourne Water developed and implemented the Better Bays and Waterways Plan (see section 1.2.4) and also undertakes water quality monitoring at fixed sites in Western Port. In 2013 they published their Research and Development program 2013-2016 which includes two research programs undertaken in Western Port.

4.2.3 Department of Environment, Land, Water and Planning

The Department of Environment, Land, and Water and Planning has continued to coordinate the implementation of the Ramsar Convention requirements in Victoria. In 2013, the department released the Victorian Waterway Management Strategy (VWMS), which sets out Victoria's policy on the management of Ramsar sites, and waterways generally. The Department has contributed to both research and on-ground works in the Western Port Ramsar Site through projects such as:

- Waterbird research by the Arthur Rylah Institute (Hansen et al. 2011, Menkhorst et al. 2015) in partnership with BirdLife Australia, CCB and Australian Government Caring for Our Country – investigation of trends in waterbird numbers and likely causes of trends. Included identification of important waterbird roosting, foraging and nesting sites within the Ramsar site.
- Increasing knowledge and understanding of mangroves - production of a discussion paper to describe mangrove ecology in Western Port with particular focus on the Grantville/Lang Lang areas, to increase community awareness.
- Mangrove planting – The Department provided funding through the Victorian Investment Framework to trial a range of mangrove revegetation approaches to address coastal erosion and undertake assessment of works to identify most effective methods.

4.2.4 Melbourne Water

Melbourne Water developed, and is implementing, the Healthy Waterways Strategy which informs the management of rivers, estuaries and wetlands in both Port Phillip and Westernport regions. The Healthy Waterways Strategy defines Melbourne Water's current role, in partnership with the community and stakeholders, in managing rivers, estuaries and wetlands from 2013/14 to 2017/18. This strategy focuses on investing in areas that the community values and that will protect and improve environmental values and increase liveability (Melbourne Water 2013). Whilst largely aimed at catchment scale management, the priorities for improving health of the catchments of Western Port will provide benefits to the Ramsar site values.

Melbourne Water, together with EPA Victoria have developed and implemented the Better Bays and Waterways program, a collaboration that commenced in 2009. The plan outlined 93 actions for improving water quality in the Port Phillip and Western Port region, with water quality targets set for reductions of sediment and nitrogen loads to Western Port.

As part of the Groundwater Dependent Ecosystem program, Melbourne Water has developed a conceptual model explaining the role of groundwater in Western Port and installed monitoring bores. Conceptual models have also been prepared for the Tarago and Bunyip catchment and the Lang Lang catchment. The links between groundwater and seagrass have also been investigated.

Melbourne Water is working with developers at produce "better than best practise" outcomes for Westernport catchments (SEPP F.8).

Melbourne Water has commissioned a serious investment into knowledge and understanding of Western Port. Firstly through the comprehensive review: *Understanding the Western Port Environment - A summary of current knowledge and priorities for future research* (Melbourne Water Corporation 2011); then through a series of research programs aimed at addressing the significant knowledge gaps identified in the review (Table 12).

Table 12: Current and recently completed research projects supported by Melbourne Water (from http://www.melbournewater.com.au/whatwedo/protectrivers/research/pages/western-port-environment-research.aspx).

Program name	Intent
Confirmation of Western Port seagrass species using genetic markers	Using molecular genetic tools to understand the seagrass species that are present and the degree to which knowledge from seagrass studies elsewhere can be applied to Western Port.
Examining the long term trends	To determine the reasons behind the decline in fish eating birds in recent

Program name	Intent
of fish-eating birds	decades and identify whether the decline is indicative of changes in the bay, or something occurring more broadly across the species distributions.
Improving our ability to model hydrodynamics in Western Port	To collect additional data that can be used to ensure that the Western Port hydrodynamic model provides and accurate description of water movements in Western Port.
Monitoring and evaluation of the risk of herbicides to key habitats in Western Port	To investigate if the current types and levels of herbicides found in the marine environment are likely to be impacting key habitats in Western Port – most notably seagrass and mangroves.
The protection and recovery of seagrass beds: The role of catchments, options for management and development of water quality targets	To expand on previous assessments (see 'Preliminary assessment of seagrass water quality requirements' project) by developing a bay-wide picture of the relationships between the presence of healthy seagrass beds with water quality and other potentially important characteristics (e.g. seabed height and extent of intertidal exposure) to drive a targeted protection, rehabilitation and management program for one of Western Port's critical habitats.
Using information from recreational fishers to understand fish biodiversity in Western Port	Analysis of long-term recreational fishing data using boat ramp surveys and angler diaries with a view to increasing our knowledge of fish biodiversity and habitat relationships in Western Port (Menkhorst et al. 2015).
Understanding process and inputs of sediment from coastal erosion	Quantifying coastal erosion rates and determining the dominant erosion processes to assist in targeted actions to reduce sediment inputs to Western Port.
Assessment of the nutrient inputs and fate within the bay	Measuring inputs of nutrients to Western Port and how they are processed across tidal mudflats to better understand the potential impact on the ecological health of the bay.
Preliminary assessment of seagrass water quality requirements	Observing the relationships between water quality and seagrass distribution to inform management guidelines for the protection of Western Port.
Potential impact of toxicants on the health of Western Port	Investigating the presence of toxicants in sediments throughout Western Port to determine whether they may be potentially impacting the health of the bay.
Importance of various habitats for maintaining fish diversity (see Jenkins et al. 2015).	To identify the importance of different habitat types found in Western Port to fish assemblages and key species to inform appropriate risk mitigation options
Mangrove planting for coastal stabilisation	Incorporation of a wide range of projects to improve the success of mangrove planting activities around Western Port, including mangrove propagation experiments, direct seeding trials, artificial reef investigation and seed collection studies.

4.2.5 Parks Victoria

Parks Victoria has continued on-ground actions specifically addressing threats to flora and fauna in parks and reserves in the Ramsar site. The Western Port Ramsar Site contains three marine parks (Yaringa, French Island and Churchill Island) as well as numerous reserves along the shoreline. Parks Victoria continues to work in collaboration with other agencies to manage pest plants and animals within the portions of the Ramsar site that they control as well as contributing to research and knowledge management through the

Research Partners Program (Table 13). Examples of Parks Victoria actions and programs in the Ramsar site include:

- Development of a management plan for the national parks within Western Port (Parks Victoria 2007).
- Monitoring and benchmarking of values within marine national parks
- Production of a marine pest guide book for Port Phillip and Western Port Bays
- Active partner in the Western Port Ramsar Protection Program

Table 13: Summary of Parks Victoria Research Partners Panel projects 2007 -2010 relevant to Western Port Ramsar Site.

Research theme	Project and lead research partner
Integration of research and management	• Developing conceptual models, University of Melbourne • Monitoring the outcomes of an adaptive experimental management program in Victoria's Marine National Parks and Marine Sanctuaries, University of Melbourne
Parks in the landscape	• How much habitat and in what configuration maintains natural levels of connectivity in southeast Australian native birds, Monash University
Performance evaluation	• Engaging communities in monitoring park values and threats, Monash University • Monitoring ecological impacts under severe uncertainty, University of Melbourne • Fox Adaptive Experimental Management Project, Arthur Rylah Institute • Sea Search: Community-based monitoring of Marine Protected Areas (MPAs) in Victoria - Post-graduate project, Deakin University • Birds as indicators of environmental condition (Stage 1), Birds Australia • Soft Sediment data assessment and future monitoring design, Primary Industries Research Victoria • Birds as indicators of environmental condition (Stage 2), Birds Australia

4.2.6 Port Phillip and Western Port CMA

The Port Phillip and Westernport CMA have implemented a variety of strategic and on-ground actions aimed at maintaining the ecological character of the Western Port Ramsar Site. Significant programs include:

- Regional Catchment Strategy (Port Phillip and Westernport CMA 2014) – set targets for environmental assets in the Port Phillip and Western Port region that would improve ecological condition and increase resilience. The key components, which are the focus of the strategy, include native vegetation, native animals, waterways and wetlands, hinterland, coasts and the bays. With regards to the Ramsar site the targets set for coastal zones and marine water quality, whilst not directly addressing priority values or threats, will contribute to maintaining the ecological character of the Ramsar site, notably seagrass condition and provision of habitat for fish.
- Regional Invasive Plant and Animal Strategy (Port Phillip and Westernport CMA 2011) – contains five objectives and 15 actions relating to the management of invasive pants and animals.
- Ramsar Protection Project – provides federal and state funding to partner organisations for the implementation of on-ground works in invasive pest and animal control.

4.3 Resource condition targets

A total of eight Resource Condition Targets (RCTs) have been defined for the Western Port Ramsar Site (Table 14). These have helped to guide the identification of management strategies and provide a goal for monitoring the ecological character of the site. Further justification for the development of these RCTs is provided in Appendix F.

Table 14: Resource Condition Targets for the Western Port Ramsar Site.

Resource condition targets	Priority value
1. Maintain the diversity of habitats for the Ramsar site: • Seagrass > 15,000 hectares • Saltmarsh > 1,100 hectares • Mangroves > 1,700 hectares • Sand / mudflats > 27,000 hectares • Rocky reef	Seagrass, saltmarsh, mangroves, intertidal flats and rocky reef
2. Maintain the diversity and abundance of native fish.	Fish
3. Maintain connectivity between inland rivers and marine areas of Western Port for migratory fish species.	Fish, threatened species (Australian grayling)
4. Maintain abundance of waterbirds in each of the following guilds (calculated as a rolling five year average of maximum annual count): • Total waterbirds > 20,000 • Migratory shorebirds > 12,000 • Australasian shorebirds > 1,100 • Ducks > 1,300 • Fishers > 600 • Gulls > 1,300 • Large wading birds > 1,300 • Swans > 2,700	Waterbird diversity and abundance
5. Provide predator free significant beach-nesting sites.	Waterbird breeding
6. Maintain predator free roosting and feeding habitats for threatened waterbirds species (saltmarsh and intertidal mud and sandflats).	Threatened species
7. Maintain the diversity and abundance of ghost shrimp.	Intertidal and subtidal flats
8. Maintain productivity of Western Port to support adequate shorebird biomass and abundance.	Waterbirds, intertidal and subtidal flats

4.4 Theme 1: Managing water quality

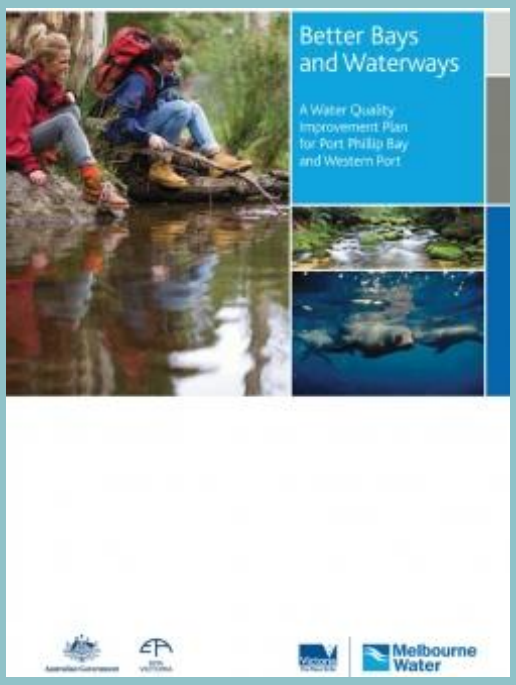
Sediment and nutrient inputs to Western Port were identified as high priority threats, with increasing concern about catchment derived toxicants. Significant research and on-ground work has been conducted on managing water quality both in terms of sources and impacts to key values within Western Port. This includes through the Better Bays and Waterways program (see below), Port Phillip and Western Port Regional Catchment Strategy and the Melbourne Water Healthy Waterways Strategy, as well as through a number of other regional initiatives. It is the intention of the Western Port Ramsar Site Management Plan to be complementary to these other initiatives, working in a coordinated manner to improve water quality in the Ramsar site.

Five management strategies have been identified to manage water quality (Table 15). The relationship between management strategies, priority threats and priority values with their associated resource condition targets is provided in Appendix G.

Table 15: Management strategies and responsible organisations for managing water quality.

Management strategy	Responsibility	Linkages to existing programs / activities
1.1 Reduce nutrient and sediment inflow: Support the implementation of riparian, in-stream and catchment works identified in the Healthy Waterways Strategy (Melbourne Water Corporation 2013); revised State Environment Protection Policy Waters of Victoria (when completed); and Port Phillip and Western Port Regional Catchment Strategy to improve water quality in storm water and river flows to Western Port.	Melbourne Water EPA Victoria DELWP CMA	Healthy Waterways Strategy PPWP Regional Catchment Strategy Review of SEPP (WoV)
1.2 Develop best practice guidelines for urban and rural run-off and an incentive scheme to facilitate uptake	Melbourne Water DELWP Local government	Urban Stormwater: Best Practice Environmental Management Guidelines.
1.3 Develop appropriate approaches for pollutant reduction and seagrass improvement, and trigger values (objectives) for water quality indicators	EPA Victoria	Review of SEPP (WoV)
1.4 Investigate the feasibility of and parameters for creating retention wetlands for improving water quality at the downstream end of priority streams entering Western Port. Implement actions that arise from the investigation (create appropriate retention wetlands).	CMA DELWP Melbourne Water Local government	
1.5 Investigate the sources, potential impact and mitigation strategies for toxicants entering Western Port through storm water drains and rivers	Melbourne Water EPA Victoria Local government	Western Port Scientific Investigations funded by Melbourne Water

Better Bays and Waterways



The Better Bays and Waterways program was developed jointly by EPA Victoria and Melbourne Water and was a five year (2009-2014) water quality improvement plan for the Port Phillip and Western Port region. More than 90 actions were identified for more than 30 organisations including local government, five Victorian Government agencies, research institutions and community groups.

The $5 million plan, jointly funded by the Australian Government, EPA Victoria and Melbourne Water, described the values, threats and condition of the region's catchments, waterways and Port Phillip and Western Port bays.

The plan outlined 93 actions, with a total investment of almost $300 million, across 15 focus areas, aimed at reducing the amount of pollutants entering waterways and bays from rural, urban and coastal areas.

Snap shot of the Better Bays and Waterways focus areas relevant to Western Port.

Example focus areas	Example actions
Rural water quality program	**5 actions** – e.g. Fencing and revegetating stream frontages and helping farmers implement practices to protect water quality.
Understanding and managing urban pollution	**8 actions** – e.g. Revise urban stormwater management standards; ensure compliance across all urban development.
Managing urban development	**10 actions** – e.g. Build urban wetlands to reduce existing stormwater pollutant loads to waterways and the bays.
Managing potentially polluting activities	**8 actions** – e.g. Accelerate programs to sewer areas still serviced by septic systems.
Bushfire rehabilitation	**8 actions** – e.g. Range of actions to minimise effects of February 2009 bushfires on waterways.
Marine environment	**4 actions** – e.g. Re-establish shoreline vegetation in targeted areas, especially mangroves on Western Port shorelines identified as at risk of erosion.
Bay monitoring	**5 actions** – e.g. Put in place a framework to monitor and report on the health of the bays.
Research and investigation	**12 actions** – e.g. Undertake research on the effectiveness of natural and constructed stormwater treatment systems.
Community engagement	**3 actions** – e.g. Continue educational programs run by Melbourne Water at schools and festivals to promote understanding of water quality.
Governance	**2 actions** – e.g. Establish a coordinating committee to oversee the implementation of Better Bays and Waterways action plan.
Reporting, evaluation, review	**6 actions** – e.g. Annually report on the implementation of Better Bays and Waterways actions

4.5 Theme 2: Living with climate change

Climate change was identified as a priority threat for management in the next seven years based largely on the effects of sea level rise on coastal vegetation communities (saltmarsh and mangroves) as well as on habitat for shorebirds. Longer term impacts from increased frequency and intensity of drought and increased storm surge were also considered a high priority threat, and the potential change in fire regimes identified as a knowledge gap.

Although it is not possible to directly influence the drivers of climate change in a management plan for a single Ramsar site, planning for resilience and adaptation to climate change is crucial and requires immediate action to maintain ecological character into the future. The issue of maintaining ecological character in a changing climate and with the inevitable changes in species distributions is being considered by the Convention (and in many other forums) both in Australia and internationally (Pittock et al. 2010, Gitay et al. 2011, Finlayson et al. 2013).

The impacts of climate change on the values of Western Port and potential mitigation strategies have been the subject of some recent research. This includes a local coastal hazard assessment (Arrowsmith and Womersley 2014); consideration of climate change impacts on key values (Melbourne Water Corporation 2011) and an assessment of potential restoration sites for saltmarsh (see text box next page).

Three management strategies have been identified to address the impact of changing climate (Table 16). The relationship between management strategies, priority threats and priority values with their associated resource condition targets is provided in Appendix G.

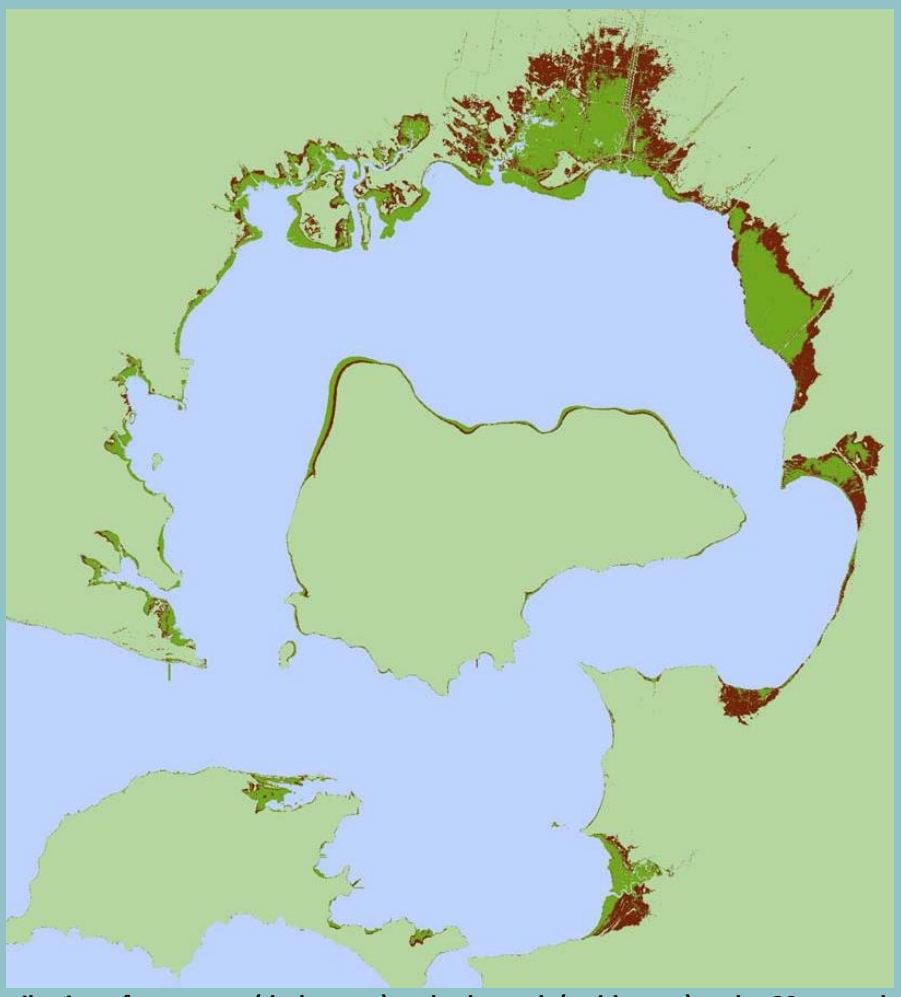
Table 16: Management strategies and responsible organisations related to living with climate change.

Management strategy	Responsibility	Linkages to existing programs / activities
2.1 Implement the recommendations of the Western Port Local Coastal Hazard Assessment. Specifically the: • Development of a strategic approach to the management and future adaptation of the existing shoreline protection works; • Provision of adaptation space for the landward migration of wetland fringed shorelines	DELWP CMA Local government	Western Port Local Coastal Hazard Assessment
2.2 Investigate the risk from and management strategies for increased frequency and intensity of fire in saltmarsh and mangrove communities	DELWP	
2.3 Investigate the risk associated with and potential mitigation strategies for climate change impacts to ecological character of the Ramsar site	DELWP CMA	

As the sea level rises where can the saltmarsh and mangroves go?

Saltmarsh and mangroves occupy much of the intertidal shoreline of the Western Port Ramsar Site. Climate change will affect these communities through a number of pathways, but sea level rise and storm surge have been identified as of immediate concern both in Western Port and elsewhere. Landward migration of saltmarsh and mangroves has long been identified as a potential mitigation strategy. That is, as the level of the sea and waves increase, saltmarsh and mangroves could gradually move inland to areas that match their inundation requirements. There are, of course, a number of factors that could prevent this, both natural (steep cliffs along the shoreline) and human induced (built barriers such as roads, levees and buildings).

If one of the management strategies to ensure the continued survival of saltmarsh and mangroves in Western Port was to set aside suitable land for migration of vegetation under future sea level conditions, it will be important to know where suitable locations can be found. To this end, a preliminary investigation has been completed into potential land suitable for mangroves and saltmarsh under an 80cm rise in mean sea level (see map below) (Boon et al. 2011). Although the authors note that the outputs of this preliminary modelling are too uncertain to inform conservation planning, it provides a broad overview and could be used to target more in depth localised investigations. The authors concluded:
"*if predicted rates of sea-level rise are realised, much of the Victorian public lands which currently support intertidal vascular vegetation will be inundated, and the conservation of saltmarsh and mangrove will require substantial areas of what is currently freehold land to be set aside for their landward migration and reassembly*."



Potential distribution of mangrove (dark green) and saltmarsh (red-brown) under 80cm sea level rise. Note that this does not account for many areas with levees and other artificial barriers to migration (Boon et al. 2011).

4.6 Theme 3: Protecting flora and fauna

Pest plants and animals, recreational activities, direct habitat removal through commercial and residential development and biological resource use (harvesting of fish and invertebrates) were all identified as high priority threats to the plants and animals of the Western Port Ramsar Site. While there has been a large and coordinated program to control predators and pest plants within the Ramsar site (see text box below), this work needs to be maintained. Similarly, while the relevant authorities assess individual development proposals, a coordinated approach to assessing the effect of multiple actions and developments may be required to adequately maintain ecological character.

Fourteen management strategies have been identified to protect flora and fauna (Table 17). The relationship between management strategies, priority threats and priority values with their associated resource condition targets is provided in Appendix G.

Table 17: Management strategies and responsible organisations for protecting flora and fauna.

Management strategy	Responsibility	Linkages to existing programs / activities
3.1 Develop and implement best practice guidelines for habitat restoration (seagrass, saltmarsh, mangroves).	DELWP NGOs	Seagrass partnership Western Port Biosphere
3.2 Restore / maintain extent and condition of key habitats in Western Port to increase resilience to the impacts of threats.	DELWP CMA Parks Victoria Local Government NGOs	Seagrass partnership Western Port Biosphere Ramsar Protection Program
3.3 Identify priority locations of habitat loss in the Ramsar site due to human activity including vehicle damage, stock grazing, illegal dumping, direct vegetation removal and implement appropriate enforcement of existing laws.	Parks Victoria Local government Landcare CMA	Ramsar Protection Program
3.4 Install and maintain fencing at priority locations to restrict recreational access to sensitive habitats in the foreshore and intertidal zone.	Parks Victoria Local government	
3.5 Develop guidelines for defining and managing buffer zones to guide assessment of local planning applications.	DELWP	DELWP Wetland Buffer Guidelines
3.6 Develop and implement a strategic approach to development in areas adjacent to the Ramsar site that consider the cumulative impact of multiple actions on ecological character.	Local government DELWP	
3.7. Continue to implement pest animal control programs (cat, fox, rat, dog, pig) in priority roosting and nesting sites within the Ramsar site.	Parks Victoria CMA Local Government NGOs	Ramsar Protection Program
3.8 Continue to implement rabbit control programs within the Ramsar site boundary to limit impacts on saltmarsh.	CMA Local Government NGOs	Ramsar Protection Program
3.9 Implement an incentive program for landholders to fence waterways, mangrove and saltmarsh areas to restrict stock access.	CMA DELWP Melbourne Water	Ramsar Protection Program
3.10 Continue to implement Spartina control programs within the Ramsar site.	Parks Victoria CMA	Ramsar Protection Program
3.11 Conduct regular surveys and implement control actions for new and emerging salt tolerant weeds.	Parks Victoria DELWP Local government	Ramsar Protection Program
3.12 Gazette of Quail Island as a Nature Conservation Reserve.	DELWP Parks Victoria	
3.13 Support activities under the Port Phillip and Western Port Invasive Plant and Animal Strategy (PPWCMA 2011).	DELWP Parks Victoria	Ramsar Protection Program
3.14 Develop and implement a marine pest strategy for Western Port.	DELWP Parks Victoria	

Ramsar Protection Program

The Ramsar Protection Program protects two wetland sites in Victoria of international importance - the Port Phillip Bay (Western Shoreline) and the Western Port site. The program aims to reduce threats to the sites, such as pest plants and animals, and increase community understanding of the importance of wetlands and how to protect them. Specialist programs include fox and rabbit control, weed control and fencing. Pest animal control in the program has been particularly effective with 7,684 hectares of land managed for pest animals, including foxes, rabbits, cats, pigs, goats and deer. A further 344 hectares of land has been fenced to exclude pest animals, stock and domestic animals such as cats and dogs, protecting habitat for native animals and migrating shorebirds.

The program is being delivered over a five year period (2013-2018) with funding of $3 million from the Australian Government through the National Landcare Programme. Program partner organisations that receive Australian Government funds and are active in the Western Port Ramsar Site are:

- Port Phillip and Westernport Catchment Management Authority
- Parks Victoria
- Phillip Island Nature Parks
- Mornington Peninsula Shire
- City of Casey
- Western Port Biosphere Reserve
- French Island Landcare
- Bass Coast Landcare Network
- BirdLife Australia

One of the critical success factors of the program has been the coordination and cooperation between partner organisations and the community.

Fencing to protect saltmarsh and mangroves (Port Phillip and Western Port CMA).

4.7 Theme 4: Improving our knowledge

Western Port is a well-studied environment and in particular the recent Melbourne Water Western Port environment research program has added greatly to our understanding of the system and its values (see text box below).

Eleven priority knowledge gaps were identified during the development of the Western Port Ramsar Site Management Plan (section 3.4). Some of these are addressed through monitoring activities (see section 5) and five management strategies have been developed to address the remainder (Table 18).

Table 18: Management strategies and responsibilities to address critical knowledge gaps.

Management strategy	Responsibility	Linkages to existing programs / activities
4.1 Investigate the relationships between reduced water quality and shorebird food availability	DELWP EPA Victoria	EPA Marine Fixed Sites Network (FSN) water quality monitoring program
4.2 Investigate the population dynamics and behaviour of the fairy tern colony	Parks Victoria DELWP	
4.3 Assess the community composition, extent and condition of benthic invertebrates in soft sediments	Parks Victoria DELWP	Parks Victoria habitat mapping and marine park monitoring
4.4 Community composition, spatial and temporal variability and presence of potentially toxic species of phytoplankton in Western Port	DELWP	
4.5 Investigate the extent and potential impact of recreational fishing in Western Port. Use recreational fish monitoring data to inform the development of numerical RCTs and LAC for fish.	DEDJTR	

Melbourne Water: Western Port Environmental Research

In March 2012 Melbourne Water released a scientific review strategically assessing our knowledge of the Western Port environment, to inform future investment to protect and improve the bay's health. The review represents an outstanding summary of the combined knowledge of the Western Port environment. The review provided 43 recommendations for research and 12 high priority research projects.

The 12 highest priority research tasks fall into several group or themes as follows:

Improving our understanding of physical processes

1. Obtain detailed and up-to-date bathymetry for Western Port.
2. Calibrate hydrodynamic models to ensure accurate representation of water movement.

Relationships between habitat forming species such as seagrasses and mangroves and water quality (nutrients and sediments)

3. Determine a preliminary nutrient budget.
4. Measure nutrient cycling in major habitats (unvegetated soft sediments and seagrass habitat).

Understand the loss and recovery of seagrasses

5. Assess the degree of nutrient and light limitation of the major primary producers, seagrass and possibly microphytobenthos.
6. Determine water quality targets for sediments and nutrients that support seagrasses (and possibly microphytobenthos).
7. Determine which species of *Zostera* are present in Western Port.
8. Determine capacity for *Zostera* to recover and colonise new areas.

The extent to which toxicants entering Western Port pose a threat to the marine environment

9. Make an initial estimate of the risk from toxicants beyond discharge points.

Iconic species (fish and waterbirds)

10. Determine linkages between fish and habitats, to better understand the significance of changes from seagrass habitat to algae-dominated habitat
11. Determine the effects of recreational fishing on fish stocks
12. Examine the trends in abundance of fish-eating birds in Western Port.

Melbourne Water then instigated a range of strategic research projects, in partnership with other Victorian government agencies and leading environmental scientists, to improve our knowledge of Western Port marine and coastal environment. This program focussed initially on high priority research tasks in an interconnected program (http://www.melbournewater.com.au/whatwedo/protectrivers/research/pages/western-port-environment-research.aspx).

4.8 Theme 5: Communication, Education, Participation and Awareness (CEPA)

The Ramsar Convention's Program on Communication, Education, Participation and Awareness (CEPA) was established to help raise awareness of wetland values and functions. The CEPA Program calls for coordinated international and national wetland education, public awareness and communication. The Program also encourages the promotion of training in the fields of wetland research and management.

While there are some excellent CEPA programs already in place in the Western Port Ramsar Site (see text box below for the Indigenous Wardens program), the lack of awareness in the broader community of wetland values and the Ramsar Convention was raised by the Stakeholder Advisory Group and Steering Committee as a significant issue for Western Port.

Five management strategies have been identified to improve communication, education, participation and awareness (Table 19). The relationship between management strategies, priority threats and priority values with their associated resource condition targets is provided in Appendix G.

Table 19: Management strategies and responsibilities for CEPA.

Management strategy	Responsibility	Linkages to existing programs / activities
5.1 Education and engagement of landholders and community members and incentive programs for streamside/shoreline/coastline fencing.	CMA DELWP Melbourne Water Parks Victoria	Ramsar Protection Program
5.2 Implement a public awareness campaign for recreational boat users and personal watercraft (e.g. jet skis) to minimise the potential impacts to shorebirds and beach nesting birds.	DELWP Parks Victoria	
5.3 Implement a community awareness campaign and reporting hotline for introduced marine pests targeting divers and recreational fishers.	DELWP	Parks Victorian Marine Invasive Species Guide
5.4 Communicate the outcomes of the three yearly Ramsar Rolling Review to the broader community through a fact sheet / report card.	DELWP	Ramsar Rolling Review
5.5 Maintain the Western Port Ramsar Site webpage (DELWP) and the process for stakeholder involvement via updates and links.	DELWP	

Indigenous Wetland Wardens

In February 2015, Port Phillip and Westernport Catchment Management Authority (PPWCMA) and BirdLife Australia held the inaugural *Indigenous Wetland Wardens* workshop within Victoria's Western Port and Port Phillip Bay Ramsar Sites.

This free training event for Indigenous Australians aims to provide participants with the skills and knowledge to identify shorebirds and gain an understanding of how to manage and preserve their critical wetland habitat.

Staff from BirdLife Australia, PPWCMA, Parks Victoria and conservation rangers from Hobsons Bay City Council led the enthusiastic group through a range of topics including wetland conservation, shorebird ecology and identification, environmental monitoring and pest plant and animal management.

Stage 1 of the workshop was conducted over two days in Altona with a mix of classroom based learning and practical field based activities at important shorebird sites, including Cheetham Wetlands and the Altona foreshore.

Stage 2 was hosted at the Willum Warrain Aboriginal Gathering Place in Hastings over three days. Participants gained an insight into wetland habitat and the threats to shorebirds throughout the Western Port Ramsar Site.

The *Indigenous Wetland Wardens* training helps bring together Indigenous Australians from a variety of backgrounds, with some participants already employed or completing formal training in natural resource management, and others attending to learn brand new skills with the hope of gaining meaningful employment in the future.

5 Monitoring

5.1 Framework

Consistent with the *Victorian Waterway Management Strategy* (VWMS), the Ramsar Convention and the Australian Ramsar Management Principles, this Western Port Ramsar Site Management Plan adopts an adaptive management approach. The Western Port Ramsar Site Management Plan sits within the broader framework of the VWMS (Department of Environment and Primary Industries 2013) as a component of regional waterway management planning (Figure 11). The Western Port Ramsar Site Management Plan will be renewed every seven years and is underpinned by a monitoring program that reports on the condition of the system with respect to change in ecological character and progress towards meeting resource condition targets.

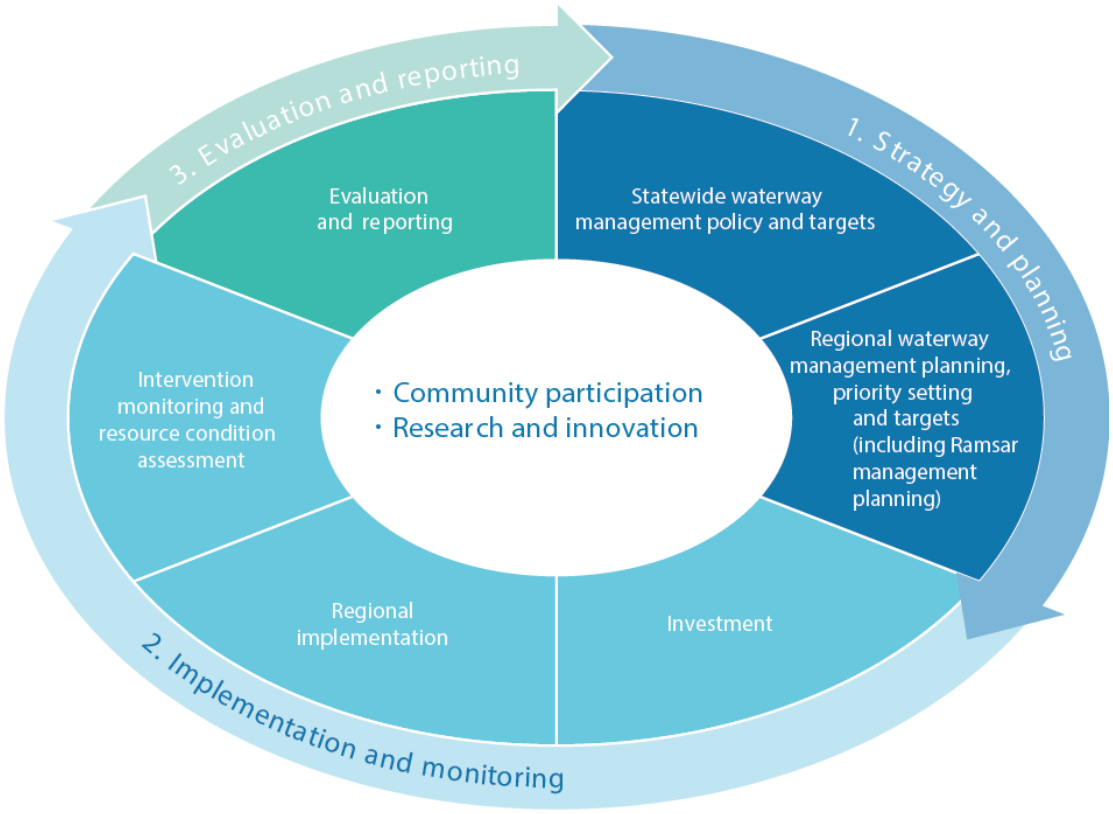


Figure 11: The adaptive management cycle of the Victorian Waterway Management Program, noting that this Ramsar management plan is a part of the regional waterway management planning process (adapted from Department of Environment and Primary Industries 2013).

5.2 Monitoring programs

Monitoring recommendations to assess progress towards resource condition targets and change in ecological character (i.e. evaluate critical components, processes and services against LAC) are provided in Table 20. Consistent with the principles of the Western Port Ramsar Site Management Plan, responsible agencies have been identified, as have links to existing, relevant programs. It should be noted that many of the existing programs have limited funding and timelines and a full assessment of ongoing monitoring against monitoring needs will be required as part of implementation planning. To this end DELWP has a current project assessing the monitoring needs across Victoria's 11 Ramsar sites, which may provide additional information for implementation planning in Western Port.

Table 20: Monitoring requirements for the Western Port Ramsar Site.

Program	Indicators and method	Frequency	Responsibility	Linkages to existing programs / activities	Recommended locations
Water quality	Salinity, dissolved oxygen, water clarity, nutrients (dissolved and total) and chlorophyll-a. Algal species and enumeration. Toxicant loads entering site from known sources.	Monthly and event based	EPA Victoria Parks Victoria Melbourne Water	Current water quality monitoring by EPA Melbourne Water funded sediments in estuary mouths study	EPA Marine Fixed Site Network (FSN) sites and priority toxicant hotspots
Intertidal mud and sand flat extent	Extent of intertidal habitats via remote sensing, using the methods developed by Murray et al. (2012).	Every five years	DELWP	None found	Entire site
Seagrass	Mapping extent using the remote sensing methods of Blake and Ball (Blake and Ball 2001). Condition assessment (see (Warry and Hindell 2012) for method used in the Gippsland Lakes).	Mapping every five years. Condition every two years.	DELWP	Parks Victoria benthic habitat mapping at French Island and Yaringa Marine Parks Melbourne Water	Entire site
Saltmarsh and mangrove extent	Extent of saltmarsh and mangroves (as per Boon et al 2011).	Every ten years	DELWP CMA	Boon et al (2011) mapped saltmarsh communities.	Entire site
Saltmarsh and mangrove condition	Purpose built condition assessment that measures: • Species composition and abundance (cover) • Invasive species • Structure • Recruitment	Every five years	DELWP CMA	Parks Victoria Marine Protected Area monitoring programs	Entire site
Invertebrate diversity, abundance	Parks Victoria method for monitoring soft sediments and reef communities.	Every two to five years	DELWP Parks Victoria	Parks Victoria Marine Protected Area monitoring programs	Representative soft and hard surface habitats
Shorebird abundance and diversity (resident and migratory species)	BirdLife Australia standard methods.	Bi-annual	DELWP	Current: Shorebirds 2020	Priority roosting sites as per (Hansen et al. 2011).
Monitoring of breeding for beach nesting species	Surveys of priority nest sites. Camera monitoring for predators.	Annual	DELWP Parks Victoria	Victorian Wader Studies Group	Priority beach nesting locations (map)
Native fish: abundance and trends	Purpose built monitoring program will need to be developed. At a minimum surveys should measure abundance and community composition. Consideration given to population age structure, perhaps via the use of otolith samples for a subsample of common species.	Annual	DELWP	Parks Victoria Marine National Parks Monitoring Program	Entire site

5.3 Evaluation and reporting

The Ramsar Rolling Review is designed to assess the status of the ecological character of Ramsar sites in Australia every three years (in line with international reporting requirements). An assessment of Victoria's Ramsar sites is being conducted in 2015 – 2016 (DELWP in prep.). This process collates information across monitoring and management projects in Ramsar sites to assess against Limits of Acceptable Change (LAC). The output is an evaluation of ecological character and a report to site managers, DELWP and the Australian Government. It is suggested that this process is the most suitable for the evaluation and reporting related to the Western Port Ramsar Site Management Plan.

6 Governance and implementation

6.1 Governance

Management of Ramsar sites in Victoria is the responsibility of the Victorian Government, through the Department of Environment, Land, Water and Planning (DELWP). Relevant international, national and Victorian state policy and legislation is listed in Section 1.2.

This Western Port Ramsar Site Management Plan is an integral component of a continuing program to develop a current management framework for Victoria's Ramsar sites.

6.2 Ramsar coordinating committee

A Ramsar Coordinating Committee comprising representatives of the partner agencies primarily responsible for the management of the Ramsar site (Port Phillip and Western Port CMA, DELWP, Parks Victoria, Melbourne Water and EPA Victoria) will be convened. This integrated approach builds on previous and current collaboration practice in the region, evident most recently in the strong participation of delivery partners in the development of the Western Port Ramsar Site Management Plan.

The Ramsar Coordinating Committee will be responsible for coordinating specific aspects of implementation within the themes of the Western Port Ramsar Site Management Plan. These responsibilities will include developing:

- annual action plans
- targeted investment proposals
- integrated delivery arrangements
- coordinated monitoring and evaluation of implementation, including integrated reporting against targets; and
- reviewing Management Plan progress bi-annually.

6.3 Resourcing implementation

Investment proposals to support actions of Western Port Ramsar Site Management Plan will be developed as investment opportunities arise. Project investment proposals will be prepared through the Ramsar Coordinating Committee in conjunction with delivery partners and will be structured to reflect the themes within the Western Port Ramsar Site Management Plan, and the regional programs of partner managing agencies.

Implementation of the Western Port Ramsar Site Management Plan will be influenced by available funding and resources. The implementation approach will ensure coordination and prioritisation of management actions so that maximum benefit is achieved with the resources that are available.

Annual priorities and programs will be developed to best match the funding cycles of investors. Throughout the implementation of the Western Port Ramsar Site Management Plan, the Ramsar Coordinating Committee will work to use the best available information tools to support the establishment of annual priorities.

Partners will seek funding for implementation of this plan through the:

- Victorian Waterway Management Program
- relevant initiatives of the State and Federal Governments
- existing agency budgets
- contributions of industries and communities

6.4 Ramsar administration

The development of the plan identified a number of administrative matters to resolve. These are described, with a brief rationale in Table 21.

Table 21: Matters related to the administering of the Ramsar Convention and the Western Port Ramsar Site.

Management strategies	Responsibility	Rationale
6.1 Review the Ramsar site boundary.	DELWP DoE Ramsar Coordinating Committee	The Ramsar site boundary was delineated at the time of listing in 1982 and more recently described in detail (DEPI 2013). Since 1982, there have been some changes to land management and an increased understanding of the aquatic ecosystems in the region and their values. A review of the boundary to consider adjoining areas based on ecological function in a changing climate is proposed.
6.2 Apply the appropriate State and Commonwealth environmental impact assessment processes for activities that have the potential to impact on the Ramsar site and Matters of National Environmental Significance (MNES).	DELWP DoE Ramsar Coordinating Committee	Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), actions that have, or are likely to have, a significant impact on a matter of national environmental significance require approval from the Australian Government Minister for the Environment (the Minister). The responsibility for referral of an action lies with the proponent. The Minister decides whether assessment and approval is required under the EPBC Act. Ramsar sites are one of the nine MNES and so assessments would be required for any activity that is likely to impact on the ecological character of the site, whether inside the site or in the catchment.
6.3 Undertake a regular review of the status of the ecological character of the Ramsar site. This review should include new and emerging issues as well as the current listed values and threats.	DELWP	The Ramsar Rolling Review is undertaken every three years and reports on the status of ecological character of the Ramsar site. As new knowledge on the values and threats within the Ramsar site becomes available (e.g. new species supported in a changing climate), this should be incorporated into the sites ecological character and management planning.
6.4 Develop action plans for this strategy.	Ramsar Coordinating Committee	This plan has identified high level strategies for a number of agencies. An annual action plan, based on priorities and available resources is required on an annual basis.
6.5 Investigate the potential of blue carbon offsets for raising resources to implement Ramsar site management and monitoring.	Ramsar Coordinating Committee	A recent investigation indicated that the blue carbon value of Western Port is in the order of $11.5 million (Carnell et al. 2015) and could represent a funding source for implementation of actions in this management strategy.

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Appendix A: Work plan

Task	Responsibility	Planned completion date
Project management Jennifer Hale will be the project manager for the consultant team and all communication between the Steering Committee, project manager and the consultant team will be via her. She will provide the DEWLP project manager regular updates via email and ensure the project runs on time. We would like to draft a project timetable at the start of the project that schedules meetings and workshops in advance, so that Steering Committee and other participants can plan for their involvement.	Jennifer Hale DEWLP	On going
Stage 1: Develop method for producing the management plan		
Project inception Meeting between the consultant team leader (Jennifer Hale) and the DEWLP project manager and potentially steering committee: Agree to project plan and timelines Communication protocols between consultant team and DELWP (e.g. fortnightly email progress reports) Contracts and milestone payments Data licenses and agreements Discuss form and content of the stakeholder engagement plan Identification of potential workshop participants and process for engaging them.	Jennifer Hale	May 25, 2015
Stakeholder engagement strategy Draft strategy presented to DEWLP for discussion and review. Finalised with input from steering committee in meeting.	Jennifer Hale DEWLP	June 1, 2015
Framework for values, threats, risk and prioritisation Develop draft criteria for the prioritisation of values and threats. Will include recommendations for a scoring and weighting system. Preliminary identification of values and threats from the recent review of marine values (ECD, Ramsar Rolling Review and existing strategy documents). Presented were possible as a map. Documentation of above into a paper and workshop agenda to be distributed to the Steering Committee one week prior to the workshop.	Jennifer Hale / Shane Brooks	June 1, 2015
Workshop 1 with steering committee, to be held in a central location (Melbourne, Frankston (CMA Offices); Phillip Island): Agree on final prioritisation criteria and method Confirmation of values and threats to be considered in the prioritisation. Agreement on the spatial scale of the prioritisation of values and threats Identification of additional data not already collated by consultant team Agreement on the objectives of the plan (Note that the responsibility for venue, catering and any payments to steering committee members is vested in DELWP)	Jennifer Hale / Shane Brooks	**June 16, 2015**
Documented outcomes of Workshop 1 in a short report circulated to Steering Committee members.	Jennifer Hale	June 23, 2015
Stage 2: Develop the management plan		
Risk assessment Update stressor models from 2011 Ramsar Rolling Review Identify risk pathways Draft risk assessment Document and provide to workshop participants, together with an agenda one week prior to workshop	Jennifer Hale / Rhonda Butcher/ Shane Books	July 6, 2015
Workshop 2: Risk assessment (Steering Committee and other participants), to run through each risk pathway and assign consequence and likelihood.	Jennifer Hale SC and SAG	**July 14, 2015**
Documented outcomes of Workshop 2 in a short report	Jennifer Hale	July 27, 2015
Prioritisation of values and threats Preliminary application of the prioritisation documented in a short report and provided to Steering Committee members together with workshop agenda, one week prior to workshop.	Jennifer Hale	August 10, 2015
Workshop 3: Identification of priority values (and locations) and threats for consideration in developing resource condition targets and strategic actions. Participants will be guided through the prioritisation process and reach agreement on priorities.	Jennifer Hale SC and SAG	**August 18, 2015**

Workshop will also consider high level themes for the management plan		
Map and short report on priorities and themes	Jennifer Hale / Shane Brooks	August 31, 2015
Review of existing management actions and strategies Review of achievements of current Western Port Ramsar Site Management Plan, by determining how many of the 66 management strategies were implemented, partially implemented, successful in contributing to objectives 6. This will be achieved through a search of published reports and stakeholder interviews. Review of existing strategies and plans to extract actions relevant to the management of the Western Port Ramsar Site.	Rhonda Butcher / Jennifer Hale	September 28, 2015
Resource condition targets Drafting realistic resource condition targets for each identified priority value / location. This will be based on a comparison with the benchmark for ecological character, set at the time of listing and documented in the ECD, and current condition, With an aim of maintaining or restoring ecological character, whichever is most relevant.	Jennifer Hale / Rhonda Butcher	October 12, 2015
Strategic actions Preparation of a short paper containing the draft resource condition targets, the outcomes of the review (with opportunities for integration highlighted) and proposed approach to identifying priority, cost effective strategic actions. Will be distributed to Steering Committee and other invitees one week prior to the workshop.	Jennifer Hale	October 12, 2015
Workshop 4 with the Steering Committee and other invitees to identify and priorities strategic actions to meet resource condition targets. We propose that to foster ownership, actions should be identified by the agencies responsible for implementation. We anticipate this occurring as a series of breakout groups in a workshop setting.	Jennifer Hale / Rhonda Butcher; SC and SAG	**October 20, 2015**
Draft list of strategic actions as output from workshop circulated to workshop participants.	Jennifer Hale	November 2, 2015
Review of draft strategic actions (Task 2.6)	SC and SAG	November 9 2015
Response to comments indicating how review comments were addressed (this may require a short telephone meeting between the consultant team leader and the DEWLP project manager to determine how to responds to conflicting comments from multiple reviewers). Provision of final strategic actions and priority locations documented in a short paper.	Jennifer Hale	November 16, 2015
Monitoring requirements Identification of monitoring needs for the implementation of the Western Port Ramsar Site and to assess change in character. The latter, will build on the monitoring requirements identified in the Ramsar Rolling Review and ECD. Development of management triggers will be part of this process. Identification of indicators for each resource condition target. Report summarising monitoring needs.	Rhonda Butcher / Jennifer Hale	September 28, 2015
Review of existing monitoring programs to identify overlaps (and opportunities of integration) and gaps (which will need to be filled by new monitoring)	Rhonda Butcher / Jennifer Hale	October 12, 2015
Workshop 4: with steering committee and other invitees to review monitoring needs and management triggers and identify priority management actions. To be held in conjunction with workshop for strategic actions.	Jennifer Hale / Rhonda Butcher; SC and SAG	**October 20, 2015**

Gantt Chart

Activities	Date																							
	25/May/2015	08/Jun/2015	22/Jun/2015	06/Jul/2015	20/Jul/2015	03/Aug/2015	17/Aug/2015	31/Aug/2015	14/Sep/2015	28/Sep/2015	12/Oct/2015	26/Oct/2015	09/Nov/2015	23/Nov/2015	07/Dec/2015	21/Dec/2015	04/Jan/2016	18/Jan/2016	01/Feb/2016	15/Feb/2016	29/Feb/2016	14/Mar/2016	28/Mar/2016	11/Apr/2016	25/Apr/2016
Project management																								
Communication with DELWP																								
Inception meeting	25																							
Finalise work plan and meeting dates																								
Stage 1. Method development																								
Stakeholder engagement strategy																								
Draft	1																							
Final			23																					
Framework for values, threats, risk																								
Preliminary id of values and threats	1																							
Risk assessment method	1																							
Draft criteria for prioritisation	1																							
Workshop 1 Steering Committee		16																						
Refinement of method			23																					
Minutes and outcomes circulated			23																					
2. Development of management plan																								
Risk assessment																								
Stressor models																								
Draft risk assessment				6																				
Workshop 2 – SC and SAG				14																				
Final risk assessment					27																			
Prioritisation of values and threats																								
Draft prioritisation						10																		
Workshop 3 – SC and SAG							18																	
Map and short report on priorities								31																
Review of plans and strategies																								
Achievements of current WPRSMP																								

Activities	Date																							
	25/May/2015	08/Jun/2015	22/Jun/2015	06/Jul/2015	20/Jul/2015	03/Aug/2015	17/Aug/2015	31/Aug/2015	14/Sep/2015	28/Sep/2015	12/Oct/2015	26/Oct/2015	09/Nov/2015	23/Nov/2015	07/Dec/2015	21/Dec/2015	04/Jan/2016	18/Jan/2016	01/Feb/2016	15/Feb/2016	29/Feb/2016	14/Mar/2016	28/Mar/2016	11/Apr/2016	25/Apr/2016
Review of existing strategies and plans																									
Resource condition targets																									
Draft targets											12														
Strategic actions																									
Paper to SC and SAG											12														
Workshop 4 – SC and SAG											20														
Draft list of strategic actions												2													
Review of draft actions													9												
Response to comments and final actions																									
Report													16												
Monitoring requirements																									
Identification of monitoring needs																									
Paper / report											12														
Workshop 4 – SC and SAG											20														
Draft list of monitoring needs												2													
Review of monitoring needs													9												
Response to comments and final actions																									
Report													16												
Writing plan and report																									
WPRSMP report - draft															11										
Review by PSC																		25							
Response to comments																									
Public consultation																									
Review of comments																									
Workshop 5 - SC																									
Final WRSMP																									

Appendix B: Communications and engagement strategy

Context and scope

Western Port is one of Australia's 65 Ramsar sites, designated in 1982 and a management plan was developed for this site in 2003[6]. There has been significant progress in both our understanding of the ecological character of Western Port and strategic direction in management of the site and Ramsar wetlands in Australia in the past decade. Under the Australian Ramsar Site Management Principles, management plans are reviewed every seven years. The plan for the Western Port Ramsar Site is past due for review and is undergoing a renewal process.

The Australian Ramsar management principles (Environment Protection and Biodiversity Conservation Regulations 2000 – Schedule 6) provide guidance about stakeholder involvement in management of Ramsar sites. Specifically:

> '1.02 Wetland management should provide for public consultation on decisions and actions that may have a significant impact on the wetland.
> 1.03 Wetland management should make special provision, if appropriate, for the involvement of people who:
> (a) have a particular interest in the wetland; and
> (b) may be affected by the management of the wetland.
> 1.04 Wetland management should provide for continuing community and technical input.'

The implementation of this Stakeholder Engagement Strategy will reflect these principles in the renewal of the Ramsar Site Plan. The objective of this Stakeholder Engagement Strategy is to provide opportunities for the broadest range of stakeholders to contribute to the renewal of the Western Port Ramsar Site Management Plan.

Method

The philosophy behind the approach to communication and engagement is grounded in the IAP2 framework (Figure 12), which is consistent with the Victorian Waterway Management Strategy. Different sections of the community have been targeted at different levels in the IAP2 framework. To reflect their different levels of interest, time commitments and preferences.

In the first instance stakeholders are considered in four groups:

1. Steering Committee

Representatives of agencies that have a significant role in the management of the Western Port Ramsar Site:

- Boon Wurrung Foundation[7]
- Department of Environment, Land, Water and Planning
- Commonwealth Department of the Environment
- Melbourne Water
- Parks Victoria
- Port Phillip and Western Port Catchment Management Authority
- Victorian Environmental Protection Authority

[6] DSE, 2003, Western Port Ramsar Site: Strategic Management Plan, Department of Sustainability and Environment, East Melbourne.

[7] Elected not to be represented on the Steering Committee

2. Stakeholder Advisory Group

Representatives of organisations with knowledge of and an interest in the management of the Ramsar site:

- Bass Coast Landcare Network
- BirdLife Australia
- Blue Wedges[8]
- Cannons Creek Coastal Management Committee
- Cardinia Environment Coalition
- Central Coastal Board
- City of Casey
- French Island Landcare
- French Island Port Stoppers[8]
- Friends of Warneet
- Mornington Peninsula Shire
- Nature Conservancy
- Phillip Island Nature Parks
- Phillip Island Conservation Society[8]
- Port of Hastings
- Port of Hastings Development Authority
- Preserve Western Port Action Group[8]
- Shire of Bass Coast
- Shire of Cardinia
- South East Councils Climate Change Alliance
- Trust for Nature
- Victorian National Parks Association[8]
- Western Port Biosphere Reserve
- Western Port Seagrass Partnership
- Westernport and Peninsula Protection Council[8].

3. Technical experts

Researchers and technical exerts with experience in Western Port will be consulted individually to answer any specific questions that arise during the development of the management plan.

4. Broader community

Members of the public and broader community will be informed about the project and have the opportunity to input to the plan in the public consultation phase.

[8] Not initially involved in the Stakeholder Advisory Group however were consulted during the latter part of the project.

Increasing level of public impact

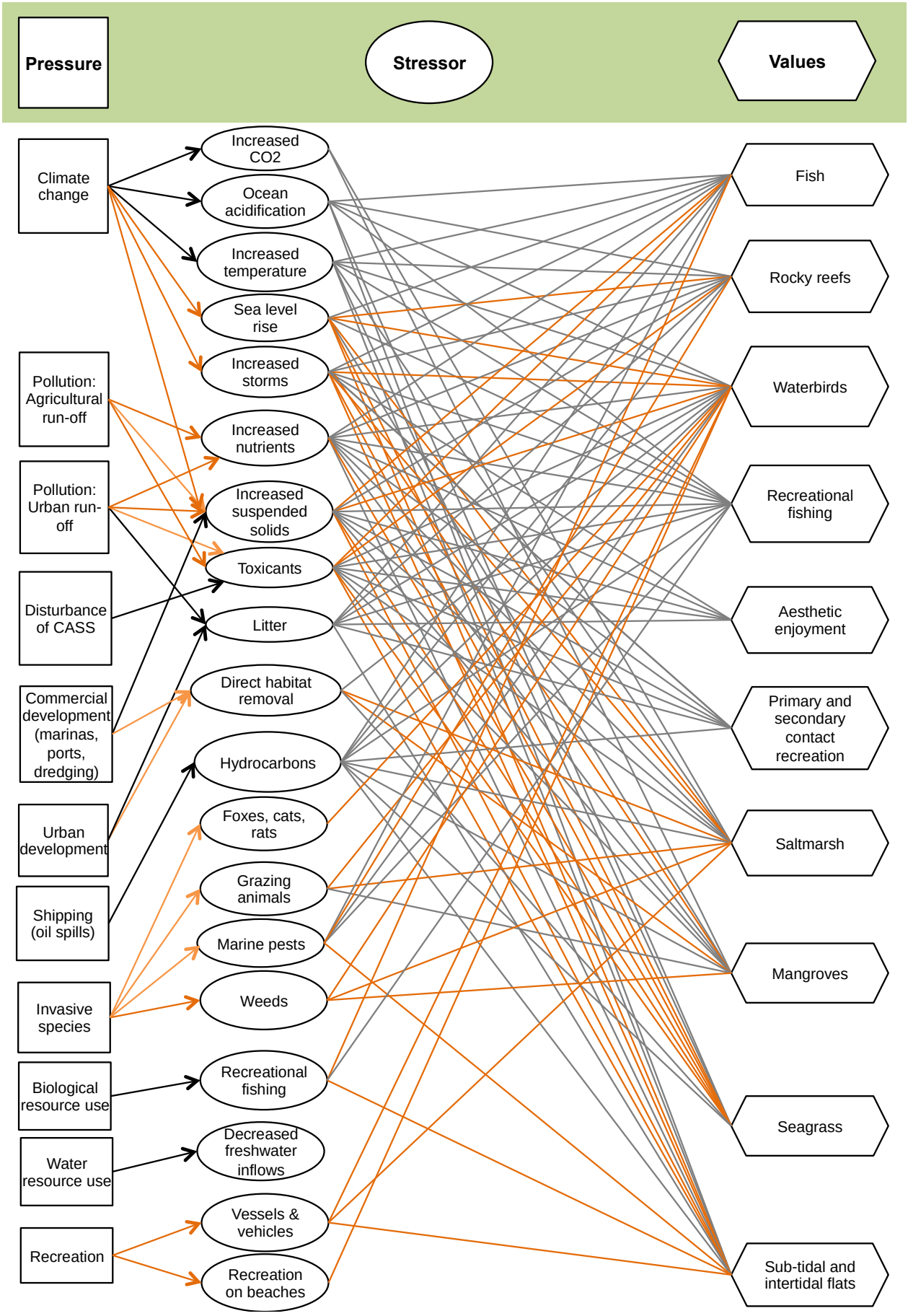
INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
Public Participation Goal:				
To provide the public with balanced and objective information to assist them in understanding the problems, alternatives and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision, including the development of alternatives and the identification of the preferred solution.	To place final decision-making in the hands of the public.
Promise to the Public:				
We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and provide feedback on how public input influenced the decision.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will look to you for direct advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.
Example Tools:				
fact sheets web sites open houses.	public comment focus groups surveys public meetings.	workshops deliberate polling.	citizen advisory committees consensus-building participatory decision-making.	citizen juries ballots delegated decisions.

Figure 12: IAP2 Public participation spectrum.

Implementation

Stakeholder Group	Lead communication	Level of Engagement	Purpose	Tools	Engagement Objectives	Key Messages
Project Manager	Consultant	Empower	Effective project delivery	Regular meetings Email project updates (fortnightly)	Ensure clarity of scope and process Encourage maximum partner input Ensure alignment with Government requirements Adhere to project plan and manage variations	
Steering Committee	Consultant	Empower	High ownership of Plan and involvement in development High agency commitment to implementation	Regular meetings (minutes) Workshops	Provide material for reporting back to agencies Maximise communication with project manager	Importance in integrating the plan with existing activities Ownership of management strategies and implementation
Stakeholder Advisory Group	Consultant	Collaborate	To ensure local knowledge and expertise informs the plan	Technical workshop Central database of relevant information	Ensure early understanding and opportunity for input Connect with external networks and expertise Obtain confirmation of identified values and threats	Their knowledge and support in monitoring is valued We need them to confirm the values of and threats to Western Port Ramsar Site. Expectation: it is a statutory process; there are clear responsibilities for government agencies; There is a Plan and it is being updated The purpose of the Plan is to assign clear responsibilities for agencies. Implementation is ongoing by agencies Values are being maintained/protected/restored
Technical experts	Consultant	Involve	To ensure the values threats and priorities are based on the best available information	Scientific literature and one-on-one consultation on specific topics	Ensure evidence based approach is adopted for the renewal of the plan	Robust transparent process Technical knowledge is valued and attributed.
Community	Consultant / DELWP	Consult	Increased understanding of role of Ramsar Plan Increased appreciation of value of Site	Website – regular updates on the plan Public comment period: forums and meetings	Maintain confidence in management of the Site Increase knowledge Keep updated with project progress Provide feedback on how input influenced decision	There is a Plan The plan is being updated Implementation is ongoing by agencies Values are being maintained/protected/restored

Appendix C: Risk Assessment



Impact pathways identified through the risk assessment process, orange indicates higher risk and significant pathway for management in the next seven years. Note that water resource use was identified as a knowledge gap and no pathways assessed.

Risk assessment for the Western Port Ramsar Site. Cells highlighted in blue provide a description of the pressure / stressor that is applicable to the relevant impact pathways below. Score indicates total risk score (likelihood x consequence). Risk scores for individual pathways that were greater than 12, were considered a priority for management in the next seven years (noting that the timeframe for the risk assessment was longer (15 years) to allow for proactive management of emerging risks). A full explanation of the risk assessment process, including descriptors for likelihood and consequence, is provided in section 3.1.

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Pollution: agricultural run-off	**Increased nutrients**					**Run-off from agricultural lands (which includes stream erosion in rural areas) contributes the largest loads of nitrogen and phosphorus to Western Port Bay (approximately 60%). Total nitrogen loads range from 400 tonnes / year in an average year to over 1000 tonnes in a wet year (Melbourne Water 2009). There is little evidence of increasing nutrient concentrations in Western Port (1990 - 2009), with a decline in concentrations (and loads) during the Millennium drought (EPA Victoria 2011b); but no long term change in nutrient concentrations from the 1970s to today (Holland et al. 2013). Under future climate, time spent in drought is projected, with medium confidence, to increase over the course of the century, with more rainfall falling in large storm events (Grose et al. 2015). This may lead to a decrease in nutrient discharges during drought, but periodic large loads during flood events. A recent study of nutrient cycling in Western Port indicates that the majority of dissolved nitrogen (over 80%) is flushed from the system into Bass Strait, although localised, less flushed areas such as Corinella may incur water quality impacts (Evrard et al. 2013). Changes in agricultural land use have occurred since 1982, with a move to more intensive land use practices.**	
Pollution: agricultural run-off	Increased nutrients	Results in increased algal growth and a decline in seagrass extent and condition	Likely	Moderate	Medium	A recent study of nutrients and seagrass in Western Port stated: "Highest nutrient concentrations were in the far north-west of Western Port at Watsons Inlet, where seagrass density is high. There was very little change in present-day nutrient concentrations compared to the 1970s for the entire bay. This led us to conclude that eutrophication is unlikely to be a controlling factor in the current distribution of seagrass within Western Port." (Holland et al. 2013). Higher risk in the East Arm, with less flushing and no recovery of seagrass since the loss in the 1970's. Local knowledge of seagrass impacts by epiphytes from Parks Victoria.	12
Pollution: agricultural run-off	Increased nutrients	Adversely affects subtidal and intertidal flats (including benthic invertebrates)	Possible	Minor	Low	Recent study indicates that "relatively little nitrogen entering the system from land is assimilated into primary producers [microphytobenthos and seagrass] and the food web owing to high rates of tidal flushing" (Evrard et al. 2013).	6

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Pollution: agricultural run-off	Increased nutrients	Adversely affect subtidal and intertidal reef communities (macroaglae and invertebrates)	Possible	Minor	Low	Reef communities in the Ramsar site are largely limited to the significant community at San Remo as well as Crawfish Rock and Eagle Rock. Although excess nutrients can negatively impact reef communities (e.g. urchin barrens of Port Phillip Bay), the risk in the comparatively low nutrient and well flushed Western Port is considered low (Bathgate et al. 2011).	6
Pollution: agricultural run-off	Increased nutrients	Adversely affects coastal saltmarsh communities	Unlikely	Minor	Low	Boon et al (2011) identified excess nutrients and eutrophication as a significant threat to coastal saltmarsh. However, the well flushed environment over most of Western Port would limit this impact in the Ramsar site.	4
Pollution: agricultural run-off	Increased nutrients	Adversely affects mangrove communities	Possible	Minor	Low	Nutrient influx into Western Port can have indirect consequences for mangroves. For example, seagrass dieback leads to an excessive deposition of seagrass detritus in mangroves, which can smother their pneumatophores and seedlings or lead to defoliation (Dittman 2011). However as the risk to seagrass is considered low, so must the impact to mangroves.	6
Pollution: agricultural run-off	Increased nutrients	Declines in seagrass , saltmarsh, mangroves adversely affects fish abundance and diversity	Possible	Moderate	Medium	"The highest risk to fish in Western Port in terms of decreased water quality, particularly increased nutrients and sediments, is the secondary effect of seagrass habitat loss." (Jenkins 2011). Risk based on risk to seagrass, noting that seagrass habitat is not essential for all fish species.	9
Pollution: agricultural run-off	Increased nutrients	Impacts to saltmarsh and mudflats affects waterbird abundance and diversity (including threatened species e.g. orange-bellied parrot)	Rare	Negligible	Negligible	Saltmarsh and mudflats are important habitats in Western Port; however risks associated with nutrients are related to decreases in primary productivity from a decrease in nutrient concentrations (Dann 2011). Risk to Orange-bellied parrot saltmarsh habitat is also low given there are very few birds that now come to Victoria and risk to saltmarsh from this pathway is low.	1

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Pollution: agricultural run-off	Increased nutrients	Results in increased algal growth and adversely affects waterbird feeding (including threatened species e.g. fairy tern)	Rare	Negligible	Negligible	This pathway is related to decrease in water clarity from algal blooms reducing the catch success of visual feeders (mostly fish eating birds). However, nutrients are not the primary cause of reduced visibility in Western Port (EPA Victoria 2011b).	1
Pollution: agricultural run-off	Increased nutrients	Results in increased algal growth and adversely affects visual amenity (aesthetic enjoyment)	Unlikely	Minor	Low	Visible algal blooms are rare in the majority of the Western Port Ramsar Site, but are more likely to occur in the less well flushed Corinella area, where chlorophyll-a concentrations regularly exceed SEPP objectives (EPA Victoria 2011b).	4
Pollution: agricultural run-off	Increased nutrients	Results in increased algal growth and adversely affects primary contact recreation	Unlikely	Minor	Low	The potentially toxic diatom *Psuedonitschia* sp. and nuisance diatom *Rhizosolenia* cf *chuii* are routinely recorded in waters just outside the Ramsar site boundary, but in low concentrations, with infrequent records of toxic dinoflagellates at very low numbers (Jenkins 2011). However, "There is a significant knowledge gap with regard to the species composition, assemblage structure and ecology of phytoplankton in Western Port" Melbourne Water 2011).	4
Pollution: agricultural run-off	Increased nutrients	Results in increased algal growth and adversely affects secondary contact recreation	Unlikely	Minor	Low	As above	4
Pollution: agricultural run-off	Increased nutrients	Impacts on fish adversely affect recreational fishing	Possible	Moderate	Medium	Based on risks to fish abundance and diversity.	9

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Pollution: sewage and stormwater (includes likely future population)	**Increased nutrients**					**Current residential development and urban areas in the Western Port catchment contribute approximately 14 % of the total nutrient loads to the site (Melbourne Water 2009). Under future population growth and urban expansion scenarios, it is predicted that there will be a 13 - 14 % increase in nitrogen and phosphorus loads from urban development by 2030 (Melbourne Water 2009). More recent advice from Melbourne Water indicates that the loads will be higher than this due to an increase in urban growth over 2009 predictions and less control on water volumes discharged. Under future climate, time spent in drought is projected, with medium confidence, to increase over the course of the century, with more rainfall falling in large storm events (Grose et al. 2015). This may lead to a decrease in nutrient discharges during drought, but periodic large loads during flood events. Suggested that all risks from this pathway be considered similar to those from agricultural run-off.**	
Pollution: septic and stormwater	Increased nutrients	Results in increased algal growth and a decline in seagrass extent and condition	Likely	Moderate	Medium	A recent study of nutrients and seagrass in Western Port stated: "Highest nutrient concentrations were in the far north-west of Western Port at Watsons Inlet, where seagrass density is high. There was very little change in present-day nutrient concentrations compared to the 1970s for the entire bay. This led us to conclude that eutrophication is unlikely to be a controlling factor in the current distribution of seagrass within Western Port." (Holland et al. 2013). Higher risk in the East Arm, with less flushing and no recovery of seagrass since the loss in the 1970's. Local knowledge of seagrass impacts by epiphytes from Parks Victoria.	12
Pollution: septic and stormwater	Increased nutrients	Adversely affects subtidal and intertidal flats (including benthic invertebrates)	Possible	Minor	Low	Recent study indicates that "relatively little nitrogen entering the system from land is assimilated into primary producers [microphytobenthos and seagrass] and the food web owing to high rates of tidal flushing" (Evrard et al. 2013).	6
Pollution: septic and stormwater	Increased nutrients	Adversely affect subtidal and intertidal reef communities (macroaglae and invertebrates)	Possible	Minor	Low	Reef communities in the Ramsar site are largely limited to the significant community at San Remo as well as Crawfish Rock and Eagle Rock. Although excess nutrients can negatively impact reef communities (e.g. urchin barrens of Port Phillip Bay), the risk in the comparatively low nutrient and well flushed Western Port is considered low (Bathgate et al. 2011).	6
Pollution: septic and stormwater	Increased nutrients	Adversely affects coastal saltmarsh communities	Unlikely	Minor	Low	Boon et al (2011) identified excess nutrients and eutrophication as a significant threat to coastal saltmarsh. However, the well flushed environment over most of Western Port would limit this impact in the Ramsar site.	4

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Pollution: septic and stormwater	Increased nutrients	Adversely affects mangrove communities	Possible	Minor	Low	Nutrient influx into Western Port can have indirect consequences for mangroves. For example, seagrass dieback leads to an excessive deposition of seagrass detritus in mangroves, which can smother their pneumatophores and seedlings or lead to defoliation (Dittman 2011). However as the risk to seagrass is considered low, so must the impact to mangroves.	6
Pollution: septic and stormwater	Increased nutrients	Declines in seagrass and /or saltmarsh adversely affects fish abundance and diversity	Possible	Moderate	Medium	"The highest risk to fish in Western Port in terms of decreased water quality, particularly increased nutrients and sediments, is the secondary effect of seagrass habitat loss." (Jenkins 2011). Risk based on risk to seagrass, noting that only some fish species are reliant on seagrass habitat.	9
Pollution: septic and stormwater	Increased nutrients	Impacts to saltmarsh and mudflats affects waterbird abundance and diversity (including threatened species e.g. orange-bellied parrot)	Rare	Negligible	Negligible	Saltmarsh and mudflats are important habitats in Western Port; however risks associated with nutrients are related to decreases in primary productivity from a decrease in nutrient concentrations (Dann 2011). Risk to Orange-bellied parrot saltmarsh habitat is also low given there are very few birds that now come to Victoria and risk to saltmarsh from this pathway is low.	1
Pollution: septic and stormwater	Increased nutrients	Results in increased algal growth and adversely affects waterbird feeding (including threatened species e.g. fairy tern)	Rare	Negligible	Negligible	This pathway is related to decrease in water clarity from algal blooms reducing the catch success of visual feeders (mostly fish eating birds). However, nutrients are not the primary cause of reduced visibility in Western Port (EPA Victoria 2011b).	1
Pollution: septic and stormwater	Increased nutrients	Results in increased algal growth and adversely affects visual amenity (aesthetic enjoyment)	Unlikely	Minor	Low	Visible algal blooms are rare in the majority of the Western Port Ramsar Site, but are more likely to occur in the less well flushed Corinella area, where chlorophyll-a concentrations regularly exceed SEPP objectives (EPA Victoria 2011b).	4

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Pollution: septic and stormwater	Increased nutrients	Results in increased algal growth and adversely affects primary contact recreation	Unlikely	Minor	Low	The potentially toxic diatom *Psuedonitschia* sp. and nuisance diatom *Rhizosolenia* cf *chuii* are routinely recorded in waters just outside the Ramsar site boundary, but in low concentrations, with infrequent records of toxic dinoflagellates at very low numbers (Jenkins 2011). However, "There is a significant knowledge gap with regard to the species composition, assemblage structure and ecology of phytoplankton in Western Port" Melbourne Water 2011).	4
Pollution: septic and stormwater	Increased nutrients	Results in increased algal growth and adversely affects secondary contact recreation	Unlikely	Minor	Low	As above	4
Pollution: septic and stormwater	Increased nutrients	Impacts on fish adversely affect recreational fishing	Unlikely	Moderate	Low	Based on risks to fish abundance and diversity	6
Pollution: agricultural run-off	**Increased sediments**					**The vast majority of sediment loads to Western Port come from rural lands (85%); with agriculture (cropping and dairy) accounting for the largest loads (Melbourne Water 2009). The dominant catchment source for fine sediment is channel and gully erosion of Lang Lang River and, to a lesser extent, Bunyip River. However, there is no long term sustained trend in suspended solids in Western Port since the time of listing, with concentrations of TSS remaining steady since monitoring commenced in 1984 (EPA Victoria 2011b; Holland et al. 2013). Under future climate, time spent in drought is projected, with medium confidence, to increase over the course of the century, with more rainfall falling in large storm events (Grose et al. 2015). This may lead to a decrease in sediment discharges during drought, but periodic large loads during flood events.**	
Pollution: agricultural run-off	Increased sediments	Reduced light and deposition adversely affects seagrass	Likely	Moderate	Medium	Seagrass loss between 1970 and 1990s has been attributed to decreased light and increased suspended sediments. A recent study concluded that TSS is a strong influence on seagrass distribution and health, with the highest TSS values being observed in the north east of Western Port where seagrass is sparse or absent (Holland et al. 2013). However, seagrass extent has increased since 1999 in the north and west (Holland et al. 2013). The seagrass in the east has not recovered and loss has been associated with increased erosion and turbidity.	12

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Pollution: agricultural run-off	Increased sediments	Reduced light and deposition adversely affects subtidal and intertidal flats (including benthic invertebrates)	Likely	Moderate	Medium	Intertidal and subtidal soft sediment communities are adapted to sedimentation. However, changes in sediment properties (e.g. grain size) and high levels of turbidity can affect productivity and community composition. The rhodolith bed north of San Remo is likely to be particularly vulnerable to sedimentation and increased turbidity (Wilson et al. 2011).	12
Pollution: agricultural run-off	Increased sediments	Reduced light and deposition adversely affects subtidal and intertidal reefs	Likely	Moderate	Medium	Sediments can impact reefs through smothering and reduced light (Bathgate et al. 2011).	12
Pollution: agricultural run-off	Increased sediments	Adversely affects coastal saltmarsh communities	Rare	Minor	Negligible	There has been an increase in mangroves at the expense of saltmarsh in Western Port. However this is related to sea level rise and decreases in surface elevation (Rogers et al. 2005a, Boon 2011, Boon et al. 2011).	2
Pollution: agricultural run-off	Increased sediments	Adversely affects mangrove communities	Rare	Minor	Negligible	There has been an increase in mangroves at the expense of saltmarsh in Western Port. However this is related to sea level rise and decreases in surface elevation (Rogers et al. 2005a, Boon 2011, Boon et al. 2011).	2
Pollution: agricultural run-off	Increased sediments	Reduced light and increased TSS adversely affects fish	Unlikely	Minor	Low	Direct impacts to fish gills are observed at very high TSS concentrations (> 100 mg/L), with larval fish considered the most (Jenkins and McKinnon 2006). Concentrations of TSS can be high in parts of Western Port, and on occasion may reach concentrations that could adversely affect larval fish. However, this does not occur in primary larval fish habitat such as seagrass beds, where suspended sediment concentrations are lower.	4
Pollution: agricultural run-off	Increased sediments	Impacts to seagrass adversely affects fish	Likely	Moderate	Medium	Derived from risks to seagrass	12
Pollution: agricultural run-off	Increased sediments	Impacts to fish and reduced visibility adversely affects feeding seabirds (including threatened species)	Possible	Minor	Low	Increased sediment in the water column may reduce the foraging efficiencies of sight-feeding seabirds. (Dann 2011).	6
Pollution: agricultural run-off	Increased sediments	Impacts to primary productivity reduce food availability for shorebirds	Possible	Minor	Low	Suspended sediments can reduce primary productivity, and consequently secondary productivity, and may also reduce secondary productivity directly by reducing the efficiency of filter-feeding mudflat biota (Dann 2011).	6

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Pollution: agricultural run-off	Increased sediments	Increased TSS adversely affects visual amenity (aesthetic enjoyment)	Possible	Negligible	Negligible	While turbid water is less visually appealing than clear water, there is no evidence of change since the time of listing.	3
Pollution: agricultural run-off	Increased sediments	Increased TSS adversely affects primary contact recreation	Possible	Minor	Low	While turbid water is less visually appealing than clear water, there is no evidence of change since the time of listing.	6
Pollution: agricultural run-off	Increased sediments	Increased TSS adversely affects secondary contact recreation	Rare	Negligible	Negligible	While turbid water is less visually appealing than clear water, there is no evidence of change since the time of listing.	1
Pollution: agricultural run-off	Increased sediments	Impacts to fish adversely affect recreational fishing	Possible	Minor	Low	Derived from risks to fish from both turbidity and seagrass loss.	6
Pollution: urban (septic tank leakage and stormwater)	**Increased sediments**					**Urban areas currently contribute about 10% of the total sediment load to Western Port, however, this is predicted to increase by 2030 by about 15% due to increased development (Melbourne Water 2009). More recent advice from Melbourne Water indicates that the loads will be higher than this due to an increase in urban growth over 2009 predictions and less control on water volumes discharged. While this is an increase, it is still less than the loads coming from agricultural activities. Suggested that all risks from this pathway be considered less likely than from agricultural run-off.**	
Pollution: septic and stormwater	Increased sediments	Reduced light and deposition adversely affects seagrass	Possible	Moderate	Medium	Seagrass loss between 1970 and 1990s has been attributed to decreased light and increased suspended sediments. A recent study concluded that TSS is a strong influence on seagrass distribution and health, with the highest TSS values being observed in the north east of Western Port where seagrass is sparse or absent (Holland et al. 2013). However, seagrass extent has increased since 1999 in the north and west (Holland et al. 2013). The seagrass in the east has not recovered and loss has been associated with increased erosion and turbidity.	9
Pollution: septic and stormwater	Increased sediments	Reduced light and deposition adversely affects subtidal and intertidal flats (including benthic invertebrates)	Possible	Moderate	Medium	Intertidal and subtidal soft sediment communities are adapted to sedimentation. However, changes in sediment properties (e.g. grain size) and high levels of turbidity can affect productivity and community composition. The rhodolith bed north of San Remo is likely to be particularly vulnerable to sedimentation and increased turbidity (Wilson et al. 2011).	9

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Pollution: septic and stormwater	Increased sediments	Reduced light and deposition adversely affects subtidal and intertidal reefs	Possible	Moderate	Medium	Sediments can impact reefs through smothering and reduced light (Bathgate et al. 2011).	9
Pollution: septic and stormwater	Increased sediments	Adversely affects coastal saltmarsh communities	Rare	Negligible	Negligible	There has been an increase in mangroves at the expense of saltmarsh in Western Port. However this is related to sea level rise and decreases in surface elevation (Rogers et al. 2005a, Boon 2011, Boon et al. 2011).	1
Pollution: septic and stormwater	Increased sediments	Adversely affects mangrove communities	Rare	Negligible	Negligible	There has been an increase in mangroves at the expense of saltmarsh in Western Port. However this is related to sea level rise and decreases in surface elevation (Rogers et al. 2005a, Boon 2011, Boon et al. 2011).	1
Pollution: septic and stormwater	Increased sediments	Reduced light and increased TSS adversely affects fish	Unlikely	Minor	Low	Direct impacts to fish gills are observed at very high TSS concentrations (> 100 mg/L), with larval fish considered the most vulnerable (Jenkins and McKinnon 2006). Concentrations of TSS can be high in parts of Western Port, and on occasion may reach concentrations that could adversely affect larval fish. However, this does not occur in primary larval fish habitat such as seagrass beds, where suspended sediment concentrations are lower.	4
Pollution: septic and stormwater	Increased sediments	Impacts to seagrass adversely affects fish	Possible	Moderate	Medium	Derived from risks to seagrass, noting that seagrass habitat is used by a sub-set of fish species in Western Port.	9
Pollution: septic and stormwater	Increased sediments	Impacts to fish and reduced visibility adversely affects feeding seabirds (including threatened species)	Unlikely	Minor	Low	Increased sediment in the water column may reduce the foraging efficiencies of sight-feeding seabirds. (Dann 2011).	4
Pollution: septic and stormwater	Increased sediments	Impacts to primary productivity reduce food availability for shorebirds	Unlikely	Minor	Low	Suspended sediments can reduce primary productivity, and consequently secondary productivity, and may also reduce secondary productivity directly by reducing the efficiency of filter-feeding mudflat biota (Dann 2011).	4
Pollution: septic and stormwater	Increased sediments	Increased TSS adversely affects visual amenity (aesthetic enjoyment)	Unlikely	Negligible	Negligible	While turbid water is less visually appealing than clear water, there is no evidence of change since the time of listing.	2

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Pollution: septic and stormwater	Increased sediments	Increased TSS adversely affects primary contact recreation	Rare	Negligible	Negligible	While turbid water is less visually appealing than clear water, there is no evidence of change since the time of listing.	1
Pollution: septic and stormwater	Increased sediments	Increased TSS adversely affects secondary contact recreation	Rare	Negligible	Negligible	While turbid water is less visually appealing than clear water, there is no evidence of change since the time of listing.	1
Pollution: septic and stormwater	Increased sediments	Impacts to fish adversely affect recreational fishing	Unlikely	Minor	Low	Derived from risks to fish	4
Commercial development (ports, marinas, dredging)	**Increased sediments**					**Dredging has occurred in Western Port since the 1920s, for port development, maintenance and deepening of harbours and shipping channels, and until 2000 for commercial fishing. While this may result in localised increases in suspended sediments, natural processes of wave and wind action are the primary drivers of sediment resuspension in Western Port. Data from other maintenance dredging programs in the Gippsland Lakes and Port Phillip Bay, indicate localised, short term impacts to suspended sediments and deposition (e.g. Hale 2006). Risks from this pathway were considered of less magnitude and consequence than from sewage and stormwater. Note this applies to current and predicted future "routine" dredging and not any potential future capital dredging program.**	
Commercial development (ports, marinas, dredging)	Increased sediments	Reduced light and deposition adversely affects seagrass	Possible	Minor	Low	Seagrass loss between 1970 and 1990s has been attributed to decreased light and increased suspended sediments. A recent study concluded that TSS is a strong influence on seagrass distribution and health, with the highest TSS values being observed in the north east of Western Port where seagrass is sparse or absent (Holland et al. 2013). However, seagrass extent has increased since 1999 in the north and west (Holland et al. 2013). The seagrass in the east has not recovered and loss has been associated with increased erosion and turbidity.	6
Commercial development (ports, marinas, dredging)	Increased sediments	Reduced light and deposition adversely affects subtidal and intertidal flats (including benthic invertebrates)	Possible	Minor	Low	Intertidal and subtidal soft sediment communities are adapted to sedimentation. However, changes in sediment properties (e.g. grain size) and high levels of turbidity can affect productivity and community composition. The rhodolith bed north of San Remo is likely to be particularly vulnerable to sedimentation and increased turbidity (Wilson et al. 2011).	6

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Commercial development (ports, marinas, dredging)	Increased sediments	Reduced light and deposition adversely affects subtidal and intertidal reefs	Possible	Minor	Low	Sediments can impact reefs through smothering and reduced light (Bathgate et al. 2011).	6
Commercial development (ports, marinas, dredging)	Increased sediments	Adversely affects coastal saltmarsh communities	Rare	Negligible	Negligible	There has been an increase in mangroves at the expense of saltmarsh in Western Port. However this is related to sea level rise and decreases in surface elevation (Rogers et al. 2005a, Boon 2011, Boon et al. 2011).	1
Commercial development (ports, marinas, dredging)	Increased sediments	Adversely affects mangrove communities	Rare	Negligible	Negligible	There has been an increase in mangroves at the expense of saltmarsh in Western Port. However this is related to sea level rise and decreases in surface elevation (Rogers et al. 2005a, Boon 2011, Boon et al. 2011).	1
Commercial development (ports, marinas, dredging)	Increased sediments	Reduced light and increased TSS adversely affects fish	Unlikely	Negligible	Negligible	Direct impacts to fish gills are observed at very high TSS concentrations (> 100 mg/L), with larval fish considered the most vulnerable (Jenkins and McKinnon 2006). Concentrations of TSS can be high in parts of Western Port, and on occasion may reach concentrations that could adversely affect larval fish. However, this does not occur in primary larval fish habitat such as seagrass beds, where suspended sediment concentrations are lower.	2
Commercial development (ports, marinas, dredging)	Increased sediments	Impacts to seagrass adversely affects fish	Possible	Minor	Low	Derived from risks to seagrass	6
Commercial development (ports, marinas, dredging)	Increased sediments	Impacts to fish and reduced visibility adversely affects feeding seabirds (including threatened species)	Unlikely	Negligible	Negligible	Increased sediment in the water column may reduce the foraging efficiencies of sight-feeding seabirds. (Dann 2011).	2
Commercial development (ports, marinas, dredging)	Increased sediments	Impacts to primary productivity reduce food availability for shorebirds	Unlikely	Negligible	Negligible	Suspended sediments can reduce primary productivity, and consequently secondary productivity, and may also reduce secondary productivity directly by reducing the efficiency of filter-feeding mudflat biota (Dann 2011).	2

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Commercial development (ports, marinas, dredging)	Increased sediments	Increased TSS adversely affects visual amenity (aesthetic enjoyment)	Unlikely	Negligible	Negligible	While turbid water is less visually appealing than clear water, there is no evidence of change since the time of listing.	2
Commercial development (ports, marinas, dredging)	Increased sediments	Increased TSS adversely affects primary contact recreation	Rare	Negligible	Negligible	While turbid water is less visually appealing than clear water, there is no evidence of change since the time of listing.	1
Commercial development (ports, marinas, dredging)	Increased sediments	Increased TSS adversely affects secondary contact recreation	Rare	Negligible	Negligible	While turbid water is less visually appealing than clear water, there is no evidence of change since the time of listing.	1
Commercial development (ports, marinas, dredging)	Increased sediments	Impacts to fish adversely affect recreational fishing	Unlikely	Negligible	Negligible	Derived from risks to fish	2
Climate change	**Increased sediments**					**Extreme events (storms and high rainfall events) are predicted to occur with high confidence (Grose et al. 2015). The soft sediments in the shallow waters over much of Western Port are highly vulnerable to resuspension. While there have been no long term changes in TSS concentrations in Western Port from the time of listing, modelling based on 2030 global climate change predictions shows there will be significant increases in suspended material throughout the system, most likely with heightened concentrations in the Eastern Arm (EPA Victoria 2011a). Risks from this pathway be considered of greater magnitude than under current conditions. Increased stormwater and agricultural inputs with extreme events.**	
Climate change: increased storm events	Increased sediments	Reduced light and deposition adversely affects seagrass	Almost certain	Moderate	High	Seagrass loss between 1970 and 1990s has been attributed to decreased light and increased suspended sediments. A recent study concluded that TSS is a strong influence on seagrass distribution and health, with the highest TSS values being observed in the north east of Western Port where seagrass is sparse or absent (Holland et al. 2013). However, seagrass extent has increased since 1999 in the north and west (Holland et al. 2013). The seagrass in the east has not recovered and loss has been associated with increased erosion and turbidity.	15

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Climate change: increased storm events	Increased sediments	Reduced light and deposition adversely affects subtidal and intertidal flats (including benthic invertebrates)	Likely	Major	High	Intertidal and subtidal soft sediment communities are adapted to sedimentation. However, changes in sediment properties (e.g. grain size) and high levels of turbidity can affect productivity and community composition. The rhodolith bed north of San Remo is likely to be particularly vulnerable to sedimentation and increased turbidity (Wilson et al. 2011).	16
Climate change: increased storm events	Increased sediments	Reduced light and deposition adversely affects subtidal and intertidal reefs	Likely	Moderate	Medium	Sediments can impact reefs through smothering and reduced light (Bathgate et al. 2011).	12
Climate change: increased storm events	Increased sediments	Adversely affects coastal saltmarsh communities	Rare	Negligible	Negligible	There has been an increase in mangroves at the expense of saltmarsh in Western Port. However this is related to sea level rise and decreases in surface elevation (Rogers et al. 2005a, Boon 2011, Boon et al. 2011).	1
Climate change: increased storm events	Increased sediments	Adversely affects mangrove communities	Rare	Negligible	Negligible	There has been an increase in mangroves at the expense of saltmarsh in Western Port. However this is related to sea level rise and decreases in surface elevation (Rogers et al. 2005a, Boon 2011, Boon et al. 2011).	1
Climate change: increased storm events	Increased sediments	Reduced light and increased TSS adversely affects fish	Likely	Major	High	Direct impacts to fish gills are observed at very high TSS concentrations (> 100 mg/L), with larval fish considered the most vulnerable (Jenkins and McKinnon 2006). Concentrations of TSS can be high in parts of Western Port, and on occasion may reach concentrations that could adversely affect larval fish. However, this does not occur in primary larval fish habitat such as seagrass beds, where suspended sediment concentrations are lower.	16
Climate change: increased storm events	Increased sediments	Impacts to seagrass adversely affects fish	Almost certain	Moderate	High	Derived from risks to seagrass, noting that only a sub-set of fish species in Western Port are reliant on seagrass.	15
Climate change: increased storm events	Increased sediments	Impacts to fish and reduced visibility adversely affects feeding seabirds (including threatened species)	Likely	Minor	Medium	Increased sediment in the water column may reduce the foraging efficiencies of sight-feeding seabirds. (Dann 2011).	8

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Climate change: increased storm events	Increased sediments	Impacts to primary productivity reduce food availability for shorebirds	Likely	Major	High	Suspended sediments can reduce primary productivity, and consequently secondary productivity, and may also reduce secondary productivity directly by reducing the efficiency of filter-feeding mudflat biota (Dann 2011).	16
Climate change: increased storm events	Increased sediments	Increased TSS adversely affects visual amenity (aesthetic enjoyment)	Possible	Minor	Low	While turbid water is less visually appealing than clear water, there is no evidence of change since the time of listing.	6
Climate change: increased storm events	Increased sediments	Increased TSS adversely affects primary contact recreation	Unlikely	Minor	Low	While turbid water is less visually appealing than clear water, there is no evidence of change since the time of listing.	4
Climate change: increased storm events	Increased sediments	Increased TSS adversely affects secondary contact recreation	Rare	Minor	Negligible	While turbid water is less visually appealing than clear water, there is no evidence of change since the time of listing.	2
Climate change: increased storm events	Increased sediments	Impacts to fish adversely affect recreational fishing	Possible	Moderate	Medium	Derived from risks to fish	9
Pollution: agricultural run-off	**Toxicants (includes metals as well as chemicals of emerging concern such as agricultural pharmaceuticals and pesticides / herbicides)**					**The types of chemicals thought to be of most concern for Western Port are heavy metals, pesticides from agricultural run off and veterinary pharmaceuticals and oestrogens from dairying (Fisher and Scott 2008). A recent survey of toxicants in sediments indicated that, in general, toxicants in Western Port sediments are not at levels likely to be causing effects to resident fauna and flora. However, in some estuarine areas several metals including arsenic, nickel, mercury and organotins, were detected at levels exceeding sediment quality guidelines and pose a moderate risk to ecosystem health. In addition pesticides were detected in a number of estuarine areas, but not in the Bay sediments (Sharp et al. 2013). A recent study of toxicants in Watson's estuary found evidence of oestrogen impacts on biota (Sharley et al. 2013). Herbicides and oestrogen concentrations and risks in the rest of Western Port remain a knowledge gap. Changing land use practices to more intensive agriculture may result in an increased risk over the next 15 years, and the risks below are based on this premise.**	

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Pollution: agricultural run-off	Toxicants	Adversely affects seagrass	Likely	Moderate	Medium	Risk to seagrass from toxicants will be predominantly via the effects of herbicides. This is currently identified as a knowledge gap for Western Port, but is being addressed by a Melbourne Water Research Project. Preliminary findings indicate a medium risk to seagrass health from combined effects of multiple herbicides (Jackie Myers, CAPIM, pers. comm). Extent of impact is a knowledge gap.	12
Pollution: agricultural run-off	Toxicants	Adversely affects subtidal and intertidal flats (including benthic invertebrates)	Likely	Moderate	Medium	Heavy metal concentrations in sediments in Western Port are generally low, and the shallow, turbid environment would result in mostly sediment bound (not bioavailable) toxicants. There is some evidence of chronic effects of oestrogens and other toxicants on biota in Watsons Creek Estuary (Sharley et al. 2013).	12
Pollution: agricultural run-off	Toxicants	Adversely affects subtidal and intertidal reefs	Likely	Moderate	Medium	Heavy metal concentrations in sediments in Western Port are generally low, and the shallow, turbid environment would result in mostly sediment bound (not bioavailable) toxicants. There is some evidence of chronic effects of oestrogens and other toxicants on biota in Watsons Creek Estuary (Sharley et al. 2013).	12
Pollution: agricultural run-off	Toxicants	Adversely affects coastal saltmarsh communities	Unlikely	Minor	Low	Toxicants are listed as a potential threat for Victorian coastal saltmarsh (Boon et al. 2011). Given that toxicant concentrations in sediments in Western Port are generally low, and the shallow, turbid environment would result in mostly sediment bound (not bioavailable) toxicants, the risk is likely to be minimal.	4
Pollution: agricultural run-off	Toxicants	Adversely affects mangrove communities	Possible	Minor	Low	Risk to mangroves from toxicants will be predominantly via the effects of herbicides. This is currently identified as a knowledge gap for Western Port, but is being addressed by a Melbourne Water Research Project. Preliminary findings indicate a low risk to mangroves from combined effects of multiple herbicides (Jackie Myers, CAPIM, pers. comm).	6
Pollution: agricultural run-off	Toxicants	Adversely affects fish reducing condition, abundance and diversity	Likely	Moderate	Medium	The early life stages of fish (eggs, larvae and young juveniles) are the most susceptible to the effects of contaminants, although other effects can occur, such as a deleterious effect of DDT accumulation on reproductive development (Jenkins and McKinnon 2006). However, given the generally low concentrations of toxicants in Western Port in sediment (Sharp et al. 2013) and water column (EPA Victoria 2011b) any effects are likely to be localised.	12
Pollution: agricultural run-off	Toxicants	Impacts to fish and invertebrates adversely affects waterbirds through the food chain	Possible	Minor	Low	Very few studies on effects of pharmaceuticals on birds, but one study indicated that antidepressants had an effect on the behaviour of starlings (Bean et al. 2014). There is the potential for impacts through the food chain. However, once again given the generally low concentrations of toxicants in Western Port in sediment (Sharp et al. 2013) and water column (EPA Victoria 2011b) any effects are likely to be localised.	6

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Pollution: agricultural run-off	Toxicants	Impacts to fish and invertebrates adversely affects recreational fishing	Possible	Minor	Low	Derived from risks to fish, noting that many recreational species spend the majority of their time in deeper waters away form the impacts of concentrated toxicants in localised areas.	6
Pollution: agricultural run-off	Toxicants	Adversely affects primary contact recreation	Rare	Minor	Negligible	Concentrations of toxicants are well below those for primary contact recreation (EPA Victoria 2011b).	2
Pollution: agricultural run-off	Toxicants	Adversely affects secondary contact recreation	Rare	Minor	Negligible	Concentrations of toxicants are well below those for secondary contact recreation (EPA Victoria 2011b).	2
Pollution: septic tank leakage and stormwater	**Toxicants (includes metals as well as chemicals of emerging concern such as pharmaceuticals and personal care products)**					**Studies from elsewhere indicate that urban treated sewage contains a range of chemicals such as steroid hormones that could pose of risk to the marine environment (Ying et al. 2002). However, movement of these chemicals from septic systems is not well understood. Studies in fish indicate effects on immune systems (Milla et al. 2011) and reproduction** (Goksøyr 2006)**. The issue of Chemicals of Emerging Concern (CECs) in Western Port is a knowledge gap both with respect to the concentration of chemicals and their potential effects on biota. Risks have been assessed based on estimations of increasing populations and urban areas.**	
Pollution: septic and stormwater	Toxicants	Adversely affects seagrass	Likely	Moderate	Medium	Risk to seagrass from toxicants will be predominantly via the effects of herbicides, the pathway includes residential applications and roadside spraying in urban areas, transported into Western Port via stormwater drainage.	12
Pollution: septic and stormwater	Toxicants	Adversely affects subtidal and intertidal flats (including benthic invertebrates)	Likely	Moderate	Medium	Heavy metal concentrations in sediments in Western Port are generally low, and the shallow, turbid environment would result in mostly sediment bound (not bioavailable) toxicants. There is some evidence of chronic effects of oestrogens and other toxicants on biota in Watsons Creek Estuary (Sharley et al. 2013).	12
Pollution: septic and stormwater	Toxicants	Adversely affects subtidal and intertidal reefs	Likely	Moderate	Medium	Heavy metal concentrations in sediments in Western Port are generally low, and the shallow, turbid environment would result in mostly sediment bound (not bioavailable) toxicants. There is some evidence of chronic effects of oestrogens and other toxicants on biota in Watsons Creek Estuary (Sharley et al. 2013).	12
Pollution: septic and stormwater	Toxicants	Adversely affects coastal saltmarsh communities	Unlikely	Minor	Low	Toxicants are listed as a potential threat for Victorian coastal saltmarsh (Boon et al. 2011). Given that toxicant concentrations in sediments in Western Port are generally low, and the shallow, turbid environment would result in mostly sediment bound (not bioavailable) toxicants, the risk is likely to be minimal.	4
Pollution: septic and stormwater	Toxicants	Adversely affects mangrove communities	Possible	Minor	Low	Risk to mangroves from toxicants will be predominantly via the effects of herbicides, the pathway includes residential applications and roadside spraying in urban areas.	6

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Pollution: septic and stormwater	Toxicants	Adversely affects fish reducing condition, abundance and diversity	Likely	Moderate	Medium	The early life stages of fish (eggs, larvae and young juveniles) are the most susceptible to the effects of contaminants, although other effects can occur, such as a deleterious effect of DDT accumulation on reproductive development (Jenkins and McKinnon 2006). However, given the generally low concentrations of toxicants in Western Port in sediment (Sharp et al. 2013) and water column (EPA Victoria 2011b) any effects are likely to be localised.	12
Pollution: septic and stormwater	Toxicants	Impacts to fish and invertebrates adversely affects waterbirds through the food chain	Possible	Minor	Low	Very few studies on effects of pharmaceuticals on birds, but one study indicated that antidepressants had an effect on the behaviour of starlings (Bean et al. 2014). There is the potential for impacts through the food chain. However, once again given the generally low concentrations of toxicants in Western Port in sediment (Sharp et al. 2013) and water column (EPA Victoria 2011b) any effects are likely to be localised.	6
Pollution: septic and stormwater	Toxicants	Impacts to fish and invertebrates adversely affects recreational fishing	Possible	Minor	Low	Derived from risks to fish	6
Pollution: septic and stormwater	Toxicants	Adversely affects primary contact recreation	Rare	Minor	Negligible	Concentrations of toxicants are well below those for primary contact recreation (EPA Victoria 2011b).	2
Pollution: septic and stormwater	Toxicants	Adversely affects secondary contact recreation	Rare	Minor	Negligible	Concentrations of toxicants are well below those for secondary contact recreation (EPA Victoria 2011b).	2
Commercial development (ports, marinas, dredging)	**Toxicants (includes metals as well as antifouling chemicals such as TBT)**					**A recent survey of toxicants in sediments indicated that, in general, toxicants in Western Port sediments are not at levels likely to be causing effects to resident fauna and flora. Concentrations of tributyltins (TBTs) have decreased dramatically since the 1980s at most sites, but may have increased at the Hastings boat ramp and Warneet slipway (Sharp et al. 2013).**	
Commercial development (ports, marinas, dredging)	Toxicants	Adversely affects seagrass	Unlikely	Minor	Low	Risk to seagrass from toxicants will be predominantly via the effects of herbicides, not this group of toxicants.	4
Commercial development (ports, marinas, dredging)	Toxicants	Adversely affects subtidal and intertidal flats (including benthic invertebrates)	Possible	Minor	Low	No direct evidence of toxicity in soft sediments of Western Port, but known from elsewhere; and snails in reef communities have been affected. Effects likely to be localised to areas of high boat activity.	6

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Commercial development (ports, marinas, dredging)	Toxicants	Adversely affects subtidal and intertidal reefs	Possible	Minor	Low	There is some evidence of imposex attributed to TBT in snails on reefs in Western Port (Nias et al. 1993), although the effects are likely to be localised.	6
Commercial development (ports, marinas, dredging)	Toxicants	Adversely affects coastal saltmarsh communities	Unlikely	Minor	Low	Toxicants are listed as a potential threat for Victorian coastal saltmarsh (Boon et al. 2011). Given that toxicant concentrations in sediments in Western Port are generally low, and the shallow, turbid environment would result in mostly sediment bound (not bioavailable) toxicants, the risk is likely to be minimal.	4
Commercial development (ports, marinas, dredging)	Toxicants	Adversely affects mangrove communities	Unlikely	Minor	Low	Risk to mangroves from toxicants will be predominantly via the effects of herbicides, not this group of toxicants.	4
Commercial development (ports, marinas, dredging)	Toxicants	Adversely affects fish reducing condition, abundance and diversity	Unlikely	Minor	Low	The early life stages of fish (eggs, larvae and young juveniles) are the most susceptible to the effects of contaminants (Jenkins and McKinnon 2006). Effects likely to be localised to areas of high boat activity.	4
Commercial development (ports, marinas, dredging)	Toxicants	Impacts to fish and invertebrates adversely affects waterbirds through the food chain	Unlikely	Minor	Low	There is the potential for impacts through the food chain. However, effects likely to be localised to areas of high boat activity.	4
Commercial development (ports, marinas, dredging)	Toxicants	Impacts to fish and invertebrates adversely affects recreational fishing	Unlikely	Minor	Low	Derived from risks to fish	4
Commercial development (ports, marinas, dredging)	Toxicants	Adversely affects primary contact recreation	Rare	Minor	Negligible	Concentrations of toxicants are well below those for primary contact recreation (EPA Victoria 2011b).	2
Commercial development (ports, marinas, dredging)	Toxicants	Adversely affects secondary contact recreation	Rare	Minor	Negligible	Concentrations of toxicants are well below those for secondary contact recreation (EPA Victoria 2011b).	2

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Urban development and recreation	**Litter (including microplastics)**					**Recent surveys of the Lower Yarra and Maribyrnong rivers indicated a large amount of litter and microplastics and micro-plastics on beaches of Port Phillip Bay (Blake and Charko 2014). This is consistent with an Australia wide study of micro-plastics in oceanic waters, which found levels in Australia similar to those in the Caribbean, but lower than in the Mediterranean (Reisser et al. 2013). There are no direct reports of litter in Western Port, but given the smaller urban environment (compared to PPB) litter and microplastics are likely to pose a lesser risk than in Port Phillip Bay.**	
Urban development and recreation	Litter (including microplastics)	Adversely affects subtidal and intertidal flats (including benthic invertebrates)	Unlikely	Minor	Low	There is evidence of ingestion and digestion of micro-plastics by marine invertebrates. Accumulation of microplastic particles in marine invertebrates could potentially cause blockages throughout the digestive system, suppressing feeding due to satiation (Wright et al. 2013), but no direct evidence from Western Port	4
Urban development and recreation	Litter (including microplastics)	Adversely affects subtidal and intertidal reefs	Unlikely	Minor	Low	As above - no direct evidence from Western Port	4
Urban development and recreation	Litter (including microplastics)	Adversely affects fish reducing condition, abundance and diversity	Unlikely	Minor	Low	Impact pathways for fish include entanglement and ingestion of plastics (Hammer et al. 2012). Studies from the northern hemisphere indicate that fish species, regardless of feeding habit, ingest micro-plastics (Lusher et al. 2013). Although the long-term effects are not fully understood, there is evidence of transfers of toxic chemicals, liver disease (Rochman et al. 2013) and blocking of the digestive tract leading to starvation (Gregory 2009) but no direct evidence from Western Port.	4
Urban development and recreation	Litter (including microplastics)	Direct impacts to sea and shorebirds	Almost certain	Minor	Medium	Entanglement is a problem for some birds in Western Port and several species, notably Pacific and Silver Gulls, Crested Terns, Little Pied Cormorants and Pelicans, are not infrequently found in the Western Port area entangled in fishing line or with fishhooks or jigs attached and either dead or incapacitated (Dann 2011). Seabirds and shorebirds are also susceptible to ingestion of micro-plastics with effects on nutrition and toxicity reported (Sutherland et al. 2012).	10
Urban development and recreation	Litter (including microplastics)	Adversely affects visual amenity (aesthetic enjoyment)	Almost certain	Minor	Medium	Litter on beaches and near shore areas may impact on visual amenity in localized areas, particularly around drains and popular beaches.	10
Urban development and recreation	Litter (including microplastics)	Adversely affects primary contact recreation	Unlikely	Minor	Low	Litter on beaches and near shore areas may impact on primary contact recreation in localised areas	4

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Urban development and recreation	Litter (including microplastics)	Adversely affects secondary contact recreation	Unlikely	Minor	Low	Litter on beaches and near shore areas may impact on secondary contact recreation in localised areas	4
Urban development and recreation	Litter (including microplastics)	Impacts to fish and invertebrates adversely affects recreational fishing	Unlikely	Moderate	Low	Derived from risks to fish	6
Disturbance of Coastal Acid Sulphate Soils (CASS)	**Metals liberated as a result of oxidation of CASS and acidity**					**Areas of CASS have been mapped around Western Port. If disturbed by prolonged drying of wetland areas or physical disturbance of the soil surface, then sulphuric acid is formed and can liberate metals from the sediments. The risk from altered pH is likely to be negligible given the buffering potential of seawater. However, the release of heavy metals may be a risk, albeit localised and of low likelihood due to current strategies and policies in place to minimise disturbance of CASS (Department of Sustainability and Environment 2009). Risks were assigned as being less likely and less severe than catchment derived toxicants**	
Disturbance CASS	Metals liberated as a result of oxidation of CASS and acidity	Adversely affects seagrass			#N/A	Risk to seagrass from toxicants will be predominantly via the effects of herbicides. Possibly not a plausible impact pathway.	0
Disturbance CASS	Metals liberated as a result of oxidation of CASS and acidity	Adversely affects subtidal and intertidal flats (including benthic invertebrates)	Unlikely	Minor	Low	Based on risks from agricultural run-off (see above)	4
Disturbance CASS	Metals liberated as a result of oxidation of CASS and acidity	Adversely affects subtidal and intertidal reefs	Unlikely	Minor	Low	Based on risks from agricultural run-off (see above)	4
Disturbance CASS	Metals liberated as a result of oxidation of CASS and acidity	Adversely affects coastal saltmarsh communities	Unlikely	Minor	Low	Based on risks from agricultural run-off (see above)	4

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Disturbance CASS	Metals liberated as a result of oxidation of CASS and acidity	Adversely affects mangrove communities	Unlikely	Minor	Low	Based on risks from agricultural run-off (see above)	4
Disturbance CASS	Metals liberated as a result of oxidation of CASS and acidity	Adversely affects fish reducing condition, abundance and diversity	Unlikely	Minor	Low	Based on risks from agricultural run-off (see above)	4
Disturbance CASS	Metals liberated as a result of oxidation of CASS and acidity	Impacts to fish and invertebrates adversely affects waterbirds through the food chain	Unlikely	Minor	Low	Based on risks from agricultural run-off (see above)	4
Disturbance CASS	Metals liberated as a result of oxidation of CASS and acidity	Impacts to fish and invertebrates adversely affects recreational fishing	Unlikely	Minor	Low	Based on risks from agricultural run-off (see above)	4
Disturbance CASS	Metals liberated as a result of oxidation of CASS and acidity	Adversely affects primary contact recreation	Rare	Minor	Negligible	Based on risks from agricultural run-off (see above)	2
Disturbance CASS	Metals liberated as a result of oxidation of CASS and acidity	Adversely affects secondary contact recreation	Rare	Minor	Negligible	Based on risks from agricultural run-off (see above)	2

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Commercial development and shipping (ports, marinas, dredging)	**Hydrocarbons**					**The Port of Hastings receives moderate numbers of vessels (50 per year) but the majority are related to the oil and gas industry. The possibility of a major oil spill in Western Port is small, with no significant spills to date. There have only been 20 spills of > 100 tonnes in Australia in the last 100 years (AMSA https://www.amsa.gov.au/environment/major-historical-incidents/). Risk management measures are in place to minimise the likelihood of a major spill and respond in the event to minimise impacts (Melbourne Water 2009). The Westernport and Peninsula Protection Council and Victorian National Parks Association commissioned modelling studies using six credible scenarios (200 tonnes of heavy fuel and 66 tonnes of diesel). The models indicated that shoreline exposure could occur rapidly (quicker than mitigation measures could be deployed) and that there would be widespread damage to ecosystems, habitats and species (APASA 2013, VNPA 2014a, 2014b). The risk assessment below is based on these scenarios, with the likelihood assessed as "Rare" based on number of ships using the port and historic records of oil spills in Australia.**	
Commercial development and shipping	Hydrocarbons	Adversely affects seagrass (direct and shading)	Rare	Extreme	Medium	Impacts of oil spills on marine biota and shorelines are well documented (e.g. Gundlach and Hayes 1978, Swan et al. 1994, Islam and Tanaka 2004) and effects are both acute and chronic, with recovery in many instances taking decades (e.g. Peterson et al. 2003). Boon et al. (2011) provides a literature review of the impacts of hydrocarbon pollution on Victorian coastal wetlands: few cases of pollution were recorded, but impacts can be prolonged.	5
Commercial development and shipping	Hydrocarbons	Adversely affects intertidal and sub-tidal flats	Rare	Extreme	Medium	As above	5
Commercial development and shipping	Hydrocarbons	Adversely affects intertidal and subtidal reefs	Rare	Extreme	Medium	As above	5
Commercial development and shipping	Hydrocarbons	Adversely affects coastal saltmarsh communities	Rare	Extreme	Medium	As above	5
Commercial development and shipping	Hydrocarbons	Adversely affects mangrove communities	Rare	Extreme	Medium	As above	5
Commercial development and shipping	Hydrocarbons	Direct oiling of wildlife: Sea and shore birds	Rare	Extreme	Medium	As above	5
Commercial development and shipping	Hydrocarbons	Indirect effects to fish (food webs, habitat alteration)	Rare	Extreme	Medium	As above	5

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Commercial development and shipping	Hydrocarbons	Indirect effects to invertebrates (food webs, habitat alteration)	Rare	Extreme	Medium	As above	5
Commercial development and shipping	Hydrocarbons	Indirect effects to sea and shorebirds (loss of food and habitat)	Rare	Extreme	Medium	As above	5
Commercial development and shipping	Hydrocarbons	Affects visual amenity (aesthetic enjoyment)	Rare	Extreme	Medium	As above	5
Commercial development and shipping	Hydrocarbons	Adversely affects recreational fishing	Rare	Extreme	Medium	As above	5
Commercial development and shipping	Hydrocarbons	Adversely affects primary contact recreation	Rare	Extreme	Medium	As above	5
Commercial development and shipping	Hydrocarbons	Adversely affects secondary contact recreation	Rare	Extreme	Medium	As above	5
Water Resource Use	**Decreased freshwater inflows**	**Increased salinity**				**Because it is a semi-enclosed bay, Western Port is subject to alterations in salinity at a range of scales. Long-term records in Western Port show strong seasonal and inter-annual variations in salinity of greater magnitude than Bass Strait. There is a potential trend for increasing salinity as a result of reduced inflows – due to diversion of water by re-cycling and other human uses, even allowing for possible increases in stormwater runoff from urbanisation (EPA Victoria 2011a). However, in systems such as Western Port that are adapted to temporal changes in salinity, small increases are not likely to have measureable impacts. The impact of water extraction, especially given land use and climate change is difficult to determine. The potential impacts on Western Port are considered a knowledge gap.**	
Invasive species	**Introduced marine pests**					**Although there are several known introduced marine pest species in Western Port, the number and extent of these pests is considerably lower than that of nearby Port Phillip Bay (PPB). Given the proximity of Western Port to PPB and prevailing currents, it is possible that larvae could be transported from PPB to Western Port. There is also the risk of new invasions. To a large extent the impacts of marine pests will be dependent on what species arrive and establish, making it difficult to assess in a general sense.**	

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Invasive species	Introduced marine pests	Adversely affects seagrass	Possible	Minor	Low	Introduced pests have not been specifically identified as a potential threat to seagrass communities in recent assessments of Western Port (Walker 2011).	6
Invasive species	Introduced marine pests	Adversely affects subtidal and intertidal flats (including benthic invertebrates)	Possible	Major	High	Recent assessments in Western Port have suggested that despite no sustained, widespread establishment of epi-benthic marine pests, depending on which species may arrive, changes to entire communities and their functions cannot be excluded (Wilson et al. 2011).	12
Invasive species	Introduced marine pests	Adversely affects subtidal and intertidal reefs	Possible	Major	High	There are areas of marine pest invasion in Western Port. For example, in San Remo and Churchill Island Marine National Park, *Codium* sp. has spread and competes with native algae for space and resources. In addition pacific oysters have been a problem requiring control. However, recent assessments have concluded "the risk to the more extensive reef areas of Western Port, which are in the southern sections, is not great." (Bathgate et al. 2011).	12
Invasive species	Introduced marine pests	Adversely affects fish reducing condition, abundance and diversity	Possible	Minor	Low	Introduced pests have not been specifically identified as a potential threat to fish diversity and abundance in recent assessments of Western Port (Jenkins 2011).	6
Invasive species	Introduced marine pests	Impacts to fish and invertebrates adversely affects waterbirds through the food chain	Possible	Minor	Low	Introduced pests have not been specifically identified as a potential threat to fish diversity and abundance in recent assessments of Western Port (Dann 2011).	6
Invasive species	Introduced marine pests	Impacts to fish and invertebrates adversely affects recreational fishing	Possible	Minor	Low	Derived from risks to fish	6
Invasive species	**Cord-grass (*Spartina* spp.)**					***Spartina* spp. is known from Western Port and the intertidal and saltmarsh habitats are vulnerable to spread of this species. It is tolerant of inundation and salinity, resistant to many herbicides and can rapidly outcompete native vegetation (Boon et al. 2011).**	
Invasive species	Cord-grass (*Spartina* spp.)	Adversely affects saltmarsh	Almost certain	Major	Extreme	Saltmarsh habitats are vulnerable to spread of this species. It is tolerant of inundation and salinity, resistant to many herbicides and can rapidly outcompete native vegetation (Boon et al. 2011).	20
Invasive species	Cord-grass (*Spartina* spp.)	Adversely affects mangroves	Almost certain	Moderate	High	Intertidal habitats are vulnerable to spread of this species. It is tolerant of inundation and salinity, resistant to many herbicides and can rapidly outcompete native vegetation (Boon et al. 2011).	15

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Invasive species	Cord-grass (*Spartina* spp.)	Adversely affects shorebirds and beach nesting seabirds	Almost certain	Moderate	High	*Spartina* is dense, and does not provide good feeding, roosting or nesting habitat. The consequences may be higher for international migratory species that have high energy demands, and threatened nesting species.	15
Invasive species	**Emerging salt tolerant weeds**					**There is a very large number of exotic species that can invade - and have invaded - at higher elevations at the edge of the saltmarsh range (e.g. sea wheat grass; *Thinopyrum junceiforme*). Impacts are mostly to saltmarsh, rather than mangroves. *Spartina* is the only likely invader into mangroves. Sea spurge is a known threat to beach nesting birds, displacing nesting sites**	
Invasive species	Emerging salt tolerant weeds	Adversely affects saltmarsh	Almost certain	Moderate	High	Based on local knowledge.	15
Invasive species	Emerging salt tolerant weeds	Adversely affects mangroves	Possible	Moderate	Medium	Based on local knowledge.	9
Invasive species	Emerging salt tolerant weeds	Adversely affects shorebirds and beach nesting seabirds	Almost certain	Moderate	High	Most pronounced in the effects on feeding habitats for Orange-bellied parrot and on nesting birds through displacement of nest sites.	15
Invasive species	**Predators (foxes and cats)**					**The PPWPCMA Invasive Plants and Animals strategy identifies predation by foxes and cats as a significant threat to shorebirds and beach nesting birds, with foxes remaining widespread throughout the Ramsar site.**	
Invasive species	Predators (foxes and cats)	Adversely affects shorebirds and beach nesting seabirds	Almost certain	Major	Extreme	The PPWPCMA Invasive Plants and Animals strategy identifies predation by foxes and cats as a significant threat to shorebirds and beach nesting birds, with foxes remaining widespread throughout the Ramsar site.	20
Invasive species	**Grazing animals (pigs, goats, rabbits)**					**Rabbits are widespread and there are localised infestations of pigs (e.g. Quail Island) and goats. There is direct evidence of extensive damage to coastal saltmarsh.**	
Invasive species	Grazing animals (pigs, goats, rabbits)	Adversely affects saltmarsh	Almost certain	Moderate	High	Rabbits are widespread and there are localised infestations of pigs (e.g. Quail Island) and goats. There is direct evidence of extensive damage to coastal saltmarsh	15
Invasive species	Grazing animals (pigs, goats, rabbits)	Adversely affects mangroves	Almost certain	Minor	Medium	Mangroves are grazed by cattle.	10
Invasive species	Grazing animals (pigs, goats, rabbits)	Adversely affects shorebirds and beach nesting seabirds	Almost certain	Moderate	High	Derived from risks to saltmarsh	15
Recreational activities	**Recreational activities in intertidal zones and on beaches**					**Vehicle damage to vegetation has been reported in Western Port reserves. The population of Greater Melbourne is predicted to increase from 4.3 million in 2013 to 7.8 million in 2051 (DTPLI 2014). This is likely to increase recreational pressure on beaches and coastal areas.**	

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Recreational activities	Vehicles in intertidal areas	Adversely affects saltmarsh	Almost certain	Moderate	High	Coastal saltmarsh is an EPBC listed ecological community and is vulnerable to impacts and slow to recover from damage. Damage arising from vehicular access is widespread around Western Port.	15
Recreational activities	Vehicles in intertidal areas	Adversely affects intertidal flats	Almost certain	Moderate	High	Based on local knowledge of SAG members.	15
Recreational activities	Vessels	Adversely affects intertidal flats	Almost certain	Minor	Medium	Based on local knowledge of SAG members.	10
Recreational activities	Vehicles in intertidal areas	Adversely affects shorebirds and beach nesting seabirds	Almost certain	Moderate	High	Two impact pathways: habitat destruction and disturbance of nesting seabirds and roosting / foraging shorebirds. Human presence impacts on shorebirds is well documented (e.g. Martin et al. 2014) with reduced feeding and unnecessary energy use feared to impact birds abilities to successfully make return journey to the northern hemisphere to breed.	15
Recreational activities	Vessels	Disturbance of shorebirds and nesting seabirds	Almost certain	Minor	Medium	Beach nesting birds (Hooded Plover, Fairy Tern, Red-capped Plovers and Oyster catchers) are highly vulnerable to disturbance by recreational boating activity. With predicted population increases, recreational boating is likely to increase.	10
Recreational activities	Recreation on beaches and shorelines	Adversely affects shorebirds and beach nesting seabirds	Almost certain	Moderate	High	Shorebirds and nesting seabirds are vulnerable to disturbance from walkers and dogs. As the population increases, it is expected that this pressure will also increase (Dann 2011).	15
Biological resource use	**Recreational fishing (includes bait harvesting e.g. ghost shrimp)**					**A survey of recreational fishers in Victoria indicates that for some species, the recreational catch is many times higher than the commercial catch (Ford and Gilmour 2013). There are policies and rules in place (size and bag limits) to limit the impact of recreational fishing on fish stocks. Risk assessment is on the basis of an increasing population resulting in an increase in recreational fishing. Although rules such as bag limits may change to ensure sustainable stocks.**	
Biological resource use	Recreational fishing	Adversely affects intertidal invertebrates	Almost certain	Moderate	High	Studies of bait pumping for ghost shrimp in Western Port indicated that changes are not just to target species, but to the ecosystem function of the entire habitat, with slow recovery (Contessa and Bird 2004).	15
Biological resource use	Recreational fishing	Adversely affects fish abundance and diversity	Almost certain	Major	Extreme	Population projections over the next 40 years, would suggest that increasing recreational fishing effort in Western Port is likely.	20
Biological resource use	Recreational fishing	Adversely affects bycatch species	Almost certain	Minor	Medium	Many non-target species are caught and discarded. There is no monitoring or rules protecting these species, but in Western Port is limited to a small number of species.	10
Biological resource use	Recreational fishing	Indirect effects to seabirds (loss of food)	Possible	Minor	Low	Based on assessment of fish, recognising that only a proportion of the species in Western Port eat fish and that there is only partial overlap between species eaten by birds and those targeted by recreational fishers.	6

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Urban development	**Habitat removal**					**Increasing populations lead to an expansion of residential and commercial areas. Although an assessment of specific projects is outside the scope of this risk assessment, the general nature of development and direct habitat removal is considered. Of particular concern is that residential and commercial development in many areas is close to the shore, preventing retreat.**	0
Urban development	Habitat removal	Adversely affects seagrass	Possible	Minor	Low	Based on land reclamation, illegal bunds and depositing of fill in intertidal areas.	6
Urban development	Habitat removal	Adversely affects saltmarsh	Likely	Moderate	Medium	Historically over 45% of the pre-European saltmarsh extent in Western Port has been lost to "land reclamation" (Boon et al. 2011). However, the recent EPBC listing of coastal saltmarsh as a vulnerable community affords the vegetation class more protection from future developments - dumping of clean fill to reclaim land has been identified as a risk in some areas of Western Port.	12
Urban development	Habitat removal	Adversely affects mangrove communities	Likely	Moderate	Medium	Mangrove habitat can be lost directly from land claiming, clearance for industrial or marina developments, and other effects of urbanisation (Dittman 2011).	12
Urban development	Habitat removal	Indirect effects to sea and shorebirds (loss of food and habitat)	Possible	Minor	Low	Based on assessment of saltmarsh, noting that birds are mobile and can move to other intertidal areas.	6
Urban development	**Lighting at night**					**A recent study from Phillip Island found that a small percentage (1 %) of short-tailed shearwaters were significantly affected by lighting at night, resulting in a 40% mortality of affected birds (Rodrıguez et al. 2014). An increased urban area around the coasts of Western Port could result in increased lighting at night.**	
Urban development	Lighting at night	Affects seabirds	Possible	Minor	Low	See above	6
Climate change						**Regional climate projections have recently been released by CSIRO for sub-cluster regions in Australia. The relevant region for Western Port Bay is "Southern Slopes Victoria West" http://www.climatechangeinaustralia.gov.au/en/climate-projections/future-climate/regional-climate-change-explorer/sub-clusters/?current=SSVWC&tooltip=true&popup=true. Projections are provided for each relevant stressor below. The risks are based on the recently completed report by Klemke and Arundel (2013). Workshop participants were asked to review the risk rankings and make any adjustments with a justification / lines of evidence to support their decisions.**	
Climate change	**Increased carbon dioxide**					**Atmospheric carbon dioxide is increasing and has increased in recent decades and recently exceeded 400 ppm (http://www.esrl.noaa.gov/gmd/ccgg/trends/).**	

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Climate change	Increased carbon dioxide	Increased photosynthesis adversely affects seagrass	Unlikely	Negligible	Negligible	Predicted that increased CO_2 may benefit seagrass (Morris 2013).	2
Climate change	Increased carbon dioxide	Increased photosynthesis adversely affects saltmarsh and mangroves	Possible	Minor	Low	Score of 'minor' impact based on rationale that selection amongst C3/C4 plants will exert little overall adverse effect on saltmarshes. Might result in some plant groups having an advantage and therefore increasing in extent (e.g. C3 taxa such as shrubs) while others will have neither an advantage or disadvantage (e.g. grasses) Paul Boon (pers. comm.).	6
Climate change	**Increased temperature**					**Surface water temperatures are predicted to increase by 0.5 degrees Celsius by 2030 with a very high degree of confidence. There will also be an increase in the frequency of extreme temperature days (Grose et al. 2015).**	
Climate change	Increased temperature	Adversely affects seagrass	Possible	Moderate	Medium	Assessment of impacts of climate change related temperature increases on seagrass and soft sediment habitats in Victoria indicated low vulnerability, but high uncertainty in embayments (Morris 2013). The risk would be higher to intertidal seagrass, than subtidal due to increased exposure.	9
Climate change	Increased temperature	Adversely affects intertidal and subtidal flats	Unlikely	Minor	Low	An assessment of climate change related increased temperature impacts to intertidal and subtidal flats indicated moderate vulnerability and adaptive capacity (Morris 2013). However, the greatest risks are for longer term projections and the likelihood and magnitude of change in the next two decades is lower.	4
Climate change	Increased temperature	Adversely affects intertidal and subtidal reefs	Possible	Moderate	Medium	An assessment of climate change related increased temperature impacts to intertidal and subtidal rocky reefs indicated high vulnerability and low adaptive capacity (Bellgrove et al. 2013). However, the greatest risks are for longer term projections (> 30 years) and the likelihood and magnitude of change in the next two decades is lower. Effects to habitat forming brown algae may have flow on effects to fauna.	9
Climate change	Increased temperature	Adversely affects saltmarsh	Possible	Moderate	Medium	Spartina is a C4 plant that is likely to be competitively advantaged by higher temperatures (and CO2) concentrations, increasing the risk to saltmarsh communities from this invasive species. Therefore risk is considered higher under climate change than that currently posed by this invasive species.	9
Climate change	Increased temperature	Adversely affects mangroves			N/A	There is a potential benefit to mangroves through expansion of range as temperatures increase (Boon et al. 2011). Not a plausible impact pathway.	0
Climate change	Increased temperature	Adversely affects fish abundance and diversity	Possible	Minor	Low	An assessment of climate change related increased temperature impacts to marine fish indicated high vulnerability and low adaptive capacity of larval stages (Hirst and Hamer 2013). However, the greatest risks are for longer term projections (> 50 years) and the likelihood and magnitude of change in the next two decades is lower.	6
Climate change	Increased temperature	Adversely affects waterbirds	Possible	Moderate	Medium	Temperature effects the timing of migration in many shorebirds, which may influence recruitment and survival (Robinson et al. 2009).	9

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Climate change	Increased temperature	Adversely affects recreational fishing	Possible	Minor	Low	Larvae of target recreational species (King George Whiting, Snapper, Sand Flathead) all vulnerable to temperature increases (Hirst and Hamer 2013). However the effects in the next 15 years are not expected to be widespread.	6
Climate change	**Sea level rise**					**Sea levels are predicted to increase by 0.08 to 0.18 m by 2030 with a very high degree of confidence (Grose et al. 2015). Western Port Local Coastal Hazard Assessment indicates widespread and significant impacts by 2100 (Arrowsmith and Womersley 2014).**	
Climate change	Sea level rise	Adversely affects seagrass	Likely	Major	High	Intertidal seagrass is highly vulnerable to sea level rise and has a low adaptive capacity (Morris 2013).	16
Climate change	Sea level rise	Adversely affects intertidal and subtidal flats	Likely	Major	High	Intertidal mudflats are highly vulnerable to sea level rise and have a low adaptive capacity (Morris 2013).	16
Climate change	Sea level rise	Adversely affects intertidal and subtidal reefs	Likely	Major	High	Intertidal and shallow subtidal rocky reefs in Victorian embayments are highly vulnerable to sea level rise with a low adaptive capacity.	16
Climate change	Sea level rise	Adversely affects saltmarsh	Almost certain	Major	Extreme	Saltmarsh and mangrove community composition and extent is largely determined by tidal depth (Boon et al. 2011). Sea level rise in areas, such as Western Port, which has significant barriers to landward migration (roads, walls, etc) has the capacity to have severe impacts on the EPBC listed ecological community (Saintilan and Rogers 2013).	20
Climate change	Sea level rise	Adversely affects mangroves	Possible	Minor	Low	Likely to favour mangroves over saltmarsh, with an expansion into current saltmarsh habitat (Boon et al. 2011).	6
Climate change	Sea level rise	Adversely affects fish abundance and diversity	Unlikely	Minor	Low	Low vulnerabilities of fish to sea level rise (adults and larvae) (Hirst and Hamer 2013).	4
Climate change	Sea level rise	Adversely affects waterbirds	Likely	Moderate	Medium	Shorebirds and beach nesting seabirds are highly vulnerable to sea level rise, with loss of habitat predicted to be extensive (Robinson et al. 2009). This may include loss of intertidal feeding habitat and supratidal habitat needed for roosting and nesting. Impacts considered moderate in the short term, but greater in the long term (Hansen et al. 2013).	12
Climate change	Sea level rise	Adversely affects recreational fishing	Unlikely	Minor	Low	Based on assessment of fish	4
Climate change	**Ocean acidification**					**pH is predicted to decrease by 0.07 to 0.08 pH units by 2030 with a medium degree of confidence (Grose et al. 2015).**	
Climate change	Ocean acidification	Adversely affects seagrass	Rare	Negligible	Negligible	Seagrass in Victoria is not considered vulnerable to predicted changes in ocean acidification (Morris 2013).	1
Climate change	Ocean acidification	Adversely affects intertidal and subtidal flats	Unlikely	Minor	Low	Assessed as being highly vulnerable, particularly for organisms with a calcified outer shell (Morris 2013). However, possibly a longer term risk, rather than in the next two decades.	4

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Climate change	Ocean acidification	Adversely affects intertidal and subtidal reefs	Unlikely	Minor	Low	Assessed as being highly vulnerable, particularly for organisms with a calcified outer shell (Bellgrove et al. 2013). However, possibly a longer term risk, rather than in the next two decades.	4
Climate change	Ocean acidification	Adversely affects fish abundance and diversity	Rare	Negligible	Negligible	Low to moderate vulnerability (Hirst and Hamer 2013).	1
Climate change	Ocean acidification	Adversely affects waterbirds	Rare	Negligible	Negligible	Only plausible pathway is through food chain effects, but considered to be very low risk in the short to medium term (noting that this risk assessment is based on the next 15 years). Longer term effects through loss fo calcified shell prey may prove a greater threat.	1
Climate change	Ocean acidification	Adversely affects recreational fishing	Rare	Negligible	Negligible	Based on assessment of fish	1
Climate change	**Increased frequency and intensity of storms leads to increased erosion of shorelines**					**Extreme events (storms and high rainfall events) are predicted (with high confidence) to increase in frequency(Grose et al. 2015). Erosion of shorelines in Western Port is currently occurring, particularly in the Eastern Arm near Lang Lang, due to the combined actions of waves and tidal cycles. A recent study concluded "There was no evidence from monitoring sites that storm events caused significantly greater erosion, however determining these thresholds and wave impacts is an important precursor for the design of effective erosion control structures." (Tomkins et al. 2014). However development close to shorelines decreases potential for inland migration if shores erode. Western Port Local Coastal Hazard Assessment indicates widespread and significant impacts by 2100 (Arrowsmith and Womersley 2014).**	
Climate change	Increased frequency and intensity of storms leads to increased erosion of shorelines	Adversely affects seagrass	Almost certain	Major	Extreme	Seagrass in intertidal zones is most vulnerable, with a very large proportion of the seagrass in Western Port in intertidal and shallow waters.	20
Climate change	Increased frequency and intensity of storms leads to increased erosion of shorelines	Adversely affects intertidal and subtidal flats	Almost certain	Major	Extreme	Similarly, intertidal flats are exposed to wave action and increased storms will result in physical damage and follow on effects to benthic invertebrates.	20

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Climate change	Increased frequency and intensity of storms leads to increased erosion of shorelines	Adversely affects intertidal and subtidal reefs	Possible	Moderate	Medium	Exposed shallow sub-tidal reefs may be physically damaged by storm surges, but are less vulnerable than intertidal habitats.	9
Climate change	Increased frequency and intensity of storms leads to increased erosion of shorelines	Adversely affects saltmarsh	Likely	Major	High	Destruction of coastal dunes systems due to wave action, higher tides and resulting loss of natural barriers adversely impact on saltmarsh.	16
Climate change	Increased frequency and intensity of storms leads to increased erosion of shorelines	Adversely affects mangroves	Likely	Major	High	Destruction of coastal dunes systems due to wave action, higher tides and resulting loss of natural barriers adversely impact on mangroves.	16
Climate change	Increased frequency and intensity of storms leads to increased erosion of shorelines	Adversely affects fish abundance and diversity	Possible	Moderate	Medium	Based on assessment of seagrass, noting that not all fish species are reliant on seagrass habitat.	9
Climate change	Increased frequency and intensity of storms leads to increased erosion of shorelines	Adversely affects waterbirds	Likely	Major	High	Due to erosion of intertidal mudflat habitats and supratidal habitat needed for roosting and nesting.	16
Climate change	Increased frequency and intensity of storms leads to increased erosion of shorelines	Adversely affects visual amenity (aesthetic enjoyment)	Unlikely	Minor	Low	Storm damage on shorelines may affect visual amenity in localised areas for periods post storm.	4

Pressure	Stressor	Impact	Likelihood	Consequence	Risk	Evidence / comments	Score
Climate change	Increased frequency and intensity of storms leads to increased erosion of shorelines	Adversely affects primary contact recreation	Unlikely	Minor	Low	Based on localised affects to beaches.	4
Climate change	Increased frequency and intensity of storms leads to increased erosion of shorelines	Adversely affects secondary contact recreation	Unlikely	Minor	Low	Based on localised affects to beaches.	4
Climate change	Increased frequency and intensity of storms leads to increased erosion of shorelines	Adversely affects recreational fishing	Possible	Moderate	Medium	Based on assessment of fish, noting that not all recreational target fish species are reliant on seagrass habitat.	9

Appendix D: Locations of priority threats

These maps were developed by the Steering Committee and Stakeholder Advisory Group in a workshop held in Hasting in August 2015. They should be considered indicative only, but are to aid in the development of action plans for implementation of management strategies.

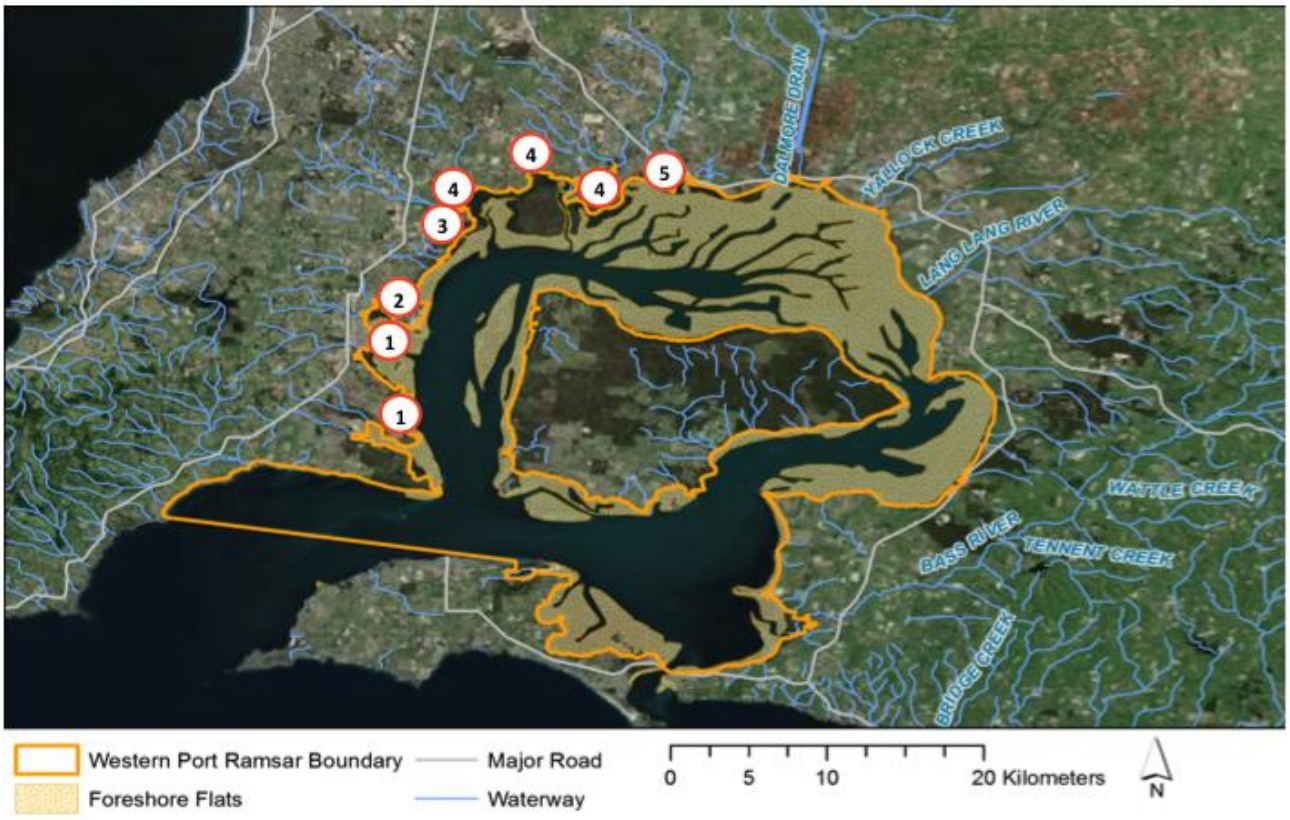
Invasive Species

Invasive Species

1. Bluebell creeper, sallow wattle
2. Pigs
3. Foxes
4. Feral cats, rabbits
5. New and emerging weed invasions
6. Domestic stock (Cattle)
7. Cord grass (*Spartina anglica* and *Spartina x townsendii* sp)
8. Pacific oyster (*Crassostrea gigas*)
9. Northern pacific sea star (*Asterias amurensis*)
10. Japanese kelp or Wakame (*Undaria pinnatifida*)
11. European green crab (*Carcinus maenas*)
12. Tall wheat grass (*Thinopyrum ponticum*)

Note: Tall wheat grass is used as an example of a new and emerging weed species and so is not located on the map.

Urban and Commercial Development

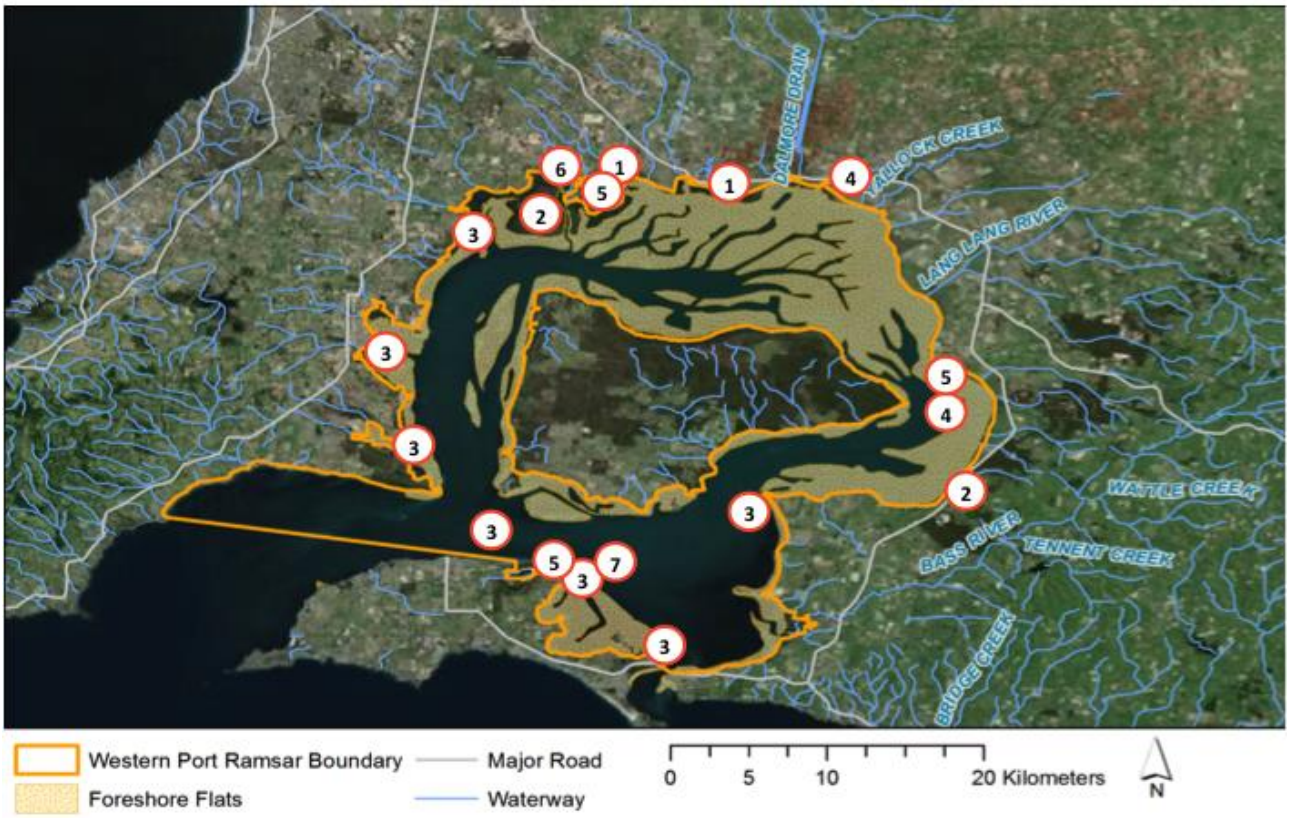


Urban and Commercial Development

1. Potential expansion of port area and increased use of Crib Point and Stony Point
2. Growth area north of Hastings
3. Yarringa marina expansion
4. Development of intensive agriculture (market gardens)
5. Illegal levee banks

Note: Development of intense agriculture (4) occurs in the catchment not the site, and locations of illegal levee banks (5) were not known by workshop participants and not so not shown on the map.

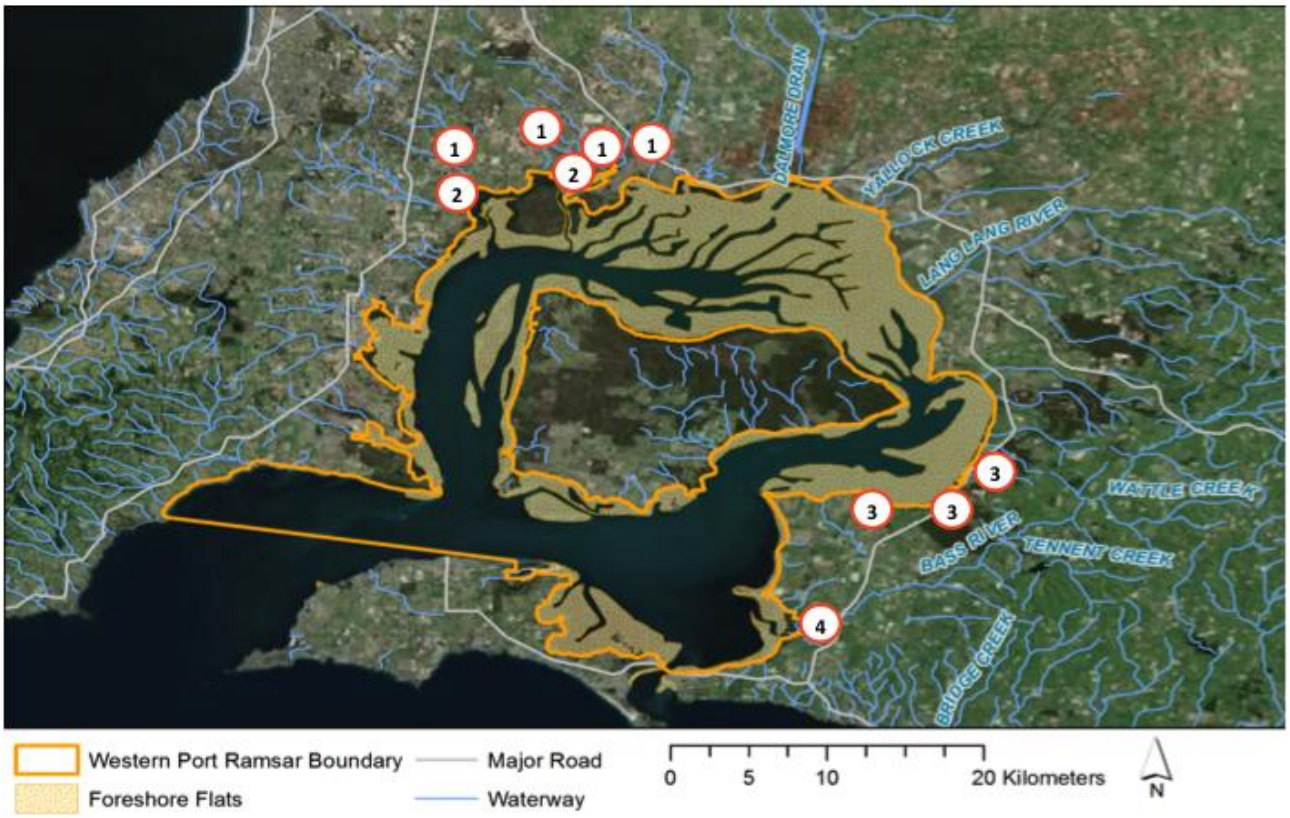
Recreation



Recreation

1. Motor bike riding in wetlands
2. Hunting and illegal release of target animals
3. Intensive boating activity (including popular boat ramps)
4. Fishing (harvest and catch and release for large fish)
5. Dogs (with and without their owners)
6. Vehicle driving on saltmarsh (access via vacant private land)
7. Personal water craft (jet ski and hovercraft)

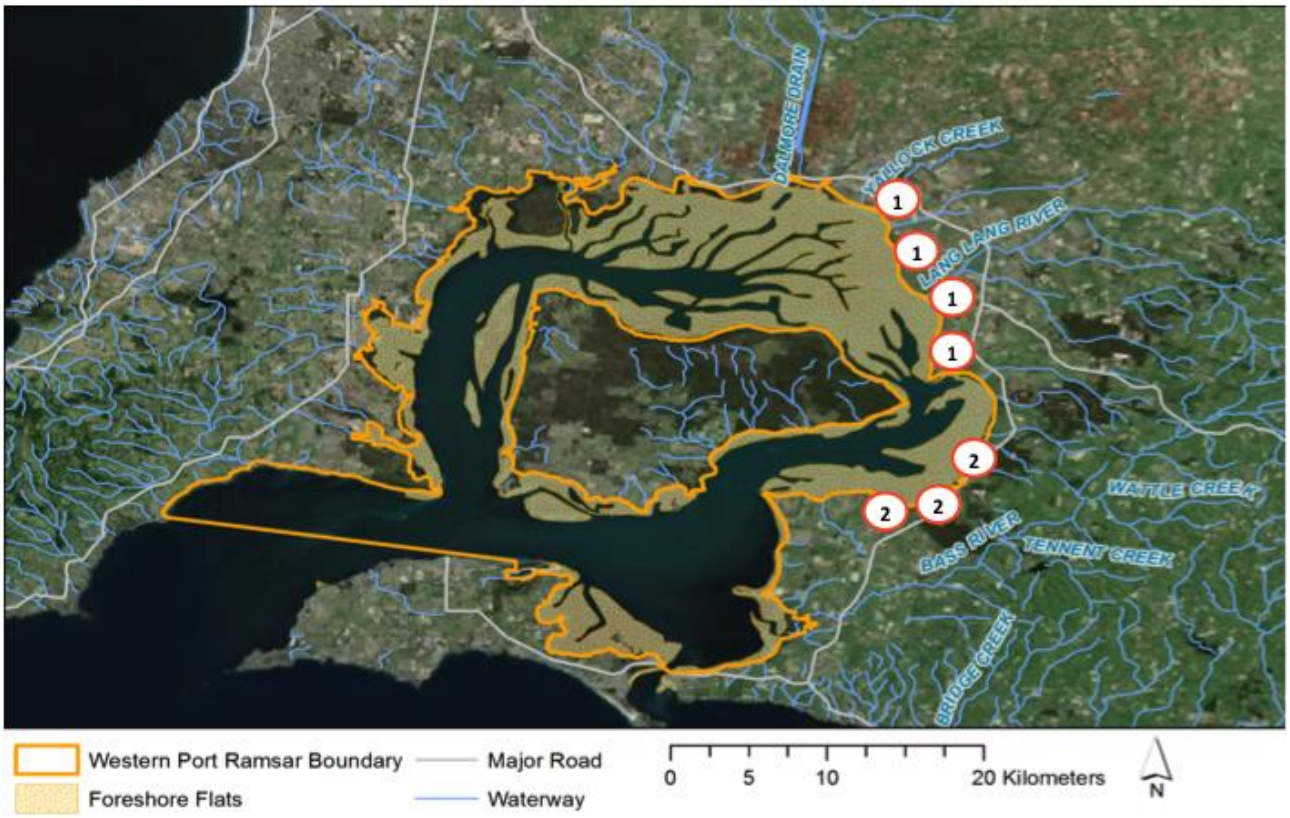
Urban stormwater and Agricultural Effluent



Stormwater and Agricultural Effluent

1. Stormwater runoff from new housing estates overloading inflowing creeks
2. Freshwater storm drain exits into saltmarsh
3. Localised erosion (often associated with residential infrastructure)
4. High sedimentation and nutrients from agricultural landuse in Bass and Lang Lang River catchments
5. Urban growth and associated stormwater inputs impacting catchments
6. Effluent from intensive agriculture (market gardens)

Climate Change



Increased frequency of storms

1. Eroding coastline – loss of "blue carbon" stores. Up to 1m retreat of coastline per year. Storm surge dominant erosive force.
2. Localised erosion from storm surge

Sea level rise

All intertidal zones

Appendix E: Review of 2003 management plan objectives and strategies

A review of the 93 management strategies within the 2003 Western Port Ramsar Site was conducted and is summarised here. The shading in the tables below indicates the current status:

- Blue-green – current or past actions have addressed the management action (in full or part, noting that this does not necessarily mean that the action is no longer required as most require ongoing activity).
- Red – the management action remains a priority, but no evidence of previous actions to address the issue could be found. Cross-references to relevant management strategies from this 2016 plan are provided.
- Unshaded – not related to priority values and threats identified in 2015.

Lead agency key:

CCB	Central Coastal Board
Councils	Mornington Peninsula Shire Council, Shire of Bass Coast, Shire of Cardinia and City of Casey.
DPI	Department of Primary Industries
DSE	Department of Sustainability and Environment (now DELWP)
ECC	Environment Conservation Council
EPA	Environment Protection Authority
MBV	Marine Board of Victoria
MSA	Marine Safety Authority
MW	Melbourne Water
PINP	Phillip Island Nature Park
PPWCMA	Port Phillip and Westernport Catchment Management Authority
PV	Parks Victoria
VCA	Victorian Channels Authority
VCC	Victorian Coastal Council

Management Objective 1: Increase the scientific understanding of wetland ecosystems and their management requirements

	Site Management Strategy	Lead agency	Priority	Example actions / programs implemented
1.1	Prioritise and coordinate environmental research by accredited research and education organisations (including community groups) in Western Port and encourage research in areas of direct relevance to management issues.	EPA, MW, DSE, PV, PINP	Higher	Melbourne Water: Understanding the Western Port Environment: a summary of current knowledge and priorities for future research (Melbourne Water Corporation 2011). PV: Research Partners Panel Projects
1.2	Investigate the causes of accelerated coastal erosion and the effect of water movement on habitat throughout the Ramsar site.	DSE, CCB, PV, PINP	Medium	Melbourne Water: Quantification of coastal erosion rates in Western Port (Tomkins et al. 2014)

Management Objective 2: Maintain or seek to restore appropriate water regimes

	Site Management Strategy	Lead agency	Priority	Example actions / programs implemented
2.1	Ensure future coastal development has minimal impact on coastal hydrodynamic characteristics and associated features and habitats.	DSE, Councils, VCC	Higher	
2.2	Support strategies in the Draft SEPP (Waters of Victoria) and draft Catchment Action Program relating to runoff generation and river flows.	PPWCMA, MW, EPA	Medium	MW: Healthy Waterways EPA and MW: Better Bays and Waterways PPWCMA: Regional catchment strategy, Ramsar Protection Program

Management Objective 3: Address adverse processes and activities

	Site Management Strategy	Lead agency	Priority	Example actions / programs implemented
3.1	Support strategies and initiatives in the Draft SEPP (Waters of Victoria) and Draft Catchment Action Program to reduce nutrient and sediment loads entering Western	PPWCMA, EPA, MW,	Higher	MW: Healthy Waterways EPA and MW: Better Bays and

	Port along watercourses, including the development of a 'Special Area Plan' for the East Arm segment of Western Port under the Catchment and Land Protection Act 1994.	CCB, DPI, DSE, Councils		Waterways PPWCMA: Regional catchment strategy, Ramsar Protection Program
3.2	Investigate the feasibility of and parameters for creating retention wetlands for improving water quality at the downstream end of priority streams entering Western Port.	MW, EPA	Higher	Current management strategy 1.4
3.3	Minimise dredging within Western Port, and ensure that the provisions of the EPA's 'Guidelines for Dredging: Best Practice Environmental Management Publication' are strictly adhered to.	DSE, PV, VCA, Toll Western Port, EPA, Councils	Higher	Patrick Ports Hastings Safety and Environment Management Plan (SEMP) for Port of Hastings (2012).
3.4	Ensure proponents are made aware that development proposals that may impact on Ramsar values should be referred to Environment Australia or an approved State authority as directed by the EPBC Act 1999.	DSE, PPWCMA, CCB	Higher	Current management strategy 6.2
3.5	Take all precautions to avoid accidental and deliberate oil and other chemical spills into Western Port.	EPA, MBV, Toll Western Port, PV	Higher	Port of Hastings SEMP; participation in the Sea Dragon National Oil Pollution exercise (May 2012).
3.6	Ensure awareness, commitment and resources to the 'Western Port Regional Marine Pollution Contingency Plan'	DSE, PV, MSA	Higher	
3.7	Take all precautions to prevent the introduction and spread of aquatic pest plants, animals and diseases, including the implementation of the 'Victorian Ballast Water Management Policy' and the 'Code of Practice' relating to the discharge of ballast water.	DSE, VCA, MBV, EPA, Toll Western Port	Higher	Patrick Ports Hastings Safety and Environment Management Plan – active Ballast Water Management with all ballast exchange for commercial ships occurring at sea.
3.8	Develop contingency plans for dealing with threatening infestations and establish a marine pest monitoring and reporting program for Western Port.	DSE, EPA	Higher	Current management strategy 3.14
3.9	Ensure future port development is subject to an appropriate level of environmental impact assessment and that measures to mitigate impacts of approved developments are put in place and monitored.	DSE, PV	Higher	
3.10	Investigate options for controlling boating activities in or adjoining sensitive habitats.	DSE, PV, MBV	Higher	Current management strategy 5.2

3.11	Educate the general public of the risks to Ramsar bird species associated with disturbance (e.g. walking, horse riding, and exercising dogs).	DSE, PV, Councils	Higher	Current management strategy 5.2
3.12	Restrict access where grazing and/or inappropriate access are damaging coastal vegetation and habitat or, if necessary, work with landholders to ensure coastal values are protected.	DSE, PV	Higher	Ramsar Protection Program
3.13	Monitor the extent of Spartina Grass invasion within and adjacent to the Western Port Ramsar Site and continue to implement plans to reduce the extent of invasions	DSE, PV, MW	Higher	Ramsar Protection Program, Melbourne Water and Parks Victoria all involved in Spartina control and associated monitoring.
3.14	Identify causes of mangrove and seagrass dieback, and take appropriate remedial action.	DSE, PV, EPA	Higher	Melbourne Water: Western Port Environmental Research Program Western Port Seagrass Partnership Mangrove planting program.
3.15	Constantly monitor to ensure that foxes do not become established on French Island and develop a clear contingency plan in the event that the fox is found on the island.	PV, DSE	Higher	Ramsar Protection Program
3.16	Participate in appropriate consents for use and development on adjacent land under the Planning and Environment Act 1987 and during the Environmental Effects Statement process (Environmental Effects Act 1978).	PV, DSE	Higher	Addressed as part of core business for DELWP.
3.17	Develop and implement plans to eradicate or limit the spread of priority pest plants in coastal areas.	DSE, PV, Councils	Higher	Ramsar Protection Program
3.18	Maintain current or higher levels of fox and rabbit control around Western Port in cooperation with private landowners.	DPI, PV	Higher	Ramsar Protection Program
3.19	Monitor and address the effects of foxes, cats and dogs on shorebird roosts.	DSE, PV	Medium	Ramsar Protection Program
3.20	Develop an interpretation program to educate the public and tourism operators on wetland values and risks	PV, DSE, Councils	Medium	Current management strategies 5.1, 5.2, 5.3 and 5.4
3.21	Undertake an inventory to establish key areas and prescribe priority actions to address coastal erosion within the Ramsar site.	CCB, DSE	Medium	Current management strategy 2.1
3.22	Investigate the extent to which low flying aircraft adversely affect important bird habitats and develop with the Civil Aviation Authority strategies for reducing any identified impacts.	DSE, PV, PINP	Lower	

Management Objective 4: Manage within an integrated catchment management framework

	Site Management Strategy	Lead agency	Priority	Example actions / programs implemented
4.1	Establish a coordination mechanism for the management of the Western Port Ramsar Site, involving all appropriate state land and water management agencies and local Councils and including integration with the Port Phillip and Western Port Regional Catchment Strategy, the Western Port SEPP and the Victorian Coastal Strategy.	DSE, All public land and water managers	Higher	Current management strategy – formation of a Ramsar Coordinating Committee
4.2	Implement the Western Port Catchment Action Program.	DSE, All public land and water managers	Higher	PPWCMA in association with multiple agencies including EPA, Melbourne Water, Parks Victoria, DELWP, and Councils among others.
4.3	Ensure coastal erosion in the northeastern arm of Western Port is recognised as a priority for action in the review of the Port Phillip and Westernport Regional Catchment Strategy	PPW, CMA	Higher	Port Phillip and Westernport Regional Catchment Strategy

Management Objective 5: Manage resource utilisation on a sustainable basis

	Site Management Strategy	Lead agency	Priority	Example actions / programs implemented
5.1	Participate in appropriate consents for use of adjacent land including, mineral extraction, intensive animal husbandry, and forestry under the Planning and Environment Act 1987 and during the Environmental Effects Statement process (Environmental Effects Act 1978).	PV, DSE	Higher	Addressed as part of core business for DELWP.
5.2	Monitor the recreational fish catch as a basis for determining revision of bag limits for recreational fishers.	DPI	Higher	Current management strategy 4.5
5.3	Develop a Fisheries Management Plan for Western Port that provides a sustainable basis for the Western Port commercial fishery.	DPI	Higher	Commercial fishing ban in place.
5.4	Continue to consolidate commercial fishing licences in Western Port consistent with Western Port and Inlets review of commercial fishing.	DPI	Higher	Commercial fishing ban in place.
5.5	Implement the environmental assessment and management recommendations of the Regional Sand Extraction Strategy – Lang Lang to Grantville.	DSE, Councils	Higher	

5.6	Ensure Management Plans are developed to protect the Marine National Parks established within the Ramsar site.	PV	Higher	Yaringa Marine National Park, French Island Marine National Park and Churchill Island Marine National Park management plan (Parks Victoria 2007)
5.7	Ensure that future aquaculture developments in and near the Ramsar site only occur if they do not impact on Ramsar site values and also meet all state legislative and administrative requirements.	DPI, PV	Higher	
5.8	Ensure that no further clearing of native coastal vegetation occurs in or adjacent to the Ramsar site for agriculture or urban development.	Councils	Higher	Current management strategies 3.4, 3.5 and 3.6
5.9	Implement actions related to fishing in the French Island National Park Management Plan and Phillip Island Nature Park Management Plan	PV, PINP	Medium	

Management Objective 6: Protect, and where appropriate enhance, ecosystem processes, habitats and species

	Site Management Strategy	Lead agency	Priority	Example actions / programs implemented
6.1	Protect and monitor existing saltmarsh and mangrove habitats and, where practicable, rehabilitate areas subject to degradation.	DSE, PV	Higher	Ramsar Protection Program
6.2	Protect important habitats for internationally important migratory waders, particularly FFG, JAMBA/CAMBA and Bonn listed species, including protecting all intertidal and saltmarsh feeding habitats from alteration, and ensuring important high tide roosting sites are not regularly disturbed by people.	DSE, PV, Councils	Higher	Current management strategies 2.1, 3.1, 3.2, 3.3, 3.5, 3.6, 3.7, 3.14 and 5.2
6.3	Ensure that the recommendations in the French Island National Park Management Plan and the Phillip Island Nature Park Management Plan relating to wetland dependent species are implemented.	PV, PINP	Higher	
6.4	Ensure implementation of the provisions of Action Statements under the Flora and Fauna Guarantee Act 1988 for all listed species.	DSE, PV, PINP	Higher	

Management Objective 7: Encourage strong partnerships between relevant agencies

	Site Management Strategy	Lead agency	Priority	Example actions / programs implemented
7.1	Encourage and support the involvement of community groups and landholders in	All land and	Higher	Ramsar Protection Program

	environmental research and management in Western Port.	Water management agencies		
7.2	Develop a consistent approach to the application of planning schemes within and around the Western Port Ramsar Site.	DSE, Councils	Higher	Current management strategies 3.5 and 3.6
7.3	Develop a coordinated coastal planning framework for Western Port under the Coastal Management Act 1995 that ensures wise use of the Western Port coast, consistent with the protection of the site's Ramsar values.	CCB	Higher	Central Regional Coastal Plan (Central Coastal Board 2015)
7.4	Promote a co-ordinated approach to environmental research and management planning and implementation between land and water management agencies in Western Port.	PPWCMA, CCB, EPA, MW, DSE, PV, Councils	Higher	Melbourne Water: Understanding the Western Port Environment: a summary of current knowledge and priorities for future research (Melbourne Water Corporation 2011). PV: Research Partners Panel Projects
7.5	Support non-agency and local government Committees of Management to protect and enhance Ramsar values.	PV, DSE, Councils	Medium	Ramsar Protection Program
7.6	Maintain ongoing liaison with the Biosphere Advisory Committee to ensure Western Port's Ramsar values are considered in planning and implementing the biosphere program.	DSE, PV, PINP, Councils	Medium	

Management Objective 8: Promote community awareness and understanding and provide opportunities for involvement in management

	Site Management Strategy	Lead agency	Priority	Example actions / programs implemented
8.1	Develop and implement a Ramsar Western Port wetland information and interpretation program.	DSE, PV, Councils	Higher	Current management strategies 5.1, 5.2, 5.3 and 5.4
8.2	Enable local interest groups to participate in the management of the Ramsar site.	CCB, PV, DSE	Higher	Ramsar Protection Program
8.3	Encourage involvement of local Aboriginal people in all facets of Ramsar site management, consistent with the commitment of the Indigenous Partnership Strategy to recognise the fundamental role Aboriginal indigenous communities have in natural resource management.	PV, DSE	Higher	PPWCMA: Indigenous Wetland Wardens Program
8.4	Consult with local Aboriginal people to ensure that other site management strategies	PV, DSE	Higher	Ongoing discussions with Traditional

	in this plan do not adversely impact on Aboriginal cultural heritage values.			Owners about Ramsar site management (via the PPWCMA)
8.5	Encourage community groups, local schools and educational institutions to visit the Ramsar wetlands, and become involved in monitoring and rehabilitation.	PV, DSE, Councils	Medium	

Management Objective 9: Ensure recreational use is consistent with the protection of natural and cultural values

	Site Management Strategy	Lead agency	Priority	Example actions / programs implemented
9.1	Educate local communities and visitors about the risks that recreational activities pose to Ramsar values, particularly to coastal vegetation and waterbird populations.	PV, DSE	Higher	Current management strategies 5.1 and 5.2
9.2	Monitor the effect of fishing and bait collection on shorebird feeding patterns and roosting habitats.	DSE, PV	Higher	Current management strategies 4.5 and 5.2
9.3	Support local ecotourism initiatives that are compatible with the maintenance of Ramsar values.	DSE, PV, Councils	Medium	
9.4	Implement an ecotourism accreditation scheme to ensure tour operators adopt clear strategies and procedures to reduce disturbance of the natural environment.	Tourism Victoria, PV	Medium	
9.5	Prohibit the approach of boats within 150 metres of the mean high water mark on Barralliar and Rams islands, except in an emergency or for authorized research or management. Discourage landings at Tortoise Head, Pelican Island, Observation Point and similar sites and encourage landings at Tankerton outside of the French Islands National Park	PV	Medium	Current management strategy 5.2

Management Objective 10: Develop ongoing consistent programs to monitor ecological character

	Site Management Strategy	Lead agency	Priority	Example actions / programs implemented
10.1	Closely monitor the status and management requirements of the critically endangered Orange-bellied Parrot.	DSE, PV	Higher	BirdLife Australia OBP program, not specific to Western Port Ramsar Site, but includes the site in the monitoring and recovery plan.
10.2	Support continued monitoring by community groups of the status of water birds in	DSE, PV,	Higher	BirdLife Australia, Friends of French

	line with the Ramsar site environmental monitoring program.	PINP		Island undertake waterbird monitoring
10.3	Establish a regular seagrass monitoring program for Western Port as a basis for determining the effectiveness of water quality management and as an indicator of environmental quality.	DSE, PV	Higher	
10.4	Continue monitoring the status of Spartina infestations in Western Port as a basis for control works.	DSE, PV	Higher	Parks Victoria program, Ramsar Protection Program
10.5	Design and implement a soundly based environmental monitoring program for Western Port involving government, community and research organisations, incorporating key indicators, integrating existing programs and supporting new or expanded programs where necessary to monitor key degrading processes (see also subsequent recommendations).	EPA, MW, DSE, PV, PINP, PPWCMA, CCB, Councils	Higher	Current management strategies 1.3 and monitoring programs listed in this plan.
10.6	Support continued monitoring of the status of the Pied Oystercatcher breeding population on French Island	DSE, PV	Medium	Monitoring program for nesting birds in this plan.
10.7	Encourage the collection of more detailed data on shorebird roosting and feeding habits.	DSE, PV	Medium	Melbourne Water and DELWP: Western Port Welcomes Waterbird project (Hansen et al. 2011)
10.8	Prepare vegetation condition reports for the terrestrial parts of the Ramsar site.	DSE, PV	Lower	

Appendix F: Derivation of Resource Condition Targets

Value	Baseline description	Limit of Acceptable Change	Current condition	Resource Condition Targets
Seagrass	First measured by Shapiro (1975) at 250 km^2 of seagrass then but this area fell to 72 km^2 in 1983–84 and then increased to 93 km^2 in 1994, and to 130 km^2 1999–2000 (Blake and Ball 2001) and Melbourne water measured 150 km^2 in 2011 (Holland et al. 2013).	None set (but this is being reviewed and will be set this year).	Current expansion in the north east of the site; but no recovery in the Cornelia segment (Walker 2011). Condition of seagrass has not been measured, but some areas are known to be affected by macroalgae.	1. Maintain the diversity of habitats for the Ramsar site: • Seagrass > 15,000 hectares • Saltmarsh > 1,100 hectares • Mangroves > 1,700 hectares • Sand / mudflats > 27,000 hectares • Rocky reef
Fish	Diverse range of fish species associated with different habitats. Recreationally important species. Conservation significant species and groups: Pipefish and sea dragons.	None set (but this is being reviewed and will be set this year).	Commercial CPUE data (up to 2009) indicate an increase in the abundance of some target species in recent years (Jenkins 2011). Concern over elephant fish and recreational fishers targeting breeding aggregations in the Ramsar site.	2. Maintain the diversity and abundance of native fish. 3. Maintain connectivity between inland rivers and marine areas of Western Port for migratory fish species.
Waterbirds: abundance and diversity	115 waterbird species recorded (some pelagic seabirds and not regularly supported by the site). > 20,000 waterbirds recorded annually > 1% of the population recorded regularly for seven species (Hansen et al. 2011) pied oystercatcher (2.3%), eastern curlew (2.8%), red-necked stint (1.8%), curlew sandpiper (2.1%), fairy tern (1.6%), pacific gull (6.3%), silver gull (3.3%)	A drop in mean or maximum values of ≥ 20% over a five year period for the guilds identified in the ECD.	There has been an increase in the abundance of some species (Pied Oystercatcher and Red-necked Avocet); but a decline in other species (Cormorants, Grey-tailed Tattler, Eastern Curlew and Curlew Sandpiper). However, the decline in some shorebird species is related to conditions outside the site (Yellow Sea) (Hansen et al. 2011). There has also been a decline in the number of fish eating birds and in particular crested tern and fairy tern (Menkhorst et al. 2015).	4. Maintain abundance of waterbirds in each of the following guilds (calculated as a rolling five year average of maximum annual count): • Total waterbirds > 20,000 • Migratory waders > 12,000 • Australasian waders > 1,100 • Ducks > 1,300 • Fishers > 600 • Gulls > 1,300 • Large wading birds > 1,300 • Swans > 2,700
Waterbirds: Breeding	The site is significant for beach nesting birds, particularly French Island, due to a lack of foxes. Fairy tern and Caspian tern breed semi-regularly on Rams Island. Australian pied oyster catchers breed regularly in the sandy beaches (and even saltmarsh) of	None set (but this is being reviewed and will be set this year).	Hooded plover counts are mostly outside the Ramsar site boundary (indicating that the site is probably not important for this species). Site is important (particularly French Island) for nesting fairy tern and oyster catchers. Data on Fairy tern nests indicate highly variable numbers, and gaps of up to five years when terns do not nest (Lacey and O'Brien 2015).	5. Predator free significant beach-nesting sites.

Value	Baseline description	Limit of Acceptable Change	Current condition	Resource Condition Targets
	French Island.		Quantitative data for other beach nesting species is a knowledge gap.	
Waterbirds: Threatened species	Curlew sandpiper Eastern curlew Fairy tern Hooded plover Orange-bellied parrot	None set (but this is being reviewed and will be set this year).	The orange-bellied parrot has not been observed at the site in recent surveys (2011 to 2014); but this reflects a decline in all mainland Australian sites (http://www.swifft.net.au/cb_pages/orange-bellied_parrot.php), and is not likely to be related to changes in character at the site. Other species present, but a statistically significant decline in eastern curlew since 1998 (Hansen et al. 2011)	6. Maintain predator free roosting and feeding habitats for threatened waterbirds species (saltmarsh and intertidal mud and sandflats).
Saltmarsh	Approximately 1,000 hectares of saltmarsh, landward of mangroves.	LAC is set at 15% change, but benchmark figure in ECD is erroneous (> than all the saltmarsh in Victoria). Will be amended.	The most recent mapping indicates approximately 1,100 hectares of saltmarsh in the site, which has not changed substantially since European settlement (Boon et al. 2011).There have been some losses since listing, with expansion of mangroves into saltmarsh areas (Rogers et al. 2005b). Saltmarshes within Western Port are considered to be in good condition (Boon 2011).	See RCT 1 above for habitats
Intertidal sand and mudflats	Characteristic habitat in Western Port supporting a diversity of invertebrates and feeding grounds for waterbirds. One of the outstanding characteristics of the soft-sediment fauna of Western Port is the high diversity of ghost shrimps (includes rare (FFG listed) species: *Paraglypturus (Eucalliax) tooradin*, and *Michelea microphylla*, a local endemic known only from Crib Point). Annual macrofaunal production in Western Port was measured at	No loss of intertidal mudflat area (270 km^2). Possibly needs a LAC based on productivity?	Although there has been work on coastal erosion (Tomkins et al. 2014), there is no current information on the extent of intertidal mudflat area. The Understanding Western Port Report (Melbourne Water 2011) suggested repetition of the 1974 and 1994 surveys were required.	See RCT 1 above for habitats 7. Maintain the diversity and abundance of ghost shrimp. 8. Maintain productivity of Western Port to support adequate shorebird biomass and abundance.

Value	Baseline description	Limit of Acceptable Change	Current condition	Resource Condition Targets
	57.3 g/m2, in 1994 (Wilson et al. 2011).			
Intertidal reefs	Comprises a small area within the Ramsar site, but includes the intertidal and subtidal reefs at San Remo, which support a high diversity of one invertebrate group — opisthobranchs (sea-slugs and sea-hares) — and are listed as a threatened community under the *Flora and Fauna Guarantee Act*. Crawfish Rock, although small is considered especially diverse The rare FFG-listed hydroid *Ralpharia coccinea* is found at Crawfish Rock, and may be endemic to Western Port (Edmunds *et al.* 2010).	Not identified as a critical CPS, so no LAC.	Very little current information, with most data now decades old (Bathgate et al. 2011).	See RCT 1 above for habitats
Mangroves	A number of sources (Boon et al. 2011, Melbourne Water Corporation. 2011, Kirkman 2013) indicate that mangrove extent in 1975 was around 12 km^2 (1,200 hectares)	LAC is set at no more than 10% change – but the benchmark figures in the ECD are incorrect. Will be amended.	The most recent assessment of mangrove extent in Western Port indicates 17.0 km^2 (1,700 hectares). This is an increase since the time of listing of approximately 40%.	See RCT 1 above for habitats

Appendix G: Cross reference of management strategies with Resource Condition Targets, knowledge gaps and threats

Resource Condition Targets

1. Maintain the diversity of habitats for the Ramsar site:
    - Seagrass > 15,000 hectares
    - Saltmarsh > 1,100 hectares
    - Mangroves > 1,700 hectares
    - Sand / mudflats > 27,000 hectares
    - Rocky reef
2. Maintain the diversity and abundance of native fish.
3. Maintain connectivity between inland rivers and marine areas of Western Port for migratory fish species.
4. Maintain abundance of waterbirds in each of the following guilds (calculated as a rolling five year average of maximum annual count):
    - Total waterbirds > 20,000
    - Migratory waders > 12,000
    - Australasian waders > 1,100
    - Ducks > 1,300
    - Fishers > 600
    - Gulls > 1,300
    - Large wading birds > 1,300
    - Swans > 2,700
5. Provide predator free significant beach-nesting sites.
6. Maintain predator free roosting and feeding habitats for threatened waterbirds species (saltmarsh and intertidal mud and sandflats).
7. Maintain the abundance and diversity of ghost shrimp.
8. Maintain productivity of Western Port to support adequate shorebird biomass and abundance.

Threats

1. Invasive species: Cord-grass (*Spartina* spp.)
2. Invasive species: new and emerging salt-tolerant weeds
3. Invasive species: foxes and cats predating on shorebirds and beach nesting birds
4. Invasive species: introduced marine pests (current and potential new invasions)
5. Invasive species: pigs, goats, rabbits in intertidal areas
6. Climate change: sea level rise
7. Climate change: increased frequency and intensity of storms leading to shoreline erosion
8. Climate change: increased frequency and intensity of storms leading to increased sediments
9. Recreation: Vehicles in the intertidal zone
10. Recreation: Disturbance of shorebirds and beach nesting birds
11. Recreational fishing (including bait pumping)
12. Nutrients from rural and agricultural areas
13. Sediments from rural and agricultural areas
14. Toxicants from rural and agricultural areas
15. Nutrients from urban areas
16. Toxicants from urban areas
17. Urban, commercial and industrial development (direct habitat removal and associated impacts)

Knowledge gaps

1. Distribution, community composition, abundance and condition of benthic infauna communities
2. Status of phytoplankton in Western Port, including toxic species
3. Chemicals of emerging concern (oestrogens, pharmaceuticals) - concentrations and potential impacts
4. Impact of current and future recreational fishing on fish populations
5. Community value and understanding of the Western Port Ramsar Site.
6. Beach nesting bird breeding and recruitment success.
7. Impact from cattle incursions from unfenced properties (e.g. fencing and unlicensed grazing of saltmarsh).
8. Extent and location of illegal removal of saltmarsh and mangrove vegetation
9. Impact of climate change on fire regimes in saltmarsh and mangrove
10. New and emerging recreational activities and impacts on wetland values.
11. Opportunities for site protection investment potential through carbon capture and storage in Western Port habitats.

Management strategies

Management Strategies	Responsibility	Linkages to existing programs / activities	Relevant RCTs	Relevant knowledge gaps	Relevant threats	Priority locations	Theme
1.1 Reduce nutrient and sediment inflow: Support the implementation of riparian, in-stream and catchment works identified in the Healthy Waterways Strategy (Melbourne Water Corporation 2013); revised State Environment Protection Policy Waters of Victoria (when completed); and Port Phillip and Western Port Regional Catchment Strategy to improve water quality in storm water and river flows to Western Port.	Melbourne Water EPA Victoria DELWP CMA	Healthy Waterways Strategy PPWP Regional Catchment Strategy SEPP (WoV)	1, 2		8, 12, 13, 14, 15, 16	Lang Lang and Bass catchments	Managing water quality
1.2 Develop best practice guidelines for urban and rural run-off and an incentive scheme to facilitate uptake	Melbourne Water DELWP Local government	Urban Stormwater: Best Practice Environmental Management Guidelines.	1, 2		8, 12, 13, 14, 15, 16	Lang Lang and Bass catchments	Managing water quality
1.3 Develop appropriate approaches for pollutant reduction and seagrass improvement, and trigger values (objectives) for water quality indicators	EPA Victoria	Review of the SEPP (WoV)	1, 2		8, 12, 13, 14, 15, 16		Managing water quality
1.4 Investigate the feasibility of and parameters for creating retention wetlands for improving water quality at the downstream end of priority streams entering Western Port. Implement actions that arise from the investigation (create appropriate retention wetlands).	CMA DELWP Local government		1, 2		8, 12, 13, 14, 15, 16	Lang Lang and Bass catchments	Managing water quality
1.5 Investigate the sources, potential impact and mitigation strategies for toxicants entering Western Port through storm water drains and rivers	Melbourne Water EPA Victoria Local government	Western Port Scientific Investigations funded by Melbourne Water	1, 2	3	14, 16		Managing water quality
2.1 Implement the recommendations of the Western Port Local Coastal Hazard Assessment. Specifically the: • Development of a strategic approach to the management and future adaptation of the existing shoreline protection works; • Provision of adaptation space for the landward migration of wetland fringed shorelines	DELWP CMA Local government	Western Port Local Coastal Hazard Assessment	1, 4, 5, 6		6, 7		Living with climate change
2.2 Investigate the risk from and management strategies for increased frequency and intensity of fire in saltmarsh and mangrove communities	DELWP		1	9			Living with climate change
2.3 Investigate the risk associated with and potential mitigation strategies for climate change impacts to ecological character of the Ramsar site	DELWP CMA		All	9	6, 7, 8		Living with climate change
3.1 Develop and implement best practice guidelines for habitat restoration (seagrass, saltmarsh, mangroves).	DELWP NGOs	Seagrass partnership Western Port Biosphere	1		1, 2, 5, 9, 17		Protecting flora and fauna

Management Strategies	Responsibility	Linkages to existing programs / activities	Relevant RCTs	Relevant knowledge gaps	Relevant threats	Priority locations	Theme
3.2 Restore / maintain extent and condition of key habitats in Western Port to increase resilience to the impacts of threats.	DELWP CMA Parks Victoria Local Government NGOs	Seagrass partnership Western Port Biosphere Ramsar Protection Program	1		All		Protecting flora and fauna
3.3 Identify priority locations of habitat loss in the Ramsar site due to human activity including vehicle damage, stock grazing, illegal dumping, direct vegetation removal and implement appropriate enforcement of existing laws.	Parks Victoria Local government Landcare CMA	Ramsar Protection Program	1	7, 8	5, 9, 17		Protecting flora and fauna
3.4 Install and maintain fencing at priority locations to restrict recreational access to sensitive habitats in the foreshore and intertidal zone.	Parks Victoria Local government		1		9, 10, 11		Protecting flora and fauna
3.5 Develop guidelines for defining and managing buffer zones to guide assessment of local planning applications.	DELWP	DELWP Wetland Buffer Guidelines	1, 4, 5, 6		17		Protecting flora and fauna
3.6 Develop and implement a strategic approach to development in areas adjacent to the Ramsar site that consider the cumulative impact of multiple actions on ecological character.	Local government DELWP		1, 4, 5, 6		17		Protecting flora and fauna
3.7. Continue to implement pest animal control programs (cat, fox, rat, dog, pig) in priority roosting and nesting sites within the Ramsar site.	Parks Victoria CMA Local Government NGOs	Ramsar Protection Program	4, 5, 6		3, 5	Roosting and beach nesting sites	Protecting flora and fauna
3.8 Continue to implement rabbit control programs within the Ramsar site boundary to limit impacts on saltmarsh.	CMA Local Government NGOs	Ramsar Protection Program	1, 4, 5, 6		5		Protecting flora and fauna
3.9 Implement an incentive program for landholders to fence waterways, mangrove and saltmarsh areas to restrict stock access.	CMA DELWP Melbourne Water	Ramsar Protection Program	1	7	5		Protecting flora and fauna
3.10 Continue to implement Spartina control programs within the Ramsar site.	Parks Victoria CMA	Ramsar Protection Program	1		1	Bass River Delta	Protecting flora and fauna
3.11 Conduct regular surveys and implement control actions for new and emerging salt tolerant weeds.	Parks Victoria DELWP Local government	Ramsar Protection Program	1		2	Beach bird nesting sites Saltmarsh in French Island, Quail Island and northern Western Port coastline	Protecting flora and fauna
3.12 Gazette of Quail Island as a Nature Conservation Reserve.	DELWP Parks Victoria		1, 4		5	Quail Island	Protecting flora and fauna

Management Strategies	Responsibility	Linkages to existing programs / activities	Relevant RCTs	Relevant knowledge gaps	Relevant threats	Priority locations	Theme
3.13 Support activities under the Port Phillip and Western Port Invasive Plant and Animal Strategy (PPWCMA 2011).	DELWP Parks Victoria	Ramsar Protection Program	1, 4, 5, 6		1, 2, 3, 4, 5		Protecting flora and fauna
3.14 Develop and implement a marine pest strategy for Western Port.	DELWP Parks Victoria		1, 2, 7		4		Protecting flora and fauna
4.1 Investigate the relationships between reduced water quality and shorebird food availability	DELWP EPA Victoria	EPA Marine Fixed Sites Network (FSN) water quality monitoring program	8		12, 13, 14, 15, 16		Improving our knowledge
4.2 Investigate the population dynamics and behaviour of the fairy tern colony	Parks Victoria DELWP		5	6	3, 10		Improving our knowledge
4.3 Assess the community composition, extent and condition of benthic invertebrates in soft sediments	Parks Victoria DELWP	Parks Victoria habitat mapping and marine park monitoring	7, 8	1			Improving our knowledge
4.4 Community composition, spatial and temporal variability and presence of potentially toxic species of phytoplankton in Western Port	DELWP		1, 8	2	12, 15		Improving our knowledge
4.5 Investigate the extent and potential impact of recreational fishing in Western Port. Use recreational fish monitoring data to inform the development of numerical RCTs and LAC for fish.	DEDJTR		2	4	11		Improving our knowledge
5.1 Education and engagement of landholders and community members and incentive programs for streamside/shoreline/coastline fencing.	CMA DELWP Melbourne Water Parks Victoria	Ramsar Protection Program	1	5	5		CEPA
5.2 Implement a public awareness campaign for recreational boat users and personal watercraft (e.g. jet skis) to minimise the potential impacts to shorebirds and beach nesting birds.	DELWP Parks Victoria		4, 5, 6	5	10	Roosting and beach nesting sites	CEPA
5.3 Implement a community awareness campaign and reporting hotline for introduced marine pests targeting divers and recreational fishers.	DELWP	Parks Victorian Marine Invasive Species Guide	1, 2, 7, 8	5	4		CEPA
5.4 Communicate the outcomes of the three yearly Ramsar Rolling Review to the broader community through a fact sheet / report card.	DELWP EPA Victoria Parks Victoria	Ramsar Rolling Review	All	5	All		CEPA
5.5 Maintain the Western Port Ramsar Site webpage (DELWP) and the process for stakeholder involvement via updates and links.	DELWP		All	5	All		CEPA

Management Strategies	Responsibility	Linkages to existing programs / activities	Relevant RCTs	Relevant knowledge gaps	Relevant threats	Priority locations	Theme
6.1 Review the Ramsar site boundary.	DELWP DoE Ramsar Coordinating Committee						Governance
6.2 Apply the appropriate State and Commonwealth environmental impact assessment processes for activities that have the potential to impact on the Ramsar site and Matters of National Environmental Significance (MNES).	DELWP DoE Ramsar Steering Committee						Governance
6.3 Undertake a regular review of the status of the ecological character of the Ramsar site. This review should include new and emerging issues as well as the current listed values and threats.	DELWP	Ramsar Rolling Review					Governance
6.4 Develop action plans for this strategy.	Ramsar Coordinating Committee						Governance
6.5 Investigate the potential of blue carbon offsets for raising resources to implement Ramsar site management and monitoring.	Ramsar Coordinating Committee						Governance

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