# Gippsland Lakes **Ramsar Site Management Plan 2024**

Maintain and improve the ecological character of the Gippsland Lakes Ramsar Site and promote wise use.

EAST GIPPSLAND CATCHMENT MANAGEMENT AUTHORITY

West Gippsland Catchment Management Authority

VICTORIA State Government

## Acknowledgement of Country

We acknowledge the Gunaikurnai people, Traditional Owners and Custodians of the land and waters of the Gippsland Lakes region, and pay our respects to their Elders past and present.

## Published by:

East Gippsland Catchment Management Authority
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Ramsar Convention on Wetlands

# Foreword

**The Gippsland Lakes are one of Victoria's most important natural assets. The health of the Lakes is critical to the sustainability of the Gippsland region.**

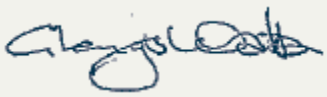
The Gippsland Lakes are internationally recognised, listed under the Ramsar convention for their very significant environmental values. Protecting the social, economic, environmental and cultural values of the sites underpins the benefits of the Lakes, that so many Victorians enjoy.

Managing such a large and complex system requires a strategic approach to direct government and community resources. This plan provides the framework to maintain and improve the environmental values of the Gippsland Lakes, in order to maintain the ecological character of the Ramsar site, as required under the Ramsar Convention on Wetlands.

The Gippsland Lakes Ramsar Site is a priority for investment in the *East and West Gippsland Waterway Strategies*. The Gippsland Lakes Ramsar Site Management Plan (the Plan) complements these strategies by providing further detailed management direction for waterways within the Ramsar site. The Plan provides clear direction for future investment to maintain and improve the health of the Gippsland Lakes Ramsar Site.

Through the process of developing the Plan, both, East and West Gippsland Catchment Management Authority's, other agencies, Traditional Owners and the community, demonstrated their willingness to work together to set the management direction for the Ramsar site. This provides a strong foundation for continuing to work together to implement the plan and achieve outcomes over the next eight years.

We encourage you to read the Plan and get involved in local activities protecting the ecological character of the Gippsland Lakes Ramsar Site.



**Glenys Watts**
Chair
Gippsland Lakes Coordinating Committee

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# Acronyms

| | |
|---|---|
| **DCCEEW** | Department of Climate Change, Energy, the Environment and Water |
| **DEDJTR** | Department of Economic Development, Jobs, Transport and Resources |
| **DEECA** | Department of Energy, Environment and Climate Action, formerly Department of Environment, Land, Water and Planning |
| **EGCMA** | East Gippsland Catchment Management Authority |
| **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 |
| **GLaWAC** | Gunaikurnai Land and Waters Aboriginal Corporation |
| **GLEF** | Gippsland Lakes Environment Fund |
| **GLES** | *Gippsland Lakes Environmental Strategy* |
| **GLCC** | Gippsland Lakes Coordinating Committee |
| **GLRSCC** | Gippsland Lakes Ramsar Site Coordinating Committee |
| **GP** | Gippsland Ports Committee of Management Incorporated |
| **LAC** | Limits of Acceptable Change |
| **MID** | Macalister Irrigation District |
| **MERI** | Monitoring, evaluation, reporting and improvement |
| **PV** | Parks Victoria |
| **PSG** | Project Steering Group |
| **RIS** | Ramsar Information Sheet |
| **RCT** | Resource Condition Target |
| **TWG** | Technical Working Group |
| **TOLMB** | Traditional Owner Land Management Board |
| **VWMS** | *Victorian Waterway Management Strategy* |
| **WGCMA** | West Gippsland Catchment Management Authority |
| **WET Trust** | Wetland Environmental Taskforce Trust |

# 01 Introduction

The *Gippsland Lakes Ramsar Site Management Plan* established the framework for the maintenance of ecological character through conservation and wise use. The original plan was released in 2015 and since this time there has been significant progress in both our understanding of the ecological character of the Gippsland Lakes 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 Gippsland Lakes Ramsar Site Management Plan (**this document**), including a full description of the plan's development and technical appendices, and

2 A Gippsland Lakes Ramsar Site Strategic 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. This management plan for the Gippsland Lakes Ramsar Site supplements and complements the East and West Gippsland Catchment Management Authority Waterway Strategies.

## 1.1 Purpose of the management plan

### 1.1.1 Ecological character

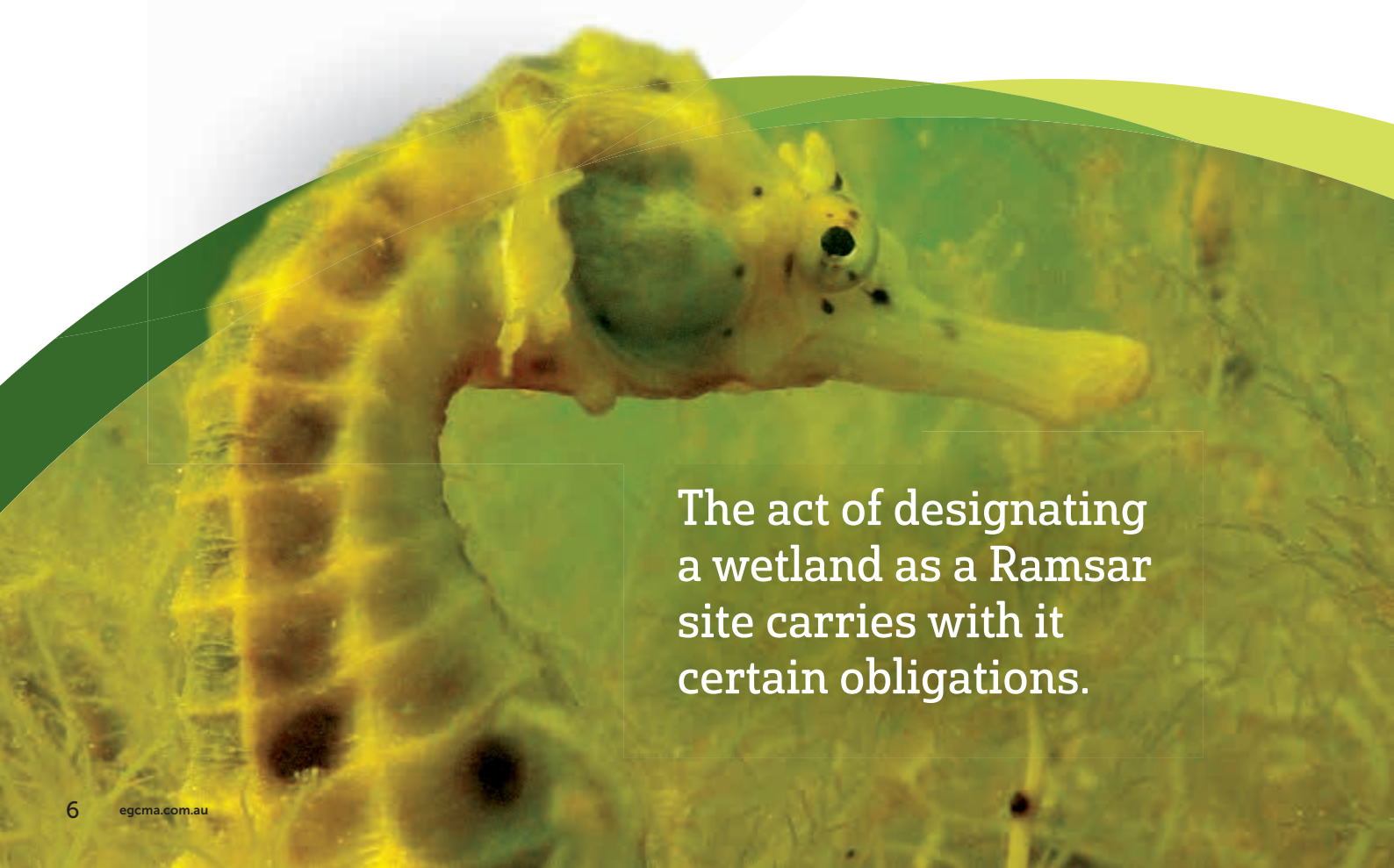
The "Ramsar Convention on Wetlands of International Importance, especially as waterfowl habitat" (hereafter referred to as the Ramsar Convention or Convention) was ratified in Ramsar, Iran in 1971. As of June 2024, there are 172 Contracting Parties, including Australia. Under the terms of the Convention 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."***

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.



The act of designating a wetland as a Ramsar site carries with it certain obligations.

## Ramsar: A network of sites

**There is a network of over 2500 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 and may remain in Australia over the southern winter period.

The Gippsland Lakes Ramsar Site supports 20 species that are international migrants and listed under migratory agreements with China, Japan and the Republic of South Korea. Important habitats within the site include intertidal mudflats and saltmarsh such as those at Lake Reeve, 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 recreational fishing (in some instances), four-wheel driving on beaches or in saltmarsh and intertidal areas, unleashed dogs; 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.

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 worldwide, a RIS 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 Climate Change, Energy, the Environment and Water (DCCEEW). 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 the Gippsland Lakes was compiled in 1999 and can be obtained from the DCCEEW website (https://www.environment.gov.au/cgi-bin/wetlands/ramsardetails.pl?refcode=21).

**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 the Gippsland Lakes 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 the Gippsland Lakes was completed in 2011 and can be accessed from the DCCEEW website (https://www.environment.gov.au/cgi-bin/wetlands/ramsardetails.pl?refcode=21). In 2023 an update to the ECD was produced that accounts for increased knowledge and understanding of the site, and accounts for changes to International and National threatened species lists. The current ECD Addendum can be found here https://www.water.vic.gov.au/waterways/wetlands/significant-wetlands.

**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 the EPBC Regulations outlines the principles relevant to the preparation of Ramsar site management plans (Text Box 1).

Ramsar site management plans must adhere to these principles. Of note is that the primary purpose of the management plan must be in accordance with the Ramsar Convention:

- to describe and maintain the ecological character of the wetland; and
- to formulate and implement planning that promotes:
  - conservation of the wetland; and
  - 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.

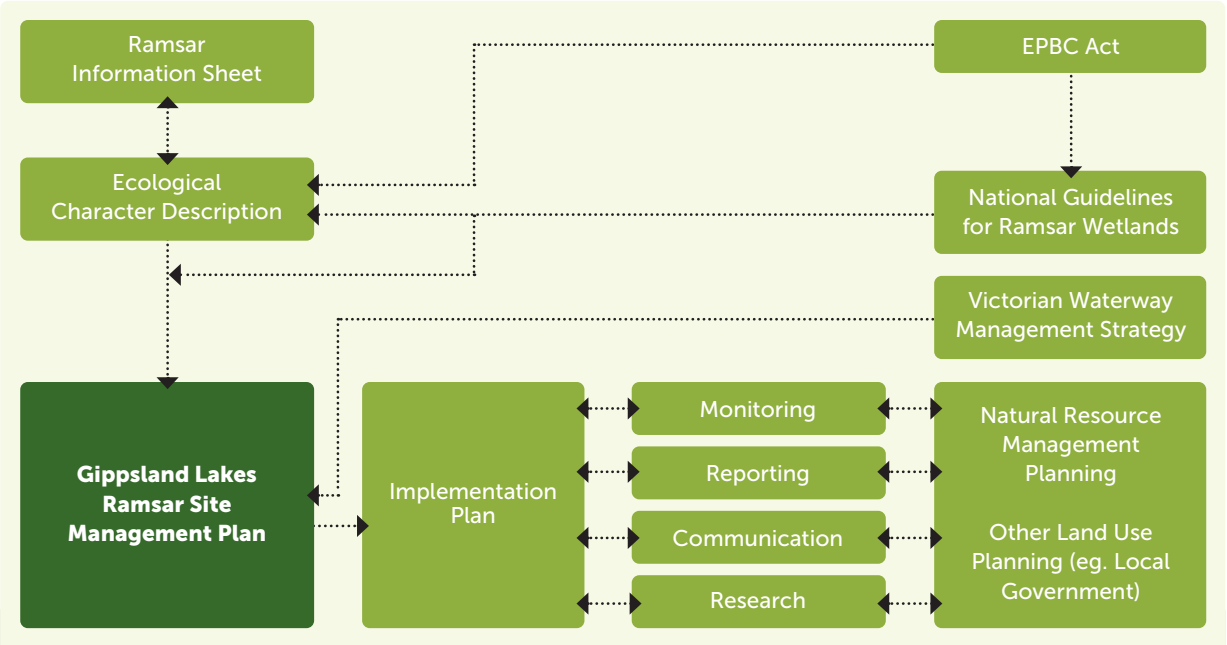



**Figure 1** The Gippsland Lakes Ramsar Site Management Plan in context of other requirements for the management of Ramsar sites (adapted from Department of Environment, Water, Heritage and the Arts 2008).

## Australian Ramsar Management Principles

**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;
- (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.

### 1.1.2 Objectives of the management plan

The primary purpose of the Gippsland Lakes 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 Gippsland Lakes Ramsar Site supports a number of socio-economic and cultural values that result from maintaining the condition of the Ramsar site (GLMAC 2013). 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 Gippsland Lakes Ramsar Site Management Plan is:

***"To maintain, and where necessary improve, the ecological character of the Gippsland Lakes Ramsar Site and promote wise use"***.

## 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 Gippsland Lakes 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;

Wetlands of International Importance are selected on the basis of their international significance in terms of ecology, botany, zoology, limnology and/or hydrology.

- *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.

### 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 (https://www.dcceew.gov.au/environment/epbc).

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, and as such, 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.

The Department of Climate Change, Energy, the Environment and Water is responsible for implementing the Ramsar Convention in Australia. Key activities include:

- Developing national guidance on implementing the Convention in Australia
- Providing funds to support the conservation and wise use of Ramsar sites
- Developing Ecological Character Descriptions for all Australian Ramsar sites, including the Gippsland Lakes
- Participating in the Partnership for the Conservation of Migratory Waterbirds in the East Asian – Australasian Flyway
- Participation in international treaties for the protection of migratory birds: Japan-Australia Migratory Bird Agreement, China-Australia Migratory Bird Agreement and the Republic of Korea-Australia Migratory Bird Agreement
- Regularly reviewing Ramsar site condition through the Ramsar Rolling Review
- Working with state and territory governments to promote the conservation Ramsar sites and wise use of all wetlands, and
- Coordinating and facilitating collaboration between the Convention's Oceania member countries.

**Native Title Act 1993**
This Act provides for the recognition and protection of native title. It establishes ways in which future dealing 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.

### 1.2.3 Victorian state policy and legislation

***Crown Land (Reserves) Act 1978***
This Act provides the framework for the administration and management of Crown land reserves including nature conservation reserves. The Act also deals with the making of regulations, committees of management and leasing and licensing.

***Environmental Effects Act 1978***
This Act requires the assessment of the potential significant environmental impacts of a proposed development through the preparation of an Environmental Effects Statement (EES).

***The Environment Protection Act 2017***
This Act establishes the Environment Protection Authority (EPA) and makes provision for the EPA's powers, duties and functions. It includes environmental obligations and protections for all Victorian and includes a general environmental duty (GED). The general environmental duty (GED) applies to all Victorians. Every Victorian has a responsibility to reduce the risk of harm to human health and

the environment from pollution and waste. It is important you know the risks and take reasonable steps to control them. By following the GED, it keeps our waterways healthy. The EPA is Victoria's environmental regulator and works to prevent and reduce the harmful effects of pollution and waste to Victorians and the environment. The GED falls under the Environment Protection Act 2017 and breaching the GED can lead to criminal or civil penalties.

***Fisheries Act 1995***
The 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***
The 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.

***National Parks Act 1975***
The 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.

***Water Act 1989***
The 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.

***Wildlife Act 1975***
The Act ensures procedures are in place to protect and conserve Victoria's wildlife and prevent any taxa of wildlife from becoming extinct. The Act also provides for the establishment of State Game Reserves. Regulations under the Act ensure that the consumptive use or other interactions with flora and fauna in Victoria does not threaten the sustainability of wild populations, while facilitating cultural and recreational pursuits in a humane, safe, ethical and sustainable manner.

***Catchment and Land Protection Act 1994 (CaLP Act)***
The 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***
The 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).

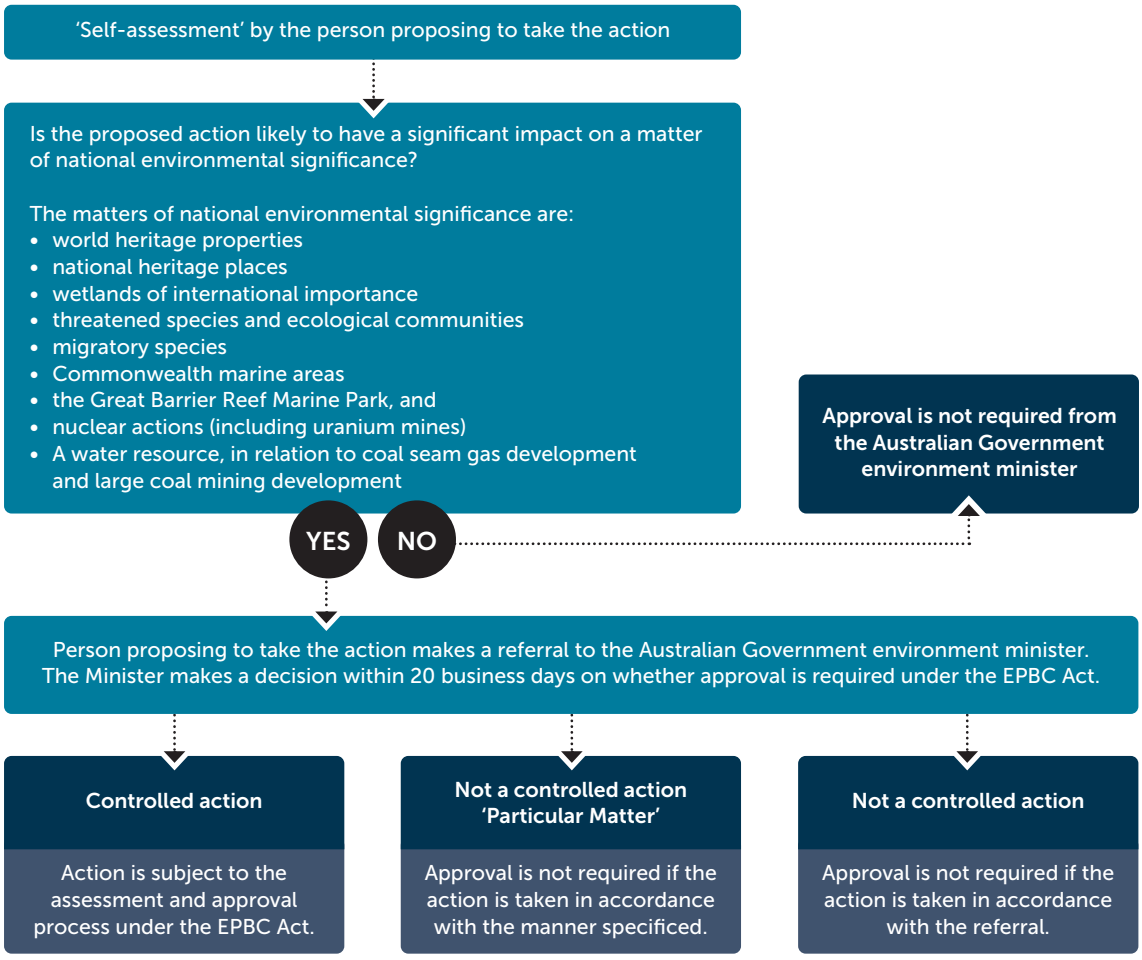
***Port Management Act 1995***
The Act to provides for the establishment, management and operation of commercial trading and local ports in Victoria and appointed Gippsland Ports as the manager for local ports in Gippsland. The Act requires (among other functions) for Gippsland Ports to develop and implement Safety and Environment Management Plans (SEMPs) for ports and waterways under its control, including the Port of Gippsland Lakes.

**Victorian Waterway Management Strategy**
The 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. The existing Victorian Waterway Management Strategy was released in 2013 and has reached the end of its lifespan. A new VWMS is currently in development and is due to be released in 2025.

## Assessing the impact of major projects on Ramsar sites

**Under the EPBC Act, a person must not take an action that has, will have or is likely to have a significant impact on any of the matters of environmental significance without approval from the Australian Government Minister for the Environment.**

In this context, an 'action' is a project, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things. The EPBC Act referral process comprises several steps:




Although the EPBC referral process begins with "self assessment" there are strict penalties for not referring an action. A person who takes an action that is likely to have a significant impact on a matter of national environmental significance, without first obtaining approval, can be liable for a civil penalty of up to $900,000 for an individual and $9 million for a body corporate, or for a criminal penalty of seven years imprisonment.

DEECA administers the statutory environmental impact assessment system for major projects in Victoria with potentially significant environmental effects. This includes referrals to the Minister for Planning for Environmental Effects Statements (EES) under the *Environment Effects Act 1978* as well as assessment and approvals for major transport projects under the *Major Transport Projects Facilitation Act 2009*. In addition, Victoria has a bilateral agreement with the Commonwealth for environmental impact assessments that avoids duplication of assessment processes. It essentially allows the Commonwealth to use the assessments made by Victoria to inform decisions about impacts to matters of national environmental significance (which includes Ramsar sites) under the EPBC Act.

This is a very simplified summary of the process, for more information see the following of the DEECA website: https://www.planning.vic.gov.au/environmental-assessments/environmental-assessment-guides/environment-effects-statements-in-victoria and the Australian Government Department of Climate Change, Energy, the Environment and Water https://www.dcceew.gov.au/environment/epbc/approvals

### 1.2.4 Regional plans and policy

**Regional Catchment Strategies (RCS)**
RCSs are statutory documents under the CaLP Act that provide the overarching framework for land, water and biodiversity management and conservation in each of the ten catchment management regions of Victoria. There are two catchment regions relevant to the Gippsland Lakes, each with their own RCS:
East Gippsland RCS
(https://eastgippsland.rcs.vic.gov.au/)
West Gippsland RCS
(https://westgippsland.rcs.vic.gov.au/).

The two RCSs are the primary planning documents for their respective regions. They identify priorities for natural resource management for water and biodiversity and provide a framework for integrated management of catchments.

**Regional Waterway Strategies (RWS)**
RWSs have been developed for each of the ten catchment management regions in Victoria. These sit under the VWMS and RCS frameworks and outline the detailed planning and management for rivers, estuaries and wetlands across the State. The East Gippsland Waterway Strategy (East Gippsland CMA 2014) and the West Gippsland Regional Waterway Strategy (West Gippsland CMA 2014) both identify the Gippsland Lakes as a priority waterway, within their regions. The Gippsland Lakes Ramsar Site Management Plan will complement and supplement the information on management of the site within these two RWS documents. The 2014 RWSs are being updated and will be released in 2026/2027.

**Central and Gippsland Sustainable Water Strategy**
The Central and Gippsland Sustainable Water Strategy outlines actions and sets policy direction for the long-term security of water supply to the region to protect; jobs, farms, ecosystems, communities and Traditional Owners that rely on them (DELWP, 2022). The Strategy's objectives are to: secure the regions urban water future and safe drinking supplies by using water wiser and more efficiently as well as increasing the use of manufactured water sources; return water to Traditional Owners across the region and strengthen Traditional Owners role in water resource planning and management; maintain and improve waterway health for environmental and healthy Country outcomes; build the resilience of agriculture to a drying and variable climate; provide for social and recreational uses and values of waterways.

**Latrobe Valley Regional Rehabilitation Strategy**
The Latrobe Valley Regional Rehabilitation Strategy (LVRRS) aims to provide guidance for climate resilient, transformation of the Latrobe Valley coal mines; to make the Hazelwood, Yallourn and Loy Yang mines and adjacent lands to be safe, stable and sustainable landforms. In 2023 the LVRRS was amended to reflect recent changes including:

- the introduction of a strengthened regulatory framework for mine rehabilitation
- the earlier planned closures of power stations at Yallourn and Loy Yang A
- commencement of an Environment Effects Statement for the proposed Hazelwood Mine Rehabilitation Project.

The amendment updates guidance on the type of conditions that could apply to water accessed for mine rehabilitation from the Latrobe River system, which ensures that water entitlements of existing water users and values in Gippsland are not diminished.

**Gippsland Lakes Priorities Plan (GLPP)**
The Gippsland Lakes Priorities Plan is an important document that guides decision making and provides a clear and transparent approach for making recommendations for funding for the Gippsland Lakes Coordinating Committee (GLCC). The GLCC submit the Priorities Plan to the Victorian Minister for Water for review and consent. The priorities are drawn from the endorsed environmental strategies and plans currently relevant to the Gippsland Lakes as follows:

- Gippsland Lakes Ramsar Site Management Plan (GLRSMP) (East Gippsland CMA 2015)
- East and West Gippsland Waterway Strategies (East Gippsland CMA 2014; West Gippsland CMA 2014)
- Parks Victoria/Traditional Owners Management Board Joint Management Plan (Gunaikurnai Traditional Owner Land Management Board 2018)
- Gunaikurnai Whole of County Plan (Gunaikurnai Land and Waters Aboriginal Corporation 2015)
- Biodiversity Response Planning for the Gippsland Lakes Landscape (DELWP 2021).

The key objectives of the plan are to:

- maintain or improve the health of the Gippsland Lakes now and for the future
- foster cooperation and coordination between agencies and organisations with an interest in the health of the Gippsland Lakes
- promote awareness of and participation by communities in the management of the Gippsland Lakes
- maximise outcomes for the Gippsland Lakes through leveraging investments
- empower Traditional Owners through joint management and self-determination, supporting capacity building and involvement in management of the Gippsland Lakes.

**Ramsar Site Coordination**
The EGCMA is the 'Ramsar Site Coordinator' for the Gippsland Lakes Ramsar Site and undertake the ongoing coordination and convening of the 'Gippsland Lakes Ramsar Site Coordinating Committee' (GLRSCC). The GLRSCC are responsible for overseeing and coordinating the on ground implementation of the Gippsland Lakes Ramsar Site Management Plan. The GLRSCC also ensure that Ramsar Roles and Responsibilities, as agreed by the Ramsar inter-agency

governance group, are implemented by the agencies involved at a site level. Membership includes all agencies and partners that have a responsibility for managing the site. The membership of the GLRSCC includes:

- East Gippsland Catchment Management Authority
- West Gippsland Catchment Management Authority
- Gunaikurnai Land and Waters Aboriginal Corporation
- Parks Victoria
- Department of Energy, Environment and Climate Action (DEECA)
- East Gippsland Water
- Gippsland Water
- East Gippsland Shire Council
- Wellington Shire Council
- Environment Protection Authority.

In 2015, the Victorian Government established a Gippsland Lakes Coordinating Committee (GLCC) to prioritise and oversee investment in community and agency projects that benefit the environmental health of the Gippsland Lakes. The GLCC is made up of five community representatives with skills in aquatic science, waterway management, cultural knowledge; and environmental science and conservation. It also includes five members who represent Victorian public-sector agencies with waterway management responsibilities. The Committee functions include: making evidence based recommendations to the Victorian Minister for Water on funding priorities, fostering collaboration between stakeholders, review of the Gippsland Lakes Priorities Plan, providing the latest knowledge and advice to the Minister on environmental issues concerning the Gippsland Lakes and reporting on outcomes to the Minister and the public.

## 1.3 Development of the plan

The Gippsland Lakes Ramsar Site Management Plan builds on the foundations of the 2015 plan. There have however, been several changes to Ramsar site management planning in Victoria over the past nine years. In line with recommendations from the Victorian Auditor General's Office (VAGO) and Public Accounts and Estimates Committee (PAEC), there is a need for site coordinators and managers to demonstrate that actions are focused on maintaining the ecological character of the Ramsar sites. For this reason, the 2024 update to the Ramsar Site Management Plan is narrower in scope than the 2015 plan and is concerned with components, processes and services identified in the ECD and ECD Addendum as being critical to ecological character. Other values that were identified in the 2015 plan (e.g. visual amenity, recreational fishing, Burrunan dolphin) are not addressed in this plan, but through other management planning processes (e.g. Regional Catchment and Waterway Strategies). In addition, management of land outside the Ramsar site boundary is not in scope except where threats are impacting ecological character.

### 1.3.1 Objectives of the development process

The East Gippsland Catchment Management Authority (EGCMA) facilitated the renewal of the 2015 Gippsland Lakes Ramsar Site Management Plan. The project was based on a robust and transparent method to analyse and prioritise values and threats within the Ramsar site, with the aim of maintaining and where possible, restoring the ecological character of the site, within a coordinated and collaborative framework for management. Further detail on the methods used is provided in the sections below:

- Risk assessment – section 3.1
- Identification of priority threats – section 3.3
- Management strategies – section 4.

### 1.3.2 Principles of the planning process

Throughout the development of the Gippsland Lakes 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 1.3.3).

- 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 not be 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 Gippsland Lakes 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 four years.

### 1.3.3 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 Ramsar Site Management Plan, stakeholders were involved in every step of the process.

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

**Project Steering Group (PSG)**
Representatives of agencies primarily responsible for the management of the Ramsar site (East and West Gippsland CMAs, DEECA, Parks Victoria, GLaWAC and GLCC).

**Gippsland Lakes Ramsar Site Coordinating Committee (GLRSCC)**
Members comprise representative of the following organisations: East and West Gippsland CMAs, DEECA, Parks Victoria, GLaWAC, Wellington Shire Council, East Gippsland Shire Council, Southern Rural Water, Gippsland Water, East Gippsland Water, EPA.

**Technical Working Group (TWG)**:
1 Technical experts in their respective fields were contacted individually for advice / input; and

2 Agencies with an interest and responsibility in managing aspects of the Gippsland Lakes were engaged and invited to participate in workshops related to identifying priority values and threats and high-level strategic actions. Members of the TWG comprised representatives of:
- Parks Victoria
- East Gippsland CMA
- West Gippsland CMA
- Victorian Environment Protection Authority
- BirdLife Australia
- Gippsland Ports
- Southern Rural Water
- East Gippsland Water
- Gippsland Water
- Greening Australia
- Trust for Nature
- Federation University
- Marine Mammal Foundation

**Community**
Broader community and stakeholder engagement through the Love Our Lakes website (https://loveourlakes.net.au/about/gippsland-lakes-ramsar-site/) and a public consultation process through the Engage Victoria platform (https://engage.vic.gov.au/).

02

# Gippsland Lakes Ramsar Site

A complete description of the ecological character of the Gippsland Lakes Ramsar Site is contained in the ECD (BMT WBM 2011) and the ECD Addendum (Hale 2023). A summary of this information relevant to the management plan for the site is provided on the following pages.

## 2.1 Location

The Gippsland Lakes Ramsar Site is located approximately 300 kilometres east of Melbourne in the State of Victoria in south-east Australia. The site extends from Sale Common east to Lake Tyers covering an area of approximately 60 000 hectares (Figure 2). The Ramsar site comprises a series of coastal lagoons formed behind a barrier dune system; however, the ocean beaches and dunes of the Gippsland Coast are outside the site boundary (BMT WBM 2011).

The Gippsland Lakes are principally within the territories of the Tatungalung and Krauatungalung clans, bordered by the Brataualung, Brayakaulung and Brabralung clan areas. The Lakes region includes the locations of important story places that relate to all aspects of Gunaikurnai life and world views, both past and present.

The Gippsland Lakes have been connected to the Southern Ocean (Bass Strait) by an artificially maintained channel at Lakes Entrance since 1889 and receive freshwater inflows from seven major river systems (Tilleard et al. 2009). Prior to 1889 the Gippsland Lakes was periodically connected to the Southern Ocean and active commercial shipping was in place. The major waterbodies comprising the Gippsland Lakes are Lake Wellington, Lake Victoria and Lake King, which are all large and shallow and occur along a salinity gradient. Lake Reeve is a narrow, shallow water body lying along the coastal dune barrier and has an area of 50 square kilometres. It is usually dry, except for times of high rainfall (Webster et al. 2001) and salinity is generally classified as hypersaline (Tilleard et al. 2009). A number of wetlands that fringe the main lakes are within the site boundary and these range from fresh (Sale Common and Macleod Morass), through brackish to hypersaline.

The Gippsland Lakes Ramsar Site was listed in 1982, and the boundary was established on the basis of land tenure and management responsibilities. This has meant that a number of wetlands are partially inside the Ramsar site. The most obvious example of this is Lake Coleman, which is essentially bisected by the Ramsar site boundary (Figure 3). There are a number of other instances where the boundary cuts through fringing wetlands. Similarly, the estuarine reaches of some of the inflowing rivers, such as the Nicholson River are within the Ramsar boundary, but not all.


**Figure 2** Location of the Gippsland Lakes Ramsar Site.

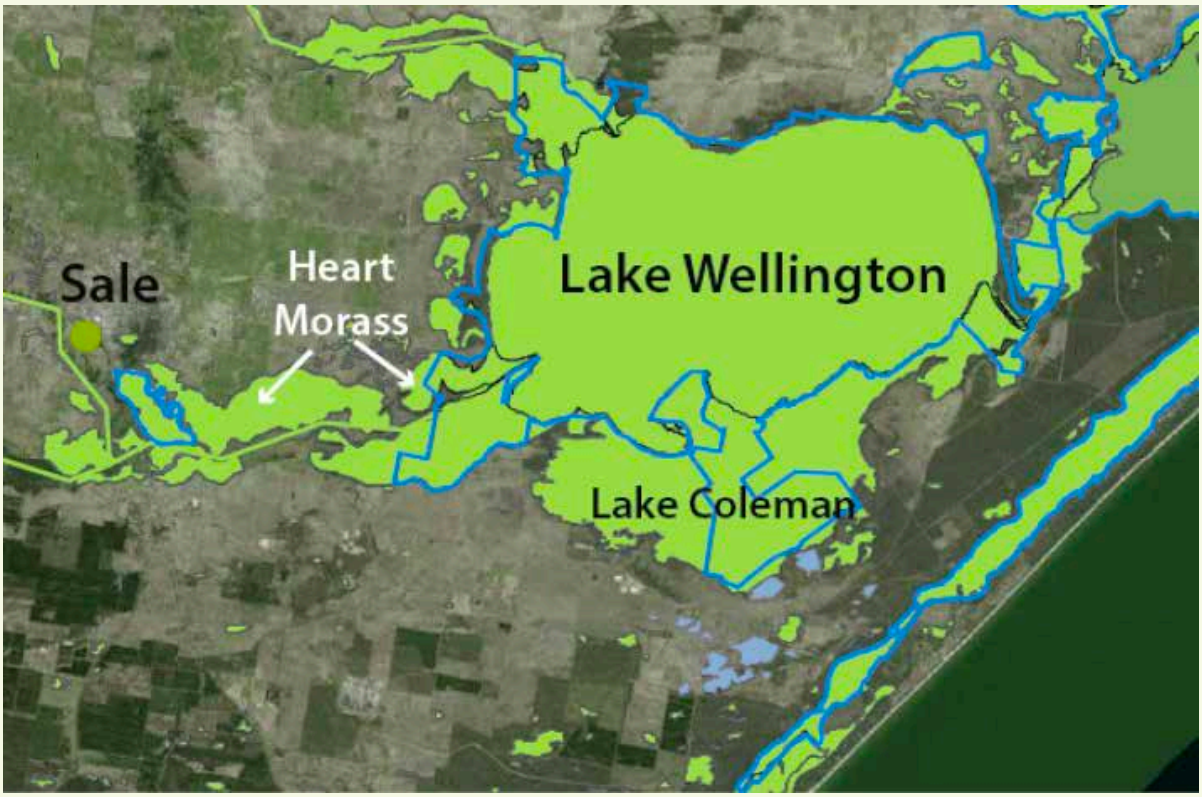



**Figure 3** Ramsar site boundary around Lake Wellington, illustrating that a portion of Lake Coleman and Heart Morass lie outside the site boundary. Blue is mapped wetland areas as shown in the Victorian Wetland Inventory; blue line is the Ramsar site boundary.

The Gippsland Lakes Ramsar Site is large, complex and made up of a variety of wetland types. The mega habitats outlined in Tillerad et al (2009) has been used to guide the identification of values, threats and management strategies for the renewal of the Gippsland Lakes Ramsar Site Management Plan. The mega-habitats are broadly aligned with Ramsar wetland types, and their use in Gippsland Lakes Ramsar Site Management Plan aligns with other plans and strategies in place for the Gippsland Lakes.

There are two broad categories, with five finer scale mega-habitats within the Gippsland Lakes Ramsar Site (Figure 4):

**Main Lakes**

- **Deep Lakes** – the permanent deep waterbodies of Lakes King, Victoria and Tyers. Includes the island habitats in Lake King, but not the fringing wetland areas.
- **Shallow Lakes** – the shallow permanent waterbodies of Jones Bay and Lake Wellington, includes the littoral common reed, but not the fringing wetlands and saltmarsh.

**Fringing wetlands**

- **Freshwater wetlands** – the two fringing wetlands that have freshwater, Sale Common and Macleod Morass.
- **Variably saline wetlands** – intermittent wetlands that fluctuate between fresh or brackish and saline, such as Heart Morass, Clydebank Morass and Dowd Morass. Includes all the areas of wetland vegetation and saltmarsh that fringe the main lakes.
- **Hypersaline wetlands** – wetlands with salinity generally greater than seawater including Lake Reeve and Victoria Lagoon.

There are a variety of tenures associated with the lands and waters of the Gippsland Lakes Ramsar Site

## 2.2 Land use and tenure

The catchment contains a number of major towns and associated urban centres (Sale, Bairnsdale, Warragul, Traralgon, Morwell and Moe); extensive coal mining and power generation in the west and the Latrobe Valley industrial development area. The catchment is predominantly forested (65 percent), but also includes large areas of dryland pasture (25 percent). There is significantly more development, industry and intensive land use in the west catchment than the east (Grayson 2006).

In 2010, alongside the consent determination, and as part of the negotiated settlement package under the Traditional Owner Settlement Act 2010 (Vic), Gunaikurnai entered into an Indigenous Land Use Agreement and a number of other agreements with the State of Victoria. These agreements build on Gunaikurnai rights as Traditional Owners and included:

- the recognition of Traditional Owner rights over all public land within the external boundary of the consent determination
- a grant of Aboriginal Title over 10 areas of land totalling approximately 46,000 hectares
- joint management arrangements over those 10 areas of land.

In 2023, Gunaikurnai were granted Aboriginal Title over a further four parks and reserves across Gunaikurnai Country. Five of these jointly managed areas join the waterways of the Gippsland Lakes and Lake Tyers (see Figure 5).

There are a variety of tenures associated with the lands and waters of the Gippsland Lakes Ramsar Site, and these are detailed in Appendix A. There are also a number of different agencies with responsibilities associated with managing aspects of the site, and these are summarised in Table 2.

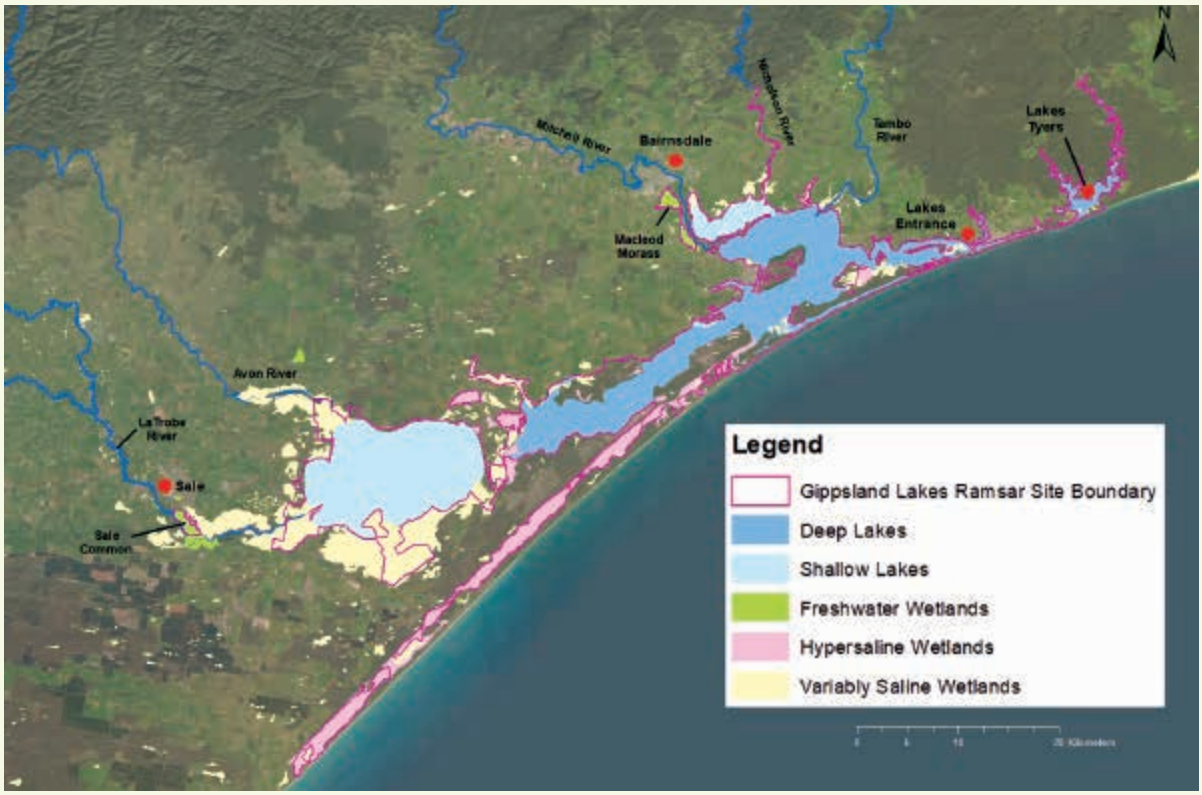



**Figure 4** Mega habitats of the Gippsland Lakes Ramsar Site (modified from Tilleard et al. 2009).

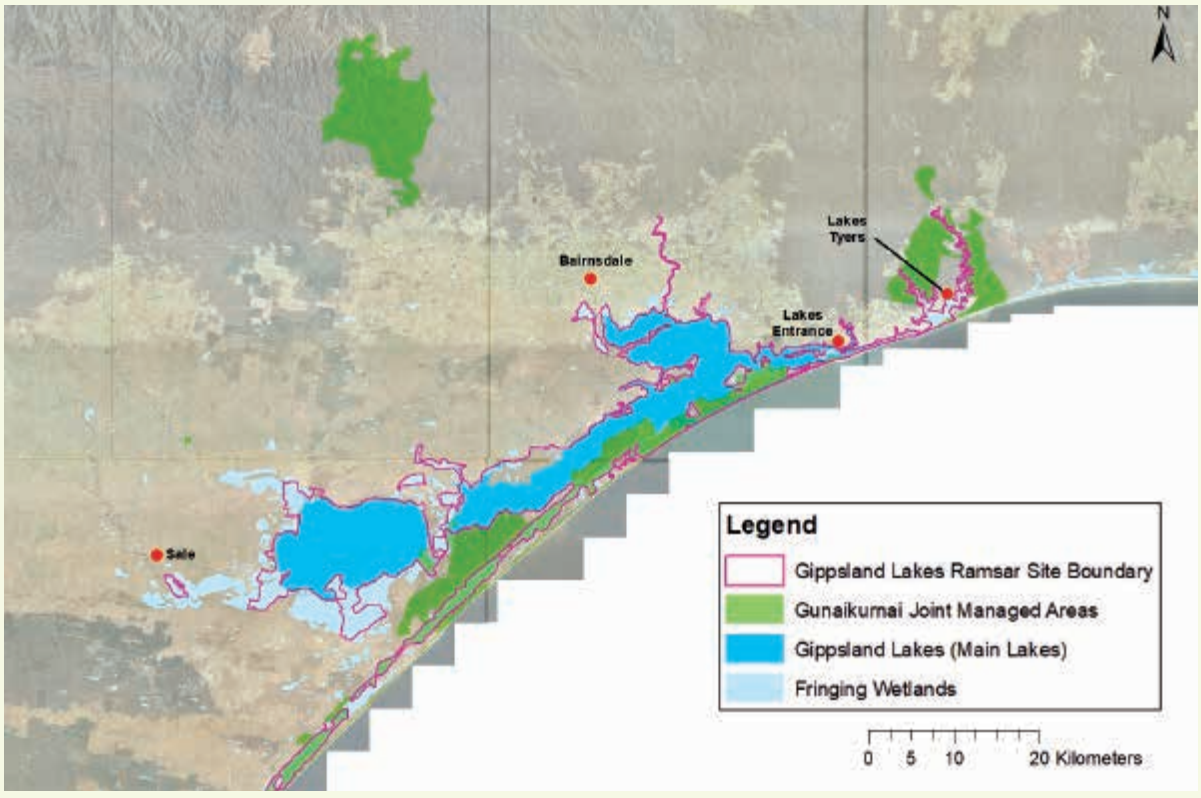



**Figure 5** Location of parks and reserves under Joint Management between GLaWAC and Parks Victoria or DEECA (The Knob Reserve only).

**Table 2** Lead management agencies and their key responsibilities (BMT WBM 2011).

| Agency | Overarching Responsibility | Responsibility to Gippsland Lakes |
|---|---|---|
| Parks Victoria | Manage parks and reserves. | Joint manage The Lakes National Park and Gippsland Lake Coastal Park. Manage Gippsland Lakes Reserve, Macleod Morass, The Sale Common, Heart, Dowd and Clydebank Morasses. |
| Department of Energy, Environment and Climate Adaptation (DEECA) | 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. | Policy for the management of the Gippsland Lakes Ramsar Site. Management of hunting at the Gippsland Lakes Ramsar Site. Management of waterbody lake beds. |
| GLaWAC | To care for, and manage Gunaikurnai Country, including the protection and enhancement of the cultural landscape. Jointly manage parks and reserves. | Joint manage The Lakes National Park and Gippsland Lake Coastal Park, Lake Tyers State Park, Raymond Island Gippsland Lakes Reserve |
| Victorian Fisheries Authority | 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*. |
| East Gippsland Shire and Wellington Shire | 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. |
| Southern Rural Water | Provide irrigation, drainage and water supply services and manage specific water supply catchments. | Supply rural water across southern Victoria including bulk supply to non-metropolitan urban water authorities and La Trobe Valley electricity generators. |
| East Gippsland Water and Gippsland Water | Provide urban water supplies and wastewater disposal services. | Provide water and sewerage services to townships neighbouring the Ramsar site. Manage water supply catchments and sewage treatment plants. Land management within and adjacent to Lake Coleman and Lake Reeve. |
| East and West Gippsland CMAs | 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. |
| Environment Protection Authority (EPA East Region) | 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 GED. |
| Gippsland Ports (GP) | GP is the manager of five local ports and two waterways in Gippsland. GP is responsible for the effective management and development of local ports and the safe use of waterways throughout the Gippsland region. | Operation of local port of Gippsland Lakes as per overarching responsibilities including specifically maintenance of ocean and port and waterway access. |
| Victorian Environmental Water Holder (VEWH) | The VEWH an independent statutory body responsible for holding and managing Victoria's environmental water entitlements. | Working with East and West Gippsland CMAs to plan and deliver environmental water in the Latrobe, Thomson and Mitchell Rivers. |

## 2.3 Criteria met

At the time that Gippsland Lakes were 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 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 Gippsland Lakes were listed are highlighted (Forests Commission 1983).

| Basis | No. | Description |
|---|---|---|
| Criteria for waterfowl | 1a | it regularly supports 10,000 ducks, geese and swans; or 10,000 coots or 20,000 waders |
| | 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. |
| 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 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 (Hale 2023):

**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 (Department of the Environment, Water, Heritage and the Arts 2008) and the site contains two waterbodies considered to be in near-natural state (Lake Tyers and Lake Reeve).

**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, fauna and ecological communities, and the site regularly supports one ecological community, 10 fauna and one flora species listed under the EPBC Act and / or IUCN Red List:

- Coastal saltmarsh – vulnerable ecological community
- Australasian bittern (*Botaurus poiciloptilus*) – Endangered (EPBC and IUCN)
- Australian fairy tern (*Sternula nereis nereis*) – Vulnerable (EPBC and IUCN)
- Bar-tailed godwit (*Limosa lapponica*) – Endangered (EPBC)
- Common greenshank (*Tringa nebularia*) – Endangered (EPBC)
- Hooded plover (*Thinornis rubricollis rubricollis*) – Vulnerable (EPBC and IUCN)

- Latham's snipe (*Gallinago hardwickii*) – Vulnerable (EPBC)
- Sharp-tailed sandpiper (*Calidris acuminata*) – Vulnerable (EPBC and IUCN)
- Green and golden bell frog (*Litoria aurea*) – Vulnerable (EPBC and IUCN)
- Growling grass frog (*Litoria raniformis*) – Vulnerable (EPBC), endangered (IUCN)
- Australian grayling (*Prototroctes maraena*) – Vulnerable (EPBC)
- Swamp everlasting (*Xerochrysum palustre*) – Vulnerable (EPBC)

**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, providing drought refuge, supporting breeding and moulting in waterfowl. There are 20 species of Palaearctic migratory shorebirds, five of which are regularly supported (in two thirds of seasons) by Gippsland Lakes Ramsar Site. The Gippsland Lakes supports breeding of waterbirds, with 50 species of wetland dependent species recorded breeding within the site (Hale 2023). Parts of the Gippsland Lakes (Jones Bay and Roseneath wetlands) are important sites for flightless moulting waterfowl, particularly black swans. In addition, freshwater wetlands are sparse in the region, and the freshwater fringing wetlands of Sale Common and Macleod Morass are considered important drought refuges.

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

Survey effort for waterbirds across the Gippsland Lakes has varied considerably over time. Annual total waterbird abundance[1] has ranged from < 1000 to almost 80,000 individuals. Despite the lack of survey data in some years, there is good evidence to support the assertion that the Ramsar site regularly supports > 20,000 waterbirds annually. Maximum annual abundance in the past 15 years (2007 to 2021) has been > 20,000 in 13 years (87% of years). The average annual abundance (1975 to 2021) was 25,863.

**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 is made using the most recent official population estimates (Wetlands International 2012). Data pooled from all sources (Atlas of Living Australia, BirdLife Australia, Field and Game Australia), indicate that three species meet this criterion (Table 4).

**Table 4** Species for which Gippsland Lakes regularly supported > 1% of the population over the 1975–2021 period (using Wetlands International 2012 estimates).

| Common Name | Species Name | Mean Maximum Annual Count 1975–2021 | Population Estimate | % of Population 1975–2021 |
|---|---|---|---|---|
| Australian fairy tern | *Sternula nereis nereis* | 38 | 1,500 | 2.5 |
| Chestnut teal | *Anas castanea* | 3527 | 100,000 | 3.5 |
| Little tern | *Sternula albifrons* | 144 | 10,000 | 1.4 |

[1] Calculated as the maximum number of each species recorded in a year, combined. This prevents double-counting and allows for the capture of waterbirds that use the system in different seasons.

**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 on.**

The Gippsland Lakes is a recognised important recreational fishery and supports one of the largest fisheries of black bream in the State, accounting for 90 percent of the total catch (Department of Primary Industries 2011). The seagrass and other habitats within the lakes act as important nursery habitat for a range of fish and crustacean species (Warry and Hindell 2012). There is evidence that populations of black bream (and other fish species) are correlated with the extent and condition of seagrass in the Gippsland Lakes (Morison et al. 1998).

In addition, the Gippsland Lakes supports several diadromous fish species including the threatened Australian grayling, with the Lakes providing a migratory route between inland freshwater habitats and the ocean.

## 2.4 Critical components, processes 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:

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

The Gippsland Lakes Ramsar Site ECD (BMT WBM 2011) and ECD addendum (Hale 2023) identifies components, process and 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 ECDs.

**Marine subtidal aquatic beds (seagrass / aquatic plants)**

Seagrass covers an area of approximately 4000-5000 hectares within the Gippsland Lakes Ramsar Site (BMT WBM 2011), although there is a high degree of variability over time (Roob and Ball 1997). Sub-tidal aquatic beds are dominated by the seagrass species *Zostera nigricaulis* (formerly *Heterozostera tasmanica*) and *Zostera muelleri* with some patches of *Ruppia* spp. (Roob and Ball 1997, Warry and Hindell 2012).

Seagrass predominantly occurs in sub-tidal beds at depths from 0.5 to 2 m, with very little seagrass in intertidal zones (Warry and Hindell 2012). Seagrass in some areas of the Ramsar site has remained relatively stable over time (e.g. along the southern areas of Lake King) while in other areas such as Jones Bay, there is a high degree of variability over time (Figure 6). Salinity and water clarity as influenced by climate and freshwater inflows play a large role in seagrass dynamics in the Gippsland Lakes (Roob and Ball 1997, Warry and Hindell 2012).

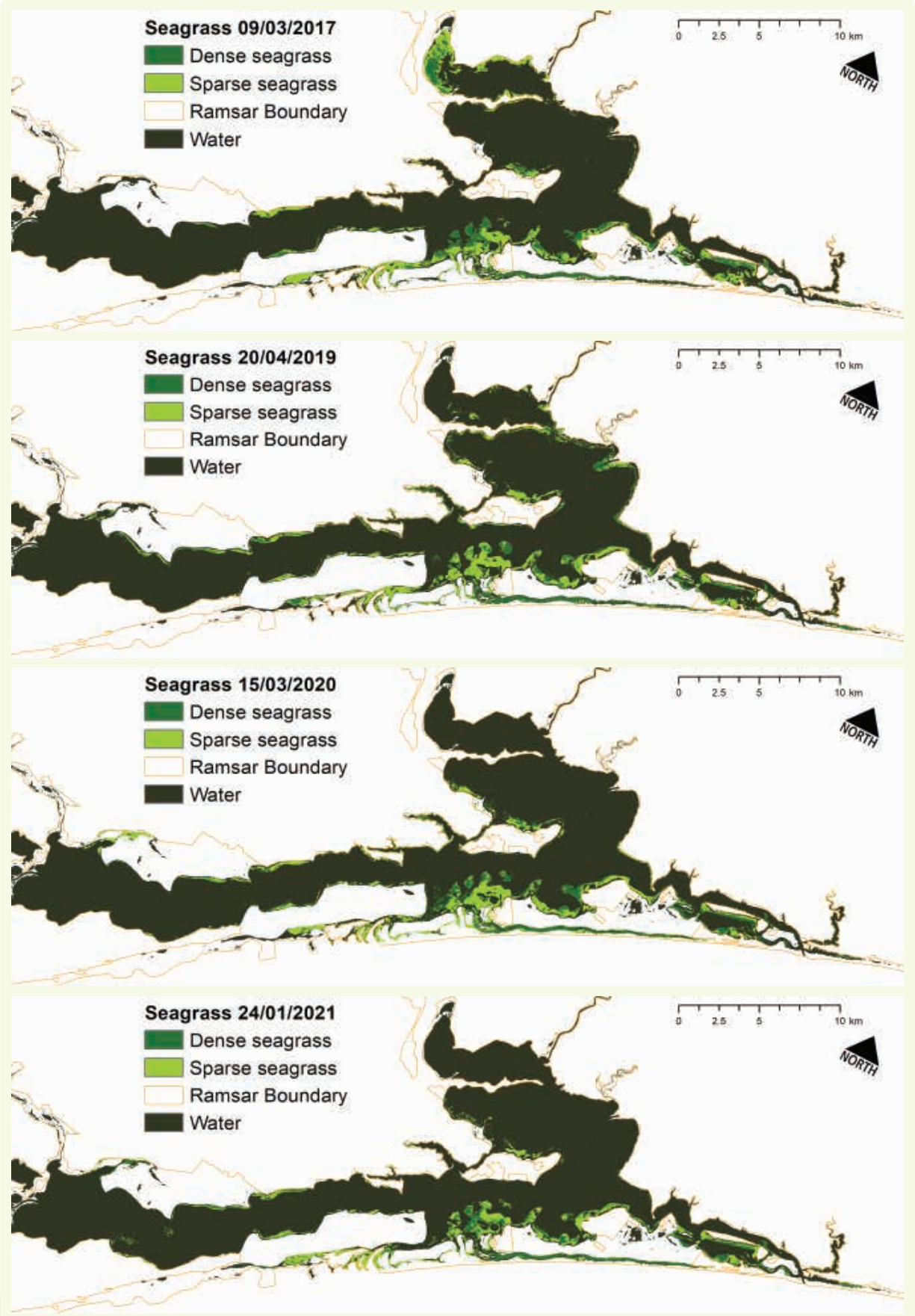



**Figure 6** Seagrass distribution in the Gippsland Lakes 2017–2021 (Brooks and Hale 2021a).

## Establishing the benchmark: "At the time of listing"

The Ramsar Convention establishes the benchmark for the ecological character of listed wetlands as:

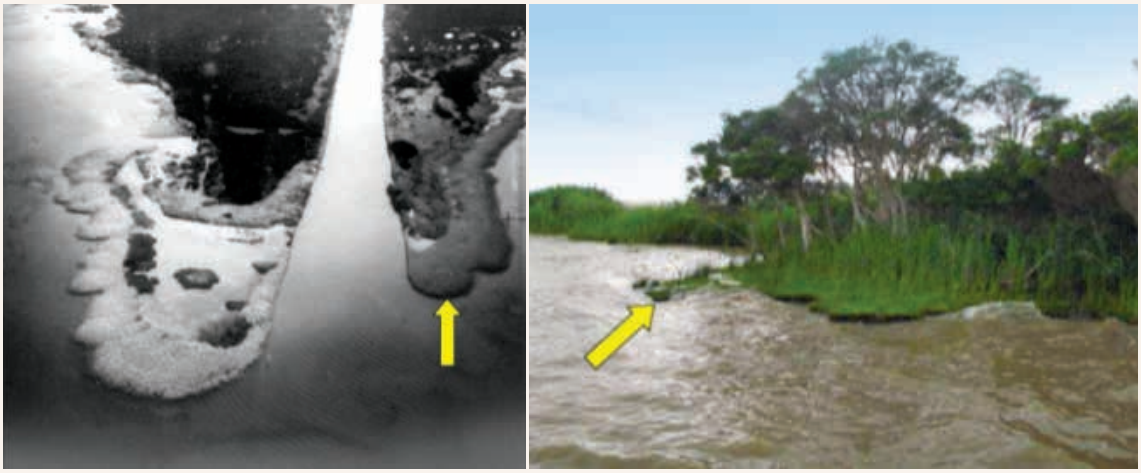
**"at the time of designation as a Ramsar Wetland of International Importance"**
(Resolution VI.1 Annex Para 2.1).

This is an important concept in terms of obligations to maintain ecological character, especially in systems such as the Gippsland Lakes, which had undergone significant ecological change prior to designation. The opening of the permanent entrance to the Southern Ocean in 1889 had two significant effects (Boon et al. 2014):

- immediate changes to decrease the variability in water level; and
- progressive increases in salinity.

The ecological effects of these physical changes were probably evident within the first few decades, and by the time of designation as a Ramsar site in 1982, Lakes King and Victoria were estuarine / marine in character. Similarly, although there have been significant historical changes in fringing vegetation at Lake Wellington and its fringing wetlands, with a loss of the submerged freshwater plant species Vallisneria australis and a decline in the extent of emergent common reed (*Phragmites australis*) fringing the waterbody (see images below), the vast majority of these changes occurred prior to 1982 (Boon et al. 2014).

Aquatic ecosystems are rarely static and stable, and the Gippsland Lakes are 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 (see section 2.5 below). Maintaining the site to maintain ecological character in a changing environment is a challenge for Ramsar site management.



Extent of common reed at Lake Wellington in the 1950s (left) and 2010 (right). The arrow indicates two comparable areas (Boon et al. 2014).

**Text Box 2** The Ramsar benchmark "the time of listing".

### Coastal brackish or saline lagoons (open water phytoplankton dominated habitats)

Planktonic food webs are an important part of the Gippsland Lakes trophic structure and the large lagoons that are dominated by phytoplankton drive the energy dynamics of the system (Grigg et al. 2004, Cook et al. 2008, Holland et al. 2009). Generally, the phytoplankton community is dominated by dinoflagellates and diatoms, typical of estuaries and coastal waters in temperate Australia (Day et al. 2011). Biomass (as indicated by chlorophyll-a) is most often in the range of 1 – 2 µg/L (Cook et al. 2008, Holland et al. 2009).

The system experiences periodic algal blooms with diatom / dinoflagette blooms recorded in seven years between 1985 and 2012 (Day et al. 2011). Post 1997, a number blooms of the cyanobacterium (blue-green algae) *Nodularia spumigena* were recorded across Lake King and Lake Victoria (Webster et al. 2001, Beardall 2008, Day et al. 2011) and in 2007, for the first time a bloom of the cyanobacterium *Synechococcus* spp. extended across large areas of the Ramsar site for over five months (Beardall 2008, Day et al. 2011). In the past decade, algal blooms of either cyanobacteria or diatoms have been recorded in half of years, several that have been extensive and resulted in the temporary closure of fisheries and recreational activities.

# The Gippsland Lakes Ramsar Site is known to support over 90 species of waterbird.

Extensive work has been conducted on the algal blooms and phytoplankton dynamics of the Gippsland Lakes (Webster et al. 2001, Grigg et al. 2004, Beardall 2008, Cook et al. 2008, Holland and Cook 2009, Holland et al. 2009, 2013a, 2013b, Day et al. 2011 among others). Conditions that lead to algal blooms are now well understood and include: low salinity (9 to 20 ppt); high nutrient concentrations, with an increased phosphorus to nitrogen ratio and elevated temperatures (Day et al. 2011, Cook and Holland 2012).

**Freshwater wetlands**

There are only two large freshwater wetland complexes remaining in the Gippsland Lakes: Sale Common and the upper parts of Macleod Morass, the latter being maintained in its current condition largely by inputs of treated wastewater from Bairnsdale (plus a regulator structure at the lower end of the wetland, which stops the intrusion of saline water from the lower Mitchell River).

Extent of wetland vegetation within the two wetlands varies in response to patterns of wetting and drying, with an expansion of emergent vegetation during drier phases as the extent of open water contracts. Mapping of wetland vegetation from satellite imagery in 2020 indicated a mosaic of open water emergent macrophytes and paperbark communities at both wetlands (Hale and Brooks 2020).

### Brackish wetlands

The brackish fringing wetlands within the Ramsar site fringe the open water areas of Lakes Wellington, Victoria and King and include Dowd, Heart and Clydebank Morasses, Lake Coleman and Tucker Swamp. They are dominated by swamp paperbark (*Melaleuca ericifolia*) woodland and common reed (*Phragmites australis*) emergent macrophyte beds (Boon et al. 2007).

There is evidence of change in the extent and distribution of these plant communities since listing. There has been a marked decline in the extent of common reed and an expansion of swamp paperbark from 1982 (around the time of listing) to 2003 (Boon et al. 2007, 2008). This has been attributed to altered water regimes (a decline in freshwater inflows) increased tidal exchange and increases in salinity (Boon et al. 2008).

### Saltmarsh

There are extensive areas of saltmarsh around the Gippsland Lakes, lining the shores of the main lakes, covering many of the fringing wetlands, and across Lake Reeve. Coastal saltmarsh communities are generally species poor compared to other wetland vegetation communities, but there are several distinct types. The most common saltmarsh communities in the Gippsland Lakes are the intertidal Wet Saltmarsh Herbland (most often dominated by beaded glasswort (*Sarcocornia quinqueflora*) and the rarely inundated Coastal Dry Saltmarsh. Comprehensive mapping of saltmarsh across the Gippsland Lakes was completed in 2011 (Boon 2011) estimated a total of over 10,000 hectares of coastal saltmarsh around the Gippsland Lakes, 4300 hectares of which was within the Ramsar site Boundary. Coastal saltmarsh is listed as a vulnerable ecological community under the EPBC Act and is important habitat for fish, when inundated as well as for feeding and roosting waterbirds, when tides are low.

### Abundance and diversity of waterbirds

The Gippsland Lakes Ramsar Site is known to support over 90 species of waterbird with periodic counts exceeding 60,000 individuals (East Gippsland CMA 2022). The majority of the significant waterbird habitat is on the islands of Lake King and in the fringing wetlands. Saltmarsh and salt-flats such as those found at Lake Reeve are important feeding grounds for waders, including migratory species, with significant numbers of red-necked stint (*Calidris ruficollis*) recorded on a number of occasions (Barter 1995,

Clemens et al. 2009). Lake Tyers and the islands of Lake King support breeding of significant numbers of little tern (*Sternula albifrons*) and fairy tern (*Sternula nereis nereis*), which then move to other areas in the site such as Jones Bay and adjacent swamps to feed.

The freshwater and brackish habitats support significant numbers of waterfowl including black swan (*Cygnus atratus*), chestnut teal (*Anas castanea*) and musk duck (*Biziura lobata*) and larger resident wading bird species (Corrick and Norman 1980). The large expanses of open water in Lakes Wellington, King and Victoria are important foraging areas for fish eating birds such as pelicans and cormorants (Coutin et al. 2003).

**Presence of threatened frog species**

There are records for two threatened frog species from the Gippsland Lakes Ramsar Site; the green and golden bell frog (*Litoria aurea*) and growling grass frog (*Litoria raniformis*) (BMT WBM 2010). Both species are known to prefer sites with a large proportion of emergent vegetation and slow moving or ponded water (Clemann and Gillespie 2012). Recent surveys have indicated that several wetlands including Clydebank Morass, Heart, Dowd and Macleod Morasses provide habitat and support breeding and recruitment of these species, especially after periods of high rainfall (Greening Australia unpublished).

**Presence of threatened wetland flora species**

The EPBC listed vulnerable swamp everlasting (*Xerochrysum palustre*) is found within the Gippsland Lakes Ramsar site. A population of all this species is located on the fringes of Lake Victoria in Blond Bay Nature Reserve (Carter and Walsh 2010a). The species occurs in freshwater wetland areas and is reliant on local rainfall for maintenance of appropriate conditions for growth, flowering and seed set.

**Diversity and abundance of native fish**

The original ECD (BMT WBM 2011) for the site identified the service "fisheries resource value" as critical to the ecological character of the Gippsland Lakes Ramsar site. The ECD addendum (Hale 2023) updated this to reflect the diversity of fish supported by the site, not all of which are recreationally important species. Over 230 species of fish have been recorded within the Gippsland Lakes (Hindell, DEECA, Friends of Beware Reef, unpublished data) spanning a wide range of life cycles. Fish species within the Gippsland Lakes Ramsar site are dispersed according to their salinity tolerances. A number of freshwater native fish species occur in the freshwater and freshes of the variably saline fringing wetlands as well as the lower reaches of the rivers within the Ramsar site, whilst the main lakes support estuarine residents, estuarine opportunists and marine stragglers.

**Hydrological regime**

The hydrology of the site is driven by freshwater inflows from the major river systems and the incursion of seawater through the entrance, with groundwater and direct rainfall contributing in a small way to the water budget (McMastera et al. 2003, Grayson et al. 2004, Tilleard and Ladson 2010). Water flows into the Gippsland Lakes from six major river basins with a combined catchment of approximately 20,000 square kilometres (Grayson et al. 2004). There is a high degree of variability in river inflows to the system, with total inflow volume varying from less than 1000 GL/ year to over 7000 GL / year. In addition, flood flows can be 10,000 times greater than non-flood flows (Tilleard et al. 2009). Adequate freshwater riverine inflows have identified as being particularly important for maintaining the freshwater fringing wetlands in the system (Tilleard and Ladson 2010, BMT WBM 2011).

The connection to Bass Strait has been permanent since 1889 but is very constricted. Due to restricted flows through the entrance, water levels and salinity in the Lakes fluctuate with freshwater inflows. For example during large flood events, water cannot pass through the entrance at the same rate that it flows into the Lakes and as a consequence, water levels rise by up to two metres and salinity decreases across a gradient from the entrance to Lake Wellington (Tilleard et al. 2009). In contrast, tidal influences are minor and essentially smoothed out by the narrow nature of the entrance. Diurnal tide in Bass Strait is in the order of one metre, but this is modulated to just a few centimetres in Lake Wellington (McMastera et al. 2003, Grayson et al. 2004, Tilleard and Ladson 2010).

Since the construction and maintenance of the permanent entrance, the system has operated as an estuary with salinity fluctuating in response to freshwater inflows. During periods of drought, when freshwater inflows are low, salinity rises across the system. Conversely, during flood periods, as observed in 1978, salinity across all surface waters dropped to near fresh (Fryer and Easton 1980). As with many estuaries, there is stratification or layering of the water column with denser more saline water underneath a freshwater layer (Figure 7). Tilleard et al. (2009) considered that the entrance was responsible for the spatial pattern in salinity and freshwater inflows principally responsible for temporal variation in salinity.

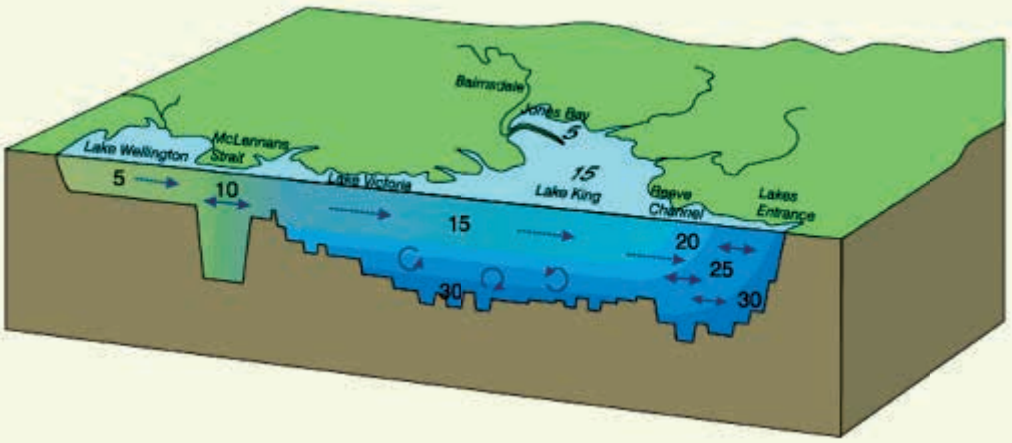



**Figure 7** Conceptual model of salinity and stratification in the Gippsland Lakes (Webster et al. 2001).

Freshwater inflows from the catchments bring with them high loads of nutrients and sediments with an estimated average of over 200,000 tonnes / year of sediment, 3000 tonnes / year of phosphorus and 2800 tonnes / year of nitrogen entering the lakes (Webster et al. 2001, Grayson et al. 2004). The entrance performs an important function to the Lakes in exporting sediments and nutrients to the ocean. During periods of low river flow this process is driven largely by oceanic water level fluctuations and flushing times are in the order of six months (Webster et al. 2001). During flood events the residence time is greatly reduced, and large plumes of sediment are visible discharging from the lakes (Figure 8).

**Figure 8** Discharge plume of fresh, turbid water following a large flood event in July 2007 (image provided courtesy of Gippsland Ports).

**Waterbird breeding**

The Gippsland Lakes Ramsar Site supports breeding of a number of waterbird species across a variety of habitats. The ECD indicates that breeding of the following waterbird species within the Ramsar site is critical to the ecological character (BMT WBM 2010a):

- Australian pelican (*Pelecanus conspicillatus*) at Crescent Island
- Little tern (Sternula albifrons) and fairy tern (*Sternula nereis nereis*) at Lake Tyers and several islands in Lake King, and
- Black swan (*Cygnus atratus*), Australian white ibis (Threskiornis moluccus), straw-necked ibis (*Threskiornis spinicollis*) and little black cormorant (*Phalacrocorax sulcirostris*) at Macleod Morass, Sale Common and Dowd Morass.

**Maintaining threatened species**

Threatened species regularly supported by the Gippsland Lakes Ramsar Site include the frog and plant species described above as well as three species of bird and one fish.

Australasian grayling (*Prototroctes maraena*).
Although there are no records of this species from within the Ramsar site boundary, it is known to occur in all six river basins that drain into the site (Berra 1982, BMT WBM 2011) and it has an obligate estuarine marine phase as part of its breeding cycle (Berra 1982, Crook et al. 2006) and so must spawn in the lakes or pass through the estuarine areas of the site to spawn in the ocean and on its return journey to freshwater habitats.

Australian fairy tern (*Sternula nereis nereis*)
An Australian resident, fish-eating bird species which feeds close inshore upon small schooling fish. It forages and breeds within the Ramsar site, with the most common breeding locations located on Crescent and Albifrons Islands (Sullivan 2020).

Hooded plover (*Thinornis rubricollis*)
An Australian resident, invertebrate eating bird species. Although its breeding habitat is largely outside the Ramsar site along the ocean beach, there are moderate numbers of adults roosting and foraging in the Ramsar site and a small number of nests recorded each year.

Australasian bittern (*Botaurus poiciloptilus*)
is a shy and cryptic wading species. Habitat preferences are for permanent, densely vegetated freshwater wetlands (Marchant and Higgins 1990). It is a diurnal forager and actively hunts prey items such as frogs and fish as well as a variety of terrestrial animals such as rodents and snakes (Menkhorst 2012). Within the Ramsar site this species is found in the tall emergent reeds and rushes of Macleod Morass, Dowd Morass and Sale Common.

## 2.5 Ecological character status 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 LAC for the Gippsland Lakes Ramsar Site were established in the ECD and ECD addendum for critical components, processes and services (BMT WBM 2010). These are described briefly below together with the most current information related to the condition of the Lakes. There is no evidence from the information below of an exceedance of a LAC in the Gippsland Lakes Ramsar site.

**Table 5** Summary of assessment against LAC for the Gippsland Lakes Ramsar Site (Hale 2023).

| Critical CPS | Limit of Acceptable Change | Assessment |
|---|---|---|
| C1 Marine subtidal aquatic beds (seagrass / aquatic plants) | Total seagrass extent will not decline below 2000 hectares for a period of greater than 20 continuous years.<br>Greater than 15 percent of the total seagrass extent will have a density of "medium" or "dense". | Between 2017 and 2021, total extent of seagrass ranged from 2235 to 2854 hectares, with 32 to 38% occurring as dense patches (Brooks and Hale 2021a).<br>**LAC is met.** |
| C2 Coastal brackish or saline lagoons (open water phytoplankton dominated habitats) | Long-term: A long-term change in ecosystem state at Lake King, Lake Victoria or Lake Tyers from relatively clear, seagrass dominated estuarine lagoons to turbid, algae dominated system (characteristic of Lake Wellington) will represent a change in ecological character. | Lakes King and Victoria have remained seagrass dominated. Lake Tyers estuary has opened several times in the past two years (June 2021; September 2021; April 2022); with anecdotal reports of changes from tannin stained water to clear "blue" water conditions when the system is open and tidal.<br>**LAC is met.** |
| | Short-term: No single cyanobacteria algal bloom event will cover greater than 10 percent of the combined area of coastal brackish/saline lagoons (that is, Lake King, Victoria, Wellington and Tyers) in two successive years. | Blooms have been defined as an algal level of "high" as indicated by DEECA phytoplankton monitoring (https://www.water.vic.gov.au/waterways/blue-green-algae). There have been nine algal blooms in the main lakes in the past two decades; 2001/02 to 2020/21:<br>• 2001/02 – Nodularia<br>• 2007/08 – Synechococcus<br>• 2010/11 – Nodularia<br>• 2011/12 – Nodularia<br>• 2015/16 – Pseudo-nitzschia<br>• 2017/18 – Synechococcus<br>• 2018/19 – Nodularia<br>• 2019/20 – Nodularia and Syenchococcus<br>• 2021/22 – Nodularia and Microcystis<br>There were successive blue-green algal blooms in the lakes in 2010/11 and 2011/12; and in the three years from 2017/18 to 2019/20. The extent of the algal blooms is difficult to determine, but it is likely that the *Nodularia* bloom in 2010/11 covered greater than 10 percent of the main lakes. The bloom in 2011/12 was, however, smaller as was the 2017/18 bloom. The *Nodularia* bloom in March 2019 was localised to around Marley Point, but the March 2020 *Syenchococcus* bloom was widespread and likely covered more than 10% of the system as did the bloom in 2022. There have therefore been several blooms that covered more than 10% of the Lakes in the past two decades, but not in successive years.<br>**LAC is met.** |

*Continued...*

**Table 5** Summary of assessment against LAC for the Gippsland Lakes Ramsar Site (Hale 2023).

| Critical CPS | Limit of Acceptable Change | Assessment |
|---|---|---|
| C3 Freshwater wetlands | Long-term: A habitat mosaic will be maintained at Sale Common and Macleod Morass that comprises open water, freshwater emergent native vegetation (sedges, rushes and reeds) and woody vegetation (swamp scrub and floodplain woodland), with no habitat comprising more than 70 percent of the total wetland area for more than five successive years. | Mapping for MacLeod Morass in May 2020 indicates: 24% open water; 50% emergent native vegetation (shallow marsh and reedbed); and 12% woody vegetation (Brooks and Hale 2021b).<br>The mapping for Sale Common indicates a difference between the wet phase in 2016 and drier conditions in 2019. The LAC, however, is met on both occasions (Hale and Brooks 2020, Brooks and Hale 2021b):<br>• Open water – 51% in 2016; 9% in 2020<br>• Native emergent vegetation – 16% in 2016; 47% in 2020<br>• Woody vegetation – 29% at both time frames<br>**LAC is met.** |
| | In existing freshwater wetland areas, the annual median salinity should not be > 1 ppt in two successive years. | Water quality data from Sale Common is limited with spot Waterwatch data most recently collected in 2017. Salinity at that time remained less than 1 ppt. Median salinity in the upper MacLeod Morass (2020-22) was 0.17 ppt (data from the Water measurement information system).<br>**LAC is met from MacLeod Morass. Insufficient data to assess LAC for Sale Common.** |
| C4 Brackish wetlands | Long-term: A habitat mosaic will be maintained at Dowd Morass that comprises open water, common reed and swamp paperbark, with no habitat comprising more than 70 percent of the total wetland area for more than five successive years. | Mapping for Dowd Morass in July 2020 indicates: 37% open water; 27% emergent native vegetation (shallow marsh and reedbed); and 31% woody vegetation (Brooks and Hale 2021b).<br>**LAC is met.** |
| C5 Saltmarsh | Total saltmarsh extent across the entire Ramsar site will not decline below 3585 hectares. | Total extent of saltmarsh in 2021 was 4924 hectares (calculated from mapping in Brooks and Hale 2021c).<br>**LAC is met.** |
| C6 Abundance & diversity of waterbirds | Mean maximum counts (calculated over a minimum of five years) will not drop below the following population thresholds:<br>• Black swan = 0.3%<br>• Chestnut teal (ducks) – 2.5%<br>• Eurasian coot (coots & rails) – 0.15%<br>• Fairy tern (terns) – 1.5%<br>• Little tern (terns) – 0.5%<br>• Little black cormorant (fishers) – 0.01%<br>• Straw-necked ibis (large wading) – 0.05% | Data pooled from multiple sources (GLCC BirdLife monthly counts, Field and Game Australia counts, Atlas of Living Australia, DEECA Summer Waterfowl Counts) indicate the following five-year averages (2017/18 – 2020/21):<br>• Black swan = 3000 (0.3%)<br>• Chestnut teal (ducks) = 4547 (4.5%)<br>• Eurasian coot (coots & rails) = 8255 (0.8%)<br>• Fairy tern (terns) =180 (12%)<br>• Little tern (terns) =113 (1.1%)<br>• Little black cormorant (fishers) = 1138 (1.1%)<br>• Straw-necked ibis (large wading) =3412 (0.3%).<br>**LAC is met.** |
| C7 Threatened frog species | Green and golden bell frog and growling grass frog are recorded breeding at least one location within the Ramsar site every five years. | Green and golden bell frog have been recorded breeding n Heart Morass in 2021 and growling grass frog have been recorded breeding in Clydebank Morass in 2022 (Greening Australia unpublished data).<br>**LAC is met.** |
| C8 Threatened wetland flora species | The threatened flora species swamp everlasting (*Xerochrysum palustre*) continues to be supported within the boundaries of the Gippsland Lakes Ramsar Site. | There is a small population of the species in Blonde Bay, with over 100 individuals recorded in 2020-21 (Trust for Nature unpublished data).<br>**LAC is met.** |
| C9 Native fish diversity and abundance | Native fish within the Ramsar site will represent each of the following life history strategies: estuarine dependent, estuarine opportunists, marine migrants, diadromous and obligate freshwater species. | Surveys by Friends of Beware Reef have recorded over 100 species of fish representing all the life history categories in surveys conducted between 2017 and 2019.<br>**LAC is met.** |

*Continued...*

**Table 5** Summary of assessment against LAC for the Gippsland Lakes Ramsar Site (Hale 2023).

| Critical CPS | Limit of Acceptable Change | Assessment |
|---|---|---|
| P1 Hydrological regime | Sale Common shall not remain dry for more than 36 continuous months.<br>Dowd and Heart Morass shall not remain dry for greater than 60 continuous months. | Heart and Dowd Morass were inundated annually from 2016/17 to 2019/20. Sale Common was 90% inundated in 2019/20 after 18 months of being dry (Clements and Suter 2020).<br>**LAC is met.** |
| P2 Waterbird breeding | Successful breeding of the following indicator species within the Ramsar site at least once every five years: Australian fairy tern, Australian white ibis, Australian pelican, black swan, chestnut teal, little black cormorant, little tern and royal spoonbill. | All indicator species have been recorded breeding in the Ramsar site in the past two years (GLCC waterbird monitoring; Field and Game Australia monitoring; Atlas of Living Australia):<br>• Australian fairy tern – all five years<br>• Australian white ibis – all five years<br>• Australian pelican – all five years<br>• Black swan – all five years<br>• Chestnut teal – all five years<br>• Little black cormorant – three years<br>• Little tern – all five years<br>• Royal spoonbill – all five years<br>**LAC is met.** |
| S1 Maintaining threatened species | Australian grayling continues to be supported in one or more of the catchments draining into the Gippsland Lakes. | Australian grayling has been recorded annually in the Thomson River from 2005 to 2020 (Tonkin et al. 2020).<br>**LAC is met.** |
| | Presence of the following threatened bird species within the Gippsland Lakes Ramsar site annually:<br>• Australasian bittern<br>• Hooded plover<br>• Sharp-tailed sandpiper<br>• in two thirds of years:<br>• Bar-tailed godwit<br>• Common greenshank<br>• Latham's snipe | Surveys of the cryptic species Australasian bittern have only been conducted in recent years, with confirmed observations in 2020, 2021 and 2022.<br>Hooded plover, bar-tailed godwit, common greenshank and sharp-tailed sandpiper have been recorded in the site annually and Latham's snipe in four of the past five years (2019 – 2023; GLCC monitoring, Atlas of Living Australia).<br>**LAC is met.** |

## 2.6 Achievements from the 2015 plan

A large amount of on groundwork and research has been undertaken within the Gippsland Lakes Ramsar Site since the release of the 2015 Ramsar Site Management Plan. A summary of this work, highlighting significant achievements related to maintaining ecological character is provided here for each management agency. Case studies of some key projects demonstrating the breadth of work being undertaken to maintain ecological character are illustrated in Figure 9.

**East Gippsland CMA**

The East Gippsland CMA are the Ramsar site coordinators and coordinate the Gippsland Lakes Program which continues to work with other agencies to address key issues in the management of the Gippsland Lakes Ramsar Site. In the term of the 2015 Gippsland Lakes Ramsar Site Strategic Management Plan, the CMA has implemented the Regional Catchment and Regional Waterway Strategies.

The CMA has been involved in; coordination of a range of monitoring projects (water quality, frogs, wetlands, seagrass, waterbirds, vegetation), coordination of research projects to address knowledge gaps, maintaining environmental flows, excluding stock, rehabilitating wetlands and improving riparian and shoreline frontages.

**West Gippsland CMA**

The West Gippsland CMA has formed a number of strategic partnerships to coordinate and maximise effort in works that have contributed significantly to restoring and maintaining the ecological character of the Ramsar site. Specific examples include:

- Together with Wetland Environmental Taskforce (WET) Trust - wetland restoration at Heart Morass;
- Together with Southern Rural Water, farmers and other partners, developed and implemented the Macalister Nutrient Reduction Program aimed at reducing nutrient and sediment loads to the Gippsland Lakes;
- Update to e-water requirements of the Latrobe River system, including Sale Common, Heart and Dowd Morasses.
- Secured and delivered environmental water in the Thomson, Macalister and Latrobe River systems; and
- Investigated, designed and delivered on ground works for environmental water delivery, reinstatement of fish passage, in-stream and bank erosion control and improved in-stream habitat, managing avulsion risk.

**Parks Victoria**

Parks Victoria has continued on ground actions specifically addressing threats to flora and fauna in parks and reserves in the Ramsar site. This includes ongoing control of significant weeds such as willow, boneseed, sea spurge and blackberry; fencing of reserves and waterways to prevent intrusion by stock; fox baiting in priority areas; removing feral pigs and goat populations in priority areas; stabilisation works on the Mitchell River Silt Jetties, sand renourishment for little terns, forging partnerships with users of parks and reserves (such as hunters) on sustainability and wise use and fire management. Parks Victoria works together with GLaWAC to joint manage areas within the Ramsar site.

**Victorian Government Department of Energy, Environment and Climate Action**

The Department of Energy, Environment and Climate Action 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 administered the $10m Gippsland Lakes Environmental Fund, which provided funding to develop and implement the Gippsland Lakes Environmental Strategy by the former Gippsland Lakes Ministerial Advisory Committee from 2011/12 to 2014/15 (inclusive). The Department also developed the Central and Gippsland Region Sustainable Water Strategy in 2022, which set out actions to secure the region's water future. The strategy identifies threats to water availability and policies and actions to help water users, water corporations and catchment management authorities manage and respond to those threats over the next 50 years.

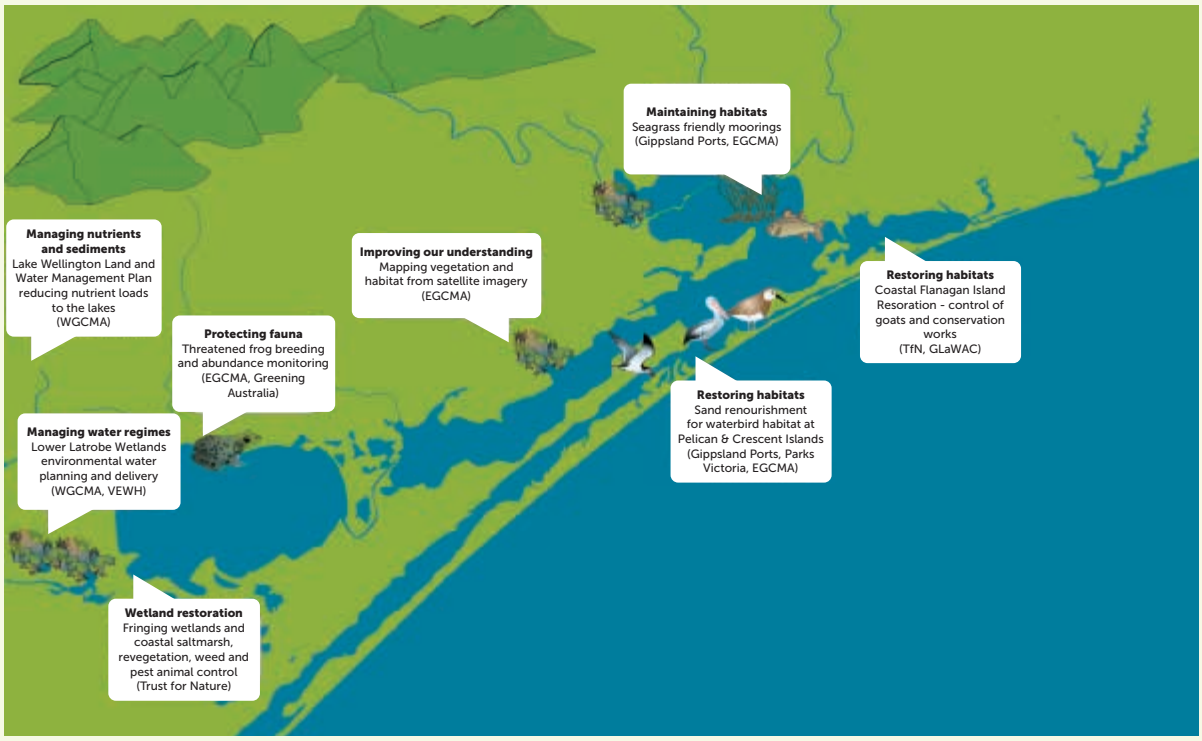



**Figure 9** Case studies demonstrating some of the achievements in maintaining ecological character of the Gippsland Lakes Ramsar Site (further details in text boxes in subsequent sections).

# 03 Priority Values and Threats

Priority threats and values for management in the next seven years were identified through a process that was based on 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). It builds on the risk assessment process undertaken in the 2015 management planning process, updating risks with new information where available. Consistent with an approach focussed on critical CPS, other values that are not identified as critical to eth ecological character of the Gippsland Lakes Ramsar Site (e.g. visual amenity, recreational fishing, Burrunan dolphin) have been omitted from the 2024 risk assessment.

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 Gippsland Lakes was undertaken to summarise the current status of ecological character and potential threats to ecological character. The spatial scale of the risk assessment was established as mega-habitat, with separate risk assessments completed for each habitat type.

The purpose of the risk assessment was to identify priority values and threats as the basis for identifying strategic actions in the Gippsland Lakes Ramsar Site Management Plan. 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 10.

### 3.1.2 Identifying risks

An impact pathway approach was adopted for identifying and analysing risks. This uses a hierarchical process to identify potential risks as follows:

- Threats (threatening activities) – actions in the Ramsar site 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. An example of an impact pathway is provided below.

| Activities | Stressors | Impact pathway |
|---|---|---|
| Dredge operation | Direct flora removal | Removal of seagrass |

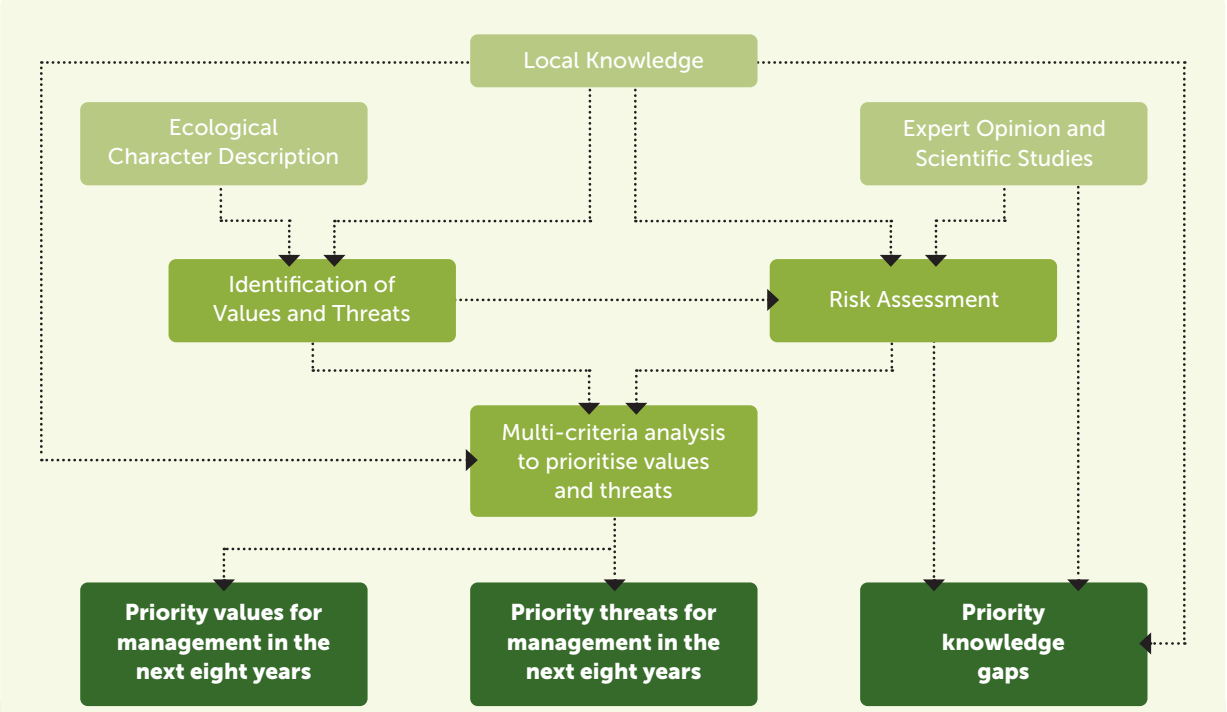



**Figure 10** Process of prioritising values and threats and the role of the risk assessment.

### 3.1.3 Analyse risks

The impact pathways formed the basis of a formal risk analysis process. Likelihood and consequence were assigned to each **impact pathway** in its entirety, integrating each of the levels in the hierarchy. Questions were put to stakeholder and agency technical staff 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?

The risk assessment was based on a few key principles:

- Risk assessment is limited to ecological character as defined by critical components, processes and services.
- Assessment of likely impacts in the next seven years (within this management cycle),
- Assessment based on the current management regime continuing, and
- Evidence based approach using scientific expertise coupled with local knowledge.

Likelihood and consequence were guided by Table 6 and Table 7, with the risk matrix (Table 8) determining the overall risk.

**Table 6** 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 7** Consequence.

| | |
|---|---|
| Negligible | Alteration or disturbance to ecosystem function, populations or habitat within natural variability. LAC will not be exceeded and no evidence of a declining trend in critical CPS. |
| Minor | Localised measurable changes to critical CPS without a major change in function (no loss of components or introduction of new species that affects ecosystem function). No sustained declining trend in ecological character and LAC will continue to be met. |
| Moderate | Widespread measurable changes to critical CPS, up to 20% of habitat likely to be affected. Decline in ecological character. LAC may be exceeded in the next 10 years but recover to within LAC within two years. |
| Major | Widespread measurable changes to critical CPS, up to 80% of habitat affected. Significant, sustained, negative trend in ecological character. LAC is predicted to be exceeded in the next 5 years with recovery within 10 years. |
| Extreme | Long term and possibly irreversible damage to one or more critical CPS. Sustained negative trend, LAC is predicted to be exceeded continually for at least 10 years. |

**Table 8** Risk matrix (adapted from AS/NZS 2006).

| | Negligible | 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 |

Critical knowledge gaps were identified and documented for inclusion in the management plan.

### 3.1.4 Stakeholder involvement

The 2015 risk assessment for each mega-habitat was updated using additional data, knowledge and ecological understanding made available in the past seven years. This draft risk assessment was provided to the project steering group (PSG) and technical working group (TWG) members for review. A series of on-line workshops were held in June and July 2023. Workshop participants were asked to review the impact pathways, likelihood and consequence ratings for each impact pathway in their area of interest or expertise. In 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.

It should be noted that a small number of potential impact pathways were raised by stakeholders in the risk assessment workshop, which were subsequently excluded. These were related to large-scale development project in the region such as the potential development of new mines in the catchment, offshore wind farms and Latrobe Valley mine rehabilitation. It was recognised that these may represent significant threats to the ecological character of the Ramsar site. However, the impacts of these large projects are being dealt with at State and Federal Levels by a separate, rigorous process that is currently underway. This Ramsar plan is deferring to this more detailed process.

The stressor model is provided in Appendix B and revised risk assessment in Appendix C.

## Using an evidence-based approach to inform the risk assessment: Changed entrance conditions and salinity in the main lakes

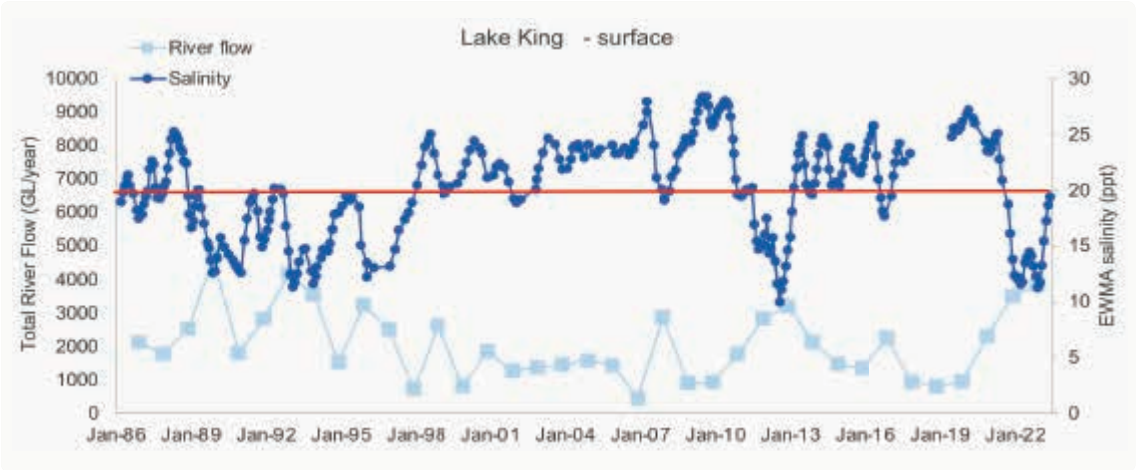
**The permanent entrance to the Gippsland Lakes was opened in 1889, since that time maintenance dredging has been required to keep the entrance open.**

Despite the dredging program, increases in water extraction and extended dry conditions during the Millennium drought (2001–2009) resulted in an increase in deposition of sediment in the navigation channel from 1975 to 2008 (Wheeler et al. 2010). To restore the original navigable depth of the channel, a different type of dredge (trailer hopper suction) was trialled in 2008 and has been used since. The new dredge did not increase the depth of the channel beyond permitted specifications and has had limited effect on the exchange of sea water between the Southern Ocean and the Gippsland Lakes.

There are multiple lines of evidence that confirm that dredging does not affect salinity in the Gippsland Lakes. Dredging does not have a significant effect on water exchange between the ocean and the lakes as the control for water flow into and out of the Lakes is not the channel but the walled entrance (Riedel 2010). That is, it is the entrance that severely restricts tidal exchange between the ocean and the lakes (Webster 2001). In addition, saltwater intrusion into the Lakes east of Metung is dominated by longer time-scale fluctuations in ocean levels. Investigations undertaken as part of the Gippsland Lakes Environment Study modelled the effects of both increasing and decreasing the channel capacity on salinity in the Lakes (among other parameters). They found that even such dramatic changes as a 150% increase or 60% decrease in channel capacity had a negligible change in the salinity in the main basins, and a moderate change in salinity in Reeve Channel This is due to the large attenuation of tide through the Entrance, which severely restricts tidal exchange between the Lakes and Bass Strait and the dominance of longer-time scale ocean level fluctuations (Webster et al. 2001).

Due to restricted flows through the entrance, water levels and salinity in the Lakes fluctuate largely due to freshwater inflows. For example, during large flood events, water cannot pass through the entrance at the same rate that it flows into the Lakes and as a consequence, water levels rise by up to 2m and salinity decreases across a gradient from the entrance to Lake Wellington (Tilleard et al. 2009). In contrast, tidal influences are minor and essentially smoothed out by the narrow nature of the entrance. Diurnal tide in Bass Strait is in the order of one metre, but this is modulated to just a few centimetres in Lake King (Tilleard et al. 2009).

Since the construction and maintenance of the permanent entrance, the system has operated as an estuary with salinity fluctuating in response to freshwater inflows. During periods of drought, when freshwater inflows are low, salinity rises across the system. Conversely during flood periods, such as occurred in 1978, salinity across all surface waters dropped to near fresh (Fryer and Easton 1980). Measured salinity in Lakes King and Victoria confirm that there has not been a step change increase in salinity following the change to the trailer hopper suction in 2008. Rather, salinity in the eastern part of the system (closest to the Entrance) have fluctuated with freshwater inflows, with a drop in salinity during high rainfall years (e.g. 2011–2012) and an increase during dry periods.



## 3.2 Priority values for management

A multi-criteria analysis was used to prioritise values for the Gippsland Lakes 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). Criteria for prioritising values are related to:

- meeting Ramsar site management obligations to maintain ecological character
- values that have been identified as being at high risk from multiple threats, and
- values that are currently in decline.

The prioritisation of values identified 15 high priority values for management in the next seven years across the mega-habitats (Table 9).

**Table 9** Priority values and mega-habitats of the Gippsland Lakes Ramsar Site.

| Value | Mega-habitats with Management Priorities | | | | |
|---|---|---|---|---|---|
| | Deep Lakes | Shallow Lakes | Freshwater Wetlands | Variably Saline Wetlands | Hypersaline Wetlands |
| Marine sub-tidal beds (seagrass) | M | H | | | |
| Coastal lagoons (open water phytoplankton) | M | H | | | |
| Fringing freshwater wetlands | | | H | | |
| Fringing brackish wetlands | | | | H | |
| Saltmarsh | | | | M | H |
| Abundance and diversity of waterbirds | H | M | M | H | H |
| Abundance and diversity of native fish | H | H | L | L | |
| Threatened species: Green and golden bell frog | | | H | H | |
| Threatened species: Growling grass frog | | | H | H | |
| Threatened species: Australian grayling | L | H | | | |
| Threatened species: Australasian bittern | | | H | H | |
| Threatened species: Fairy tern | H | M | | | |
| Threatened species: Hooded plover | H | | | | |
| Threatened species: migratory waders | M | M | | H | H |
| Waterbird breeding | H | | H | H | |

**Management Priorities:** H High M Moderate L Lower

## 3.3 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 using two approaches. Firstly, all identified individual risk pathways that were assessed as high or extreme were considered a priority for management in the life of the plan. Secondly, risks were assessed cumulatively looking at the pressures and stressors across all risk pathways and identifying risks that may individually be medium but combined have a significant cumulative impact. Priority threats in each section of the Ramsar site are provided in Table 10 and described briefly below. The relationship between values and threats is illustrated in Figure 10.

**Table 10** Priority threats at each location in the Ramsar site.

| Priorities for management | Locations | | | | |
|---|---|---|---|---|---|
| | Deep Lakes | Shallow Lakes | Freshwater Wetlands | Variably Saline Wetlands | Hypersaline Wetlands |
| 1. Climate change: sea level rise and storms impacting on island habitats and affecting beach nesting birds and foraging shorebirds | ✔ | | | | |
| 2. Climate change: increased bushfires reduce water quality and impacts on seagrass, fish and waterbirds | ✔ | ✔ | ✔ | ✔ | ✔ |
| 3. The combined effects of water resource use and climate change alter water regimes and increase salinity affecting wetland vegetation, fish, frogs and waterbirds | | ✔ | ✔ | ✔ | ✔ |
| 4. Inflows of nutrients and sediments from the catchment impact seagrass and fish | ✔ | ✔ | | | |
| 5. Toxicants from catchment inflows, industrial effluents and stormwater impact biota | ✔ | ✔ | ✔ | ✔ | |
| 6. Invasive species: native emergent macrophytes (giant rush) displace native vegetation and reduce habitat quality for aquatic fauna | | | ✔ | | |
| 7. Invasive species: non-native fish (e.g. carp and Gambusia) alter habitat, and compete and predate on native fish and tadpoles | | ✔ | ✔ | ✔ | |
| 8. Invasive species: foxes and cats predating on waterbirds | | | ✔ | ✔ | |
| 9. Invasive species: salt tolerant weeds impacting saltmarsh and waterbird habitat | | | | ✔ | ✔ |
| 10. Invasive species: non-native grazing animals (deer) impacting vegetation and destroying waterbird nests | ✔ | ✔ | ✔ | ✔ | ✔ |
| 11. Invasive species: terrestrial weeds (e.g. sea spurge) impacts on beach nesting bird sites | ✔ | | | | ✔ |
| 12. Recreation: boats, jets skis, dogs, hunting, walkers disturbing waterbird feeding, breeding and roosting | ✔ | ✔ | ✔ | ✔ | ✔ |
| 13. Recreation: vehicles damaging saltmarsh | | | | ✔ | ✔ |

### 3.3.1 Climate change

The most recent regional climate change models for the Gippsland region projected the following conditions, relative to a 1986–2005 baseline (Clarke et al. 2019):

- Very high confidence of an increase in maximum daily temperature increases of 0.9 to 1.2 °C by 2030 and 1.8 to 2.0 °C by 2050.
- Very high confidence of a significant increase in the number and duration of extreme temperature periods.
- Medium to high confidence that cool-season rainfall will decrease, but the magnitude of this change is uncertain. Annual mean rainfall is projected to change by -15% to +1% by 2030 and by -24% to +14% by 2090.
- High confidence that there will be an increase in the frequency of heavy rainfall events.
- Very high confidence in a 10–30% increase in mean evaporation.
- Very high confidence in a continued increase in mean sea level and the frequency of extreme coastal sea levels (i.e. storm surges). Mean sea level is likely to increase by 2050 by 0.24 metres over 1990 levels.

The future climate in the Gippsland region is predicted to be hotter, drier and with more frequent and intense storms. Three stressors related to climate change were identified as priority threats to the ecological character of the Gippsland Lakes Ramsar Site as described below.

#### Sea level rise

A combination of factors is contributing to sea level rise. This includes thermal expansion of the ocean as temperatures increase as well as inflows of water as glaciers and ice sheets melt. Accurate measures of sea level from satellite extend back to 1992, and this indicates that sea levels are rising at a rate of around 3.5 mm per year (Figure 11). This means that mean sea level has increased by at least 12 cm since the Gippsland Lakes was listed as a Ramsar site. In terms of future projections, it is estimated that the seas around the Gippsland Coast will rise by 30 to 60 centimetres by 2050 (https://research.csiro.au/slrwavescoast/sea-level/future-sea-level-changes/).

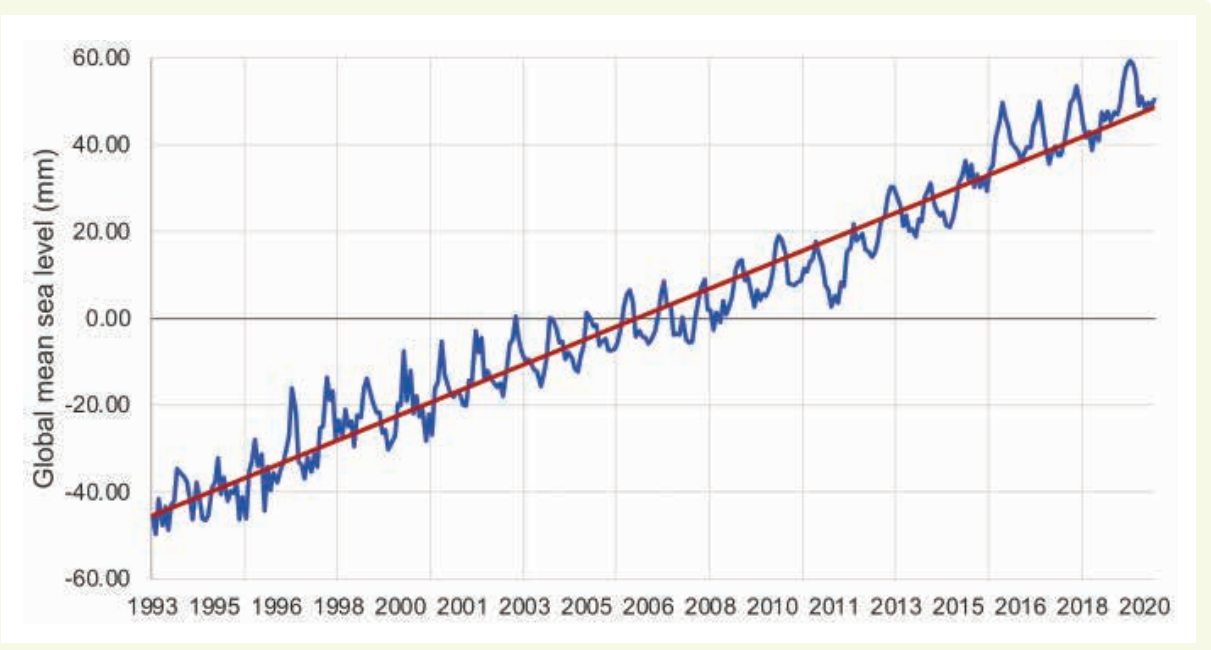



**Figure 11** Mean global sea level since 1992 with seasonal signal (blue) and trend line (red). (https://www.cmar.csiro.au/sealevel/sl_hist_last_decades.html).

Some recent work completed by GLaWAC in partnership with Monash University covering the Gippsland Lakes region of Gunaikurnai Country, including the Gippsland Lakes Coastal Park and the Lakes National Park, has shown that this culturally important area is at risk from the impacts of a changing climate.

Modelling and analysis have shown that a portion of cultural sites will be impacted by rising sea levels by 2030. Sites in areas with sandy sediments or unconsolidated alluvium are particularly susceptible to erosion, with predicted storm surges to impact a larger proportion of known sites than rising lake levels alone over the same period.

Overall, by 2030, under the "best-case" scenario modelled in this work, over 80% of the identified sites assessed by GLaWAC and its partners will be impacted by one or more of the predicted environmental changes under a climate change future.

**Increased frequency and intensity of storms**

There is a high confidence of an increase in the frequency and intensity of storms. In addition to mean sea level rise, impact studies need to consider that extreme coastal sea levels are exacerbated by rising sea levels and are caused by a combination of factors including astronomical tides, storm surges and wind-waves (Timbal et al. 2016).

Within the Ramsar site this was considered to be the greatest threat to areas that are already experiencing erosion, such as the islands of Lake King which are important bird nesting habitat and the shorelines of Lake Wellington, which have already experienced significant change.

**Increased bushfire risk**

Fire weather has become more dangerous in southern Australia since the mid-1900s with longer fire seasons that are commencing earlier. Increases in temperature and decreases in rainfall are predicted to continue the changes in fire risk. For example, there is high confidence that there will be a 32% increase in the number of high fire risk days in Bairnsdale by 2050s (Clarke at al. 2019). Increased frequency and intensity of fires in the catchment will increase the duration and frequency of large sediment and nutrient inflows to the Lakes post bushfire.

### 3.3.2 Water resource use

There is continued increased demand for and extraction of water from the rivers of the Gippsland Lakes catchment, particularly in the west of the catchment in the Latrobe and Thomson River Basins. There was significant water resource use and development prior to the listing of the Gippsland Lakes as a wetland of international importance in 1982, and it is likely as populations increase and the effects of climate change further reduce water availability, that there will be increasing demand for water in the catchments of the Lakes. The amount of water extracted from the system for consumptive use is smaller in the east of the lakes and the Mitchell River, for example has only 2% of the flow on average extracted, this increases to > 20% in the Latrobe system and > 40% in the Thomson (DELWP 2020a). In the Thomson system about half the consumptive use is for Melbourne water supplies and half for irrigation in the Gippsland region (e.g. the Macalister Irrigation District), with other minor urban and industrial uses accounting for a small percentage (DELWP 2005, 2007, 2009, 2014, 2015, 2016, 2019, 2020b, 2021).

Changes to surface water inflows in the Gippsland Lakes are affecting both water regimes and salinity, particularly in the wetlands fringing Lake Wellington. Reduced freshwater inflows also impact on water managers ability to provide freshwater to the Lower Latrobe wetlands as the salt wedge in the Latrobe Estuary is increasingly pushed upstream above the water inflow points for wetland watering (Alluvium 2020a, Hale and Boon 2022).

### 3.3.3 Nutrient and sediment inflows

Nitrogen and phosphorus loads entering the Gippsland Lakes are a recognised important driver of phytoplankton dynamics in the main lakes (Cook et al. 2008, Holland et al. 2009, Cook and Holland 2012). Loads are linked closely to the volume of river inflows, which in turn is linked to rainfall. In high flow (high rainfall) years, nutrient loads entering the Lakes are generally higher, and in low rainfall years, loads are lower. In addition, events such as bushfires in the catchment, result in the mobilisation of large amounts of sediment and nutrients into the system.

There is evidence that the large inflows of nutrients and sediments from the catchments in 2020 and 2021 led to prolonged periods of low water clarity in Jones Bay and a subsequent decline in above ground seagrass biomass. This impact pathway was considered to represent a high risk to ecological character.

## Combined effects of water resource use and climate change

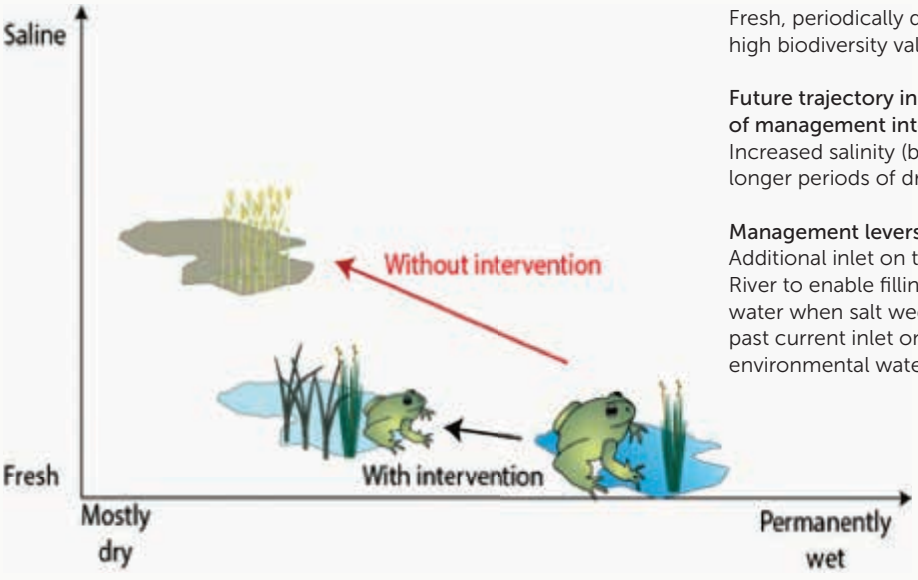
**Water resource use and climate change act in combination to decrease freshwater inflows into the Gippsland Lakes.**

In the east of the system, sea level rise is also exacerbating the problem by increasing the flow of marine water into Lake Wellington through MacLennan Strait. Population growth in Greater Melbourne and the catchment of the Gippsland Lakes, together with several large-scale projects that threaten to increase water extraction from the system will continue to drive increased water use and despite efficiencies and programs that seek to recover water for the environment, water extraction from the system will likely continue into the future. Similarly, climate modelling indicates that sea level will continue to rise, most likely at an accelerated rate. Consequently, we can expect the salinity of Lake Wellington to continue to increase. The effect of water resource use and rising sea levels on fringing wetlands is dependent on their connectivity to Lake Wellington and impacts to freshwater inflows, including the ability to augment natural inflows with environmental water.

To date there have been realised, measurable changes in Lake Wellington and several variably saline wetlands such as Dowd Morass and Lake Coleman, which are connected to Lake Wellington at relatively low water levels. As a consequence, saline water moves from Lake Wellington into these systems increasing salinity and periods of inundation (i.e. making the wetlands more permanent). This has impacts to vegetation, with a decline in paperbark condition and recruitment already evident in some locations.

The environmental water requirements of the Lower Latrobe Wetlands have been identified but achieving these will become increasingly difficult under future climate conditions. Water is delivered from the Latrobe River through regulators, but if the salt wedge moves up the Latrobe Estuary past these regulating structures, the ability to get freshwater into the wetlands is compromised. Several infrastructure changes have been identified to improve water management at these three sites. This is expected to improve water management at wetlands such as Sale Common. An example of the expected trajectory of change at Sale Common under future conditions with and without management interventions is shown below. This has been extracted from the Lake Wellington Scoping Study (Hale and Boon 2022) which reviewed the status and management options for altered water regimes and increasing salinity in the fringing wetlands.

Over time, as freshwater inflows continue to decrease, the effects on water regimes and salinity is expected to expand to other parts of the Gippsland Lakes. Expected responses include an increase and landward migration of saltmarsh and a decline in freshwater wetland vegetation extent.




**Sale Common**

**Current condition**
Fresh, periodically dry, supporting high biodiversity values.

**Future trajectory in the absence of management interventions**
Increased salinity (brackish) and longer periods of dry.

**Management levers**
Additional inlet on the Thomson River to enable filling with fresh water when salt wedge extends up past current inlet on Latrobe River, environmental water recovery.


### 3.3.4 Invasive species

There are broad range of pest plants and animals that are impacting the habitats and communities of the Gippsland Lakes. Introduced predators such as foxes and cats have a direct impact on waterbirds, including shorebirds and beach nesting species such as the threatened little tern and fairy tern. Large herbivores, particularly deer are common in the fringing wetlands and can cause significant damage to wetland vegetation communities. There is also evidence of trampling of nests of beach nesting birds resulting in breeding and recruitment impacts. Other herbivores such as rabbits, goats and pigs have caused localised damage to wetland habitats.

Common carp (*Cyprinus carpio*) are a prolific invasive fish species that not only impact native fish through competition and food chain effects, but also have profound effects on aquatic habitat. Carp contribute to poor water quality by uprooting vegetation and stirring up sediments during feeding, leading to increased turbidity (Koehn 2004). They are present in Lake Wellington and several fringing wetlands and there is anecdotal evidence of significant impacts to vegetation communities in MacLeod Morass.

Several introduced marine pests are known to occur in the Gippsland Lakes including European green crab (*Carcinus maenas*), Asian bag mussel (*Arcuatula senhousia*) and the introduced green macroalgae (*Codium fragile* subsp. fragile) (Bott et al. 2023). The risk to Lake King is considered high, but more so for the potential for new, introductions of more problematic species such as the Pacific sea star (*Asterias amurensis*) than the species currently present.

Pest plant species are a threat to ecological character at a number of locations around the lakes. For example, coastal terrestrial plants such as sea-spurge (*Euphorbia paralias*) displacing the sandy habitat that shore nesting birds such as little tern, fairy tern and hooded plover require for nesting. These birds build a nest in a scrape in the sand and a lack of sandy habitat can reduce breeding success (Mead et al. 2012). In other places, salt tolerant weeds are invading areas of saltmarsh not only impacting the EPBC listed vulnerable vegetation community, but also foraging waterbirds. In Sale Common, dense stands of the native, but invasive plant species giant rush (*Juncus ingens*) has colonised areas of previously open water, reducing habitat for waterbirds and frogs.

### 3.3.5 Recreation

The Gippsland Lakes support significant recreational activities including boating, hunting, fishing and camping. Recreational pressure is growing as populations in Victoria and beyond grow and increasing numbers of tourists visit the Gippsland Lakes.

**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 the Ramsar site and elsewhere. There is growing evidence that disturbance of waterbirds by human activities (walking, boating, hunting, vehicles) can have significant negative impacts on both feeding behaviour and habitat use (Glover et al. 2015, Livezey et al. 2016). The consequences for individuals and populations can be significant, with decreased time spent feeding, increased energy spent in flying away from disturbances, nest abandonment and ultimately population declines all cited as potential effects (Glover et al. 2011, Martín et al. 2015).

Waterbird foraging and nesting sites in the Ramsar site are all close to where recreational activities, particularly boating and hunting occur. Increased recreational pressure may already be having an inadvertent impact on habitats and populations.

**Vehicles in the intertidal zone**

Vehicle damage to coastal saltmarsh communities has been reported from many areas in the Gippsland Lakes (Boon et al. 2011, Brooks and Hale 2021a). Saltmarsh communities are slow to recover from disturbance and damage can be subtle (stem breakage) to long lasting and severe (e.g. wheel ruts). While the extent of vehicle access to intertidal areas has been addressed by Parks Victoria, there remains access and damage to the high value saltmarsh communities in the fringing wetlands (Figure 12).

**Figure 12** Vehicle damage to coastal saltmarsh in Victoria Lagoon in 2021 (Brooks and Hale 2021a).

## 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** | Management of toxicants (including chemicals of emerging concern): to minimise impacts on ecological character. |
| **2** | Impacts of deer on ecological character. |
| **3** | Management options to address risks from avian disease (e.g. botulism, avian flu). |
| **4** | Management options to address risks from impacts of introduced marine pests on ecological character. |
| **5** | Understand potential impact of recreational fishing on native fish abundance and diversity. |
| **6** | Effective control measure for carp in fringing wetlands. |
| **7** | Risk of Acid Sulfate Soils to the ecological character of the Gippsland Lakes. |

Increased recreational pressure may already be having an inadvertent impact on habitats and populations.

# 04 Site Management Strategies

Site management strategies are targeted at actions that will maintain the ecological character of the Ramsar site.

## 4.1 Approach

There are two types of indicators that are relevant to the management of the Ramsar site:

1. **Limits of Acceptable Change (LAC)** are set in the Ecological Character Description (ECD) and are based on the conditions at the time of listing. LAC can be updated based on new knowledge that improves confidence in the LAC and this occurred with the ECD Addendum. LAC are the thresholds at which ecological character may be compromised.

2. **Resource Condition Targets (RCTs)** are established in the Ramsar Site Management Plan and are the aspirational condition for each of the identified priority values (i.e. where do we want / expect the condition of each priority value to be at the end of this management plan?). These will help to assess the effectiveness of the management plan in maintaining (or improving) ecological character.

How each of these three levels of indicators fit into the planning and development process is illustrated in Figure 13. As part of Ramsar management planning, LAC were previously developed for the site and are documented in the draft ECD. These are formal instruments against which change in ecological character is assessed and reported to the Convention every three years. RCTs were developed by expert opinion and local knowledge, with consideration of the LAC and expected natural variability for each value.

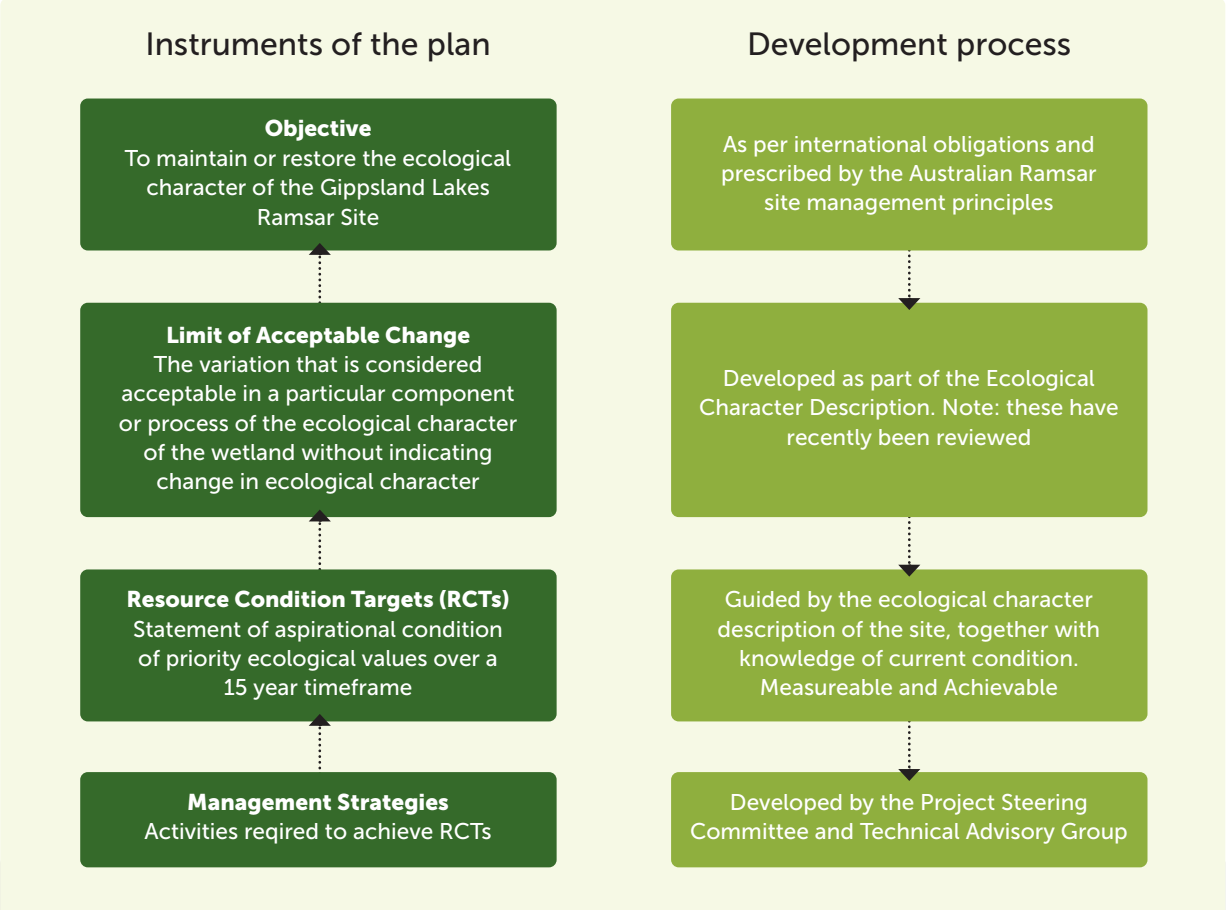



**Figure 13** Relationships between the different instruments of the plan and their development process.

### 4.1.1 Stakeholder involvement

Resource Condition Targets and management strategies to address priority values, threats and knowledge gaps were developed and refined by the Project Steering Group and Technical Working Group in two on-line workshops in August 2023. The outputs of the workshop were used to assign management strategies to one of five themes.

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

| | |
|---|---|
| **Theme 1** | Maintaining and restoring habitat |
| **Theme 2** | Protecting fauna |
| **Theme 3** | Managing nutrients and sediments |
| **Theme 4** | Managing water regimes |
| **Theme 5** | Cultural Landscapes |
| **Theme 6** | Improving understanding. |

## 4.2 Resource condition targets

A total of 22 Resource Condition Targets have been defined for the Gippsland Lakes Ramsar Site (Table 11). These have helped to guide the identification of management strategies and provide a goal for monitoring the ecological character of the site (Appendix E). These have been refined for the 2024 RSMP to:

1. Ensure they are focussed on critical CPS and not other values such as Burrunan dolphin, visual amenity or fishing, which are not identified as critical to the ecological character of the Gippsland Lakes Ramsar site.
2. Make each RCT objectively measurable.

**Table 11** Resource Condition Targets for the Gippsland Lakes Ramsar Site.

| Resource Condition Targets | Associated Values |
|---|---|
| 1. Extent of medium-dense seagrass in Lakes Victoria and King to be greater than 3200 hectares. | Marine sub-tidal beds (seagrass) |
| 2. Extent of medium-dense seagrass in Lake Tyers to be > 300 hectares. | |
| 3. Lakes Victoria and King remain clear with median secchi depths of > 1 m | Coastal lagoons (open water phytoplankton) |
| 4. Annual median chlorophyll-a concentrations will be within the 80th percentile of reference years (1986–1988). That is will not exceed:<br>• 20 µg/L in Lake Wellington<br>• 10 µg/L in Lake Victoria<br>• 5 µg/Lin Lake King. | |
| 5. Maintain Macleod Morass and Sale Common as freshwater marshes (i.e. median annual salinity < 1ppt). | Freshwater wetlands |
| 6. Maintain "good" (as indicated as a biota score of > 16 according to the Index of Wetland Condition) freshwater vegetation condition at Macleod Morass and Sale Common at 80% of representative sites. | |
| 7. Maintain an average extent of emergent macrophyte vegetation:<br>• Tall emergent marsh > 800 hectares<br>• Shallow marsh > 550 hectares<br>• Paperbark >2300 hectares | Brackish wetlands |
| 8. Maintain "good" (as indicated as a biota score of > 16 according to the Index of Wetland Condition) vegetation condition in variably saline wetlands at 80% of representative sites. | |
| 9. Maintain saltmarsh extent at > 4000 hectares. | Saltmarsh |
| 10. Maintain "good" (as indicated as a score of > 16 according to the Index of Wetland Condition biota assessment method) saltmarsh condition at 80% of representative sites. | |
| 11. Total diversity of waterbirds across the site remains above 86 species. | Abundance and diversity of waterbirds |
| 12. The site supports greater than 20,000 waterbirds in three out of five years. | |
| 13. Green and golden bell frog and growling grass frog are recorded at Dutson Downs, Heart Morass, Clydebank Morass, Dowd Morass, Macleod Morass within a five year period. | Threatened frog species |
| 14. Successful breeding of green and golden bell frog and growling grass frog is recorded at least once every three years at a minimum of five wetlands including the Lower Latrobe Wetlands. | |
| 15. Maintain native fish species richness, with a minimum of 70 species recorded in the Deep and Shallow lakes over any five-year period (based on Warry and Hindell 2012). | Abundance and diversity of native fish |
| 16. Maintain fish diversity for species within each of the following life history strategy: estuarine dependent, estuarine opportunists, marine migrants, diadromous, and obligate freshwater species. | |
| 17. Australasian bittern detected annually within the Ramsar site and at least once every two years at the following sites: Macleod Morass, Dowd Morass, Heart Morass and Clydebank Morass). | Threatened species |
| 18. Annual presence of threatened shorebird species within the Ramsar site (bar-tailed godwit, common greenshank, Latham's snipe and sharp-tailed sandpiper). | |
| 19. Average abundance of swamp everlasting to be > 500 stems in Blonde Bay (five year average) with evidence of flowering biennially. | |
| 20. Annual successful breeding of the following beach-nesting bird species: little tern, fairy tern, pied oystercatcher, hooded plover and red-capped plover. | Waterbird breeding |
| 21. Maintain a breeding colony of Australian pelican within the Gippsland Lakes. | |
| 22. Successful breeding of Australasian darters, pied cormorants, little black cormorants, straw-necked ibis, Australian white ibis and royal spoonbills at least once every two years. | |

## 4.3 Theme 1: Maintaining and restoring habitats[2]

Parks Victoria, GLaWAC, DEECA, East and West Gippsland CMAs and Gippsland Ports with partner organisations, community groups and volunteers have been actively involved in a wide range of projects aimed at maintaining and restoring habitats in the Gippsland Lakes. Activities include excluding stock from waterways, improving the condition/health of wetlands, improving riparian and shoreline frontages, active revegetation, weed and invasive native plant species control. Three case studies presented below highlight some of the successes.

### Restoring habitat: Coastal Flanagan Island Restoration

**Flannagan Island is one of several small islands located in the Gippsland Lakes south of Nyerimilang.**

The small freehold island, measuring 75 hectares in size, provides important refuge and habitat for ground nesting birds. It is also recognised for the important estuarine wetlands and saltmarsh mosaics distributed across the island.

Historically, Flannagan Island was cleared for cattle grazing purposes with goats introduced as part of the management regime of vegetation on the island. The millennium drought caused prolonged dry periods on the island contributing further to the reduced cover and condition of native vegetation. Between 2017-2019, Flannagan Island underwent a goat removal program and became protected under a conservation covenant with Trust for Nature.

As part of the conservation covenant agreement, Trust for Nature developed and implemented the Flannagan Island Restoration Plan and Revegetation Strategy in 2022. This plan was implemented in partnership with landholders, Birdlife Australia and the Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) to deliver key on ground activities including weed control, revegetation, and bird surveys. Additionally, the GLaWAC NRM Crew were involved in training days led by Trust for Nature helping to facilitate knowledge sharing between partners.

Collaboration between regional project partners, Traditional Owners and environmental agencies to implement on ground works that protect and restore the Gippsland Lakes are an integral part of the Gippsland Lakes Program. This project demonstrates the value of their combined expert and local knowledge being to deliver environmental works that will improve and protect habitat within the Gippsland Lakes into the future.

[2] Restore in this context refers to maintaining ecological character at the time of listing.

## Restoring habitat: Sand re-nourishment

**Gippsland Lakes provide important habitat for many nesting shorebirds which are a critical component of the Gippsland Lakes Ramsar Site**

Of note are the Little and Fairy Terns, both of which are listed as 'critically endangered' under the Environment Protection and Biodiversity Act 1999. Collectively, these species are referred to as small terns.

Small terns are vulnerable to a number of threats, particularly due to their use of available open sand habitat within coastal sites for nesting and breeding. Within the Gippsland Lakes, open beach habitat has been impacted by various environmental pressures which regularly alter the existing sand profile. Significant pressures include flooding and storm activity resulting in an increase in lake levels as well as artificial wave action caused by boat activity. Due to the specific requirements of the small terns for nesting, changes in sand profiles overtime create sub-optimal habitat for the species and reduced breeding opportunities.

Between 2015 and 2017, sand renourishment works were undertaken across priority identified habitat sites in the Gippsland Lakes including Crescent, Pelican, Rigby and Albifrons Islands, as well as Horries Spit. The works aimed to restore or create areas of critical habitat to support breeding of the two target species. A study was conducted by Alluvium in 2020 to assess the effectiveness of the sand renourishment works undertaken and found that this type of management approach was successful in creating suitable habitat for breeding. Challenges for the long-term management of these sites however will be posed by a range of influences including seasonal storm activity, emergent dense vegetation, anthropogenic activity including boat use and predation by pest fauna including foxes.

## Restoring habitat: Seagrass friendly moorings

**The Gippsland Lakes supports a diversity of important ecosystems including seagrass beds which provide essential habitat, food and shelter for aquatic life as well as improving water quality and reducing the impacts of erosion.**

Seagrass beds are widely distributed throughout the Gippsland Lakes and are recognised as a critical component of the ecological character of the Gippsland Lakes Ramsar Site for the many key functions they provide. Seagrass meadows also are an indicator for the health of the Lakes and the cover and distribution of seagrass across the lakes is regularly mapped.

Human led activities including traditional boat mooring and anchoring has been identified as one of the key threats to seagrass beds globally due to its ability to reduce seagrass cover and extent following chain disturbance along the bed surface as the boat moves in the water. The Gippsland Lakes has been identified as a priority site for management, especially in summer months when recreational boat use is at its highest for the region.

To address this challenge, environmental managers worked in partnership with key agencies to install over 30 seagrass friendly swing moorings at high use sites across the Gippsland Lakes between 2019-2022. Seagrass friendly swing moorings work to reduce impact on the seabed due to the use of buoyant materials that keep all moving parts of the mooring off the lake bottom. This reduces the impact on seagrass beds located close to the mooring sites whilst also continuing to support recreational activities within the Lakes.

A protocol has been developed to monitor the effectiveness of the newly established seagrass friendly swing moorings in minimising impacts on seagrass beds. Monitoring of seagrass density and cover at seagrass friendly mooring sites and reference sites commenced in 2022 across sample sites within the Gippsland Lakes. Results from the monitoring will be used to inform future management priorities for seagrass protection and restoration in the Gippsland Lakes. By understanding the effectiveness of our management actions we can improve how we protect and help rejuvenate seagrass populations now and into the future.

Many of the habitats of the Gippsland Lakes were identified as priority values for management during the life of this plan on the basis of both their ecological significance, community value and current threats. Direct impacts from physical damage (from erosion or human activities) as well as from introduced plants and animals were identified as critical threats. Seven management strategies have been developed to meet RCTs by maintaining habitat values and addressing priority threats (Table 12). The relationship between management strategies, priority threats and priority values are provided in Appendix F.

**Table 12** Management strategies and responsibilities for maintaining and restoring habitat.

| Management Strategies | Responsibility | Linkages to existing programs / activities | Relevant mega-habitat(s) |
|---|---|---|---|
| 1A. Implement actions within the Gippsland Lakes to protect and restore seagrass beds. | EGCMA, Parks Victoria, GLaWAC, Gippsland Ports | Seagrass friendly moorings, seagrass restoration | Deep Lakes<br>Shallow Lakes |
| 1B. Continue to implement island renourishment for beach nesting birds. | Gippsland Ports, DEECA, Parks Victoria, EGCMA | On-going active management of sand islands for nesting bird habitat. | Deep Lakes |
| 1C. Protect, restore and enhance breeding and foraging habitat for beach nesting birds. | Gippsland Ports, EGCMA, Parks Victoria, GLaWAC | Gippsland Lakes Environment Fund program. | Deep Lakes<br>Shallow Lakes |
| 1D. Identify and implement opportunities for improving and enhancing habitat connectivity and adaptation in response to the impacts of climate change within the Ramsar site and adjacent priority areas. | EGCMA, WGCMA, Parks Victoria, GLaWAC | East and West Gippsland Regional Waterway Strategies, Gippsland Lakes Priorities Plan | All |
| 1E. Implement actions to control giant rush in Sale Common as required. | WGCMA | Gippsland Lakes Priorities Plan | Freshwater wetlands |
| 1F. Update the Gippsland Lakes Invasive Species Strategy and implement priority actions. | Parks Victoria, GLaWAC, EGCMA, WGCMA | Gippsland Lakes Priorities Plan | All |
| 1G. Control illegal recreational activities to minimise / prevent physical damage to habitats in priority areas. | Parks Victoria | Gippsland Lakes Priorities Plan | Deep Lakes, Shallow Lakes<br>Hypersaline wetlands |

Erosion, human impacts and pest plants and animals were identified as priority threats to the Ramsar site.

## 4.4 Theme 2: Protecting fauna

Protecting fauna in the Gippsland Lakes has been a focus for a number of programs over the past decade. There has been work on controlling introduced animals such as foxes and carp; protection of important nesting sites and raising awareness of the potential harm to shorebirds and nesting birds from disturbance. The case studies presented below illustrate the need for continued protection of the vulnerable fauna of the Gippsland Lakes Ramsar Site.

### Protecting fauna: Threatened frog species

**The Gippsland Lakes and surrounding fringing wetlands provide important habitat for the nationally threatened Green and Golden Bell frog and Growling Grass frog.**

Both species are currently listed as 'vulnerable' under the *Environment Protection and Biodiversity Act 1999*. In 2004 both species were also listed as well as the International Union for Conservation of Nature's (IUCN) Red List.

Monitoring of both Green and Golden Bell frog and the Growling Grass Frog populations has been delivered over the life of the 2015 Gippsland Lakes Ramsar Site Management Plan by project partner Greening Australia. To support in the consistent collection of data to make assessments against the Limits of Acceptable Change and Resource Condition Targets, the Gippsland Lakes Frog Monitoring Framework was developed. Targeted on ground seasonal surveying has been delivered in accordance with the Framework to detect population distribution and breeding events within the Ramsar Site and adjacent priority fringing wetlands.

To support the ongoing protection of both threatened species within the Gippsland Lakes catchment, monitoring data has also been utilised to inform habitat restoration works at key fringing wetland sites which has improved habitat connectivity and refugia. These works were delivered through the Gippsland Lakes Program which is a $7.8 million-dollar government investment to encourage government agencies, groups and individual landowners to collaboratively deliver activities to improve the health of the Gippsland Lakes.

## Protecting fauna: The Burrunan dolphin

**In 2011 a potential new species of dolphin, the Burrunan dolphin (*Tursiops australis*), was described from south-eastern Australia (Charlton-Robb et al. 2011).**

The Gippsland Lakes is home to one of only two known resident populations of this species, with an estimated resident population size of just 50 individuals (Charlton-Robb et al. 2014). During winter, however, the numbers increase, with over 150 individuals recorded. It is thought that this is due to migration of males between the Gippsland Lakes and Tasmania in a seasonal pattern, arriving in the Gippsland Lakes in winter to breed, then heading south to Tasmania in summer. By contrast, the female population appears to be more sedentary, remaining in the Lakes year-round.

Throughout the implementation of the 2015 Gippsland Lakes Ramsar Site Management Plan, the Marine Mammal Foundation (MMF), led by Dr. Kate Robb and her research team, has undertaken seasonal fauna assessments of the Burrunan Dolphin within the Gippsland Lakes to investigate trends in species demographics, behaviour and the distribution of both the resident and transient populations.

Although not considered critical to the ecological character of the Gippsland Lakes Ramsar site and not covered by this Ramsar site management plan, the Burrunan dolphin is listed as critically endangered under the *Victoria Flora and Fauna Guarantee Act* and is valued by the local community who have been actively involved in monitoring the species through the Lakes Champions Community Stewardship project. Developed in 2020 and funded through the GLCC Community Grants program, the citizen science initiative has involved many volunteers who participated in monitoring dolphin and vessel interactions at various locations across the Gippsland Lakes. Volunteers also assisted MMF in raising awareness of the impacts of tourism and boating on the Burrunan dolphin population in the Gippsland Lakes, particularly by vessel pursuit which has been shown to alter feeding and resting behaviour (Howes et al. 2012, Filby et al. 2014).

Managing boating and tourism in the Gippsland Lakes is important to maintain the Burrunan Dolphin population and the long-term sustainability of dolphin related tourism.

Pest plants and animals and recreational activities were identified as high priority threats to fauna in the Gippsland Lakes Ramsar site. In addition, continued and coordinated approaches to managing introduced marine pests was identified as a priority. Four management strategies have been identified to protect fauna (Table 13). The relationship between management strategies, priority threats and priority values with their associated RCTs is provided in Appendix F.

**Table 13** Management strategies and responsibilities for protecting fauna.

| Management Strategies | Responsibility | Linkages to existing programs / activities | Relevant mega-habitat(s) |
|---|---|---|---|
| 2A. Control of introduced predators in priority bird areas | Parks Victoria, DEECA | Biodiversity programs by Parks Victoria and DEECA, Gippsland Lakes Invasive Species Strategy | All |
| 2B. Develop and implement measures to improve public awareness to reduce disturbance to migratory waders and nesting birds | BirdLife Australia | | Deep Lakes and Shallow Lakes and any other mega-habitats where there are high recreational impacts |
| 2C. Develop a marine pest strategy for the Gippsland Lakes and implement priority actions | EGCMA, Gippsland Ports, DEECA | Introduced marine pest surveys, GP bio-security protocols | Deep Lakes, Shallow Lakes, |
| 2D. Control of non-native grazing animals (deer, goats) and pigs | Parks Victoria, DEECA | Gippsland Lakes Invasive Species Strategy | All |

Pest plants and animals and recreational activities were identified as high priority threats to fauna in the Gippsland Lakes Ramsar site.

## 4.5 Theme 3: Managing nutrients and sediments

Nutrient and sediment inputs to the Gippsland Lakes have been the subject of extensive investigation and committed on ground management actions. In the past decade, our understanding of the triggers for algal blooms and nutrient and sediment sources has been greatly improved. In addition, agencies such as the West and East Gippsland CMAs have worked with landholders, industry and communities to try and reduce the loads of nutrients and sediments entering the Gippsland Lakes from the catchment. The two case studies reflect both the improvement in our knowledge and the achievements of on ground actions.

### The impacts of increased nutrients: the history of algal blooms

**A study of the long-term history of algal blooms in the Gippsland Lakes from sediment cores indicates that there are two distinct periods of blue-green algal blooms in the Lakes (Holland et al. 2013a).**

The first was prior to the permanent opening of the entrance to the Southern Ocean, and it is thought that the intermittently closed and open lagoon system was eutrophic. This is followed by a period immediately post construction of the channel at Lakes Entrance in 1889 of low algal growth, as the system filled and flushed with marine water. The second period of increased blue-green algal blooms has occurred post 1986 and is a result of a build of nutrients in the system from historical and contemporary land practices in the catchment (Webster et al. 2001, Beardall 2008, Day et al. 2011).

Algal blooms are linked to periods of increased nutrients, which arrive in large loads following heavy rainfall and in extreme loads following widespread bushfires in the catchment. Erosion from cleared land and degraded river banks are a significant source of sediment and nutrients (Hancock et al. 2007). The West and East Gippsland CMAs and other agencies such as Southern Rural Water have a number of programs in place to address nutrient and sediment movement from the catchment to the Lakes to help reduce algal blooms and protect the ecological character of the Gippsland Lakes Ramsar Site.

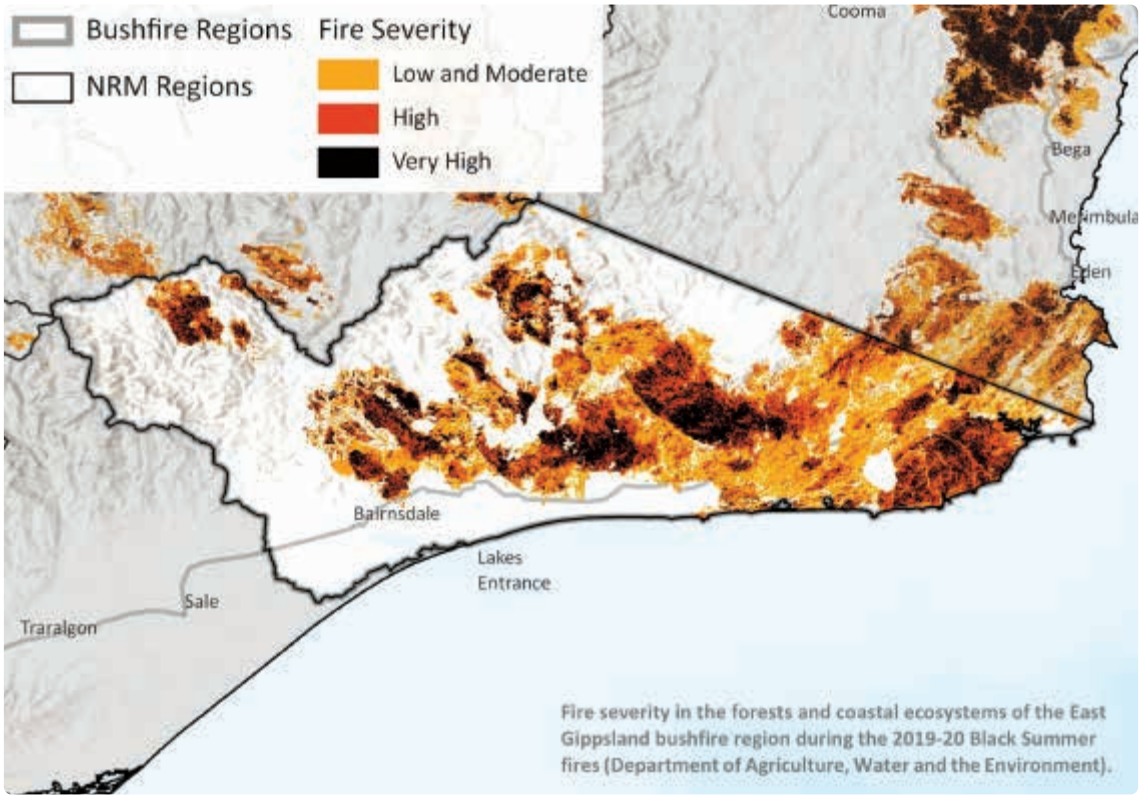
## Bush fire risks to the Gippsland Lakes

**During the 2019-20 Summer, a landscape scale bushfire burnt across over 1 million hectares of land across the Eastern Victoria.**

Approximately 59% of East Gippsland was impacted resulting in the significant loss of native vegetation, fauna and human assets as well as causing a reduction in water quality from increased sediment loads within the catchment (CSIRO 2022).

In 2022, the CSIRO were commissioned by Commonwealth Government to analyse the impacts of the 2019-20 bushfires on the ecological character of the Gippsland Lakes Ramsar Site (GLRS), with particular focus on water quality. Water quality is a key critical process of the GLRS and is also identified within two knowledge gaps including the impacts of fire and climate change on key aquatic habitats within the Gippsland Lakes Ramsar Site.

The study utilised available water quality data from monitoring stations located on impacted tributaries which are directly linked to the Gippsland Lakes including the Mitchell, Nicholson and Tambo Rivers. Rainfall data was also used as part of the analysis. The main risks identified for water quality within the Gippsland Lakes catchment was the increased transport of ash, sediments and other pollutants including toxicants and metals within the lower catchments of connecting tributaries. Natural sedimentation occurs within catchments however fire increases runoff due to the erosion of soils from loss of vegetation. Additionally, heavy rainfall post fire contributed further to runoff and increased sedimentation within the catchment.




Fire severity in the forests and coastal ecosystems of the East Gippsland bushfire region during the 2019-20 Black Summer fires (Department of Agriculture, Water and the Environment).

Nutrient and sediment inflows from the catchment to the main lakes were identified as one of the highest priority threats for this Ramsar Site Management Plan. Impact pathways from general agricultural run-off and elevated nutrient and sediment loads following bushfires, were identified as high risks for seagrass, fish and waterbirds (including the threatened fairy tern). A single integrated management strategy has been identified to address this important issue and maintain ecological character (Table 14). The relationship between management strategies, priority threats and priority values with their associated RCTs is provided in Appendix F.

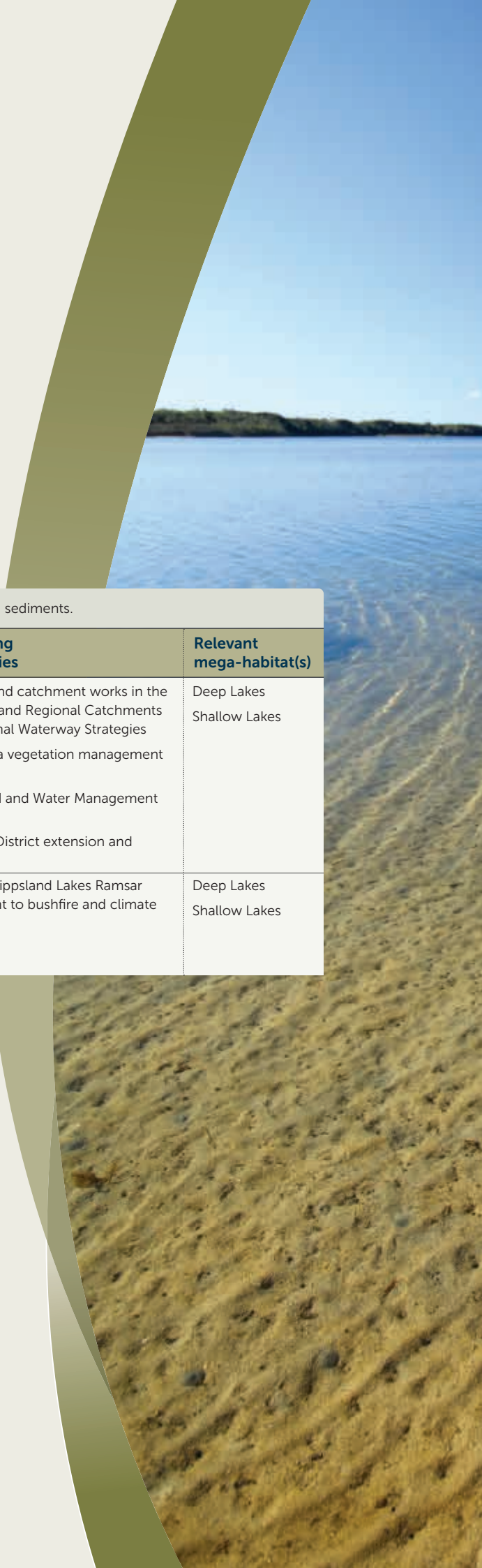


**Table 14** Management strategies and responsibilities for managing nutrients and sediments.

| Management Strategies | Responsibility | Linkages to existing programs / activities | Relevant mega-habitat(s) |
|---|---|---|---|
| 3A. Reduce nutrient and sediment loads to the Gippsland Lakes through riparian, in-stream and catchment works to improve water quality of river flows to the Gippsland Lakes. | East and West Gippsland CMAs, DEECA, PV, EGW, SRW, GW | Riparian, in-stream and catchment works in the East and West Gippsland Regional Catchments Strategies and Regional Waterway Strategies<br>Existing Parks Victoria vegetation management programs<br>Lake Wellington Land and Water Management Plan<br>Macalister Irrigation District extension and incentives program | Deep Lakes<br>Shallow Lakes |
| 3B. Work with responsible bushfire management agencies to reduce the potential impacts of high intensity burns on water quality entering the Gippsland Lakes. | East and West Gippsland CMAs, DEECA | Vulnerability of the Gippsland Lakes Ramsar Site and its catchment to bushfire and climate change | Deep Lakes<br>Shallow Lakes |

Nutrient and sediment inflows from the catchment to the main lakes were identified as one of the highest priority threats for this Ramsar Site Management Plan.

## 4.6 Theme 4: Managing water regimes

In the past decade or so there have been significant developments with respect to environmental water management in the Gippsland Lakes and catchment. Environmental water management arrangements have been established for the lower Latrobe wetlands (see text box below) and some rivers flowing into the Gippsland Lakes and used to *"preserve environmental values and health of water ecosystems including their biodiversity, ecological functioning and quality of water and other uses that depend on the environmental condition" (Water Act 1989)*. East and West Gippsland CMAs have worked with storage operators, water entitlement-holders and landholders to maximise the environmental benefits from the environmental water and integrate it with other waterway management works and measures. The recently released Central and Gippsland Region Sustainable Water Strategy (DEECA 2022) aims to recover water for the environment in key catchments to improve ecological outcomes.

Despite these achievements, altered water regimes and increasing salinity in the shallow lakes and fringing wetlands of the Gippsland Lakes Ramsar Site were identified as a priority threat for this Ramsar site management plan due to the potential to impact ecological character through changes in vegetation diversity and extent, disruption of bird breeding cycles and a loss of breeding triggers for estuarine fish. Three management strategies have been identified in this plan to address this issue by supporting existing work in the Ramsar site and complementing relevant government policy and decision making (Table 15). The relationship between management strategies, priority threats and priority values with their associated RCTs is provided in Appendix F.

The Central and Gippsland Region Sustainable Water Strategy CGRSWS (DEECA 2022) aims to recover additional water for the environment to improve ecological outcomes for priority rivers and the Gippsland Lakes Ramsar Site. Environmental water recovery volumes for the Latrobe estuary and lower Latrobe wetlands (Hale et al. 2022) are included within the CGRSWS's water recovery volumes for their source rivers: the Thomson, Macalister, Latrobe and Tyers rivers. The CGRSWS also includes important actions to optimise the value from environmental water recovery for the Gippsland Lakes system, particularly the lower Latrobe wetlands.

**In the context of climate change, protection of all freshwater inflows (including flood waters and environmental water) into the Gippsland Lakes is important as it plays a crucial role in maintaining the ecological character of the Ramsar Site.**

## Managing water regimes: maintaining and improving ecological character in the Lower Latrobe Wetlands

**The Lower Latrobe Wetlands comprise Sale Common, Heart Morass and Dowd Morass and are located at the end of the Latrobe River near where it discharges to Lake Wellington.**

The ecological character of these wetlands is threatened by water resource use and climate change, resulting in altered water regimes and salinity. Water and land managers and local communities have worked together to repair the wetlands for over 30 years, including the introduction of water entitlements held for the environment.

After over 10 years of delivering water for the environment to the lower Latrobe wetlands, Sale Common saw the nationally endangered Australasian Bittern return in 2019 for the first time since the 1990s. In 2021–22, environmental water was used to complement natural inundation and there were over 300 waterbird nests spotted including of the colonial nesting royal spoonbill, yellow-billed spoonbill, little pied cormorant, and little black cormorant, representing the largest breeding event in the Lower Latrobe Wetlands since 2012. In addition, increased numbers of musk duck were observed, a species culturally significant to the Gunaikurnai Traditional Owners.

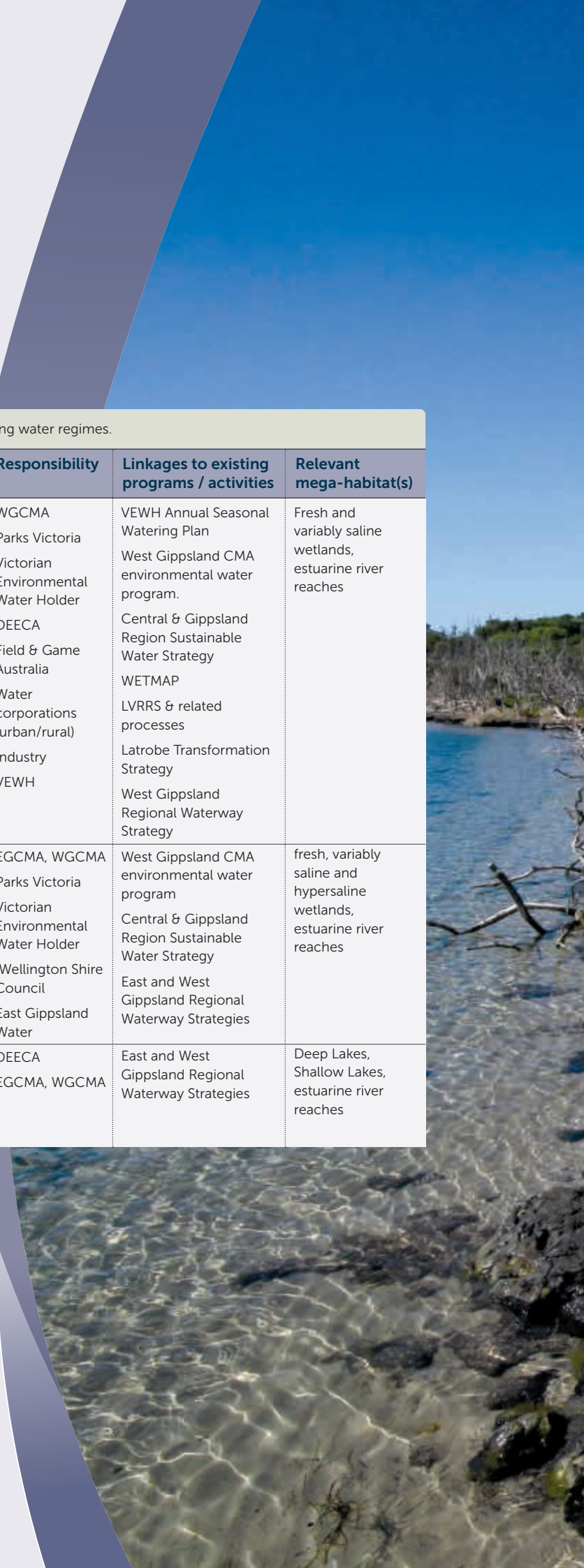
Monitoring in March 2022 revealed frog breeding events in the wetlands including the nationally vulnerable growling grass frog and green and golden bell frog, which were recorded for the first-time breeding at Heart Morass.

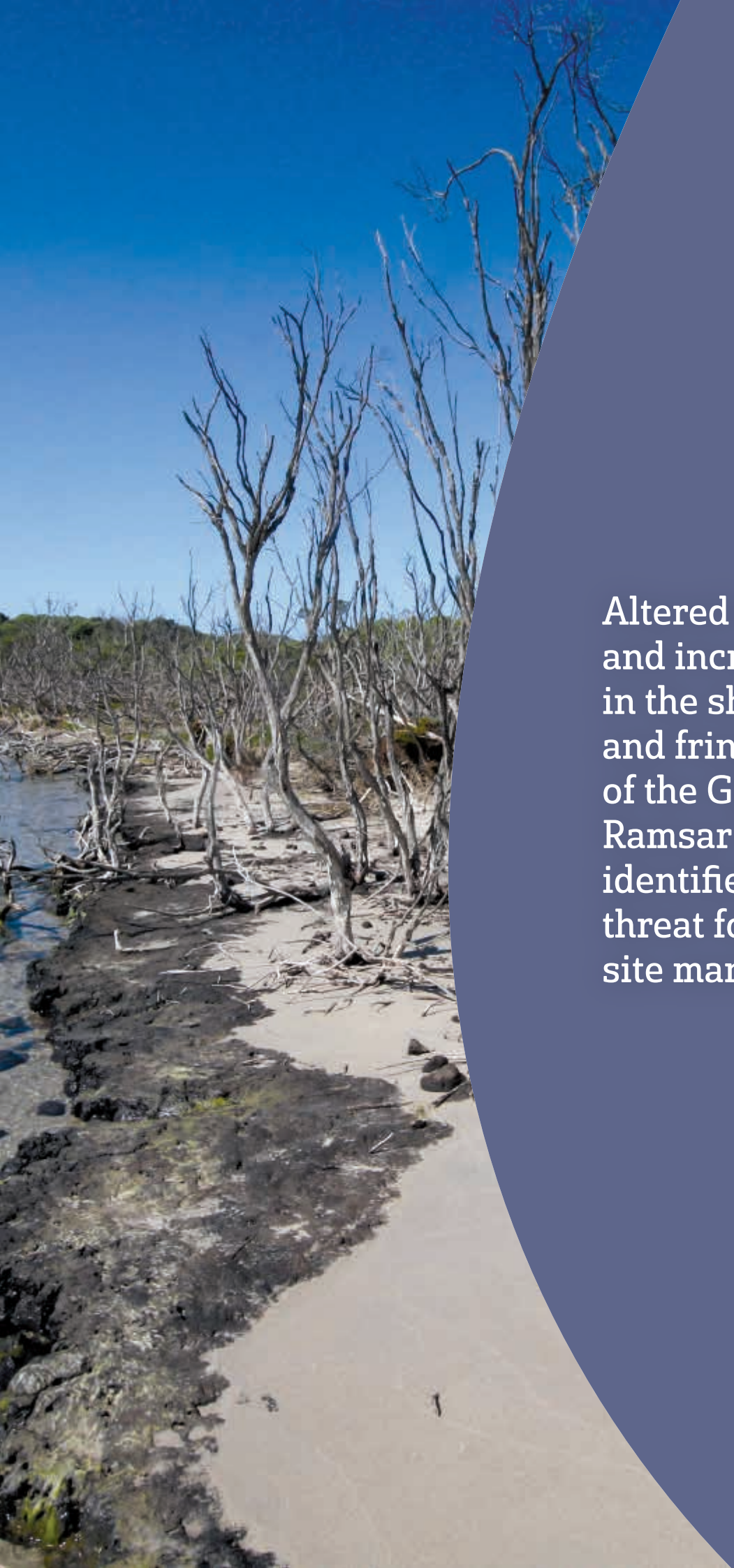
In addition, after large scale flooding, fishers noted a marked increase in Estuary Perch and Australian Bass indicating breeding and migration events in 2020–21. For the Australian Bass, Australia's longest-lived fish species, this was the largest breeding event in the Latrobe system since the 1980s.

Delivering water for the environment over the previous dry years has helped to maintain systems and prepare them for the natural flood 'boom times'. Environmental flows will continue to be delivered in response to emerging conditions and will become increasingly important in a system impacted by water use and climate change.

**Table 15** Management strategies and responsibilities for managing water regimes.

| Management Strategies | Responsibility | Linkages to existing programs / activities | Relevant mega-habitat(s) |
|---|---|---|---|
| 4A. Address the combined effects of water use and climate change on the ecological character of the lower Latrobe wetlands (Sale Common, Dowd Morass and Heart Morass) by prioritising:<br>• Regular planning, delivery, monitoring and evaluation of the use of environmental water entitlements;<br>• Recovery of the water needed for the Lower Latrobe wetlands through implementation of the policies in the Central and Gippsland Region Sustainable Water Strategy with respect to water recovery in the Thomson, Macalister, Latrobe and Tyers rivers; and<br>• Implementation of actions in the Central and Gippsland Region Sustainable Water Strategy with respect to improving the delivery of environmental water to the lower Latrobe wetlands. | WGCMA<br>Parks Victoria<br>Victorian Environmental Water Holder<br>DEECA<br>Field & Game Australia<br>Water corporations (urban/rural)<br>Industry<br>VEWH | VEWH Annual Seasonal Watering Plan<br>West Gippsland CMA environmental water program.<br>Central & Gippsland Region Sustainable Water Strategy<br>WETMAP<br>LVRRS & related processes<br>Latrobe Transformation Strategy<br>West Gippsland Regional Waterway Strategy | Fresh and variably saline wetlands, estuarine river reaches |
| 4B. Investigate, and where feasible and cost effective, implement actions that enable and facilitate effective management of the water and salt regimes of priority fringing wetlands, including Sale Common, Heart Morass, Dowd Morass and Macleod Morass. For example: actions in the Central & Gippsland Region Sustainable Water Strategy, technical studies, management plans and/or agreements, water entitlements, on ground works, operational management and monitoring. | EGCMA, WGCMA<br>Parks Victoria<br>Victorian Environmental Water Holder<br>Wellington Shire Council<br>East Gippsland Water | West Gippsland CMA environmental water program<br>Central & Gippsland Region Sustainable Water Strategy<br>East and West Gippsland Regional Waterway Strategies | fresh, variably saline and hypersaline wetlands, estuarine river reaches |
| 4C. Implement the actions of the Central and Gippsland Region Sustainable Water Strategy with respect to water recovery and flows in the rivers of the Gippsland Lakes to address the combined effects of water use and climate change on ecological character. | DEECA<br>EGCMA, WGCMA | East and West Gippsland Regional Waterway Strategies | Deep Lakes, Shallow Lakes, estuarine river reaches |





Altered water regimes and increasing salinity in the shallow lakes and fringing wetlands of the Gippsland Lakes Ramsar Site were identified as a priority threat for this Ramsar site management plan.

## 4.7 Theme 5: Cultural Landscapes

The Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) wishes to pursue outcomes for Healthy Country in a self-determined way which means 'our people are making decision to benefit the Gunaikurnai and their future'. The Gunaikurnai people have the longest history here and will make decisions to care for Country for the long term. The Gunaikurnai creation story speaks of Borun, the Pelican, and Tuk, the Musk Duck and how they became the mother and father of the five clans, the creators of Gunaikurnai. This story is linked to the waterways and wetlands across Gunaikurnai Country, including the Gippsland Lakes.

GLaWAC wishes to see principles of holistic management of Country pursued.

> *"As Gunaikurnai, we see our land (Wurruk), waters (Yarnda), air (Watpootjan) and every living thing as one. All things come from Wurruk, Yarnda and Watpootjan and they are the spiritual life-giving resources, providing us with resources and forming the basis of our cultural practices. We have a cultural responsibility to ensure that all of it is looked after.[3]"*

> *"For many thousands of years Gunaikurnai have lived in the valleys, on the fertile plains and up in the mountains of our traditional Country. Our Country was created by the spirits – the ancestors who link us to the land and bestow on us identity, rights and responsibilities. They defined our relationship with the land – how it should be used, how to move through it safely and how to care for it. In return, Country provided physical and spiritual nourishment for our people, with plentiful food, medicine, water and natural resources for survival.[3]"*

Current arrangements in natural resource management and planning in Victoria often divide parts of the landscape to inform management. The holistic view of Country held by Gunaikurnai is guiding GLaWAC's approach.

> *"Our Country is the land, the rivers and the ocean, the people and the stories, the past and the future. All of it is connected. All of it is important to us. Country heals us and connects us to our ancestors, our culture and history. We are sustained by our Country – through the water, food, medicines and materials that it provides us.[1]"*

The Gippsland Lakes are principally within the territories of the Tatungalung and Krauatungalung clans, bordered by the Brataualung, Brayakaulung and Brabralung clan areas. The Lakes region includes the locations of important story places that relate to all aspects of Gunaikurnai life and world views, both past and present.

The lands and waters of the lakes and associated wetlands comprise traditional hunting, fishing, camping and gathering places of the Old People. Major base camp locations can be found along the dunes between the lakes and the ocean, with many shell accumulations still evident as archaeological sites. Burial places are also located within the dunes. Many "artefact scatters", consisting mainly of the stone implements made and used by the Old People, are present around the lake shores and the wetland margins, highlighting the selective use of all parts of this landscape. Culturally modified trees ("scarred trees") are found primarily on the lake shores and riverbanks. This is a sensitive, culturally important area as well as a rich and dynamic environment. Recent research has shown that this culturally important area is at risk from the impacts of a changing climate.

GLaWAC seeks to influence, and be genuinely involved in healing Country, protecting our cultural sites and traditions on Country, and enhancing community wellbeing, through training, education and economic development opportunities that arise from these aspirations.

Around the Gippsland Lakes and the region more broadly, GLaWAC is involved through a variety of operational programs and partnerships. The level of involvement, number of programs, and their interconnected nature is complex.

[3] Gunaikurnai Whole of Country Plan (2015).

## Improving access to an important Cultural Landscape: The Lake Tyers Camping and Access Strategy

**Lake Tyers State Park incorporates the area known as Bung Yarnda in the Gunaikurnai language.**

The park extends from the sea at Lake Tyers Beach township to Mount Nowa Nowa and surrounds the privately owned Lake Tyers Aboriginal Trust (the Trust) land and Lake Tyers itself. The park has particularly strong Aboriginal cultural values, both tangible and intangible, that are of the utmost importance to GLaWAC, the Trust community and the broader Gunaikurnai community.

The park attracts visitors from the broader community, especially for fishing and camping but also picnicking, bush walking, nature study and bush driving. In some locations these recreational activities have a direct impact on cultural and environmental values.

GLaWAC, Parks Victoria and the Gunaikurnai Traditional Owners Land Management Board (GKTOLMB) have developed a Camping and Access Strategy for Lake Tyers State Park as part of joint management. The agencies respect the importance of this area for Aboriginal people and are seeking to address the significant impacts that are occurring on the cultural and environmental values of the park.

The strategy aimed to protect the cultural and environmental values throughout the park; and improve the recreational opportunities and facilities for visitors to the park.

The strategy reviewed and considered day visitor and camping sites; vehicle and boating access; and walking tracks.

Beyond protection, the cultural and environmental values of the park should be celebrated, and improved visitor experiences need to be provided along with opportunities for the Aboriginal and non-Aboriginal community to connect with the park. The strategy aligns with the Joint Management Plan, Whole-of-Country Plan and the Parks Victoria Shaping Our Future strategy.

GLaWAC, in partnership with Parks Victoria, gave Traditional Owners, the community and key stakeholders the opportunity to inform the development of this strategy. The Lake Tyers Access and Camping Strategy Engagement Plan included very broad community consultation and therefore has now incorporates Gunaikurnai knowledge, values and practices into the development of this land use strategy.

**Table 16** Management strategies to enhance the Gippsland Lakes Cultural Landscape.

| Management Strategies | Responsibility | Linkages to existing programs / activities | Relevant mega-habitat(s) |
|---|---|---|---|
| 5A: Continue to support the Gunaikurnai (through GLaWAC) to heal Gippsland Lakes Country through self-determined opportunities, including the implementation of spiritual and cultural practice. Prioritise partnership with GLaWAC to develop and implement a Cultural Landscapes program for the Gippsland Lakes. | GLaWAC<br>All partners | Cultural Landscape Strategy<br>Joint Management program<br>GLCC program of works | All |
| 5B: Actively involve Gunaikurnai in decision making and governance structures around the Gippsland Lakes Ramsar site, including self-determined opportunities for experience and skills development in Ramsar site management and governance. | GLaWAC<br>DEECA<br>East and West Gippsland CMAs<br>Parks Victoria | Gippsland Lakes Coordinaing Committee (GLCC)<br>Gippsland Lakes Ramsar Site Coordinating Committee | All |
| 5C: Align and implement priorities in GLaWAC Healthy Water Plan (in preparation) relevant for the Gippsland Lakes and its catchment, including priorities and outcomes from the ongoing Nanjet to Mallacoota Sea Country Indigenous Protection Area project. | GLaWAC<br>DEECA<br>East and West Gippsland CMAs<br>Parks Victoria | Water is Life<br>Water is Life – GLaWAC Nation Statement<br>Nanjet to Mallacoota - Sea Country IPA (in progress)<br>GLaWAC Healthy Water Plan (in preparation) | All |
| 5D: Support the continued research and collection of information across the Gippsland Lakes Cultural landscape. Explore opportunities for 'two way' data and information sharing (where culturally appropriate) to help protect and restore sites and places important to Gunaikurnai. | GLaWAC<br>All partners | GK Cultural mapping program | All |
| 5E: Prioritise and align management actions (through other themes in the GLRSMP) to restore the Gippsland Lakes cultural landscape, including the protecting and enhancement of culturally significant species. | GLaWAC<br>All partners | GLCC program of works | All |

This is a sensitive, culturally important area as well as a rich and dynamic environment. Recent research has shown that this culturally important area is at risk from the impacts of a changing climate.

## 4.8 Theme 6: Improving our understanding

The Gippsland Lakes are a well-studied system and there has been a long history of monitoring and scientific investigation. A small number of priority knowledge gaps were identified (see section 3.4).

Some of these are addressed through monitoring activities (see section 5) and six management strategies have been developed to address the remainder (Table 17).

### Improving our understanding: Mapping vegetation using satellite imagery

**The Gippsland Lakes is a large Ramsar site that covers almost 60,000 hectares and monitoring the extent of vegetation communities within the site can be resource intensive.**

Remote sensing offers a cost-effective approach for mapping inundation dependent vegetation types over the entire site. In 2019, a trial of using different types of imagery to map seagrass in the Gippsland Lakes was undertaken. Imagery from the European Space Agency's Sentinel-2 satellite was compared to lower resolution Landsat imagery and higher resolution (and expensive / less available) Worldview imagery. It was concluded that Sentinel-2 was appropriate for image analysis and mapping to assess Gippsland Lakes Ramsar site LAC because it provides higher resolution than Landsat (10 m versus 30 m), has consistent coverage of the entire Ramsar site, is free of charge, is frequently available and will be accessible into the foreseeable future.

A supervised classification model was developed, whereby the system is "trained" to identify 10 different classes of landcover (seagrass, saltmarsh, tall marsh (reed beds), shallow marsh, swamp scrub (paperbark), coastal scrub/heathlands, agricultural land, forest, bare ground (includes roads and rooftops) and open water.

The timing of the imagery capture for mapping was found to be important, particularly for identifying tall marsh. In the Gippsland Lakes this vegetation community is dominated by common reed and bullrush, both of which appear green in spring and summer and turn brown in winter. By comparing summer and winter satellite images, it was possible to distinguish tall marsh from other emergent wetland vegetation.

This cost-effective method of monitoring vegetation community and habitat extent over time, developed in the Gippsland Lakes, has since been used at other Ramsar sites in Victoria to evaluate LAC and inform management of ecological character.

**Source**: Brooks, S. and Hale, J. (2021) Gippsland Lakes Fringing Wetland Vegetation Mapping. A report to East Gippsland CMA.

Tall marsh in **summer** in MacLeod Morass.

Tall marsh in **winter** in MacLeod Morass.

**Table 17** Management strategies to address critical knowledge gaps.

| Management Strategies | Responsibility | Linkages to existing programs / activities | Relevant mega-habitat(s) |
|---|---|---|---|
| 6A. Investigate potential management options for the risks to ecological character from known toxicants (e.g. PFAS and mercury). | EGCMA, EPA Victoria | Australian Defence Force Remediation Action Plan for the RAAF Base East Sale | All |
| 6B. Investigate further the risks from new and emerging toxicants and chemicals to Gippsland Lakes Ramsar values and the potential management options. | EGCMA, EPA Victoria | | All |
| 6C. Investigate, and where feasible and cost effective, implement actions that enable and facilitate effective management of carp in fringing wetlands. | WGCMA, DEECA | | Freshwater wetlands, variably saline wetlands |
| 6D. Develop and implement a response plan for addressing risks associated with avian diseases. | DEECA, BirdLife | Agriculture Victoria avian flu response plan | All |
| 6E. Develop a response plan for identifying and managing risks to ecological character from introduced marine pests. | DEECA, Parks Victoria | | Deep and Shallow Lakes |
| 6F. Investigate the severity and extent of impact deer and other introduced herbivores are having on waterbird nest sites and sensitive wetland environments such as coastal saltmarsh. | EGCMA, Parks Victoria | | All |
| 6G. Awareness raising/education about the Ramsar Convention, the condition of the Gippsland Lakes, environmental impact assessment, management options and implications. | DEECA<br>East and West Gippsland CMAs | | All |
| 6H. Understand the risks of activating Acid Sulfate Soils that may impact on the ecological character of the Gippsland Lakes. | DEECA<br>East and West Gippsland CMAs | | All |

The Gippsland Lakes are a well-studied system and there has been a long history of monitoring and scientific investigation.

# 05

# Monitoring, evaluation, reporting and improvement

Assessment of the ecological character of the Ramsar site and progress of this management plan is underpinned by a monitoring, evaluation, reporting and improvement (MERI) Framework.

## 5.1 Framework

Consistent with the Victorian Waterway Management Strategy (VWMS), the Ramsar Convention and the Australian Ramsar Management Principles, this Gippsland Lakes Ramsar Site Management Plan adopts an adaptive management approach. The Gippsland Lakes 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 through a four and seven year review.

In 2018, Victoria developed a Ramsar monitoring evaluation reporting and improvement (MERI) Framework to improve confidence in the effectiveness of management of Victoria's Ramsar sites and to assist Victoria in meeting national reporting obligations under the Ramsar Convention (Figure 14).

Under the framework each Victorian Ramsar site has developed a MERI plan, a living document that describes two types of monitoring:

1. MERI to assess the status of ecological character and meet Ramsar reporting obligations
2. MERI to evaluate the effectiveness of management at the site:
   a. General assessment of the implementation of management actions and progress towards achieving RCTs for all critical CPS
   b. Detailed evaluation testing assumptions associated with management of at least one critical CPS, with the results used to update the evidentiary basis for and to improve the effectiveness of management.

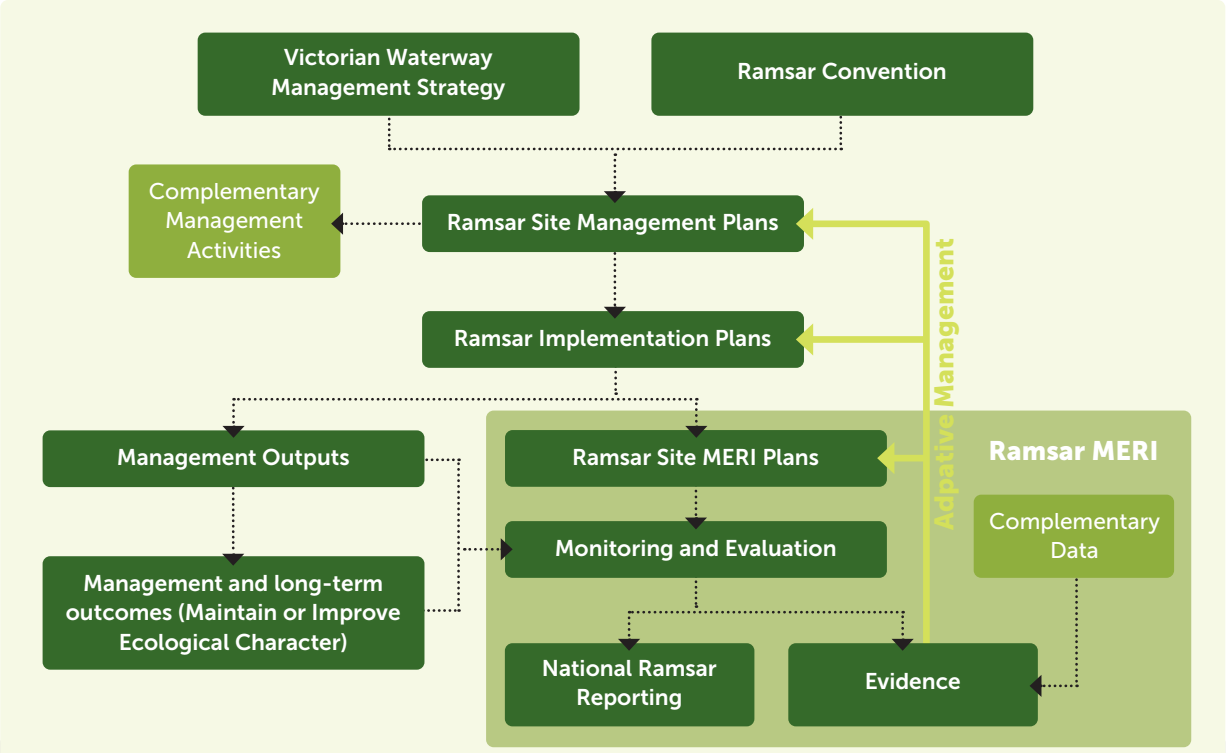



**Figure 14** Monitoring, evaluation, reporting and improvement framework (DEECA unpublished).

A summary of monitoring within the Gippsland Lakes MERI Plan is provided in Table 18.

**Table 18** Monitoring program for the Gippsland Lakes Ramsar Site.

| Recommended monitoring | | | | Linkages to existing programs / activities |
|---|---|---|---|---|
| **Program** | **Indicators and Method** | **Frequency** | **Responsibility** | |
| Seagrass | Extent and density of seagrass communities. | Mapping every five years | DEECA | Recent mapping of seagrass extent in 2019 – 2021. |
| Water quality monitoring in priority lakes and wetlands | Salinity, dissolved oxygen, water clarity | Monthly and event based | EPA Victoria, DEECA | Current water quality monitoring by EPA Victoria covers Deep and Shallow Lakes. Continuous loggers in place at the Lower Latrobe Wetlands and Macleod Morass |
| Mapping of wetland (including saltmarsh) vegetation communities in the Ramsar site. | Mapping of wetland EVCs, consistent with that of Boon (2011) and current WGCMA mapping. | Every five years | DEECA, Parks Victoria, East and West Gippsland CMAs | Recent mapping of saltmarsh across the Ramsar site and within buffers in 2021. |
| Condition assessments of priority vegetation communities: swamp paperbark, emergent macrophytes, saltmarsh | Methods based on recognised methods against EVC benchmarks. | Every ten years | DEECA, Parks Victoria, East and West Gippsland CMAs | Saltmarsh condition assessments undertaken in 2019 and 2022. |
| Monitoring of threatened plant species: swamp everlasting | Population | Annual | DEECA, Parks Victoria | Existing monitoring and protection programs for a selected group of threatened plants are in place by DEECA and Parks Victoria. |
| Waterbird counts and breeding records (including for cryptic species such as the Australasian bittern). | Abundance of each species, and evidence of breeding. Build on existing programs, but with a preference for a total wetland / site count at priority locations. | Annual | DEECA, Parks Victoria | Current: Waterfowl annual counts (game species); nesting tern monitoring; and Gippsland Lakes waterbird monitoring program. |
| Frog monitoring: adults and tadpoles / juveniles | Audio monitoring of calls | Annual | DEECA, Parks Victoria | Greening Australia monitoring of threatened frog species, |
| Native fish: abundance and species | Purpose built monitoring program will need to be developed. At a minimum, surveys should measure abundance and community composition. | Annual | DEECA | Current (historic) sampling in the Deep and Shallow Lakes only. Needs to be expanded to include sampling in the freshwater wetlands and estuarine reaches. |

06

# Governance and Implementation

Management of the Gippsland Lakes involves a range of governemnt, non-government, Traditional Owners, community groups and volunteers.

## 6.1 Governance

The roles and responsibilities for managing Ramsar sites in Victoria can be summarised follows:

**Ramsar state-wide coordinator**

DEECA will undertake a state-wide coordination and oversight role:

- Coordinate and oversee implementation of the VAGO audit recommendations.
- Facilitate a coordinated and consistent approach to MERI and adaptive management.
- Undertake preliminary and formal assessment in response to potential change in ecological character.
- Develop a management response in partnership with the site coordinator and site manager/s where change in ecological character has been confirmed.
- Address issues that are not able to be managed at a site level.

East Gippsland Catchment Management Authority are the Ramsar Site Coordinator for the Gippsland Lakes.

- Lead RIS and ECD updates undertaken in consultation with the Ramsar site coordinator.
- Oversee renewal of management plans and ensure that they meet the Australian Ramsar Management Principles, follow an adaptive management approach and address issues of management effectiveness identified through the MERI framework.

### Ramsar site coordinator

East Gippsland CMA is the site coordinator and has the following responsibilities:

- Convene and chair a site coordination committee.
- Ensure coordination committee is engaged.
- In consultation with the coordination committee oversee the implementation of Ramsar site management plan priorities, according to available resources, by:
  - developing an annual action plan that determines and assigns agreed responsibility for actions, and development of annual investment proposals
  - developing and overseeing the implementation of an annual monitoring plan, as guided by the MERI framework; and
  - maintaining up-to-date information in the MERI database.
- Maintain communications with the state-wide coordinator, including:
  - annual investment and implementation reporting
  - tracking ecological character status via the MERI database; and
  - annual reporting on ecological character status (more frequent if limits of acceptable change have been exceeded).
- Maintain communications with agencies that manage small areas within the Ramsar site, in line with responsibilities set out in site management plans.
- Ensuring that monitoring data is appropriately curated for future reference.
- Provide input to state-wide projects (undertaken by state-wide coordinator) relating to Ramsar sites, including any updates to RIS and ECD.
- Oversee strengthening of Ramsar site management plan for sites where this is required.
- Lead the renewal of Ramsar site management plan.

### Ramsar site manager/s

The Ramsar site manager/s for the Gippsland Lakes include Parks Victoria, GLaWAC and Gippsland Ports and they have the following responsibilities:

- Participate in the site coordinating committee activities.
- Implement their agreed responsibilities outlined in Ramsar site annual action plans, in collaboration with regional partners.
- Notify the coordinator of any indication of exceeding limits of acceptable change for the critical components, processes and services as set out in the ecological character description for the site.

## 6.2 Implementation

The East Gippsland CMA as the Ramsar Site Coordinator co-ordinates implementation of this Gippsland Lakes Ramsar Site Management Plan, on behalf of regional agency partners.

A Gippsland Lakes Ramsar Coordinating Committee (GLRCC) comprise of representatives of the partner agencies and are primarily responsible for the management of the Ramsar site (East and West Gippsland CMAs, GLaWAC, Parks Victoria, DEECA.

### 6.2.1 Implementation planning

Each of the agency delivery partners (East and West Gippsland CMAs, DEECA, Parks Victoria and GLaWAC), will prepare agency implementation plans for the actions for which they are identified as responsible in the Gippsland Lakes Ramsar Site Management Plan, by 30 June each year. Each agency will work within their established legislative, regulatory and administrative arrangements.

The East Gippsland CMA will integrate these agency plans into a single action plan for the Gippsland Lakes Ramsar Site Management Plan by December each year to ensure that the responsibilities for individual management actions are clearly established, priorities and sequencing is logical, implementation is focused and coordinated, and funding opportunities are identified.

### 6.2.2 Gippsland Lakes Ramsar Coordinating Committee

The GLRSCC is convened and co-ordinated by East Gippsland CMA.

This integration 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 Gippsland Lakes Ramsar Site Management Plan.

The GLRSCC will be responsible for coordinating specific aspects of implementation within the themes of the Gippsland Lakes Ramsar Site Management Plan. These responsibilities will include developing:

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

### 6.2.3 Resourcing implementation

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

Implementation of the Gippsland Lakes Ramsar Site Management Plan will be influenced by available funding and resources. The implementation approach that will be applied will coordinate the prioritisation of management actions so that maximum benefit is achieved with the resources that are available. The annual priorities are captured in annual action plans which detail the resources required and responsible partners for their implementation and provide a mechanism to chart and evaluate the implementation of the Ramsar site management plan.

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

- Victorian Waterway Programs Investment Framework;
- Relevant initiatives of the State and Federal Governments;
- Existing agency budgets; and
- Contributions of industries and communities.

## 6.3 Communication

The East Gippsland CMA will co-ordinate communications and engagement for the Ramsar site as part of its role in co-ordinating the GLRSCC and overseeing the implementation of the Gippsland Lakes Ramsar Site Management Plan.

## 6.4 Ramsar Administration

There are a number of administrative matters required to be undertaken as a component of managing the Gippsland Lakes Ramsar Site. These are described, with a brief rationale in Table 19.

**Table 19** Matters related to the administering of the Ramsar Convention and the Gippsland Lakes Ramsar Site.

| Management Strategies | Responsibility | Rationale |
|---|---|---|
| 7A. Review the Ramsar site boundary to consider the inclusion of areas of wetlands dissected by the current boundary | DEECA<br>Gippsland Lakes 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. |
| 7B. Update the Ramsar Information Sheet | DEECA, DCCEEW | Ramsar information sheets (RIS) are scheduled for review and updating every six years. DEECA is currently working with DCCEEW to update the RIS to include additional data and knowledge. |
| 7C. 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). | DEECA, DCCEEW | 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.<br>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. |
| 7D. Undertake a regular review of the status of the ecological character of the Ramsar site. | EGCMA, DEECA | Annual reporting against LAC and RCT to be incorporated int the Ramsar Management System and reported to the Australian Government as required. |
| 7E. Develop rubrics / thresholds for assessing progress towards RCTs | EGCMA, WGCMA, DEECA, Parks Victoria | Transparent evaluation of management effectiveness s with respect to RCTs is reliant on agreed indicators and thresholds. These will be developed with site managers and technical experts. |
| 7F. Develop annual action plans for this strategy | EGCMA with GLCC | This plan has identified high level strategies for a number of agencies. |

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# Appendix A Land Tenure and Management

**Table 20** Land tenure and management of the Gippsland Lakes Ramsar Site (BMT WBM 2011).

| Area | Land tenure | Legal status | Management |
|---|---|---|---|
| Sale Common | Nature Conservation Reserve – Wildlife Reserve | Crown Land (Reserves) Act 1978 and Wildlife Act 1975 | Parks Victoria |
| Dowd Morass (part) Heart Morass | State Wildlife Reserve classified as State Game Reserve | Crown Land (Reserves) Act 1978 and Wildlife Act 1975 | Parks Victoria |
| Clydebank Morass | State Wildlife Reserve classified as State Game Reserve | Crown Land (Reserves) Act 1978 and Wildlife Act 1975 | Parks Victoria |
| Lake Wellington (western shoreline) | Public Purposes Reserve | Crown Land (Reserves) Act 1978 | DEECA |
| Lake Wellington (shoreline – Disher Bay) | Public Purpose Reserve, Unreserved Crown Land | Crown Land (Reserves) Act 1978 | DEECA |
| Lake Wellington (shoreline – Swell Point to Roseneath Point) | Public Purpose Reserve | Crown Land (Reserves) Act 1978 | DEECA |
| Lake Wellington (eastern shoreline) | Public Purpose Reserve, Salt Lake – Unreserved Crown Land | Crown Land (Reserves) Act 1978 | DEECA |
| Lake Wellington | Crown Land Reserve | Crown Land (Reserves) Act 1978 | DEECA |
| Lake Coleman | State Wildlife Reserve classified as State Game Reserve | Crown Land (Reserves) Act 1978 and Wildlife Act 1975 | Parks Victoria |
| Land adjoining Lake Coleman Wildlife Reserve to south | Land vested in Gippsland Water | Water Act 1989 | Gippsland Water |
| Lake Reeve | Gippsland Lakes Coastal Park | National Parks Act 1975 | Parks Victoria & GLaWAC |
| Gippsland Lakes Coastal Park | Coastal Park | National Parks Act 1975 | Parks Victoria & GLaWAC |
| Land near McLennan Strait | Part of Gippsland Lakes Coastal Park | National Parks Act 1975 | Parks Victoria & GLaWAC |
| | Public Purpose Reserve | Crown Land (Reserves) Act 1978 | DEECA |
| Morley Swamp | Natural Features Reserve – Gippsland Lakes Reserve | Crown Land (Reserves) Act 1978 | Parks Victoria |
| Backwater Morass | Natural Features Reserve – Gippsland Lakes Reserve | Crown Land (Reserves) Act 1978 | Parks Victoria |
| Red Morass | Natural Features Reserve – Gippsland Lakes Reserve | Crown Land (Reserves) Act 1978 | Parks Victoria |

*Continued...*

**Table 20** Land tenure and management of the Gippsland Lakes Ramsar Site (BMT WBM 2011).

| Area | Land tenure | Legal status | Management |
|---|---|---|---|
| Victoria Lagoon | Natural Features Reserve – Wildlife Reserve classified as State Game Reserve | Crown Land (Reserves) Act 1978 | Parks Victoria |
| Lake Victoria | Crown Land Reserve | Crown Land (Reserves) Act 1978 | DEECA |
| The Lakes National Park | The Lakes National Park | National Parks Act 1975 | Parks Victoria & GLaWAC |
| Blond Bay | Natural Features Reserve – Wildlife Reserve classified as State Game Reserve | Crown Land (Reserves) Act 1978 and Wildlife Act 1975 | Parks Victoria |
| Lake King | Public Purposes Reserve | Crown Land (Reserves) Act 1978 | DEECA |
| Raymond Island | Natural Features Reserve – Gippsland Lakes Reserve | Crown Land (Reserves) Act 1978 | Parks Victoria & GLaWAC |
| Macleod Morass | Natural Features Reserve – Wildlife Reserve classified as State Game Reserve | Crown Land (Reserves) Act 1978 and Wildlife Act 1975 | Parks Victoria |
| Jones Bay | Natural Features Reserve – Wildlife Reserve classified as State Game Reserve* and Natural Features Reserve – Gippsland Lakes Reserve | Crown Land (Reserves) Act 1978 and Wildlife Act 1975 | Parks Victoria |
| Mitchell River | Public Purpose Reserve | Land Act 1958 | DEECA |
| Swan Reach | Natural Features Reserve – Gippsland Lakes Reserve | Crown Land (Reserves) Act 1978 and Wildlife Act 1975 | Parks Victoria |
| Lake Tyers | State Park | National Parks Act 1975 | DEECA & GLaWAC |
| Land to the south of Lake King | Gippsland Lakes Coastal Park | National Parks Act 1975 | Parks Victoria & GLaWAC |
| North Arm (near Lakes Entrance) | Public Purpose Reserve | Crown Land (Reserves) Act 1978 | DEECA |
| Lakes Entrance to Lake Tyers including Lake Bunga | Lakes Entrance – Lake Tyers Coastal Reserve | Crown Land (Reserves) Act 1978 | Parks Victoria, East Gippsland Shire Council |

# Appendix B
# Stressor Model

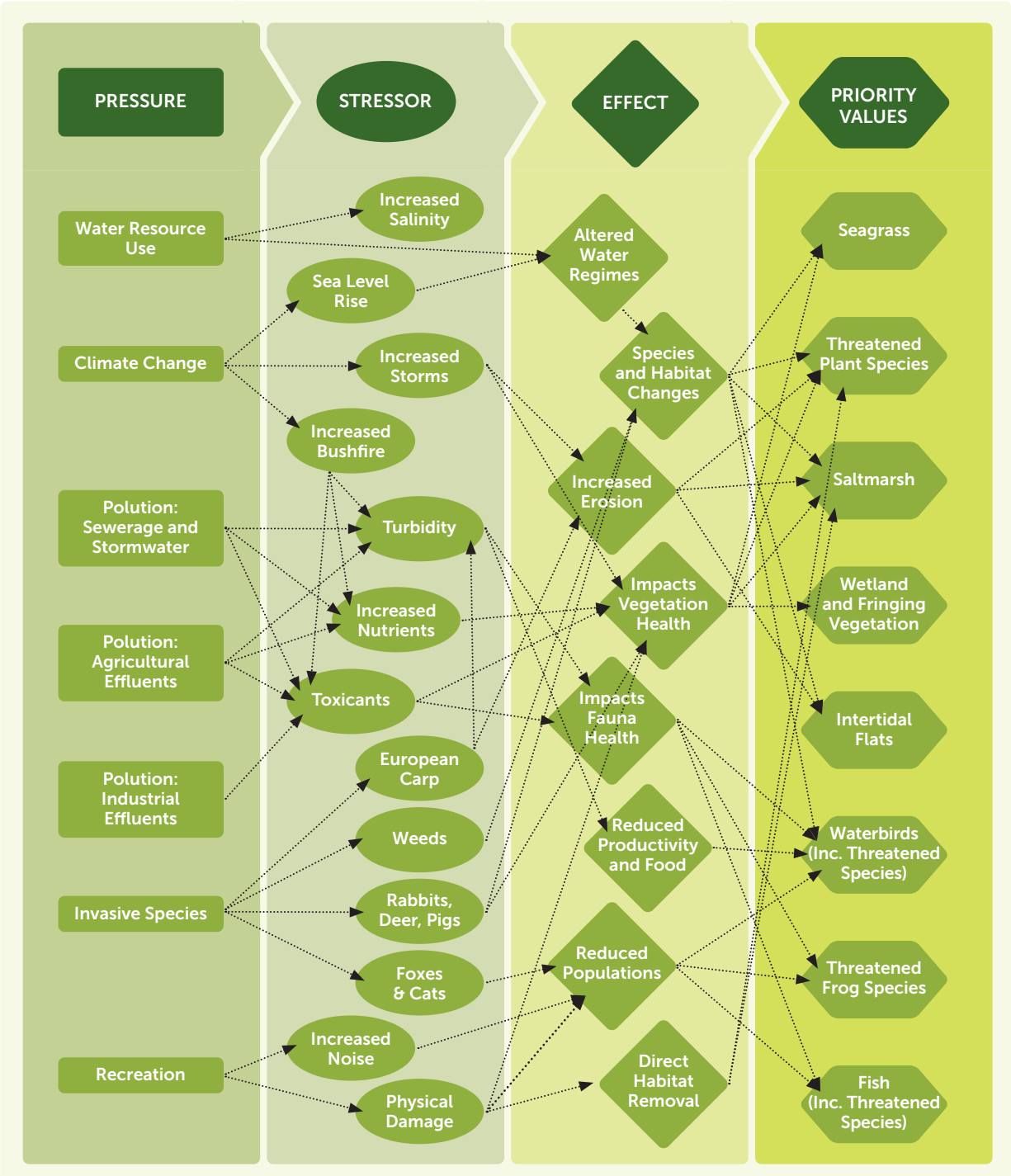


**Figure 15** Stressor model illustrating the major linkages between high priority threats (pressures and stressors) and high priority values.

# Appendix C
# Risk Assessment

**Table A-1** Risk Assessment for the Deep Lakes mega-habitat.

## Deep Lakes

### Threat
### Residential and commercial development

Increases in urban and built-up areas in and around the Gippsland Lakes has been comparatively low. For example, Land Cover Time series of Victoria indicates just 13 hectares increase in "built up" areas in the Gippsland Lakes sub region over the past 15 years, and a 700 hectare increase in urban development (total area of region is around 230,000 ha). In the Deep Lakes this is limited to areas around major centres such as Paynesville, Metung, Lakes Entrance, Eagle Point. Some concern over the potential infrastructure for house boats at Lake Tyers.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased erosion | Direct impacts on shoreline vegetation | Likely | Minor | Medium | Studies have indicated that the vast majority of erosion hazard and shoreline erosion is due to historic change in salinity resulting in a loss of fringing vegetation (Sjerp et al. 2002). Direct impacts to littoral vegetation are small compared to the entire shoreline of the Deep Lakes. |
| Increased erosion | Loss of vegetation results in loss of habitat for waterbirds | Likely | Minor | Medium | See above |
| Increased lighting at night and noise | Affects waterbirds | Likely | Minor | Medium | Marine and wading bird species are attracted to artificial light, which has the potential to disrupt migratory shorebirds (Gauthreaux Jr and Belser 2006) and effect feeding patterns of night foragers (Montevecchi 2006). However, there is also evidence to suggest that artificial lighting in coastal and estuary areas increases feeding success of night foragers (Santos et al. 2010). The amount of light produced from urban areas compared to the size of the lakes is comparatively small. |

### Threat
### Pollution: Agricultural activities

#### Stressor
#### Increased nutrients

Total nitrogen loads entering the Gippsland Lakes from the six major rivers from 2017 to 2022 ranged between 426 tonnes in 2018 to 2885 tonnes in 2021. Similarly, total phosphorus loads ranged from 23 tonnes in 2019 to 397 tonnes in 2021. Loads are tightly coupled to flows, with higher loads in high rainfall years. In 2006, the greatest sources of nutrients into the Gippsland Lakes were from the Macalister irrigation district, with smaller loads into Jones Bay from agriculture on the Mitchell River floodplain (Grayson et al. 2006). There have been initiatives since this time to reduce loads from agricultural hotspots in the region (Lake Wellington Land and Water Management Plan, WGCMA, 2018).

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased nutrients | Increased algal growth and a decline in seagrass health | Likely | Moderate | Medium | Well documented ecological pathway (e.g. Cook et al. 2008, Holland et al. 2009, 2013b, Cook and Holland 2012). However, there is no evidence of a decline in seagrass in the Deep Lakes mega-habitat (2017 - 2021) and there has been an increase in seagrass extent in Lake Victoria over this period (Brooks and Hale 2021a). |

*Continued...*

**Table A-1** Risk Assessment for the Deep Lakes mega-habitat.

## Deep Lakes

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased nutrients | Increased algal growth, decreased dissolved oxygen and impacts to aquatic biota (fish) | Likely | Moderate | Medium | Low dissolved oxygen events are recorded in the lakes during bloom conditions (EPA Victoria 2008). There are documented fish deaths from low dissolved oxygen events in the Deep Lakes (e.g. Lake Tyers June 2014). There has been a decline in dissolved oxygen in the bottom waters of Lakes Victoria and King during periods of stratification (East Gippsland CMA 2022). |
| Increased nutrients | Increased algal growth, impacts waterbird feeding (general) | Unlikely | Minor | Low | In general, higher nutrients usually means higher productivity and this is considered to be beneficial for waterbirds (Robledano Aymerich et al. 2008, Rogers et al. 2013, Mott et al. 2023). |
| Increased nutrients | Increased algal growth, impact waterbird feeding (threatened species: fairy terns) | Likely | Major | High | Risk is considered high, due to the increased energy requirements by nesting terns from having to forage further, resulting in decreased recruitment success. |

### Threat
Pollution: Agricultural activities

#### Stressor
Increased sediments

**Sediment loads from agricultural lands have been estimated to comprise approximately two thirds of the load to the lakes (Grayson 2006). While the pathway is based on sound ecological theory, much of the sediment may be deposited near the freshwater inflows. Turbidity in Lakes King and Victoria is mostly low, with secchi depths > 2 m (EPA Victoria 2013). While Lake King remained clear and in "good" condition, the two wet years (2020-21 and 2021-22) resulted in increased suspended sediments in Lakes Victoria. Pathway includes agricultural effluents and run-off as well as vegetation clearing and grazing in riparian zones / stream banks.**

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased sediments | Reduced light / smothering affects seagrass | Possible | Minor | Low | No evidence of a decline in seagrass in the Deep Lakes mega-habitat (2017 - 2021) and there has been an increase in seagrass extent in Lake Victoria over this period (Brooks and Hale 2021a). |
| Increased sediments | Reduced visibility affects migration of diadromous fish. | Unlikely | Major | Medium | The Australian grayling migrates from fresh to marine waters as part of its lifecycle, with the return of juveniles to the river in spring (November) the most vulnerable phase (Koehn and O'Connor 1990). Juveniles of similar species have been known to avoid areas with > 25 NTU (Australian Marine Ecology 2006). The species is short-lived, breeding only one in its lifecycle and a loss of a single cohort would be significant. Turbidity has remained below 25 NTU in Lakes Victoria and King (2010 - 2022 data from EPA Victoria). |
| Increased sediments | Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates) | Rare | Minor | Negligible | Primary Industries Research Victoria (2006\) indicated that a threshold of 100 mg/L was a conservative estimate for expecting effects on fish and marine invertebrates (considering effects to more vulnerable juvenile stages). TSS in the main lakes has not been recorded above this threshold, although samples are limited. |
| Increased sediments | Reduced light affects waterbird feeding | Unlikely | Negligible | Negligible | The pathway includes piscivores and ducks and swans feeding on submerged vegetation. Assumption is that the bloom rarely covers the entire deep lakes system and birds can relocate to better feeding grounds; and that the disruption to feeding by sediment is less likely than from algal blooms. |

*Continued...*

**Table A-1** Risk Assessment for the Deep Lakes mega-habitat.

# Deep Lakes

## Threat
## Pollution: Agricultural activities

### Stressor
Increased toxicants

Surveys of sediment toxicants in the Deep Lakes are low and mostly below detection limits. The exceptions are a small number of samples above ANZECC guidelines for mercury (Reeves and Trewarn 2016, Snell 2019). Majority of sediments in the Deep Lakes are sandy and not likely to store toxicants. Studies on toxicants (including pesticides and heavy metals) in the Latrobe catchment indicated low levels in sediments and potential capture and storage of toxicants in farm dams (Mossop et al. 2013).

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased toxicants | Affects seagrass | Possible | Minor | Low | No evidence of a decline in seagrass in the Deep Lakes mega-habitat (2017 - 2021) and there has been an increase in seagrass extent in Lake Victoria over this period (Brooks and Hale 2021a). |
| Increased toxicants | Affects fish and invertebrates. | Possible | Minor | Low | No evidence of a decline in diversity or abundance of native fish and no reports of poor condition (East Gippsland CMA 2022). |
| Increased toxicants | Affects waterbirds through the food chain | Possible | Minor | Low | No evidence of toxic effects to waterbirds in the Deep Lakes (East Gippsland CMA 2022). |

## Threat
## Pollution: Sewerage and stormwater

### Stressor
Increased nutrients

Although the loads of nutrients that enter the deep lakes from sewage and stormwater are unknown, it is expected that they are low compared to catchment inputs and compared to the volume of the lake. The likelihood and consequence of each pathway has been adjusted accordingly.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased nutrients | Increased algal growth and a decline in seagrass health | Possible | Minor | Low | Refer to general threat comment above. |
| Increased nutrients | Increased algal growth, decreased dissolved oxygen and impacts to aquatic biota (fish) | Rare | Minor | Negligible | Refer to general threat comment above. |
| Increased nutrients | Increased algal growth, impact waterbird feeding | Unlikely | Negligible | Negligible | Refer to general threat comment above. |

*Continued...*

**Table A-1** Risk Assessment for the Deep Lakes mega-habitat.

# Deep Lakes

## Threat
## Pollution: Sewerage and stormwater

### Stressor
Increased sediments

Although the loads of sediments that enter the deep lakes from sewage and stormwater are unknown, it is expected that they are low compared to catchment inputs and compared to the volume of the lake. The likelihood and consequence of each pathway has been adjusted accordingly.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased sediments | Reduced light / smothering affects seagrass | Rare | Negligible | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates) | Rare | Negligible | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced light affects waterbird feeding | Rare | Negligible | Negligible | Refer to general threat comment above. |

## Threat
## Pollution: Sewerage and stormwater

### Stressor
Increased toxicants

Surveys of sediment toxicants in the Deep Lakes are low and mostly below detection limits. The exceptions are a small number of samples above ANZECC guidelines for mercury (Snell 2019; Reeves and Trewarn 2016). Majority of sediments in the Deep Lakes are sandy and not likely to store toxicants.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased toxicants | Affects seagrass | Possible | Minor | Low | Refer to general threat comment above. |
| Increased toxicants | Affects fish and invertebrates | Possible | Minor | Low | Refer to general threat comment above. |
| Increased toxicants | Affects waterbirds through the food chain | Possible | Minor | Low | Refer to general threat comment above. |

## Threat
## Climate change: Increased bushfires

CSIRO study of the impacts of bushfires on the Gippsland Lakes Ramsar site concluded: "the (2019-20) fire burned significant parts of the Gippsland Lakes catchment area resulting in runoff loaded with sediment and other pollutants. The Mitchell, Nicholson and Tambo Rivers were badly impacted and the inflows from these rivers to the Gippsland Lakes continued to record high sediment loads even a year after the bushfire event." (Kirono et al. 2022). The risk is periodical, rather than constant.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased nutrients and sediment | Affects seagrass | Likely | Moderate | Medium | No evidence of a decline in seagrass in the Deep Lakes mega-habitat (2017 - 2021) and there has been an increase in seagrass extent in Lake Victoria over this period (Brooks and Hale 2021a). |
| Increased nutrients and sediment | Affects aquatic biota (fish) | Likely | Moderate | Medium | Refer to general threat comment above. |

*Continued...*

**Table A-1** Risk Assessment for the Deep Lakes mega-habitat.

## Deep Lakes

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased nutrients and sediment | Reduced visibility affects migration of diadromous fish | Possible | Major | High | The Australian grayling migrates from fresh to marine waters as part of its lifecycle, with the return of juveniles to the river in spring (November) the most vulnerable phase (Koehn and O'Connor 1990). Juveniles of similar species have been known to avoid areas with > 25 NTU (Australian Marine Ecology 2006). The species is short-lived, breeding only one in its lifecycle and a loss of a single cohort would be significant. Turbidity has remained below 25 NTU in Lakes Victoria and King (2010 - 2022 data from EPA Victoria). |
| Increased nutrients and sediment | Increased algal growth, impact waterbird feeding (general) | Likely | Minor | Low | The pathway includes piscivores and ducks and swans feeding on submerged vegetation. In general, higher nutrients usually means higher productivity and this is considered to be beneficial for waterbirds (Aymerich et al. 2008; Rogers et al. 2013; Mott et al. 2023). |
| Increased nutrients and sediment | Increased algal growth, impact waterbird feeding (threatened species: fairy terns) | Likely | Major | High | Risk is considered high, due to the increased energy requirements by nesting terns from having to forage further, resulting in decreased recruitment success. |

**Threat**
Pollution: Mining effluents

**Stressor**
Increased toxicants

There are three large coal mines in the catchment of the Gippsland Lakes and a number of historic mines, including gold mines that may still be having an effect. Evidence of elevated mercury, that could come from coal (or coal burning for electricity) or historic gold mining (Glover et al. 1980, Fabris et al. 1999, Fabris 2012) (Glover et al. 1980, Fabris et al. 1999, Fabris 2012). The most recent surveys indicate elevated levels of mercury in Heart Morass and Lake Victoria, and arsenic in Lake Wellington (Reeves and Trewarn 2016).

Mine rehabilitation (filling the voids with water) has the potential to result in water quality impacts. These are yet to be identified or defined, but evidence from international literature suggests that heavy metals, sulphates and acidity are common problems (McCullough and Schultze 2015). It is not likely that this will be a realised threat in the life of this Ramsar Site Management Plan, but planning should consider future risks.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased toxicants | Affects seagrass | Likely | Minor | Medium | Seagrass can be affected by toxicants, but this is more likely to be from copper than mercury (Macinnis-Ng and Ralph 2002, Ambo-Rappe et al. 2011). |
| Increased toxicants | Affects biota (fish and invertebrates | Almost certain | Moderate | High | Evidence of elevated levels of mercury in dolphins in the Gippsland Lakes. Levels in live animals were also high, and are attributable to chronic low dose exposure to mercury from the dolphin's diet (Monk et al. 2014). More recent evidence indicates high concentrations of toxicants in these top end predators, suggesting that food chain is affected (Kate Robb, pers. com). |
| Increased toxicants | Affects waterbirds | Almost certain | Moderate | High | Evidence from dolphins (see above) and also from a small number of samples of waterbirds from the site (Deb Sullivan, personal communication). Risk to fish eating birds, would be the highest as top end predators. |

*Continued...*

**Table A-1** Risk Assessment for the Deep Lakes mega-habitat.

# Deep Lakes

## Threat
### Pollution: Mining effluents

Grayson (2006) indicated just 2% of TSS loads were from mining operations. All likelihood and consequences were assigned based on this low level of sediment contribution.

### Stressor
Increased sediments

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased sediments | Reduced light / smothering affects seagrass | Unlikely | Negligible | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced visibility affects migration of diadromous fish. | Rare | Negligible | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates) | Rare | Negligible | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced light affects waterbird feeding | Rare | Negligible | Negligible | Refer to general threat comment above. |

## Threat
### Pollution: oil spills (off-shore)

Oil spill mapping indicates that there needs to be a large, sustained release of oil from more than one production well in Bass Strait, for the spill to enter the Ramsar site. This is considered to be a very unlikely scenario, but consequences are based on the impacts in the event oil does enter the Ramsar site, which would be at comparatively low levels.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Hydrocarbons | Affects seagrass | Possible | Minor | Negligible | Refer to general threat comment above. |
| Hydrocarbons | Direct oiling of wildlife | Rare | Minor | Negligible | Refer to general threat comment above. |
| Hydrocarbons | Indirect long term effects (food webs, aquatic biota) | Rare | Major | Low | Refer to general threat comment above. |

## Threat
### Pollution: oil spills (vessels)

Based on incidents reported to Gippsland Ports - spills occur, but effects are generally localised and short-lived. Risk may have increased with increasing recreational use of the lakes and more boats in the water.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Hydrocarbons | Affects seagrass | Likely | Negligible | Negligible | Refer to general threat comment above. |
| Hydrocarbons | Direct oiling of wildlife | Likely | Minor | Medium | Refer to general threat comment above. |
| Hydrocarbons | Indirect long term effects (food webs, aquatic biota) | Possible | Minor | Low | Refer to general threat comment above. |

*Continued...*

**Table A-1** Risk Assessment for the Deep Lakes mega-habitat.

# Deep Lakes

## Threat
### Water resource use: Domestic, agricultural, mines, and plantations

There is no evidence of a sustained increase in salinity in Lakes King and Victoria (East Gippsland CMA 2022). Water resource use for domestic and agriculture is managed and significant increases in allocations above current are not likely (rather there are targets for increased environmental water allocations). Future altered freshwater inflows are more likely to occur as a result of climate change.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased salinity | Increased salinity affects breeding triggers for black bream and other estuarine fish | Possible | Minor | Low | The direct impact (decreased salinity affecting spawning and recruitment) occurs in the estuarine reaches of the rivers. However, the flow on impacts to fish populations are relevant to the deep water habitat. |
| Increased salinity | Effects on fish flow to affect waterbirds through the food chain | Possible | Minor | Low | Refer to general threat comment above. |
| Increased salinity | Disrupts stratification and internal nutrient cycling; promoting algal blooms | Unlikely | Minor | Low | Refer to general threat comment above. |

## Threat
### Water resource use: mining and mine rehabilitation

The effect of mine rehabilitation on water quantity and regimes is not known as the methods for mine rehabilitation have yet to be investigated fully and risks evaluated.

**Stressor**
Increased salinity

## Threat
### Invasive species

Surveys in 2015, 2018 and 2020 found several introduced marine pests present in the Gippsland Lakes: Pacific Oyster (***Crassotrea gigas***), the European green crab (***Carcinus maenas***), the Asian bag mussel (Arcuatula senhousia) and the introduced green macroalgae (***Codium fragile*** subsp. fragile) (Hirst and Bott 2015, Bott et al. 2023). The authors suggested that the risk profile for the Gippsland Lakes was considerably lower than other Victorian embayments with less commercial traffic.

**Stressor**
Introduced marine pests

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Introduced marine pests | Increased competition and predation results in a decline in native species extent, diversity and abundance | Almost certain | Moderate | High | Refer to general threat comment above. |

*Continued...*

**Table A-1** Risk Assessment for the Deep Lakes mega-habitat.

# Deep Lakes

## Threat
Invasive species

### Stressor
Non-native predators (foxes and cats)

Foxes and cats are present in the Ramsar site and currently controlled by Parks Victoria and CMA programs.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Non-native terrestrial animals (foxes and cats) | Predation on nesting, feeding and roosting waterbirds | Almost certain | Major | Extreme | Impacts to tern nesting sites on the islands of the Deep Lakes already observed, with the loss of an entire breeding colony in 2022 (Deb Sullivan, BirdLife, personal communication). |

## Threat
Invasive species

### Stressor
Non-native herbivores (deer)

Sambar deer and hog deer both are having significant effects on vegetation and waterbird communities on the islands of the Deep Lakes. While sambar deer are controlled by management activities, hog deer are protected.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Non-native herbivores (deer) | Trampling and grazing of vegetation on the islands of the Deep Lakes | Almost certain | Moderate | High | Refer to general threat comment above. |
| Non-native herbivores (deer) | Impacts to waterbirds foraging and breeding | Almost certain | Moderate | High | Refer to general threat comment above. |

## Threat
Invasive species

### Stressor
Non-native terrestrial plants (e.g. sea spurge)

Well established impact pathway with colonisation of sand dunes and island beaches.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Non-native terrestrial plants (e.g. sea spurge) | Reduction in habitat for nesting terns | Almost certain | Moderate | High | Beach nesting birds require open sand habitat to create nests (Maguire 2008), encroachment of terrestrial weeds into island beaches reduces suitable nesting sites. |

*Continued...*

**Table A-1** Risk Assessment for the Deep Lakes mega-habitat.

# Deep Lakes

## Threat
Climate change and severe weather: Drought

### Stressor
Increased salinity

Based on same evidence and assumptions as "decreased freshwater flows from water resource use". An assessment of the potential impacts of altered climate on river flow and river fed wetlands (such as the Gippsland Lakes) indicated that there would be a significant reduction in flow in the Latrobe River and a longer period between flow events that would inundate and flush wetlands (Tilleard and Ladson 2010, DSE 2013).

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased salinity | Affects breeding triggers for black bream and other estuarine fish (in estuarine reaches) | Possible | Minor | Low | Salinity and halocline requirements for black bream breeding and recruitment are well established (Hindell et al. 2008b, Williams et al. 2012). |
| Increased salinity | Effects on fish flow through to waterbirds through the food chain. | Possible | Minor | Low | Refer to general threat comment above. |
| Increased salinity | Disrupts stratification and internal nutrient cycling; promoting algal blooms | Unlikely | Minor | Low | Refer to general threat comment above. |

## Threat
Climate change and severe weather: Drought

### Stressor
Increased inundation and physical damage

The most recent scaled-down climate change models for the Gippsland region projected very high confidence in a continued increase in mean sea level and the frequency of extreme coastal sea levels (i.e. storm surges). Mean sea level is likely to increase by 2050 by 0.24 metres over 1990 levels (Clarke et al. 2019). In terms of sea level rise, again there is clear evidence of realised change and projections for continued change into the distant future. Sea level is currently 23 cm higher than it was in 1890 (circa the opening of a permanent entrance). The average sea level rise off the coast of Gippsland was (1993 to 2015) 6 mm / year (Bureau of Meteorology 2016). This means that mean sea level has increased by at least 12 cm since the Gippsland Lakes was listed as a Ramsar site.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased inundation and physical damage | Affects intertidal and sub-tidal seagrass condition and extent | Likely | Moderate | Medium | No evidence of sustained change in seagrass extent / condition in the Deep Lakes (Brooks and Hale 2021). |
| Increased inundation and physical damage | Impacts to seagrass affect aquatic biota | Possible | Minor | Low | Refer to general threat comment above. |
| Increased inundation and physical damage | Impacts to shorelines of island habitats impacts waterbird foraging and breeding | Almost certain | Major | Extreme | Refer to general threat comment above. |

*Continued...*

**Table A-1** Risk Assessment for the Deep Lakes mega-habitat.

# Deep Lakes

## Threat
## Dredging

Dredging in the Gippsland Lakes is managed through an Environmental Management Plan (approved by State and Federal regulatory agencies). Risks here are consistent with the approved risk assessment for the Gippsland Lakes Ocean Access Program (Gippsland Ports 2022).

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased tidal exchange | Impacts biota (fish, waterbirds) | Rare | Moderate | Negligible | Evidence from hydrodynamic modelling indicates no effect of the modifications to the channel on salinity in the Lakes ((Reynolds et al. 2011). Which is consistent with previous investigations (Webster et al. 2001). |
| Direct habitat removal | Loss of seagrass | Almost certain | Minor | Medium | Dredging only occurs in navigation channels - there is some evidence of seagrass regrowth into some of these channels between dredging and small amounts of seagrass may be removed. |
| Direct habitat removal | Loss of benthic invertebrates | Almost certain | Negligible | Negligible | Dredge footprint is small and in previously dredged locations |
| Direct habitat removal | Loss of seagrass and benthic invertebrates affects fish and waterbirds through habitat loss and food chain effects | Unlikely | Minor | Low | Refer to general threat comment above. |
| Increased suspended sediments | Impacts seagrass | Unlikely | Minor | Low | Dredge plumes from dredges in the Gippsland Lakes do not to persist in the water column for long periods of time or to extend far from operating dredges the potential area of seagrass that could be affected is small. |
| Increased suspended sediments | Impacts fish and other aquatic biota | Rare | Negligible | Negligible | Jenkins and McKinnon (2006) indicated that a threshold of 100 mg/L was a conservative estimate for expecting effects on fish and marine invertebrates (considering effects to more vulnerable juvenile stages). Dredging in the Gippsland Lakes does not result in widespread high levels of suspended sediments |

## Threat
## Fishing and harvesting aquatic resources

The State Government committed to ending commercial netting in the Gippsland Lakes by 1 April 2021, and all fishers elected to exit 12 months prior on 1 April 2020. Recreational fishing continues and is managed through the Gippsland Lakes Recreational Fishery Plan 2020. The effect of recreational fishing on fish communities remains a knowledge gap.

### Stressor
Direct removal of native fauna

*Continued...*

**Table A-1** Risk Assessment for the Deep Lakes mega-habitat.

# Deep Lakes

## Threat
## Recreational activities

Increasing populations have resulted in increased tourist and recreational pressures in the Gippsland Lakes, especially over summer.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased noise, traffic, dogs, walkers | Disturbance of shorebirds and nesting waterbirds | Almost certain | Moderate | High | The Deep lakes are not core habitat for shorebirds, but contain the nesting habitat for many species including little terns, fairy terns and Australian pelican Nesting birds and migratory shorebirds can be impacted by noise (motorised watercraft), people and dogs on the beach. |
| Increased boat traffic | Physical removal of seagrass | Possible | Minor | Low | Work has been underway on installing seagrass friendly moorings at a number of locations at the site. Monitoring shows highly variable seagrass cover at mooring locations, but no evidence of significant or continued impacts. |
| Nutrients and litter | Waste for recreational activities impacts aquatic biota and waterbirds | Possible | Negligible | Negligible | Refer to general threat comment above. |
| Nutrients and litter | Waste and oil from boats | Possible | Minor | Low | Knowledge gap - oil slicks associated with operation of bilge pumps following rain events: around Paynesville, Metung, Lakes Entrance |

**Table A-2** Risk Assessment for the shallow lakes mega-habitat.

# Shallow Lakes

## Threat
### Residential and commercial development

Increases in urban and built-up areas in and around the Gippsland Lakes has been comparatively low. For example, Land Cover Time series of Victoria indicates just 13 hectares increase in "built up" areas in the Gippsland Lakes sub region over the past 15 years, and a 700 hectare increase in urban development (total area of region is around 230,000 ha). There are notable proposals for increased development adjacent to the Ramsar site, particularly at Lake Wellington. While the development is on private land, there may be some impacts to buffers and noise / light.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased erosion | Direct impacts on shoreline vegetation | Likely | Minor | Medium | Studies have indicated that the vast majority of erosion hazard and shoreline erosion is due to historic change in salinity resulting in a loss of fringing vegetation (Sjerp et al. 2002). Direct impacts to littoral vegetation are small compared to the entire shoreline of the Shallow Lakes. |
| Increased erosion | Loss of vegetation results in loss of habitat for waterbirds | Possible | Minor | Low | Waterbird habitat in the Shallow Lakes is limited to open water foragers (the majority of foraging habitat along the shorelines is classified as "variably saline" mega-habitat. |
| Increased lighting at night and noise | Affects waterbirds | Likely | Minor | Medium | Marine and wading bird species are attracted to artificial light, which has the potential to disrupt migratory shorebirds (Gauthreaux Jr and Belser 2006) and effect feeding patterns of night foragers (Montevecchi 2006). However, there is also evidence to suggest that artificial lighting in coastal and estuary areas increases feeding success of night foragers (Santos et al. 2010). The amount of light produced from urban areas compared to the size of the lakes is comparatively small. |

## Threat
### Pollution: Agricultural activities

#### Stressor
Increased nutrients

Total nitrogen loads entering the Gippsland Lakes from the six major rivers from 2017 to 2022 ranged between 426 tonnes in 2018 to 2885 tonnes in 2021. Similarly, total phosphorus loads ranged from 23 tonnes in 2019 to 397 tonnes in 2021. Loads are tightly coupled to flows, with higher loads in high rainfall years. In 2006, the greatest sources of nutrients into the Gippsland Lakes were from the Macalister irrigation district, with smaller loads into Jones Bay from agriculture on the Mitchell River floodplain (Grayson et al. 2006). There have been initiatives since this time to reduce loads from agricultural hotspots in the region (Lake Wellington Land and Water Management Plan, WGCMA, 2018).

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased nutrients | Increased algal growth and a decline in seagrass health | Likely | Moderate | Medium | Well documented ecological pathway (e.g. Cook et al. 2008, Holland et al. 2009, 2013b, Cook and Holland 2012). However, there is no evidence of a decline in seagrass in the Deep Lakes mega-habitat (2017 - 2021) and there has been an increase in seagrass extent in Lake Victoria over this period (Brooks and Hale 2021a). |
| Increased nutrients | Increased algal growth, decreased dissolved oxygen and impacts to aquatic biota (fish) | Likely | Moderate | Medium | Only plausible in Jones Bay, which experiences some low oxygen events. Lake Wellington remains large well mixed due to the shallow water and wind action. |
| Increased nutrients | Increased algal growth, impacts waterbird feeding (general) | Likely | Minor | Low | In general, higher nutrients usually means higher productivity and this is considered to be beneficial for waterbirds (Robledano Aymerich et al. 2008, Rogers et al. 2013, Mott et al. 2023). |
| Increased nutrients | Increased algal growth, impact waterbird feeding (threatened species: fairy terns) | Likely | Major | High | Risk is considered high, due to the increased energy requirements by nesting terns from having to forage further, resulting in decreased recruitment success. |

*Continued...*

**Table A-2** Risk Assessment for the shallow lakes mega-habitat.

# Shallow Lakes

## Threat
Pollution: Agricultural activities

### Stressor
Increased sediments

Sediment loads from agricultural lands have been estimated to comprise approximately two thirds of the load to the lakes (Grayson 2006). Historically, this was the cause of the decline in submerged plants in Lake Wellington (Harris et al. 1998). Turbidity measures from Jones Bay are not available, but evidence form satellite imagery and on ground observations indicates high turbidity following heavy rainfall in the catchment. The lakes are by their nature shallow, and constant resuspension of bottom sediments makes these environments more turbid. Pathway includes agricultural effluents and run-off as well as vegetation clearing and grazing in riparian zones / stream banks.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased sediments | Reduced light / smothering affects seagrass | Almost certain | Moderate | High | There has been a significant decline in seagrass in Jones Bay from 2017 to 2021 (Brooks and Hale 2021a). The cause of this decline is likely to be low light (from sediment inflows during high rainfall years). How much of this is from agricultural lands is not known. The effects are most likely to be short lived and seagrass in Jones Bay is expected to recover in lower rainfall years. |
| Increased sediments | Reduced visibility affects migration of diadromous fish. | Possible | Major | High | The Australian grayling migrates from fresh to marine waters as part of its lifecycle, with the return of juveniles to the river in spring (November) the most vulnerable phase (Koehn and O'Connor 1990). Juveniles of similar species have been known to avoid areas with > 25 NTU (Australian Marine Ecology 2006). The species is short-lived, breeding only one in its lifecycle and a loss of a single cohort would be significant. Turbidity is often above 25 NTU in Lake Wellington (2010 - 2022 data from EPA Victoria). The effects of this on migration of grayling (and other fish) remains unknown. |
| Increased sediments | Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates) | Possible | Minor | Low | Primary Industries Research Victoria (2006\) indicated that a threshold of 100 mg/L was a conservative estimate for expecting effects on fish and marine invertebrates (considering effects to more vulnerable juvenile stages). TSS in Lake Wellington has exceeded 100 mg/L on three occasions in the past 19 years (all in 2019). |
| Increased sediments | Reduced light affects waterbird feeding | Possible | Minor | Low | The pathway includes piscivores, large wading birds and ducks and swans. Water clarity in Lake Wellington is very low (secchi depth median of < 1 m) (EPA Victoria 2013) and this has been attributed to catchment inflows of turbid water (Harris et al. 1998). However, this occurred post listing as a Ramsar site (benchmark for ecological character). |

*Continued...*

**Table A-2** Risk Assessment for the shallow lakes mega-habitat.

# Shallow Lakes

## Threat
## Pollution: Agricultural activities

### Stressor
Increased toxicants

Surveys of sediment toxicants in the Shallow Lakes are low and mostly below detection limits. The exceptions are a small number of samples above ANZECC guidelines for mercury (Reeves and Trewarn 2016, Snell 2019). Studies on toxicants (including pesticides and heavy metals) in the Latrobe catchment indicated low levels in sediments and potential capture and storage of toxicants in farm dams (Mossop et al. 2013).

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased toxicants | Affects seagrass | Possible | Minor | Low | Refer to general threat comment above. |
| Increased toxicants | Affects fish and invertebrates. | Possible | Minor | Low | Refer to general threat comment above. |
| Increased toxicants | Affects waterbirds through the food chain | Possible | Minor | Low | Refer to general threat comment above. |

## Threat
## Pollution: Sewage and stormwater

### Stressor
Increased nutrients

Although the loads of nutrients that enter the shallow lakes from sewage and stormwater are unknown, it is expected that they are low compared to catchment inputs and compared to the volume of the lake. Inflows to Jones Bay are being addressed through constructed wetlands designed to reduce 80% of phosphorus and 30% of nitrogen (East Gippsland Shire Council). The likelihood and consequence of each pathway has been adjusted accordingly.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased nutrients | Increased algal growth and a decline in seagrass health | Possible | Minor | Low | Refer to general threat comment above. |
| Increased nutrients | Increased algal growth, decreased dissolved oxygen and impacts to aquatic biota (fish) | Rare | Minor | Negligible | Refer to general threat comment above. |
| Increased nutrients | Increased algal growth, impact waterbird feeding | Unlikely | Negligible | Negligible | Refer to general threat comment above. |

*Continued...*

**Table A-2** Risk Assessment for the shallow lakes mega-habitat.

# Shallow Lakes

## Threat
Pollution: Sewage and stormwater

### Stressor
Increased sediments

Although the loads of sediments that enter the shallow lakes from sewage and stormwater are unknown, it is expected that they are low compared to catchment inputs and compared to the volume of the lake. Inflows to Jones Bay are being addressed through constructed wetlands designed to reduce 80% of phosphorus and 30% of nitrogen (East Gippsland Shire Council). The likelihood and consequence of each pathway has been adjusted accordingly.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased sediments | Reduced light / smothering affects seagrass | Rare | Negligible | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates) | Rare | Negligible | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced light affects waterbird feeding | Rare | Negligible | Negligible | Refer to general threat comment above. |

## Threat
Pollution: Sewage and stormwater

### Stressor
Increased toxicants

Surveys of sediment toxicants in the Shallow Lakes are low and mostly below detection limits. The exceptions are a small number of samples above ANZECC guidelines for mercury (Snell 2019; Reeves and Trewarn 2016). Studies on toxicants (including pesticides and heavy metals) in the Latrobe catchment indicated low levels in sediments and potential capture and storage of toxicants in farm dams (Mossop et al. 2013).

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased toxicants | Affects seagrass | Possible | Minor | Low | Refer to general threat comment above. |
| Increased toxicants | Affects fish and invertebrates. | Possible | Minor | Low | Refer to general threat comment above. |
| Increased toxicants | Affects waterbirds through the food chain | Possible | Minor | Low | Refer to general threat comment above. |

*Continued...*

**Table A-2** Risk Assessment for the shallow lakes mega-habitat.

# Shallow Lakes

## Threat
### Climate change: Increased bushfires

### Stressor
Increased nutrients and sediments

CSIRO study of the impacts of bushfires on the Gippsland Lakes Ramsar site concluded: "the (2019-20) fire burned significant parts of the Gippsland Lakes catchment area resulting in runoff loaded with sediment and other pollutants" (Kirono et al. 2022). This event resulted in three times the average annual load of phosphorus and over twice the average annual load of nitrogen entered the lakes after intense rainfall fell on burned catchments mobilising large amounts of sediment and associated nutrients (SKM 2008). All likelihood and consequences for these pathways have been adjusted from those assessed for agricultural effluents to reflect the increased magnitude.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased nutrients and sediment | Affects seagrass | Likely | Major | High | Refer to general threat comment above. |
| Increased nutrients and sediment | Affects aquatic biota (fish) | Likely | Major | High | Refer to general threat comment above. |
| Increased nutrients and sediment | Reduced visibility affects migration of diadromous fish. | Possible | Major | High | Refer to general threat comment above. |
| Increased nutrients and sediment | Increased algal growth, impact waterbird feeding (general) | Unlikely | Minor | Low | Refer to general threat comment above. |
| Increased nutrients and sediment | Increased algal growth, impact waterbird feeding (threatened species: fairy terns) | Likely | Major | High | Refer to general threat comment above. |

## Threat
### Climate change: Increased bushfires

### Stressor
Increased salinity

Regrowth of forest following bushfire can have a significant effect on run-off. It is estimated that the 2003 and 2006/7 bushfires will in the medium term result in an annual 7% reduction in flow into the Gippsland Lakes (SKM 2009). This is considerably less than the impacts of water resource use and climate change and risks are adjusted accordingly.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased salinity | Affects fringing vegetation | Unlikely | Minor | Low | Refer to general threat comment above. |
| Increased salinity | Affects aquatic biota (fish) | Unlikely | Minor | Low | Refer to general threat comment above. |
| Increased salinity | Increased salinity affects breeding triggers for black bream and other estuarine fish. | Unlikely | Moderate | Low | Refer to general threat comment above. |

*Continued...*

**Table A-2** Risk Assessment for the shallow lakes mega-habitat.

# Shallow Lakes

## Threat
Pollution: Mining effluents

### Stressor
Increased toxicants

There are three large coal mines in the catchment of the Gippsland Lakes and a number of historic mines, including gold mines that may still be having an effect. Evidence of elevated mercury, that could come from coal (or coal burning for electricity) or historic gold mining (Glover et al. 1980, Fabris et al. 1999, Fabris 2012) (Glover et al. 1980, Fabris et al. 1999, Fabris 2012). The most recent surveys indicate elevated levels of mercury in Heart Morass and Lake Victoria, and arsenic in Lake Wellington (Reeves and Trewarn 2016).

Mine rehabilitation (filling the voids with water) has the potential to result in water quality impacts. These are yet to be identified or defined, but evidence from international literature suggests that heavy metals, sulphates and acidity are common problems (McCullough and Schultze 2015). It is not likely that this will be a realised threat in the life of this Ramsar Site Management Plan, but planning should consider future risks.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased toxicants | Affects seagrass | Likely | Minor | Medium | Seagrass can be affected by toxicants, but this is more likely to be from copper than mercury (Macinnis-Ng and Ralph 2002, Ambo-Rappe et al. 2011). |
| Increased toxicants | Affects biota (fish and invertebrates | Almost certain | Moderate | High | Evidence of elevated levels of mercury in dolphins in the Gippsland Lakes. Levels in live animals were also high, and are attributable to chronic low dose exposure to mercury from the dolphin's diet (Monk et al. 2014). More recent evidence indicates high concentrations of toxicants in these top end predators, suggesting that food chain is affected (Kate Robb, pers. com). |
| Increased toxicants | Affects waterbirds | Almost certain | Moderate | High | Evidence from dolphins (see above) and also from a small number of samples of waterbirds from the site (Deb Sullivan, personal communication). Risk to fish eating birds, would be the highest as top end predators. |

## Threat
Pollution: Mining effluents

### Stressor
Increased sediments

Grayson (2006) indicated just 2% of TSS loads were from mining operations. All likelihood and consequences were assigned based on this low level of sediment contribution.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased sediments | Reduced light / smothering affects seagrass | Unlikely | Negligible | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced visibility affects migration of diadromous fish. | Rare | Negligible | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates) | Rare | Negligible | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced light affects waterbird feeding | Rare | Negligible | Negligible | Refer to general threat comment above. |

*Continued...*

**Table A-2** Risk Assessment for the shallow lakes mega-habitat.

# Shallow Lakes

## Threat
## Pollution: Oil spills (off-shore)

**Stressor**
Hydrocarbons

Oil spill mapping indicates even in the event of a very large spill, oil would not extend to this mega-habitat. Not a plausible pathway.

## Threat
## Pollution: Oil spills (vessels)

**Stressor**
Hydrocarbons

Based on incidents reported to Gippsland Ports - spills occur, but effects are generally localised and short-lived. Risk may have increased with increasing recreational use of the lakes and more boats in the water.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Hydrocarbons | Affects seagrass | Likely | Negligible | Negligible | Refer to general threat comment above. |
| Hydrocarbons | Direct oiling of wildlife | Likely | Minor | Medium | Refer to general threat comment above. |
| Hydrocarbons | Indirect long term effects (food webs, aquatic biota) | Possible | Minor | Low | Refer to general threat comment above. |

## Threat
## Water resource use: Domestic, agricultural, mines, and plantations

Approximately one-third of average annual flow in the Latrobe, Thomson and Macalister Rivers is diverted, affecting all but large floods (Tilleard and Ladson 2010). The effects on the Shallow lakes are related to increased salinity rather than altered water regimes. However, the literature suggests that the changes to ecology have already occurred at Lake Wellington, and the risk of future increases in salinity are focused more on the fringing wetlands. Impacts in the east from water resource use are higher than in the west (DELWP 2020).

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased salinity | Affects littoral vegetation | Possible | Minor | Low | Refer to general threat comment above. |
| Increased salinity | Effects on fish flow to affect waterbirds through the food chain | Possible | Minor | Low | Refer to general threat comment above. |
| Increased salinity | Increased salinity affects breeding triggers for black bream and other estuarine fish | Almost certain | Moderate | High | The estuarine reach of the Nicholson River has been included in this mega-habitat as they all feed into Jones Bay within the Ramsar site. Salinity is important in the success of the spawning of black bream and a reduction in freshwater inflows has been identified as a threat to the population of this species (Tilleard et al. 2009, BMT WBM 2011, Kemp et al. 2013). Recent assessments by Fisheries Victoria have indicated that populations of black bream are likely to be on a trajectory of decline, with the last large recruitment event nearly three decades ago in the late 1980s (Conron et al. 2020). |

*Continued...*

**Table A-2** Risk Assessment for the shallow lakes mega-habitat.

# Shallow Lakes

## Threat
### Water resource use: Mining and mine rehabilitation

**Stressor**
Increased salinity

The effect of mine rehabilitation on water quantity and regimes is not known as the methods for mine rehabilitation have yet to be investigated fully and risks evaluated.

## Threat
### Invasive species

**Stressor**
Introduced marine pests

Surveys in 2015, 2018 and 2020 found several introduced marine pests present in the Gippsland Lakes: Pacific Oyster (***Crassotrea gigas***), the European green crab (***Carcinus maenas***), the Asian bag mussel (***Arcuatula senhousia***) and the introduced green macroalgae (***Codium fragile*** subsp. fragile) (Hirst and Bott 2015, Bott et al. 2023). The authors suggested that the risk profile for the Gippsland Lakes was considerably lower than other Victorian embayments with less commercial traffic.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Introduced marine pests | Increased competition and predation results in a decline in native species extent, diversity and abundance | Possible | Moderate | Medium | Risk lower in the fresher Shallow Lakes than the Deep Lakes mega-habitat. |

## Threat
### Invasive species

**Stressor**
Non-native predators (foxes and cats)

Foxes and cats are present in the Ramsar site and currently controlled by Parks Victoria and CMA programs.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Non-native terrestrial animals (foxes and cats) | Predation on nesting, feeding and roosting waterbirds | Almost certain | Moderate | High | Particularly in Jones Bay which is a major bird hotspot and a refuge for salt tolerant bird species. |

## Threat
### Invasive species

**Stressor**
Non-native herbivores (deer)

Sambar deer and hog deer both are having significant effects on vegetation and waterbird communities on the islands of the Deep Lakes. While sambar deer are controlled by management activities, hog deer are protected.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Non-native herbivores (deer) | Trampling and grazing of fringing vegetation | Possible | Minor | Low | The Shallow Lakes habitat ends at the high water mark – the majority of the fringing vegetation is in the "variably saline wetland" mega-habitat and this risk is captured there. |
| Non-native herbivores (deer) | Impacts to waterbirds foraging and breeding | Possible | Minor | Low | The Shallow Lakes habitat ends at the high water mark – the majority of the impact from deer is in the "variably saline wetland" mega-habitat and this risk is captured there. |

*Continued...*

**Table A-2** Risk Assessment for the shallow lakes mega-habitat.

# Shallow Lakes

## Threat
### Invasive species

**Stressor**
Non-native fish (e.g. Common carp)

Carp are known to occur in Lake Wellington and have been identified as a cause for loss of vegetation and increased turbidity (Harris et al. 1998).

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Non-native fish (e.g. carp) | Increase in turbidity affecting flora and fauna | Almost certain | Moderate | High | Refer to general threat comment above. |
| Non-native fish (e.g. carp) | Competition and predation affect native fish | Almost certain | Moderate | High | Refer to general threat comment above. |

## Threat
### Climate change and severe weather: Drought

**Stressor**
Increased salinity

Based on same evidence and assumptions as "decreased freshwater flows from water resource use". An assessment of the potential impacts of altered climate on river flow and river fed wetlands (such as the Gippsland Lakes) indicated that there would be a significant reduction in flow in the Latrobe River and a longer period between flow events that would inundate and flush wetlands (Tilleard and Ladson 2010, DSE 2013).

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased salinity | Affects littoral vegetation | Possible | Minor | Low | Refer to general threat comment above. |
| Increased salinity | Effects on fish flow to affect waterbirds through the food chain | Possible | Minor | Low | Refer to general threat comment above. |
| Increased salinity | Increased salinity affects breeding triggers for black bream and other estuarine fish | Almost certain | Moderate | High | The estuarine reach of the Nicholson River has been included in this mega-habitat as they all feed into Jones Bay within the Ramsar site. Salinity is important in the success of the spawning of black bream and a reduction in freshwater inflows has been identified as a threat to the population of this species (Tilleard et al. 2009, BMT WBM 2011, Kemp et al. 2013). Recent assessments by Fisheries Victoria have indicated that populations of black bream are likely to be on a trajectory of decline, with the last large recruitment event nearly three decades ago in the late 1980s (Conron et al. 2020). |

*Continued...*

**Table A-2** Risk Assessment for the shallow lakes mega-habitat.

# Shallow Lakes

## Threat
## Climate change and severe weather: Drought

### Stressor
Increased inundation and physical damage

The most recent scaled-down climate change models for the Gippsland region projected very high confidence in a continued increase in mean sea level and the frequency of extreme coastal sea levels (i.e. storm surges). Mean sea level is likely to increase by 2050 by 0.24 metres over 1990 levels (Clarke et al. 2019). In terms of sea level rise, again there is clear evidence of realised change and projections for continued change into the distant future. Sea level is currently 23 cm higher than it was in 1890 (circa the opening of a permanent entrance). The average sea level rise off the coast of Gippsland was (1993 to 2015) 6 mm / year (Bureau of Meteorology 2016). This means that mean sea level has increased by at least 12 cm since the Gippsland Lakes was listed as a Ramsar site.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased inundation and physical damage | Affects littoral vegetation | Likely | Major | High | Increases in salinity, coupled with high wave action have resulted in a decline in common reed around Lake Wellington and increased vulnerability to erosion. |
| Increased inundation and physical damage | Affects intertidal and sub-tidal seagrass condition and extent | Possible | Moderate | Medium | Impacts to seagrass in Jones Bay are not related to storm surges, but rather high turbidity in above average rainfall years. |
| Increased inundation and physical damage | Impacts to seagrass affect aquatic biota | Almost certain | Moderate | Medium | Refer to general threat comment above. |

## Threat
## Dredging

Dredging in the Gippsland Lakes is managed through an Environmental Management Plan (approved by State and Federal regulatory agencies). Risks here are consistent with the approved risk assessment for the Gippsland Lakes Ocean Access Program (Gippsland Ports 2022).

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased tidal exchange | Impacts biota (fish, waterbirds) | Rare | Moderate | Negligible | Evidence from hydrodynamic modelling indicates no effect of the modifications to the channel on salinity in the Lakes (Reynolds et al. 2011). Which is consistent with previous investigations (Webster et al. 2001). |
| Direct habitat removal | Loss of seagrass | Possible | Minor | Low | Dredging only occurs in navigation channels – there is little evidence of seagrass in navigation channels of the Shallow Wetlands. |
| Direct habitat removal | Loss of benthic invertebrates | Almost certain | Negligible | Negligible | Dredge footprint is small and in previously dredged locations. |
| Direct habitat removal | Loss of seagrass and benthic invertebrates affects fish and waterbirds through habitat loss and food chain effects. | Unlikely | Minor | Low | Refer to general threat comment above. |
| Increased suspended sediments | Impacts seagrass | Unlikely | Minor | Low | Dredge plumes from dredges in the Gippsland Lakes do not to persist in the water column for long periods of time or to extend far from operating dredges the potential area of seagrass that could be affected is small. |
| Increased suspended sediments | Impacts fish and other aquatic biota | Rare | Negligible | Negligible | Jenkins and McKinnon (2006) indicated that a threshold of 100 mg/L was a conservative estimate for expecting effects on fish and marine invertebrates (considering effects to more vulnerable juvenile stages). Dredging in the Gippsland Lakes does not result in widespread high levels of suspended sediments. |

*Continued...*

**Table A-2** Risk Assessment for the shallow lakes mega-habitat.

# Shallow Lakes

## Threat
### Fishing and harvesting aquatic resources

The State Government committed to ending commercial netting in the Gippsland Lakes by 1 April 2021, and all fishers elected to exit 12 months prior on 1 April 2020. Recreational fishing continues and is managed through the Gippsland Lakes Recreational Fishery Plan 2020. The effect of recreational fishing on fish communities remains a knowledge gap.

**Stressor**
Direct removal of native fauna

## Threat
### Recreational activities

Increasing populations have resulted in increased tourist and recreational pressures in the Gippsland Lakes, especially over summer.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased noise, traffic, dogs, walkers | Disturbance of shorebirds and nesting waterbirds | Likely | Minor | Medium | The Shallow Lakes are not core habitat for shorebirds, nor do they contain nesting habitat (captured in the variably saline wetlands mega-habitat). |
| Increased boat traffic | Physical removal of seagrass | Possible | Minor | Low | Work has been underway on installing seagrass friendly moorings at a number of locations at the site. Monitoring shows highly variable seagrass cover at mooring locations, but no evidence of significant or continued impacts. |
| Nutrients and litter | Waste for recreational activities impacts aquatic biota and waterbirds | Possible | Negligible | Negligible | Refer to general threat comment above. |
| Nutrients and litter | Waste and oil from boats | Possible | Minor | Low | Knowledge gap - oil slicks associated with operation of bilge pumps following rain events: around Paynesville, Metung, Lakes Entrance |

**Table A-3** Risk Assessment for the freshwater wetlands mega-habitat.

# Freshwater Lakes

## Threat
Pollution: Agricultural activities

### Stressor
Increased nutrients

Around 60% of the nutrient loads in catchment inflows to the lakes are from Agricultural activities (Grayson et al. 2006). Australian wetlands are adapted to boom and bust ecology and variability in nutrients (Boulton and Brock 1999) and so impacts are generally less than for the Deep Lakes. Pathway includes agricultural effluents and run-off as well as vegetation clearing and grazing in riparian zones / stream banks.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased nutrients | Increased algal growth impacts freshwater macrophytes | Possible | Minor | Low | Presence of algal blooms (including toxic cyanobacteria) have been reported for both Sale Common and Macleod Morass; linked to increased nutrients in the system (Earth Tech 2003, Parks Victoria 2005). Impacts of this on wetland vegetation possible, but not commonly observed. |
| Increased nutrients | Increased algal growth, decreased dissolved oxygen and impacts to aquatic biota (fish) | Possible | Minor | Low | Although algal blooms have occurred, there is little or no water quality information from these freshwater areas and low dissolved oxygen events and fish kills have not been reported. |
| Increased nutrients | Increased algal growth, impacts waterbird feeding) | Possible | Negligible | Negligible | Macleod Morass and Sale Common are characterised by extensive reed beds (Parks Victoria 2005, BMT WBM 2010). This habitat for feeding waterbirds is not likely to be significantly impacted by algal blooms. Given the lack of evidence of impacts on fish, the only plausible impact pathway is reduced visibility and catch success in piscivores. |

## Threat
Pollution: Agricultural activities

### Stressor
Increased sediments

Sediment loads from agricultural lands have been estimated to comprise approximately two thirds of the load to the lakes (Grayson 2006). Historically, this was the cause of the decline in submerged plants in Lake Wellington (Harris et al. 1998). However, both MacLeod Morass and Sale Common are emergent macrophyte dominated, reducing the impact in this mega-habitat. Pathway includes agricultural effluents and run-off as well as vegetation clearing and grazing in riparian zones / stream banks.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased sediments | Impacts freshwater macrophytes | Unlikely | Minor | Low | |
| Increased sediments | Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates) | Rare | Minor | Negligible | Primary Industries Research Victoria (2006) indicated that a threshold of 100 mg/L was a conservative estimate for expecting effects on fish and marine invertebrates (considering effects to more vulnerable juvenile stages). Although there is no data, this level of TSS is unlikely to occur for any length of time. |
| Increased sediments | Reduced light affects waterbird feeding | Unlikely | Negligible | Negligible | The pathway includes piscivores, large wading birds and ducks and swans. There is no evidence on this impact in freshwater wetlands in the Ramsar site. |

*Continued...*

**Table A-3** Risk Assessment for the freshwater wetlands mega-habitat.

# Freshwater Lakes

## Threat
## Pollution: Agricultural activities

Toxicants from agricultural actives entering freshwater wetlands is not well understood. Studies on toxicants (including pesticides and heavy metals) in the Latrobe catchment indicated low levels in sediments and potential capture and storage of toxicants in farm dams (Mossop et al. 2023).

### Stressor
Increased toxicants

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased toxicants | Affects fish | Possible | Minor | Low | Refer to general threat comment above. |
| Increased toxicants | Affects frogs | Possible | Minor | Low | Refer to general threat comment above. |
| Increased toxicants | Affects waterbirds | Possible | Minor | Low | Refer to general threat comment above. |

## Threat
## Pollution: Sewage and stormwater

Sale Common receives water from Flooding Creek which has considerable input of wastewater and stormwater from the town of Sale (Earth Tech 2003, Parks Victoria 2007). Similarly, Macleod Morass receives wastewater form the Bairnsdale WTP (Parks Victoria 2005). The impacts of wastewater discharge to MacLeod Morass were assessed through a qualitative risk assessment process (Hale and Boon 2019). These risks are reflected here.

### Stressor
Increased nutrients

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased nutrients | Increased algal growth impacts freshwater macrophytes | Possible | Minor | Low | Refer to general threat comment above. |
| Increased nutrients | Increased algal growth, decreased dissolved oxygen and impacts to aquatic biota (fish) | Likely | Moderate | Medium | There are periodic very low dissolved oxygen readings from Macleod Morass (EcoWise 2009). The available data are, however, severely limited to snap-shots taken at single points in time and there is little information on which to base to base a risk assessment of fish kills or large-scale prolonged anoxia. In addition, while fish kills have been observed in the morass in the past (Parks Victoria personal communication) the cause of these deaths remains unknown. Risk is low for Sale Common, but medium for Macleod Morass. |
| Increased nutrients | Increased algal growth, impacts waterbird feeding) | Unlikely | Negligible | Negligible | Refer to general threat comment above. |

*Continued...*

**Table A-3** Risk Assessment for the freshwater wetlands mega-habitat.

# Freshwater Lakes

## Threat
### Pollution: Sewage and stormwater

**Stressor**
Increased sediments

Total suspended solids in the discharge from the Bairnsdale WWTP have a median value (2010 – 2018) of 11 mg/L and are below EPA licence conditions (except for 2018). Loads to Sale Common from sewage and wastewater are not known but could be similar to those from agricultural activities.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased sediments | Impacts freshwater macrophytes | Unlikely | Minor | Low | Refer to general threat comment above. |
| Increased sediments | Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates) | Rare | Minor | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced light affects waterbird feeding | Unlikely | Negligible | Negligible | Refer to general threat comment above. |

## Threat
### Pollution: Sewage and stormwater

**Stressor**
Increased toxicants

Although there are no direct data, heavy metals are easily and effectively removed during common treatment processes in sewage treatment facilities and heavy metal concentrations in wastewater discharges are typically low (Smith et al. 1996). In addition, results of an investigation into 20 common micropollutants from the Bairnsdale WWTP concluded that removal rates were high for target chemicals between raw influent and the constructed wetland effluent, and no chemicals were detected in Macleod Morass (McKeown 2011). Toxicant loads to Sale Common are not known but expected to be lower than that of Macleod Morass.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased toxicants | Affects freshwater macrophytes | Unlikely | Minor | Low | Refer to general threat comment above. |
| Increased toxicants | Affects fish and frogs | Unlikely | Major | Medium | Refer to general threat comment above. |
| Increased toxicants | Affects waterbirds | Unlikely | Major | Medium | Refer to general threat comment above. |

## Threat
### Climate change: Increased bushfires

**Stressor**
Increased nutrients and sediments

Assumption that this impact pathway is for a large fire followed by heavy rain / significant flow as what occurred in 2006/7. This event resulted in three times the average annual load of phosphorus and over twice the average annual load of nitrogen entered the lakes after intense rainfall fell on burned catchments mobilising large amounts of sediment and associated nutrients (SKM 2008). However, the impacts on freshwater marshes dominated by emergent vegetation were considered less than that on open clear water systems (Deep Lakes). It is also likely that the small catchments of the creeks that feed onto the freshwater systems are less likely to carry significant loads post fire.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased nutrients and sediment | Affects freshwater macrophytes | Possible | Minor | Low | Refer to general threat comment above. |
| Increased nutrients and sediment | Affects fish and frogs | Possible | Minor | Low | Refer to general threat comment above. |
| Increased nutrients and sediment | Affects waterbirds | Possible | Negligible | Negligible | Refer to general threat comment above. |

*Continued...*

**Table A-3** Risk Assessment for the freshwater wetlands mega-habitat.

# Freshwater Lakes

## Threat
### Climate change: Increased bushfires

Regrowth of forest following bushfire can have a significant effect on run-off. It is estimated that the 2003 and 2006/7 bushfires will in the medium term result in an annual 7% reduction in flow into the Gippsland Lakes (SKM 2009). This is considerably less than the impacts of water resource use and climate change and risks are adjusted accordingly.

### Stressor
Altered water regimes / increased salinity

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Altered water regimes / increased salinity | Affects freshwater macrophytes | Unlikely | Minor | Low | Refer to general threat comment above. |
| Altered water regimes / increased salinity | Affects fish and frogs | Unlikely | Minor | Low | Refer to general threat comment above. |
| Altered water regimes / increased salinity | Affects waterbirds | Unlikely | Negligible | Negligible | Refer to general threat comment above. |

## Threat
### Pollution: Mining effluents

Mine rehabilitation (filling the voids with water) has the potential to result in water quality impacts. These are yet to be identified or defined, but evidence from international literature suggests that heavy metals, sulphates and acidity are common problems (McCullough and Schultze 2015). It is not likely that this will be a realised threat in the life of this Ramsar Site Management Plan, but planning should consider future risks.

### Stressor
Increased toxicants

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased toxicants | Affects macrophytes | Possible | Minor | Low | Refer to general threat comment above. |
| Increased toxicants | Affects biota (fish and invertebrates) | Possible | Moderate | Medium | Refer to general threat comment above. |
| Increased toxicants | Affects waterbirds | Possible | Moderate | Medium | Refer to general threat comment above. |

*Continued...*

**Table A-3** Risk Assessment for the freshwater wetlands mega-habitat.

# Freshwater Lakes

## Threat
### Pollution: Mining effluents

**Stressor**
Increased sediments

Grayson (2006) indicated just 2% of TSS loads were from mining operations. All likelihood and consequences were assigned based on this low level of sediment contribution.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased sediments | Affects macrophytes | Unlikely | Negligible | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates) | Rare | Negligible | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced light affects waterbird feeding | Rare | Negligible | Negligible | Refer to general threat comment above. |

## Threat
### Pollution: Oil spills (off-shore)

**Stressor**
Hydrocarbons

Oil spill mapping indicates even in the event of a very large spill, oil would not extend to this mega-habitat. Not a plausible pathway.

## Threat
### Pollution: Industrial and military effluents

Studies have indicated that the RAAF base in Sale may have been a source of PFAS into waterways from fire suppression activities and training (Senversa 2018). An EPA investigation in 2018 found that levels of PFAS in water and soil were below guideline levels at Heart, Dowd and Macleod Morass and Lake Wellington. Some waterfowl flesh, however, was above levels for human consumption (EPA Victoria 2019). In addition, recent investigations have shown high levels of PFAS in dolphins from the Gippsland Lakes (Foord et al. 2024).

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Toxicants | Affects freshwater macrophytes | Unlikely | Moderate | Low | Refer to general threat comment above. |
| Toxicants | Affects biota (fish and invertebrates) | Possible | Moderate | Medium | Refer to general threat comment above. |
| Toxicants | Affects waterbirds | Possible | Moderate | Medium | Refer to general threat comment above. |

*Continued...*

**Table A-3** Risk Assessment for the freshwater wetlands mega-habitat.

# Freshwater Lakes

## Threat
### Water resource use: Domestic, agricultural, mines, and plantations

### Stressor
Altered water regimes

There is some evidence of reduced inundation of both Macleod Morass and Sale Common during dry periods and a reduction in flushing flows in Sale Common (Alluvium 2020b, Hale and Clarke 2020, Hale and Boon 2022). The long term water resource assessment (DELWP 2020) indicates that water resource use did not contribute significantly to a decline in water availability in the Mitchell River (1975 - 2017) but may have contributed to lower water availability in the Latrobe and Thomson Basins. The impact, however, is significantly less than that of climate change.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Altered water regimes | Affects native vegetation | Almost certain | Moderate | High | Altered flows suggested as mechanisms for changes to vegetation community composition and extent (BMT WBM 2010). |
| Altered water regimes | Affects waterbird feeding through habitat alteration | Likely | Moderate | Medium | Australasian bittern has been recorded at Macleod Morass and prefers dense emergent vegetation. |
| Altered water regimes | Affect waterbird breeding | Likely | Moderate | Medium | Macleod Morass is considered important for breeding colonial nesting species: Australian white ibis (up to 300 pairs); straw-necked ibis (up to 300 pairs); and Sale Common for black swan (up to 500 pairs) (BMT WBM 2010). The importance of maintaining water levels to complete waterbird breeding cycles is well established (Brandis 2010). |
| Altered water regimes | Affects threatened frog species | Likely | Major | High | Growling grass frog (*Litoria raniformis*) has been recorded in Sale Common (Urlus and Ricciardello 2012) which is reliant on freshwater habitat for feeding and breeding (Gillespie 1996). Recent reviews have indicated that altered water regimes and reduced complexity of aquatic vegetation are probably causes of current localised extinctions, and predictors of future extinctions in growling grass frog (Wassens et al. 2010). |

## Threat
### Water resource use: Domestic, agricultural, mines, and plantations

### Stressor
Increased salinity

Reduced freshwater flows and increased salinity result in upstream migration of the salt wedge in the Latrobe Estuary. When saline water moves up the Latrobe Estuary past the structure connecting Sale Common to the Latrobe River, it may affect the ability of site managers to direct freshwater into the wetland. The effects of water resource use in East Gippsland are less pronounced and the impacts on Macleod Morass are presumed lower, with saline water intrusion form Lake King controlled through a regulator (Hale and Clarke 2020). Evidence suggests that to date water in the upper Morass and Sale Common has remained fresh.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased salinity | Affects native vegetation | Possible | Moderate | Medium | Refer to general threat comment above. |
| Increased salinity | Affects waterbird feeding through habitat alteration | Possible | Moderate | Medium | Refer to general threat comment above. |
| Increased salinity | Affect waterbird breeding | Possible | Moderate | Medium | Refer to general threat comment above. |
| Increased salinity | Affects threatened frog species | Possible | Moderate | Medium | Refer to general threat comment above. |

*Continued...*

**Table A-3** Risk Assessment for the freshwater wetlands mega-habitat.

# Freshwater Lakes

## Threat
### Water resource use: Domestic, agricultural, mines, and plantations

**Stressor**
Increased acidity

Acid sulphate soils are known from the fringing wetlands (Boon et al. 2007)), but studies from Sale Common indicate that there are Potential ASS, but not active.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased acidity | Impacts flora and fauna (including threatened species) | Unlikely | Moderate | Low | Refer to general threat comment above. |
| Increased acidity | Toxicants in the sediments are mobilised impacting flora and fauna | Unlikely | Major | Medium | Toxicant levels in these freshwater systems are not known, results from brackish fringing wetlands indicated no mobilisation of toxicants from acidification (Boon et al. 2007). |

## Threat
### Water resource use: Mining and mine rehabilitation

**Stressor**
Increased salinity

The effect of mine rehabilitation on water quantity and regimes is not known as the methods for mine rehabilitation have yet to be investigated fully and risks evaluated.

## Threat
### Invasive species

**Stressor**
Non-native predators (foxes and cats)

Foxes and cats are present in the Ramsar site and currently controlled by Parks Victoria and CMA programs.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Non-native terrestrial animals (foxes and cats) | Predation on nesting, feeding and roosting waterbirds | Almost certain | Moderate | High | Refer to general threat comment above. |
| Non-native terrestrial animals (foxes and cats) | Predation on frogs (including threatened species) | Possible | Moderate | Medium | Based on recent research that suggests that foxes and cats do prey on frogs, but at lower levels than mammals and birds.(Woinarski et al. 2017, Fleming et al. 2021). |

*Continued...*

**Table A-3** Risk Assessment for the freshwater wetlands mega-habitat.

# Freshwater Lakes

## Threat
Invasive species

### Stressor
Native species (giant rush)

Giant rush (Juncus ingens) has previously proved problematic in Sale Common, expanding into areas of open water and reducing habitat values (Hale and Boon 2022).

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Native species (giant rush) | Increased competition displaces native vegetation species | Almost certain | Moderate | High | Refer to general threat comment above. |
| Native species (giant rush) | Impacts to vegetation impact fauna through habitat alteration | Likely | Moderate | Medium | Refer to general threat comment above. |

## Threat
Invasive species

### Stressor
Aquatic plants (e.g. Brazilian milfoil, Mexican water lily)

Site managers' report invasive aquatic plants as a problem particularly at Sale Common.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Aquatic plants | Increased competition displaces native vegetation species | Almost certain | Minor | Medium | Refer to general threat comment above. |

## Threat
Invasive species

### Stressor
Emergent macrophytes (e.g. reed canary grass)

Reed canary grass has already been seen to have impacts in Sale Common, forming a thick thatch impacting vegetation and habitat.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Emergent macrophytes | Increased competition displaces native vegetation species | Almost certain | Minor | Medium | Refer to general threat comment above. |
| Emergent macrophytes) | Impacts to vegetation impact fauna through habitat alteration | Almost certain | Minor | Medium | Refer to general threat comment above. |

*Continued...*

**Table A-3** Risk Assessment for the freshwater wetlands mega-habitat.

# Freshwater Lakes

## Threat
Invasive species

### Stressor
Non-native fish (carp)

Carp are present at both freshwater wetlands, with evidence of damage to plant communities at Macleod Morass.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Non-native fish (carp) | Predation and competition affect diversity and abundance of native fish | Almost certain | Minor | Medium | Refer to general threat comment above. |
| Non-native fish (carp) | Habitat alteration results in impacts to aquatic macrophytes | Almost certain | Minor | Medium | Refer to general threat comment above. |

## Threat
Invasive species

### Stressor
Non-native herbivores (deer)

Deer have been observed in both Sale Common and MacLeod Morass, but with less impact than in other parts of the Ramsar site.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Non-native herbivores (deer) | Trampling and grazing of fringing vegetation | Almost certain | Minor | Medium | Refer to general threat comment above. |
| Non-native herbivores (deer) | Impacts to waterbirds foraging and breeding | Almost certain | Minor | Medium | Refer to general threat comment above. |

**Table A-3** Risk Assessment for the freshwater wetlands mega-habitat.

# Freshwater Lakes

## Threat
## Climate change and severe weather: Drought

Based on same evidence and assumptions as "decreased freshwater flows from water resource use". An assessment of the potential impacts of altered climate on river flow and river fed wetlands (such as the Gippsland Lakes) indicated that there would be a significant reduction in flow in the Latrobe River and a longer period between flow events that would inundate and flush wetlands (Tilleard and Ladson 2010, DSE 2013).

### Stressor
Altered water regimes

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Altered water regimes | Affects native vegetation | Almost certain | Moderate | High | Altered flows suggested as mechanisms for changes to vegetation community composition and extent (BMT WBM 2010). |
| Altered water regimes | Affects waterbird feeding through habitat alteration | Likely | Moderate | Medium | Australasian bittern has been recorded at Macleod Morass and prefers dense emergent vegetation. |
| Altered water regimes | Affect waterbird breeding | Likely | Moderate | Medium | Macleod Morass is considered important for breeding colonial nesting species: Australian white ibis (up to 300 pairs); straw-necked ibis (up to 300 pairs); and Sale Common for black swan (up to 500 pairs) (BMT WBM 2010). The importance of maintaining water levels to complete waterbird breeding cycles is well established (Brandis 2010). |
| Altered water regimes | Affects threatened frog species | Likely | Major | High | Growling grass frog (*Litoria raniformis*) has been recorded in Sale Common (Urlus and Ricciardello 2012) which is reliant on freshwater habitat for feeding and breeding (Gillespie 1996). Recent reviews have indicated that altered water regimes and reduced complexity of aquatic vegetation are probably causes of current localised extinctions, and predictors of future extinctions in growling grass frog (Wassens et al. 2010). |

## Threat
## Climate change and severe weather: Drought

Based on same evidence and assumptions as "increased salinity from water resource use".

### Stressor
Increased salinity

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased salinity | Affects native vegetation | Possible | Moderate | Medium | Refer to general threat comment above. |
| Increased salinity | Affects waterbird feeding through habitat alteration | Possible | Moderate | Medium | Refer to general threat comment above. |
| Increased salinity | Affect waterbird breeding | Possible | Moderate | Medium | Refer to general threat comment above. |
| Increased salinity | Affects threatened frog species | Possible | Moderate | Medium | Refer to general threat comment above. |

*Continued...*

**Table A-3** Risk Assessment for the freshwater wetlands mega-habitat.

# Freshwater Lakes

## Threat
### Climate change and severe weather: Drought

**Stressor**
Increased temperature

The most recent scaled-down climate change models for the Gippsland region projected very high confidence in a continued increase in temperatures and extreme temperature days (Clarke et al. 2019).

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased inundation and physical damage | Increased risks of avian disease | Likely | Moderate | Medium | Avian diseases such as botulism have already been observed in Macleod Morass. Avian disease has been linked to increasing temperatures and lower water levels (Lafrancois et al. 2011). |

## Threat
### Climate change and severe weather: Sea level rise

Sea level rise (coupled with reduced freshwater inflows) results in increased movement of sea water into Lake Wellington resulting in increased salinity. Increases in salinity have already been realised in Lake Wellington. Average annual salinity from modelled and measured data shows that, while there is a large degree of variability between years, there has been a clear increase in salinity in Lake Wellington over time (Hale and Boon 2022). This results in increased intrusion of saline water in the Latrobe Estuary and impacts the ability to fill Sale Common with freshwater.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased salinity | Affects native vegetation | Possible | Moderate | Medium | Refer to general threat comment above. |
| Increased salinity | Affects waterbird feeding through habitat alteration | Possible | Minor | Low | Refer to general threat comment above. |
| Increased salinity | Affect waterbird breeding | Possible | Minor | Low | Refer to general threat comment above. |
| Increased salinity | Affects threatened frog species | Possible | Minor | Low | Refer to general threat comment above. |

## Threat
### Recreational activities

Increasing populations have resulted in increased tourist and recreational pressures in the Gippsland Lakes, especially over summer. This includes the fringing wetlands, although to a lesser degree than the main lakes.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased noise, traffic, dogs, walkers | Disturbance of shorebirds and nesting waterbirds | Almost certain | Moderate | High | Recent upgrades to the highway and walking track at Sale Common have increased access and disturbance. |
| Nutrients and litter | Waste for recreational activities impacts aquatic biota and waterbirds | Possible | Negligible | Negligible | Refer to general threat comment above. |
| Physical damage from illegal off-road vehicles | Affects vegetation and habitat for biota | Almost certain | Moderate | High | Refer to general threat comment above. |

**Table A-4** Risk Assessment for the variably saline wetlands mega-habitat.

# Variably Saline Wetlands

## Threat
## Pollution: Agricultural activities

### Stressor
Increased nutrients

Around 60% of the nutrient loads in catchment inflows to the lakes are from Agricultural activities (Grayson et al. 2006). Australian wetlands are adapted to boom and bust ecology and variability in nutrients (Boulton and Brock 1999) and so impacts are generally less than for the Deep Lakes. Pathway includes agricultural effluents and run-off as well as vegetation clearing and grazing in riparian zones / stream banks.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased nutrients | Increased algal growth impacts emergent macrophytes and saltmarsh | Rare | Minor | Negligible | Although algal blooms have been recorded in this mega-habitat (SKM 2001, Boon et al. 2007) the majority of these wetlands are marshes dominated by emergent vegetation, with coloured water. Algal blooms are unlikely to impact these vegetation types. |
| Increased nutrients | Increased algal growth, decreased dissolved oxygen and impacts to aquatic biota (fish) | Possible | Minor | Low | Low dissolved oxygen events have been recorded in some fringing wetlands; e.g. Dowds Morass (Boon et al. 2007), but whether this has resulted in fish deaths remains unknown. |
| Increased nutrients | Increased algal growth, impacts waterbird feeding) | Possible | Negligible | Negligible | These wetlands are considered most important for large wading birds and shorebirds (BMT WBM 2010). These feeding habitats are less likely to be impacted by increased primary productivity. |

## Threat
## Pollution: Agricultural activities

### Stressor
Increased sediments

Sediment loads from agricultural lands have been estimated to comprise approximately two thirds of the load to the lakes (Grayson 2006). Historically, this was the cause of the decline in submerged plants in Lake Wellington (Harris et al. 1998). However, most of the fringing wetlands are dominated by emergent vegetation and / or coloured water, reducing the impact in this mega-habitat. Pathway includes agricultural effluents and run-off as well as vegetation clearing and grazing in riparian zones / stream banks.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased sediments | Impacts emergent macrophytes and saltmarsh | Rare | Minor | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates) | Rare | Minor | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced light affects waterbird feeding | Rare | Negligible | Negligible | Refer to general threat comment above. |

*Continued...*

**Table A-4** Risk Assessment for the variably saline wetlands mega-habitat.

# Variably Saline Wetlands

## Threat
### Pollution: Agricultural activities

Toxicants from agricultural actives entering freshwater wetlands is not well understood. Studies on toxicants (including pesticides and heavy metals) in the Latrobe catchment indicated low levels in sediments and potential capture and storage of toxicants in farm dams (Mossop et al. 2023).

### Stressor
Increased toxicants

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased toxicants | Affects fish | Possible | Moderate | Medium | Refer to general threat comment above. |
| Increased toxicants | Affects frogs | Possible | Moderate | Medium | Refer to general threat comment above. |
| Increased toxicants | Affects waterbirds | Possible | Moderate | Medium | Refer to general threat comment above. |

## Threat
### Pollution: Sewage and stormwater

A number of the fringing wetlands receive wastewater from WTP or storm water sources (Parks Victoria 2007). Elevated nutrients and sediments have been identified as a potential issue from this source at a number of the fringing wetlands (SKM 2001, Boon et al. 2007).

### Stressor
Increased nutrients

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased nutrients | Increased algal growth impacts emergent macrophytes and saltmarsh | Possible | Minor | Low | Refer to general threat comment above. |
| Increased nutrients | Increased algal growth, decreased dissolved oxygen and impacts to aquatic biota (fish) | Possible | Minor | Low | Refer to general threat comment above. |
| Increased nutrients | Increased algal growth, impacts waterbird feeding) | Unlikely | Negligible | Negligible | Refer to general threat comment above. |

*Continued...*

**Table A-4** Risk Assessment for the variably saline wetlands mega-habitat.

# Variably Saline Wetlands

## Threat
## Pollution: Sewage and stormwater

### Stressor
Increased sediments

Loads of sediments form stormwater and sewage to fringing wetlands are not known but could be similar to those from agricultural activities.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased sediments | Impacts emergent macrophytes and saltmarsh | Rare | Minor | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates) | Rare | Minor | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced light affects waterbird feeding | Rare | Negligible | Negligible | Refer to general threat comment above. |

## Threat
## Climate change: Increased bushfires

### Stressor
Increased nutrients and sediments

Assumption that this impact pathway is for a large fire followed by heavy rain / significant flow as what occurred in 2006/7. This event resulted in three times the average annual load of phosphorus and over twice the average annual load of nitrogen entered the lakes after intense rainfall fell on burned catchments mobilising large amounts of sediment and associated nutrients (SKM 2008). However, the impacts on wetlands dominated by emergent vegetation were considered less than that on open clear water systems (Deep Lakes). It is also likely that the small catchments of the creeks that feed onto the fringing wetlands are less likely to carry significant loads post fire.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased nutrients and sediment | Affects freshwater macrophytes | Possible | Minor | Low | Refer to general threat comment above. |
| Increased nutrients and sediment | Affects fish and frogs | Possible | Minor | Low | Refer to general threat comment above. |
| Increased nutrients and sediment | Affects waterbirds | Possible | Negligible | Negligible | Refer to general threat comment above. |

*Continued...*

**Table A-4** Risk Assessment for the variably saline wetlands mega-habitat.

# Variably Saline Wetlands

## Threat
### Climate change: Increased bushfires

Regrowth of forest following bushfire can have a significant effect on run-off. It is estimated that the 2003 and 2006/7 bushfires will in the medium term result in an annual 7% reduction in flow into the Gippsland Lakes (SKM 2009). This is considerably less than the impacts of water resource use and climate change and risks are adjusted accordingly.

### Stressor
Altered water regimes / increased salinity

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Altered water regimes / increased salinity | Affects macrophytes and saltmarsh | Unlikely | Minor | Low | Refer to general threat comment above. |
| Altered water regimes / increased salinity | Affects fish and frogs | Unlikely | Minor | Low | Refer to general threat comment above. |
| Altered water regimes / increased salinity | Affects waterbirds | Unlikely | Negligible | Negligible | Refer to general threat comment above. |

## Threat
### Pollution: Mining effluents

Mine rehabilitation (filling the voids with water) has the potential to result in water quality impacts. These are yet to be identified or defined, but evidence from international literature suggests that heavy metals, sulphates and acidity are common problems (McCullough and Schultze 2015). It is not likely that this will be a realised threat in the life of this Ramsar Site Management Plan, but planning should consider future risks.

### Stressor
Increased toxicants

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased toxicants | Affects macrophytes and saltmarsh | Possible | Minor | Low | Refer to general threat comment above. |
| Increased toxicants | Affects biota (fish and invertebrates) | Possible | Moderate | Medium | Refer to general threat comment above. |
| Increased toxicants | Affects waterbirds | Possible | Moderate | Medium | Refer to general threat comment above. |

*Continued...*

**Table A-4** Risk Assessment for the variably saline wetlands mega-habitat.

# Variably Saline Wetlands

## Threat
### Pollution: Mining effluents

**Stressor**
Increased sediments

Grayson (2006) indicated just 2% of TSS loads were from mining operations. All likelihood and consequences were assigned based on this low level of sediment contribution.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased sediments | Affects macrophytes and saltmarsh | Unlikely | Negligible | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates) | Rare | Negligible | Negligible | Refer to general threat comment above. |
| Increased sediments | Reduced light affects waterbird feeding | Rare | Negligible | Negligible | Refer to general threat comment above. |

## Threat
### Pollution: Oil spills (off-shore)

**Stressor**
Hydrocarbons

Oil spill mapping indicates even in the event of a very large spill, oil would not extend to this mega-habitat. Not a plausible pathway.

## Threat
### Pollution: Industrial and military effluents

Studies have indicated that the RAAF base in Sale may have been a source of PFAS into waterways from fire suppression activities and training (Senversa 2018). An EPA investigation in 2018 found that levels of PFAS in water and soil were below guideline levels at Heart, Dowd and Macleod Morass and Lake Wellington. Some waterfowl flesh, however, was above levels for human consumption (EPA Victoria 2019). In addition, recent investigations have shown high levels of PFAS in dolphins from the Gippsland Lakes (Foord et al. 2024).

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased toxicants | Affects macrophytes and saltmarsh | Unlikely | Moderate | Low | Refer to general threat comment above. |
| Increased toxicants | Affects biota (fish and invertebrates) | Possible | Moderate | Medium | Refer to general threat comment above. |
| Increased toxicants | Affects waterbirds | Possible | Moderate | Medium | Refer to general threat comment above. |

*Continued...*

**Table A-4** Risk Assessment for the variably saline wetlands mega-habitat.

# Variably Saline Wetlands

## Threat
### Water resource use: Domestic, agricultural, mines, and plantations

There is some evidence of reduced inundation of several of the fringing wetlands (Alluvium 2020; Hale and Boon 2022). The long term water resource assessment (DELWP 2020) indicates that water resource use did not contribute significantly to a decline in water availability in the Mitchell River (1975–2017) but may have contributed to lower water availability in the Latrobe and Thomson Basins. The impact, however, is significantly less than that of climate change.

## Stressor
### Altered water regimes

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Altered water regimes | Affects native vegetation | Almost certain | Moderate | High | Altered flows suggested as mechanisms for changes to vegetation community composition and extent (BMT WBM 2010). |
| Altered water regimes | Affects waterbird feeding through habitat alteration | Almost certain | Moderate | High | Australasian bittern has been recorded at several fringing wetlands. |
| Altered water regimes | Affect waterbird breeding | Likely | Moderate | Medium | The fringing wetlands are important sites for waterbird breeding (Sullivan 2020). The importance of maintaining water levels to complete waterbird breeding cycles is well established (Brandis 2010). |
| Altered water regimes | Affects threatened frog species | Likely | Major | High | Growling grass frog (*Litoria raniformis*) has been recorded in Heart Morass (Urlus and Ricciardello 2012) which is reliant on freshwater habitat for feeding and breeding (Gillespie 1996). Recent reviews have indicated that altered water regimes and reduced complexity of aquatic vegetation are probably causes of current localised extinctions, and predictors of future extinctions in growling grass frog (Wassens et al. 2010). |

*Continued...*

**Table A-4** Risk Assessment for the variably saline wetlands mega-habitat.

# Variably Saline Wetlands

## Threat
### Water resource use: Domestic, agricultural, mines, and plantations

Reduced freshwater flows and increased salinity result in upstream migration of the salt wedge in the Latrobe Estuary. When saline water moves up the Latrobe Estuary past the structure connecting Heart and Dowd Morass to the Latrobe River, it may affect the ability of site managers to direct freshwater into the wetland. The effects of water resource use in East Gippsland are less pronounced and the impacts on fringing wetlands further east are presumed lower.

### Stressor
Increased salinity

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased salinity | Affects native vegetation | Almost certain | Moderate | High | Increased salinity has been identified as a critical threat to a large number of the fringing wetlands (SKM 2001, 2004, Boon et al. 2007, Tilleard et al. 2009). Limited data suggested that increased salinity has occurred and continues to occur resulting in significant ecological shifts (Borg and Savage 2005). |
| Increased salinity | Affects waterbird feeding through habitat alteration | Possible | Moderate | Medium | Refer to general threat comment above. |
| Increased salinity | Affect waterbird breeding | Possible | Moderate | Medium | Waterbirds are mobile and adapted to a range of aquatic habitats. Many of the species that use these variably saline wetlands would be adapted to the range of salinity. |
| Increased salinity | Affects threatened frog species | Almost certain | Moderate | High | Increased salinity reduces habitat for frogs, with threatened species recorded in many of the fringing wetlands. |

## Threat
### Water resource use: Domestic, agricultural, mines, and plantations

Acid sulphate soils are known from the fringing wetlands (Boon et al. 2007), and recent studies indicate that at Dowd and Heart Morass, there are active ASS that have resulted in very low pH levels < 3 (Unland 2009, Taylor 2011).

### Stressor
Increased acidity

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased acidity | Impacts flora and fauna (including threatened species) | Almost certain | Moderate | High | Refer to general threat comment above. |
| Increased acidity | Toxicants in the sediments are mobilised impacting flora and fauna | Likely | Major | High | Recent studies indicated that the ASS in both Dowd and Heart Morass have led to the mobilisation of metals at concentrations that are likely to cause biological effects (Unland 2009, Taylor 2011). |

*Continued...*

**Table A-4** Risk Assessment for the variably saline wetlands mega-habitat.

# Variably Saline Wetlands

## Threat
### Water resource use: Mining and mine rehabilitation

**Stressor**
Increased salinity

The effect of mine rehabilitation on water quantity and regimes is not known as the methods for mine rehabilitation have yet to be investigated fully and risks evaluated.

## Threat
### Invasive species

**Stressor**
Non-native predators (foxes and cats)

Foxes and cats are present in the Ramsar site and currently controlled by Parks Victoria and CMA programs.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Non-native terrestrial animals (foxes and cats) | Predation on nesting, feeding and roosting waterbirds | Almost certain | Moderate | High | Refer to general threat comment above. |
| Non-native terrestrial animals (foxes and cats) | Predation on frogs (including threatened species) | Possible | Moderate | Medium | Based on recent research that suggests that foxes and cats do prey on frogs, but at lower levels than mammals and birds.(Woinarski et al. 2017, Fleming et al. 2021). |

## Threat
### Invasive species

**Stressor**
Non-native plants (e.g. spiny rush)

Observed at several fringing wetlands impacting on saltmarsh and habitat.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Non-native plants (e.g. spiny rush) | Increased competition displaces native vegetation species | Almost certain | Minor | Medium | Refer to general threat comment above. |
| Non-native plants (e.g. spiny rush) | Impacts to vegetation impact fauna through habitat alteration | Almost certain | Minor | Medium | Refer to general threat comment above. |

*Continued...*

**Table A-4** Risk Assessment for the variably saline wetlands mega-habitat.

# Variably Saline Wetlands

## Threat
Invasive species

### Stressor
Non-native fish (carp)

Observed at several fringing wetlands impacting on saltmarsh and habitat.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Non-native fish (carp) | Predation and competition affect diversity and abundance of native fish | Almost certain | Minor | Medium | Refer to general threat comment above. |
| Non-native fish (carp) | Habitat alteration results in impacts to aquatic macrophytes | Almost certain | Minor | Medium | Refer to general threat comment above. |

## Threat
Invasive species

### Stressor
Non-native herbivores (deer)

Deer have been observed in many of the fringing wetlands with extensive damage at some locations.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Non-native herbivores (deer) | Trampling and grazing of fringing vegetation | Almost certain | Minor | Medium | Refer to general threat comment above. |
| Non-native herbivores (deer) | Impacts to waterbirds foraging and breeding | Almost certain | Moderate | High | Refer to general threat comment above. |

## Threat
Invasive species

### Stressor
Non-native herbivores (pigs, goats, rabbits)

Localised impacts from pigs, goats and rabbits, but impacts less than that for deer.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Non-native herbivores (pigs, goats, rabbits) | Trampling and grazing of fringing vegetation | Almost certain | Minor | Medium | Refer to general threat comment above. |
| Non-native herbivores (pigs, goats, rabbits) | Impacts to waterbirds foraging and breeding | Possible | Minor | Low | Refer to general threat comment above. |

*Continued...*

**Table A-4** Risk Assessment for the variably saline wetlands mega-habitat.

# Variably Saline Wetlands

## Threat
Climate change and severe weather: Drought

### Stressor
Altered water regimes

Based on same evidence and assumptions as "decreased freshwater flows from water resource use". An assessment of the potential impacts of altered climate on river flow and river fed wetlands (such as the Gippsland Lakes) indicated that there would be a significant reduction in flow in the Latrobe River and a longer period between flow events that would inundate and flush wetlands (Tilleard and Ladson 2010, DSE 2013). This was considered to be a significantly increased risk to the ecology of the system than from water resource use alone.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Altered water regimes | Affects native vegetation | Almost certain | Moderate | High | Refer to general threat comment above. |
| Altered water regimes | Affects waterbird feeding through habitat alteration | Likely | Moderate | Medium | Refer to general threat comment above. |
| Altered water regimes | Affect waterbird breeding | Likely | Moderate | Medium | Refer to general threat comment above. |
| Altered water regimes | Affects threatened frog species | Likely | Major | High | Refer to general threat comment above. |

## Threat
Climate change and severe weather: Drought

### Stressor
Increased salinity

Based on same evidence and assumptions as "increased salinity from water resource use". This was considered to be a significantly increased risk to the ecology of the system than from water resource use alone.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased salinity | Affects native vegetation | Almost certain | Moderate | High | Refer to general threat comment above. |
| Increased salinity | Affects waterbird feeding through habitat alteration | Likely | Moderate | Medium | Refer to general threat comment above. |
| Increased salinity | Affect waterbird breeding | Likely | Moderate | Medium | Refer to general threat comment above. |
| Increased salinity | Affects threatened frog species | Likely | Major | High | Refer to general threat comment above. |

*Continued...*

**Table A-4** Risk Assessment for the variably saline wetlands mega-habitat.

# Variably Saline Wetlands

## Threat
## Climate change and severe weather: Drought

### Stressor
Increased temperature

The most recent scaled-down climate change models for the Gippsland region projected very high confidence in a continued increase in temperatures and extreme temperature days (Clarke et al. 2019).

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased inundation and physical damage | Increased risks of avian disease | Likely | Moderate | Medium | Avian diseases such as botulism have already been observed in Macleod Morass and could be present in some of the variably saline wetlands. Avian disease has been linked to increasing temperatures and lower water levels (Lafrancois et al. 2011). |

## Threat
## Climate change and severe weather: Sea level rise

Sea level rise (coupled with reduced freshwater inflows) results in increased movement of sea water into Lake Wellington resulting in increased salinity. Increased salinity in Lake Wellington affects wetlands that fringe the lake and are hydrologically connected. Increases in salinity have already been observed in Dowd Morass and are suspected in several other fringing wetlands (Hale and Boon 2022).

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased salinity | Affects native vegetation | Almost certain | Moderate | High | Refer to general threat comment above. |
| Increased salinity | Affects waterbird feeding through habitat alteration | Likely | Minor | Medium | Refer to general threat comment above. |
| Increased salinity | Affect waterbird breeding | Likely | Minor | Medium | Refer to general threat comment above. |
| Increased salinity | Affects threatened frog species | Almost certain | Moderate | High | Refer to general threat comment above. |

## Threat
## Recreational activities

Increasing populations have resulted in increased tourist and recreational pressures in the Gippsland Lakes, especially over summer. This includes the fringing wetlands, although to a lesser degree than the main lakes.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased noise, traffic, dogs, walkers | Disturbance of shorebirds and nesting waterbirds | Almost certain | Moderate | High | A number of the fringing wetlands are considered important shorebird sites (BMT WBM 2010) and activities such as dog walking, hunting and other active recreational activities have the potential to disturb birds, reducing resources for return migration to the northern hemisphere. |
| Nutrients and litter | Waste for recreational activities impacts aquatic biota and waterbirds | Possible | Negligible | Negligible | Refer to general threat comment above. |
| Physical damage from illegal off-road vehicles | Affects vegetation and habitat for biota | Almost certain | Moderate | High | Evidence from several fringing wetlands with destruction of saltmarsh and habitat. |

**Table A-5** Risk Assessment for the hypersaline wetlands mega-habitat.

# Hypersaline Wetlands

## Threat
### Pollution: Agricultural activities

Hydrology of Lake Reeve is different from the rest of the lakes, it receives water from Merrimans Creek and Carrs Creek; with the latter the only sizeable stream draining into the Lake. It has a catchment area of 250 square kilometres and is non perennial and contributes very small flows except during a wet winter (SKM 2004). It also receives some tidal flow from the main lakes, which might be a potential pathway for nutrients from the main catchments to enter the system. Algal blooms have been recorded in the Lake, but given the intermittent nature of Lake Reeve, and the dominant vegetation community being fringing saltmarsh, it is unlikely to be impacting the vegetation.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased nutrients | Increased algal growth impacts saltmarsh | Unlikely | Minor | Low | Algal blooms have been recorded in the Lake, but given the intermittent nature of Lake Reeve, and the dominant vegetation community being fringing saltmarsh, it is unlikely to be impacting the vegetation. |
| Increased nutrients | Increased algal growth, decreased dissolved oxygen and impacts to aquatic biota (fish) | Rare | Minor | Negligible | Lake Reeve is mostly intermittent, with only a small residual pool, salinity is hypersaline, and so it is unlikely to supports a diverse fish community. The invertebrates fauna would be resilient to harsh conditions, and not likely to be negatively impacted by algal blooms. |
| Increased nutrients | Increased algal growth, impacts waterbird feeding | Rare | Negligible | Negligible | Lake Reeve is significant for supporting feeding and roosting of shorebirds (BMT WBM 2010). Increased primary productivity is not excepted to negatively impact on these species. |

## Threat
### Pollution: Sewage and stormwater

Previous studies have indicated that (SKM 2004):
- estimated total phosphorus load to Lake Reeve from Loch Sport septic tanks is 49%
- estimated total nitrogen load to Lake Reeve from Loch Sport septic tanks is 27%
- estimated faecal coliform load to Lake Reeve from Loch Sport septic tanks is 36%

However, as stated above, emergent saltmarsh communities are unlikely to be significantly affected by increased nutrients and algae.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased nutrients | Increased algal growth impacts emergent macrophytes and saltmarsh | Unlikely | Minor | Low | As stated above, emergent saltmarsh communities are unlikely to be significantly affected by increased nutrients and algae. |
| Increased nutrients | Increased algal growth, decreased dissolved oxygen and impacts to aquatic biota (fish) | Rare | Minor | Negligible | Refer to general threat comment above. |
| Increased nutrients | Increased algal growth, impacts waterbird feeding | Rare | Negligible | Negligible | Refer to general threat comment above. |

*Continued...*

**Table A-5** Risk Assessment for the hypersaline wetlands mega-habitat.

# Hypersaline Wetlands

## Threat
### Climate change: Increased bushfires

Assumption that this impact pathway is for a large fire followed by heavy rain / significant flow as what occurred in 2006/7 in the west of the site and 2019 in the east. On neither occasion did the plume enter into Lake Reeve or other hypersaline wetlands. Not a plausible pathway.

## Threat
### Pollution: Mining effluents

Not a plausible pathway for this mega-habitat.

## Threat
### Pollution: Oil spills (off-shore)

Oil spill mapping indicates that there needs to be a large, sustained release of oil from more than one production well in Bass Strait, for the spill to enter the Ramsar site. This is considered to be a very unlikely scenario, but consequences are based on the impacts in the event oil does enter the Ramsar site, which would be at comparatively low levels.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Hydrocarbons | Affects saltmarsh | Rare | Moderate | Negligible | Refer to general threat comment above. |
| Hydrocarbons | Direct oiling of wildlife | Rare | Minor | Negligible | Refer to general threat comment above. |
| Hydrocarbons | Indirect long term effects (food webs) | Rare | Major | Low | Refer to general threat comment above. |

## Threat
### Water resource use: Domestic, agricultural, mines, and plantations

The GeoScience Australia Waterbodies tool (https://www.ga.gov.au/scientific-topics/dea) shows % inundation of Australian wetlands from the Landsat satellite imager. There is no evidence of a sustained change in inundation at Lake Reeve, Victoria Lagoon or Red Morass from 1987 to 2022.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Altered water regimes | Affects saltmarsh | Unlikely | Moderate | Low | Refer to general threat comment above. |
| Altered water regimes | Affects waterbirds | Unlikely | Moderate | Low | Refer to general threat comment above. |

## Threat
### Invasive species

Foxes and cats are present in the Ramsar site and currently controlled by Parks Victoria and CMA programs.

#### Stressor
Non-native predators (foxes and cats)

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Non-native terrestrial animals (foxes and cats) | Predation on nesting, feeding and roosting waterbirds | Almost certain | Minor | Medium | Important habitat for shorebirds and other wading birds, but less vulnerable than nesting birds in Deep Lakes. |

*Continued...*

**Table A-5** Risk Assessment for the hypersaline wetlands mega-habitat.

# Hypersaline Wetlands

## Threat
Invasive species

### Stressor
Non-native plants (e.g. spiny rush)

Observed by site managers and delivery partners.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Non-native plants (e.g. spiny rush) | Impacts to saltmarsh | Almost certain | Moderate | High | Refer to general threat comment above. |
| Non-native plants (e.g. spiny rush) | Impacts to vegetation impact waterbirds through habitat alteration | Almost certain | Minor | Medium | Refer to general threat comment above. |

## Threat
Invasive species

### Stressor
Non-native herbivores (deer)

Sambar deer and hog deer both are having significant effects on vegetation and waterbird communities. While sambar deer are controlled by management activities, hog deer are protected.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Non-native herbivores (deer) | Trampling and grazing of saltmarsh | Almost certain | Moderate | High | Refer to general threat comment above. |
| Non-native herbivores (deer) | Impacts to waterbirds foraging | Almost certain | Moderate | High | Refer to general threat comment above. |

## Threat
Climate change and severe weather: Drought

The GeoScience Australia Waterbodies tool (https://www.ga.gov.au/scientific-topics/dea) shows % inundation of Australian wetlands from the Landsat satellite imager. There is no evidence of a sustained change in inundation at Lake Reeve, Victoria Lagoon or Red Morass from 1987 to 2022.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Altered water regimes | Affects saltmarsh | Unlikely | Moderate | Low | Refer to general threat comment above. |
| Altered water regimes | Affects waterbirds | Unlikely | Moderate | Low | Refer to general threat comment above. |

## Threat
Recreational activities

Increasing populations have resulted in increased tourist and recreational pressures in the Gippsland Lakes, especially over summer. This includes the hypersaline wetlands, although to a lesser degree than the main lakes.

| Stressors | Impact Pathway | Likelihood | Consequence | Risk | Evidence / Comments |
|---|---|---|---|---|---|
| Increased noise, traffic, dogs, walkers | Disturbance of shorebirds | Likely | Moderate | Medium | Refer to general threat comment above. |
| Nutrients and litter | Waste for recreational activities impacts aquatic biota and waterbirds | Possible | Negligible | Negligible | Refer to general threat comment above. |
| Physical damage | Affects vegetation and habitat for biota | Almost certain | Moderate | High | High Evidence from several hypersaline wetlands with destruction of saltmarsh and habitat. |

# Appendix D Implementation of the 2015 Plan

A review of the management strategies within the 2015 Gippsland Lakes Ramsar Site Management Plan was conducted in 2023 and is summarised below.

| Management strategy | Status |
|---|---|
| 1A. Manage boat and swing moorings to minimize physical damage to seagrass beds. | Complete – 30 seagrass friendly moorings installed. |
| | Commenced – planning for another 10 seagrass friendly mooring to be installed next year. |
| 1B. Implement island renourishment and re-vegetation. | Ongoing – renourishment completed at Pelican and Crescent Island. Further work planned. |
| 1C. Protect and restore habitat at little tern and fairy tern nesting and post-breeding sites. Manage sea spurge at little tern and fairy tern nesting sites. | Ongoing – Fox and weed control on islands and outer barrier undertaken seasonally by PV and GLaWAC. |
| 1D. Improve native vegetation corridors and connectivity within and between all habitat types represented in the Ramsar site. | Ongoing – Wetland rehabilitation works across various projects including locations such as: Sale Common, Macleod Morass, Lake Wellington, Lake Reeve. |
| 1E. Continue protection and rehabilitation of the Heart Morass. | Ongoing – Implementation of the Heart Morass Rehabilitation Plan. |
| 1F. Continue strategic protection and rehabilitation of wetlands on private property that contribute to maintaining the ecological character of the Ramsar site. | Ongoing – Wetland rehabilitation works at Hollands Landing, Jones Bay, Flannagan Is and Cobblers Creek. |
| 1G. Implement actions to control invasive native species such as Typha and Giant Rush in freshwater wetlands as required. | Ongoing – Sale Common. |
| | Complete – Investigations into Typha expansion and control at Macleod Morass |
| 1H. Actively manage priority non-native pest plants. | Ongoing – Wide range of projects including implementation of Gippsland Lakes Invasive Species Strategy |
| 1I. Develop and implement instream and riparian habitat protection and/or rehabilitation programs for the estuarine river reaches. | Ongoing – Wide range of river health works including; stock exclusion, fencing, revegetation and installation of woody instream habitat. |
| 1J. Explicitly consider impacts to visual amenity of the landscape when assessing planning applications adjacent to the site. | Ongoing (Business as Usual) – Development applications assessed in accordance with planning regulations. |
| 1K. Monitor and where possible control off-road vehicle use at priority locations within the Ramsar site. | Ongoing – recreation and public land management and surveillance, development and implementation of Lake Tyers Camping and Access Strategy. |
| | Commenced – bollard installation at 4 priority sites including Lake Wellington wetlands. |

*Continued...*

| Management strategy | Status |
|---|---|
| 1L. Develop management strategies to maintain and restore the Mitchell River silt jetties. | Complete – Investigations, prioritisation and delivery of stabilisation works and revegetation. |
| 2A. Control of introduced predators in priority bird areas. | Ongoing – Fox control (McLeod Morass, Outer Barrier, Barrier Islands), predator scat analysis and fox control at Blond Bay. |
| 2B. Increase signs in priority migratory wader and nesting bird habitats to reduce disturbance. | Complete – Signage erected in key breeding and roosting sites. |
| 2C. Identify key nursery areas for the Burrunan dolphins. | Complete – Investigation and report on key nursery areas. Monitoring of Burrunan dolphins across the lakes. |
| 2D. Investigate the risk posed by human disturbance to migratory waders develop and implement feasible actions to address the risks. | Complete – Study completed into the human disturbance rates of birds at 4 locations in the lakes. |
| 2E. Develop and implement a public awareness campaign to reduce harassment and boating injuries to Burrunan dolphins. | Complete – Communications products **social media, signage, brochures and booklets with tourism operators and visitor information centres**. |
| 2F. Implement an introduced marine pest strategy for the Gippsland Lakes. | Complete – Survey of marine pests. |
| | Complete – Marine pest risk assessment. |
| 3A. Reduce nutrient and sediment loads to the Gippsland Lakes through riparian, in-stream and catchment works to improve water quality of river flows to the Gippsland Lakes. | Ongoing – Implementation of works to reduce nutrient runoff from irrigated land and waterway erosion. |
| | Complete – Construction of stormwater treatment wetland at Broadlands, Jones Bay catchment. |
| | Commenced – Construction of stormwater treatment wetland in East Bairnsdale, Jones Bay catchment. |
| 4A. Undertake regular planning, delivery, monitoring and evaluation of the use of environmental water entitlements in the lower Latrobe wetlands (Sale Common, Heart Morass, Dowd Morass) and the Latrobe River estuary. | Ongoing – Planning and delivery of environmental water entitlements and associated monitoring |
| 4B. Investigate, and where feasible and cost effective, implement actions that enable and facilitate effective management of the water and salt regimes of priority fringing wetlands, including Sale Common, Heart Morass, Dowd Morass, Lake Reeve, and Macleod Morass. For example: technical studies, management plans and/or agreements, water entitlements, on-ground works, operational management and monitoring. | Ongoing – Investigations at Macleod Morass Implementation yet to commence. |
| | Complete – Investigations and plans completed and funding largely secured for watering infrastructure at Sale Common, Heart Morass and Dowd Morass. |
| | Ongoing – Upgrades and construction of new watering infrastructure for Sale Common, Heart Morass and Dowd Morass, and protection and improvement of the environmental water reserve. |
| 4C. Maintain and where necessary improve hydrological connectivity and freshwater inflows to the Gippsland Lakes for fish migration and breeding. | Ongoing – Numerous projects including provision of fish passage and provision of e-flows in Latrobe, Thomson and Macalister rivers and associated monitoring. |
| 4D. Develop and implement a procedure for the management of estuary mouth closures for Lake Tyers and Merriman Creek | Ongoing – Estuary Opening Protocols for Lake Tyers. |
| | Commenced – Investigations at Merriman Creek. |
| 5A. Implement joint management of the Gippsland Lakes Coastal Park, The Lakes National Park, Lake Tyers State Park and Raymond Island Gippsland Lakes Reserve. | Ongoing – Joint management of land around the Gippsland Lakes is a partnership between Gunaikurnai Traditional Owners and Parks Victoria. As part of the model, Gunaikurnai and Parks Victoria Rangers are collectively responsible for the on-ground management of 4 parks and reserves within the Gippsland Lakes Ramsar Site (The Lakes NP, Gippsland Lakes CP, Lake Tyers SP, and Raymond Island GLR). |

*Continued...*

| Management strategy | Status |
|---|---|
| 5B. Deliver training and knowledge to increase the capacity of the Aboriginal community to be involved in the management of the Ramsar site. | Ongoing – GLaWAC are involved in a range of projects around the Gippsland Lakes in partnership with regional organisations. GLaWAC has worked with individual partners to deliver on ground works and identify opportunities for training and development through programs around the lakes. A continued focus on this is needed. |
| 5C. Conduct a comprehensive survey of all waterways in the Ramsar site with respect to cultural significance. | Commenced – GLaWAC has begun and is continuing a comprehensive cultural mapping program, around the Gippsland Lakes and Lake Tyers, as well as broader areas along the Gippsland coast, including predictive modelling. This program is improving knowledge and understanding of culturally significant sites as well as identifying sites under current or future threats. |
| 5E. Recognise the cultural value of water bodies, collect data on cultural flows and to take steps to ensure that these values are included in decisions regarding Ramsar site management. | Ongoing – GLaWAC continue to pursue water rights as a priority, including the cultural obligations and values associated with water. Cultural values have been incorporated into Latrobe and Thomson flows studies, and a Mitchell River estuary risk assessment. GLaWAC have undertaken Aboriginal Water Assessments across rivers and wetlands within and the Ramsar site. A continued focus on this is needed. |
| 5F. Develop and implement traditional ecological knowledge projects within the Ramsar site. | Commenced – Traditional Owner (via GLaWAC) involvement occurs in many Gippsland Lakes projects. Continued efforts from all partners is needed to ensure ongoing opportunities for the use of traditional ecological knowledge in projects within the Ramsar site. |
| 6A. Investigate priority species and locations for waterbird breeding and migratory wader refuges within the Ramsar site. Assess that habitat requirements are being met at priority locations. | Commenced – Study completed on "Reducing human disturbance on migratory and resident shorebird hotspots in the Gippsland Lakes" and investigation into refuge sites commenced. |
| 6B. Assess the distribution of heavy metals and other contaminants (including mercury) in the Gippsland Lakes and the level of risk (i.e. bioavailability). | Complete – Heavy metals study complete. |
| 6C. Investigate the risks of toxicants (steroid hormones) in Macleod Morass. | Complete – Study at Bairnsdale WWTP and risk assessment for MacLeod Morass. |
| 6D. Investigate the cues for migration and recruitment of native fish. | Complete – Several studies completed on Australian grayling and black bream. |
| 6E. Assess the impacts of blue-green algal blooms on waterbird populations and recruitment success. | Ongoing - Blue green algal blooms routinely monitored by DEECA. |
| 6F. Assess variability in the extent and condition of seagrass, including environmental thresholds for change. | Ongoing - Framework complete, mapping and monitoring of seagrass extent. |
| 6G. Investigate the habitat use and requirements for Australian grayling within the Ramsar site. | Complete – report on Grayling habitat use in the Gippsland Lakes (ARI). |
| 6H. Assess the importance of estuarine reaches to amphibians, aquatic reptiles, and mammals. | Complete – Study completed and key species identified that utilise estuarine reaches within the Gippsland Lakes. |
| 6I. Investigate the risk associated with and potential mitigation strategies for climate change impacts to ecological character of the Ramsar site. | Ongoing - Multiple projects ongoing including assessing risks and options and modelling habitat changes. |
| 6J. Investigate the impacts of altered freshwater inflows on nutrient cycling and productivity in the Deep Lakes, including thresholds for change. | Complete – Various studies including water quality monitoring, modelling of nutrient loads including phosphorus, effects of climate change. |

*Continued...*

| Management strategy | Status |
|---|---|
| 6K. Investigate the impact of high nutrient and sediment loads to fresh and variably saline wetlands following bushfires. | Complete – Study completed by CSIRO "Vulnerability of the Gippsland Lakes Ramsar Site and its catchment to bushfire and climate change". |
| 6L. Investigate feasible management options for the control of invasive freshwater fish (carp and gambusia). | Commenced – Carp exclusion plots are being installed in Sale Common and Macleod Morass to measure impact of carp on submerged vegetation. |
| 6M. Investigate options for improving the ecological condition of Lake Wellington. | Complete – Lake Wellington and Fringing Wetlands Scoping Study. |
| 6N. Investigate the non-breeding habitat requirements of threatened frog species. | Complete – Habitat enhancement within Macleod Morass and studies at Clydebank Morass. |
| 6O. Awareness raising/education about the Ramsar Convention, the condition of the Gippsland Lakes, environmental impact assessment, management options and implications. | Ongoing - Communications and engagement via Love our Lakes. |
| 7A. Review the Ramsar site boundary. | Complete – Updated boundary description. |
| 7B. Update the Ramsar Information Sheet. | Ongoing – draft update complete. DEECA currently working with Australian Government to finalise. |
| 7C. Review and where necessary update Limits of Acceptable Change, in particular for areas that are currently not covered by current LAC such as Lake Tyers. | Complete – Ecological Character Description Addendum. |
| 7D. 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). | Ongoing – Business as usual impact assessment for projects with the potential to impact on ecological character. |
| 7E. 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. | Ongoing – Ramsar rolling review, Gippsland Lakes Environment Report, Ramsar site monitoring and evaluation. |
| 7F. Develop implementation plans for this strategy. | Complete – Gippsland Lakes Priorities Plan 2016 and 2021. |

# Appendix E Derivation of Resource Condition Targets

| Value | Baseline description | Limit of Acceptable Change | Current condition | Resource Condition Targets |
|---|---|---|---|---|
| C1 Marine subtidal aquatic beds (seagrass / aquatic plants) | In 1997 medium to dense seagrass covered an area of around 3600 hectares within the Gippsland Lakes Ramsar Site although there is a high degree of variability over time (Roob and Ball 1997). | Total seagrass extent will not decline below 2000 hectares for a period of greater than 20 continuous years.<br><br>Greater than 15 percent of the total seagrass extent will have a density of "medium" or "dense". | Between 2017 and 2021, total extent of seagrass ranged from 2235 to 2854 hectares, in the main lakes (excluding Lake Tyers) with 32 to 38% occurring as dense patches (Brooks and Hale 2021a). | Extent of medium-dense seagrass in Lakes Victoria and King to be greater than 3200 hectares.<br><br>Extent of medium-dense seagrass in Lake Tyers to be greater than 300 hectares. |
| C2 Coastal brackish or saline lagoons (open water phytoplankton dominated habitats) | Planktonic food webs are an important part of the Gippsland Lakes trophic structure and the large lagoons that are dominated by phytoplankton drive the energy dynamics of the system (Grigg et al. 2004, Cook et al. 2008, Holland et al. 2009).<br><br>The system experiences periodic algal blooms. | Long term: A long-term change in ecosystem state at Lake King, Lake Victoria or Lake Tyers from relatively clear, seagrass dominated estuarine lagoons to turbid, algae dominated system (characteristic of Lake Wellington) will represent a change in ecological character.<br><br>Short-term: No single cyanobacteria algal bloom event will cover greater than 10 per cent of the combined area of coastal brackish/ saline lagoons (that is, Lake King, Victoria, Wellington and Tyers) in two successive years. | Lakes King and Victoria have remained seagrass dominated.<br><br>Blooms have been defined as an algal level of "high" as indicated by DEECA phytoplankton monitoring. There have been nine algal blooms in the main lakes in the past two decades: 2001/02 to 2020/21. | Lakes Victoria and King remain clear with median secchi depths of > 1 m<br><br>Annual median chlorophyll-a concentrations will be within the 80th percentile of reference years (1986-1988). That is will not exceed:<br>• 20 µg/L in Lake Wellington<br>• 10 µg/L in Lake Victoria<br>• 5 µg/Lin Lake King |
| Freshwater wetlands | Freshwater wetlands within the site at the time of listing were limited to Sale Common and Macleod Morass. They provide a habitat mosaic of open water, emergent macrophytes and paperbark. | A habitat mosaic will be maintained at Sale Common and Macleod Morass that comprises open water, freshwater emergent native vegetation (sedges, rushes and reeds) and woody vegetation (swamp scrub and floodplain woodland), with no habitat comprising more than 70 percent of the total wetland area for more than five successive years.<br><br>In existing freshwater wetland areas, the annual median salinity should not be > 1 ppt in two successive years. | Mapping for MacLeod Morass in May 2020 indicates: 24% open water; 50% emergent native vegetation (shallow marsh and reedbed); and 12% woody vegetation (Brooks and Hale 2021a).<br><br>The mapping for Sale Common indicates a difference between the wet phase in 2016 and drier conditions in 2019. The LAC, however, is met on both occasions (Hale and Brooks 2020, Brooks and Hale 2021a). | Maintain the average extent of freshwater macrophytes:<br>• Sale Common > 100 hectares<br>• Macleod Morass > 200 hectares<br><br>Maintain "good" (as indicated as a biota score of > 16 according to the Index of Wetland Condition) freshwater vegetation condition at Macleod Morass and Sale Common at 80% of representative sites.<br><br>Maintain Macleod Morass and Sale Common as freshwater marshes (i.e. median annual salinity < 1 ppt). |

*Continued...*

| Value | Baseline description | Limit of Acceptable Change | Current condition | Resource Condition Targets |
|---|---|---|---|---|
| Brackish wetlands | The brackish fringing wetlands within the Ramsar site fringe the open water areas of Lakes Wellington, Victoria and King and include Dowd, Heart and Clydebank Morasses, Lake Coleman and Tucker Swamp. They are dominated by swamp paperbark (*Melaleuca ericifolia*) woodland, emergent macrophyte beds and saltmarsh (Boon et al. 2007). | A habitat mosaic will be maintained at Dowd Morass that comprises open water, common reed and swamp paperbark, with no habitat comprising more than 70 percent of the total wetland area for more than five successive years. | Mapping for Dowd Morass in July 2020 indicates: 37% open water; 27% emergent native vegetation (shallow marsh and reedbed); and 31% woody vegetation (Brooks and Hale 2021a). | Maintain an average extent of structural habitat across the variably saline wetlands:<br>• Tall emergent marsh > 800 hectares<br>• Shallow marsh > 550 hectares<br>• Paperbark > 2300 hectares<br><br>Maintain "good" (as indicated as a biota score of > 16 according to the Index of Wetland Condition) vegetation condition in variably saline wetlands at 80% of representative sites. |
| Saltmarsh | Saltmarsh communities occur in the fringing wetlands and dominate in hypersaline wetland areas such as Lake Reeve and Victoria Lagoon. Dominant species include *Sarcocornia quinqueflora*, *Tecticornia pergranulata* and *Gahnia filum* (Boon et al. 2011). There is little information on the extent of saltmarsh habitat at the time of listing. In 2010 there was approximately 4300 hectares of saltmarsh (Boon et al. 2011). | Total saltmarsh extent across the entire Ramsar site will not decline below 3585 hectares. | Total extent of saltmarsh in 2021 was 4924 hectares (calculated from mapping in Brooks and Hale 2021c) | Maintain saltmarsh extent at > 4000 hectares.<br><br>Maintain "good" as indicated as a score of > 16 according to the Index of Wetland Condition biota assessment method) saltmarsh condition at 80% of representative sites. |
| Abundance & diversity of waterbirds | The Gippsland Lakes Ramsar Site is known to support over 90 species of waterbird with periodic counts exceeding 60,000 individuals (East Gippsland CMA 2022) The majority of the significant waterbird habitat is on the islands of Lake King and in the fringing wetlands. Saltmarsh and salt-flats such as those found at Lake Reeve are important feeding grounds for waders, including migratory species. | Mean maximum counts (calculated over a minimum of five years) will not drop below the following population thresholds:<br>• Black swan = 0.3%<br>• Chestnut teal (ducks) – 2.5%<br>• Eurasian coot (coots & rails) – 0.15%<br>• Fairy tern (terns) – 1.5%<br>• Little tern (terns) – 0.5%<br>• Little black cormorant (fishers) – 0.01%<br>• Straw-necked ibis (large wading) – 0.05% | Data pooled from multiple sources (GLCC BirdLife monthly counts, Field and Game Australia counts, Atlas of Living Australia, DEECA Summer Waterfowl Counts) indicate the following five-year averages (2017/18 – 2020/21):<br>• Black swan = 3000 (0.3%)<br>• Chestnut teal (ducks) = 4547 (4.5%)<br>• Eurasian coot (coots & rails) = 8255 (0.8%)<br>• Fairy tern (terns) = 180 (12%)<br>• Little tern (terns) = 113 (1.1%)<br>• Little black cormorant (fishers) = 1138 (1.1%)<br>• Straw-necked ibis (large wading) =3412 (0.3%). | Total diversity of waterbirds across the site remains above 86.<br><br>The site supports greater than 20,000 waterbirds in three out of five years. |
| Waterbird breeding | The Gippsland Lakes Ramsar Site supports breeding of a number of waterbird species across a variety of habitats. The ECD indicates that breeding of the following waterbird species within the Ramsar site is critical to the ecological character (BMT WBM 2010a):<br>• Australian pelican<br>• Little tern and fairy tern; and<br>• Black swan, Australian white ibis, straw-necked ibis, and little black cormorant<br>• Royal spoonbills. | Successful breeding of the following indicator species within the Ramsar site at least once every five years: Australian fairy tern, Australian white ibis, Australian pelican, black swan, chestnut teal, little black cormorant, little tern and royal spoonbill. | All indicator species have been recorded breeding in the Ramsar site in the past five years (GLCC waterbird monitoring; Field and Game Australia monitoring; Atlas of Living Australia). | Annual successful breeding of the following beach-nesting bird species: little tern, fairy tern, pied oystercatcher, hooded plover and red-capped plover.<br><br>Maintain a breeding colony of Australian pelican within the Gippsland Lakes.<br><br>Successful breeding of Australasian darters, pied cormorants, little black cormorants, straw-necked ibis, Australian white ibis and royal spoonbills at least once every two years. |

*Continued...*

| Value | Baseline description | Limit of Acceptable Change | Current condition | Resource Condition Targets |
|---|---|---|---|---|
| Threatened frog species | There are regular records for two threatened frog species from the Gippsland Lakes Ramsar Site. Species have been recorded in Sale Common, Dutson Downs, Dowd Morass, Heart Morass, Clydebank Morass, Macleod Morass (Jim Reside, pers. comm.). | Green and golden bell frog and growling grass frog are recorded breeding at least one location within the Ramsar site every five years. | Green and golden bell frog have been recorded breeding n Heart Morass in 2021 and growling grass frog have been recorded breeding in Clydebank Morass in 2022 (Greening Australia unpublished data). | Green and golden bell frog and growling grass frog are recorded at all of the following locations: Dutson Downs, Heart Morass, Clydebank Morass, Dowd Morass, Macleod Morass within a five year period.<br><br>Successful breeding of green and golden bell frog and growling grass frog at a minimum of five wetlands in any three-year period, including in the Lower Latrobe Wetlands. |
| Abundance and diversity of native fish | Over 230 species of fish have been recorded within the Gippsland Lakes (Hindell, DEECA, Friends of Beware Reef, unpublished data) spanning a wide range of life cycles. Fish species within the Gippsland Lakes Ramsar site are distributed according to their salinity tolerances. A number of freshwater native fish species occur in the freshwater and fresher of the variably saline fringing wetlands as well as the lower reaches of the rivers within the Ramsar site, whilst the main lakes support estuarine residents, estuarine opportunists and marine stragglers. | Native fish within the Ramsar site will represent each of the following life history strategies: estuarine dependent, estuarine opportunists, marine migrants, diadromous and obligate freshwater species. | Surveys by Friends of Beware Reef have recorded over 100 species of fish representing all the life history categories in surveys conducted between 2017 and 2019. | Maintain native fish species richness, with a minimum of 70 species recorded in the Deep and Shallow Lakes over any five-year period.<br><br>Maintain fish diversity for species within each of the following life history strategy: estuarine dependent, estuarine opportunists, marine migrants, diadromous, and obligate freshwater species. |
| Threatened flora species: Swamp everlasting | Threatened wetland plant found in Blonde Bay in freshwater, rain filled depressions. | The threatened flora species swamp everlasting (*Xerochrysum palustre*) continues to be supported within the boundaries of the Gippsland Lakes Ramsar Site. | There is a small population of the species in Blonde Bay, with over 100 individuals recorded in 2020-21 (Trust for Nature unpublished data). | Average abundance of swamp everlasting to be > 500 stems in Blonde Bay (5-year average) with evidence of flowering biennially. |
| Threatened fauna species | The Gippsland Lakes Ramsar site regularly supports several nationally threatened fauna species including the Australian grayling, Australian fairy tern and Australasian bittern and hooded plover.<br><br>Updates to the EPBC listed of threatened species, mean that several migratory shorebirds that are regularly supported by the site are now listed as threatened. | Australian grayling continues to be supported in one or more of the catchments draining into the Gippsland Lakes.<br><br>Presence of the following threatened bird species within the Gippsland Lakes Ramsar site annually:<br>• Australasian bittern<br>• Hooded plover<br>• Sharp-tailed sandpiper<br>in two thirds of years:<br>• Bar-tailed godwit<br>• Common greenshank<br>• Latham's snipe | Australian grayling has been recorded annually in the Thomson River from 2005 to 2020 (Tonkin et al. 2020).<br><br>Surveys of the cryptic species Australasian bittern have only been conducted in recent years, with confirmed observations in 2020, 2021 and 2022. | Australasian bittern detected annually within the Ramsar site and at least once every two years at the following sites: Macleod Morass, Dowd Morass, Heart Morass and Clydebank Morass.<br><br>(Hooded plover and Australian fairy tern covered by RCT for waterbird breeding).<br><br>Annual presence of threatened shorebird species within the Ramsar site (bar-tailed godwit, common greenshank, Latham's snipe and sharp-tailed sandpiper). |

# Appendix F
# Cross reference of management strategies with priority values, threats and knowledge gaps

| Priority values | Priority threats | Knowledge gaps |
|---|---|---|
| V1. Marine sub-tidal beds (seagrass) | T1. Climate change: sea level rise and storms impacting on island habitats and affecting beach nesting birds and foraging shorebirds | K1. Management of toxicants (including chemicals of emerging concern): to minimise impacts on ecological character site |
| V2. Coastal lagoons (open water phytoplankton) | T2. Climate change: increased bushfires reduce water quality and impacts on seagrass, fish and waterbirds | K2. Impacts of deer on ecological character |
| V3. Fringing freshwater wetlands | T3. The combined effects of water resource use and climate change alter water regimes and increase salinity affecting wetland vegetation, fish, frogs and waterbirds | K3. Management options to address risks from avian disease (e.g. botulism, avian flu) |
| V4. Fringing brackish wetlands | T4. Inflows of nutrients and sediments from the catchment impact seagrass and fish | K4. Management options to address risks from impacts of introduced marine pests on ecological character |
| V5. Saltmarsh | T5. Toxicants from catchment inflows, mining and stormwater impact biota | K5. Impact of recreational fishing on native fish abundance and diversity |
| V6. Abundance & diversity of waterbirds | T6. Invasive species: native emergent macrophytes (giant rush) displace native vegetation and reduce habitat quality for aquatic fauna | K6. Potential risk of Acid Sulfate Soil activation and impacts to ecological character |
| V7. Abundance and diversity of native fish | T7. Invasive species: non-native fish (e.g. carp and Gambusia) alter habitat, and compete and predate on native fish and tadpoles | |
| V8. Threatened species: Green and golden bell frog | T8. Invasive species: foxes and cats predating on waterbirds | |
| V9. Threatened species: Growling grass frog | T9. Invasive species: salt tolerant weeds impacting saltmarsh and waterbird habitat | |
| V10. Threatened species: Australian grayling | T10. Invasive species: non-native grazing animals (deer) impacting vegetation and destroying waterbird nests | |
| V11. Threatened species: Australasian bittern | T11. Invasive species: terrestrial weeds (e.g. sea spurge) impacts on beach nesting bird sites | |
| V12. Threatened species: Fairy tern | T12. Recreation: boats, jets skis, dogs, walkers disturbing waterbird feeding, breeding and roosting | |
| V13. Threatened species: Hooded plover | T13. Recreation: vehicles damaging saltmarsh | |
| V14. Threatened species: migratory waders | | |
| V15. Waterbird breeding | | |

| Mangement Strategies | Responsibility | Linkages to existing programs / activities | Relevant priority values | Relevant knowledge gaps | Relevant threats | Relevant mega-habitats |
|---|---|---|---|---|---|---|
| 1A. Implement actions within the Gippsland Lakes to protect and restore seagrass beds. | EGCMA, Parks Victoria, GLaWAC, Gippsland Ports | Seagrass friendly moorings, seagrass restoration | V1 | | T2, T4, T12 | Deep Lakes, Shallow Lakes |
| 1B Continue to implement island renourishment for beach nesting birds. | Gippsland Ports, DEECA, Parks Victoria, EGCMA | On-going active management of sand islands for nesting bird habitat. | V6, V12, V13, V14 | | T1 | Deep Lakes |
| 1C. Protect, restore and enhance breeding and foraging habitat for beach nesting birds. | Gippsland Ports, EGCMA, Parks Victoria, GLaWAC | Gippsland Lakes Environment Fund program. | V6, V12, V13, V14 | | T1 | Deep Lakes, Shallow Lakes |
| 1D. Identify and implement opportunities for improving and enhancing habitat connectivity and adaptation in response to the impacts of climate change within the Ramsar site and adjacent priority areas. | EGCMA, WGCMA, Parks Victoria, GLaWAC | East and West Gippsland Regional Waterway Strategies, Gippsland Lakes Priorities Plan | All | | T1, T2, T3 | All |
| 1E. Implement actions to control giant rush in Sale Common as required. | WGCMA | Gippsland Lakes Priorities Plan | V3 | | T6 | Freshwater wetlands |
| 1F. Update the Gippsland Lakes Invasive Species Strategy and implement priority actions. | Parks Victoria, GLaWAC, EGCMA, WGCMA | Gippsland Lakes Priorities Plan | All | K2, K4 | T6, T7, T8, T9, T10, T11 | All |
| 1G. Control illegal recreational activities to minimise / prevent physical damage to habitats in priority areas. | Parks Victoria | Gippsland Lakes Priorities Plan | V4, V5, V6 | | T13 | Deep Lakes, Shallow Lakes, Hypersaline wetlands |
| 2A. Control of introduced predators in priority bird areas | Parks Victoria, DEECA | Biodiversity programs by Parks Victoria and DEECA, Gippsland Lakes Invasive Species Strategy | V6, V11, V12, V13, V14 | | T8 | All |
| 2B. Develop and implement measures to improve public awareness to reduce disturbance to migratory waders and nesting birds | BirdLife Australia | | V6, V11, V12, V13, V14 | | T12 | Deep Lakes, Shallow Lakes |
| 2C. Develop a marine pest strategy for the Gippsland Lakes and implement priority actions | EGCMA, Gippsland Ports | Introduced marine pest surveys, GP bio-security protocols | V1, V7 | K4 | | Deep Lakes, Shallow Lakes |
| 2D. Control of non-native grazing animals (deer, goats) and pigs | Parks Victoria, DEECA | Gippsland Lakes Invasive Species Strategy | V3, V4, V5, V6, V12, V13, V14 | K2 | T10 | All |
| 3A. Reduce nutrient and sediment loads to the Gippsland Lakes through riparian, in-stream and catchment works to improve water quality of river flows to the Gippsland Lakes. | East and West Gippsland CMAs, DEECA, PV, EGW, SRW, GW | Riparian, in-stream and catchment works in the East and West Gippsland Regional Catchments Strategies and Regional Waterway Strategies<br><br>Existing Parks Victoria vegetation management programs<br><br>CORE 4 program in dryland and irrigated areas of West Gippsland<br><br>MID extension and incentives program | All | | T2, T4 | Deep Lakes, Shallow Lakes |

*Continued...*

| Mangement Strategies | Responsibility | Linkages to existing programs / activities | Relevant priority values | Relevant knowledge gaps | Relevant threats | Relevant mega-habitats |
|---|---|---|---|---|---|---|
| 4A. Address the combined effects of water use and climate change on the ecological character of the lower Latrobe wetlands (Sale Common, Dowd Morass and Heart Morass) by prioritising:<br>• Regular planning, delivery, monitoring and evaluation of the use of environmental water entitlements;<br>• Recovery of the water needed for the Lower Latrobe wetlands through implementation of the policies in the Central and Gippsland Region Sustainable Water Strategy with respect to water recovery in the Thomson, Macalister, Latrobe and Tyers rivers; and<br>• Implementation of actions in the Central and Gippsland Region Sustainable Water Strategy with respect to improving the delivery of environmental water to the lower Latrobe wetlands. | WGCMA, Parks Victoria, Victorian Environmental Water Holder, DEECA, Field & Game Australia, Water corporations (urban/rural), Industry, VEWH | West Gippsland CMA environmental water program.<br><br>Gippsland Region Sustainable Water Strategy | V3, V4, V6, V7, V8, V9, V10, V11, V14 | | T3 | Fresh and variably saline wetlands |
| 4B. Investigate, and where feasible and cost effective, implement actions that enable and facilitate effective management of the water and salt regimes of priority fringing wetlands, including Sale Common, Heart Morass, Dowd Morass, Lake Reeve and Macleod Morass. For example: technical studies, management plans and/or agreements, water entitlements, on-ground works, operational management and monitoring. | EGCMA, WGCMA, Parks Victoria, Victorian Environmental Water Holder, Wellington Shire Council, East Gippsland Water, DEECA | West Gippsland CMA environmental water program Gippsland Region Sustainable Water Strategy | V3, V4, V5, V6, V7, V8, V9, V10, V11 | | T3 | Fresh, variably saline and hypersaline wetlands |
| 4C. Implement the actions of the Central and Gippsland Region Sustainable Water Strategy with respect to water recovery in the rivers of the Gippsland Lakes to address the combined effects of water use and climate change on ecological character. | East and West Gippsland CMAs | East and West Gippsland Regional Waterway Strategies | V3, V4, V6, V7, V8, V9, V10, V11 | | T2, T3 | Shallow Lakes, fresh and variably saline wetlands |
| 6A. Investigate potential management options for the risks to ecological character from known toxicants (e.g. PFAS and mercury). | EGCMA, EPA Victoria | Australian Defence Force has a Remediation Action Plan for the RAAF Base East Sale | All | K1 | T5 | All |
| 6B. Investigate further the risks from new and emerging toxicants and chemicals to Gippsland Lakes Ramsar values and the potential management options. | EGCMA, EPA Victoria | | All | K1 | T5 | All |
| 6C. Investigate, and where feasible and cost effective, implement actions that enable and facilitate effective management of carp in fringing wetlands. | WGCMA, DEECA | | V3, V4, V7, V8, V9, V10 | | T7 | Fresh and variably saline wetlands |
| 6D. Develop and implement a response plan for addressing risks associated with avian diseases. | DEECA, BirdLife | Agriculture Victoria avian flu response plan | V6, V11, V12, V13, V14 | K3 | | All |

*Continued...*

| Mangement Strategies | Responsibility | Linkages to existing programs / activities | Relevant priority values | Relevant knowledge gaps | Relevant threats | Relevant mega-habitats |
|---|---|---|---|---|---|---|
| 6E. Develop a response plan for identifying and managing risks to ecological character from introduced marine pests. | DEECA, Parks Victoria | | All | K4 | | Deep and Shallow Lakes |
| 6F. Investigate the severity and extent of impact deer and other introduced herbivores are having on waterbird nest sites and sensitive wetland environments such as coastal saltmarsh. | EGCMA, Parks Victoria | | V6, V11, V12, V13, V14, V15 | K2 | T10 | All |
| 6G. Awareness raising/education about the Ramsar Convention, the condition of the Gippsland Lakes, environmental impact assessment, management options and implications. | DEECA, East and West Gippsland CMAs | | All | All | All | All |
| 6H. Understand the risks of activating Acid Sulfate Soils that may impact on the ecological character of the Gippsland Lakes. | DEECA, East and West Gippsland CMAs | | All | K6 | T5 | |
| 7A. Review the Ramsar site boundary to consider the inclusion of areas of wetlands dissected by the current boundary | DEECA, Gippsland Lakes Ramsar Coordinating Committee | | | | | |
| 7B. Update the Ramsar Information Sheet | DEECA | | | | | |
| 7C. 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). | DEECA, DCCEEW | | | | | |
| 7D. Undertake a regular review of the status of the ecological character of the Ramsar site. | EGCMA, DEECA | | | | | |
| 7E. Develop rubrics / thresholds for assessing progress towards RCTs | EGCMA, WGCMA, DEECA, Parks Victoria | | | | | |
| 7F. Develop annual action plans for this strategy | EGCMA with GLCC | | | | | |

# Notes

# Notes

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EAST GIPPSLAND CATCHMENT MANAGEMENT AUTHORITY

West Gippsland Catchment Management Authority

VICTORIA State Government