MANAGEMENT PLAN

Pitt Water
NATURE RESERVE

Department of Primary Industries, Parks, Water and Environment

Tasmania
Explore the possibilities

Pitt Water Nature Reserve
Management Plan

Pitt Water Nature Reserve Management Plan

This management plan applies to Pitt Water Nature Reserve, which is reserved under the *Nature Conservation Act 2002.* The nature reserve is part of the Pitt Water-Orielton Lagoon Ramsar Site, however only areas reserved under the *Nature Conservation Act 2002* are covered by this management plan.

This management plan has been prepared in accordance with the requirements of Part 3 of the *National Parks and Reserves Management Act 2002.* Unless otherwise specified, this plan adopts the interpretation of terms given in Section 3 of the *National Parks and Reserves Management Act 2002*. The term 'Director' refers to the Director of National Parks and Wildlife. The term 'reserve' refers to the Pitt Water Nature Reserve which encompasses five sections: Barilla Bay, upper Pitt Water, Orielton Lagoon, Woody Island and Barren Island.

In accordance with Section 30(1) of the *National Parks and Reserves Management Act 2002*, the managing authority for the reserve, in this case the Director of National Parks and Wildlife, shall carry out duties in relation to the reserve for the purpose of giving effect to, and in accordance with the provisions of this management plan.

The appendices do not form part of this statutory plan, but are provided as additional information to assist in management.

The draft management plan for the reserve was released for public comment from 1 November 2010 until 10 December 2010. Eleven public representations were received. The Tasmanian Planning Commission reviewed public comments on the plan and the Director's report on proposed responses to those comments and provided a report to the Minister in February 2012.

Many people have assisted in the preparation of this plan with ideas, feedback and information. Their time and effort is gratefully acknowledged.

Approval

This management plan was approved by His Excellency the Governor-in-Council on 18 March 2013 and took effect on 15 May 2013, being seven days after publication of that approval in the Government Gazette.

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Contents

List of figures

List of tables

Abbreviations and terminology

For the interpretation of ‘commercial vessel’, ‘lightweight craft’, ‘motor boat’ and ‘vessel’ refer to the relevant legislation noted in this list.

ASS	acid sulfate soils
BCB	Biodiversity Conservation Branch, part of DPIPWE
CAMBA	China–Australia Migratory Bird Agreement
CLAC	Crown Land Assessment and Classification Project
commercial vessel	‘commercial vessel’ has the same meaning as in the *Marine and Safety Authority Act 1997*
DEPHA	Department of Environment, Parks, Heritage and the Arts (until 30 June 2009)
DIER	Department of Infrastructure, Energy and Resources
DPIPWE	Department of Primary Industries, Parks, Water and Environment (from 1 July 2009)
DPIW	Department of Primary Industries and Water (until 30 June 2009)
ECD	Ecological Character Description
ecological character	The combination of the ecosystem components, processes and benefits/services that characterise the wetland at any given point in time (Ramsar Resolution IX.1 Annex A, 2005)
ecosystem services	The benefits that people receive from ecosystems
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999* (Cwth)
JAMBA	Japan–Australia Migratory Bird Agreement
lightweight craft	‘lightweight craft’ has the same meaning as in the Marine and Safety (General) Regulations 2010
MOU	Memorandum of Understanding
MAST	Marine and Safety Tasmania
motor boat	‘motor boat’ has the same meaning as in the Marine and Safety (Motor Boats and Licences) By-Laws 2008
NRM	Natural Resource Management
PAPL	Protected Areas on Private Land Program
PASS	potential acid sulfate soils
PEV	Protected Environmental Value
PWS	Parks and Wildlife Service
Ramsar Convention	The Convention on Wetlands of International Importance (the Ramsar Convention) is an intergovernmental treaty that provides the framework for international cooperation for the conservation and wise use of wetlands.
ROKAMBA	Republic of Korea–Australia Migratory Bird Agreement
Smartline mapping	The Smartline Coastal Geomorphic Map of Australia is a detailed map of coastal landform types
STCA	Southern Tasmania Councils Authority
TAFI	Tasmanian Aquaculture and Fisheries Institute
TASMARC	Tasmanian Shoreline Monitoring and Archiving Project
TSPA	*Threatened Species Protection Act 1995* (Tas.)
UTAS	University of Tasmania
vessel	‘vessel’ has the same meaning as in the *Marine and Safety Authority Act 1997*
wise use	The wise use of wetlands is the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development (Ramsar Resolution IX.1 Annex A, 2005)
WONS	Weeds of National Significance

1. Summary

The Pitt Water Nature Reserve (the 'reserve') is located in south-eastern Tasmania and covers approximately 826.3 hectares. It is managed by the Tasmanian Parks and Wildlife Service (PWS). Most of the reserve lies within the Pitt Water-Orielton Lagoon Ramsar Site (the 'Ramsar site'). The site was included on the list of Wetlands of International Importance under the Ramsar convention on wetlands on 16 November 1982.

Pitt Water Nature Reserve provides habitat for migratory and resident birds, is an important estuarine ecosystem and an essential nursery for marine life. The reserve provides habitat for a number of threatened birds, animals and plants, including some unusual and unique species.

The reserve forms part of the Pitt Water-Orielton Lagoon Ramsar Site, one of ten Ramsar sites (wetlands of international importance) in Tasmania. It is an extensive and diverse wetland and is the only Ramsar site in Tasmania located in an urban area.

The reserve is part of the major summer feeding grounds for migratory shorebirds in Tasmania and the most southern in Australia.

The reserve supports significant populations of migratory birds including eastern curlew, bar-tailed godwit, common greenshank, curlew sandpiper and red-necked stint. Some species fly to the site from as far away as the Arctic tundra. Twenty six bird species that occur in and around the reserve are listed on the Japan–Australia Migratory Bird Agreement (JAMBA). Twenty bird species are listed on both the China–Australia Migratory Bird Agreement (CAMBA) and the Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA). See Appendix 5 for the species list. The importance of Orielton Lagoon as a shorebird feeding area and resting site has also been recognised through listing on the East Asian – Australasian Flyway Reserve Network that links some of the important wetlands along this flyway.

The reserve also provides year-round habitat for many Tasmanian resident shorebirds. The foreshore and islands are important feeding and breeding sites for pied oystercatchers and many seabirds, including terns and gulls. It is one of the only areas in Tasmania where great crested grebe are regularly seen.

The reserve supports some of the most significant samphire vegetation in Tasmania and provides habitat for other saltmarsh species. Seagrasses are another important vegetation type that is protected within the reserve. The reserve is home to at least seven threatened flora species, such as lemon beautyheads (*Calocephalus citreus*) and yellow sea-lavender (*Limonium australe* var. *australe*).

Eight threatened fauna species have also been recorded, including the threatened live-bearing seastar (*Parvulastra vivipara*), white-bellied sea-eagle (*Haliaeetus leucogaster*) and eastern curlew (*Numenius madagascariensis*). The reserve is also one of the only places where the rare chequered blue butterfly *(Theclinesthes serpentata lavara)* can be found.

The Barilla Bay and upper Pitt Water and Orielton Lagoon sections of the reserve are under increasing pressure from adjacent land uses, particularly urban and industrial development. Unauthorised use of the reserve, pollution

and the encroachment of neighbours threaten the integrity of the reserve's values. A number of strategies are proposed in this plan to reduce these threats.

Management prescriptions, strategies and actions

This plan is aimed at ensuring the long term viability of the values for which Pitt Water Nature Reserve was established to protect. The plan outlines the legislative management objectives for nature reserves, as well as reserve-specific objectives, prescriptions, strategies and actions.

There are a number of key threatening processes that have or have the potential to detrimentally affect the values of the reserve. Key management initiatives in this plan include directions to:

- improve water quality, particularly in Orielton Lagoon through better stormwater management;
- ensure the continuation of important weed removal activities, including Weeds of National Significance;
- manage access to the reserve to reduce disturbance to birds as well as lessen other potential threats, such as pollution. The most noteworthy access strategies are the seasonal restriction of access to Woody Island to minimise the disturbance of sea-eagles during the breeding season and prohibition on use of motorised vessels (when under power);
- provide guidance for the formalisation of a pre-existing occupation of the reserve to improve environmental outcomes; and
- improve liaison with local municipal councils, landowners and interested groups or community members to minimise threats and assist with the implementation of management actions recommended for adjacent land. This is important because many threats to the reserve originate beyond its boundaries. The plan also outlines opportunities for improving community engagement and understanding about the threats to the values of the reserve.

2. Overview

2.1 Purpose of this management plan

This plan applies to all land and water designated as the Pitt Water Nature Reserve.

This plan outlines the long-term management objectives of the reserve and the necessary management strategies and actions to meet those objectives (refer to the Implementation Schedule at the rear of the plan for the prioritised and numbered list of strategies and actions). The reserve is surrounded by intensive uses and is located at the end of a large catchment. While the plan provides for policies and actions for management inside the reserve, it cannot prescribe actions beyond the boundaries of the reserve. Therefore, the plan proposes developing close liaison with local municipal councils and the community to assist with management actions to improve the protection of the reserve into the future, as well as promote better environmental management of adjacent areas.

A non-statutory inter-agency management strategy will be prepared for the entire Ramsar site at a later date.

2.2 Location, plan area and access

Pitt Water Nature Reserve is located in the Clarence and Sorell municipalities. It is approximately twenty kilometres east of the city of Hobart and lies between the towns of Sorell and Cambridge. Daily management is the responsibility of the PWS Southern Region's South East Field Centre. The reserve covers approximately 826.3 hectares (as at November 2012).

The reserve comprises five separate sections that include terrestrial, intertidal and marine areas (see Figure 1):

- Orielton Lagoon and some land immediately adjacent to the lagoon;
- a section of Barilla Bay in the west of Pitt Water;
- the northern section of Pitt Water to the high water mark, where the Coal River discharges into Pitt Water ('upper Pitt Water');
- Woody Island to the low water mark; and
- Barren Island to the low water mark.

The reserve consists of almost land-locked estuarine areas and therefore is highly vulnerable to practices on adjacent land. In some areas, the reserve only extends to the high water mark. The surrounding land is mostly privately owned or narrow coastal public reserves. The private land is used for a variety of purposes including grazing, residential, industrial and recreational use.

Most of the reserve lies within the 3334 hectare Pitt Water-Orielton Lagoon Ramsar Site. (See Map 1 for the location of the reserve in relation to the broader Ramsar site). There may be some confusion in the local community about the boundaries of the reserve due to the separation of the nature

reserve into five separate areas, as well as the mixture of land tenures within the Ramsar site.

Orielton Lagoon is the most easily accessible section of the reserve, as well as the area most vulnerable to damage. It is a shallow lagoon and on average is 1.3 metres deep. Direct disturbance and pollution from stormwater and sewage/wastewater treatment facilities are major threats. The main access points are located along the shoreline at Sorell, Shark Point Road, Midway Point and via the Tasman Highway along the Sorell causeway. Public access to the rest of the reserve is limited as it is largely surrounded by private land and the islands are a considerable distance offshore. Multiple access points and encroachments onto the reserve around Orielton Lagoon are commonplace.

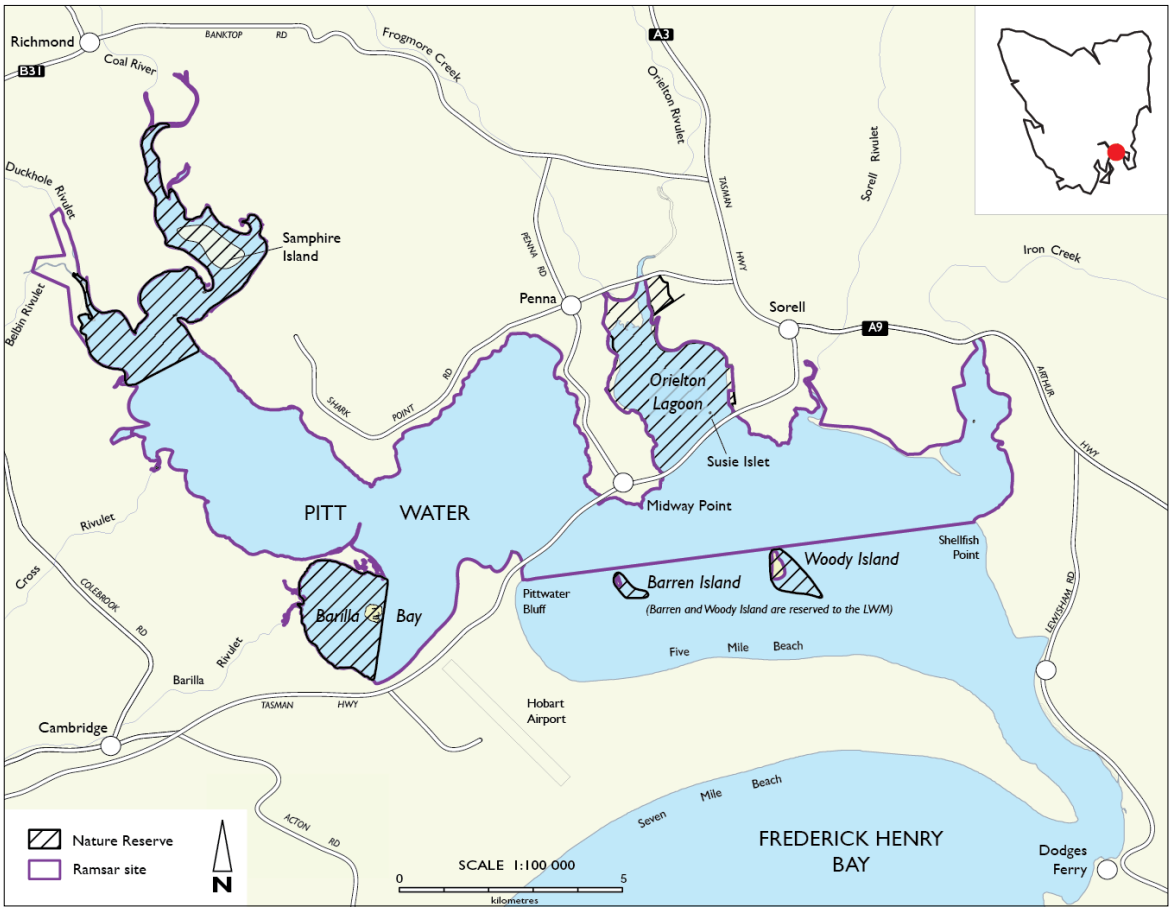

Figure 1 Map of Pitt Water Nature Reserve and Pitt Water-Orielton Lagoon Ramsar site

2.3 International significance – agreements and conventions

The Convention on Wetlands of International Importance

The Convention on Wetlands of International Importance (the Ramsar Convention) is an intergovernmental treaty that provides the framework for international cooperation for the conservation and wise use[1] of wetlands.

The broad aim of the Ramsar Convention is to halt and, where possible, reverse worldwide loss of wetlands, which are considered one of the world's most threatened habitats.

The Pitt Water Nature Reserve (with the exception of Barren and Woody Islands and a portion of land on the north-east edge of Orielton Lagoon) lies within the Pitt Water-Orielton Lagoon Ramsar Site. See Appendix 1 for more Ramsar site information.

Migratory bird agreements and other conventions

The reserve is part of an important area for migratory shorebirds that fly there from as far away as the Arctic tundra. It is one of the major summer feeding grounds in Tasmania and the most southern in Australia for listed migratory species under the Japan–Australia Migratory Bird Agreement (JAMBA), the China–Australia Migratory Bird Agreement (CAMBA) and the Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA). See also Appendix 1. Australia has obligations to ensure the protection of listed migratory bird species and their habitat.

The East Asian – Australasian Flyway Network

Pitt Water Nature Reserve is within the most southern part of the East Asian–Australasian Flyway that stretches from Siberia and Alaska southwards through east and south-eastern Asia to Australia and New Zealand. Although Australia does not provide breeding habitat for migratory birds, it is an essential area for feeding and roosting.

2.4 Legislation and administration

Nature Reserve

Nature reserves are proclaimed under the Tasmanian *Nature Conservation Act 2002* and managed under the *National Parks and Reserves Management Act 2002*.

The reserve has been assigned to the IUCN Category IV, which comprises area protected for the conservation of habitat and species through management intervention. This classification emphasises the primary importance of nature conservation within the reserve.

[1] See the 'Abbreviations and terminology' list for a definition of 'wise use'.

Other relevant Tasmanian legislation and policies

Threatened plants and animals within the reserve are protected under the *Threatened Species Protection Act 1995*. The *National Parks and Reserves Management Act 2002* does not apply to fish and other living marine resources – the protection and use of living marine resources is regulated under the *Living Marine Resources Management Act 1995*. Most vertebrate wildlife in the reserve is also protected under the Wildlife Regulations (General) 2010, issued under the *Nature Conservation Act 2002*. Other legislation also applies, such as the *Inland Fisheries Act 1995*.

All items of Aboriginal heritage in Tasmania are protected under the *Aboriginal Relics Act 1975*. Historic cultural heritage is protected under the *Historic Cultural Heritage Act 1995*.

The *Marine and Safety Authority Act 1997* gives Marine and Safety Tasmania (MAST) jurisdiction over all coastal waters and vessels. However, under the *National Parks and Reserves Management Act 2002* and the National Parks and Reserved Land Regulations 2009*,* the PWS has the authority to place restrictions on the use of vessels within the reserve.

The *Environmental Management and Pollution Control Act 1994* gives the Department of Primary Industries, Parks, Water and Environment (DPIPWE) and local councils the authority to prevent pollution or take action against persons who allow pollutants to enter the waters of the reserve.

The Sorell and Clarence City Councils carry out land use planning for their municipal areas including the reserve, under the *Land Use Planning and Approvals Act 1993*. Under this Act, land use planning does not extend into waters unless by way of a structure, such as a jetty.

The State Policy on Water Quality Management 1997 applies to all waters of the reserve. The Tasmanian State Coastal Policy 1996 also applies to the reserve. The three main principles of this coastal policy are:

- natural and cultural values of the coast shall be protected;
- the coast shall be used and developed in a sustainable manner; and
- integrated management and protection of the coastal zone is a shared responsibility.

The reserve is part of the Southern Natural Resource Management Region, as established under the *Natural Resource Management Act 2002*. The main task of the Southern Tasmanian Natural Resource Management (NRM) Regional Committee is to develop and implement a regional strategy, to be accredited by the state and the Commonwealth governments. The regional committee's role in setting priorities and recommending funding merits it being informed of all significant management proposals for the reserve. The NRM Regional Committee has a proactive ability to access funding for research and on-ground works. The *Natural Resource Management Act 2002* does not affect the statutory processes for establishing and managing the reserves.

Ramsar site

Australia's obligations under the Ramsar Convention for wetlands in Tasmania are met primarily through legislation and administrative arrangements governed by the state government. Accordingly, the Ramsar Convention is implemented primarily under state and territory legislation. The Wetlands Unit of the Commonwealth environment department is the administrative authority for the Ramsar Convention in Australia. The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a national legislative framework for the protection of Ramsar sites.

The *National Parks and Reserves Management Act 2002* does not apply to the whole Pitt Water-Orielton Lagoon Ramsar Site (see Figure 1). It applies only to the land reserved under the *Nature Conservation Act 2002*. The balance of the Ramsar site, excluding private property, is managed under the provisions of the *Crown Lands Act 1976*.

See Appendix 1 for the original and current criteria for the listing of the Pitt Water-Orielton Lagoon Ramsar site.

Nationally Important Wetland

Pitt Water-Orielton Lagoon is also listed as a nationally important wetland in *A Directory of Important Wetlands in Australia* ("the Directory"), a comprehensive inventory that identifies and provides information on the values of Australia's nationally important wetlands.

An Australian wetland may be considered nationally important if it meets at least one of six criteria. According to the Directory (Environment Australia 2001) Pitt Water-Orielton Lagoon meets the following criteria:

> *Criterion 3: It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail.*
>
> *Criterion 4: The wetland supports 1% or more of the national populations of any native plant or animal taxa.*
>
> *Criterion 5: The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level.*

2.5 Proclamation history

Proposals to establish a reserve in the Pitt Water-Orielton Lagoon area date back to 1970. Proposals included the establishment of a wildlife sanctuary to protect birds from shooting during the duck hunting season. A reserve named 'Koomela Nature Reserve' was proposed in 1981 to include the whole of Pitt Water, Woody and Barren Islands to Iron Creek. In 1985, the proposed Koomela Nature Reserve was changed to Pitt Water Nature Reserve.

The reserve was first proclaimed as a nature reserve of 776 hectares in 1995. The nature reserve status allows for the highest level of protection of the reserve. In 2006, the reserve was extended by approximately 14.6 hectares through the addition of three sections of land on the boundary of Orielton

Lagoon (Central Plan Registry map 7178). The extensions were made through the Crown Land Assessment and Classification (CLAC) Project. The purpose of the CLAC project was to assess and classify all unallocated Crown land and public reserves under the *Crown Lands Act 1976*. The provisions of this management plan apply to these reserve extensions.

The Pitt Water-Orielton Lagoon Ramsar Site was designated in 1982 as the sixth Ramsar site in Australia to be listed under the Ramsar Convention. Its boundary was redefined in 1994.

3. Vision and management objectives

3.1 Vision

Developing a vision for the reserve provides a signpost for the future management and direction. It is important that management decisions have a clear and structured path to follow. Strategic direction assists in avoiding inappropriate decisions and actions and ensures that the area continues to be worthy of its reservation status.

The vision for Pitt Water Nature Reserve is that it is managed as one of the most important Tasmanian habitats for migratory and resident birds and marine life, and is recognised as a place where:

> The ecological character and diversity of the reserve has been maintained or improved. Populations of threatened species are healthy and viable. Resident shorebirds and migratory bird species continue to use the reserve for roosting, feeding and breeding. Bird habitat areas are provided with extra protection from disturbance, pollution, pests and weeds.
>
> The water quality of Orielton Lagoon has improved. Saltmarsh and seagrass communities have re-established. Sites of cultural significance have been identified and are conserved.
>
> Research, education and community engagement is encouraged and supported. Members of the community, especially neighbours, are aware of the values of the reserve and are involved in projects to help rehabilitate the area.
>
> The community appreciates the reserve for its unique wetland environment and the natural scenic landscapes. Visitor access is carefully managed to ensure birds and other values are not disturbed or damaged whilst providing a balanced interaction between people and the natural habitat.

Figure 2 View of Pitt Water and Barilla Bay from Cambridge Hill

3.2 Purpose and management objectives of Nature Reserves

Purpose of Nature Reserves

Nature reserves are a category of reserved land under the *Nature Conservation Act 2002.* Nature reserves are areas of land that contain natural values that:

- contribute to the natural biological diversity or geological diversity of the land, or both; and
- are unique, important or have representative value.

Management objectives

The management objectives of nature reserves are set out in the *National Parks and Reserves Management Act 2002*. The management objectives of nature reserves that apply to the Pitt Water Nature Reserve are listed below.

Because of the complex interrelationship of factors to be considered in managing the nature reserve, the reasons these objectives apply and the manner in which the objectives will be achieved are dealt with in a number of sections of the management plan. The sections of management plan that primarily deal with each management objective in the Act are shown in brackets.

The management objectives are:

- to conserve natural biological diversity (sections 4.4 and 4.5);
- to conserve geological diversity (section 4.2);
- to preserve the quality of water and protect catchments (section 4.3);
- to conserve sites or areas of cultural significance (section 4.7);
- to encourage education based on the purpose of reservation and the natural or cultural values of the nature reserve, or both (4.10);
- to encourage research, particularly that which furthers the purposes of reservation (section 5.2);
- to protect the nature reserve against, and rehabilitate the nature reserve following, adverse impacts such as those of fire, introduced species, diseases and soil erosion on the nature reserve's natural and cultural values and on assets within and adjacent to the nature reserve (sections 4.2 to 4.9); and
- to encourage cooperative management programs with Aboriginal people in areas of significance to them in a manner consistent with the purpose of reservation and the other management objectives (sections 4.7 and 4.10).

3.3 Specific objectives for the reserve

The objectives listed below address the reserve's specific values and issues:

Maintenance of habitat under climate change

- To maintain existing habitat, including mudflats and native vegetation for optimum resilience as the reserve is faced with climatic changes.

Geology, geomorphology and soils

- To identify and protect sites of geoconservation significance within the reserve.
- To regularly inspect areas subject to erosion and take appropriate action, if necessary.
- To monitor areas that are susceptible to erosion or have a high potential of containing acid sulfate soils in the reserve or on adjacent land where it may affect the values of the reserve.
- To minimise the disturbance of material that has a high potential of containing acid sulfate soils.

Water values

- To maintain or enhance the water quality of the reserve, particularly in Orielton Lagoon.
- To improve water quality by minimising the impact of threatening processes, particularly stormwater, sewage and sedimentation, to enhance aquatic ecological values and restore habitat for threatened and migratory species, particularly seagrass beds.
- To ensure that the ecological requirements of the reserve are prioritised when establishing environmental flows for the rivers and tributaries flowing into the reserve.

Flora values

- To protect, maintain and monitor natural flora diversity, particularly of threatened species.
- To protect threatened species of flora from loss beyond what may be expected from natural variability or seasonal influences.

Fauna values

- To maintain and enhance the natural values of the reserve.
- To protect, maintain and monitor natural fauna diversity, particularly of threatened species.

- To ensure that there is no loss of any threatened species of fauna due to local effects, beyond that expected through natural variability, migration or seasonal influences.
- To protect and enhance habitat for migratory and resident birds.

Pests and weeds

- To eradicate pests where feasible and warranted by the actual or potential impact upon the identified values of the reserve.
- To control and manage pests where eradication is not possible or warranted.
- To eradicate weeds where feasible and warranted by the actual or potential impact upon the identified values of the reserve and in accordance with schedules of the *Weed Management Act 1999* (Tas.).
- To control and contain weeds where eradication is not possible or warranted.

Cultural heritage values

- To identify and protect Aboriginal heritage sites and values.
- To identify and protect sites of historical significance.

Natural landscape values

- To protect and maintain scenic vistas and features of the natural landscape within the reserve.
- To maintain the connectivity of habitat, native vegetation and refugia in the landscape.

Visitors and access

- To allow for visitation that has a negligible impact on the values of the reserve, and no impact on bird habitat areas, whilst still providing for educational and interactive experiences.
- To prohibit activities that cause observed disturbance to birds, especially on or near the foreshore.

Education, interpretation and community involvement

- To provide quality contemporary and relevant visitor information and education opportunities.
- To ensure that the local community and visitors are informed about the significance of the nature reserve and Ramsar site status, the boundaries of the reserve and the reserve restrictions.
- To target school involvement in educational initiatives.
- To increase community awareness of direct and indirect impacts caused by human actions and to help the community understand the values and management aims for the reserve, particularly the threats posed by stormwater, domestic pets and disturbance.

- To allow for interpretation and educational activities without compromising conservation values.
- To work with councils to raise awareness of the values of the reserve with the community and adjacent property developers.
- To encourage and support community involvement through organisations such as Coastcare, NRM and Landcare.

Adjacent land use and other external influences

- To protect the reserve from impacts caused by residential, commercial and industrial development on surrounding land.
- To be proactive concerning adjacent land uses through environmental initiatives, such as education about appropriate vegetation.

Implementation

- To ensure that management activities and other works are appropriate and compatible with this plan and the values of the reserve.

Research

- To facilitate and promote research to improve understanding of the reserve; and maintain and facilitate data collection and analysis to inform decision making relevant to the reserve.

3.4 Tasmanian Reserve Management Code of Practice

The *Tasmanian Reserve Management Code of Practice 2003* specifies appropriate standards and practices for new activities in reserves which have been approved through project planning and assessment processes. It also provides best practice operational standards. The General Principles and Basic Approach specified in the *Tasmanian Reserve Management Code of Practice 2003* have been adopted in the development of this management plan and will be applied in the conduct of operational management activities in the reserve.

4. Conservation and protection of values

4.1 Maintenance of habitat under climate change

Tasmania in general has a temperate maritime climate and temperatures in the south-east are generally among the warmest in the state. Because of the prevailing westerly wind flow, this area falls in a rain shadow for much of the year. Rain that does fall is fairly evenly spread over the year with slight peaks in autumn and spring when changeable weather patterns bring easterly winds. Extended dry periods make rehabilitation difficult.

Future threats – climate change and sea-level rise

As a coastal and estuarine reserve, it is likely that the effects of climate change will significantly affect the physical and biological values of the reserve (Resource Management and Conservation Division, DPIW 2008). Prahalad (2009) suggests that climate change and sea-level rise are the biggest long-term threats to saltmarsh vegetation and bird habitat, with changes to vegetation composition, erosion and salinity.

It has been estimated that climate change could cause sea-level rise in excess of one metre this century (Rahmstorf 2010). Potential effects include erosion of intertidal feeding areas through storm surge activity; changes to coastal vegetation, such as inland movement of samphire; habitat loss for species with limited distribution; and changes to food availability for resident and migratory shorebirds. Roost sites will also likely be altered or lost from sea-level rise.

Objective

- To maintain existing habitat, including mudflats and native vegetation as much as possible for optimum resilience as the reserve is faced with climatic changes.

Strategies and actions

- Monitor the reserve for changes caused by climate change.
- Use tools, such as Smartline mapping, to investigate the probable impacts of climate change and to inform management decisions.
- Protect and, where necessary, rehabilitate degraded areas that will help build resilience against threats caused by sea-level rise and storm surges.
- Identify important areas on adjacent private properties to enable the landward retreat of coastal vegetation from the reserve. Liaise with the owners of the relevant properties to raise awareness about the importance of the areas and how to manage areas facing expected

sea-level rise due to climate change; and, if appropriate, encourage protection through covenants and other measures.

4.2 Geology, geomorphology and soils

Pitt Water and Orielton Lagoon were formed by the near closure of the mouth of the Coal River by a mid-bay spit (Seven Mile Beach). The spit was formed from marine sediments deposited after the Holocene sea-level had risen to its current height (between 6000 and 7000 years ago). It controls the mouth of the Pitt Water estuary, leaving a 500m wide tidal inlet at Dodges Ferry. The entire spit is listed on the Tasmanian Geodiversity Database (the listing was under review in 2012). The restriction of flow around the spit caused flooding of the surrounding low-lying land and the formation of extensive mudflats where silt has been deposited. The underlying rock type in most of the area is Jurassic dolerite (Davies 1997).

Figure 3 Gully erosion on land adjacent to Orielton Lagoon accelerated by motorbike use

The majority of the low-lying land around Pitt Water is of recent alluvial or aeolian origin. Pitt Water formed as the sea-level rose between 6000 to 10,000 years ago and drowned the mouth of the Coal River. The nature and distribution of these materials produce landscape features that react differently to use and management. In the few places where rocky outcrops extend to the edge of the lagoon, such as Midway Point, the geology consists of Triassic sandstone. Tertiary basalt occurs at the eastern side of Orielton Lagoon at Sorell and extends past Sorell Rivulet. Outcrops of basalt also occur on the western side of Orielton Lagoon. Soils around Orielton Lagoon are susceptible to tunnel and gully erosion (Figure 3). The majority of the surrounding hills consist of Jurassic dolerite with outcrops extending to the water in various locations.

Acid sulfate soils (ASS) probability mapping of the area has shown that the reserve and some of the surrounding area contain potential acid sulfate soils (PASS) that are currently in an undisturbed state. Two sites sampled in 2009 as part of the Tasmanian Acid Sulfate Soils Information Project were found to

have actual ASS (Figure 4 – see the LIST for locations of additional sample sites). ASS are naturally occurring soils that contain iron sulfides that when disturbed or exposed through excavation, drainage or changes to the water table, oxidise and release sulfuric acid. The release of significant quantities of acid, together with associated heavy metals and other contaminants, can cause significant environmental, economic and social impacts on coastal communities, such as the death of organisms and vegetation, decline of agriculture and aquaculture industries and damage to infrastructure (DPIPWE 2009). Areas around the reserve predicted to have a high potential of containing ASS (>70% chance of occurrence) include the intertidal and subtidal areas, and parts of Barilla Bay, the northern section of Pitt Water and the northern shore of Orielton Lagoon (Figure 4). Fortunately the majority of the areas predicted to have a high potential of containing coastal ASS lie within the reserve or the privately covenanted land adjacent to the reserve at Barilla Bay and can therefore be guaranteed a good level of protection from disturbance.

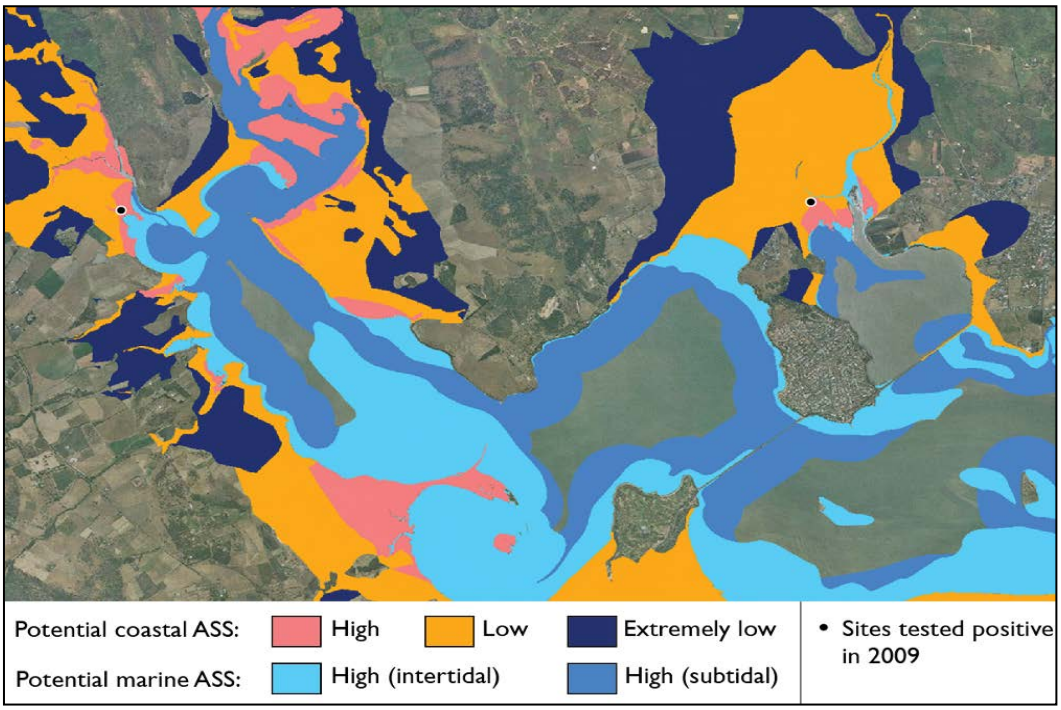

Figure 4 Predictive mapping of areas that potentially contain acid sulfate soils

Source: TheList

No sites of geoconservation significance have been identified within the reserve, although the Pitt Water flood tide delta that surrounds Woody Island has been identified as a site of outstanding significance.

Objectives

- To identify and protect sites of geoconservation significance within the reserve.

- To regularly inspect areas subject to erosion and take appropriate action, if necessary.
- To monitor areas that are susceptible to erosion or have a high potential of containing acid sulfate soils in the reserve or on adjacent land where it may affect the values of the reserve.
- To minimise the disturbance of material that has a high potential of containing acid sulfate soils.

Strategies and actions

- Conduct surveys to identify sites with high erosion risk or where erosion has been accelerated by human activities. Where appropriate, the Tasmanian Shoreline Monitoring and Archiving Project (TASMARC) methodology should be used to monitor change.
- Monitor erosion of soils, drains and tracks in and adjacent to the reserve.
- Encourage councils and nearby property owners to minimise erosion, especially of gullies that channel artificially high levels of sediment directly into the reserve, through use of active mitigation and prevention measures.
- Work with councils and nearby property owners to fence and actively rehabilitate eroded areas.
- Where possible, avoid undertaking activities that may cause disturbance to areas mapped as having a high potential of containing acid sulfate soils (Figure 4). If unavoidable, activities should be designed to minimise the impact and an ASS management plan should be developed (in accordance with the Tasmanian Acid Sulfate Soil Management Guidelines).

4.3 Water values

Hydrology and water quality

The maintenance of water quality is a primary consideration in the management of the reserve, as water is the basis for its ecological structure and character. The Pitt Water catchment area primarily drains water from the Coal River and Sorell Rivulet into Pitt Water, Orielton Rivulet and Frogmore Creek into Orielton Lagoon, and Iron Creek into Iron Creek Bay. There are also a number of unnamed minor tributaries and drainage channels. The catchment is subject to flooding and flow rates vary considerably throughout the year.

It is likely that Craigbourne Dam has had a significant ecological impact on part of the reserve. This large dam was constructed on the Coal River near Colebrook in 1985 primarily for irrigation storage. Summer flows in the Coal River have been significantly altered by these water releases and summer outflows from the Coal River into Pitt Water are now generally above those which would have occurred naturally (Fuller 1996, Gallagher 1998). Before being dammed, the Coal River often ceased to flow during the summer

months (Gallagher 1998). Since being dammed, the river also ceased to flow in drought years when the dam was empty.

No monitoring has been undertaken to assess the effects of Craigbourne Dam on flood flows. Flood flows still reach Pitt Water, particularly from White Kangaroo Rivulet (via the Coal River) but have probably diminished in magnitude in recent years due to an increase in off-stream dams being built. The outlet of Craigbourne Dam does not have flood control gates or other means of simulating flood conditions downstream when they occur upstream. The effects of this reduced flow are unknown and have not been assessed as part of this management plan.

It is likely that the ecology of the Coal River estuary has changed since the irrigation scheme commenced operating and altered the flow regime. It is important that the ecological requirements of Pitt Water are assessed and prioritised in all future water allocations, including the setting of environmental flows for the Coal River, or the approval of any future irrigation development.

Frederick Henry Bay and the mouth of Pitt Water are subjected to a tidal range of approximately 1.4 metres. The tidal range is also dependent on wind strength, barometric pressure and wind direction at the time and flooding events. Salinity varies considerably with climatic conditions and the flow of the river, but the water is generally higher and saltier in late summer and lower and fresher during winter. The hydrodynamics in Pitt Water have been significantly altered by the causeways that restrict the flow of water to the upper reaches of Pitt Water and Orielton Lagoon (Crawford et al. 1997).

Orielton Lagoon

Before enclosure in 1953 (see below), Orielton Lagoon would have had similar aquatic fauna diversity to other areas of Pitt Water. Following enclosure, there were extreme fluctuations in salinity and temperature and loss of seagrass habitat. Rees (1993) found that within Pitt Water the seagrass cover decreased from approximately 1276 hectares in 1950 (before the causeway was modified) to 75 hectares (a 94% decrease) by 1990. By 1990 seagrass had totally disappeared from Orielton Lagoon.

During this period, there was increased sedimentation due to untreated stormwater and catchment activities and high bacteria levels as a result of discharge from the sewage treatment plant at Midway Point. There were toxic algal blooms and a significant loss of species, particularly fish, marine plants and invertebrates. Since this time, some of the stormwater is now at least partially treated but remains a potential source of nutrients and a threat to the environmental quality of Orielton Lagoon. See ‘Sewage’ below.

Since 1999, substantial improvements have been observed in Orielton Lagoon. The fauna composition now reflects a more diverse assemblage of benthic macro-invertebrates, indicating that there has been a significant improvement in environmental condition of the lagoon (Davies et al. 2006).

The causeway

The natural hydrological regime of Orielton Lagoon has been vastly altered by the Sorell causeway (Figure 5) which was originally constructed in 1885 and

then modified in 1906 and 1953 (Buttermore 1977). Modifications in 1953 resulted in Orielton Lagoon becoming isolated from Pitt Water with very limited water exchange and a severe reduction in water quality. Davies et al. (2006) noted that:

> The construction of the causeway at Orielton Lagoon instigated changes in sediment composition and salinity due to constraints on tidal water and sediment exchange, and changes in local hydraulic conditions in the lagoon during large flood events.

Figure 5 The Sorell causeway separates Orielton Lagoon from the rest of Pitt Water

Tidal movement and sediment exchange into and out of the lagoon was impeded except during extremely high tides or during large flood events. In the absence of sea water input, the water only entered the lagoon through precipitation, groundwater seepage, rivers and stormwater (Saunders et al. 2007). Consequently salinity varied greatly, depending on input and evaporation levels. It has been suggested that these salinity variations were responsible for the decrease and decomposition of plant material, particularly saltmarsh and seagrasses that do not tolerate extended exposure to freshwater (Brett 1992, Kinhill 1993).

In 1962 an attempt was made to turn Orielton Lagoon into a freshwater lake. Baffles were built on the causeway sills to block all flow of seawater and brown trout were introduced (Saunders et al. 2007, Priscilla Park pers. comm.). However, freshwater conditions did not eventuate and the lagoon became brackish. Together with runoff and sewage, the lagoon became nutrient-enriched, leading to further algal blooms and eutrophication.

Offensive odours were often reported due to the transition of saltmarsh and seagrass vegetation communities to predominantly filamentous algae. During the late 1980s and 1990s, extensive blue-green algal blooms increased odour problems, and were an aesthetic and public health concern. The blooms reached their most extensive in the summer of 1992-93. The species primarily responsible was the toxic alga *Nodularia spumigena*.

The baffles were removed in 1975 to increase tidal flushing, dilute nutrients and prevent extreme salinity fluctuations (Saunders et al. 2007). However, before remediation work in 1993, tidal flow accounted for only 12% of inputs to

the lagoon, with sewage accounting for 4%. Following the lowering of the sills in 1993, tidal flushing accounted for 96% of water inputs (Kinhill 1993; Nolan-ITU & Sorell Council 1998). Additional modifications to the causeway occurred in 1998 to further improve tidal exchange and stabilise salinity and nutrient levels. The primary objective of the modifications to reduce the incidence of algal blooms has largely been met as they are now much less frequent than in the past (Nolan-ITU & Sorell Council 1998).

Sewage

Treated sewage from Midway Point was discharged into Orielton Lagoon from 1969. It contributed significantly to the degradation of the lagoon by increasing algal growth and bacteria levels. Unacceptable bacterial levels were frequently recorded and algal blooms were relatively common. The Sorell Council holds the data and results of extensive sampling undertaken by the (then) Department of Primary Industries and Water (now the Department of Primary Industries, Parks, Water and Environment).

A wastewater re-use system was implemented in 1999 by Sorell Council, utilising four existing ponds for treatment and storage of wastewater at Penna. Much of the treated effluent from the Sorell Township and Midway Point sewerage plants is piped to these holding ponds. A pipeline has been installed from Sorell to Penna across Orielton Lagoon. The treated effluent is high in nutrients and is used for irrigation of nearby farmland, orchards and a golf course. The new wastewater management practices, including a re-use system, have significantly reduced the nutrient and faecal coliform input into Orielton Lagoon and Pitt Water. Runoff from land irrigated with this water is a concern if used close to the reserve. In recent years, excess discharges have been made via the Sorell sewage treatment plant and Sorell Rivulet. The sewage treatment plants and associated infrastructure are now managed by Southern Water.

Surrounding land use

The hydrology of the reserve has also been impacted by the degradation of surrounding land and tributaries by stock access, weeds, severe erosion, residential, agricultural and industrial use and extraction of water. Artificially high levels of erosion and sedimentation from these impacts have major implications for the water quality and ecology of the reserve. Increased sedimentation causes turbidity, harms benthic fauna and flora, and accelerates successional change. As an indicator of the extent of sedimentation, historical reports indicate that Pitt Water and the Coal River were previously deep enough for barges to travel to Richmond. In contrast, a survey in 1996 found that the exposed mud flats of the Coal River consisted of approximately 50cm of soft sediment overlying a hard sediment base, thought to be the original riverbed before European land clearance and agricultural activities. Gully erosion is also prevalent around Orielton Lagoon and is an especially threatening process as gullies channel sedimentation straight into the wetland.

In addition to sedimentation, runoff from planted croplands, pastures and other agricultural areas with high fertiliser use may also have contributed to

increased nutrient loads in the reserve. Nutrient (nitrogen, nitrate and phosphorus) levels in the Coal River are generally at low levels, however a few high flow events can carry the majority of annual nutrient load (Gallagher 1998). Algal blooms, such as the blue-green algal bloom that occurred in Craigbourne Dam in June 1997, may have been triggered by increased nutrient availability, along with sunlight, higher temperatures and lower levels of wind (Gallagher 1998).

Figure 6 An eroded open drain in Sorell discharges directly into Orielton Lagoon

Stormwater

Stormwater is one of the most significant threats to the reserve, although an important component of the lagoon water input. Stormwater is rainfall that carries sediment, nutrients or chemicals that adversely affect benthic flora and the ecological integrity of Orielton Lagoon and the estuary. Some threatened species are especially sensitive to water pollution, such as the endangered seastar (*Parvulastra vivipara*).

In 1993, Kinhill estimated that stormwater contributed significantly to the nutrient loading, including up to 20% of total nitrogen and 16% of total phosphorous entering Orielton Lagoon.

Some of the stormwater is now at least partially treated. Some treatments allow only for the removal of solid pollutants such as litter, while others also reduce sediment and nutrient loads. Stormwater remains a potential source of nutrients and a threat to the environmental quality of Orielton Lagoon.

Pollutants in urban stormwater include:

- suspended solids (such as dust, soil and sediment) which cause turbidity and absorb and transport other pollutants found in runoff, such as metals, phosphorous and organics;
- fuel, oil, lubricants, exhaust emissions and heavy metals contained in road runoff;

- detergents and oils from washing and maintaining vehicles at the curb-side;
- nutrients (such as nitrogen and phosphorous) from inappropriate fertiliser use on gardens and lawns, and faecal waste from pets; and
- general rubbish, especially plastics, metals, packaging materials and organic litter (Armstrong 1996).

The total number of outlets that discharge stormwater into the reserve is not recorded but in 2004 there were at least twelve outlets into Orielton Lagoon, with two more constructed since (fourteen outlets in total). It is not known if there are other outlets in Barilla Bay or upper Pitt Water and none are regulated. Sorell Council is undertaking a comprehensive survey and preparing a stormwater management plan. (For a template, see the Derwent Estuary Program's 'A model stormwater management plan for Hobart Regional Councils' at http://www.derwentestuary.org.au/file.php?id=135).

At least two of the Midway Point stormwater outlets contain litter racks or sediment traps. Some traps have been replaced through Coastcare grants. Traps require regular maintenance to ensure that they work effectively. Insufficiently maintained gross pollutant traps can increase pollution levels by increasing phosphate and nutrient levels as trapped waste breaks down. Systems designed specifically for stormwater pollutant removal, including constructed wetlands, ponds and vegetated swales, are the preferred treatment systems in the reserve. Stormwater outlets must also have adequate scour protection to minimise erosion at the discharge point, particularly in areas with dispersive soils.

Figure 7 Solid waste trap beside Orielton Lagoon at Midway Point

The volume of stormwater can be reduced through simple water-sensitive urban design principles. These principles should become requirements or conditions on development permits approved by councils. For example, the volume of stormwater could be significantly reduced if rainwater tanks (minimum 2000 litres) were installed on all new houses and tanks were plumbed to the toilet, laundry or outside garden-watering systems. Runoff from

hard surfaces such as driveways should also be directed to gardens or swales designed for stormwater retention. The State Stormwater Strategy (2010) should be referred to for practical guidance about water-sensitive urban design principles and applications that are based on best management practices currently in use at local, national and international levels.

Figure 8 A stormwater drain discharging sediment directly into Orielton Lagoon

Water quality policy

The State Policy on Water Quality Management requires that Protected Environmental Values (PEVs) and water quality objectives are set for all water bodies around the state. PEVs have been established for the estuarine and semi-enclosed marine surface waters of Pitt Water Nature Reserve.

PEVs are used as the basis for setting discharge requirements for point sources of pollution, such as sewage treatment plants and industry. Pollution sources, such as stormwater, should be managed to protect the PEVs by compliance with approved codes of practice, or by developing and implementing best practice environmental management guidelines where codes are not available. For specific details on the avoidance of pollutant discharges, refer to Part 4 of the State Policy on Water Quality Management 1997.

PEVs have been established for the estuarine waters of the reserve through The Environmental Management Goals for Tasmanian Surface Waters for the South-East Coast Catchments (DPIWE 2003). As a minimum, the water quality of surface waters in the reserve shall be managed to provide water of a physical and chemical nature to support a healthy but modified aquatic ecosystem from which, if permitted, edible fish, crustacea and shellfish could be harvested and which would allow people to safely engage in recreation activities such as swimming, paddling or fishing in aesthetically pleasing waters (DPIWE 2003a).

The PEVs were part of a Tasmanian Aquaculture and Fisheries Institute (TAFI) water quality project to develop a Coastal and Estuarine Resource

Condition Assessment framework (completed in 2008). The framework was trialled in five estuaries in the southern Tasmania, including Pitt Water and Orielton Lagoon.

The disturbance of acid sulfate soils in areas that drain into the reserve may also have an impact on water quality.

Objectives

- To maintain or enhance the water quality of the reserve, particularly in Orielton Lagoon.
- To improve water quality by minimising the impact of threatening processes, particularly stormwater, sewage and sedimentation, to enhance aquatic ecological values and restore habitat for threatened and migratory species, particularly seagrass beds.
- To ensure that the ecological requirements of the reserve are prioritised when establishing environmental flows for the rivers and tributaries flowing into the reserve.

Strategies and actions

Hydrology and water quality

- Liaise with relevant organisations to develop and implement programs to monitor and improve understanding about water quality and the implications of upstream hydrological change.
- Monitor water quality from the ground application of recycled water from the water re-use scheme.
- Liaise with relevant bodies to ensure that the ecological requirements of the reserve are integrated and prioritised in the establishment of environmental flows for the Coal River, and are appropriately considered in the assessment and development of any further irrigation infrastructure that may have an adverse impact on the reserve.
- Liaise with research agencies to ensure the compilation, review and interpretation of any relevant research or monitoring data that are collected by various agencies, groups or councils.
- Assist councils with information and advice in support of funding applications that will benefit the reserve.
- In cooperation with relevant agencies, councils and community groups, manage the reserve to maintain or enhance water quality to the standard designated by Protected Environmental Values.
- Liaise with conservation specialists in government agencies, councils and adjacent landowners to monitor and control the rates, foci and sources of artificially high sedimentation into the reserve and its tributaries.
- Liaise with councils and surrounding landowners to manage drainage channels on adjacent land in order to minimise erosion and the entry of artificially high levels of sedimentation into the reserve. Also encourage

hardening of roads and drains that are identified as particularly susceptible to erosion.

- Liaise with adjacent landowners and councils to:
    - develop buffer zones along watercourses and the shoreline to reduce runoff of sediment, pesticides and fertilisers;
    - encourage the protection and enhancement of areas of vegetation that perform natural biofiltration;
    - encourage the adoption of measures to minimise disturbance caused by activities in areas mapped as having a high potential of containing acid sulfate soils (Figure 4);
    - implement relevant codes of practice and guidelines to reduce impacts on the reserve's values.

Stormwater

- Ensure that no new outlets are constructed, or existing outlets modified, to discharge stormwater into the reserve unless it is demonstrated by the proponent that the new or modified outlet will have a neutral or positive environmental impact for the reserve, and it is assessed and approved by the PWS.
- Encourage local councils to take into consideration the 'Guidelines for development' on adjacent lands that may adversely affect the values of Pitt Water Nature Reserve (see Appendix 3), in particular stormwater provisions for new subdivisons which will result in increased discharge to existing stormwater outlets. Aim to include this arrangement in the Tasmanian Government Partnership Agreement Process.
- Support councils to investigate and use best practice methods to minimise the impact of the upstream discharge of stormwater that has an adverse effect on the water quality of the reserve.
- Support councils to conduct a review of existing stormwater outlets by identifying and mapping existing outlets and treatment systems around the reserve and upstream of it.
- Ensure stormwater outlets are appropriately leased or licenced.
- Ensure that processes are in place for liaison with councils to work towards the installation of appropriate systems for the treatment of stormwater before it is discharged into the reserve.
- Liaise with councils to ensure that sediment traps are emptied and regularly cleaned and that methods are developed to clean the traps efficiently. Facilitate adequate access to sediment traps for regular cleaning, without detracting from the natural and cultural values of the area.

4.4 Flora values

Threatened species

Seven threatened plants found in the reserve are listed under the Tasmanian *Threatened Species Protection Act 1995* (TSPA). Rough speargrass (*Austrostipa scabra*) and woolly new-holland-daisy (*Vittadinia gracilis*) occur in

dry habitat. Lemon beautyheads (*Calocephalus citreus* – Figure 9) are only found in a few dry grassland areas in south-eastern Tasmania, including Orielton Lagoon and alongside Shark Point Road (Sorell). Both species grow in disturbed areas. Fennel pondweed (*Stuckenia pectinata*) is found in brackish lagoon areas and estuaries. Yellow sea-lavender (*Limonium australe* var. *australe*) and the wilsonia (*Wilsonia humilis* and *Wilsonia rotundifolia*) inhabit the saltmarshes and coastal mudflats. The reserve has been identified as a key site for lemon beautyheads (DPIWE 2003b).

No threatened flora species found in the reserve are currently listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Figure 9 Lemon beautyheads *(Calocephalus citreus)*

Table 1 Threatened flora species found in the reserve

Name	Common name	Significance
Austrostipa scabra	rough speargrass	r
Calocephalus citreus	lemon beautyheads	r
Limonium australe var. *australe*	yellow sea-lavender	r
Stuckenia pectinata	fennel pondweed	r
Vittadinia gracilis	woolly new-holland-daisy	r
Wilsonia humilis	silky wilsonia	r
Wilsonia rotundifolia	roundleaf wilsonia	r

Threatened Species Protection Act 1995

r = rare in Tasmania

Samphire

The reserve contains one of the most significant areas of samphire in Tasmania (Kirkpatrick and Glasby 1981). Although coastal saltmarshes are recognised globally as areas with high ecological value, they are increasingly threatened by impacts such as rising sea-levels, trampling and pollution (Saintilan 2009). The reservation of upper Pitt Water, Barilla Bay and Orielton

Lagoon has contributed greatly to the protection of coastal saltmarsh species in Tasmania.

Saltmarsh is an important aspect of the ecology of the reserve, providing marine nurseries as well as habitat for birds to breed, feed and roost (Saintilan 2009; Prahalad 2009). As noted by Dunn (2010), saltmarsh is a critical component of the reserve, both biologicially and for its role in sedimentary processes and hydrology of the shoreline. All but one of the poorly reserved saltmarsh species in Tasmania occur within the reserve. Approximately fifteen hectares of saltmarsh occur on the northern shore of Orielton Lagoon. The dominant species are beaded glasswort (*Sarcocornia quinqueflora*) and roundleaf pigface (*Disphysma crassifolium* subsp*. clavellatum*). In upper Pitt Water, dominant samphire species include beaded glasswort (*Sarcocornia quinqueflora*), Barilla bush or shrubby glasswort (*Tectacornia arbuscula*), sea rush (*Juncus krausii*), pale rush (*Juncus pallidus*), coast saw edge (*Gahnia trifida*), spear grass (*Stipa stipoides*), Australian saltgrass (*Distichlis distichophylla*) and creeping bookweed (*Samolus repens*). Other species found in the saltmarsh include narrowleaf wilsonia (*Wilsonia backhousei*), Australian saltmarshgrass (*Puccinellia stricta*), blue tussock grass (*Poa poiformis*), tussock grass (*P. labillardierei*) and sea rush (*J. kraussii*) (see Appendix 4).

With the lowering of the sills on the causeway and the associated increased tidal flushing of Orielton Lagoon, some of the Barilla bush (*T. arbuscula*) is regenerating, although grazing by rabbits is thought to hinder regeneration. Kelp gulls (*Larus dominicanus*) are congregating in this area and may also impact on the regeneration potential of the Barilla bush. The saltmarsh at Orielton Lagoon has been nominated as an area for monitoring, based on mapping by Prahalad (2009) (see operational documents at rear of plan). External factors must be considered when evaluating changes to saltmarsh vegetation, including sea-level rise and landward retreat.

Figure 10 Saltmarsh on the northern shore of Orielton Lagoon

Aquatic vegetation

Aquatic vegetation in the reserve primarily consists of seagrasses. Seagrass (*Zostera muelleri*) occurs on intertidal flats and shallow areas, Tasman grasswrack (*Heterozostera tasmanica*) on beds and channels, and seatassel (*Ruppia* spp.) where freshwater flushing occurs (Rees 1993). Seagrass cover in Pitt Water suffered a massive decline between 1953 and 1990, thought to be due to increased nutrient levels and sedimentation. The extent of decline had serious implications for the overall biodiversity of the area, including food supplies and critical nursery habitat for many marine species, some of which are commercially important outside the reserve.

Other vegetation

The majority of the native vegetation on land adjacent to the reserve has been cleared for agricultural or urban development. Only small pockets of remnant vegetation and single trees exist in the area. The native vegetation would have been open grassy woodland consisting of species such as black peppermint (*Eucalyptus amygdalina*), white gum (*E. viminalis*), she-oak (*Allocasuarina verticillata*), blackwood (*Acacia melanoxylon*), black wattle (*Acacia mearnsii*), prickly box (*Bursaria spinosa*), snowy bossia (*Bossiaea cinerea*), coastal saltbush (*Rhagodia candolleana*), native hop bush (*Dodonaea viscosa*) and blue tussock grass (*Poa poiformis*). Some of this vegetation is still present on Woody Island. Bryophytes occur all around the lagoon but are generally restricted to sheltered and shaded areas, particularly watercourses and below undercut banks.

Objectives

- To protect, maintain and monitor natural flora diversity, particularly of threatened species.
- To protect threatened species of flora from loss beyond what may be expected from natural variability or seasonal influences.

Strategies and actions

- Minimise the impact of threatening processes on flora species including weeds, disease, pollution, sedimentation or trampling.
- Develop and implement hygiene protocols to prevent the introduction and spread of weeds and pathogens (especially *Phytophthora cinnamomi* and marine pests) within the reserve.
- Undertake vegetation surveys, if necessary, and collate a comprehensive plant list for the reserve (see Appendix 4).
- Re-survey the saltmarsh areas of Orielton Lagoon based on the mapping undertaken by Prahalad (2009).
- Monitor threatened species and, where necessary, undertake research and management actions to ensure their survival.
- If deemed necessary through monitoring and research, limit public access to areas where threatened species occur.

- Survey seagrass to measure whether the area has altered in size from the 75 hectares recorded in 1990.
- Design and implement a seagrass monitoring program.
- In consultation with the Tasmanian Aquaculture and Fisheries Institute (TAFI), investigate seagrass revegetation, including trials in Orielton Lagoon. If feasible, implement a seagrass revegetation program.
- Facilitate the revegetation of samphire and assess whether replanting is necessary. Identify and protect areas likely to be important habitat for the likely inland retreat of saltmarsh as the sealevel rises.
- Encourage nearby property owners, including councils, to implement appropriate revegetation using suitable native plant species (see Appendix 4 for guidance) and non-invasive garden species in domestic situations.
- Encourage the involvement of community and volunteer groups in weed management and revegetation projects in the reserve.
- Coordinate funding applications to facilitate rehabilitation projects in and adjacent to the reserve in accordance with this plan.

4.5 Fauna values

Threatened species

Eight fauna species found in the reserve are listed under the Tasmanian *Threatened Species Protection Act 1995* (TSPA). One of these, the swift parrot, is also listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Table 2 Threatened fauna species found in the reserve

Name	Common name	Significance	
Haliaeetus leucogaster	white-bellied sea-eagle	v	
Lathamus discolour	swift parrot	e	EN
Numenius madagascariensis	eastern curlew	e	
Parvulastra vivipara	live-bearing seastar	e	
Podiceps cristatus	great crested grebe	v	
Sterna albifrons sinensis	little tern	e	
Sterna nereis nereis	fairy tern	v	
Theclinesthes serpentata lavara	chequered blue butterfly	r	

Threatened Species Protection Act 1995

e = endangered in Tasmania
v = vulnerable in Tasmania
r = rare in Tasmania

Environment Protection and Biodiversity Conservation Act 1999

EN = nationally endangered

Additional threatened species likely to be present in the reserve include the saltmarsh looper moth (*Dasybela achroa*) and the green and gold frog (*Litoria raniformis*). Both species are listed as vulnerable and have been recorded in the nearby area.

Relevant nationally endorsed recovery plans include the Threatened Tasmanian Eagles Recovery Plan and the Swift Parrot Recovery Plan.

Migratory shorebirds (waders)

The reserve and surrounding area has long been regarded as important habitat for non-breeding migratory shorebirds. Migratory species use the reserve to rest and feed intensively to build up fat and protein reserves to fuel their northern migration. Thirty-two migratory species have been recorded in the reserve and surrounding area, some of which are very rare. The reserve is the southern-most area in Australia where relatively high numbers of migratory shorebirds occur including eastern curlew (*Numenius madagascariensis*), bar-tailed godwit (*Limosa lapponica*), common greenshank (*Tringa nebularia*), curlew sandpiper (*Calidris ferruginea*), whimbrel (*Numenius phaeopus*) and red-necked stint (*Calidris ruficollis*).

Thirty-one bird species (mostly shorebirds) that occur in and around the reserve are listed on JAMBA, CAMBA or ROKAMBA (see Appendix 5). Most migratory species breed in the Arctic region during the northern hemisphere summer and migrate southward for the southern hemisphere summer, following the East Asian–Australasian Flyway (migration route). In contrast, the double-banded plover (*Charadrius bicinctus*) breeds in New Zealand and migrates to Australia in February or March for winter, returning to New Zealand around August. The samphire area on the northern foreshore of Orielton Lagoon and along the eastern shore adjacent to Sorell is particularly important habitat for double-banded plover.

Resident shorebirds and other birds

The reserve is important habitat for a variety of resident shorebirds and other birds. For example, white-bellied sea-eagles inhabit Woody Island, where a nest is present, and one or two royal spoonbills (*Platalea regia*) have been recorded on Susie Islet. Orielton Lagoon is one of the few Tasmanian localities where great crested grebes (*Podiceps cristatus*) are regularly seen. Other birds regularly observed include great cormorant (*Phalacrocorax carbo*), little pied cormorant (*P. melanoleucos*), masked lapwing (*Vanellus miles*), pied oyster catcher (*Haematopus longirostris*), hoary-headed grebe (*Poliocephalus poliocephalus*), red-capped plover (*Charadrius ruficapillus*), musk duck (*Biziura lobata*), white-faced heron (*Egretta novaehollandiae*) and black swan (*Cygnus atratus*). Pied oystercatchers and red-capped plovers breed within the reserve. The fairy tern and little tern (*S. albifrons sinensis*) have also been sighted in the Pitt Water area, but do not breed there.

Silver gulls (*Larus novaehollandiae*) nest in the reserve and have colonised the Pitt Water and Sorell causeways, where they have become a traffic hazard and many have been killed. Fences have been erected to prevent fledgling birds from wandering into the path of vehicles and being killed. Silver gulls traditionally nested on Barren Island until weeds such as African boxthorn (*Lycium ferocissimum*) reduced the availability of nesting sites (Horner 1997a).

Since the removal of weeds from Barren Island by the PWS and Green Corps members, the number of silver gulls nesting on Barren Island has increased (Horner 1999).

Figure 11 Susie Islet in Orielton Lagoon is an important refuge for birds

Other significant species

The tiny live-bearing endemic seastar *Parvulastra vivipara* can be found under rocks in the intertidal zone surrounding Pitt Water and along the platforms of the Pitt Water causeway (Materia 1994). It is one of only three seastar species known worldwide to bear live young instead of producing eggs. It has a very restricted geographic range. Although identified at a number of locations around south-east Tasmania, they occupy a total area of less than three hectares. During upgrading of the causeway in April 1998, some seastars were temporarily moved to a nearby cove and later returned successfully. Sandstone is their preferred habitat.

The samphire surrounding Barilla Bay is one of a few localities in Tasmania where the rare chequered blue butterfly (*Theclinesthes serpentata lavara*) has been recorded. There is no data on trends for this species in the reserve.

The Pitt Water area is also important habitat for sharks, skates and rays to breed and find refuge. All the waters of the reserve, excluding Orielton Lagoon[2], are protected as a Shark Refuge, where the taking of sharks is prohibited (Rule 71 of the Fisheries (Scalefish) Rules 2004, issued under the *Living Marine Resources Management Act 1995*).

Bird habitat areas

The most important habitat in the reserve for migratory species are roosting areas during high tide and mudflats for feeding during low tide. The mudflats surrounding Barilla Bay and Orielton Lagoon are particularly important feeding areas for resident and migratory shorebirds in southeast Tasmania. Foraging occurs in these areas at low tide when the intertidal mudflats are exposed.

2 Orielton Lagoon is specified as 'inland waters' under the *Inland Fisheries Act 1995* and therefore cannot be declared a shark refuge under the *Living Marine Resources Management Act 1995*.

Open habitat is important for migratory species and resident shorebirds as they roost in areas where they can watch for potential predators.

The foreshores are important breeding areas for resident species such as pied oystercatchers. Woody Island, Barren Island and Susie Islet (Figure 11) are important refuges and roosting sites for many birds. Barren Island is also an important breeding site for Pacific gull (*Larus pacificus*), silver gull, Caspian tern (*Sterna caspia*) and crested tern (*Sterna bergii*).

Indicative habitat for migratory and resident birds has been identified in order to help inform management of the reserve (see Appendix 2).

Threats

In addition to threats of pollution, weeds and general disturbance, a number of developments have caused significant threats to birds in the past. The construction of the cycleway destroyed and covered roosting areas of the bar-tailed godwit (Priscilla Park pers. comm.); high voltage power lines across the mouth of Orielton Rivulet have caused mortality of birds (Priscilla Park pers. comm.); and stormwater outlets have been constructed near bird feeding areas. Historical impacts include hunting of cormorants and eastern curlew during the early twentieth century (Priscilla Park pers. comm.).

Objectives

- To maintain and enhance the natural values of the reserve.
- To protect, maintain and monitor natural fauna diversity, particularly of threatened species.
- To ensure that there is no loss of any threatened species of fauna beyond that expected through natural variability, migration or seasonal influences.
- To protect and enhance habitat for migratory and resident birds.

Prescription

In accordance with Section 37 of the *National Parks and Reserves Management Act 2002* and this management plan, Woody Island is declared to be a “restricted area” to which the public does not have a general right of access. Public access to Woody Island will not be permitted without the written authority of the Director of National Parks and Wildlife. An authority will generally not be granted during the period July to February.

Strategies and actions

- Permit appropriate studies into the ecological requirements of fauna in the reserve and management implications, particularly in relation to migratory species.
- Identify and monitor key indicator species of the reserve to determine the health of the reserve and other changes over time.

- Support research projects to monitor populations of shorebird and migratory species.
- Minimise disturbance of migratory species and resident shorebirds, especially at or near identified bird habitat areas and throughout the reserve.
- Monitor threatened species and, where necessary, undertake research and management actions to ensure their survival.
- If foxes become established in Tasmania consider additional measures, such as fencing, to protect the breeding areas of species at risk.
- Limit public access to areas of threatened species and bird habitat areas, if deemed necessary.
- Inform visitors that Woody Island is a restricted area during the specified period to minimise disturbance during the breeding seasons of threatened species.
- Investigate whether green and gold frogs are present in the reserve and manage activities to avoid the spread of chytrid fungus.
- Ensure that adequate areas containing the important food plants of the chequered blue butterfly are protected from damage caused by inappropriate use or other impacts such as litter.
- Monitor the impacts of vessel use on the reserve, particularly damage to habitat on Woody Island.
- Permit scientific studies of the aquatic biota of the reserve to provide improved information which can be used to identify the food sources of waterfowl and shorebirds in the reserve.
- If considered necessary, undertake proactive on-ground actions, such as construction of fences or other structures to protect threatened species.
- Liaise with contractors to ensure that construction activities undertaken on the causeway adjacent to Orielton Lagoon cause minimal disturbance to the values of the reserve, especially the endangered seastar (*Parvulastra vivipara*).

4.6 Pests and weeds

Pests and diseases

Due to the close proximity of the reserve to urban areas, many cats and dogs have access to the reserve. Diet studies have revealed that across Australia domestic and feral cats kill over a hundred species of birds, fifty species of both reptiles and mammals, and many species of amphibians and invertebrates (Dredge 1993). Dogs are known to chase and catch shorebirds or to force breeding birds from their nests. Their eggs may then die or be eaten either by the dogs or by other predators. Many birds are especially vulnerable at high tide when roosting. In the past, horses have caused damage by compacting and trampling saltmarsh vegetation, mudflats and

nests (Parr 1988). Grazing by rabbits also presents a threat to vegetation, particularly saltmarsh regrowth. Rabbits were successfully eradicated from Woody Island in March 1990 using 1080 poison baits (Fisher 2001).

Based on the current distribution of introduced invertebrate aquatic species in Tasmanian waters, several species are potential threats to the reserve. They include the toxic dinoflagellate (*Gymnodinium catanatum*), the North Pacific seastar (*Asterias amurensis*), and European shore crab (*Carcinus meanus*).

Domestic ducks, primarily those derived from mallards, are increasingly being observed in the reserve. Mallards are known to interbreed with the Pacific black duck (*A. superciliosa*). Kelp gulls, self-introduced in the late 1950s from New Zealand, pose a threat by disturbing habitat of migratory species and resident shorebirds, such as the samphire flats to the north of Orielton Lagoon.

Phytophthora cinnamomi may be detrimental to some vegetation in the reserve, while chytrid fungus has the potential to affect amphibian populations that may be present in the reserve, such as the threatened green and gold frog.

The following national threat abatement plans should be considered where relevant: ‘Threat abatement plan for competition and land degradation by rabbits - 2008’; ‘Threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis - 2006’; and ‘Threat abatement plan for dieback caused by the root-rot fungus *Phytophthora cinnamomi* - 2001'.

Objectives

- To eradicate pests where feasible and warranted by their actual or potential impact upon the identified values of the reserve.
- To control and manage pests where eradication is not possible or warranted.

Strategies and actions

- Eradicate or control pests where practical and warranted, in line with relevant national threat abatement plans.
- Monitor for signs indicating the introduction and colonisation of new pests or diseases.
- If considered necessary, investigate and implement measures to control populations of domestic ducks.
- Monitor populations of introduced predators and undertake control programs if warranted.
- Increase community awareness about threats posed by domestic cats and dogs.

Weeds

A variety of weed species pose threats to the reserve. Highly invasive weeds such as boneseed (*Chrysanthemoides monilifera*), gorse (*Ulex europaeus*), blackberry (*Rubus fruticosis*) and African boxthorn (*Lycium ferocissimum*) have been long established along the shoreline of the reserve, on land adjacent to the reserve and some on Susie Islet in Orielton Lagoon. They degrade shorebird habitat by invading mudflats and foreshores. Other weeds that are present in the reserve include thistles (various species) and fennel (*Foeniculum vulgare*).

Boxthorn reduces the availability of nesting sites for silver gulls, thus reducing their use of this traditional breeding site (Horner 1998). In addition to boxthorn and blackberry, pine trees (*Pinus radiata*) and mirror bush (*Coprosma repens*) are found on Woody Island. Although all the large pine trees have been removed, weed seedlings continue to germinate from existing seed or to be reintroduced by birds (Fisher 2001).

Figure 12 Weeds found around Orielton Lagoon include gorse, thistles and fennel

Control work by the Orielton Lagoon Action Committee, Birdlife Tasmania (formerly Birds Tasmania) and volunteers has been successful in controlling boxthorn and preventing its establishment on the mudflats. The Pitt Water Catchment Implementation Committee has identified boxthorn as its primary target for future weed eradication projects. Boxthorn and pine trees that degraded nesting habit on Barren Island have been removed by the PWS and Green Corps volunteers.

Significant progress has been made to control boneseed in and around the reserve since 2008. All known infestations have had primary control and are under an annual monitoring and follow-up program that is overseen by the Southern Tasmania Weed Strategy program, a partnership between the Southern Tasmania Councils Authority (STCA) and NRM South, with funding support from the Australian Government's Caring For Our Country program. Sorell Council, Conservation Volunteers Australia and volunteers are involved in work to further control boneseed.

A possible significant future threat to mudflat habitat is rice grass (*Spartina anglica*). It has not been recorded in the Pitt Water estuary but has previously been removed from sites within the Derwent River estuary. Seeds can be easily dispersed in the feathers of birds. Early detection is essential to prevent this species becoming established in the area. Another species of concern is *Undaria pinnatifida*, a brown macroalgae that is endemic to Japan. Infestations of *Undaria* may become established on the seagress beds, causing extensive changes to the ecosystems of the reserve. In 2010 *Undaria* was recorded in nearby Dodges Ferry and has also been recorded in Frederick Henry Bay (Sandy Leighton, pers. comm.) With continued dumping and spread from gardens, other weeds are likely to be introduced, such as the lawn species buffalo grass (*Stenotaphrum secundatum*). A variety of garden escapes and invasive grasses are also found invading the foreshore.

Objectives

- To eradicate weeds where feasible and warranted by the actual or potential impact upon the identified values of the reserve and in accordance with schedules of the *Weed Management Act 1999 (*Tas.).
- To control and contain weeds where eradication is not possible or warranted.

Strategies and actions

Weed removal

- Implement actions to eradicate or control weeds, with a focus on introduced species that affect the values for which the reserve was designated, particularly impacts on threatened or migratory species and protected communities.
- Give priority to the removal of Weeds of National Significance and declared weeds, such as boneseed, gorse, blackberry, boxthorn, broom, tree lucerne, fennel, as well as other environmental weeds and garden escapes.
- Prioritise removal of weeds in breeding areas such as Susie Islet, Woody Island and Barren Island where birds (such as silver gulls) may be displaced through habitat loss, to the detriment of surrounding areas.
- Target boxthorn and other weed species in bird habitat areas, particularly the exposed mudflats and nesting areas of Orielton Lagoon. Aim for biannual control of invasive high priority weeds and remove plants before seed is produced.
- Monitor Woody and Barren Islands for the presence of weeds such as pine trees, boxthorn, boneseed, mirror bush and blackberry. These species need to be periodically removed or poisoned due to existing seed and continual reintroduction by birds.
- Develop and implement hygiene protocols and raise awareness to minimise the introduction and spread of weeds, pests and pathogens within the reserve (especially *Phytophthora cinnamomi* and chytrid fungus).

- Develop strategies to deal with new introductions of highly invasive weeds and monitor the reserve for new introductions, especially rice grass.
- Undertake measures to ensure that weed control activities do not significantly reduce water quality, disturb threatened species, or accelerate soil erosion.
- Include in weed removal strategies provisions for revegetation with local native plant species.
- Increase community awareness to discourage dumping of garden waste on the reserve and the risk of garden plants spreading into the reserve.
- Cooperate with community groups, organisations and other government agencies to monitor the outbreak or spread of weeds in nearby areas that are likely to spread into the reserve.
- Liaise with councils, adjacent landowners, NRM South and the community to ensure weed management approaches are coordinated, integrated, use best practice techniques and are followed up annually.

4.7 Cultural heritage values

Aboriginal heritage

Knowledge of early Aboriginal history in the area is known through historical records and archaeological investigation of sites created over thousands of years of Aboriginal occupation and use. The reserve was the territory of the Moomairremener, a band of the Oyster Bay tribe (Brown 1991, Ryan 1996). The tribe's territory encompassed much of the Tasmanian east coast and extended north from the Derwent River estuary to the Fingal Valley and west to the midlands. The tribe comprised at least fifteen bands with a total population of 600 to 800 people (Brown 1991). Other bands such as the Leenowwenne and Pangerninghe of the Big River tribe also harvested the rich resources of Pitt Water (Ryan 1996).

Aboriginal values extend beyond site resources and include natural features comprising animals, plants and the landscape. The area continues to be of significance for the Aboriginal community. A survey of the eastern shore of Orielton Lagoon and a search of the Tasmanian Aboriginal Site Index was undertaken in May 2007. Results indicated a high number of heritage sites around the lagoon. It is highly likely that many more sites exist within the reserve as physical and oral evidence suggests that the area was used extensively by Aboriginal groups.

Many sites within the reserve have been registered on the Tasmanian Aboriginal Site Index. They vary from an isolated artefact scatter to middens and quarry sites. Middens located in the upper region of Pitt Water consist primarily of native oysters. Oyster shells and stone fragments, believed to be of Aboriginal origin, have been found in the area.

Aboriginal sites need to be located, identified and protected, particularly from the impacts of development and visitor use. There is potential for the

Tasmanian Aboriginal community to promote and interpret these sites and provide a greater understanding of Aboriginal culture to the wider community.

Objective

- To identify and protect Aboriginal heritage sites and values.

Strategies and actions

- Report all Aboriginal sites to the Director in accordance with the *Aboriginal Relics Act 1975* or updated legislation.
- Consult with representatives of the Tasmanian Aboriginal community regarding the management of Aboriginal heritage values in the reserve.
- Where necessary, conduct surveys for Aboriginal heritage in the reserve, after consultation with the body responsible for administering Aboriginal heritage legislation in Tasmania.
- Develop and implement protection strategies to identify, monitor and conserve significant sites.
- Ensure that all PWS staff, volunteers and contractors involved in works at the reserve are aware of the cultural sensitivity of the area.
- With the agreement and involvement of the Tasmanian Aboriginal community, incorporate Aboriginal use and values of the area into interpretive and educational resource materials.
- Work with councils to improve knowledge and management of Aboriginal heritage values.

Historic heritage

The Richmond and Coal River district was one of the first areas explored by Europeans following the settlement at Risdon by Lieutenant John Bowen in September 1803 (Morgan 1992). Settlement occurred as early as 1807 when the inhabitants of Norfolk Island were transferred to Tasmania and given small land grants in the area as compensation for their transfer (Whishaw c1929).

By 1813 the area was heavily settled and during the early 1800s the district developed into a substantial wheat-growing area and became the largest and wealthiest settlement in the colony. Richmond was once considered the granary of Australia, supplying wheat to Van Diemen's Land and to New South Wales (Morgan 1992). The first flourmill in the area was built at Sorell by Robert Nash in 1815 (Whishaw c1929).

With the decline in wheat prices in the 1820s farmers diversified with crops such as peas, barley, potatoes and corn (Austral Archaeology 1996). During the early nineteenth century, the ash from burnt saltmarsh species was used to manufacture soap. By 1819 soap of the best quality was being made from cattle suet and marine ashes sourced from the Pitt Water district (probably Barilla Bay) (Whinray 1981).

Orchards were established in the area and by 1921 there were 130 fruit growers in the Sorell municipality, although by 1952 the number had decreased to 32. With the construction of the Craigbourne Dam and the Southeast Irrigation Scheme in 1987, large-scale intensive cropping became a major agricultural practice within the Coal River valley and on the western side of Pitt Water.

The area is historically significant as an important transport link that utilised trains, ferries, bridges and causeways. Regular postal services to Sorell were established in 1824, although weekly messengers had operated since 1816 (Austral Archaeology 1996). John Bingham's rowing punt provided direct transportation services to Sorell during the early twentieth century and a number of ferries also operated at the extremity of Seven Mile Beach. The most well-known ferry operator was Ralph Dodge who operated from 1830 until his death in 1871 (Austral Archaeology 1996).

A small mining venture commenced in 1840 in the Richmond coal field, south-east of Richmond and to the north of the mouth of the Coal River (Bacon 1991). This mine was abandoned by 1844 and no subsequent mining has taken place in the area (Bacon 1991).

Work commenced in 1866 on a causeway between Midway Point and Sorell and was opened in 1874.

In 1892 a railway was constructed that crossed Pitt Water at Shark Point via a causeway and bridge (Austral Archaeology 1996). The line operated until 1926 and was dismantled in 1929. Shark Point Road was constructed on the foundations of the old railway.

No historic sites have been identified in the reserve, however sites may be identified in the future.

Objective

- To identify and protect sites of historical significance.

Strategies and actions

- Record any identified historically significant sites on the Tasmanian Historic Places Inventory and report to the Tasmanian Heritage Office.
- Develop conservation plans or assessments for historic sites if necessary.

4.8 Natural landscape values

The reserve has natural scenic values and features that are important components of the landscape. The natural landscape values are important for many local residents, and to people travelling through the area. It is also part of one of the first picturesque views of Tasmania for visitors arriving at the Hobart airport. Features include stunning water views, flocks of birds and extensive blooms of native pigface (*Carpobrotus rossii*).

Figure 13 View of Orielton Lagoon from the Pitt Water Golf Club towards Sorell Township

The reserve facilitates landscape connectivity through the conservation of habitat and other natural values between the catchments and the estuary. The reserve and Ramsar site provide an important refuge for waterfowl during drought (Dunn 2010).

Some parts of the reserve have been degraded and require rehabilitation. Routine collection of litter is required, as well as more extensive projects to improve the shoreline of the reserve.

Figure 14 Rubbish along Orielton Rivulet on the northern shore of Orielton Lagoon

Recent extensions of the reserve, gained through the Crown Land Assessment and Classification Project (CLAC), also require rehabilitation to ensure that these areas comply with their nature reserve status. Requirements include the control of access points, weeds and erosion and the rehabilitation of samphire, seagrass and coastal vegetation. Encroachment of domestic gardens and dumping of garden waste is an increasing concern and must be addressed.

Objectives

- To protect and maintain scenic vistas and features of the natural landscape within the reserve.
- To maintain the connectivity of habitat, native vegetation and refugia in the landscape.

Strategies and actions

- Identify and protect the significant natural scenic values and features of the reserve.
- Assess the visual impact of any proposed developments to minimise visual intrusiveness, including management infrastructure such as fences.
- Collect and store data including photographs and maps, to enable changes to the landscape to be assessed and measured.
- Rehabilitate parts of the reserve where significant erosion or vegetation loss has occurred.
- Investigate sources of eutrophication and determine remedies where possible.
- Assess recent additions to the reserve gained through the CLAC process.

4.9 Visitors and access

Visitation has the potential to greatly diminish the values of the reserve. Direct disturbance caused by visitor access is one of the most significant urban threats to the reserve. For migratory and resident shorebirds, disturbance causes reduced feeding, prevents rest and wastes energy through increasing their vigilance or moving to another area. Access and subsequent trampling causes permanent damage to fragile vegetation such as saltmarsh, leading to compacted bare areas. It is difficult to restrict access.

Due to the location of the sections of reserve, there are a variety of access points. Woody and Barren islands are generally only accessible by watercraft. The two eastern-most sections, at Barilla Bay West and northern Pitt Water, are only accessible by watercraft or across private land with landowner permission. Orielton Lagoon is located next to Sorell, one of Hobart's fastest growing urban satellites. This section is bounded to the south by the causeway, which carries a major arterial road, the Tasman Highway and a busy walkway/cycleway. Orielton Lagoon has multiple public access points

around its perimeter, including from public roads, adjacent Crown land, council-managed land and private property.

Figure 15 Fencing that minimises inappropriate access to the Orielton Lagoon foreshore

Boating

While the use of vessels (boating) is a semi-regular activity within the Pitt Water area, it can disturb birds and has the potential to cause pollution.

Woody Island is sometimes used for picnicking or informal camping by small boat parties or kayakers. Visitation to Woody Island and Barren Island may cause vegetation damage and disturbance of wildlife. Of particular concern is disturbance of the habitat of threatened species on Woody Island, particularly during the breeding season. See section 4.5 regarding the restriction of access to Woody Island.

Recreational vehicle use

Off-road driving is not permitted in the reserve, however motorbike access is especially difficult to prevent. Rocks, fences and gates have been installed at many locations to limit access although numerous access points remain. Many barriers are destroyed soon after their installation. It is important to prevent motorbike riding, particularly where there are identified important bird habitat areas for nesting, roosting or feeding.

Bird watching

As habitat for numerous migratory species and resident shorebirds, the reserve is a potentially popular location for bird watching. However, many areas are relatively inaccessible due to a significant amount of the reserve being surrounded by private property. Bird watching is most likely to be undertaken around Orielton Lagoon.

Walking and cycling

The Sorell walkway/cycleway and the 'Forcett Street Walkway' (Figure 16) on the eastern shore of Orielton Lagoon (between Forcett and Montagu Streets, Sorell) lie outside the reserve and are popular areas for local residents to visit. Walking in other parts of the reserve is infrequent due to the difficulty of access and the muddy shoreline. Walking at the shoreline of the reserve and the use of vessels has the potential to disturb all species of birds. Sustained walking and cycling use causes damage to saltmarsh vegetation through trampling and soil compaction that creates bare areas and depressions (Prahalad 2009).

Provisions have been made for people to access areas where they are less likely to disturb birds or damage fragile vegetation. Several fences and a walkway on the bank above Orielton Lagoon were constructed in 2008 to reduce the incidence of pedestrians and dogs causing disturbance. Pedestrian gates on the western side of Orielton Lagoon and the boundary of Orielton Lagoon and Shark Point Road allow for pedestrian access beyond fences. Samphire vegetation could become trampled at the Shark Point access if the number of visitors was to increase.

Figure 16 The 'Forcett Street Walkway'

Objectives

- To allow for visitation that has a negligible impact on the values of the reserve, and nil impact on bird habitat areas, whilst still providing for educational and interactive experiences.
- To prohibit activities that cause observed disturbance to birds, especially on or near the foreshore and white-bellied sea-eagle nests.

Prescriptions

- The use of motor boats[3] and commercial vessels[4] is prohibited in the reserve. In some cases singular or infrequent access by motor boats or commercial vessels may be permitted through a written authority from the Director of National Parks and Wildlife if it is considered that the access will not cause significant disturbance to birds or other detrimental impacts.
- The use of all vessels[5] and lightweight craft[6] is prohibited within the Orielton Lagoon section of the reserve.
- The use of certain vessels in the reserve may be considered by the PWS if it is necessary for approved research or management activities or other activities considered appropriate by the Director of National Parks and Wildlife.

Strategies and actions

- Continue to prohibit recreational vehicle use within the reserve, in order to maintain the natural values of the reserve.
- Prohibit new access points and all public access to the foreshore of Orielton Lagoon to avoid disturbance and trampling.
- Monitor sensitive and important areas vulnerable to degradation or disturbance through visitation including the Shark Point Road access point. Consider closing this access point (remove the gate) if there is sustained damage to the samphire community through trampling, or repeated bird disturbance is observed.
- Through liaison with MAST, seek for the waters of Orielton Lagoon to be designated as a 'prohibited area for navigation' under the Marine and Safety (Motor Boat and Licences) By-Laws 2008, if appropriate, as per the prescriptions in this management plan.
- Ensure that signs clearly inform visitors about where vessels are not allowed in the reserve.
- Install permanent markers at Barilla Bay and in the upper reaches of Pitt Water to define the straight-line boundaries of the nature reserve across water.
- Discourage public access to areas of the reserve that have been identified as critical bird areas or are known locations of threatened species or protected communities. Consider installing signs at strategic points to discourage access to these important areas.
- Continue to use fences and similar techniques to prevent non-compatible activities in the reserve.

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[3] See the 'Abbreviations and terminology' list for a definition of 'motor boat'.

[4] See the 'Abbreviations and terminology' list for a definition of 'commercial vessel'.

[5] See the 'Abbreviations and terminology' list for a definition of 'vessel'.

[6] See the 'Abbreviations and terminology' list for a definition of 'lightweight craft'.

- Regularly monitor the condition of tracks, fences and other infrastructure. Undertake maintenance where required.
- Monitor Woody Island for impacts from visitation and compliance with access restrictions.
- Install signs to prohibit campfires on Woody Island.
- Ensure that any new structures are constructed with minimal intrusion on the natural/landscape values and visual amenity of the reserve.
- Monitor the erosion of soils, roads or tracks within the reserve and undertake action in consultation with specialists to rehabilitate and restore damaged or degraded areas.
- Support sustainable activities to facilitate education, awareness and appreciation of the values of the reserve.
- Develop rehabilitation plans for sections of the foreshore around Orielton Lagoon and Pitt Water to guide rehabilitation activities.
- Provide assistance and advice to community groups and other organisations for the preparation of grant applications for projects that will help to protect the foreshore areas, the reserve and adjacent land in general. Assist groups with the implementation of such projects.

4.10 Education, interpretation and community involvement

Education

The reserve is a potentially important educational resource. Migratory species and resident shorebirds, threatened species, seagrass and saltmarsh communities, and water quality are examples of many subjects of research or projects for the University of Tasmania, local schools or other special-interest groups. It is important that the growing local community is aware of the international and local importance of the values of the reserve (including ecosystem services) and the damage caused by inappropriate land use, access and visitor behaviour. It is also important that the relevant management authorities cooperate to ensure that the community is informed about the reserve and Ramsar site boundaries; people will thereby be more inclined to report inappropriate activity and modify their own behaviour.

Interpretation

An interpretative brochure was published in 2008 and distributed to nearby residents as part of the South East Coastal Management Project, funded through NRM South. A PWS Fact Sheet was also published in 2008.

There are a number of signs around Orielton Lagoon that have been erected to provide information on authorised and prohibited uses of the reserve. The signs incorrectly name the reserve ‘Orielton Lagoon Nature Reserve’ (Figure 17). There are also two interpretation signs located along the Forcett Street Walkway and one on the Sorell Causeway.

Figure 17 An existing nature reserve sign on the northern side of Orielton Lagoon

More signs are required to inform visitors about the nature reserve's conservation status, its boundaries, reasons for reservation and its significance as part of the Ramsar site. The Ramsar Convention Bureau (1996a) states, "Contracting Parties should endeavour to place descriptive signs at all Ramsar sites."[7] Currently the only sign in the area informing visitors of the wetland's Ramsar status is on the Sorell Causeway. Another sign was removed from the Waterview Bird Sanctuary in early 2010 but was later replaced by the PWS (Figure 18). An interpretative panel featuring the Coal River and the Ramsar Site is located in Richmond.

Figure 18 Ramsar sign at Waterview Bird Sanctuary

[7] Ramsar Convention Bureau 1996a: 'Guidance on signs for Ramsar sites', <http://www.ramsar.org/about/about_sitesigns.htm>.

A block of land adjacent to Orielton Lagoon where the causeway meets Sorell has been identified as unallocated Crown Land and will be reserved. It will be a valuable buffer from urban impacts as well as a possible location for centralised interpretation displays.

Community involvement

There is currently a general lack of knowledge and appreciation in the local community of the values of the reserve. There is also a lack of a coordinated approach to community and stakeholder involvement. Remediation projects have been the initiatives of a number of community groups, some of which are no longer active.

The close proximity of the reserve to the urban area makes it an important place for communicating messages about its values but also makes it vulnerable to human impacts. By developing and fostering community involvement, the PWS can help ensure community support, improve awareness of the values and facilitate the protection of the reserve. A number of projects have been successfully undertaken in or adjacent to the reserve in partnership with local community groups. Activities such as revegetation, fencing, stormwater remediation and weed control have contributed to reduced erosion, sedimentation and pollution, and have improved habitat and water quality.

Community and volunteer-assisted remediation projects, led by the Southern Tasmania Weed Strategy project, the Orielton Lagoon Action Committee and the NRM South (managing a Caring For Our Country project), have included: the mapping and ongoing control of priority weeds; the installation of fencing to limit access to the foreshore; revegetation works; and the construction of pedestrian gates at key sites to prevent vehicle access but still allow pedestrians to view the shore at a distance.

Objectives

- To provide quality contemporary and relevant visitor information and education opportunities.
- To ensure that the local community and visitors are informed about the significance of the nature reserve and Ramsar site status, the boundaries of the reserve and the reserve restrictions.
- To target school involvement in educational initiatives.
- To increase community awareness of direct and indirect impacts caused by human actions and to help the community understand the values and management aims for the reserve, particularly the threats posed by stormwater, domestic pets and disturbance.
- To allow for interpretation and educational activities without compromising conservation values.
- To work with councils to raise awareness of the values of the reserve with the community and adjacent property developers.
- To encourage and support community involvement through organisations such as Coastcare, NRM and Landcare.

Strategies and actions

Signs

- Develop and implement a plan for signs that enable visitors to easily identify the reserve's boundaries, the reserve and Ramsar site status and prohibited activities.
- Update existing 'Orielton Lagoon Nature Reserve' signs around Orielton Lagoon with signs bearing the correct reserve name (ie 'Pitt Water Nature Reserve'). To avoid confusion, consideration should be given to a subordinate sign to identify Orielton Lagoon, given that Pitt Water itself is topographically separated from Orielton Lagoon (eg 'Pitt Water Nature Reserve-Orielton Lagoon section').
- Liaise with managers of nearby key visitor sites about opportunities for the installation of interpretive information about the values of the reserve and Ramsar site.
- Include information on signs and in interpretive material on the importance of the reserve for the protection of threatened species and communities of high conservation value, Ramsar status, as well as descriptions of the reserve's vegetation characteristics.

Education

- Develop a centralised interpretive display at an accessible point alongside or near the reserve.
- Provide information in the form of a display board, brochures, Discovery Ranger talks or other appropriate means at prominent places such as the Sorell Council Chambers, the Sorell Library or local schools.
- Facilitate the distribution of the Pitt Water-Orielton Lagoon Ramsar site brochure and other appropriate educational material to local residents to raise awareness about how they can reduce their direct and indirect impacts on the reserve.
- Engage key community stakeholders in the management of the reserve to enhance stewardship and community awareness of significant values and threats, as well as ecosystem services.
- Promote cooperative initiatives to resolve confusion in the community about land tenure, encourage appropriate activities and improve understanding of the values of the area, such as the production of maps with boundaries and responsibilities clearly marked.

Community involvement

- Continue to support existing and new local community groups and initiatives, such as World Wetlands Day, Clean-Up Australia Day and community-based projects, to revegetate the reserve, collect rubbish and undertake other approved activities that are of benefit to the reserve.
- Continue to encourage and support community involvement and volunteer programs within and adjacent to the reserve, where activities are consistent with the objectives of this plan.

- Develop good working relations with adjacent land managers, the local community, councils, interest groups and individuals in the Aboriginal community on matters of mutual interest.
- Continue to consult with Birdlife Tasmania, councils and conservation specialists in government agencies on management issues.
- Liaise with aquaculture operators to ensure that expansion or changes in their operations in Pitt Water do not have any adverse impacts on the reserve.
- Help local groups to apply for grants for rehabilitation projects.
- Monitor the level and nature of feedback from the community about the management of the reserve.
- Encourage community Bushwatch programs to monitor and report violations such as the illegal collection of specimens, or motorbike use in the reserve.

4.11 Adjacent land use and other external influences

Reserve boundaries

Some confusion exists regarding the location of the boundaries of the Pitt Water Nature Reserve. This confusion has been caused by a number of factors including recent reserve extensions, different reserve classes in close proximity (nature reserve, conservation area and Ramsar site), and altered high water levels.

The boundary of some sections of the reserve is to the high water mark only. The high water level in the lagoon has changed since the reserve was proclaimed, due to the lowering of sills on the Sorell causeway to increase flushing of Orielton Lagoon.

Confusion over reserve boundaries may have led to the deliberate or accidental encroachment of some land uses and activities. As well as the encroachment of the golf course discussed in the ‘Urban and industrial land use’ section, other unauthorised activities may include the collection of scientific specimens in the reserve or vessel use in Orielton Lagoon. Many of these impacts are likely to continue unless the boundaries are more clearly identified.

Objective

- To identify and mark the boundaries of the reserve to ensure visitors and surrounding landowners are aware of the correct reserve boundaries and to prevent further encroachment and unauthorised activities.

Strategies and actions

- Install signs or fences to clearly identify the surveyed boundaries of the reserve and prohibited uses or activities.

- Support projects that will deliver clearer identification of the boundary of the reserve and Ramsar site.
- Liaise with local councils and adjoining landowners to ensure that they are aware of the boundaries of the reserve and adjacent properties.
- Progress the reservation of unallocated Crown Land adjacent to Orielton Lagoon at the end of the causeway at Sorell.
- Monitor and act on reserve encroachments.

Urban and industrial land use

The reserve faces increasing pressures from rapid urban and industrial developments in both the wider catchment and closer to the reserve. The Sorell Municipality is considered to be one of the fastest growing municipalities in Tasmania. Increasingly dense residential areas occur at Sorell, Midway Point and Penna and near the northwest boundary of Orielton Lagoon. The knoll to the north of Orielton Lagoon, off Wolstenholme Drive, is one of only a few areas surrounding the Lagoon that have not been developed for housing.

The presence of these urban areas has a significant adverse impact on the conservation values of the reserve. The integrity of the foreshore has undergone considerable decline. This threat is increasing as the area becomes more urbanised. Clearing of native vegetation and introduction of new weeds has changed floral composition and continues to do so, and has contributed to sedimentation of the lagoon and modified the micro-habitats of the area.

Major impacts associated with these residential and industrial areas include:

- the input of stormwater and the pollutants it contains;
- dumping of rubbish and vegetative material, such as grass and shrub clippings (Figure 19);
- the expansion of gardens onto the buffer zone land adjacent to Pitt Water and Orielton Lagoon;
- the removal of vegetation from boundaries to enhance views for residents;
- the dumping of engine blocks, batteries, tyres, bottles and other plastics in the reserve;
- possible impacts from construction and excavation activities when they cause erosion or occur in areas mapped as having a high potential of containing acid sulfate soils (Figure 4);
- increased levels of access to the reserve foreshore, as well as illegal access and use of the reserve by people with horses, dogs and vehicles; and
- increased general disturbance to wildlife from noise, pets and human activities.

Figure 19 Garden material dumped near Orielton Lagoon

A large proportion of land surrounding Orielton Lagoon and the wider Pitt Water area is currently zoned as 'rural' in the Sorell and Clarence planning schemes. The rural zoning provides a buffer against more intensive industrial and urban use of land immediately adjacent to the Ramsar site. If the zoning is changed to allow for more intensive use, adequate protection measures should be provided to prevent environmental degradation and disturbance from human activity including stormwater, domestic pets and weeds.

Objectives

- To protect the reserve from impacts caused by residential, commercial and industrial development on surrounding land.
- To be proactive concerning adjacent land uses through environmental initiatives, such as education about appropriate plant species for domestic gardens.

Strategies and actions

Planning and development

- Liaise with councils to minimise urban and industrial impacts on the reserve through amendments to the planning schemes and implementation of planning conditions.
- Provide support to councils for environmental remediation projects, implementation of storm water upgrades and maintenance of wastewater disposal and re-use schemes.
- Encourage local councils to take into consideration the 'Guidelines for development' on adjacent lands that may adversely affect the values of Pitt Water Nature Reserve (see Appendix 3).
- Encourage councils to retain existing rural zoning or to zone for environmental protection on land adjacent to the Ramsar site and

nature reserve under the Southern Tasmania Regional Plan and other local government planning initiatives.

- Ensure that future development proposals for land around the reserve take into account bird habitat areas and sensitivity of birds to disturbance from human activities.

Other protection measures (external impacts)

- Investigate the designation of a buffer zone (with no direct public access) around the terrestrial borders of the reserve to minimise disturbance and protect shorebird habitat. Provide assistance to fence buffer zones.
- Encourage landowners to leave buffer zones around riparian areas or creeks and to fence these off from cultivated or grazing land.
- Ensure that threatened species on adjacent land are protected through the mechanisms available under the *Threatened Species Protection Act 1995* and that conditions to protect threatened species are included in relevant development approvals.
- Liaise with Sorell Council to improve manure management associated with the riding club situated on council land (Miena Park) to minimise nutrients and sediment entering the reserve.
- Work with councils and community groups to develop and implement catchment management plans.

Pitt Water Golf Club

The Pitt Water Golf Club abuts the north-western shore of Orielton Lagoon. As a result of a proclamation in 2008 (see 'Proclamation history'), part of the Golf Club's course is now located in the reserve resulting in an activity which is in conflict with the nature reserve status. The land was formerly classified as Crown land (Public Reserve).

Figure 20 The Pitt Water Golf Club tee 15 at 'Reynolds Point' that occupies the reserve

The tee area at Reynolds Point (Figure 20) is currently licenced annually however part of a fairway also lies on the reserve. Discussions have been held with a view to improving environmental management by reducing adverse impacts (nutrient inputs) and deterioration of native vegetation adjacent to bird habitat areas, in return for formalising the use of the area through an appropriate authority (lease or licence). A small section of the golf club's private property, typically submerged land, is part of the Ramsar site.

Objectives (specific to the Pitt Water Golf Club)

- To formalise the pre-existing occupation of the reserve by the Pitt Water Golf Club in return for improvements in the environmental management of the occupied area.
- To ensure further adverse impacts on the reserve are minimised and as much of the occupied area as possible is rehabilitated.
- Once the lease or licence boundaries are determined, no further expansion of the golf course and associated infrastructure will be permitted in the reserve.

Prescription

The pre-existing use and occupation by the Pitt Water Golf Club of the former public reserve which is now part of the Pitt Water Nature Reserve is acknowledged. The occupation will be formalised through an authority (lease or licence) with appropriate conditions to improve environmental outcomes. The conditions for the Pitt Water Golf Club will include provisions to:

- minimise impacts on water quality;
- minimise disturbance to all species of birds;
- provide, to the greatest extent possible, a buffer zone between the golf course and the lagoon through rehabilitation of native vegetation on some areas between the foreshore and fairways;
- undertake weed control on the reserve; and
- ensure that there are no further encroachments into the reserve.

Strategies and actions

- Establish an authority (lease or licence) with appropriate conditions with the Pitt Water Golf Club.
- Work with the Pitt Water Golf Club to develop a landscape and rehabilitation plan and to support the rehabilitation of native vegetation.
- Enter into discussions with the Pitt Water Golf Club to ensure appropriate mechanisms protect samphire vegetation to the north of the reserve; and discuss the possibility of placing a conservation covenant over the samphire vegetation.
- Identify options to clearly mark reserve and licence boundaries north of Reynolds Point (tee 15).

Agriculture

The majority of the land surrounding Pitt Water has been cleared for agricultural use. Land on the western side of Pitt Water is serviced by the Southeast Irrigation Scheme and is irrigated for intensive cropping including orchards and viticulture. Orchards are also located near Penna. The number and size of orchards in the Penna region may increase following the recent establishment of the wastewater re-use scheme. Some sediment, pesticides, herbicides, fertilisers and other nutrients from these agricultural activities are likely to enter the reserve. Construction and excavation activities that occur in areas mapped as having a high potential of containing acid sulfate soils (Figure 4) may also have a detrimental effect on the reserve.

In the past, stock could enter the reserve and cause disturbance and damage to the foreshore and vegetation. Fences now prevent stock from entering the reserve in most cases but there are still some properties that remain unfenced in the upper Pitt Water area.

A large section of a farm bordering the reserve has been protected under a private conservation covenant as part of the Protected Areas on Private Land Program (PAPL). Established in 2005, the covenant is a valuable extension to conservation in the area by protecting an additional 36.37 hectares of tidal mudflats, saltmarsh and coastal grassland adjacent to the reserve at Barilla Bay (UPI: 1400128) (Figure 21). Another PAPL reserve was established in 2010. It is located adjacent to the reserve in the upper Pitt Water area near the mouth of the Coal River (13.46 hectares).

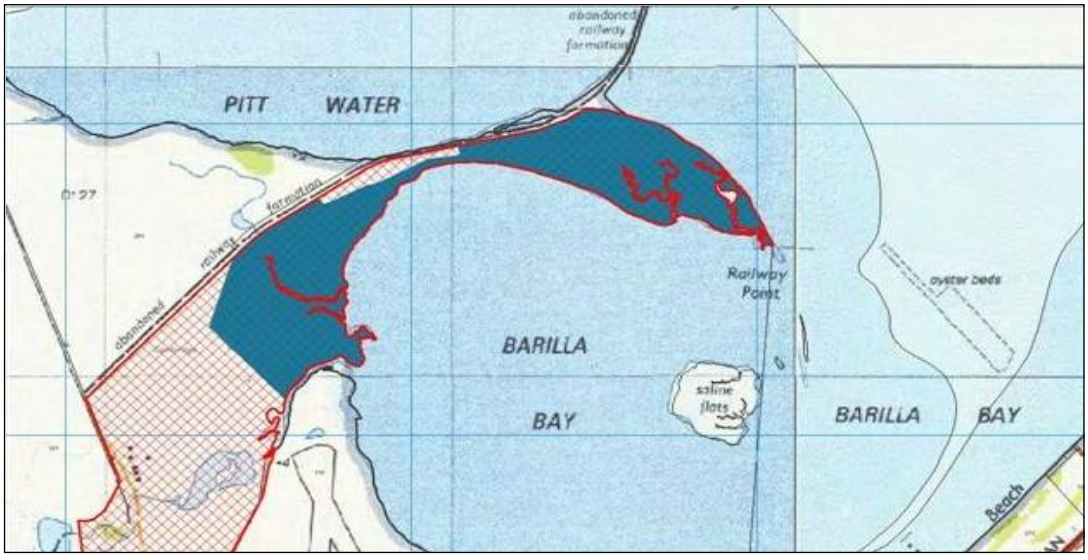

Figure 21 The private covenant land adjacent to the reserve (dark blue area)

Source: TheList

Objective

- To monitor the condition of the reserve where it borders private land used for agricultural activities.

Strategies and actions

- Periodically monitor remote sections of the reserve for impacts originating on adjacent private land, such as stock access.
- Liaise with and encourage landowners to protect the reserve foreshore through projects such as fence maintenance, foreshore rehabilitation, and the establishment of buffer zones, conservation covenants and management agreements.
- Provide support to the owner of the covenanted land at Barilla Bay.
- Support and provide assistance and advice to landowners and groups in the preparation of grant applications for projects, if required, to protect the reserve adjacent to agricultural land.
- Liaise with and encourage landowners, managers and local interest groups and individuals to protect the foreshore by a variety of methods such as:
    - fencing to prevent stock access;
    - measures to minimise drainage of excess recycled water into the reserve;
    - tree planting where appropriate, the development of no-plough zones and measures to prevent siltation from construction works; and
    - revegetation of eroded gullies.

5. Other management considerations

5.1 Implementation

All management activities in the reserve are to be appropriate and compatible with this plan and the conservation of the reserve's environmental and heritage values, protection of threatened species, water quality, and the natural landscape. Limited funds and resources are continuing challenges to balance with the ability of the PWS to adequately respond to reserve management requirements. Management activities in the reserve must be responsive to these constraints. The content of this management plan is subject to the provision of funding and other resources sufficient to meet them and may be given priority at the Director's discretion according to resource availability.

Objective

- To ensure that management activities and other works are appropriate and compatible with this plan and the values of the reserve.

Strategies and actions

- Use the National Parks and Reserved Land Regulations to formalise the implementation of relevant prescriptions in this plan.
- Ensure that management activities do not impact on the values of the reserve. In particular, the timing of activities should not coincide with critical life-stages for birds, such as nesting and pre-departure feeding for migratory species.
- Minimise areas of disturbance arising from any developments (eg improvements to stormwater treatment or fencing). Where necessary, peg or fence to define the limits of the site that may be disturbed. If trees or shrubs or other site features to be retained occur within this area, protect them for the duration of the works.
- Implement strategies as far as practicable to alleviate and minimise any adverse effects of management activities and other works.
- Encourage the community, in partnership with the PWS, to apply for funding for rehabilitation and other projects from external sources.
- Continue to consult with conservation specialists in government agencies and Birdlife Tasmania on bird values, threats and management issues.
- Ensure that actions are implemented in line with relevant national recovery and threat abatement plans.
- Annually review and revise a works program based on the Implementation Schedule.

5.2 Research

Research projects should be conducted within the reserve to improve the understanding of the values, ecological processes, characteristics and management of the reserve. Where possible, research projects should address the monitoring measures outlined in this plan or the knowledge gaps identified for the Ramsar site in the Ecological Character Description by Dunn (2010) listed in Table 3. It is essential that research and monitoring continue to capitalise upon existing long-term data sets available for the reserve. Data informs decision-making to ensure definitive and appropriate actions are undertaken and provides context and justification for management. The level of research and monitoring will depend on the availability of resources. Community-based interest groups should be encouraged and assisted where possible to continue their research and monitoring efforts, in conjunction and association with DPIPWE and the PWS.

Table 3 Knowledge gaps identified in the Ecological Character Description[8]

Component	Specific component or process	Identified knowledge gaps	Suggested monitoring or other action to address gaps
freshwater flows	flows downstream from Richmond	patterns of freshwater flows	maintain continuous monitoring at Richmond and upstream sites
	flows in Orielton Rivulet	patterns of freshwater flows	reinstate and maintain continuous monitoring at Brinktop Road
geomorphology	sediment transport in upper Coal River	contribution of shoreline erosion to sediment budget rate of deposition and mapping of depositional features	sediment budget assess depositional features from air photos as baseline sediment pin monitoring at key sites
	intertidal flats used as feeding area	intertidal exposure at Orielton Lagoon under different tide levels	map and model exposure
	sediment transport within Orielton Lagoon	rate and areas of deposition and erosion sediment sources	map and model sediment deposition and erosion measure sediment input from rivers and shoreline
	sediment movement, channel development and geomorphic condition of flats south of causeway at Sorell	depth and nature of sediments at tidal flats near Sorell sediment sources and channel characteristics	investigate depth, characteristics and sediment transport of tidal flats below second causeway

[8] Applicable for entire Ramsar site. Based on Dunn 2010.

tidal movements	tidal penetration to Richmond	height and residence times for saline waters to the head of the estuary at Richmond	monitoring of salinity and salinity profiles from first causeway to Richmond
	tidal exchange and tidal processes in Orielton Lagoon	extent of exchange of tidal waters in and circulation patterns in Orielton Lagoon	monitor tidal exchange and circulation under different tidal regimes
	sea-level rise and impacts on saltmarsh and shorelines	extent of sea-level rise impacts compared with natural change in evolving system	expand shoreline vulnerability studies to key areas of high sensitivity/significance
water quality in Orielton Lagoon	water quality characteristics across extent of Orielton Lagoon	single site only near causeway, need validation for representation of entire lagoon.	comprehensive survey of water quality, including near stormwater outlets
fish community	fish nursery areas	status of fish nursery areas, available habitat for different species	mapping of types of sediments and seagrass in relation to tidal movement, exposure
invertebrate communities	prey species for shorebirds at all favoured locations	compare with two areas sampled and full range of prey species	surveys of invertebrate communities
	saltmarsh invertebrates	species at all saltmarsh sites and habitat types	surveys of invertebrate communities
	pelagic invertebrates benthic invertebrates of open marine waters	presence and abundance presence and abundance	surveys of invertebrate communities

Objective

- To facilitate and promote research to improve understanding of the reserve; and maintain and facilitate data collection and analysis to inform decision-making relevant to the reserve.

Strategies and actions

- Continue to require authorisations to be issued by the PWS and DPIPWE before any fieldwork commences.
- Ensure that authorisations for the collection of material within the reserve are not issued where it is possible and appropriate to collect the material elsewhere. Only permit research that does not have significant adverse effects on the natural, cultural, or aesthetic values of the reserve.
- Consult the Aboriginal community and ensure that a permit is obtained for any research involving Aboriginal heritage.

- Ensure that one copy of research reports and studies is provided to the Director of National Parks and Wildlife, the field centre and the library servicing the PWS. Ensure that submissions are made within six months of completing the fieldwork unless another period is specified.
- Ensure that adequate reporting is a condition of all scientific research permits. If appropriate, research results should be published to contribute to public understanding.
- Liaise with relevant organisations to ensure that research is conducted to inform the monitoring measures outlined in this plan or to address identified key knowledge gaps (Table 3).
- In conjunction with other organisations and community groups, monitor the distribution, abundance and control of introduced animals, plants and diseases to determine appropriate management and control measures.
- Monitor impacts on the natural values of the reserve and Ramsar site caused by marine farms, agricultural activities, increased urbanisation or other activities and events. Liaise with the conservation specialists in DPIPWE and TAFI regarding the management of these impacts and research opportunities.
- Liaise with community groups and schools to encourage community involvement in monitoring programs.

5.3 Effectiveness monitoring and plan review

This plan aims to direct improvements in how the reserve is managed, used and enjoyed.

PWS is committed to a system of adaptive management (Jones 2005). Preparing a plan is just one step in a cyclic process of good reserve management. The system is intended to be simple and flexible. It is focused on achieving results.

Monitoring and evaluation are important parts of management implementation.

The stating of clear measurable performance indicators also provides the community and partners in implementation with an easy method of holding PWS to account.

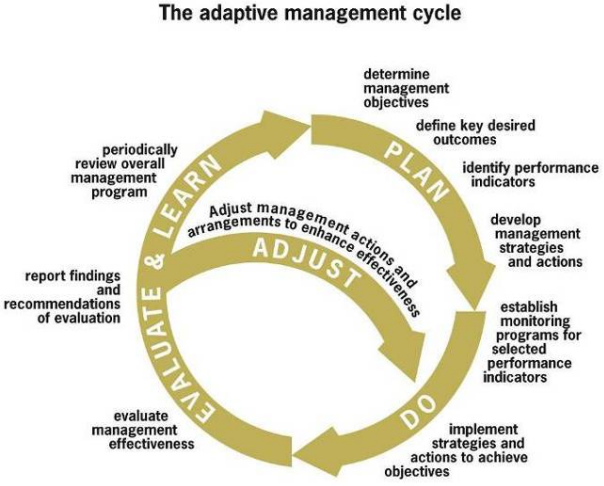

Figure 22 The adaptive management cycle

Source: Jones 2005

Key Desired Outcomes

Not all outcomes of this plan will be evaluated to ascertain management effectiveness, due to a limited allocation of resources to undertake the required monitoring actions.

Based on the preceding sections of the plan, the following are key desired outcomes for reserve management over the life of the plan:

- Stormwater impacts to Orielton Lagoon have been reduced;
- Visitors are informed about the correct reserve name, boundary locations and significance of the reserve's values;
- The area affected by Weeds of National Significance has decreased;
- Important bird habitat areas are protected from threats; and
- Saltmarsh vegetation has increased since 2009.

See the operational document 'Key desired outcomes, indicators and effectiveness monitoring' at the rear of this plan.

Review

The management plan is to have an interim evaluation after five years. This evaluation will be a check on the performance indicators by collating relevant data, reviewing progress and making recommendations as appropriate for any adjustments in management. These performance indicators are found in the operational documents at the rear of the plan. An informal public feedback process may also be run at this time. The management plan has been prepared with an intended ten year life after which there will be an evaluation of the plan's effectiveness.

Strategies and actions

- Undertake an interim evaluation of the management plan after five years and a full evaluation after ten years, together with a review of the vision, objectives and strategies, involving full public engagement.
- Implement the monitoring actions as described in the operational document 'Key desired outcomes, indicators and effectiveness monitoring' to enable the assessment of management effectiveness in achieving the key desired outcomes.

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7. Appendices

Appendix 1 Information about Ramsar and other international agreements

The Convention on Wetlands of International Importance

The Convention on Wetlands of International Importance (the Ramsar Convention) is an intergovernmental treaty that provides the framework for international cooperation for the conservation and wise use[9] of wetlands. It is the oldest major international conservation convention and takes its name from the Iranian city of Ramsar where the treaty was adopted in 1971.

The broad aim of the Ramsar Convention is to halt and, where possible, reverse worldwide loss of wetlands, which are considered one of the world's most threatened habitats. The primary purpose of Ramsar sites is to support the description and maintenance of the ecological character[10] of wetlands and the formulation and implementation of planning that promotes their conservation.

Management of wetlands and Ramsar sites should be in accordance with the duties and obligations of signatories to the Convention. In particular, Article 3.1 states that the contracting parties 'shall formulate and implement their planning so as to promote the conservation of wetlands included in the list, and as far as possible the wise use of wetlands in their territory'.

The List of Wetlands of International Importance has been established under the Ramsar Convention. Sovereignty of Ramsar sites remains with the countries within which the sites are located. Countries that have joined the convention are required to implement policies that aim to guarantee conservation and sustainable use of wetlands. They are expected to manage their Ramsar sites and all other wetlands so as to protect their unique ecological character.

Australia was the first nation to become a contracting party to the convention, in 1971. In June 2011, Australia had 64 Ramsar sites covering approximately 8.1 million hectares, ten of which are located in Tasmania.

Criteria for listing as a Ramsar site

Pitt Water-Orielton Lagoon met four criteria for listing as a Ramsar site at the time of listing in 1982. The criteria used refer to those adopted by the First Conference of the Contracting Parties, Cagliari (24-29 November 1980). Since 1982, the Ramsar criteria have been modified and extended to recognise the importance of the wetlands for fish and other fauna (approved at the Conference of the Contracting Parties in 1999 and 2005).

[9] See the 'Abbreviations and terminology' list for a definition of 'wise use'.

[10] See the 'Abbreviations and terminology' list for a definition of 'ecological character'.

Original and current criteria for Pitt Water-Orielton Lagoon Ramsar site[11]

Current criteria (2005 criteria)	**Original criteria at time of listing** (1980 criteria)
Criterion 2: A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.	Criterion 2: A wetland should be considered internationally important if it: (a) supports an appreciable number of a rare, vulnerable or endangered species or subspecies of plant or animal.
Criterion 3: A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.	Criterion 2 (continued): A wetland should be considered internationally important if it: (b) is of special values for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna; (d) is of special value for its endemic animal or plant species or communities. Criterion 3: A wetland should be considered internationally important if it is a particularly good example of a specific type of wetland characteristic of its region.
Criterion 4: A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.	n/a
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.	n/a
Criterion 9: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of wetland-dependent non-avian animal species.	n/a

Ecological character

An ecological character description (ECD) for Pitt Water-Orielton Lagoon Ramsar site was prepared by Helen Dunn in 2010. An ECD is a baseline description of a wetland at a given point in time. ECDs are used to assess change in the ecological character of wetlands and are prepared in accordance with the *National Framework and Guidance for Describing the Ecological Character of Australia's Ramsar Wetlands*. Dunn's ECD consists of an integrated description of the critical components, processes and ecosystem services of the Ramsar site, as well as a description of the trends evident since the time of listing (Dunn 2010).

Much of the ECD information is relevant to the reserve and is summarised here.

The following key threats identified in the ECD (Dunn 2010) are relevant to the reserve:

[11] Based on Dunn 2010.

- loss of freshwater inputs (reduced rainfall; increasing number of dams and level of water extraction);
- changes in sediment transport (as a consequence of long-term changes to Orielton Lagoon's tidal movement and limited flows in the Coal River);
- agricultural activities adjacent to the reserve (poorly managed irrigation; erosion caused by overgrazing and clearing in the riparian zone);
- waste products and nutrients (stormwater and pollution inputs);
- urban development (causing increased disturbance);
- invasive species (existing and potential); and
- climate change (causing increased water temperatures, modified rainfall patterns and sea-level rise).

Dunn (2010) notes that some of the most significant changes that have occurred since the listing of the Ramsar site in 1982 are the construction of a dam on the Coal River controlling river flows into the reserve segment located in the northern section of Pitt Water, and successful water quality improvements in Orielton Lagoon through improved tidal exchange and the complete removal of sewage outfalls since 2007. Dunn also notes that there appears to be evidence of the impacts of climate change and sea-level rise, such as a possible contribution to saltmarsh erosion.

Critical components, processes and ecosystem services

The following tables are based on the ECD and have been included to complement the information in the preceding sections. See Dunn (2010) for more detail.

The critical components and processes are those that are important determinants of the site's unique character; that are important for supporting the Ramsar criteria under which the site is listed; where change is reasonably likely to occur over short to medium time scales (<100 years); and, that will cause significant negative consequences if change occurs (DEWHA 2008).

Ecosystem services are 'the benefits that people receive from ecosystems' (Millennium Ecosystem Assessment 2005).

Critical components and processes of the reserve[12]

Component	Sub-component	Features and processes	
		Upper Pitt Water	**Orielton Lagoon**
climate	rainfall	low and variable; cool temperate climate; exposed to NW and SW winds	
hydrology	estuary type	wave-dominated estuary; shallow estuary with marked tidal channels	shallow water body (1.5m)
	tidal exchange	shallow estuary with marked tidal channels	limited tidal exchange
	freshwater inflow	low	
	stream flow	often ceases in summer months	
	groundwater inputs	low	
water quality	salinity	dominantly marine	variable (near fresh to hypersaline)
	nutrient levels	low	high
	coliforms	low	high
	chlorophyll levels	low	high
	water temperature	stable marine	variable (diurnally and seasonally)
geomorphology	geomorphic type	drowned valley	artificially enclosed lagoon
	intertidal flats	extensive	
		complex sandbanks, ridges and bars	
		sediment movement controlled by tidal movement	limited sediment movement
	sediment source	largely from shoreline erosion	
flora	littoral vegetation	saltmarshes	
	submerged vegetation	seagrass beds	
fauna	invertebrates	interstitial fauna of intertidal flats	
		saltmarshes	
		benthic fauna	
		fauna of rocky shorelines	
	fish	estuarine fish community	
		shark breeding area	
	birds	migratory shorebirds	
		resident shorebirds	
		waterbirds, seabirds	
		feeding areas, nest sites, roosting sites	
		refuges in times of drought	

[12] Shows commonalities and differences between the two main types of areas in the reserve. Based on Dunn 2010.

Critical ecosystem services provided by the reserve[13]

Component	Benefit / process
Provisioning services	*products obtained from ecosystems*
wetland products	fish nursery area
Regulation services	*benefits obtained from regulation within the ecosystem or as a result of ecosystem processes*
pollution control and detoxification	treated effluent and stormwater enter the estuary and are diluted to acceptable levels
potential to moderate the effects of sea-level rise in limited areas	causeway may dampen effects of sea-level rise (Orielton Lagoon)
Cultural services	*non-material benefits that people obtain from ecosystems through emotive and cognitive experiences and responses*
recreation	facilitates passive recreational activities from beyond reserve boundaries, such as bird-watching and walking
tourism	the reserve is alongside a major highway and can often be seen from the air by visitors as they descend to the airport
spiritual and inspirational	the reserve plays an important role in defining the character of the Sorell municipality
scientific and educational	the reserve has been the site of important research over several decades, notably on saltmarsh ecology and the impacts of human intervention in the management of a coastal wetland (Orielton Lagoon)
	the reserve has been included in regular counts of shorebirds for several decades
Supporting services	*services that are necessary for production of all other ecosystem services, including sustaining biodiversity and habitats*
nutrient cycling	the reserve plays a role in cycling and discharge of nutrients from the surrounding catchments
sediment cycling	tidal movement and freshwater flows re-suspend and recycle sediments and maintain sedimentary environments
maintenance of biodiversity	supports the diversity of intertidal and subtidal habitats for marine life and shorebirds
	supports a range of ecological communities including fish, saltmarsh vegetation, invertebrates of saltmarsh, intertidal flats and benthic environments
	supports a number of nationally and locally threatened species
	supports an extensive and diverse area of a threatened non-forest vegetation community (saltmarsh)

[13] Based on Dunn 2010.

Migratory bird agreements and other conventions

The reserve is an important area for migratory shorebirds that fly there from as far away as the Arctic tundra. It is one of the major summer feeding grounds in Tasmania and is the southern-most in Australia. As a signatory to the Japan-Australia Migratory Bird Agreement (JAMBA), the China-Australia Migratory Bird Agreement (CAMBA) and the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA), Australia has obligations to ensure the protection of listed migratory bird species and their habitat.

The Australian Government also has international obligations to protect migratory birds under the *Convention on the Conservation of Migratory Species of Wild Animals* and the *Convention on Biological Diversity*.

The East Asian–Australasian Flyway Network

A flyway is a concept developed to describe areas of the world used by species as a migration route. Different species migrate in a variety of patterns and use a range of breeding, feeding, roosting and staging sites. Consequently, a single flyway is composed of many overlapping migration systems, each with different habitat and migratory routes. Some birds can make an annual migration of around 25,000 kilometres. Recent research into migratory species and shorebird species indicates that there are up to nine flyways worldwide.

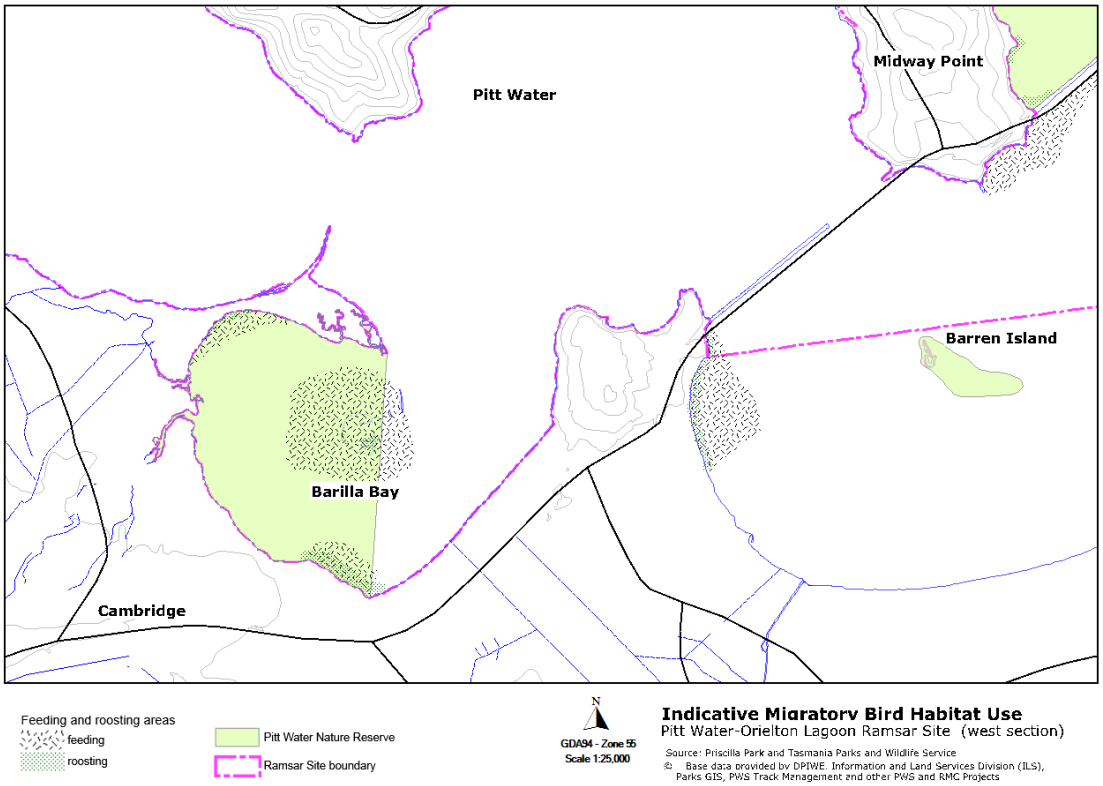
The *Partnership for the Conservation of Migratory Waterbirds and the Sustainable Use of their Habitats in the East Asian–Australasian Flyway* (Flyway Partnership) was launched in 2006. It is an important development in international efforts to conserve migratory species and their habitat along the flyway.

Pitt Water Nature Reserve and the Pitt Water-Orielton Lagoon Ramsar Site are the southern- most part of the route in the East Asian–Australasian Flyway. The Flyway stretches from Siberia and Alaska southwards through east and south-east Asia to Australia and New Zealand. Although Australia does not provide breeding habitat for migratory birds, it is an essential area for feeding and roosting.

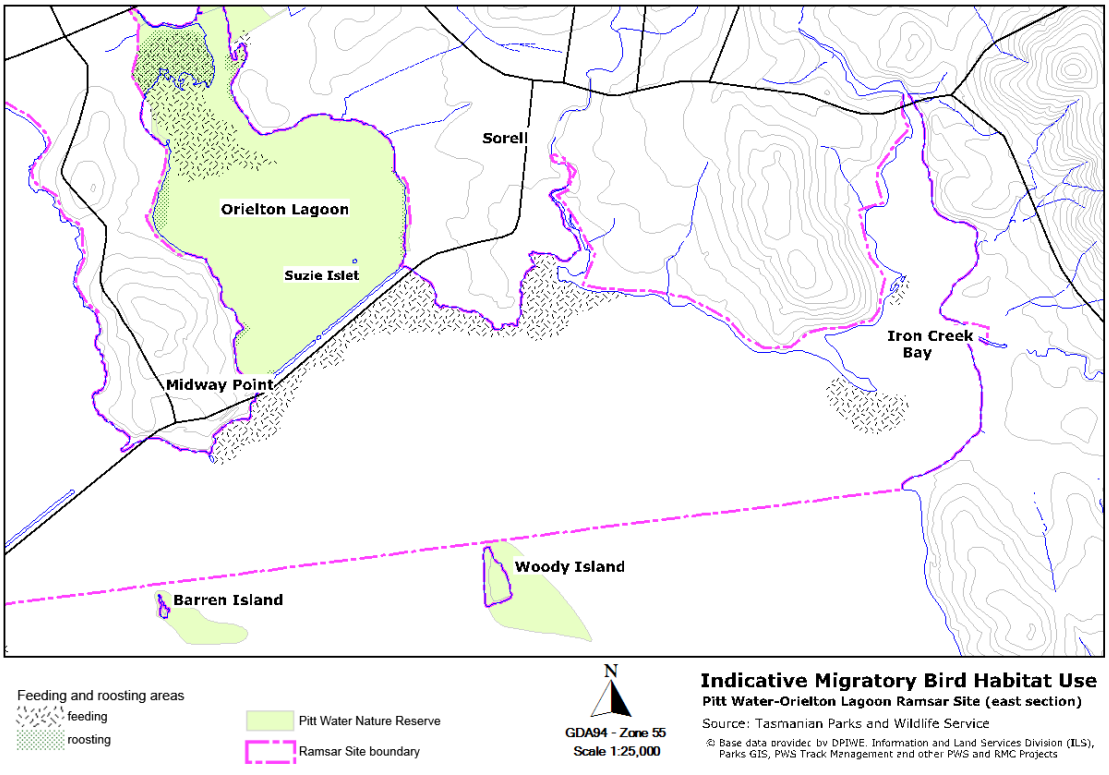
Australia is a member of the East Asian–Australasian Shorebird Site Network, established by Wetlands International to link and promote the conservation and sustainable use of coastal wetland habitat at critical sites along the Flyway.

Appendix 2 Indicative migratory bird and shorebird habitat

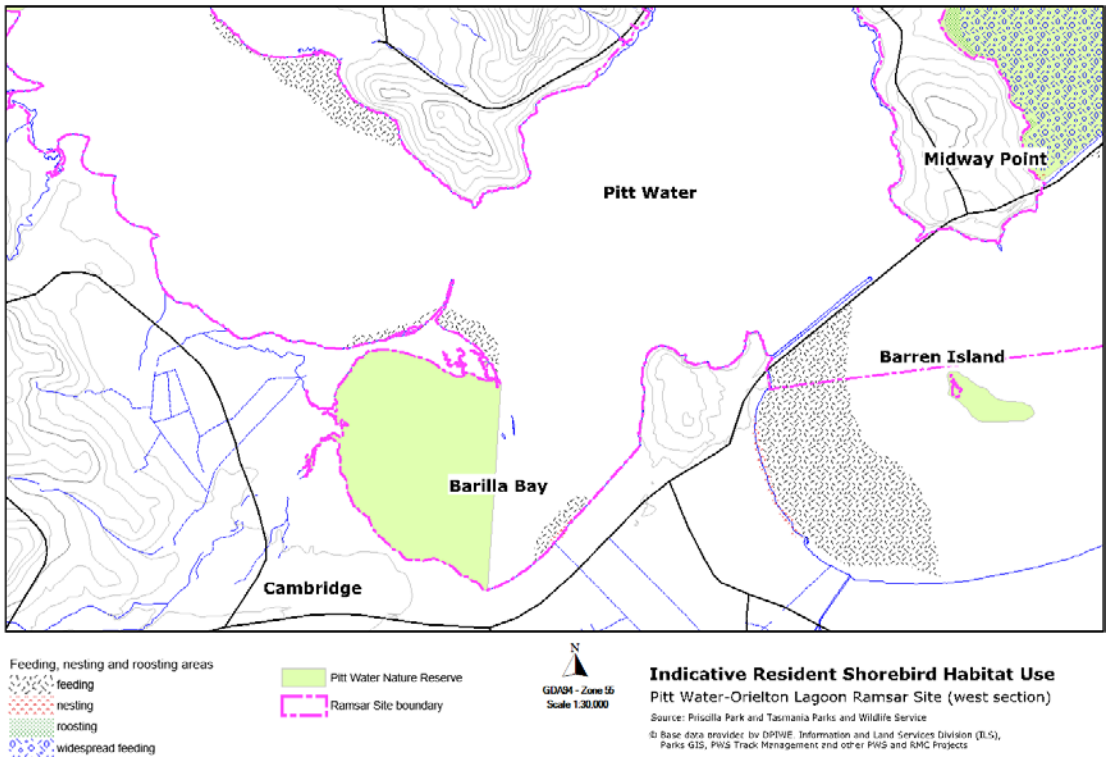
Map 1 Indicative migratory bird habitat (west section)



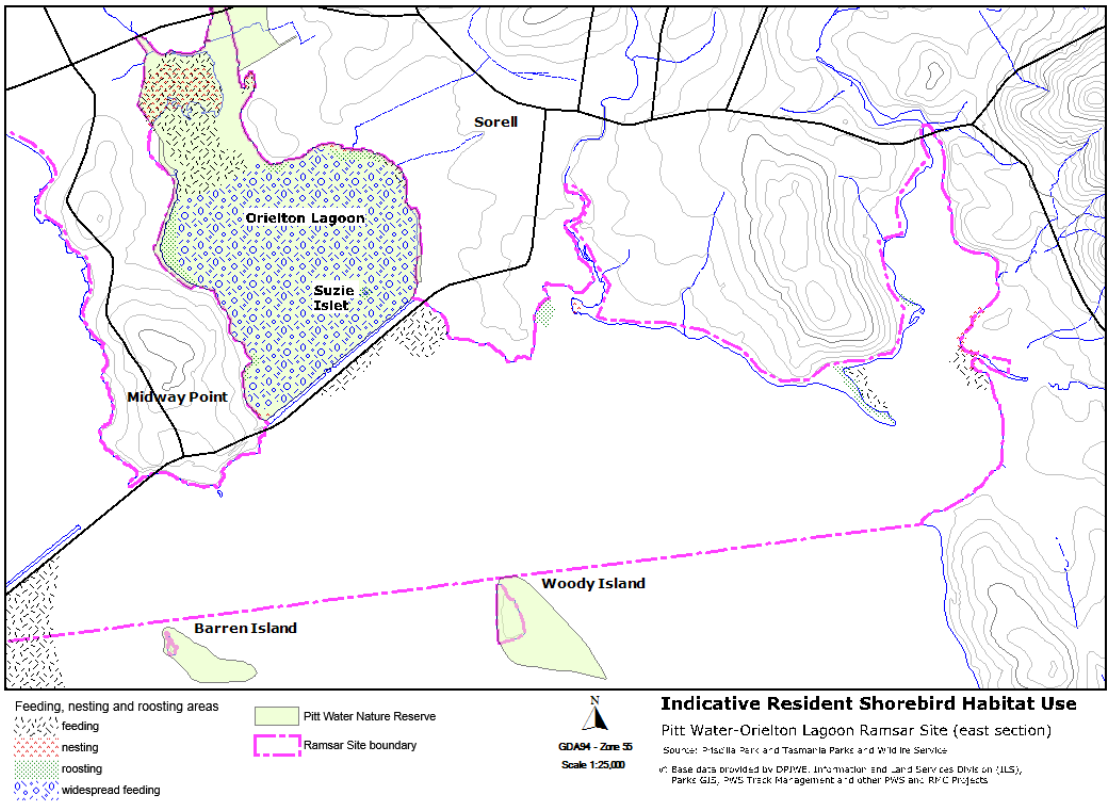
Map 2 Indicative migratory bird habitat (east section)



Map 3 Indicative resident shorebird habitat (west section)



Map 4 Indicative resident shorebird habitat (east section)



Appendix 3 Guidelines for development

The intent of these guidelines is to assist councils to provide advice to reduce the impact of proposed developments on the values of Pitt Water Nature Reserve.

Factor and reserve value affected	Potential impact if not addressed	Best Practice Response
Stormwater treatment: - quality of receiving waters	The number and size of lots/houses/hardened areas exponentially increases the quantity of stormwater and this corresponds with a reduction in the quality of stormwater. There is documented evidence that developments, including subdivisions without stormwater devices based on water-sensitive urban design principles, result in increased sedimentation, nutrient load and litter which may lead to a loss of benthic species and shorebird and waterfowl habitats. Stormwater contaminated with sulfuric acid, heavy metals and other contaminants may be released into the reserve from acid sulfate soils.	The developer submits a plan with the development application for the disposal/dispersal of stormwater using best practice stormwater control methods (including volume reduction) and water sensitive urban design principles. Information is available from www.derwentestuary.org.au and the State Stormwater Strategy. The installation of rainwater tanks and disposal of water at or close to the source of stormwater is promoted to reduce the effects of stormwater on water quality. The designated stormwater disposal system is included as a condition of the Planning Permit for a development. Stormwater treatment systems for individual houses are included in the conditions of the building or plumbing permits.
Access to foreshore: - fauna - vegetation - coastal landforms	The effects of increased access can result in a decrease in species diversity, disturbance of wildlife and reduced vegetation condition. The foreshore is important habitat for migratory and resident shorebirds that will be adversely affected if access to the foreshore increases. Access issues may include: - Increased recreation use (development of unplanned tracks, change in use, mountain bikes, etc); - Increase in spread of weeds through garden escapes and dumped garden waste; - Increased impact on Aboriginal values in coastal areas; - cutting of vegetation for views; and - illegal earthworks.	Plans which do not have direct access onto the reserve from the individual house lots are supported. The reserve is zoned for no dogs under the Council's Dog Management Plan as it is a "sensitive wildlife habitat" and this is communicated to developers and residents. The developer and vendor is aware that the vegetation in the reserve is protected by the National Parks and Reserved Land Regulations 1999 and that penalties apply for removal of vegetation and dumping of garden waste. Access controls (barriers and signs) are funded by the developer where the development could result in additional access to the foreshore. The developer fences the reserve-private property boundary before ground-breaking activities; and this is included as a condition of the Planning Permit for the development.
Fences: - fauna - vegetation	Fences need special consideration depending on the movement patterns of resident wildlife and prevention of human and pets entering the reserve. Rural wire fences allow for native animal movement but also may not prevent roaming domestic animals from entering the reserve. Solid fences that are smooth-faced toward the house (i.e. framing on the outside) are best for keeping domestic animals from entering the reserve. They can also become barriers to wildlife movement. Chain link fences can be death-traps for swift parrots. The responsibility for fencing usually lies with the vendor through a covenant on the title.	The developer fences the reserve-private property boundary using materials that are best suited for keeping domestic animals from entering the reserve, prior to the sale of the lots; and this is included as a condition of the Planning Permit for the development.

Factor and reserve value affected	**Potential impact if not addressed**	**Best Practice Response**
Building colour/ materials: - landscape values	Decrease in scenic amenity and altered visitor experience	The colour of building materials are muted if landscape values are important.
External lighting, noise: - fauna values, especially shorebirds	Disturbance of feeding and roosting regime, also greater illumination of predators	All external lighting must be sited and designed to eliminate light shining upwards and into the reserve (where there is known nesting, feeding or roosting habitat)
Window position/ design: - birds especially swift parrots	Death of swift parrots arising from collision with windows (if nectar-bearing eucalypts eg *E. globulus and E. ovata* are nearby)	Buildings do not have visible sight lines through windows/doors on opposite walls as this will increase collisions.
Earthworks: - quality of receiving waters, particularly where there is important shorebird feeding habitat nearby	Earthworks associated with subdivisions and building works without erosion and sediment controls in place result in sediment entering waterways.	A Sediment and Erosion Control Plan is submitted with the development application and is applied for the life of the construction, to be inspected during the construction phase of the development to ensure that erosion and sediment generation does not detrimentally affect the reserve. For more information, see the guidelines 'Soil and Water Management on Building and Construction Sites' www.derwentestuary.org.au/folder.php?id=315. Following the completion of a subdivision, inspections are made to ensure that sediment is not moving from individual lots into the stormwater system.
Trenching for services: - Aboriginal - historic - vegetation	Destruction of non-renewable cultural sites, including Aboriginal and sub-surface historic heritage. Reduced vegetation condition via: - Increase in spread of weeds and plant disease through disturbance of natural ground cover; - Providing an "access" opportunity as there is a cleared route along the trenching route (see access above) Dispersive soils erode and increase sediment load. Disturbance of material that has a high potential of containing acid sulfate soil and releasing sulfuric acid.	Developers understand that the approval of the reserve manager is required before services can be installed on reserved land and that assessments and plans may be necessary (at the developer's cost) before an approval can be considered.
Boundary setback: - vegetation - landscape	Variation of a setback may result in vegetation needing to be removed in order to satisfy the requirements of fuel modified zones. Vegetation clearing and buildings may affect visual amenity and experience for reserve users	Council minimum setbacks are adhered to in the approval of development applications.
Gardens with a boundary common to the reserve: - vegetation - fauna	Garden plants escape into the reserve and become environmental weeds	Engage with owners of adjoining private property to help them understand the importance of excluding environmental weeds from gardens.
Buffer zone: - fauna	Disturbance of feeding and roosting regimes and other impacts may be amplified	Create a buffer zone where subdivisions are proposed using the 5% proportion of land for open space or where the taking of 5% contribution is not permitted (in rural zones in Sorell); enter into negotiations for private conservation covenants.

Appendix 4 Plant species recorded in the Ramsar Site

Family	Scientific name	Common name	Status
Dicotyledons	*Acacia dealbata*	silver wattle	
	Acacia mearnsii	black wattle	
	Acacia longifolia subsp. *sophorae*	coast wattle	
	Acacia verticillata subsp. *verticillata*	prickly moses	
	Acaena novae-zealandiae	common buzzy	
	Allocasuarina verticillata	drooping sheoak	
	Aotus ericoides	golden pea	
	Atriplex prostrata	creeping orache	
	Banksia marginata	silver banksia	
	Billardiera longifolia	purple appleberry	
	Bursaria spinosa	prickly box	
	Calocephalus citreus	lemon beautyheads	r
	Carpobrotus rossii	native pigface	
	Cassinia aculeata	dollybush	
	Crassula sieberiana	rock stonecrop	
	Disphysma crassifolium subsp. *clavellatum*	roundleaf pigface	
	Dodonaea viscosa	broadleaf hopbush	
	Epacris impressa	common heath	
	Erynium vesiculosum	prickfoot	
	Eucalyptus globulus subsp. *globulus*	Tasmanian blue gum	
	Eucalyptus ovata	black gum	
	Eucalyptus viminalis	white gum	
	Gompholobium huegilii	common wedgepea	
	Gonocarpus tetragynus	common raspwort	
	Goodenia lanata	trailing native-primrose	
	Lawrencia spicata	candle saltmallow	
	Lepiloena preissii	slender watermat	
	Lilaeopsis polyantha	jointed swampstalks	
	Limonium australe var. *australe*	yellow sea-lavender	r
	Limonosella australe	southern mudwort	
	Myoporum insulare	common boobialla	
	Olearia floribunda	flowery daisybush	
	Puccinellia stricta	Australian saltmarshgrass	
	Rhagodia candolleana subsp. *candolleana*	coastal saltbush	
	Samolus repens	creeping brookweed	
	Sarcocornia quinqueflora	beaded glasswort	
	Scaevola hookeri	creeping fanflower	
	Selliera radicans	shiny swampmat	
	Senecio linearifolius	common fireweed groundsel	
	Senecio quadridentatus	cotton fireweed	
	Stuckenia pectinata	fennel pondweed	r
	Suaeda australis	southern seablite	
	Tectacornia arbuscula	shrubby glasswort	
	Tetragonia tetragoniodes	New Zealand spinach	

Family	Scientific name	Common name	Status
	Vellereophyton dealbatum	white cudweed	
	Vittadinia gracilis	woolly new-holland-daisy	r
	Wilsonia backhousei	narrowleaf wilsonia	
	Wilsonia humilis	silky wilsonia	r
	Wilsonia rotundifolia	roundleaf wilsonia	r
	Viola hederacea	ivyleaf violet	
Monocotyledons	*Agrostis avenacea*	bentgrass	
	Austrodanthonia laevis	smooth wallabygrass	
	Austrodanthonia penicillata	slender wallabygrass	
	Austrodanthonia pilosa	velvet wallabygrass	
	Austrodanthonia setacea	bristly wallabygrass	
	Austrostipa scabra	rough speargrass	r
	Centroplepis strigosa		
	Distichlis distichophylla	Australian saltgrass	
	Ehrharta distichophylla	hairy ricegrass	
	Gahnia trifida	coast sawsedge	
	Isolepis nodosa		
	Juncus kraussii	sea rush	
	Juncus pallidus	pale rush	
	Lepidosperma concavum	sand swordsedge	
	Poa labillardierei	silver tussockgrass	
	Poa poiformis	coastal tussockgrass	
	Schoenus nitens	shiny bogsedge	
	Stipa stipoides	spear grass	
	Themeda triandra	kangaroo grass	
	Triglochin striatum	streaked arrowgrass	
Pteridophyta	*Pteridium esculentum*	bracken	
Mosses	*Pleuridium nervosum*		
	Didimodon subtorqatus		
	Pottia dummondii subsp. *obscura*		
	Acaulon integrifolia		
	Phascum tasmanicum subsp. *tasmanicum*		
	Pottia starckeana		
Liverworts	*Riccia bifurca*		
Aquatic plants	*Zostera muelleri*	seagrass	
	Heterozostera tasmanica	Tasman grasswrack	
	Ruppia spp.	seatassel	
Introduced plants	*Coprosma repens*	mirror bush	
	Chrysanthemoides monilifera	boneseed	
	Foeniculum vulgare	fennel	
	Gazania spp.	gazania	
	Lycium ferocissimum	African boxthorn	
	Pinus radiata	radiata pine	
	Rosa rubiginosa	sweet briar	
	Rubus fruticosis	blackberry	
	Ulex europaeus	gorse	
		thistles (various species)	

KEY

State legislation r : rare

Appendix 5 Birds recorded in the Ramsar Site

Family	Scientific name	Common name	Status / Listing
Phasianidae	*Coturnix ypsilophora*	brown quail	
Anatidae	*Oxyura australis*	blue-billed duck	
	Biziura lobata	musk duck	
	Cygnus atratus	black swan	
	Cereopsis novaehollandiae	Cape Barren goose	
	Tadorna tadornoides	Australian shelduck	
	Anas superciliosa	Pacific black duck	
	Anas rhynchotis	Australasian shoveler	
	Anas gracilis	grey teal	
	Anas castanea	chestnut teal	
	Aythya australis	hardhead	
Podicipedidae	*Poliocephalus poliocephalus*	hoary-headed grebe	
	Podiceps cristatus	great crested grebe	v
Procellarideae	*Pachyptila turtur**	fairy prion	
Phalacrocoracidae	*Phalacrocorax melanoleucos*	little pied cormorant	
	Phalacrocorax fuscescens	black-faced cormorant	
	Phalacrocorax varius	pied cormorant	
	Phalacrocorax sulcirostris	little black cormorant	
	Phalacrocorax carbo	great cormorant	
Pelecanidae	*Pelecanus conspicillatus*	Australian pelican	
Ardeidae	*Egretta novaehollandiae*	white-faced heron	
	Egretta garzetta	little egret	
	Ardea alba	great egret	# +
	Ardea ibis	cattle egret	# +
Threskiornithidae	*Threskiornis molucca*	Australian white ibis	
	Platalea regia	royal spoonbill	
Accipitridae	*Haliaeetus leucogaster*	white-bellied sea eagle	v +
	Circus approximans	swamp harrier	
	Accipiter fasciatus	brown goshawk	
	Accipiter cirrhocephalus	collared sparrow hawk	
	Aquila audax	wedge-tailed eagle	e
Falconidae	*Falco berigora*	brown falcon	
	Falco longipennis	Australian hobby	
	Falco peregrinus	peregrine falcon	
	Falco cenchroides	nankeen kestrel	
Rallidae	*Gallinula mortierii*	Tasmanian native-hen	
	Fulica atra	Eurasian coot	
Scolopacidae	*Gallinago hardwickii*	Latham's snipe	#
	Limosa limosa	black-tailed godwit	# +
	Limosa haemastica	Hudsonian godwit	
	Limosa lapponica	bar-tailed godwit	# +
	Numenius phaeopus	whimbrel	# +
	Numenius madagascariensis	eastern curlew	e # +
	Tringa stagnatilis	marsh sandpiper	# +
	Tringa nebularia	common greenshank	# +

Family	Scientific name	Common name	Status / Listing
	Actitis hypoleucos	common sandpiper	# +
	Heteroscelus brevipes	grey-tailed tattler	# +
	Arenaria interpres	ruddy turnstone	# +
	Calidris tenuirostris	great knot	# +
	Calidris canutus	red knot	# +
	Calidris minuta	little stint	# +
	Calidris ruficollis	red-necked stint	# +
	Calidris melanotos	pectoral sandpiper	# +
	Calidris acuminata	sharp-tailed sandpiper	# +
	Calidris ferruginea	curlew sandpiper	# +
	Tryngites subruficollis	buff-breasted sandpiper	#
	Philomachus pugnax	ruff	# +
Haematopodidae	*Haematopus longirostris*	pied oystercatcher	
	Haematopus fuliginosus	sooty oystercatcher	
Recurvirostridae	*Himantopus himantopus*	black-winged stilt	
	Cladorhynchus leucophalus	banded stilt	
Charadriidae	*Pluvialis fulva*	Pacific golden plover	# +
	Pluvialis squatarola	grey plover	# +
	Charadrius ruficapillus	red-capped plover	
	Charadrius bicinctus	double-banded plover	
	Charadrius Mongols	lesser sand plover	# +
	Charadrius leschenaultii	greater sand plover	# +
	Charadrius veredus	oriental plover	#
	Elseyornis melanops	black-fronted dotterel	
	Vanellus tricolor	banded lapwing	
	Vanellus miles	masked lapwing	
Laridae	*Larus pacificus*	Pacific gull	
	Larus dominicanus	kelp gull	
	Larus novaehollandiae	silver gull	
	Sterna caspia	Caspian tern	# +
	Sterna bergii	crested tern	
	Sterna albifrons sinensis	little tern	e # +
	Sterna nereis nereis	fairy tern	v
	Chlidonias leucopterus	white-winged black tern	
Columbiformes	*Phaps chalcoptera*	common bronzewing	
Cacatuidae	*Calyptorhynchus funereus*	yellow-tailed black-cockatoo	
	Cacatua roseicapilla	galah	
	Cacatua galerita	sulphur-crested cockatoo	
Psittacidae	*Glossopsitta concinna*	musk lorikeet	
	Platycercus caledonicus	green rosella	
	Platycercus eximius	eastern rosella	
	Lathamus discolor	swift parrot	v
	Neophema chrysostoma	blue-winged parrot	
Cuculidae	*Cuculus pallidus*	pallid cuckoo	
	Cacomantis flabelliformis	fan-tailed cuckoo	
	Chrysococcyx basalis	Horsfield's bronze cuckoo	

Family	Scientific name	Common name	Status / Listing
Strigidae	*Ninox novaeseelandiae*	southern boobook	
Tytonidae	*Tyto novaehollandiae*	masked owl	e
Podargidae	*Podargus strigoides*	tawny frogmouth	
Apodidae	*Hirundapus caudacutus*	white-throated needletail	# +
Halcyonidae	*Dacelo novaeguineae*	laughing kookaburra	
Maluridae	*Malurus cyaneus*	superb fairy-wren	
Pardalotidae	*Pardolotus punctatus*	spotted pardolate	
	Pardolotus striatus	striated pardolate	
	Calamanthus fuliginosus	striated fieldwren	
	Acanthiza pusilla	brown thornbill	
	Acanthiza chrysorrhoa	yellow-rumped thornbill	
Meliphagidae	*Anthocaera paradoxa*	yellow wattlebird	
	Anthocaera chrysoptera	little wattlebird	
	Manorina melanocephala	noisy miner	
	Lichenostomus flavicollis	yellow-throated honeyeater	
	Phylidonyris pyrrhoptera	crescent honeyeater	
	Phylidonyris novaehollandiae	New Holland honeyeater	
	Melithreptus affinis	black-headed honeyeater	
	Acanthorhynchus tenuirostris	eastern spinebill	
	Ephthianura albifrons	white-fronted chat	
Petroicidae	*Petroica multicolor*	scarlet robin	
	Petroica phoenicea	flame robin	
	Melanodryas vittata	dusky robin	
Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush	
Dicruridae	*Rhipidura fuliginosa*	grey fantail	
Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike	
Artamidae	*Artamus cyanopterus*	dusky woodswallow	
	Cracticus torquatus	grey butcherbird	
	Gymnorhina tibicen	Australian magpie	
	Strepera versicolor	grey currawong	
Corvidae	*Corvus tasmanicus*	forest raven	
Alaudidae	*Alauda arvensis*	skylark	
Motacillidae	*Anthus novaeseelandiae*	Richard's pipit	
Passeridae	*Passer domesticus*	house sparrow	
Fringillidae	*Carduelis chloris*	European greenfinch	
	Carduelis carduelis	European goldfinch	
Hirundinidae	*Hirundo neoxena*	welcome swallow	
	Hirundo nigricans	tree martin	
Sylviidae	*Megalurus gramineus*	little grassbird	
Zosteropidae	*Zosterops lateralis*	silvereye	
Muscicapidae	*Turdus merula*	common blackbird	
Sturnidae	*Sturnus vulgaris*	common starling	

KEY

State legislation v : vulnerable r : rare e : endangered
International agreements # : JAMBA + : CAMBA

* NB. It is unknown which subspecies this record relates to. The taxonomic distinction of the subspecies *Pachyptila turtur turtur* and *Pachyptila turtur subantarctica* is currently uncertain.

8. Operational documents

Operational Document 1

Key desired outcomes, indicators and effectiveness monitoring

Outcome 1	**Stormwater impacts to Orielton Lagoon have been reduced**
Indicator	Number and condition of stormwater outlets discharging into Orielton Lagoon.
Monitoring action	• Identify, map, photograph and report on stormwater outlets to document environmental protection devices and operating condition.
Great result	By 2014, no new outlets have been installed that discharge into Orielton Lagoon unless they have been demonstrated to have a neutral or positive environmental benefit for the reserve. Sorell Council has identified, mapped, photographed and reported on all existing stormwater outlets and has installed adequate environmental protection devices on all outlets, which are maintained regularly.
Acceptable result	By 2017, no new outlets have been installed that discharge into Orielton Lagoon unless they have been demonstrated to have a neutral or positive environmental benefit for the reserve. Sorell Council has identified, mapped, photographed and reported on all existing stormwater outlets and no significant impacts are evident.
Unacceptable result	New stormwater outlets have been installed that discharge into Orielton Lagoon and have a detrimental impact. Sorell Council has not identified, mapped, photographed or reported on existing outlets. Substantial impacts, such as scouring, are evident.

Outcome 2	**Visitors are informed about the correct reserve name, boundary locations and significance of the reserve's values**
Indicator	Signs have been installed to correctly identify the tenure and interpret the Ramsar status and values of the reserve.
Monitoring action	• Photograph signs after installation.
Great result	By 2014, signs are installed at key locations along the boundary to identify the reserve and interpretive signs have been installed.
Acceptable result	By 2017, signs are installed at key locations along the boundary to identify the reserve.
Unacceptable result	By 2017, no new signs have been installed.

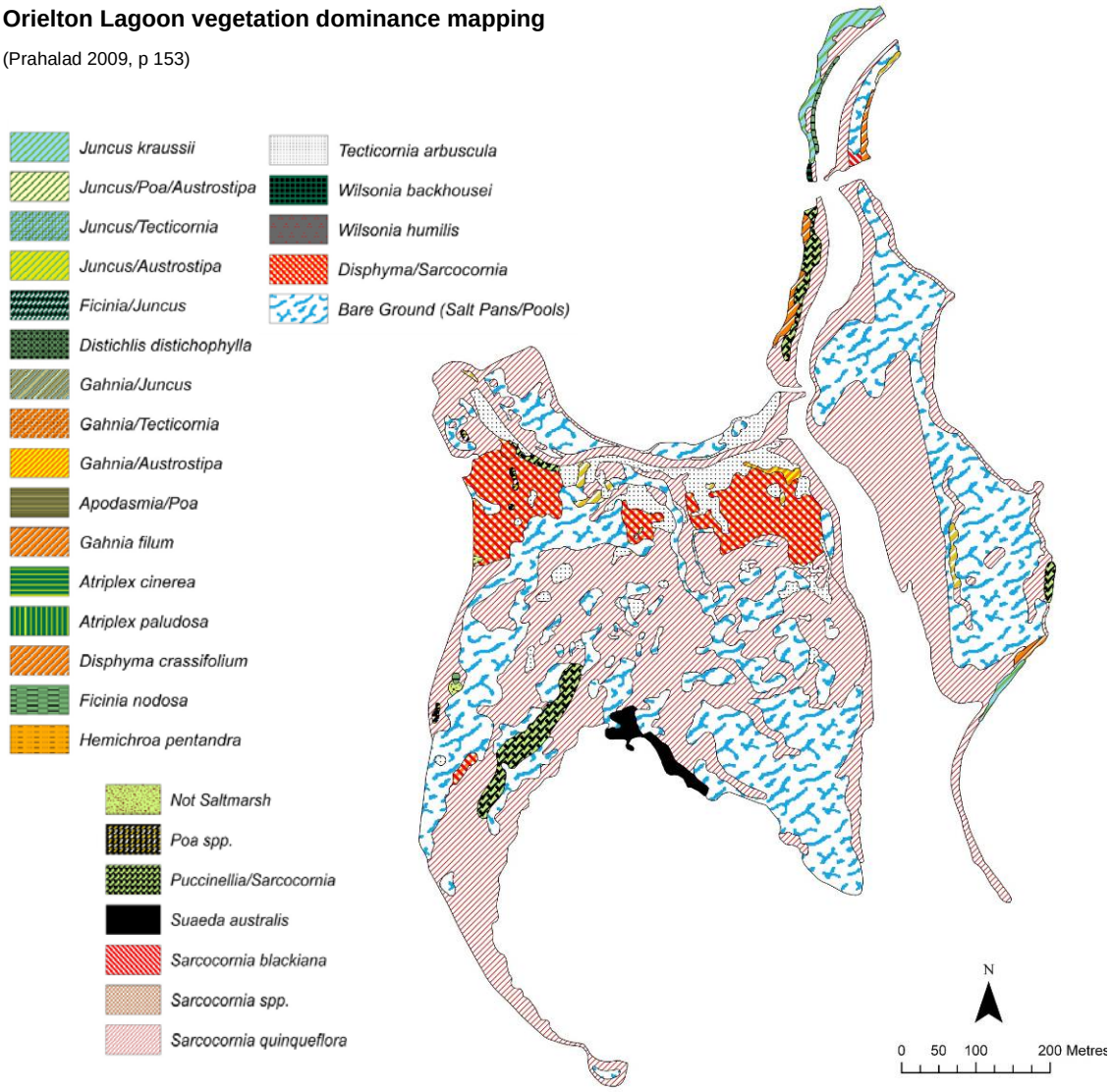
Outcome 3	**The area affected by Weeds of National Significance has decreased**
Indicator	Distribution of Weeds of National Significance (WONS) in the reserve.
Monitoring action	• Map the presence of specific WONS in the reserve.
Great result	By 2022, all populations of WONS are controlled in the reserve and have been replaced with native species appropriate for habitat.
Acceptable result	By 2022, most existing WONS are controlled in the reserve (except where they provide important habitat) and no new plants are identified.
Unacceptable result	By 2022, the area affected by WONS has increased.

Outcome 4	**Important bird habitat areas are protected from threats**
Indicators	Number of breeding pairs of resident shorebirds. Species diversity of migratory birds. Evidence of disturbance that threatens bird habitat areas – reports or evidence of human or other disturbances near important bird habitat areas (such as damaged fences, footprints, tyre tracks or walking pads).
Monitoring actions	• Record reports and evidence of disturbance. Photograph evidence and record date of disturbance. • Confirm breeding success of resident birds with Birdlife Tasmania. • Confirm numbers of double-banded plovers with Birdlife Tasmania.
Great result	By 2022 - all important bird habitat areas are fenced to prevent human-induced disturbance and the fences are maintained; - defined species (eg pied oyster catchers) breed successfully in the majority of years; and - double-banded plovers continue to utilise the shores of Orielton Lagoon in increasing numbers.
Acceptable result	By 2022 - all important bird habitat areas are fenced to prevent human-induced disturbance and the fences are maintained; - pied oyster catchers are present but breeding success is reduced; and - double-banded plovers continue to utilise the shores of Orielton Lagoon in consistent numbers.
Unacceptable result	By 2022 - some important bird habitat areas are fenced but are not maintained; - pied oyster catchers are present but declining in numbers; and - double-banded plovers no longer utilise the shores of Orielton Lagoon.

Outcome 5	**Saltmarsh vegetation has increased since 2009**[14]
Indicator	Area covered by saltmarsh vegetation at Orielton Lagoon.
Monitoring action	• In 2022 commission a survey to measure the extent of saltmarsh vegetation at Orielton Lagoon.
Great result	By 2022, the extent of saltmarsh vegetation has increased compared with 2009 levels.
Acceptable result	By 2022, the extent of saltmarsh vegetation has remained the same as 2009 levels.
Unacceptable result	By 2022, the extent of saltmarsh vegetation has decreased from 2009 levels or has not been resurveyed.

Orielton Lagoon vegetation dominance mapping

(Prahalad 2009, p 153)



[14] It is recommended that monitoring is based on the findings of Prahalad 2009. Outcomes may be affected by external influences.

Operational Document 2

Implementation schedule

Implementation priorities:

Very high (VH): <1 year; High (H): 2 - 3 years; Medium (M): 4 - 5 years; Low (L): >5years

Ongoing tasks have also been marked.
Implementation is subject to funds, staff and resources.
To be reviewed and revised annually.

Strategy and actions		Who	Priority
1.	**Climate**		
1.1.	Monitor the reserve for changes caused by climate change.	PWS/BCB/ UTAS	L
1.2.	Use tools, such as Smartline mapping, to investigate the probable impacts of climate change and to inform management decisions.	PWS/ BCB/ UTAS	M
1.3.	Protect and, where necessary, rehabilitate degraded areas that will help build resilience against threats caused by sea-level rise and storm surges.	PWS	L
1.4.	Identify important areas on adjacent private properties to enable the landward retreat of coastal vegetation from the reserve. Liaise with the owners of the relevant properties to raise awareness about the importance of the areas and how to manage areas facing expected sea-level rise due to climate change; and, if appropriate, encourage protection through covenants and other measures.	BCB/PWS	H
2.	**Geology, geomorphology and soils**		
2.1.	Conduct surveys to identify sites with high erosion risk or where erosion has been accelerated by human activities. Where appropriate, the Tasmanian Shoreline Monitoring and Archiving Project (TASMARC) methodology should be used to monitor change.	PWS/UTAS	M
2.2.	Monitor erosion of soils, drains and tracks in and adjacent to the reserve.	PWS	VH
2.3.	Encourage councils and nearby property owners to minimise erosion, especially of gullies that channel artificially high levels of sediment directly into the reserve, through use of active mitigation and prevention measures.	PWS	VH
2.4.	Work with councils and nearby property owners to fence and actively rehabilitate eroded areas.	PWS	M
2.5.	Where possible, avoid undertaking activities that may cause disturbance to areas mapped as having a high potential of containing acid sulfate soils (Figure 4). If unavoidable, activities should be designed to minimise the impact and an ASS management plan should be developed (in accordance with the Tasmanian Acid Sulfate Soil Management Guidelines).	PWS	H
3.	**Water values**		
	Water quality		
3.1.	Liaise with relevant organisations to develop and implement programs to monitor and improve understanding about water quality and the implications of upstream hydrological change.	PWS	L
3.2.	Monitor water quality from the ground application of recycled water from the water re-use scheme.	PWS/ Southern Water	H

3.3.	Liaise with relevant bodies to ensure that the ecological requirements of the reserve are integrated and prioritised in the establishment of environmental flows for the Coal River, and are appropriately considered in the assessment and development of any further irrigation infrastructure that may have an adverse impact on the reserve.	PWS/ councils/ Irrigation Development Board	M
3.4.	Liaise with research agencies to ensure the compilation, review and interpretation of any relevant research or monitoring data that are collected by various agencies, groups or councils.	PWS	ongoing (M)
3.5.	Assist councils with information and advice in support of funding applications that will benefit the reserve.	PWS	H
3.6.	In cooperation with relevant agencies, councils and community groups, manage the reserve to maintain or enhance water quality to the standard designated by Protected Environmental Values.	PWS	ongoing (M)
3.7.	Liaise with conservation specialists in government agencies, councils and adjacent landowners to monitor and control the rates, foci and sources of artificially high sedimentation into the reserve and its tributaries.	PWS	M
3.8.	Liaise with councils and surrounding landowners to manage drainage channels on adjacent land in order to minimise erosion and the entry of artificially high levels of sedimentation into the reserve. Also encourage hardening of roads and drains that are identified as particularly susceptible to erosion.	PWS	H
3.9.	Liaise with adjacent landowners and councils to - develop buffer zones along watercourses and the shoreline to reduce runoff of sediment, pesticides and fertilisers; - encourage the protection and enhancement of areas of vegetation that perform natural biofiltration; - encourage the adoption of measures to minimise disturbance caused by activities in areas mapped as having a high potential of containing acid sulfate soils (Figure 4); - implement relevant codes of practice and guidelines to reduce impacts on the reserve's values.	PWS/ councils	H
	Stormwater		
3.10.	Ensure that no new outlets are constructed, or existing outlets modified, to discharge stormwater into the reserve unless it is demonstrated by the proponent that the new or modified outlet will have a neutral or positive environmental impact for the reserve, and it is assessed and approved by the PWS.	PWS	H
3.11.	Encourage local councils to take into consideration the 'Guidelines for developments' on adjacent lands that may adversely affect the values of Pitt Water Nature Reserve (see Appendix 3), in particular the stormwater provisions for new subdivisions which will result in increased discharge to existing stormwater outlets. Aim to include this arrangement in the Tasmanian Government Partnership Agreement Process.	PWS	H
3.12.	Support councils to investigate and use best practice methods to minimise the impact of the upstream discharge of stormwater that has an adverse effect on the water quality of the reserve.	PWS	H
3.13.	Support councils to identify and map existing stormwater outlets and treatment systems around the reserve and upstream of it.	PWS	VH
3.14.	Ensure stormwater outlets are appropriately leased or licenced.	PWS	VH
3.15.	Ensure that processes are in place for liaison with councils to work towards the installation of appropriate systems for the treatment of stormwater before it is discharged into the reserve.	PWS	H
3.16.	Liaise with councils to ensure that sediment traps are emptied and regularly cleaned and that methods are developed to clean the traps efficiently. Facilitate adequate access to sediment traps for regular cleaning, without detracting from the natural and cultural values of the area.	PWS/ councils	M

4.	**Flora values**		
4.1.	Minimise the impact of threatening processes on flora species including weeds, disease, pollution, sedimentation or trampling.	PWS	ongoing (M)
4.2.	Develop and implement hygiene protocols to prevent the introduction and spread of weeds and pathogens (especially *Phytophthora cinnamomi* and marine pests) within the reserve.	PWS	M
4.3.	Undertake vegetation surveys, if necessary, and collate a comprehensive plant list for the reserve (see Appendix 4).	PWS	M
4.4.	Re-survey the saltmarsh areas of Orielton Lagoon based on the mapping undertaken by Prahalad (2009).	PWS	M
4.5.	Monitor threatened species and, where necessary, undertake research and management actions to ensure their survival.	PWS	M
4.6.	If deemed necessary through monitoring and research, limit public access to areas where threatened species occur.	PWS	ongoing
4.7.	Survey seagrass to measure whether its area has altered in size from the 75 hectares recorded in 1990.	TAFI	L
4.8.	Design and implement a seagrass monitoring program.	TAFI	L
4.9.	In consultation with the Tasmanian Aquaculture and Fisheries Institute (TAFI), investigate seagrass revegetation, including trials in Orielton Lagoon. If feasible, implement a seagrass revegetation program.	TAFI	L
4.10.	Facilitate the revegetation of samphire and assess whether replanting is necessary. Identify and protect areas likely to be important habitat for the likely inland retreat of saltmarsh as the sea-level rises.	PWS/ BCB	M
4.11.	Encourage nearby property owners, including councils, to implement appropriate revegetation using suitable native plant species (see Appendix 4 for guidance) and non-invasive garden species in domestic situations.	PWS/ councils	ongoing
4.12.	Encourage the involvement of community and volunteer groups in weed management and revegetation projects in the reserve.	PWS	ongoing
4.13.	Coordinate funding applications to facilitate rehabilitation projects in and adjacent to the reserve in accordance with this plan.	PWS	ongoing
5.	**Fauna values**		
5.1.	Permit appropriate studies into the ecological requirements of fauna in the reserve and management implications, particularly in relation to migratory species.	PWS	ongoing
5.2.	Identify and monitor key indicator species of the reserve to determine the health of the reserve and other changes over time.	PWS	ongoing
5.3.	Support research projects to monitor populations of shorebird and migratory species.	PWS	ongoing
5.4.	Minimise disturbance of migratory species and resident shorebirds, especially at or near identified bird habitat areas and throughout the reserve.	PWS	ongoing
5.5.	Monitor threatened species and, where necessary, undertake research and management actions to ensure their survival.	BCB	ongoing
5.6.	If foxes become established in Tasmania consider additional measures, such as fencing, to protect the breeding areas of species at risk.	PWS	L
5.7.	Limit public access to areas of threatened species and bird habitat areas, if deemed necessary.	PWS	ongoing
5.8.	Inform visitors that Woody Island is a restricted area during the specified period to minimise disturbance during the breeding seasons of threatened species.	PWS	VH
5.9.	Investigate whether green and gold frogs are present in the reserve and manage activities to avoid the spread of chytrid fungus.	BCB/ PWS	M

5.10.	Ensure that adequate areas containing the important food plants of the chequered blue butterfly are protected from damage caused by inappropriate use or other impacts such as litter.	PWS	M
5.11.	Monitor the impacts of vessel use on the reserve, particularly damage to habitat on Woody Island.	PWS	M
5.12.	Permit scientific studies of the aquatic biota of the reserve to provide improved information which can be used to identify the food sources of waterfowl and shorebirds in the reserve.	PWS	ongoing
5.13.	If considered necessary, undertake proactive on-ground actions, such as construction of fences or other structures to protect threatened species.	PWS	M
5.14.	Liaise with contractors to ensure that construction activities undertaken on the causeway adjacent to Orielton Lagoon cause minimal disturbance to the values of the reserve, especially the endangered seastar (*Parvulastra vivipara*).	PWS	ongoing (L)
6.	**Pests and weeds**		
	Pests		
6.1.	Eradicate or control pests where practical and warranted, in line with relevant national threat abatement plans.	PWS	L
6.2.	Monitor for signs indicating the introduction and colonisation of new pests or diseases.	PWS/ BCB	ongoing
6.3.	If considered necessary, investigate and implement measures to control populations of domestic ducks.	BCB	L
6.4.	Monitor populations of introduced predators and undertake control programs if warranted.	PWS	L
6.5.	Increase community awareness about threats posed by domestic cats and dogs.	PWS	M
	Weeds		
6.6.	Implement actions to eradicate or control weeds, with a focus on introduced species that affect the values for which the reserve was designated, particularly impacts on threatened or migratory species and protected communities.	PWS	H
6.7.	Give priority to the removal of Weeds of National Significance and declared weeds, such as boneseed, gorse, blackberry, boxthorn, broom, tree lucerne, fennel, as well as other environmental weeds and garden escapes.	PWS	H
6.8.	Prioritise removal of weeds in breeding areas such as Susie Islet, Woody Island and Barren Island where birds (such as silver gulls) may be displaced through habitat loss, to the detriment of surrounding areas.	PWS/ Birdlife Tas	M
6.9.	Target boxthorn and other weed species in bird habitat areas, particularly the exposed mudflats and nesting areas of Orielton Lagoon. Aim for biannual control of invasive high priority weeds and remove plants before seed is produced.	PWS	M
6.10.	Monitor Woody and Barren Islands for the presence of weeds such as pine trees, boxthorn, boneseed, mirror bush and blackberry. These species need to be periodically removed or poisoned due to existing seed and continual reintroduction by birds.	PWS	M
6.11.	Develop and implement hygiene protocols and raise awareness to minimise the introduction and spread of weeds, pests and pathogens within the reserve (especially *Phytophthora cinnamomi* and chytrid fungus).	PWS	M
6.12.	Develop strategies to deal with new introductions of highly invasive weeds and monitor the reserve for new introductions, especially rice grass.	PWS	M

6.13.	Undertake measures to ensure that weed control activities do not significantly reduce water quality, disturb threatened species, or accelerate soil erosion.	PWS	M
6.14.	Include in weed removal strategies provisions for revegetation with local native plant species.	PWS	M
6.15.	Increase community awareness to discourage dumping of garden waste on the reserve and the risk of garden plants spreading into the reserve.	PWS	M
6.16.	Cooperate with community groups, organisations and other government agencies to monitor the outbreak or spread of weeds in nearby areas that are likely to spread into the reserve.	PWS	M
6.17.	Liaise with councils, adjacent landowners, NRM South and the community to ensure weed management approaches are coordinated, integrated, use best practice techniques and are followed up annually.	PWS	M
7.	**Cultural heritage values**		
	Aboriginal heritage		
7.1.	Report all Aboriginal sites to the Director in accordance with the *Aboriginal Relics Act 1975* or updated legislation.	PWS	ongoing (H)
7.2.	Consult with representatives of the Tasmanian Aboriginal community regarding the management of Aboriginal heritage values in the reserve.	PWS	ongoing (H)
7.3.	Where necessary, conduct surveys for Aboriginal heritage in the reserve, after consultation with the body responsible for administering Aboriginal heritage legislation in Tasmania.	PWS	ongoing (H)
7.4.	Develop and implement protection strategies to identify, monitor and conserve significant sites.	PWS	ongoing (H)
7.5.	Ensure that all PWS staff, volunteers and contractors involved in works at the reserve are aware of the cultural sensitivity of the area.	PWS	H
7.6.	With the agreement and involvement of the Tasmanian Aboriginal community, incorporate Aboriginal use and values of the area into interpretive and educational resource materials.	PWS	L
7.7.	Work with councils to improve knowledge and management of Aboriginal heritage values.	PWS	M
	Historic heritage		
7.8.	Record any identified historically significant sites on the Tasmanian Historic Places Inventory and report to the Tasmanian Heritage Office.	PWS	ongoing
7.9.	Develop conservation plans or assessments for historic sites if necessary.	PWS	ongoing
8.	**Natural landscape values**		
8.1.	Identify and protect the significant natural scenic values and features of the reserve.	PWS	ongoing
8.2.	Assess the visual impact of any proposed developments to minimise visual intrusiveness, including management infrastructure such as fences.	PWS	M
8.3.	Collect and store data including photographs and maps, to enable changes to the landscape to be assessed and measured.	PWS	L
8.4.	Rehabilitate parts of the reserve where significant erosion or vegetation loss has occurred.	PWS	M
8.5.	Investigate sources of eutrophication and determine remedies where possible.	DIER/ councils	ongoing
8.6.	Assess recent additions to the reserve gained through the CLAC process.	PWS	M

9.	**Visitors and access**		
9.1.	Continue to prohibit recreational vehicle use within the reserve, in order to maintain the natural values of the reserve.	PWS	H
9.2.	Prohibit new access points and all public access to the foreshore of Orielton Lagoon to avoid disturbance and trampling.	PWS	ongoing
9.3.	Monitor sensitive and important areas vulnerable to degradation or disturbance through visitation including the Shark Point Road access point. Consider closing this access point (remove the gate) if there is sustained damage to the samphire community through trampling, or repeated bird disturbance is observed.	PWS	M
9.4.	Through liaison with MAST, seek for the waters of Orielton Lagoon to be designated as a 'prohibited area for navigation' under the Marine and Safety (Motor Boat and Licences) By-Laws 2008, if appropriate, as per the prescriptions for vessels in this management plan.	PWS	M
9.5.	Ensure that signs clearly inform visitors that vessels are not allowed in Orielton Lagoon.	PWS	M
9.6.	Install permanent markers at Barilla Bay and in the upper reaches of Pitt Water to define the straight-line boundaries of the nature reserve across water.	PWS/ MAST	L
9.7.	Discourage public access to areas of the reserve that have been identified as critical bird areas or are known locations of threatened species or protected communities. Consider installing signs at strategic points to discourage access to these important areas.	PWS	M
9.8.	Continue to use fences and similar techniques to prevent non-compatible activities in the reserve.	PWS	ongoing
9.9.	Regularly monitor the condition of tracks, fences and other infrastructure. Undertake maintenance where required.	PWS	ongoing
9.10.	Monitor Woody Island for impacts from visitation and compliance with seasonal access restrictions.	PWS	M
9.11.	Install signs to prohibit campfires on Woody Island.	PWS	M
9.12.	Ensure that any new structures are constructed with minimal intrusion on the natural/landscape values and visual amenity of the reserve.	PWS	ongoing
9.13.	Monitor the erosion of soils, roads or tracks within the reserve and undertake action in consultation with specialists to rehabilitate and restore damaged or degraded areas.	PWS/ BCB	M
9.14.	Support sustainable activities to facilitate education, awareness and appreciation of the values of the reserve.	PWS	M
9.15.	Develop rehabilitation plans for sections of the foreshore around Orielton Lagoon and Pitt Water to guide rehabilitation activities.	PWS	M
9.16.	Provide assistance and advice to community groups and other organisations for the preparation of grant applications for projects that will help to protect the foreshore areas, the reserve and adjacent land in general. Assist groups with the implementation of such projects.	PWS	ongoing
10.	**Education, interpretation and community involvement**		
	Signs		
10.1.	Develop and implement a plan for signs that enable visitors to easily identify the reserve's boundaries, the reserve and Ramsar site status and prohibited activities.	PWS	H
10.2.	Update existing 'Orielton Lagoon Nature Reserve' signs around Orielton Lagoon with signs bearing the correct reserve name (ie 'Pitt Water Nature Reserve'). To avoid confusion, consideration should be given to a subordinate sign to identify Orielton Lagoon, given that Pitt Water itself is topographically separated from Orielton Lagoon (eg 'Pitt Water Nature Reserve-Orielton Lagoon section').	PWS	H

10.3.	Liaise with managers of nearby key visitor sites about opportunities for the installation of interpretive information about the values of the reserve and Ramsar site.	PWS	L
10.4.	Include information on signs and in interpretive material on the importance of the reserve for the protection of threatened species and communities of high conservation value, Ramsar status, as well as descriptions of the reserve's vegetation characteristics.	PWS	L
	Education		
10.5.	Develop a centralised interpretive display at an accessible point alongside or near the reserve.	PWS	L
10.6.	Provide information in the form of a display board, brochures, Discovery Ranger talks or other appropriate means at prominent places such as the Sorell Council Chambers, the Sorell Library or local schools.	PWS	L
10.7.	Facilitate the distribution of the Pitt Water-Orielton Lagoon Ramsar site brochure or other appropriate educational material to local residents to raise awareness about how they can reduce their direct and indirect impacts on the reserve.	PWS	L
10.8.	Engage key community stakeholders in the management of the reserve to enhance stewardship and community awareness of significant values and threats, as well as ecosystem services.	PWS	ongoing
10.9.	Promote cooperative initiatives to resolve confusion in the community about land tenure, encourage appropriate activities and improve understanding of the values of the area, such as the production of maps with boundaries and responsibilities clearly marked.	PWS	L
	Community involvement		
10.10.	Continue to support existing and new local community groups and initiatives, such as World Wetlands Day, Clean-Up Australia Day and community-based projects to revegetate the reserve, collect rubbish and undertake other approved activities that are of benefit to the reserve.	PWS	ongoing
10.11.	Continue to encourage and support community involvement and volunteer programs within and adjacent to the reserve, where activities are consistent with the objectives of this plan.	PWS	ongoing
10.12.	Develop good working relations with adjacent land managers, the local community, councils, interest groups and individuals in the Aboriginal community on matters of mutual interest.	PWS	ongoing
10.13.	Continue to consult with Birdlife Tasmania, councils and conservation specialists in government agencies on management issues.	PWS	ongoing
10.14.	Liaise with aquaculture operators to ensure that expansion or changes in their operations in Pitt Water do not have any adverse impacts on the reserve.	PWS	ongoing
10.15.	Help local groups to apply for grants for rehabilitation projects.	PWS	ongoing
10.16.	Monitor the level and nature of feedback from the community about the management of the reserve.	PWS	ongoing
10.17.	Encourage community Bushwatch programs to monitor and report violations such as the illegal collection of specimens, or motorbike use in the reserve.	PWS	ongoing
11.	**Adjacent land use and other external influences**		
	Reserve boundaries		
11.1.	Install signs or fences to clearly identify the surveyed boundaries of the reserve and prohibited uses or activities.	PWS	H
11.2.	Support projects that will deliver clearer identification of the boundary of the reserve and Ramsar site.	PWS	L
11.3.	Liaise with local councils and adjoining landowners to ensure that they are aware of the boundaries of the reserve and adjacent properties.	PWS	ongoing (M)

11.4.	Progress the reservation of unallocated Crown Land adjacent to Orielton Lagoon at the end of the causeway at Sorell.	PWS	H
11.5.	Monitor and act on reserve encroachments.	PWS	ongoing (M)
	Urban and industrial land use – planning and development		
11.6.	Liaise with councils to minimise urban and industrial impacts on the reserve through amendments to the planning schemes and implementation of planning conditions.	PWS	VH
11.7.	Provide support to councils for environmental remediation projects, implementation of storm water upgrades and maintenance of wastewater disposal and re-use schemes.	PWS	H
11.8.	Encourage local councils to take into consideration the 'Guidelines for development' on adjacent lands that may adversely affect the values of Pitt Water Nature Reserve (see Appendix 3).	PWS	H
11.9.	Encourage councils to retain existing rural zoning or to zone for environmental protection on land adjacent to the Ramsar site and nature reserve under the new Southern Tasmania Regional Planning Project (managed by the Southern Tasmania Councils Authority).	PWS	H
11.10.	Ensure that future development proposals for land around the reserve take into account bird habitat areas and sensitivity of birds to disturbance from human activities.	PWS	H
	Urban and industrial land use – other protection measures (external impacts)		
11.11.	Investigate the designation of a buffer zone (with no direct public access) around the terrestrial borders of the reserve to minimise disturbance and protect shorebird habitat. Provide assistance to fence buffer zones.	PWS	M
11.12.	Encourage landowners to leave buffer zones around riparian areas or creeks and to fence these off from cultivated or grazing land.	PWS	H
11.13.	Ensure that threatened species on adjacent land are protected through the mechanisms available under the *Threatened Species Protection Act 1995* and that conditions to protect threatened species are included in relevant development approvals.	PWS	ongoing
11.14.	Liaise with Sorell Council to improve manure management associated with the riding club situated on council land (Miena Park) to minimise nutrients and sediment entering the reserve.	PWS	ongoing
11.15.	Work with councils and community groups to develop and implement catchment management plans.	PWS	ongoing
	Pitt Water Golf Club		
11.16.	Establish an authority (lease or licence) with appropriate conditions with the Pitt Water Golf Club.	PWS	VH
11.17.	Work with the Pitt Water Golf Club to develop a landscape and rehabilitation plan and to support the rehabilitation of native vegetation.	PWS	H
11.18.	Enter into discussions with the Pitt Water Golf Club to ensure appropriate mechanisms protect samphire vegetation to the north of the reserve; and discuss the possibility of placing a conservation covenant over the samphire vegetation.	PWS	H
11.19.	Identify options to clearly mark reserve and/or lease boundaries north of Reynolds Point (tee 15).	PWS	H

Agriculture		
11.20. Periodically monitor remote sections of the reserve for impacts originating on adjacent private land, such as stock access.	PWS	ongoing (M)
11.21. Liaise with and encourage landowners to protect the reserve foreshore through projects such as fence maintenance, foreshore rehabilitation, and the establishment of buffer zones, conservation covenants and management agreements.	PWS	M
11.22. Provide support to the owner of the covenanted land at Barilla Bay.	PWS	M
11.23. Support and provide assistance and advice to landowners and groups in the preparation of grant applications for projects, if required, to protect the reserve adjacent to agricultural land.	PWS	ongoing (M)
11.24. Liaise with and encourage landowners, managers and local interest groups and individuals to protect the foreshore by a variety of methods such as: - fencing to prevent stock access; - measures to minimise drainage of excess recycled water into the reserve; - tree planting where appropriate, the development of no-plough zones and measures to prevent siltation from construction works; and - revegetation of eroded gullies.	PWS	ongoing (M)
12. Implementation		
12.1. Use the National Parks and Reserved Land Regulations to formalise the implementation of relevant prescriptions in this plan.	PWS	ongoing
12.2. Ensure that management activities do not impact on the values of the reserve. In particular, the timing of activities should not coincide with critical life-stages for birds, such as nesting and pre-departure feeding for migratory species.	PWS	ongoing (M)
12.3. Minimise areas of disturbance arising from any developments (eg improvements to stormwater treatment or fencing). Where necessary, peg or fence to define the limits of the site that may be disturbed. If trees or shrubs or other site features to be retained occur within this area, protect them for the duration of the works.	PWS	ongoing (M)
12.4. Implement strategies as far as practicable to alleviate and minimise any adverse effects of management activities and other works.	PWS	ongoing
12.5. Encourage the community, in partnership with the PWS, to apply for funding for rehabilitation and other projects from external sources.	PWS	ongoing
12.6. Continue to consult with conservation specialists in government agencies and Birdlife Tasmania on bird values, threats and management issues.	PWS	ongoing
12.7. Ensure that actions are implemented in line with relevant national recovery and threat abatement plans.	PWS	ongoing
12.8. Annually review and revise a works program based on this Implementation Schedule.	PWS	ongoing (annually)
13. Research		
13.1. Continue to require authorisations to be issued by the PWS and DPIPWE before any fieldwork commences.	PWS	ongoing
13.2. Ensure that authorisations for the collection of material within the reserve are not issued where it is possible and appropriate to collect the material elsewhere. Only permit research that does not have significant adverse effects on the natural, cultural, or aesthetic values of the reserve.	PWS	ongoing
13.3. Consult the Aboriginal community and ensure that a permit is obtained for any research involving Aboriginal heritage.	PWS	ongoing

13.4. Ensure that one copy of research reports and studies is provided to the Director of National Parks and Wildlife, the field centre and the library servicing the PWS. Ensure that submissions are made within six months of completing the fieldwork unless another period is specified.	PWS	ongoing
13.5. Ensure that adequate reporting is a condition of all scientific research permits. If appropriate, research results should be published to contribute to public understanding.	PWS	ongoing
13.6. Liaise with relevant organisations to ensure that research is conducted to inform the monitoring measures outlined in this plan or to address identified key knowledge gaps (Table 3).	PWS	L
13.7. In conjunction with other organisations and community groups, monitor the distribution, abundance and control of introduced animals, plants and disease to determine appropriate management and control measures.	PWS	L
13.8. Monitor impacts on the natural values of the reserve and Ramsar site caused by marine farms, agricultural activities, increased urbanisation or other activities and events. Liaise with the conservation specialists in DPIPWE and TAFI regarding the management of these impacts and research opportunities.	PWS/ DPIPWE/ TAFI	ongoing
13.9. Liaise with community groups and schools to encourage community involvement in monitoring programs.	PWS	L
14. Effectiveness monitoring and plan review		
14.1. Undertake an interim evaluation of the management plan after five years and a full evaluation after ten years, together with a review of the vision, objectives and strategies, involving full public engagement.	PWS	H
14.2. Implement the monitoring actions as described in the operational document ‘Key desired outcomes, indicators and effectiveness monitoring’ to enable the assessment of management effectiveness in achieving the key desired outcomes.	PWS	H

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