Environmental Water Managemement Plan

Piambie

mallee
catchment management authority

Version Number	Description	Issued To	Issue Date
1	Draft V1	L. North (Sunraysia Environmental Pty Ltd)	09/04/2015
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10	Reviewed and updated to align with DEECA guidelines – Alluvium Consulting Australia	E. Johnston (Mallee CMA)	17/05/2024

Acknowledgement of Country

Mallee Catchment Management Authority (CMA) acknowledges and respects Traditional Owners, Aboriginal communities and organisations. We recognise the diversity of their cultures and the deep connections they have with Victoria's lands and waters. We value partnerships with them for the health of people and Country.

Mallee CMA Board, management and staff pay their respects to Elders past, present and emerging and recognise the primacy of Traditional Owners' obligations, rights and responsibilities to use and care for their traditional lands and waters.

Abbreviations and acronyms

ACHRIS	Aboriginal Cultural Heritage Register and Information System
AHD	Australian Height Datum
AM	Adaptive Management
BWS	Basin Wide Environmental Watering Strategy
CAMBA	China-Australia Migratory Bird Agreement
CEWH	Commonwealth Environmental Water Holder
CMA	Catchment Management Authority
Ctf	Commence to flow
DCCEEW	Department of Climate Change, Energy, the Environment and Water (C'wth)
DEECA	Department of Energy, Environment and Climate Action (Victorian)
DELWP	Department of Environment, Land, Water and Planning (now DEECA)
EPBC	Environment Protection and Biodiversity Conservation
EVC	Ecological Vegetation Class
EWMP	Environmental Water Management Plan
EWP	Environmental Watering Plan
EWR	Environmental Water Reserve
FFG	Flora and Fauna Guarantee
IAP2	International Association of Public Participation
IWC	Index of Wetland Condition
JAMBA	Japan-Australia Migratory Bird Agreement
MDBA	Murray-Darling Basin Authority
LTWP	Long Term Watering Plan
RAP	Registered Aboriginal Party
ROKAMBA	Republic of Korea – Australia Migratory Bird Agreement
SMART	Specific, Measurable, Achievable, Relevant, Time-bound
SWP	Seasonal Watering Proposal
VBA	Victorian Biodiversity Atlas
VEWH	Victorian Environmental Water Holder
VWMS	Victorian Waterway Management Strategy
WMU	Waterway Management Unit

Executive Summary

Environmental Water Management Plans (EWMPs) have been developed for key sites in the Mallee region. The Mallee Waterway Strategy 2014-22 (Mallee CMA, 2014) identified 23 Waterway Management Units (WMU) from 216 targeted waterways in the Mallee. The hydrological interconnectedness and commonality of threats impacting on the waterway values were used to group the WMUs into planning units. This EWMP has been developed for the Piambie WMU sub-unit, hereafter referred to as Piambie. The EWMP will help to guide future environmental watering activities for this area.

Piambie is located in the Murray Fans bioregion within the Mallee Catchment Management Authority (Mallee CMA) region 5 km east of the township of Piambie and covers 2,170 ha. The target area for this EWMP covers 389 ha and includes Bridge Creek and Bridge Creek floodplain; a complex of three wetlands known as Fishers Lagoon Complex; and smaller wetlands close to the River Murray known as Piambie Bend East and Piambie Bend West.

Piambie consists of a forested floodplain area with a creek and several wetlands, ranging from deep to shallow freshwater. These provide habitat for a large range of flora and fauna. Records indicate 64 species of native fauna have been observed at Piambie, including 5 listed species, such as the inland carpet python (*Morelia spilota metcalfei*). In addition, Piambie is one of only a handful of sites in the Mallee CMA region where tough scurf-pea (*Cullen tenax*) is known to occur. Other significant flora in the target area includes the iconic river red gum, black box and lignum communities, which provide habitat to native fauna.

The floodplains and wetlands will continue to receive less than their optimal 'natural' frequency of flooding without intervention. This declining floodplain vegetation health, diversity of habitat types, and presence of water-dependent endangered species suggest the site would respond well to environmental watering.

The long-term management goal of the Piambie EWMP is to provide a flow regime that more closely reflects natural events, thus improving the capacity of the target area to provide a productive ecosystem for native flora and fauna.

To achieve this ecological and hydrological objectives were designed with the consideration of separate inundation zones. These have been developed to sustain the various ecological components of Bridge Creek and five targeted wetlands and have been incorporated into an optimal watering regime. The ecological objectives for the Piambie target area are outlined below:

P1: By 2030, improve condition and maintain extent from baseline levels of lignum (*Duma florulenta*) and black box (*E. largiflorens*) and to sustain communities and processes reliant on such communities at Bridge Creek and Bridge Creek Floodplain, Piambie.

P2a: By 2030, improve vital habitat at Fishers Lagoon Complex and Piambie Bends East and West, Piambe by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicators Groups.

P2b: By 2030, improve condition and maintain extent from baseline levels of river red gum (*Eucalyptus camaldulensis*) to sustain communities and processes reliant on mature river red gum at Fishers Lagoon Complex and Piambie Bends East and West, Piambie.

The intended watering regime to meet the environmental objectives for each of the wetlands is provided below.

Fishers Lagoon, Bridge Creek and Floodplain

Inundate the length of Bridge Creek through to Fishers Lagoon Complex three years in ten with a maximum interval of seven years between events. Maintain water in the creek and on the floodplain for three months to improve health of fringing river red gum and floodplain black box and lignum. Allow Fishers Lagoon Complex to recede slowly (it is expected water will be retained in Fishers Lagoon Complex for 2 years). Fishers Lagoon Complex is to be inundated six in ten years, encouraging aquatic macrophyte diversity.

Piambie Bends East and West

Inundate the wetlands and fringing river red gum woodlands six times in ten years with a maximum interval of three years between events. Maintain water on the floodplain for two months to maintain the health of river red gum communities. Allow ponding in Piambie Bend West for four months to maintain wetland function. Allow natural recession and ponding for six to twelve months in deeper areas of Piambie Bend East.

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1 Introduction

1.1 PURPOSE AND SCOPE OF AN EWMP

An EWMP is a management plan for a wetland, wetland complex or river system that sets out the environmental watering goals and objectives, and the water regime required to meet the set objectives. An EWMP describes the:

- consultation undertaken for EWMP preparation and implementation
- asset overview and characteristics
- water-dependent environmental values present
- water-related threats to the environmental values
- management goals for the asset
- environmental objectives, targets and values that environmental watering of the asset will support or improve
- watering requirements needed to meet environmental objectives
- environmental water delivery infrastructure, management and constraints
- risks associated with environmental water delivery
- outcomes intended to be demonstrated through monitoring and assessment, and
- knowledge gaps to address

Further information on the purposes of EWMPs and how they relate to other plans, strategies and policies is provided in Appendix 1.

1.2 POLICY CONTEXT

Management of environmental water in Victoria is a statewide partnership between the Victorian Environmental Water Holder (VEWH), catchment management authorities (including Melbourne Water), DEECA, land managers including Parks Victoria and local councils, water corporations, Traditional Owner groups, and interstate agencies including the Commonwealth Environmental Water Holder (CEWH) and the Murray–Darling Basin Authority (MDBA).

Environmental watering in Victoria has historically been supported by management plans such as EWMPs, that document key information including the watering requirements of an asset, predicted ecological responses and water delivery arrangements. These plans support annual decisions about which sites should receive water and help managers evaluate how well those assets responded to the water they received or what could be done better.

A range of international treaties, conventions and initiatives, as well as National and State Acts, policies and strategies determine management of the target area. Those with particular relevance to Piambie and the management of its environmental values are listed in Table 1.

Table 1. Legislation, conventions, and listings relevant to the target area

Legislation, Agreement or Convention	Jurisdiction
Environment Protection and Biodiversity Conservation Act 1999	National
Flora and Fauna Guarantee Act 1988	State
Japan-Australia Migratory Bird Agreement (JAMBA)	International
China-Australia Migratory Bird Agreement (CAMBA)	International
Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA)	International

2 Partnership and Consultation

2.1 TARGET AUDIENCE

This section identifies the target audience and modes of consultation necessary to manage environmental water delivery, report against stated objectives and targets, and promote adaptive management over the life of the EWMP.

Engagement with different stakeholder groups is based on the International Association of Public Participation (IAP2) spectrum (Figure 1). The spectrum allows for a tailored approach based on stakeholder groups and their needs.

IAP2 Spectrum of Public Participation

IAP2's Spectrum of Public Participation was designed to assist with the selection of the level of participation that defines the public's role in any public participation process. The Spectrum is used internationally, and it is found in public participation plans around the world.

INCREASING IMPACT ON THE DECISION

	INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
PUBLIC PARTICIPATION GOAL	To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision making in the hands of the public.
PROMISE TO THE PUBLIC	We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and aspirations, and provide feedback on how public input influenced the decision.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will look to you for advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.

Figure 1 IAP2 Spectrum (Source: (c) International Association for Public Participation www.iap2.org)

Table 2 lists the main stakeholder groups with an interest in environmental water based on their needs and interests and level of engagement required. To read more about the role of specific stakeholders in environmental water at Piambie, refer to Section 3.2.

Mallee CMA develops a communication and engagement plan each year that covers environmental watering events for the entire Mallee CMA region, including Piambie. This ensures that all stakeholders and community members are aware of the Piambie environmental watering operations.

Table 2. Stakeholder groups with an interest in environmental water at Piambie.

Stakeholder groups	Stakeholders	Needs and interests	IAP2 level	Consultation modes
Public Land Managers	DEECA, Parks Victoria	Managing impacts from watering such as access, State-level environmental management	Collaborate	Via meetings
River Operators	Goulburn Murray Water	Manage water storage	Collaborate	Via formal meetings.
Local Government	Swan Hill Rural City Council	Access during watering events.	Involve	Meetings, phone calls, correspondence.
Aboriginal Stakeholders	See Section 2.4: Traditional Owners	Ongoing connection to Country and protection of cultural heritage and values. Environmental impacts and benefits. environmental watering regimes and how these may be timed to support/promote cultural values. Provides assistance in planning and implementation of programs.	Involve	Via Mallee CMA's Aboriginal engagement team. Engagement is largely undertaken in-person and, where possible, on Country.
Private landowners and managers	Local landholders	Managing impacts from watering such as access. Provides assistance in planning and implementation of programs.	Collaborate	Directly affected landholders will be informed of watering proposals and asked to provide feedback if relevant.
Community (interest groups)	Kooloonong - Natya Landcare Group Community members	Watering benefits and impacts on local communities such as access to parks and river during watering events.	Consult	Via existing groups such as the Mallee CMA Land and Water Committee. Via Mallee CMA social media and news
Environmental water holders	Victorian Environmental Water Holder	Decision-making around annual environmental water usage.	Collaborate	Via formal meetings.

2.2 DEVELOPING/UPDATING THE EWMP

In the development of this EWMP, Mallee CMA carried out community consultation in the following ways:

- Discussions with the Mallee CMA Land and Water Advisory Committee
- Workshops and on-Country engagement with Traditional Owners (see Section 2.4)
- Meetings with agency stakeholders
- Meetings with landholders
- Online surveys
- In-person engagement at local events such as markets and environmental group meetings
- Social media platforms
- Meeting with local agencies.

2.2.1 Verifying asset values

Asset values at Piambie have been established through environmental assessments and the development of previous versions of this EWMP. Consultation has been a key part of these processes with Traditional Owners, community members and technical specialists. Mallee CMA has continued to engage on asset values

throughout the development of the EWMP, particularly with Traditional Owners and private and public landholders.

2.2.2 Informing proposed management objectives, targets and approaches

Mallee CMA has an established working relationship with those who have an extensive knowledge of Piambie and floodplain ecosystems. This work has been central to providing a basis for local knowledge and expertise.

Combined with the Seasonal Watering Proposal, the data and knowledge from the proposed monitoring activities will guide future watering events, as part of the adaptive management approach.

2.2.3 Promoting adaptive management

Mallee CMA and other partners will take an adaptive management approach taking into account both varying seasonal conditions and lessons learned from previous events.

After the annual adaptive management checkpoint, Mallee CMA will adapt the EWMP if needed, which would then go through consultation, giving stakeholders the opportunity to see any updates.

2.3 COMMUNITY ENGAGEMENT

Community stakeholders were engaged during local events such as the local markets and local environmental group meetings. This engagement included a 'Pins in Maps' activity, where the community provided information on uses and values at specific locations at the site.

Community stakeholders were also engaged via an online survey, which was hosted on the Mallee CMA website in December 2023 – January 2024. The survey was designed to enable community, landholders, recreational users, environmental groups and other interested parties to provide input to the plans. The survey supplements earlier community engagement about the Piambie EWMPs, and annual community engagement that informs the Seasonal Watering Proposal (SWP). Community consultation occurs at the IAP2 level of CONSULT.

2.4 TRADITIONAL OWNERS

Engagement with Traditional Owners is conducted in an intimate group setting at the INVOLVE level of the IAP2 framework, with the level of interest and involvement self-determined by the group.

Mallee CMA held discussions with Traditional Owners representatives from Culpra Milli Aboriginal Corporation, Munatunga Elders Aboriginal Corporation, Gilbie Aboriginal Corporation, Tati Tati Land and Water Indigenous Corporation, Tati Tai Wadi Wadi Land and Water Indigenous Corporation, Wadi Wadi Nation and Dadi Dadi Weki Weki Aboriginal Corporation representatives on Country at Bridge Creek in November 2023. Through this engagement activity, Traditional Owner stakeholders were asked to identify the cultural values/uses at specific sites by placing pins on a map where they occurred. Information from this consultation has informed cultural site use and values incorporated into this EWMP. In-line with EWMP guidelines, consultation with Traditional Owners is ongoing.

3 Asset Overview

The Mallee CMA region is situated in the north-west of Victoria. The area of responsibility is close to 39,000 km2 (3.9 million ha) and has a regional population estimated to be 65,000. Population centres include Mildura, Birchip, Sea Lake, Ouyen, Robinvale, Red Cliffs and Merbein. The boundaries of the Mallee CMA region cover almost one fifth of Victoria, making it the largest area managed by a CMA in the state.

Approximately 40% of the land area within the Mallee CMA boundary is public land, consisting mainly of national parks, reserves, wilderness, and large areas of riverine and dryland forests. The other 60% is predominantly dryland crops, but there is also a significant investment in irrigated horticulture including grapes, citrus, almonds, olives and vegetables along the River Murray corridor. Irrigated crops contribute over 40% of the value of agricultural production for the region.

The site for this plan is Piambie Water Management Unit (WMU) sub-unit of the Heywood WMU (hereafter referred to as Piambie in this document). The Heywood WMU encompasses both Piambie and Heywood Lakes WMU sub-units (MCMA, 2014). Piambie is located on the River Murray floodplain, approximately 5 km north east of the township of Piambie and 40 km north of Nyah, between 1275 and 1259 river km (Figure 2).

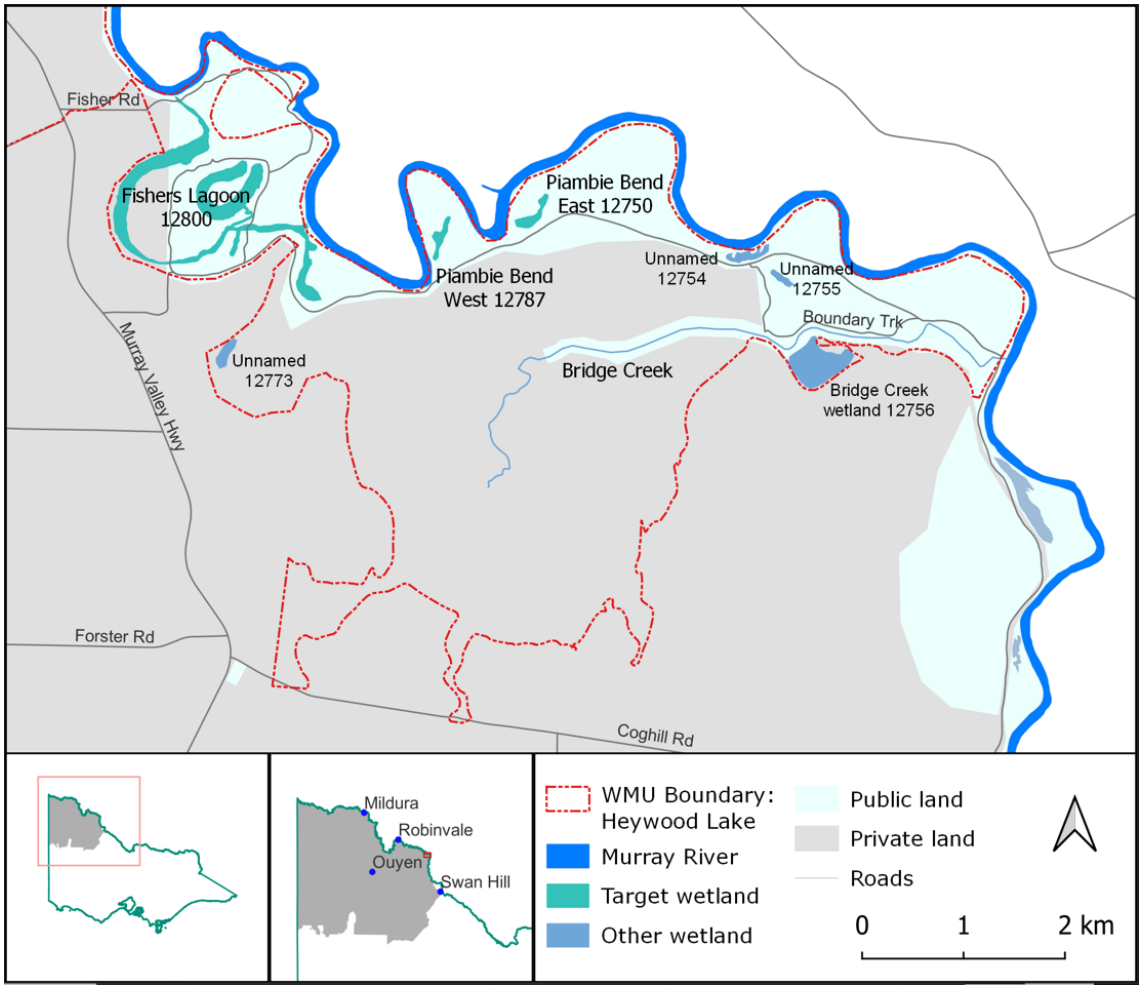

Figure 2. Piambie wetlands

3.1 CATCHMENT SETTING

Piambie's target area is in the Murray Fans bioregion, downstream of Nyah, and is characterised by a flat to gently undulating landscape on recent unconsolidated sediments with evidence of former stream channels, braided old river meanders, palaeochannels, and broad floodplain areas associated with major river systems and prior steams (known as braided/anastomosing streams). Alluvial deposits from the Cainozoic period gave rise to the red brown earths and texture contrast soils (Chromosols and Sodosols) that support Riverine Grassy Forests and Riverine Grassy Chenopod Woodlands (DEPI 2014).

Piambie is located between several key sites on the River Murray: the junction of the Wakool and River Murray is ten river kilometres upstream of Piambie; one kilometre upstream of this junction is the Nationally Important Major Mitchell Lagoons; and to the west is the Nationally Important Heywoods Lake.

The upstream extremity of Piambie marks the transition from the riverine landscape to the Mallee landscape. The Mallee landscape extends from Wakool Junction to the Darling River Junction at Wentworth. Through this section, the river generally has a single channel within a large trench of 10-20 m deep (Thoms et al 2000).

West of Piambie the landscape follows a pattern typical of the Mallee CMA region, with floodplain giving way to grazing land, and elevated terraces of mallee dunes. To the south, the dunes surrounding Kenley have experienced significant irrigated horticultural development including winegrapes, almonds and citrus orchards. Significant irrigated horticultural development has also occurred around Piambie, extending from Heywoods Lake through the mallee dunes towards the River Murray floodplain. Cereal crops and grazing occur across parts of the floodplain. Piambie is bounded by the River Murray to the north and east.

Piambie is comprised predominantly of high-level floodplain terraces and some deeply incised creeks and wetlands (EA 2006). Several former meander loops occur in low lying areas close to the River Murray.

3.2 LAND STATUS AND MANAGEMENT

Several agencies and individuals are involved in managing the land and water at Piambie (Table 3). Piambie is subject to four land classifications, including the proposed Murray River Park Land management boundaries, as shown in Figure 3.

Table 3. Land and water Managers at Piambie.

Organisation	**Management Role**
Minister for Water (Vic)	• Oversee Victoria's environmental water management policy framework, and its implementation. • Administer the broader water allocation and entitlements framework and the Water Act 1989 (Vic).
Mallee CMA	• The waterway manager that plans and identifies environmental water needs across the Mallee region Water Act 1989 (Vic). • Approves and manages delivery of environmental water and monitoring and reporting of outcomes, in accordance with ecological objectives.

Organisation	Management Role
Parks Victoria	• The land manager for the Crown land under the National Parks Act 1975 (Vic) and Crown Land (Reserves) Act 1978 (Vic) • Manages pests and specific environmental impacts. • Supports watering on public land and manages any impacts, for example by engaging with site visitors about environmental water-related matters and managing public access during and after an event.
Victorian Environmental Water Holder	• Manager of Victoria's environmental water entitlements
Private Landholders	• Land user, provides assistance in planning and implementation of programs

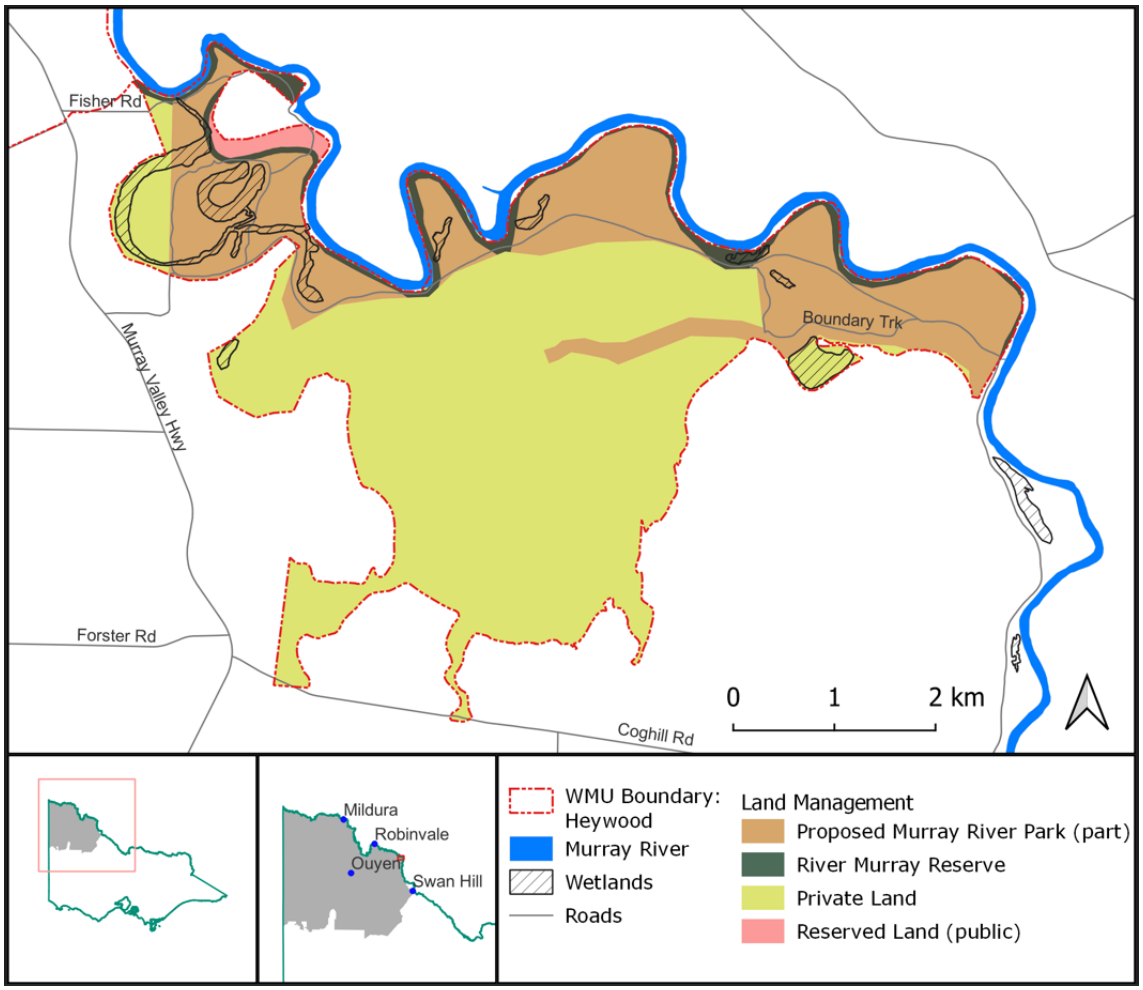

Figure 3. Piambie land management boundaries.

3.3 ASSET CHARACTERISTICS

Piambie covers 2,170 ha, which includes Bridge Creek and nine wetlands. The whole of Piambie has a water requirement as a floodplain complex but the focus for this plan is restricted to a target area of 389 ha (Figure 2). The target area is the extent to which environmental water can be delivered, and includes 3 shallow freshwater marsh and 3 deep freshwater marsh wetlands (Table 4). Piambie's

target area includes Bridge Creek and the Bridge Creek floodplain, and three of the seven wetlands: Fishers Lagoon, and two wetlands close to the River Murray, referred to in this plan as Piambie Bend West and Piambie Bend East (Figure 2). The three unnamed wetlands and Bridge Creek wetland have been excluded from the target area but are important ecological assets that should benefit from Basin Plan flows along the River Murray.

Bridge Creek is a wide creek bed fringed by River Red Gum and, on higher elevations, Black Box and Lignum. The creek meanders across the floodplain and becomes indistinguishable from the broader floodplain-wetland environment, before re-joining the northern end in a definable effluent, and flowing into Fishers Lagoon East, West and Central. Only the eastern most 7 km of Bridge Creek is indicated on Figure 2; the exact course across the floodplain is not currently recorded in the Mallee CMA spatial database.

Bridge Creek Floodplain is not a mapped wetland. Higher flow volumes in Bridge Creek provide water to floodplain vegetation consisting of Lignum and Black Box communities. Fishers Lagoon (12800) is comprised of three connected wetlands, which include a rich mosaic of vegetation types. Piambie Bend East (12750) and Piambie Bend West (12787) consist of herbland or marshland fringed by River Red Gum woodlands and grasslands.

Table 4. Wetland Characteristics at Piambie

Characteristics	Description
Name	Piambie
Mapping ID (Wetland Current layer)	Fishers Lagoon: 12800 Piambie Bend West: 12787 Piambie Bend East: 12750 Bridge Creek Wetland: 12756 Unnamed: 12773 Unnamed: 12754 Unnamed: 12755
Area of wetlands (in target area)	91.88ha (66.51ha)
Bioregion	Murray Fans
Conservation status	Bioregional conservation status: area of EVCs listed as Least Concern, Depleted, Vulnerable and Endangered.
Land status	Proposed Murray River Park River Murray Reserve Private Land Reserved Land (public)
Land manager	Parks Victoria, Private
Surrounding land use	Grazing, reserve, private pump access road, irrigated agriculture.

Characteristics	Description
Water supply	River Murray
Wetland category (Corrick classification)	12800 (Fishers Bend): 99 – No Category 12787 (Piambie Bend West): 4 – Deep Freshwater Marsh 12750 (Piambie Bend East): 4 – Deep Freshwater Marsh 12756 (Bridge Creek Wetland): 3 – Shallow Freshwater Marsh 12773: 3 – Shallow Freshwater Marsh 12754: 3 – Shallow Freshwater Marsh 12755: 4 – Deep Freshwater Marsh
Wetland type (current wetland layer)	12800 (Fishers Bend): Unknown 12787 (Piambie Bend West): Unknown 12750 (Piambie Bend East): Temporary freshwater lakes 12756 (Bridge Creek Wetland): Unknown 12773: Unknown 12754: Unknown 12755: Unknown
Wetland depth at capacity	Bridge Creek: 4.2m Bridge Creek floodplain: 1.4m Fishers Lagoon East: 1.35m Fishers Lagoon West: 2.1m Fishers Lagoon central: 1.6m Piambie West: 3.4m Piambie East: 3.1m

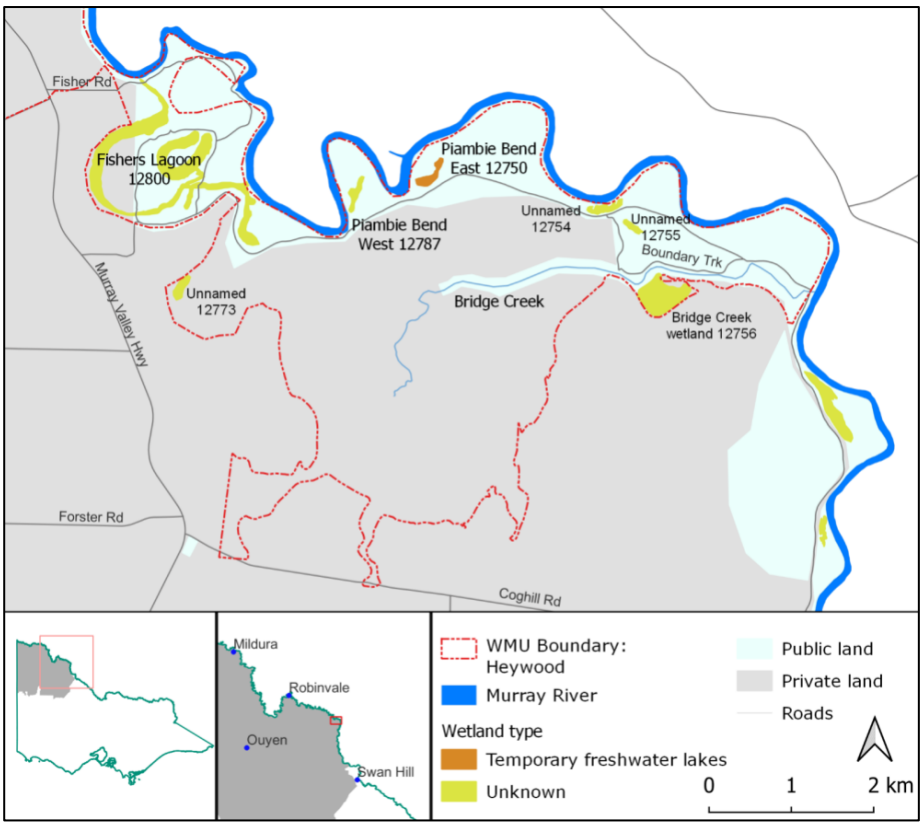

Figure 4. Piambie wetland type

3.3.1 Conceptualisation of the site

Piambie has been represented in a conceptual model. The model provides a visual representation of the site's processes and components that are discussed throughout this EWMP.

The vegetation structure of Piambie comprises **aquatic macrophytes** in Fishers Lagoon Complex and Piambie Bends East and West, and herbs and forbs at creek bed level. **River Red Gum** fringe the Creek, and on higher elevations of the floodplain, **Black Box** and **Lignum** are found.
Healthy vegetation structure provides habitat potential. Older Black Box and Red Gum can provide hollows for nests, **hollow logs** for the Inland **Carpet Python**, and a good understorey that is structurally diverse comprising **Lignum**, **grasses**, leaf matter and debris offer cover, forage, breeding and feeding sites for bush birds, reptiles and invertebrates.

Freshwater inflows to the system will be delivered as environmental water to provide a range of feeding, breeding, watering points and habitats for native fauna. This inundation leads to the rapid release of nutrients from the soils, and the seed and egg banks of plants and aquatic invertebrates emerge. This pulse in aquatic macrophytes and invertebrates may provide food for aquatic fauna such as

frogs, which in turn provides food for **waterbirds**. The wetland becomes more productive and surrounding vegetation such as **Lignum,** **understorey** and **Eucalypt** species benefit from periodic inundation as water levels rise and fall. Healthy vegetation may promote visitation by woodland birds such as the Regent Parrot, and terrestrial fauna for perching and nesting sites, and provides fallen timber and hollows for nesting and shelter.

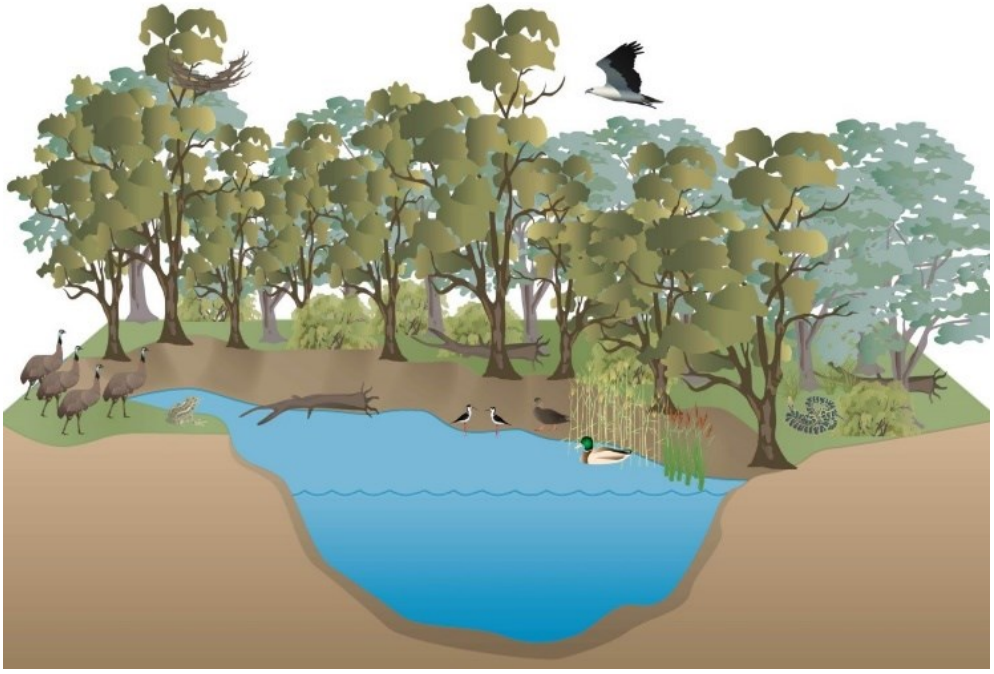

Figure 5. Conceptualisation of Piambie

3.4 ENVIRONMENTAL WATER SOURCES

The Environmental Water Reserve (EWR) is the legally recognised amount of water set aside to meet environmental needs. The Reserve can include minimum river flows, unregulated flows and specific environmental entitlements. Environmental entitlements can be called out of storage when needed and delivered to wetlands or streams to protect their environmental values and health.

The Victorian Minister for Environment, Climate Change and Water appointed Commissioners to Victoria's first independent body for holding and managing environmental water on 1 July 2011 – The Victorian Environmental Water Holder (VEWH) is responsible for holding and managing Victoria's environmental water entitlements and sourcing water from the Victorian Murray system for delivery to Piambie Bend. This could include water held by the VEWH or CEWH. Details of the VEWH's environmental water entitlements are available at: https://www.vewh.vic.gov.au/watering-program/how-much-water-is-available.

4 Current/Historical Hydrological Regime and System Operations

Wetland hydrology is the most important determinant in the establishment and maintenance of wetland types and processes. It affects the chemical and physical aspects of the wetland which in turn affects the type of flora and fauna that the wetland supports. A wetland's hydrology is determined by the physical form of the wetland, surface and groundwater inflows and outflows in addition to precipitation and evapotranspiration. Duration, frequency and seasonality (timing) of wetland inundation are the main characteristics of the hydrological regime for wetlands.

The target area at Piambie is located on the Victorian floodplain of the River Murray (1275 km to 1259 km) just below river gauge (# 414200) below Wakool Junction. This area receives water from the River Murray, and the Edwards-Wakool system, which receives excess volume diverted from the Murray above the Barmah Choke.

Table 5. Ctf rates for Piambie wetlands

Wetland	Commence to flow (ctf) with River Murray flows
Fishers Lagoon West	18,000ML/day
Fishers Lagoon East	24,000ML/day
Fishers Lagoon Central	25,000ML/day
Bridge Creek	34,500ML/day
Piambie Bend East	25,000ML/day
Piambie Bend West	26,500ML/day

The junction of the River Murray and Edward-Wakool system occurs just upstream of Piambie. Prior to river regulation, the floodplain below the junction experienced inundation more frequently and these events had a greater duration (Ecological Associates 2007).

4.1 GROUNDWATER AND SALINITY INTERACTIONS

There are groundwater bores at Piambie, and ongoing groundwater monitoring but as of 2024 there has been no surveys or research done. The interaction of wetlands with groundwater and associated salinity risks at Piambie remain a knowledge gap.

4.2 ENVIRONMENTAL WATERING

Environmental watering began at Piambie in 2014, using water from the sources outlined in Table 5. Water was pumped from the River Murray into the eastern end of Bridge Creek (Figures 7 – 9). Pump Site on the River Murray and levee constructed for delivery of environmental water to Bridge Creek.

Table 6. A summary of environmental watering at Piambie.

Water year	Waterbody	Time of inflow	Environmental Water Source	Total volume (ML)	Area (ha) inundated
2010-11	Bridge Creek*, Fishers Lagoon	Spring, Summer and Autumn	Natural Flows	n/a	n/a
2014-15	Bridge Creek*, Fishers Lagoon	Winter (June) - Spring	VEWH/CEWH	1,200	Bridge Ck & f/pl 364 ha
2016-17	Bridge Creek*, Fishers Lagoon	Spring	Natural Flows	n/a	n/a
2019-20	Bridge Creek	Spring	VEWH	776	Bridge Ck & floodplain
2021-22	Fishers Lagoon, Piambie Bend East, Piambie Bend West	Spring	Natural Flows	n/a	n/a
2022-23	Bridge Creek, Fishers Lagoon, Piambie Bend East, Piambie Bend West	Winter - Spring	Natural Flows	n/a	n/a
2023-24	Bridge Creek (minimal duration), Fishers Lagoon, Piambie Bend East, Piambie Bend West	Spring	Natural Flows	n/a	n/a

**including wetland.*

Figure 6. Pump site on the River Murray

Figure 7. Levee constructed for delivery of environmental water to Bridge Creek

Figure 8. Environmental water delivery to Bridge Creek December 2019

5 Water Dependent Values

Wetlands and waterways on the floodplain are a vital component of the landscape and support flora and fauna which vary with the type of wetland/waterway and through time. The condition of the wetlands at Piambie will have broader impacts on the condition of adjacent or otherwise linked lignum and black box ecosystems in the surrounding landscape, as Piambie provides ecological functions such as habitat for keystone species.

The habitat provided by vegetation communities around wetlands is essential for maintaining populations of water dependent fauna species. Other ecological functions provided by floodplain complexes include water filtration, slowing surface water flow to reduce soil and channel erosion, flood mitigation and reducing nutrient input into waterways. Protecting the ecological functioning of wetlands ensures these vital services are maintained.

Piambie provides a range of shelter and food resources for indigenous fauna, flora and vegetation communities. The types of habitat provided, and consequently the species that utilise the site, change as water fills the wetlands, creek and floodplain and recedes again.

It is recommended that flora and fauna surveys are repeated at the site to improve knowledge of the site's ecological values.

5.1 ENVIRONMENTAL VALUES

5.1.1 Ecosystem type and function

The conservation significance of Victorian wetland types has been determined by comparing the estimated extent prior to European settlement (Victorian Wetland Inventory - Pre-European) with the current extent (Victorian Wetland Inventory - Current).

The wetlands addressed in this EWMP are classified as either Deep Freshwater Marsh, Shallow Freshwater Marsh, or are not categorised (see Table 4). It has been estimated that about 4000 wetlands have been lost since European settlement,

with more than 90% of these lost on private land (Mallee CMA 2006). Piambie represents an excellent opportunity to help protect wetlands and a creek system on private land.

Shallow Freshwater Marsh is the third most depleted category in the Murray Fans bioregion within the Mallee CMA Region, which makes Piambie Bend East and West significant in the Mallee (Mallee CMA 2006). The extent of Deep Freshwater Marsh has also declined across the State (-70%), and within the Mallee CMA (-45%).

Table 7. Changes in the area of wetlands in the target area (Corrick classification).

Corrick category (Current and Pre - European)	Wetland name	Area (ha)	Percentage change in wetland area from 1788 to 1994		
			Change in Victoria	Change in Mallee CMA	Change in Murray Fans Bioregion
Shallow Freshwater Marsh	12756 (Bridge Creek wetland) 12773 12754	17.86 2.88 3.14	-60%	-6%	-10%
Deep Freshwater Marsh	12787 (Piambie Bend West) 12750 (Piambie Bend East) 12755	2.82 3.45 1.49	-70%	-45%	-6%

Ecosystem functions

Healthy creek and wetland ecosystems have the potential to support distinctive communities of plants and animals and provide numerous ecosystem services. These ecosystems can perform important functions necessary to maintain the hydrological, physical and ecological health of the river systems and floodplain.

These ecosystem functions can include:

- providing extended foraging and breeding opportunities for native terrestrial fauna;
- providing extended foraging and breeding habitat for water birds during periods of inundation;
- absorbing and releasing floodwaters;
- in-stream primary production;
- providing organic material to rivers to maintain riverine food chains; and
- providing feeding, breeding and drought refuge sites for an array of flora and fauna.

Altered water regimes in the target area due to river regulation and extended dry conditions have seen a decrease in the frequency and extent of inundation on the floodplain and within Bridge Creek. This combined with the previous maintenance of a permanent water level in Fishers Lagoon West, and subsequent loss of dry phases, has reduced the ability for the creek and wetlands to perform these valuable ecosystem functions.

5.1.2 Flora and Fauna Values

EVCs

Within the target area, the most extensive Ecological Vegetation Class (EVC) is the Vulnerable Lignum Swampy Woodland. Parts of Bridge Creek are identified in the mapping as Bare Rock/Ground, Lignum Swampy Woodland, Lignum Swamp, and Floodway Pond Herbland. Fishers Lagoon Complex represents a diverse mosaic of EVCs including herbland, marsh, grassy wetland and woodlands. Eleven water dependent EVCs are identified within the target area; these are listed in Table 9 and shown in Figure 9. For a full list of EVCs mapped at Piambie and details on each see Appendix 2.

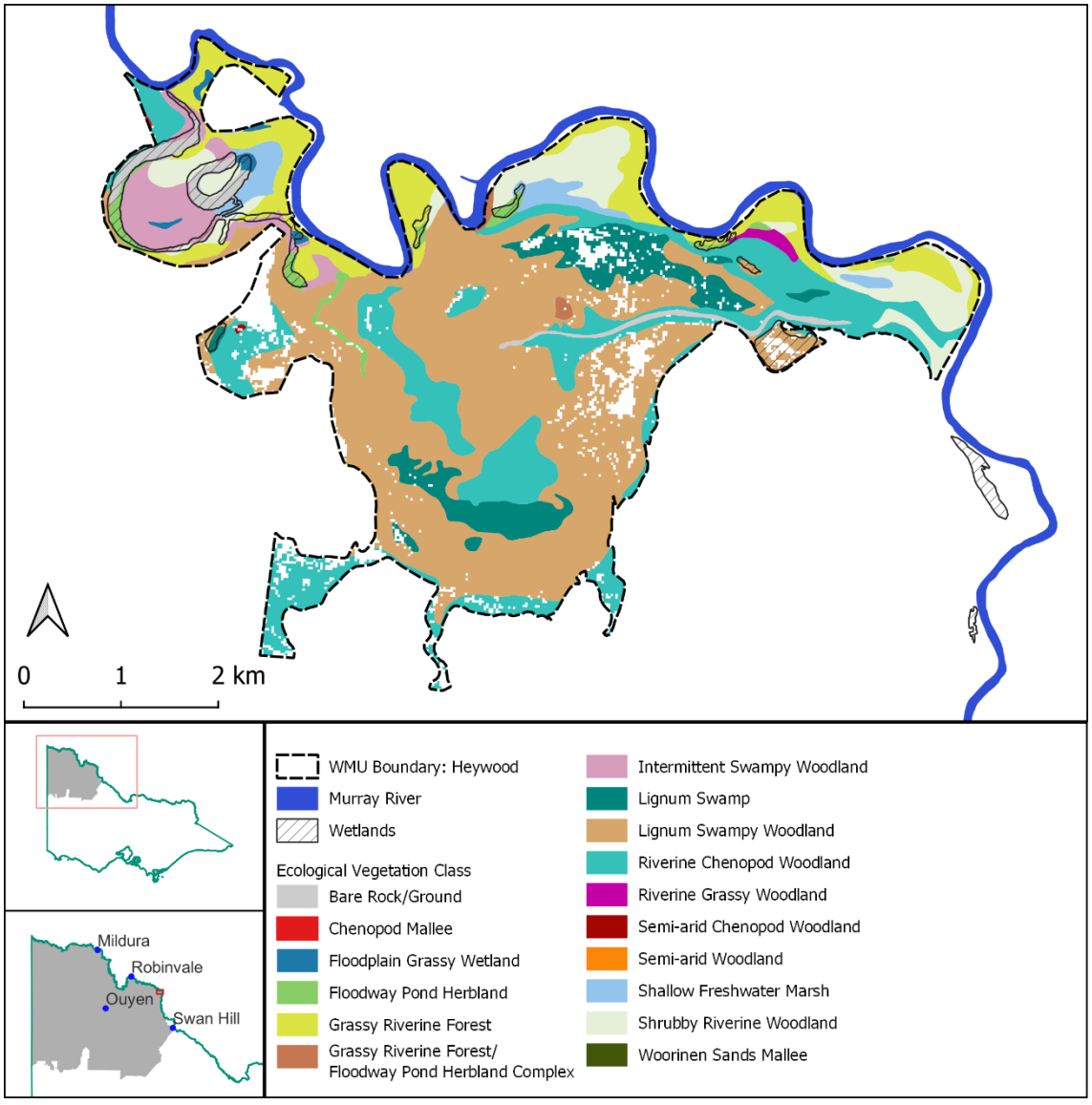

Figure 9. Ecological Vegetation Classes (EVCs) at Piambie

Table 8. Ecological Vegetation Classes modelled as present within the Piambie target area

EVC Number	EVC Name	Bioregional Conservation Status
103	Riverine Chenopod Woodland	Depleted
104	Lignum Swamp	Vulnerable
106	Grassy Riverine Forest	Depleted
200	Shallow Freshwater Marsh	Vulnerable
295	Riverine Grassy Woodland	Depleted (Terrestrial BCS)
809	Floodplain Grassy Wetland	Endangered
810	Floodway Pond Herbland	Depleted
811	Grassy Riverine Forest/ Floodway Pond Herbland Complex	Vulnerable
813	Intermittent Swampy Woodland	Depleted
818	Shrubby Riverine Woodland	Least Concern (Terrestrial BCS)
823	Lignum Swampy Woodland	Depleted

Across the Piambie target area, the overstorey is generally comprised of river red gum (*Eucalyptus camaldulensis*) and/or black box (*Eucalyptus largiflorens*) with a mid-storey of lignum (*Muehlenbeckia florulenta*).

Black box is the dominant tree species in the endangered Riverine Chenopod Woodland EVC that is mapped surrounding much of Bridge Creek and parts of the floodplain. River red gum lines the creek bank, with black box occurring on higher ground.

Bridge creek traverses the floodplain and its course becomes 'lost' as it passes through the vulnerable Lignum Swampy Woodland and the vulnerable Lignum Swamp before rejoining the creek path towards Fishers Lagoon East.

Black box is co-dominant with river red gum in the Shrubby Riverine Woodland EVC that is within close proximity to Fishers Lagoon West and Central. The balance of this part of Piambie includes herbland, wetland, grassland and woodland EVCs comprising a diverse array of flora, with generally higher water requirements than the creek zones.

Figure 10. Bridge Creek is fringed by river red gum. Black box occurs on higher ground, visible in the background.

The endangered Floodplain Grassy Wetland occurs in two sites near Fishers Lagoon East and West. This EVC is naturally quite restricted within the Mallee CMA, however it is presumed to be even rarer due to reduced frequency and extent of inundation events.

Black box provides essential habitat and foraging opportunities for a range of species including the inland carpet python. Healthy black box helps provide important vegetative corridors to other areas above the floodplain for a range of transient terrestrial and avian native fauna. Black box can tolerate a range of conditions from wet to dry (Roberts & Marston 2011), however under extended periods of dry conditions trees will suffer a decline in health and eventually death (Ecological Associates 2007).

Tangled lignum is considered to be the most significant floodplain shrub in mainland Australia due to its extensive distribution, local dominance and value as habitat (Roberts & Marston 2011). Lignum occurs in many EVCs across the Piambie target area and, combined with other understorey species offers shelter for a range of birdlife, nesting sites for smaller birds, and cover for reptiles including the inland carpet python.

River red gum is the most widespread eucalypt tree in Australia, occupying riparian habitats along water courses and wetlands (Roberts & Marston 2011). Trees in poor condition have little contribution to the function and productivity of the ecosystem and the quality of woodland habitat is greatly reduced (Roberts & Marston 2011). Healthy river red gums contribute to the wetland ecosystem by depositing organic material, and fallen trees and branches provide structural habitat features for native fauna such as the inland carpet python. Older trees can provide perching sites for birdlife, nesting sites for the white-bellied sea-eagle, and Square-tailed kite, as well as hollows for the regent parrot and brown treecreeper.

Fauna

66 species have been recorded at Piambie (Appendix 3), 2 of which are introduced. Of special interest and management responsibility are the 5 water dependant fauna species listed in legislation, agreements or conventions.

Piambie supports species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Victoria's *Flora and Fauna Guarantee Act 1988* (FFG Act) (Table 10).

These records are drawn from incidental and targeted surveys; however, it is fair to assume that more listed species are likely to occur due to the availability of habitat and nearby sightings.

Table 9. Listed water-dependant fauna at Piambie

Scientific Name	Common Name	FFG Act	EPBC Act Status
Climacteris picumnus	Brown treecreeper	n/a	Vulnerable
Morelia spilota metcalfei	Carpet python	Endangered	n/a
Hieraaetus morphnoides	Little eagle	Vulnerable	n/a
Aphelocephala leucopsis	Southern whiteface	n/a	Vulnerable
Lophoictinia isura	Square-tailed kite	Vulnerable	n/a

Of the 5 species listed, the carpet python (*Morelia spilota metcalfei*) is considered indirectly water dependent due to habitat requirements (e.g. dependent on nesting hollows in riparian trees) (Office of Environment & Heritage, 2017). The rest are directly dependent on water due to food, shelter or breeding requirements.

Provision of environmental water is likely to enhance vegetation quality, structure and diversity and consequently encourage the listed fauna that depend on a healthy ecosystem through the provision of habitat, hollows, nest building materials, foraging feeding and breeding sites at Piambie. It is also expected that delivery of environmental water to the wetlands and creek will offer additional feeding, breeding and foraging sites for aquatic species including fish and frogs.

The square-tailed kite (*Lophoictinia isura*), forages eucalypt-dominated forests and woodlands including riparian woodlands. It builds a large stick platform nest up to 90 cm across, usually in the high fork of a living tree and feeds on small birds, reptiles and large insects. Healthy river red gum and black box will help to provide nest building materials and nesting sites for this species and the white-bellied sea-eagle. Environmental watering that promotes a productive ecosystem will also enhance food web development for these species.

The inland carpet python (*Morelia spilota metcalfei*) has been recorded at several sites at Piambie, which led to the designation of Special Management Zones for the species. The inland carpet python is indirectly dependent on a healthy floodplain environment. A healthy wetland system will provide the necessary vegetation for cover, opportunities for shelter in hollows, and food sources, which may help promote a breeding population. Delivery of environmental watering under this plan will potentially encourage diversity and improve quality of floodplain vegetation, increasing the habitat value of the target area for this species. Watering events can be managed to minimise impact on potential breeding sites December to March.

The brown tree-creeper (*Climacteris Picumnus*) has also been recorded at Piambie. It is indirectly dependent on water, preferring forests bordering wetlands with an open understorey including saltbush, lignum, cumbungi and grasses. It is dependent on tree hollows for nesting and fallen timber for foraging (OEH, 2014a).

The emu (*Dromaius novaehollandiae*) is known to feed on a wide variety of leaves, grasses, fruits and insects, the potential for such food sources can be enhanced through delivery of environmental water (OEH, 2014b). Emu's also use rivers and wetlands for wading on hot days.

Piambie has also been the site of several regent parrot (*Polytelis anthopeplus*) surveys, including 2001 and 2003. During those surveys suitable habitat was found around lagoons and potential nest trees scattered along the river and throughout the bend (Ecosurveys 2002; 2004). Whilst no official sightings are recorded, the area has been identified as potential habitat for the EPBC listed regent parrot (Ecosurveys 2004). The species is recorded in the neighbouring WMU sub-units: Major Mitchell Lagoon; and Heywood. Careful management of environmental water at Piambie may improve habitat potential for the vulnerable regent parrot.

Though not recorded in the species list, Fishers Lagoon Complex is described as an "important breeding area" for the nationally and State significant, white-bellied sea-eagle (*Haliaeetus leucogaster*) (M. Rohde pers. comm. cited in Ecological Associates 2006). In the Mallee CMA region, the white-bellied sea-eagle nests near water in large live or dead trees. They breed between April and August and create stick nests of up to 1.7 metres across. Known to forage over large expanses of open water, the white-bellied sea-eagle feeds on fish, birds, reptiles, mammals, crustaceans and carrion. The Victorian population is thought to be as low, estimated at 100 breeding pairs in the early 2000s(DSE 2003b). Deterioration of inland water resources and disturbance of nesting pairs by human activity are listed as threats for this species (Department of the Environment 2015).

Growling grass frogs are listed as vulnerable under the EPBC Act, and are usually found in seasonally flooded wetlands with complex aquatic vegetation communities and rely on drought refuges to survive dry periods. The growling grass frog is particularly sensitive to changes in wetland hydrology and prefers annual flooding and long periods of inundation (five to seven months) due to a long larval phase. This frog requires flooding in spring/summer for successful recruitment as this is when it is active and breeding takes place. It can be excluded from wetlands under reduced flood frequency (Rogers & Ralph 2011). As growling grass frogs are not recorded in the species list, Piambie is not managed specifically for this species. However, during a site visit to Bridge Creek and Fishers Lagoon East during a watering event in August 2014, the calls of several frog species were noted including the eastern common froglet (*Crinia signifera*), eastern sing-bearing froglet (*Crinia parinsignifera*), spotted marsh frog (*Limnodynastes tasmaniensis*) and eastern banjo frog (*Limnodynastes dumerilii*). It is expected that frog communities will benefit from delivery of environmental water at Piambie by improving vegetation complexity and providing habitat for feeding and breeding.

The River Murray in this reach offers habitat for native fish species. Smaller, vegetation dependent species such as the vulnerable Murray-Darling rainbowfish (*Melanotaenia fluviatilis*) are recorded in the vicinity of Piambie (Lintermans 2007) and may also use the Piambie wetland complex and aquatic macrophytes for feeding and breeding opportunities.

Waterbirds such as ducks and waders are also likely to benefit from delivery of environmental water through the expansion of foraging, feeding and breeding sites.

Flora

One hundred and thirty-four species of flora have been recorded at Piambie (a full list of flora can be found in Appendix 4). Of these, seven are listed under the FFG Act (Table 11), and thirty-three are introduced.

Table 10. Listed Flora at Piambie

Scientific Name	Common Name	FFG Act	EPBC Act Status
Acacia oswaldii	Umbrella wattle	Critically Endangered	n/a
Cullen tenax	Tough scurf-pea	Endangered	n/a
Sporobolus caroli	Yakka grass	Endangered	n/a
Swainsona microphylla	Small-leaf swainson-pea	Endangered	n/a
Atriplex lindleyi subsp. conduplicata	Baldoo	Vulnerable	n/a
Minuria cunninghamii	Bush minuria	Vulnerable	n/a
Malacocera tricornis	Goat head	Vulnerable	n/a

The array of flora recorded (Appendix 4), indicate that Piambie maintains good floristic diversity. Water dependent and flood tolerant flora species recorded at Piambie include knob sedge (*Carex inversa*), spiny flat-sedge (*Cyperus gymnocaulos*), common blown-grass (*Lachnagrostis filiformis*) and common nardoo (*Marsilea drummondii*) (Appendix 4). Emergent macrophytes are often found on the perimeter of ephemeral or seasonally inundated waterways and can provide essential habitat for frogs. During flooding, native fish will also utilise reed beds and semi-emergent vegetation where they feed on macro-invertebrates and shelter from predators (Ecological Associates 2007b). Emergent macrophytes require annual flooding of approximately 6-12 months depending on species. The return of an inundation cycle more closely mimicking natural conditions may encourage a diversity of species requiring differing water regimes.

Of particular significance on the floodplain is the endangered tough scurf-pea (*Cullen tenax*). This species has been recorded in areas subject to seasonal flooding, and may be benefited by inundation through reduced competition from grasses (DSE 2015). In this part of the CMA region there is evidence to suggest that mass recruitment follows shallow flooding or heavy rain, and that extended dry periods can cause stalled growth or even death of mature plants (ABC database). Records of tough scurf-pea (*Cullen tenax*) led to the listing of two areas of public land within the WMU as Special Protection Zones.

5.1.3 Current Condition

The condition of wetlands within the target area of Piambie has not been assessed using the Index of Wetland Condition (IWC) method.

Piambie is able to support a rich diversity of flora and fauna. Native vegetation is present along the entire length of Bridge Creek. An expanse of floodplain vegetation that was once used as grazing land is no longer grazed, and the vegetation is recovering. The iconic river red gum and black box are the principal sources of hollows, providing essential habitat to a range of species, including the endangered inland carpet python and near threatened brown treecreeper. Healthy trees may also offer potential habitat for the endangered regent parrot, and nest building materials for the vulnerable white-bellied sea-eagle and square-tailed kite.

The floodplain vegetation is, in places, dense and of good structural diversity. Large expanses of lignum and black box and the associated understorey, and leaf litter and fallen timber, offer excellent habitat for the carpet python and brown

treecreeper. In addition, Piambie is one of only a handful of known sites within the Mallee CMA region for the endangered tough scurf-pea. Structural diversity is also important for producing wood, leaf litter and microhabitat, which supports the needs of smaller fauna (McElhinny, 2002). Leaf litter and decomposing vegetation also support the needs of fungi, who have a key role in maintaining soil health/condition.

With connectivity to the River Murray, the wetlands and creek at Piambie provide potential for refuge and/or extended breeding and foraging areas for native fauna species including fish and frogs.

The western wetland of the Fishers Lagoon complex was used as a holding basin for irrigation water, and was kept inundated for many years, but now remains dry unless significant River Murray flows occur. The eastern wetland of Fishers Lagoon is traversed by a private pump access track. There is no current monitoring data for thecondition of Piambie Bend East and West wetlands.

Figure 11. Fishers Lagoon West (2015)

The condition of the wetlands at Piambie is dependent on an appropriate flow regime. The historic environmental watering at Piambie has met environmental watering targets for Bridge Creek. This would indicate that the environmental values at Bridge Creek are in a desirable state and are able to support the ecological values identified in this EWMP. Environmental watering targets have not been met for Fishers Lagoon, indicating that Fishers Lagoon ecological values may be at risk. Whether the environmental watering targets have been met is unknown for Piambie Bend East and Piambie Bend West, so information is unable to be inferred from environmental watering outcomes about the condition of these wetland sites.

Figure 12. Fishers Lagoon East (2015)

Figure 13. The track crossing Fishers Lagoon East

5.2 SHARED BENEFITS

5.2.1 Traditional Owner Cultural Values

The Mallee has been occupied for thousands of generations by Indigenous people with human activity dated as far back as 23,400 years ago. The region's rich and diverse Indigenous heritage has been formed through the historical and spiritual significance of sites associated with this habitation; together with the strong connection Traditional Owners continue to have with the natural landscapes of the Mallee.

In Indigenous culture, water is inseparable from the land, air, plants and animals. Caring for, and healing, Country is an inherited cultural obligation that is reliant upon having water in the landscape in the right place, at the right time of year. Water creates and sustains life, and is a living and cultural entity that connects Traditional Owners to Ancestors, Country, cultural practice and identity.
Within the Mallee CMA region, the River Murray and its associated waterways continue to be culturally significant habitation areas for many Aboriginal groups. The high number of Indigenous cultural heritage sites throughout the Murray floodplain is unique in Victoria because of their concentration and diversity. It is typical to find high densities of identified Indigenous cultural heritage sites located around, or close to, freshwater sources. The Aboriginal Heritage Regulations 2018 define "areas of cultural heritage sensitivity" which include land within 200 m of named waterways and land within 50 m of registered Aboriginal cultural heritage places. A review of the Aboriginal Cultural Heritage Register and Information System (ACHRIS) confirms that the wetlands at Piambie are defined as areas of cultural heritage sensitivity.

Within the Mallee CMA region, the River Murray and its associated waterways were important areas for multiple Aboriginal groups, containing many places of spiritual significance. The high number of Indigenous Cultural Heritage sites throughout the Murray floodplain is unique in Victoria, for both concentration and diversity. They include large numbers of burial, shell midden and hunting sites.
Several early European records exist of different language groups within the area (Clark, cited in Bell 2012) including Tati Tati people (Tindale, cited in Bell 2012) and Wadi Wadi people (Howitt, cited in Bell 2012). Aboriginal people had a strong connection to the area and made use of the natural resources within the forest for bush medicine, basket weaving and other cultural activities.

Engagement undertaken with Culpra Milli Aboriginal Corporation, Munatunga Elders, Gilbie Aboriginal Corporation, Tati Tati Land and Water Indigenous Corporation, Wadi Wadi Land and Water Indigenous Corporation, Wadi Wadi Nation and Dadi Dadi Weki Weki Aboriginal Corporation representatives on Country at Bridge Creek in November 2023 found that there was an ongoing connection to the wetlands at Piambie, with Traditional Owner community members invested in the ecological health and sustainable management of water at the site. Participants in the on Country engagement identified that fish breeding, fishing water, native vegetation, insects and the water itself were culturally valued.

5.2.2 European Heritage Values

European heritage reflects the pioneering history of the area. On his third expedition to the interior, Major Thomas Mitchell followed the Murrumbidgee River to its junction with the River Murray and, after returning from the Murray-Darling junction, he continued his exploration through the Piambie area. This history is reflected in the naming of the Major Mitchell Lagoons, south of Piambie.

European settlement followed Mitchell's exploration, and the area became part of a large squatting run, which was subsequently broken up into three parcels of land in 1884. Piambie is located on two of these parcels, purchased by Alice Creswick and Harry Creswick. The land was run under the Narrung Pastoral Licence until the lease was cancelled in 1919 (Fisher, cited in Bell 2012).

Bridge Creek is said to have gained its name from a bridge across the creek, the remnants of which are still visible (Figure 14). A camp was located on the northern bank of the creek, possibly for workers harvesting timber from the bend (pers. comm. Andrew Paul, March 2015).

5.2.3 Recreational Values

The region is popular for swimming, camping, fishing, boating, socialising, four-wheel driving, picnics, barbeques and walking.

Figure 14. Remnants of the bridge that gave Bridge Creek its name

5.2.4 Economic Values

Parts of Piambie have been used for grazing in the past, and Fishers Lagoon West was used for private storage of water for many years. Due to this use as irrigation storage, minimum water levels were maintained to enable efficient and reliable operation. The landholder would pump water into Fishers Lagoon West when river flows were insufficient to maintain pool level. This no longer occurs.

The river frontage has been gazetted as River Murray Reserve and part of Bridge Creek is reserved. Areas of private land are used for grazing.

5.2.5 Educational Values

Piambie is not known to be currently used for educational purposes.

5.3 TRAJECTORY OF CHANGE

Since regulation, natural flood events through the entire length of Bridge Creek occur much less frequently. This has reduced the volume and frequency of water available to the vegetation along the creek banks.

Local reports suggest Bridge Creek was able to hold water for approximately three years after inundation. It was also suggested that Bridge Creek dried out for 'the first time in a century' during the Millennium Drought (1997-2010) and that tree health declined dramatically (pers. comm. A. Paul, March 2015). Without intervention, it is believed that tree health will continue to decline if dry conditions persist.

Fishers Lagoon West experienced near-constant inundation for many years due to regulation, which is likely to have reduced the diversity of aquatic macrophytes and seasonal flora species. It now remains dry unless high river flows occur.

Piambie Bend East and West have experienced a reduction in inundation frequency and duration, which may have limited the condition (diversity and extent) of EVCs in the target areas.

The condition of Bridge Creek and the wetlands within the target area will continue to decline without regular and well-planned environmental watering targeting appropriate objectives. The reduced flooding duration and frequency will continue to impact the ecology of the wetlands through:

- reduced productivity;
- reduced connectivity for movement of organic matter and fish;
- reduction of suitable nesting and roosting sites for waterbird species that rely on flooded shrub land and forest;
- lower capacity to provide nesting sites for hollow-dependent birds and reptiles;
- reduced understorey quality as habitat and shelter for birds and reptiles; and
- limited food sources for all waterbird types, reptiles and amphibians through declines in vegetation condition and reduced terrestrial and aquatic invertebrates

Without improvements to flow frequency and extent, the health of the ecosystem of Piambie is likely to further decline.

Photopoint monitoring is undertaken at Piambie (Bridge Creek) to monitor wetland condition over time. Photopoints were taken in 2019 and 2020 – in the time between the two photos presented below (Figure 15) Bridge Creek received spring flows from VEWH (see Table 7).

Figure 15. Photopoint monitoring of Bridge Creek at Piambie. Left: photo 12/05/2019, Right: photo 27/05/2020.

6 Managing Water Related Threats

Changed water regime

The regulation of the River Murray has altered the water regime at Piambie. Flow events of the magnitude required to allow flows into the creek and wetlands of the floodplain are less frequent and of shorter duration. Combined with dry conditions over the last decade, this has affected the vigour of the vegetation and placed trees under stress, affecting the productivity and functioning of the floodplain ecosystem.

Fishers Lagoon West, once an ephemeral wetland was modified and, for a period, was permanently inundated to maintain supply of irrigation water. Regulator structures were placed to achieve this and are likely to create a barrier to fish passage and prevent more frequent inundation of connected sections of the floodplain. When use of the lagoon for irrigation water ceased, a drying phase occurred, once more altering both the hydrology and the ecosystem, impacting condition.

Management of water-related threats

Management of water related threats at Piambie is undertaken through maintaining the optimal watering regime. As part of this process, the wetlands will periodically be allowed to dry out, enabling the reduction of invasive aquatic species such as European carp. Drawdown and inundation of wetlands in line with the optimal watering regime will also manage invasive flora species not suited to natural water cycles.

ASSESSING RISK

Consideration of risk provides a link between recognition of system threats and key management processes, including decade and seasonal planning. Risk assessments are composed of both likelihood and consequence components. In this instance, likelihood is influenced by the probability that there will be sufficient environmental water to maintain creek flows and water levels.

From a seasonal watering perspective, prioritisation of watering actions will be based on consequence. While consequence for an individual wetland can be determined, environmental water allocations require consideration of the consequences at larger scales. For the Mallee CMA it is the region, for the VEWH it is Victoria and the CEWH it is the Murray Darling Basin.

Not all consequences can be identified as readily and so we have provided a process that can be followed in Appendix 5.

7 Management Goals, Objectives and Targets

7.1 MANAGEMENT GOAL

The overall goal proposed for the Piambie target area has been developed through consultation with various experts and stakeholders including DEWLP, Parks Victoria, and local residents. The goal considers the values the wetland supports and the potential threats that need to be managed. This includes consideration of the values the wetland has historically supported and the likely values it could support into the future.

The management goal for Piambie is:

To provide a flow regime that more closely reflects natural events, thus improving the capacity of the target area to provide a productive ecosystem for native flora and fauna.

This is strongly linked to the goals of the Mallee Waterway Strategy 2014-22 (Mallee CMA 2014), which are to:

- To maintain or improve habitat within waterways and on surrounding riparian land;
- To manage all land tenures for water quality benefits and respond appropriately to threatening events (both natural and pollution based);
- To restore appropriate water regimes and improve connectivity;
- To protect the extent and condition of Cultural Heritage (Indigenous and non-Indigenous) sites associated with waterways; and
- To increase community capacity for, awareness of and participation in waterway management.

7.2 ENVIRONMENTAL OBJECTIVES AND TARGETS

Environmental objectives represent the desired environmental outcomes of the site based on the management goal, above, as well as the key values outlined in the Water Dependent Values section. It is intended that EWMP objectives will be described in terms of the primary environmental outcomes, in most cases ecological attributes. The focus of the objectives should be on the final ecological outcomes and not the drivers per se.

During 2020, the environmental objectives (formally ecological objectives) undertook a refinement process with the intent of improving the specificity and measurability of the objectives through the development of targets, and to improve line of sight to the Basin Plan. While the process attempted to maintain the intent and integrity of the original objectives, it provided an opportunity to reassess the suitability of these objectives for the asset. The rationalisation, assessment of SMARTness, mapping to Basin Plan and update of each objective for Piambie can be found in Section 5.21 of Butcher et al. (2020).

The outcome of the refinement process in 2020 resulted in the consolidation of the original four objectives into three concise objectives. Updated objective numbering is consistent with Butcher et al (2020).

While every attempt has been made to make the following objectives and targets as complete as possible, there still remains gaps in critical information. As such, baselines are not able to be set at this time. In the interests of moving forward, the objectives and targets have been written in a way (i.e. red highlighted text) that

allows this information to be included at a later stage as this information becomes available.

Table 11. Environmental objectives and targets for Piambie

EWMP Objective	Target
P1: By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) and Black Box (*E. largiflorens*) and to sustain communities and processes reliant on such communities at Bridge Creek and Bridge Creek Floodplain, Piambie.	By 2030, condition in standardised transects that span the floodplain elevation gradient and existing spatial distribution at Bridge Creek and Bridge Creek Floodplain, Piambie, ≥70% of Lignum plants in good condition with a Lignum Condition Score (LCI) ≥4. AND By 2030 a positive trend in the condition score of Black Box dominated EVC benchmarks at Bridge Creek and Bridge Creek Floodplain, Piambie at 80% of sites over the 10 year period OR By 2030, at stressed sites (see Wallace et al. 2020) at Bridge Creek and Bridge Creek Floodplain, Piambie: in standardised transects that span the floodplain elevation gradient and existing spatial distribution, ≥70% of viable trees will have a Tree Condition Index Score (TCI) ≥ 10 by 2030
P2a: By 2030, improve vital habitat at Fishers Lagoon Complex and Piambie Bends East and West, Piambie by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicators Groups.	By 2030, increase diversity of native of macrophytes at Fishers Lagoon Complex and Piambie Bends East and West, Piambe with ≥2 species from each of the following Water Regime Indicator Groups present in 80% of years: • Aquatic (small floating) (Asf) (no species recorded) • Aquatic (obligate submerged) (Aos) (no species recorded) • Aquatic (submerged to partially emergent) (Ase) (no species recorded) • Aquatic graminoids (persistent) (Agp) (no species recorded) • Aquatic to semi-aquatic (persistent) (Asp) (Common Blown-grass *Lachnagrostis filiformis s.l.*, Common Nardoo *Marsilea drummondii*) • Seasonally immersed – low growing (Slg) (Common Woodruff *Asperula conferta,* Spreading Goodenia *Goodenia heteromera*, Rough Raspwort Haloragis aspera, River Bluebell Wahlenbergia fluminalis) • Seasonally inundated – emergent non woody (Sen) (Spiny Flat-sedge *Cyperus gymnocaulos*, Warrego Summer-grass *Paspalidium* jubiflorum) • Seasonally inundated – emergent woody (Sew) (no species recorded) • Mud herbs (Muh) (Western Bitter-cress *Cardamine lineariloba*, Australian Hollyhock *Malva weinmanniana*)
P2b: By 2030, improve condition and maintain extent from baseline levels of River Red Gum (*Eucalyptus camaldulensis*) to sustain communities and processes reliant on mature River Red Gum at Fishers Lagoon Complex and Piambie Bends East and West, Piambie	By 2030, a positive trend in the condition score of River Red Gum dominated EVC benchmarks Fishers Lagoon Complex and Piambie Bends East and West, Piambie at 80% of sites over the 10 year period OR By 2030, at stressed sites (see Wallace et al. 2020) Fishers Lagoon Complex and Piambie Bends East and West, Piambe: in standardised transects that span the floodplain elevation gradient and existing spatial distribution, ≥70% of viable trees will have a Tree Condition Index Score (TCI) ≥ 10. Baseline condition of trees at Murrumbidgee Junction to be established.

7.3 REGIONAL SIGNIFICANCE

Piambie supports a range of environmental values of local, regional and Basin significance as described in Section 5. These values are linked to the management goals and environmental objectives and targets described in Section 7. Details of the links between the environmental objectives and environmental outcomes at a regional/Basin scale are provided in Appendix 6.

The management goals and environmental objectives and targets are aligned with the goals of the Mallee Waterway Strategy as described in Section 7.1. The Mallee Waterway Strategy identifies Fishers Lagoon and Bridge Creek wetland as medium

priority wetlands within the Heywood WMU. Bridge Creek is a high priority reach with the Heywood WMU.

7.4 ALIGNMENT TO BASIN PLAN

The primary environmental outcome of the Basin Plan is the protection and restoration of water-dependent ecosystems and ecosystem functions in the Murray-Darling Basin, with strengthened resilience to a changing climate. The MDBA is required to measure progress towards achieving the objectives of the Basin Plan Environmental Watering Plan (EWP) (Chapter 8 of the Basin Plan) by using the targets in Schedule 7 and having regard to the long-term average sustainable diversion limits, ecological objectives and ecological targets. These are set out in Long-Term Watering Plans (LTWP), the Basin-wide Environmental Watering Strategy (BWS) and annual Basin environmental watering priorities. Details on the alignment of the updated Piambie EWMP environmental objectives to the Basin Plan are provided in Table 13 and Appendix 6.

Table 12. Mapping updated Piambie EWMP objectives to Basin Plan

EWMP Objective	Alignment with Basin Plan		
	8.05 Ecosystem and biodiversity	8.06 Ecosystem function	8.07 Ecosystem resilience
P1: By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) and Black Box (*E. largiflorens*) and to sustain communities and processes reliant on such communities at Bridge Creek and Bridge Creek Floodplain, Piambie.	8.05,3(b)	n/a	n/a
P2a: By 2030, improve vital habitat at Fishers Lagoon Complex and Piambie Bends East and West, Piambie by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicators Groups.	8.05,3(b)	8.06,6(b)	n/a
P2b: By 2030, improve condition and maintain extent from baseline levels of River Red Gum (*Eucalyptus camaldulensis*) to sustain communities and processes reliant on mature River Red Gum at Fishers Lagoon Complex and Piambie Bends East and West, Piambie	8.05,3(b)	8.06,6(b)	n/a

8 Environmental Water Requirements and Intended Water Regime

8.1 WATERING REQUIREMENTS AND INTENDED WATERING REGIME

The management objectives at Piambie focus on providing a flow regime that more closely reflects natural events, to improve the capacity of the target area to provide a productive ecosystem for native flora and fauna.

Seasonal emergent and semi-emergent macrophytes may occur within the target area wetlands. Flood requirements vary depending on species, however annual inundation may encourage germination, vegetative growth and/or reproduction (Rogers & Ralph 2011). Durations of six to twelve months are required to sustain vigorous growth. Following natural seasonality is encouraged.

River Red Gum trees fringe Bridge Creek and all target area wetlands. River Red Gum Woodlands require flooding every two to four years with durations of two to four months. Flood events may differ and a variance in ponding duration around the mean requirement for this species is encouraged. Although the timing of flooding is not vital for River Red Gums, spring-summer flooding encourages greater growth. Timing is important for understorey plant communities, however. The critical interval for Red Gum Woodlands is five to seven years to prevent deterioration of tree condition (Roberts & Marston 2011).

Black Box stands occur predominantly along Bridge Creek and on the Bridge Creek Floodplain. Black Box occurs on higher levels of the floodplain and requires flooding to occur every three to seven years with durations of two to six months. This species can tolerate shorter flood durations but plant vigour will suffer. Although timing of flood events is not crucial for Black Box it will affect understorey and other woodland flora. Black Box trees may survive prolonged periods of 12 to 16 years with no flooding but tree health will suffer and woodlands will become dysfunctional (Roberts & Marston 2011).

Lignum is a dominant species on higher elevations of the Bridge Creek floodplain and at Fishers Lagoon Complex. Lignum can tolerate a wide range of wet and dry conditions as well as moderate salinity levels. Flood requirements vary with frequencies of one to three years needed to maintain large shrubs with vigorous canopy and flooding every three to five years for maintenance of healthy shrubs. Intervals of seven to ten years can be tolerated by small shrubs but growth will decline and these plants do not accommodate nesting by birds. Durations of three to seven months is required to sustain vigorous canopy, but continuous flooding is detrimental. Although timing of flooding is not crucial for Lignum, following natural seasonality is encouraged to provide for understorey and wetland plants (Roberts & Marston 2011).

The environmental water requirements below have been derived from the environmental objectives and targets and following a review of pre-regulation hydrology data. The intended watering regime is anticipated to deliver the environmental water requirements for the target area with current infrastructure. Watering requirements and the intended water regime are described below and summarised in Table 13. Due to the inter-annual variability of these estimates (due to climatic conditions), determination of the predicted volume requirements in any given year will need to be undertaken by the environmental water manager when watering is planned.

8.1.1 Fishers Lagoon, Bridge Creek and Floodplain

Fishers Lagoon Complex has a requirement for greater frequency and longer duration of inundation compared to Bridge Creek and Floodplain. Thus, the watering regime proposed is targeted at firstly the River Red Gum, Black Box and Lignum communities at a lower frequency, and secondly at delivering water via Bridge Creek to the Lagoons and Wetland, for retention over several years. The optimal watering regime is to:

Inundate the length of Bridge Creek and Fishers Lagoon Complex three years in ten with a maximum interval of seven years between events.
Maintain water in the creek and on the floodplain for three months to improve health of fringing River Red Gum and floodplain Black Box and Lignum.
Allow Fishers Lagoon Complex to recede slowly (it is expected water will be retained in Fishers Lagoon Complex for 2 years)
Fishers Lagoon Complex is to be inundated six in ten years, encouraging aquatic macrophyte diversity.

8.1.2 Piambie Bend East and West

Environmental water has not yet been delivered to Piambie Bends East and West, and levees are required to retain water on the floodplains. The optimal watering regime is to:

Inundate the wetlands and fringing River Red Gum Woodlands six times in ten years with a maximum interval of three years between events.
Maintain water on the floodplain for two months to maintain the health of River Red Gum communities.
Allow ponding in Piambie Bend West for four months to maintain wetland function.
Allow natural recession and ponding for six to twelve months in deeper areas of Piambie Bend East.

Table 13. Intended watering regime for Piambie target area

Objective	Mean frequency of events (number per 10 yrs)			Tolerable interval between events (years)		Duration of ponding (months)			Timing of inflows
	Min	Opt	Max	Min	Max	Min	Opt	Max	
P1: Improve condition and maintain extent of Lignum	3	5	10	1	7	3	5	7	Winter / Spring
P1: Improve condition and maintain extent of Black Box	2	3	3	3	10	2	4	6	Winter / spring
P2a: Improve vital habitat by increasing the diversity of aquatic macrophytes	3	6	10	0	3	1	6	12	Winter / Spring
P2b: Improve condition and maintain extent of River Red Gum	3	4	7	2	7	2	3	8	Spring / Summer

8.2 EXPECTED WATERING EFFECTS

This section aims to explicitly outline the potential watering actions and expected watering effects needed to achieve the stated environmental objective.

Table 14. Expected watering effects and potential watering action required to achieve environmental objectives

Objective code	Environmental Objective	Potential Watering Action	Expected Watering Effect
P1	By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) and Black Box (*E. largiflorens*) and to sustain communities and processes reliant on such communities at Bridge Creek and Bridge Creek Floodplain, Piambie.	Maintain regular flooding every 3 years, with ponding of 3-7 months duration. Allow water levels to receded over Summer / Autumn	Maintain appropriate seasonal variation in water levels to improve condition and extent of Lignum and Black Box.
P2a	By 2030, improve vital habitat at Fishers Lagoon Complex and Piambie Bends East and West, Piambe by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicators Groups.	Maintain regular flooding every 6 years, with ponding of 6 months duration. Allow water levels to receded over Summer / Autumn	Inundate areas of exposed sediments in Spring to increase aquatic macrophyte extent.
P2b	By 2030, improve condition and maintain extent from baseline levels of River Red Gum (*Eucalyptus camaldulensis*) to sustain communities and processes reliant on mature River Red Gum at Fishers Lagoon Complex and Piambie Bends East and West, Piambie.	Maintain regular flooding every 4 years with varying ponding duration. Allow water levels to receded over Autumn	Maintain appropriate seasonal variation in water levels to improve condition and extent of River Red Gum.

8.3 SEASONALLY ADAPTIVE APPROACH

To allow for adaptive and integrated management, the watering requirements have been framed using an adaptive approach which identifies priorities for environmental watering under different seasonal conditions. This means that a watering regime is identified for optimal conditions, as well as the maximum and minimum tolerable watering scenarios. The planning scenarios under different seasonal conditions for Piambie are described in Figure 17. The example watering actions presented in Figure 16 are indicative of the actions that may be delivered under the various planning scenarios. Other factors such as the condition of the site, recent watering history and forecast water availability will also influence the watering actions that are delivered.

Figure 16. Indicative seasonally adaptive approach

9 Environmental Water Delivery Infrastructure

9.1 WATER DELIVERY INFRASTRUCTURE

The existing arrangements limit the extent of area that can be inundated by environmental watering at Piambie. Current infrastructure consists of:

A low track crossing between Fishers Lagoon East and West that provides public access to the floodplain and a private pump site.

Three regulators on Fishers Lagoon Complex that were constructed to retain water for irrigation (Figures 18 to 20). These regulators are in a deteriorated condition, and significant maintenance is required for these to be used for water delivery.

Figure 17. Photograph of a regulator structure still in use near the western end of Fishers Lagoon West

Figure 18. Photograph taken of a regulator structure in disrepair, this structure is located on the creek inlet to Central Fishers Lagoon

Figure 19. Photograph taken of a regulator structure not in use near the eastern end of Fishers Lagoon West.

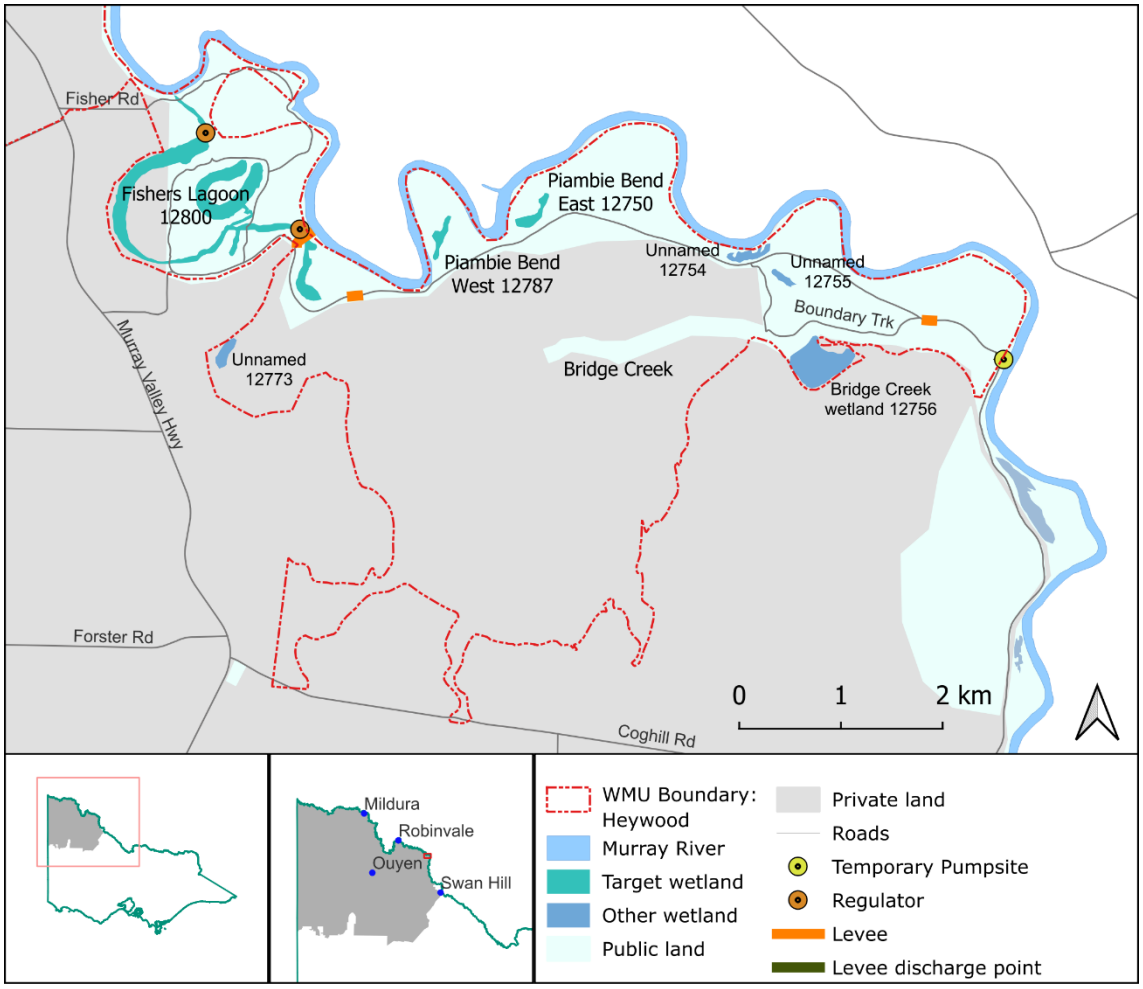

Figure 20. Location of temporary infrastructure at Piambie

9.2 CONSTRAINTS

The most significant constraints to returning the Piambie system to a more natural water regime include the ability to hold back water in Bridge Creek to inundate the floodplain, and the ability to retain water in the Fishers Lagoon Complex at a sufficient depth.

Bridge Creek can currently receive environmental water using a diesel pump, pumping from the River Murray at the upstream connection point. By continuing to pump water into the creek, water flows across the floodplain towards, and eventually connects with, the Fishers Lagoon Complex. This involves inundation of approximately 364 ha, requiring approximately 1,580 ML of environmental water, however infrastructure is required to retain water on the floodplain and efficiently inundate the target area. Local knowledge suggests the Fishers Lagoon Complex retains water for several years after inundation, as do several deeper pools within Bridge Creek (Ecological Associates 2006). It may be suitable to inundate Bridge Creek through to Fishers Lagoon Complex in some years, and merely the Creek and Floodplain in other years.

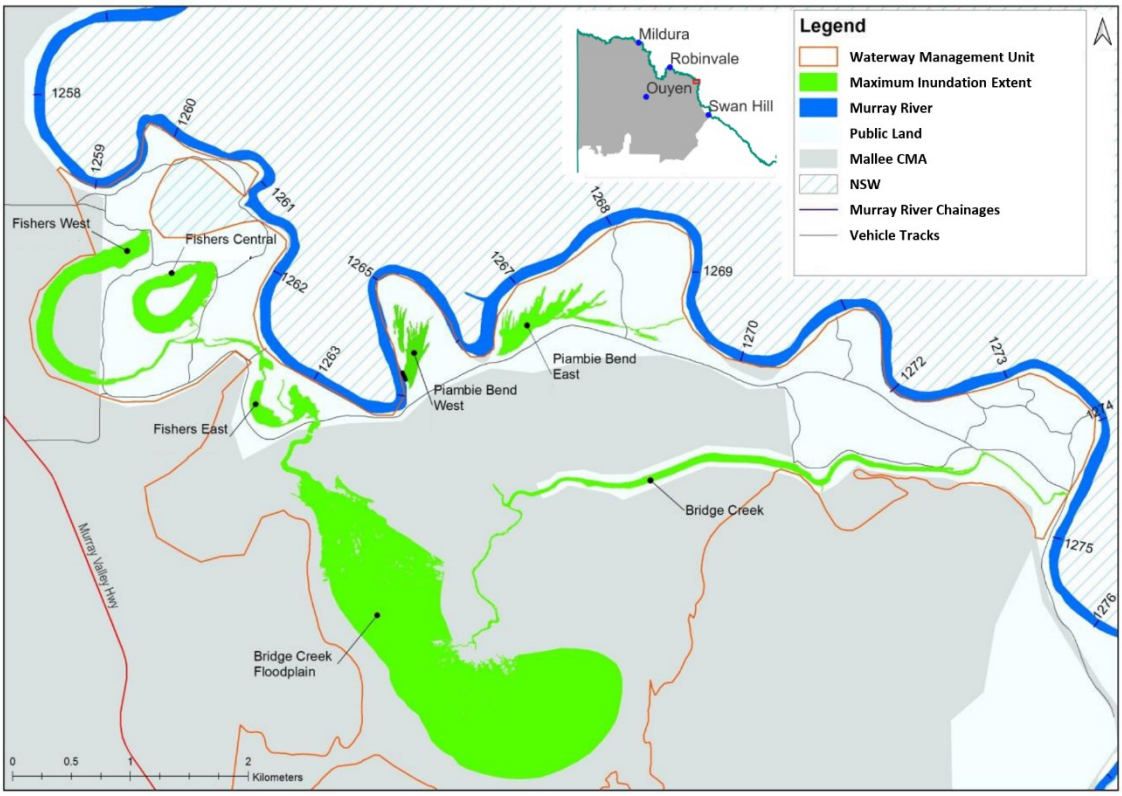

Figure 21. Maximum achievable inundation extent through temporary pumping

10 Demonstrating Outcomes

10.1 ENVIRONMENTAL MONITORING

The following priorities for monitoring have been identified for the Piambie target area (Table 16). These monitoring priorities will enable environmental water managers to assess progress against targets and assist in the adaptive management of the target area to achieve the stated environmental objectives and outcomes. The link between stated objectives and monitoring priorities are described in Table 15.

Table 15. Links between environmental objectives, monitoring questions and monitoring priorities

Objective	Monitoring Focus	Monitoring Questions	Method	When
Overarching management objective	Wetland Condition	Has there been an overall rehabilitation in the condition of the target area by 2030?	Undertake IWC method assessment	Every 5 years
P1	Condition and extent of Lignum	By 2030, are ≥70% of Lignum plants in good condition with a Lignum Condition Score (LCI) ≥4?	Undertake Lignum population monitoring using standardised transects that span the floodplain elevation gradient and existing spatial distribution	Every three years

Objective	Monitoring Focus	Monitoring Questions	Method	When
P1	Condition and extent of Black Box	Is the condition of Black Box improving? What is the extent of Black Box compared to the baseline? Are new trees being recruited into the forest and woodland populations?	Evaluate survival of seedlings over a 15 year period, transect survey and Tree Condition Index (TCI) score assessments, photo point monitoring, remote sensing	Annually
P2a	Diversity of aquatic macrophytes	By 2030 has there been an increase in diversity of aquatic macrophytes with ≥2 species from each of the listed Water Regime Indicator Groups present in 80% of years?	Undertake surveys of aquatic macrophytes at Fishers Lagoon Complex and Piambie Bends East and West (including species ID and extent). Compare results against benchmark of initial survey.	Every three years
P2b	Condition and extent of River Red Gum	Is the condition of River red gum improving? What is the extent compared to the baseline? Are new trees being recruited into the forest and woodland populations?	TSC tool, field assessments Evaluate survival of seedlings over a 15 year period, transect survey and Tree Condition Index (TCI) score assessments, photo point monitoring, remote sensing	Annually

10.2 MONITORING PRORITIES AT THE ASSET

Ecological monitoring is required to demonstrate the effectiveness of environmental watering in achieving ecological objectives, to help manage environmental risks and to identify opportunities to improve the efficiency and effectiveness of the program. The broad program logic for the lake is:

- Objectives (Section 7.2)
- Environmental flows to provide:
    - Vegetation habitat
- Outcomes
    - River red gum condition
    - Black box condition

The highest priorities for monitoring at Piambie are the monitoring questions that most strongly influence watering decisions and the evaluation of watering effectiveness.

All these priorities align with the following long-term outcomes of the Mallee Regional Catchment Strategy Waterway theme:

- The condition of high value aquatic and riparian habitat is improved
- Appropriate water regimes are restored to priority waterways and connectivity is improved.

Table 16. Monitoring priorities at Piambie

Monitoring Priority	Reason for Priority
Water delivery	Adaptive management: water is managed to meet EWMP objectives.
Index of wetland condition assessments	These provide information on changes in hydrology and water quality that impact on flora and fauna
Black Box stand condition and extent	To develop baselines to assist condition assessments. Key for assessing progress against objectives of the Basin Plan Environmental Watering Plan (EWP), Basin Plan Schedule 7 targets, Basin wide Environmental Watering strategy (BWS) and Victorian Murray Long Term Watering Plan. Black Box stands are an important long-term indicator of the effectiveness of environmental water.
River Red Gum stand condition and extent	To develop baselines to assist condition assessments. Key for assessing progress against objectives of the Basin Plan Environmental Watering Plan (EWP), Basin Plan Schedule 7 targets, Basin wide Environmental Watering strategy (BWS) and Victorian Murray Long Term Watering Plan.
Lignum condition and extent	To develop baselines to assist condition assessments. Key for assessing progress against objectives of the Basin Plan Environmental Watering Plan (EWP), Basin Plan Schedule 7 targets, Basin wide Environmental Watering strategy (BWS) and Victorian Murray Long Term Watering Plan.
Diversity of aquatic macrophytes	To develop baselines to assist condition assessments. Key for assessing progress against objectives of the Basin Plan Environmental Watering Plan (EWP), Basin Plan Schedule 7 targets, Basin wide Environmental Watering strategy (BWS) and Victorian Murray Long Term Watering Plan.
Species surveys in the target area	To develop baselines to assist condition assessments. Key for assessing progress against objectives of the Basin Plan Environmental Watering Plan (EWP), Basin Plan Schedule 7 targets, Basin wide Environmental Watering strategy (BWS) and Victorian Murray Long Term Watering Plan.
Structure, composition and condition of riparian vegetation (and its capacity to support critical habitat)	To develop baselines to assist condition assessments. Key for assessing progress against objectives of the Basin Plan Environmental Watering Plan (EWP), Basin Plan Schedule 7 targets, Basin wide Environmental Watering strategy (BWS) and Victorian Murray Long Term Watering Plan.

11 Adaptive Management

Mallee CMA uses an adaptive management approach in planning and managing environmental watering actions.

Adaptive management is the process of incorporating new scientific and operational information into the implementation of a project or plan to ensure that management actions are appropriate, effective and contribute to goals efficiently. It is a standard and well-established practice for environmental water management, recognising the inherent uncertainties and risks associated with the complex relationships between changes to hydrology and ecological responses, and the potential for a watering event to provide both positive and adverse outcomes. Figure 23 shows an illustration of the adaptive management cycle for environmental water delivery.

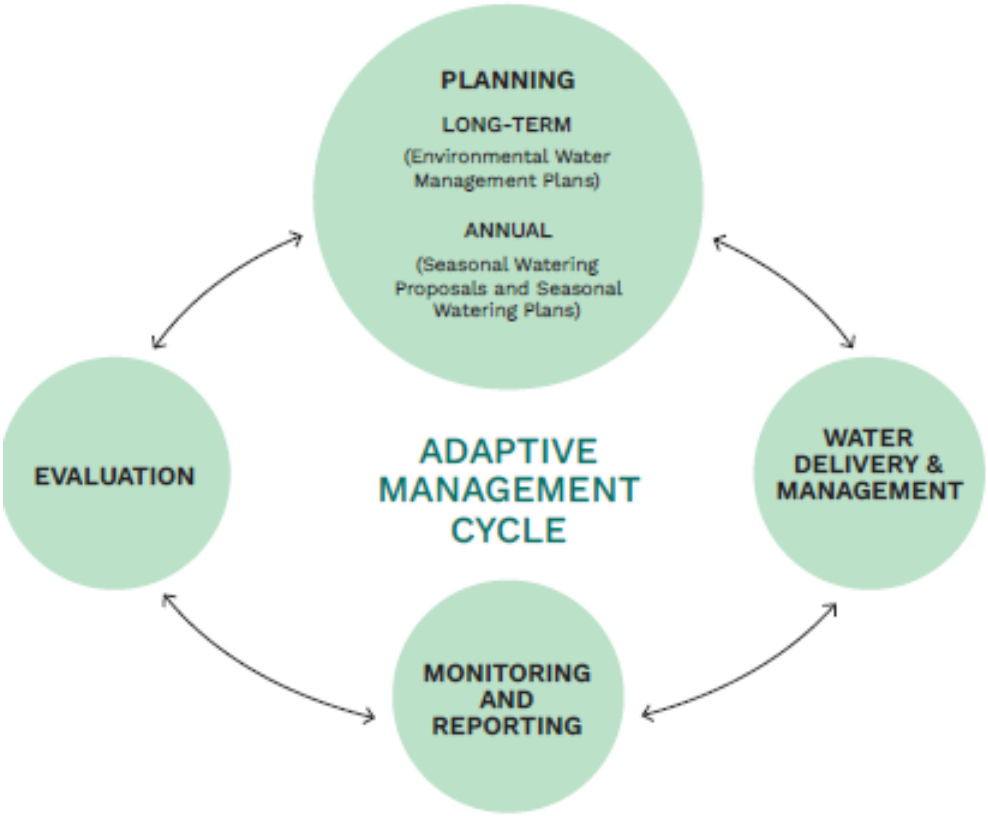

Figure 22. The adaptive management cycle for environmental water delivery and management

Mallee CMA uses three main pathways to identify inputs to the adaptive management process (also referred to as lessons):

- monitoring to detect differences between what was planned and the outcomes at the environmental watering site
- incidental observations by managers, operators or other observers that identify opportunities to reduce risk or improve outcomes
- research or investigations into hydraulic or ecological management practices that could improve the conceptual models on which operations are based.

Mallee CMA formally documents lessons to strengthen organisational memory and provide transparency in continual improvement measures. Recording of lessons is crucial for both annual environmental watering actions and long-term planning. Demonstrating continual improvement provides the justification for monitoring programs and confirms that assets are being managed responsibly.

An adaptive management framework has several components that work together to build lessons learned from environmental watering actions and program partners into the environmental water program. This produces iterative improvements in the way environmental watering is undertaken using the best available evidence.

The EWMP will be constantly refined to incorporate learnings from ecological monitoring as well as feedback from community consultation.

Land managers and river operators are included in the operational planning cycle which include adaptive management processes to incorporate learnings and risk management.

12 Knowledge gaps and recommendations

This plan is based on best information at the time of writing. In some cases, information is scarce or outdated. Further investigation and information collection will continue and the results of this further work will continue to build a better picture of the site and add rigor to future planning. Some areas where further knowledge would be beneficial are outlined in Table 18. Any future monitoring plan could include a number of these recommendations.

Table 17. Knowledge gaps and recommendations for the target area

Knowledge and data gaps	Action recommended	Responsibility
Map and quantify population of Tough Scurf-pea (*Cullen tenax*)	Survey to quantify extent and size of population, map key areas, during growing season (Sept-May), identify exclusion zones for earthworks. Ongoing monitoring to assess effects of water delivery.	Implementation of any of these recommendations would be dependent on investment from Victorian and Australian Government funding sources as projects managed through the Mallee CMA
Index of Wetland Condition/ Index of Stream Condition Assessments	IWC/ISC assessments undertaken to establish baseline condition and as the basis for ongoing monitoring of improvement over time	
Flow path of Bridge Creek	Use existing aerial imagery to map flow path and update Mallee CMA GIS data, ground truth as part of ISC assessment, or obtain/update LiDAR data. Estimate ctf for all wetlands and update records accordingly. Cultural heritage assessment and mapping of values within target area.	
Accurate *ctf* values		
Full extent of cultural Heritage values		
Impact of watering program on native vegetation	Continue to investigate and understand the range of species at the site, including surveys of vegetation, including aquatic macrophytes.	
Condition and extent of Black Box stands, River Red Gum stands, and Lignum and aquatic macrophytes.	Undertake methods identified in Table 16.	
Species present in the target area	Species surveys and ecological assessments of the capacity of the site to support critical habitat	
Structure, composition and condition of riparian vegetation (and its capacity to support critical habitat)	Species surveys, ecological assessments of vegetation structure (including leaf litter and hollow logs) and condition. Use of drones for large-scale condition assessment.	
Landholder Management Agreements	Landholder agreements should be signed outlining the proposed watering regimes and any inundation of private land.	
Operating rules for structures	Development of operating rules for structures and each wetland within the target area.	

Knowledge and data gaps	Action recommended	Responsibility
Condition of current infrastructure on-site – particularly the regulators at the Fishers Lagoon complex.	Assessment undertaken on current condition of infrastructure on-site.	

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APPENDIX 1. ENVIRONMENTAL WATER MANAGEMENT PLAN CONTEXT

Environmental water in Victoria is managed as an integral part of the Victorian Waterway Management Program. The state-level Victorian Waterway Management Strategy (VWMS) provides the overarching framework for environmental water management (see accompanying figure). The Mallee Waterway Strategy (2014-22) drives implementation of the VWMS at the regional level. Information from the Mallee Waterway Strategy is a key input to environmental water planning arrangements, including the selection of eligible assets to receive environmental water. Environmental water management plans are site-specific plans developed for a wetland or wetland complex deemed a priority to receive environmental water through the Mallee Waterway Strategy development process. This document is the Environmental Water Management Plan (EWMP) for Piambie in the Mallee Catchment Management region.

Environmental watering in the Mallee Region has historically been supported by management plans such as this one, that document key information including the watering requirements of an asset, predicted ecological responses and water delivery arrangements. These plans support annual decisions about which sites should receive water and assist managers to evaluate how well those assets respond to the water they receive or what could be done better. Environmental water management at Piambie is further underpinned by the Murray-Darling Basin Plan 2012 (Commonwealth) and the associated Basin-wide environmental watering strategy. In accordance with Basin Plan requirements, Victoria has also developed the Victorian Murray Water Resource Plan and Victorian Murray Long-Term Watering Plan, which apply at Piambie.

Mallee Catchment Management Authority (MCMA), the Victorian Department of Energy, Environment and Climate Action (DEECA), the Victorian Environmental Water Holder (VEWH) and Traditional Owner groups have worked together to develop several EWMPs for watered assets throughout the Mallee region. These plans are continually updated through an adaptive management process. A primary purpose of EWMPs is to provide a consistent set of documents that support seasonal watering proposals to be submitted by asset managers to the VEWH annually.

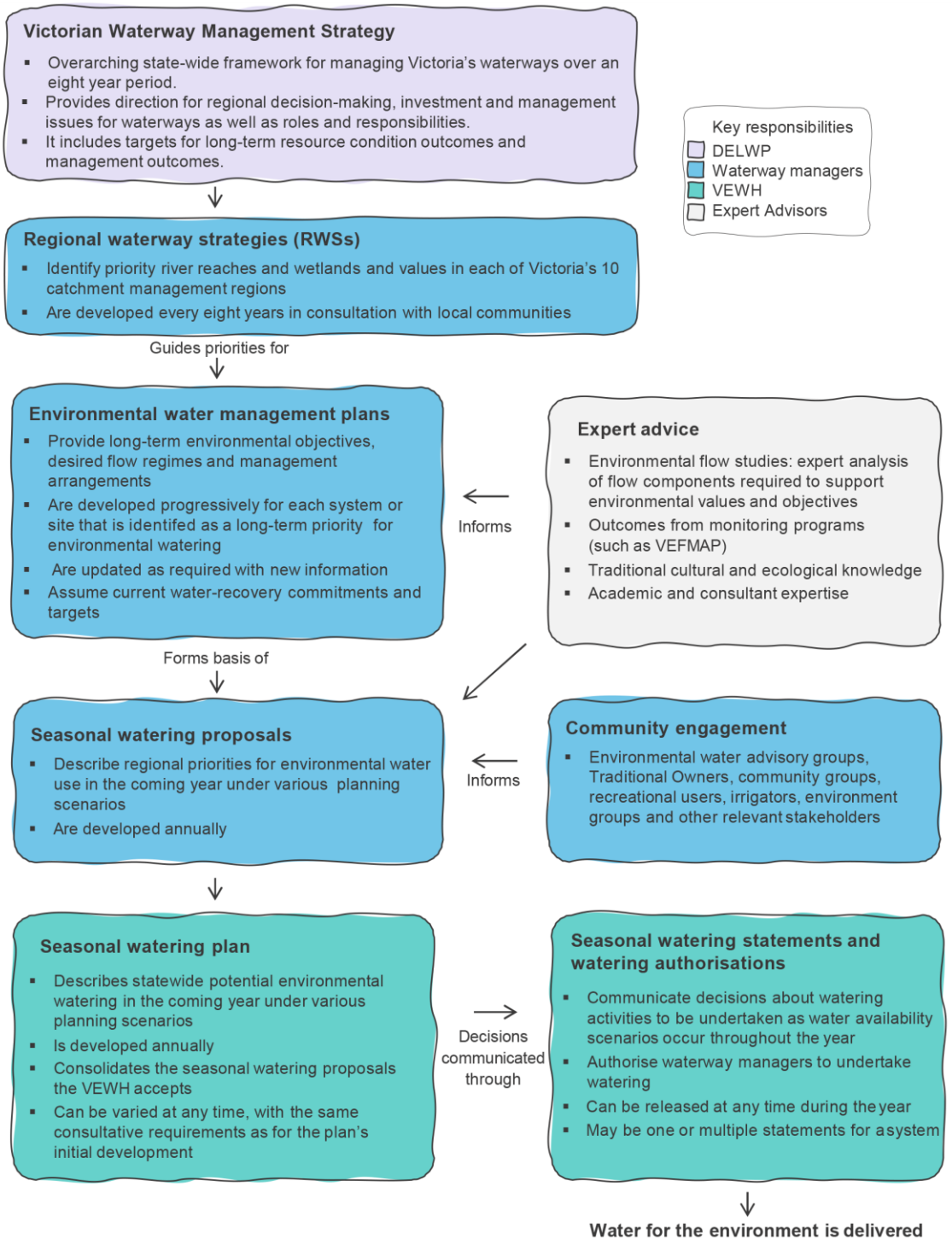

Figure 23. EWMP policy context.

APPENDIX 2. ECOLOGICAL VEGETATION CLASSES

EVC no.	EVC name	Bioregional conservation status	Description
103	Riverine Chenopod Woodland	Endangered	Eucalypt woodland to 15 m tall with a diverse shrubby and grassy understorey occurring on most elevated riverine terraces. Confined to heavy clay soils on higher level terraces within or on the margins of riverine floodplains (or former floodplains), naturally subject to only extremely infrequent incidental shallow flooding from major events if at all flooded.
104	Lignum Swamp	Vulnerable	Typically treeless shrubland to 4 m tall, with robust (but sometimes patchy) growth of lignum. Widespread wetland vegetation type in low rainfall areas on heavy soils, subject to infrequent inundation resulting from overbank flows from rivers or local runoff.
106	Grassy Riverine Forest	Depleted	Occurs on the floodplain of major rivers, in a slightly elevated position where floods are infrequent, on deposited silts and sands, forming fertile alluvial soils. River Red Gum forest to 25 m tall with a groundlayer dominated by graminoids. Occasional tall shrubs present.
200	Shallow Freshwater Marsh	Vulnerable	Shallow Freshwater Marsh occupies open sheets of water which are usually perennial although contract in size during the drier months. Large stands of River Red Gum or Lignum are often found around shallow freshwater marshes, with reeds, rushes and Cane Grass, or low-growing herbs and sedges, dominating the vegetation. Shallow Freshwater Marsh also occurs on deep brown anaerobic) silts where creeks and rivers broaden and flow slows as the water enters floodplains.
295	Riverine Grassy Woodland	Vulnerable (Terrestrial BCS)	Occurs on the floodplain of major rivers, in a slightly elevated position where floods are rare, on deposited silts and sands, forming fertile alluvial soils. River Red Gum woodland to 20 m tall with a groundlayer dominated by graminoids and sometimes lightly shrubby or with chenopod shrubs.
809	Floodplain Grassy Wetland	Endangered	Wetland dominated by floating aquatic grasses (which persist to some extent as turf during drier periods), occurring in the most flood-prone riverine areas. Typically treeless, but sometimes with thickets of saplings or scattered more mature specimens of River Red Gum. Occupies temporary shallow lakes in the most flood-prone riverine areas, also occurs as a narrow intermediate band around some floodway ponds.
810	Floodway Pond Herbland	Depleted	Low herbland to < 0.3 m tall with occasional emergent life forms, usually with a high content of ephemeral species. Floors of ponds associated with floodway systems. Typically heavy deeply cracking clay soils. Characteristically smaller wetlands with a more regular flooding and drying cycle in comparison to sites supporting Lake Bed Herbland.
811	Grassy Riverine Forest/ Floodway Pond Herbland Complex	Vulnerable	Eucalypt dominated forest or woodland of flood-prone areas, where herbaceous species characteristic of drying mud within wetlands (Floodway Pond Herbland [EVC 810] or in part Lake Bed Herbland [EVC 107]) are conspicuous in association or fine-scale mosaic with Paspalidium jubiflorum and other species characteristic of Grassy Riverine Forest (EVC 106). Restricted extent, River Murray system mainly in far north-west, but upstream at least as far as Barmah Forest.
813	Intermittent Swampy Woodland	Endangered	Eucalypt woodland to 15 m tall with a variously shrubby and rhizomatous sedgy – turf grass understorey, at best development dominated by flood stimulated species in association with flora tolerant of inundation. Flooding is unreliable but extensive when it happens. Occupies low elevation areas on river terraces (mostly at the rear point-bar deposits or adjacent to major floodways) and lacustrine verges (where sometimes localised to narrow transitional bands). Soils often have a shallow sand layer over heavy and frequently slightly brackish soils.

818	Shrubby Riverine Woodland	Least Concern (Terrestrial BCS)	Eucalypt woodland to open forest to 15 m tall of less flood-prone (riverine) watercourse fringes, principally on levees and higher sections of point-bar deposits. The understorey includes a range of species shared with drier floodplain habitats with a sparse shrub component, ground-layer patchily dominated by various life-forms. A range of large dicot herbs (mostly herbaceous perennial, several with a growth-form approaching that of small shrub) are often conspicuous.
823	Lignum Swampy Woodland	Vulnerable	Understorey dominated by Lignum, typically of robust character and relatively dense (at least in patches), in association with a low Eucalypt and/or Acacia woodland to 15 m tall. The ground layer includes a component of obligate wetland flora that is able to persist even if dormant over dry periods.

APPENDIX 3. FAUNA SPECIES LIST

Table 18. Piambie Fauna Species List

Scientific Name	Common Name	Type
Gymnorhina tibicen	Australian magpie	B
Pelecanus conspicillatus	Australian pelican	B
Corvus coronoides	Australian raven	B
Chenonetta jubata	Australian wood duck	B
Elseyornis melanops	Black-fronted dotterel	B
Northiella haematogaster	Blue bonnet	B
Entomyzon cyanotis	Blue-faced honeyeater	B
Climacteris picumnus	Brown treecreeper	B
Melithreptus brevirostris	Brown-headed honeyeater	B
Morelia spilota metcalfei	Carpet python	R
Pomatostomus ruficeps	Chestnut-crowned babbler	B
Acanthiza uropygialis	Chestnut-rumped thornbill	B
Phaps chalcoptera	Common bronzewing	B
Crinia signifera	Common froglet	A
Ocyphaps lophotes	Crested pigeon	B
Platycercus eximius	Eastern rosella	B
Crinia parinsignifera	Eastern sign-bearing froglet	A
Dromaius novaehollandiae	Emu	B
Oryctolagus cuniculus	European rabbit*	M
Cacomantis flabelliformis	Fan-tailed cuckoo	B
Eolophus roseicapilla	Galah	B
Rhipidura albiscapa	Grey fantail	B
Colluricincla harmonica	Grey shrike-thrush	B
Anas gracilis	Grey teal	B
Macropus spp.	Kangaroo	M
Dacelo novaeguineae	Laughing kookaburra	B
Hieraaetus morphnoides	Little eagle	B
Philemon citreogularis	Little friarbird	B
Microcarbo melanoleucos	Little pied cormorant	B
Grallina cyanoleuca	Magpie-lark	B
Barnardius zonarius barnardi	Mallee ringneck	B
Dicaeum hirundinaceum	Mistletoebird	B
Manorina melanocephala	Noisy miner	B
Anas superciliosa	Pacific black duck	B
Cracticus nigrogularis	Pied butcherbird	B
Sus scrofa	Pig (feral)*	M
Merops ornatus	Rainbow bee-eater	B
Vulpes vulpes	Red fox*	M

Scientific Name	Common Name	Type
Petroica goodenovii	Red-capped robin	B
Psephotus haematonotus	Red-rumped parrot	B
Cincloramphus mathewsi	Rufous songlark	B
Pachycephala rufiventris	Rufous whistler	B
Todiramphus sanctus	Sacred kingfisher	B
Limnodynastes dumerilii	Southern bullfrog (ssp. unknown)	A
Aphelocephala leucopsis	Southern whiteface	B
Limnodynastes tasmaniensis	Spotted marsh frog (race unknown)	A
Lophoictinia isura	Square-tailed kite	B
Pardalotus striatus	Striated pardalote	B
Plectorhyncha lanceolata	Striped honeyeater	B
Cacatua galerita	Sulphur-crested cockatoo	B
Malurus cyaneus	Superb fairy-wren	B
Aquila audax	Wedge-tailed eagle	B
Smicrornis brevirostris	Weebill	B
Hirundo neoxena	Welcome swallow	B
Macropus fuliginosus	Western grey kangaroo	M
Haliastur sphenurus	Whistling kite	B
Pomatostomus superciliosus	White-browed babbler	B
Ptilotula penicillata	White-plumed honeyeater	B
Corcorax melanorhamphos	White-winged chough	B
Malurus leucopterus	White-winged fairy-wren	B
Lalage tricolor	White-winged triller	B
Rhipidura leucophrys	Willie wagtail	B
Platycercus elegans flaveolus	Yellow rosella	B
Acanthiza nana	Yellow thornbill	B
Ptilotula ornata	Yellow-plumed honeyeater	B
Acanthiza chrysorrhoa	Yellow-rumped thornbill	B

*Introduced species
Lifeform type: Invertebrate (I), Fish (F), Amphibian (A), Reptile (R), Bird (B), Mammal (M)
Source: Naturekit search 2023.

APPENDIX 4. FLORA SPECIES LIST

Table 19. Piambie Flora Species List

Scientific Name	Common Name
fam. Asteraceae gen. Erigeron	
Euchiton sphaericus	Annual cudweed
Tetragonia moorei	Annual spinach
Ehrharta longiflora	Annual veldt-grass*
Symphyotrichum subulatum	Aster-weed*
Daucus glochidiatus	Australian carrot
Malva preissiana s.l.	Australian hollyhock
Osteocarpum acropterum var. deminutum	Babbagia
Atriplex lindleyi subsp. conduplicata	Baldoo
Atriplex semibaccata	Berry saltbush
Erodium botrys	Big heron's-bill*
Eucalyptus largiflorens	Black box
Solanum nigrum s.l.	Black nightshade*
Erodium crinitum	Blue heron's-bill
Maireana spp.	Bluebush
Haloragis glauca f. glauca	Bluish raspwort
Amyema miquelii	Box mistletoe
Plantago coronopus	Buck's-horn plantain*
Bulbine spp.	Bulbine lily
Medicago polymorpha	Burr medic*
Minuria cunninghamii	Bush minuria
Arctotheca calendula	Cape weed*
Alectryon oleifolius subsp. canescens	Cattle bush
Dysphania pumilio	Clammy goosefoot^
Lachnagrostis filiformis s.l.	Common blown-grass
Erodium cicutarium	Common heron's-bill*
Alternanthera nodiflora	Common joyweed
Marsilea drummondii	Common nardoo
Centipeda cunninghamii	Common sneezeweed
Sonchus oleraceus	Common sow-thistle*
Rytidosperma caespitosum	Common wallaby-grass
Asperula conferta	Common woodruff
Atriplex lindleyi subsp. inflata	Corky saltbush
Senecio quadridentatus	Cotton fireweed
Crassula spp.	Crassula
Persicaria prostrata	Creeping knotweed
Brachyscome spp.	Daisy
Enneapogon nigricans	Dark bottle-washers
Vittadinia dissecta s.l.	Dissected New Holland daisy
fam. Convolvulaceae gen. Cuscuta	Dodder

Scientific Name	Common Name
Geococcus pusillus	Earth cress
Maireana pentatropis	Erect bluebush
Acacia stenophylla	Eumong^
Reichardia tingitana	False sow-thistle*
Vulpia spp.	Fescue*
Juncus subsecundus	Finger rush
Actinobole uliginosum	Flannel cudweed
Euphorbia drummondii s.l.	Flat spurge^
Atriplex lindleyi	Flat-top saltbush
Erigeron bonariensis	Flaxleaf fleabane*
Phyla nodiflora var. minor	Fog-fruit*
Malacocera tricornis	Goat head
Goodenia spp.	Goodenia
Eucalyptus microcarpa	Grey box
Sclerolaena muricata var. villosa	Grey roly-poly
Glinus lotoides	Hairy carpet-weed
Trifolium arvense var. arvense	Hare's-foot clover*
Rhagodia spinescens	Hedge saltbush^
Gnaphalium polycaulon	Indian cudweed
Carex inversa	Knob sedge^
Exocarpos aphyllus	Leafless ballart
Maireana aphylla	Leafless bluebush
Alternanthera denticulata s.l.	Lesser joyweed
Centaurea melitensis	Malta thistle*
Medicago spp.	Medic*
Brassica tournefortii	Mediterranean turnip*
Amyema spp.	Mistletoe
Cynodon dactylon var. pulchellus	Native couch
Linum marginale	Native flax
Picris angustifolia	Native picris
Tetragonia spp.	Native spinach
Verbena officinalis var. gaudichaudii	Native verbena
Vittadinia spp.	New Holland daisy
Chenopodium nitrariaceum	Nitre goosefoot
Nitraria billardierei	Nitre-bush
Einadia nutans	Nodding saltbush
Calocephalus sonderi	Pale beauty-heads
Dianella longifolia s.l.	Pale flax-lily
Goodenia glauca	Pale goodenia
Rhodanthe corymbiflora	Paper sunray
Phalaris paradoxa	Paradoxical canary-grass*
Lolium perenne	Perennial rye-grass*
Convolvulus erubescens s.l.	Pink bindweed
Alternanthera sp. 1 (Plains)	Plains joyweed
Plantago spp.	Plantain

Scientific Name	Common Name
Lactuca serriola	Prickly lettuce*
Salsola tragus	Prickly saltwort
Calandrinia spp.	Purslane
Solanum esuriale	Quena
Vulpia myuros	Rat's-tail fescue*
Lotus cruentus	Red bird's-foot trefoil
Bromus rubens	Red brome*
Wahlenbergia fluminalis	River bluebell
Eucalyptus camaldulensis	River red-gum
Brachyscome sp. aff. readeri	Riverina daisy
Maireana rohrlachii	Rohrlach's bluebush
Cressa australis	Rosinweed
Haloragis aspera	Rough raspwort
Austrostipa scabra subsp. falcata	Rough spear-grass
Enchylaena tomentosa var. tomentosa	Ruby saltbush
Scorzonera laciniata	Scorzonera*
Capsella bursa-pastoris	Shepherd's purse*
Maireana brevifolia	Short-leaf bluebush
Sclerochlamys brachyptera	Short-wing saltbush
Rumex brownii	Slender dock
Senecio glossanthus s.l.	Slender groundsel
Goodenia pusilliflora	Small-flower goodenia
Malva parviflora	Small-flower mallow*
Swainsona microphylla	Small-leaf swainson-pea
Hypochaeris glabra	Smooth cat's-ear*
Cirsium vulgare	Spear thistle*
Enteropogon acicularis	Spider grass
Cyperus gymnocaulos	Spiny flat-sedge
Goodenia heteromera	Spreading goodenia
Sphaeromorphaea littoralis	Spreading nut-heads
Vulpia bromoides	Squirrel-tail fescue*
Centaurea calcitrapa	Star thistle*
Sclerolaena tricuspis	Streaked copperburr
Trifolium subterraneum	Subterranean clover*
Swainsona spp.	Swainson pea
Senecio runcinifolius	Tall fireweed
Sclerolaena divaricata	Tangled copperburr
Duma florulenta	Tangled lignum
Cullen tenax	Tough scurf-pea
Lotus spp.	Trefoil
Brassica spp.	Turnip*
Acacia oswaldii	Umbrella wattle
Rytidosperma spp.	Wallaby grass
Paspalidium jubiflorum	Warrego summer-grass^
Pittosporum angustifolium	Weeping pittosporum

Scientific Name	Common Name
Opuntia robusta	Wheel cactus*
Avena fatua	Wild oat*
Sporobolus caroli	Yakka grass
Eclipta platyglossa subsp. platyglossa	Yellow twin-heads^

*Introduced species
Source: Naturekit search 2023.

APPENDIX 5. ASSESSING RISKS

Assessing Risk - Consequence

Prioritising wetland watering is often difficult because there is no framework by which the fate of different species can be compared. To support prioritization, this guide seeks to put each wetland and its associated species within a regional context. The process can also be used when communicating the rationale behind decisions or support engagement by providing a framework for discussion.

The process is presented in Figure A1, with a more detailed explanation provided in Tables A1 and A2.

Table A1.

Row	Question	Rationale	Response	Risk	Go To
1	Will the species persist *in situ*?	If the species will survive without intervention, It becomes a lower priority	Yes	Low	
			No		Row 2
2	Will the species persist in a connected refuge?	If the species has the capacity (its own capability and appropriate connectivity) to survive, it becomes a lower priority	Yes		Table 2
			No		Row 3
3	Is the species common?	If a species is common then there may be other populations that are more likely or easier to protect than the ones in the wetland.	Yes	Med	
			No	High	

Table A2

Row	Question	Rationale	Response	Risk	Go To
1	Is the species short or long lived?	Long-lived species often have greater capacity to endure periods of hardship, whereas short lived species are programmed to die.	Long	Med	
			Short		Row 2
2	Does the species need the wetland to recruit?	If the species requires the wetland to recruit then sustaining will require protection of wetland condition.	No	Med	
			Yes		Row 3
3	Is the species common?	If a species is common then there may be other populations that are more likely or easier to protect than the ones in the wetland.	Yes	Mod	
			No	High	

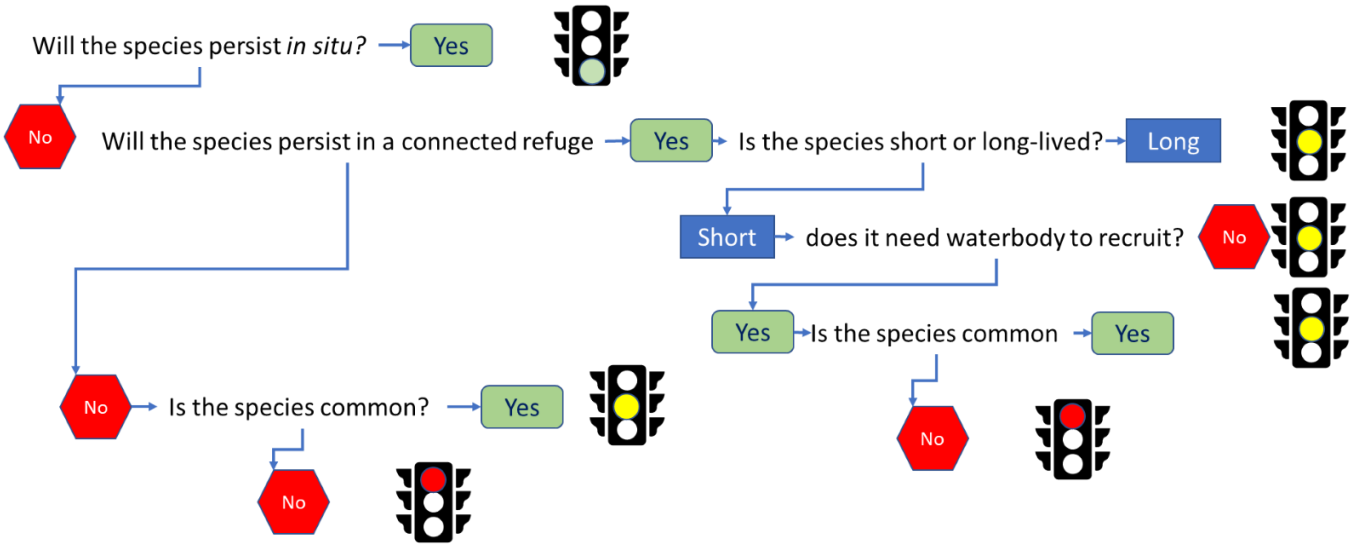

Figure A1 – Decision tree for assessing risk

APPENDIX 6. PIAMBIE EWMP UPDATED ENVIRONMENTAL OBJECTIVES, FURTHER INFORMATION (FROM BUTCHER ET AL. 2020)

Information describing rationale behind updated environmental objectives and targets for Piambie EWMP (from Butcher at el. 2020).

SMARTness and rationalisation

Site-specific environmental objectives for the Piambie EWMP (Mallee CMA 2015d).

EWMP objectives
P1: Improve vegetation health and structure in the River Red Gum communities (EVCs 106, 295, 809, 813, 818, 823) Improve vegetation health and structure in the Black Box communities (EVCs 103, 813, 818, 823). Improve vegetation health and structure in the Lignum communities (EVCs 104, 813, 818, 823). Bridge Creek, Bridge Creek Floodplain
P2: Increase aquatic macrophyte diversity and area in the Freshwater marsh habitats (EVCs 200, 810, 811). Maintain vegetation health and structure in the fringing River Red Gum communities (EVCs 106, 809, 813, 818, 823). Fishers Lagoon Complex
P3: Increase aquatic macrophyte diversity and area in the Freshwater marsh habitats (EVCs 200, 810, 811) Maintain vegetation health and structure in the fringing River Red Gum communities (EVCs 106, 809, 813, 818, 823). Piambie Bends East and West
P4: Increase dissolved organic matter, particulate matter and macroinvertebrate productivity

Assessment of SMARTness of current Piambie EWMP objectives. Scoring: 1 is criterion met, 0 is criterion not met, and 0.5 is partially met

	Specific		Measurable			Achievable		Relevant		Timely	
Objective	Magnitude clearly specified	Location and scale detailed	Indicators available or easily developed	Can be analysed using accepted statistical practices	Capacity to collect data exists	Under river operating constraints and current climate variability	Considered feasible by knowledgeable stakeholders	Matters driven by environmental watering and/or works and measures	Linked to BP objectives	Absolute date or time period specified	Considers likely lags in response
P1	0	0.5	1	1	1	0.5	1	1	1	0	0
P2	0	0.5	1	1	1	0.5	1	1	1	0	0
P3	0	0.5	1	1	1	0.5	1	1	1	0	0
P4	0	0	0.5	1	0.5	0.5	0	0.5	0.5	0	0

Rationalised environmental objectives for the Piambie EWMP (Mallee CMA 2015d).

Objective	Issue	Outcome
P1	No issue with objective other than its not fully SMART and no baseline data.	Objective updated to align with Basin Plan language.
P2	Split aquatic macrophytes and RRG into two objectives and combine with P3	Objective updated to align with Basin Plan language and combined with P3 macrophyte component, RRG split into separate objective
P3	Combined with P2	Combined with P2
P4	No baseline to establish magnitude of change in dissolved organic carbon and particulate matter. Macroinvertebrates are notoriously variable and difficult to measure as an outcome of watering. Not considered a priority value for the asset by the MCMA. Likelihood that invertebrate communities will be adequately supported from the other watering actions at the asset.	Delete

Mapping to Basin Plan

Basin Plan Schedule 8 and 9 criteria.

Schedule 8 criteria met	Schedule 9 criteria met
From DELWP (2015a)	
1: CAMBA **4:** FFG Act, EPBC act, DSE Listed **5:** Flows into the creek and wetlands of the floodplain are less frequent. 103 Riverine Chenopod Woodland – Endangered^	**1:** Supports the creation and maintenance of vital habitats and populations **2:** water quality - ecosystem processes supports the transportation and dilution of nutrients, organic matter and sediment; supports the dilution of carbon and nutrients from the floodplain to the river system **4:** lateral connectivity - (between floodplains, anabranches and wetlands)
Updated assessment	
3(b): Prevents declines in native biota	**1(e):** Vital habitat - preventing decline of native biota **4(b):** Lateral connectivity - off-stream primary productivity

^ Mapping PEA criteria 5 to EVC is not appropriate

Mapping Piambie EWMP objectives to Basin Plan EWP objectives, Schedule 7 targets, BWS QEEO, and LTWP Vic Murray objective.

EWMP objectives	Relevant Basin Plan EWP objective	Relevant Schedule 7 target	Relevant BWS QEEO	LTWP objective
P1: Improve vegetation health and structure in the River Red Gum communities (EVCs 106, 295, 809, 813, 818, 823) Improve vegetation health and structure in the Black Box communities (EVCs 103, 813, 818, 823). Improve vegetation health and structure in the Lignum communities (EVCs 104, 813, 818, 823). Bridge Creek, Bridge Creek Floodplain	8.05,3(b) 8.06,6(b)	Condition of priority asset - prevention of decline in native biota Diversity of native water dependent vegetation Condition of priority ecosystem functions - creation of vital habitat - habitat for prevention of decline in native species	B2.2 B2.8 B2.10	LTWPVM5 LTWPVM7 LTWPVM8
P2: Increase aquatic macrophyte diversity and area in the Freshwater marsh habitats (EVCs 200, 810, 811). Maintain vegetation health and structure in the fringing River Red Gum communities (EVCs 106, 809, 813, 818, 823). Fishers Lagoon Complex	8.05,3(b) 8.06,6(b)	Condition of priority asset - prevention of decline in native biota Diversity of native water dependent vegetation Condition of priority ecosystem functions - creation of vital habitat - habitat for prevention of decline in native species	B2.11 B2.2 RRG	LTWPVM2 LTWPVM5 RRG
P3: Increase aquatic macrophyte diversity and area in the Freshwater marsh habitats (EVCs 200, 810, 811) Maintain vegetation health and structure in the fringing River Red Gum communities (EVCs 106, 809, 813, 818, 823). Piambie Bends East and West	8.05,3(b) 8.06,6(b)	Condition of priority asset - prevention of decline in native biota Diversity of native water dependent Vegetation Condition of priority ecosystem functions - creation of vital habitat - habitat for prevention of decline in native species	B2.11 B2.2 RRG	LTWPVM2 LTWPVM5 RRG
P4: Increase dissolved organic matter, particulate matter and macroinvertebrate productivity	8.05,3(b) 8.06,7	Condition of priority asset - prevention of decline in native biota Condition of priority ecosystem functions - connectivity - lateral - off-stream primary productivity	None specified	None specified

Updated objectives for Piambie

Current objective	P1: Improve vegetation health and structure in the River Red Gum communities (EVCs 106, 295, 809, 813, 818, 823) Improve vegetation health and structure in the Black Box communities (EVCs 103, 813, 818, 823). Improve vegetation health and structure in the Lignum communities (EVCs 104, 813, 818, 823). Bridge Creek, Bridge Creek Floodplain
Comments	May want to split into three objectives
EWP objective(s)	8.05,3(b)
Schedule 7 targets	Condition of priority asset - prevention of decline in native biota Diversity of native water dependent vegetation
PEA/PEF criteria met	PEA 3(b) Prevents declines in native biota PEF 1(e) Vital habitat - preventing decline of native biota
BEWS QEEO	B2.8 By 2024 improve condition of Black Box and river red gum B2.2 No decline in the condition of river red gum and black box across the Basin B2.10 Maintain extent of Lignum along the Murray River from the junction with the Wakool River to downstream of Lock 3, including Chowilla and Hattah Lakes
LTWP objective	LTWPVM8 Improve the condition of shrub and lignum dominated EVCs LTWPVM5 Improve the condition of river red gum dominated EVCs LTWPVM6 Improve the condition of Black Box dominated EVCs
LTWP target	A positive trend in the condition score of River Red Gums dominated Ecological Vegetation Class (EVC) benchmarks at 80% of sites over the 10 year period to 2025 A positive trend in the condition score of Black Box dominated EVC benchmarks at 50% of sites over the 10 year period to 2025 A positive trend in the condition score of Shrub and Lignum dominated EVC benchmarks at 50% of sites over the 10 year period to 2025
2020 Objective:	By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) and Black Box (*E. largiflorens*) and to sustain communities and processes reliant on such communities at Bridge Creek and Bridge Creek Floodplain, Piambie
2020 Targets:	By 2030, condition in standardised transects that span the floodplain elevation gradient and existing spatial distribution at Bridge Creek and Bridge Creek Floodplain, Piambie, ≥70% of Lignum plants in good condition with a Lignum Condition Score (LCI) ≥4. **AND** By 2030 a positive trend in the condition score of Black Box dominated EVC benchmarks at Bridge Creek and Bridge Creek Floodplain, Piambie at 80% of sites over the 10 year period OR By 2030, at stressed sites (see Wallace et al. 2020) at Bridge Creek and Bridge Creek Floodplain, Piambie: in standardised transects that span the floodplain elevation gradient and existing spatial distribution, ≥70% of viable trees will have a Tree Condition Index Score (TCI) ≥ 10 by 2030

Current objective	P2: Increase aquatic macrophyte diversity and area in the Freshwater marsh habitats (EVCs 200, 810, 811). Maintain vegetation health and structure in the fringing River Red Gum communities (EVCs 106, 809, 813, 818, 823). Fishers Lagoon Complex
Comments	Objectives split into one on macrophytes and one on RRG. For the macrophytes - adopted WRIGs developed by DELWP. Some species need to be identified as currently not all aquatic WRIGs represented in the flora lists in the EWMP.
EWP objective(s)	8.05,3(b) 8.06,6(b)
Schedule 7 targets	Condition of priority asset - prevention of decline in native biota Diversity of native water dependent vegetation Condition of native water dependent vegetation Condition of priority ecosystem functions - creation of vital habitat - habitat for prevention of decline in native species
PEA/PEF criteria met	PEA 3(b) Prevents declines in native biota PEF 1(e) Vital habitat - preventing decline of native biota
BWS QEEO	B2.11 To maintain the current extent of non-woody vegetation
LTWP objective	LTWPVM2 Improve the species richness of aquatic vegetation in wetlands
LTWP target	None specified for non-woody vegetation
2020 Objective P2a:	By 2030, improve vital habitat at Fishers Lagoon Complex and Piambie Bends East and West, Piambe by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicators Groups.
2020 Targets P2a:	By 2030, increase diversity of native of macrophytes at Fishers Lagoon Complex and Piambie Bends East and West, Piambe with ≥2 species from each of the following Water Regime Indicator Groups present in 80% of years: • Aquatic (small floating) (Asf) (no species recorded) • Aquatic (obligate submerged) (Aos) (no species recorded) • Aquatic (submerged to partially emergent) (Ase) (no species recorded) • Aquatic graminoids (persistent) (Agp) (no species recorded) • Aquatic to semi-aquatic (persistent) (Asp) (Common Blown-grass *Lachnagrostis filiformis s.l.*, Common Nardoo *Marsilea drummondii*) • Seasonally immersed – low growing (Slg) (Common Woodruff *Asperula conferta*, Spreading Goodenia *Goodenia heteromera*, Rough Raspwort *Haloragis aspera*, River Bluebell *Wahlenbergia fluminalis*) • Seasonally inundated – emergent non woody (Sen) (Spiny Flat-sedge *Cyperus gymnocaulos*, Warrego Summer-grass *Paspalidium jubiflorum*) • Seasonally inundated – emergent woody (Sew) (no species recorded) • Mud herbs (Muh) (Western Bitter-cress *Cardamine lineariloba*, Australian Hollyhock *Malva weinmanniana*)

Comments	
EWP objective(s)	8.05,3(b) 8.06,6(b)
Schedule 7 targets	Condition of priority asset - prevention of decline in native biota Diversity of native water dependent vegetation Condition of native water dependent vegetation Condition of priority ecosystem functions - creation of vital habitat - habitat for prevention of decline in native species
PEA/PEF criteria met	PEA 3(b) Prevents declines in native biota PEF 1(e) Vital habitat - preventing decline of native biota
BEWS QEEO	B2.2 No decline in the condition of River Red Gum and Black Box across the Basin
LTWP objective	LTWPVM5 Improve the condition of river red gum dominated EVCs
LTWP target	A positive trend in the condition score of River Red Gums dominated Ecological Vegetation Class (EVC) benchmarks at 80% of sites over the 10 year period to 2025
2020 Objective P2b:	By 2030, improve condition and maintain extent from baseline levels of River Red Gum (*Eucalyptus camaldulensis*) to sustain communities and processes reliant on mature River Red Gum at Fishers Lagoon Complex and Piambie Bends East and West, Piambe
2020 Targets P2b:	By 2030, a positive trend in the condition score of River Red Gum dominated EVC benchmarks Fishers Lagoon Complex and Piambie Bends East and West, Piambe at 80% of sites over the 10 year period OR By 2030, at stressed sites (see Wallace et al. 2020) Fishers Lagoon Complex and Piambie Bends East and West, Piambe: in standardised transects that span the floodplain elevation gradient and existing spatial distribution, ≥70% of viable trees will have a Tree Condition Index Score (TCI) ≥ 10. Baseline condition of trees at Murrumbidgee Junction to be established.

Current objective	**P3: Increase aquatic macrophyte diversity and area in the Freshwater marsh habitats (EVCs 200, 810, 811) Maintain vegetation health and structure in the fringing River Red Gum communities (EVCs 106, 809, 813, 818, 823). Piambie Bends East and West**
Comments	Combined with P2a and P2b

Current objective	**P4: Increase dissolved organic matter, particulate matter and macroinvertebrate productivity**
Comments	Deleted

APPENDIX 7. COMMUNITY AND AGENCY ENGAGEMENT 2024 SUMMARY

Community Engagement

Community stakeholders were engaged via an online survey, which was hosted on the Mallee CMA website in December 2023 – January 2024. The survey was designed to enable community, landholders, recreational users, environmental groups and other interested parties to provide input to the plans. Community stakeholders were also engaged during local events such as the local markets and local environmental group meetings, though no community members engaged at in-person events provided information on Piambie wetlands. The survey supplements earlier community engagement about the Piambie EWMPs, and annual community engagement that informs the Seasonal Watering Proposal (SWP). Community consultation occurs at the IAP2 level of CONSULT.

Only one participant completed who completed the online survey (a local resident) identified Piambie as a site that they visit. Fishers Lagoon and Bridge Creek are accessed for a range of uses on a weekly basis, year-round. These uses were ranked in priority order, as follows:

Table 20. Uses of target wetlands at Piambie, ranked in priority order. Source: Mallee CMA online engagement, 2024.

Priority	Use
1	Work
2	Fishing
3	Socialising
4	Boating

In response to the question 'Both wetting and drying cycles are important for wetland health. Since river regulation, our wetlands often don't get the inundation they need because when floods do occur, they are shorter and less frequent. How would you feel about natural watering cycles returning to this area?', the participant responded 'Yes'.

Agency Engagement

Mallee CMA consulted with Parks Victoria and Lower Murray Water about the Piambie EWMP in February 2024. During this session, Parks Victoria provided information about the condition of infrastructure at Piambie.

mallee
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