Wemen-Liparoo Environmental Water Management Plan

Document Control

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Cover photo: Vegetation response to environmental water delivery at Liparoo West Billabong, December 2019.

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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 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 Wemen-Liparoo WMU sub-unit, hereafter referred to as Wemen-Liparoo. The EWMP will help to guide future environmental watering activities for this area.

Wemen-Liparoo is located within the Happy Valley WMU, located 10km west of Wemen within the Murray-Kulkyne Park. This EWMP addresses the land and water management of this site.

Wemen-Liparoo provides habitat for eight-listed water dependent species. Additionally, the diverse wetland and floodplain features provide extensive habitat for small-bodied native fish, waterbirds, frogs and turtles. Wemen-Liparoo is located within the Murray-Kulkyne Park and offers good conservation outcomes through land management and implementation of an appropriate environmental water regime.

The water management goal for the Wemen-Liparoo EWMP is to provide seasonal habitat for small-bodied native fish, large waders and waterfowl and to promote the health of Lignum Swampy Woodland.

The management goal is supported by the following ecological objectives: *Liparoo*

West and Liparoo East Billabongs

- Support seasonal habitat for small native fish
- Provide seasonal feeding habitat for large waders and waterfowl
- Maintain a community of drought-tolerant emergent aquatic macrophytes at the wetland edge

Liparoo West - Lignum Swampy Woodland area

- Healthy and productive Lignum Swampy Woodland community that supports frogs and small native fish when flooded
- Maintain Lignum Shrubland and provide occasional breeding events by platform building waterbirds including Ibis and Spoonbill The optimal watering regime for Wemen-Liparoo is to:

Fill Liparoo West Billabong and Liparoo East Billabongs to 45.3m AHD every second year in winter and allow natural recession of water levels resulting in a seasonal drying or partial drying of the wetland. In every fourth year inundate target area to 45.7m AHD in September to flood the Lignum Swampy Woodland area. Top up by pumping to maintain inundation of Lignum Swampy Woodland for up to six months and then allow natural recession of water levels.

Recommendations have been made for the installation of infrastructure, which will include road raising and possibly the construction of regulators to allow the target areas to be inundated to the target level.

1 Introduction

This Environmental Water Management Plan (EWMP) has been prepared by the Mallee Catchment Management Authority (CMA) to establish the long-term management goals of Wemen-Liparoo.

The key purposes of the EWMP are to:

- identify long-term objectives and water requirements for the wetlands, identified as a high priority by the Mallee CMA;
- provide a vehicle for community consultation, including for the long-term objectives and water requirements of the wetlands;
- inform the development of seasonal watering proposals and seasonal watering plans; and
- inform the long-term watering plans to be developed under the Basin Plan requirements.

2 Site overview

2.1 Site location

The Mallee CMA region is situated in the north-west of Victoria. The area of responsibility is close to 39,000 km^2 (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 Murray River corridor. Irrigated crops contribute over 40% of the value of agricultural production for the region.

In 2006, the Mallee CMA engaged consultants (Ecological Associates, 2006a) to investigate water management options for the Murray River floodplain from Robinvale to Wallpolla Island. One of the major outcomes of these investigations was the development of a system of Floodplain Management Units (FMUs). These divide the floodplain into management units in which water regimes can be managed independently, but which are relatively consistent in their ecological values and land uses. The Mallee CMA has based its environmental water management plans on these FMUs to support effective management of hydrologically connected systems. In addition to this, the Mallee CMA has also used individual FMUs or groupings of FMUs to form Waterway Management Units (WMUs) for planning within its Mallee Waterway Strategy.

The site for this plan is the Wemen-Liparoo FMU, hereafter referred to as Wemen-Liparoo in this document. Wemen-Liparoo is located within the Happy Valley WMU, located 10km west of Wemen within the Murray-Kulkyne Park.

A regional context document (North, 2014) has been prepared to compliment the Mallee CMA EWMPs and should be read in conjunction with this document.

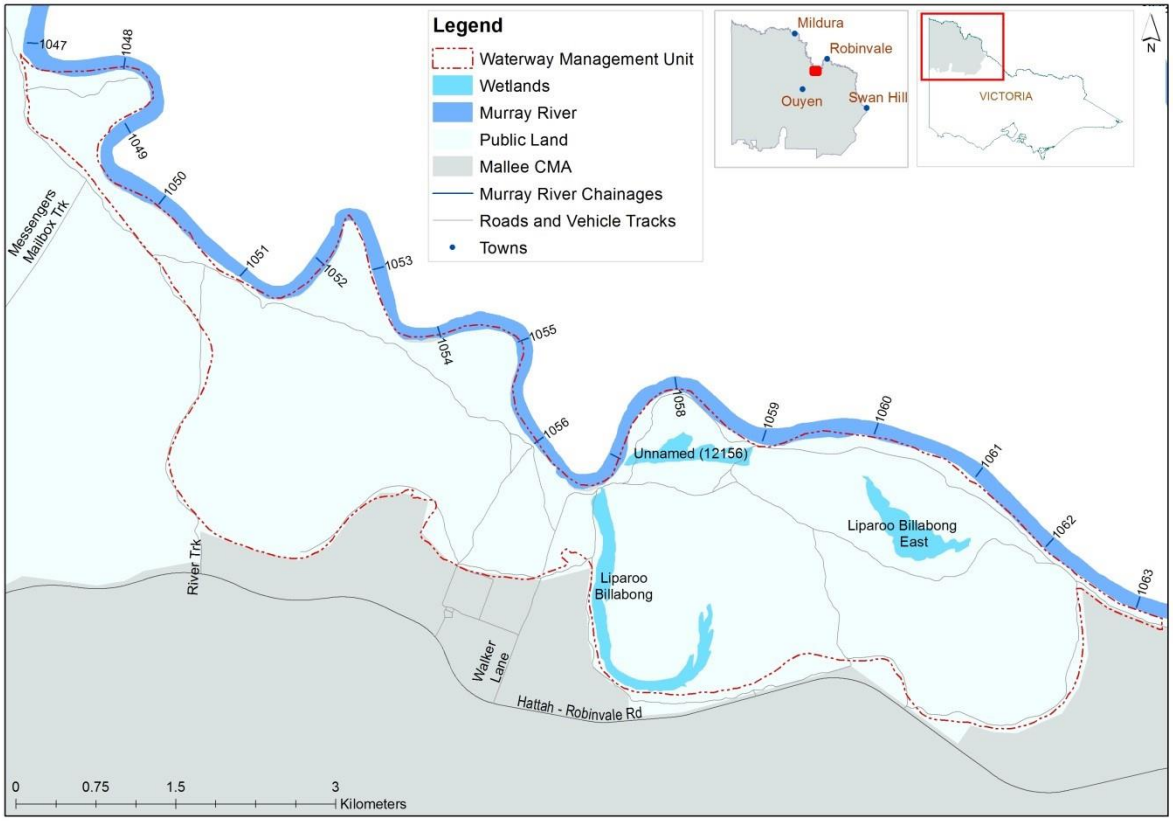


Figure 1 – Wemen-Liparoo Water Management Unit (WMU). Note, Liparoo Billabong is now known as Liparoo West and Liparoo Billabong East as Liparoo East.

2.2 Catchment setting

The Wemen / Liparoo floodplain management unit is located in the Robinvale Plains bioregion. The Robinvale Plains Bioregion is characterised by a narrow gorge confined by the cliffs along the Murray River, which is entrenched within older up-faulted Cainozoic sedimentary rocks. Alluvium deposits from the Cainozoic period gave rise to the red brown earths, cracking clays and texture contrast soils (Dermosols, Vertosols, Chromosols and Sodosols) which support Riverine Grassy Forest and Riverine Grassy Chenopod Woodland Ecosystems (DEPI, 2015).

The Robinvale Plains bioregion contains the floodplain from Boundary Bend in the east to Mildura in the west, and is close to the boundary with the Murray Mallee bioregion which stretches inland.

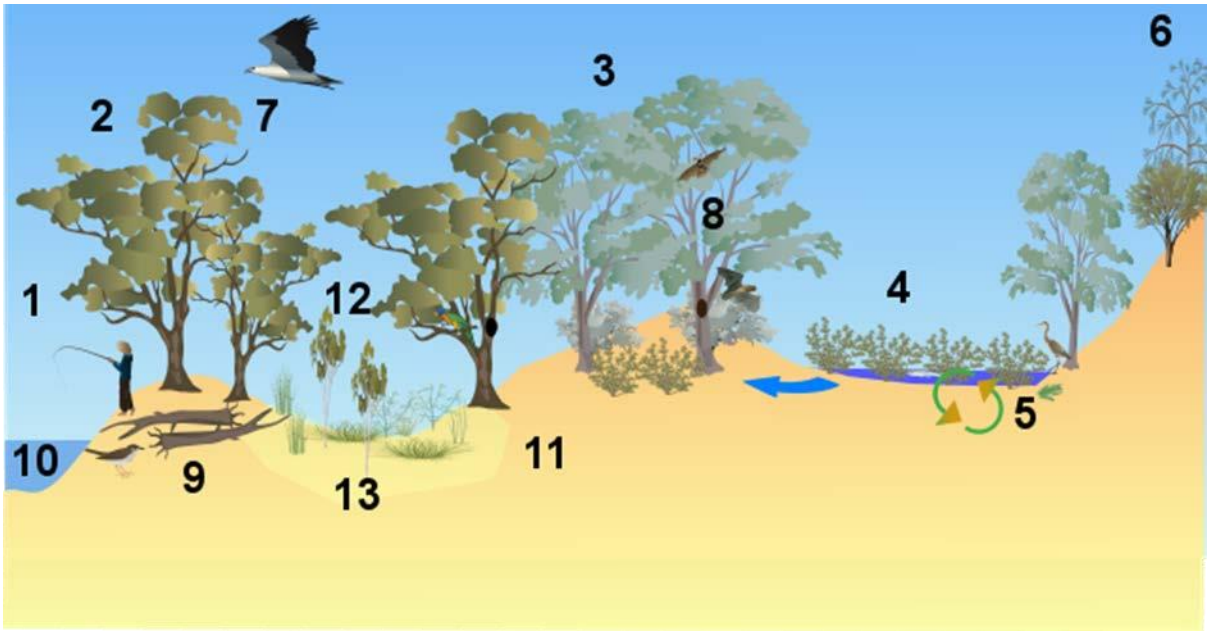
2.3 Wemen-Liparoo

Wemen-Liparoo is situated on the Murray River floodplain, 10km west of Wemen.

The floodplain near the river comprises narrow meander scroll terraces vegetated by River Red Gum communities. Higher ground supports Lignum Shrublands and Black Box woodland. Wemen-Liparoo includes two named wetland Liparoo East Billabong and Liparoo West Billabong and an unnamed wetland. Wemen-Liparoo is located within the Murray-Kulkyne Park.

2.4 Conceptualisation of the site

Wemen-Liparoo is represented in a conceptual model presented below. This is a visual representation of the processes and components within the target area that are discussed throughout this EWMP.



1. Wemen-Liparoo is located in the Robinvale Plains bioregion, within the Murray-Kulkyne Park, 10km west of Wemen. It is a popular access point for recreational fishing in the Murray River.
2. Adjacent to the Murray River narrow meander scroll terraces support River Red Gum communities.
3. Higher terraces support Lignum shrublands and Black Box woodland. Black Box dominated vegetation communities close to flow paths are healthy and vigorous, having access to water through bank recharge, even if not inundated.
4. A large depression at the eastern end of the site supports an area of infrequently flooded Lignum Swampy Woodland. While the area receives some inundation from local runoff and rainfall, major flooding will encourage Lignum growth and provide roosting and feeding opportunities (such as frogs, small fish) as well as temporary breeding habitat for Ibis and waterfowl and small bodied fish.
5. Inundation of the Lignum Swampy Woodland will also provide habitat for drought-tolerant burrowing frogs and enhance primary productivity and nutrient cycling.
6. Higher areas of land to the south of the site support Semi-arid Woodland and Semi-arid Chenopod Woodland.
7. Large, mature, hollow bearing River Red Gum are plentiful at the site, lining the connecting channels and wetlands. These provide important habitat for including hollows for nesting of Regent Parrot and nesting and perching sites for White-bellied Sea-eagles.

8. A diverse range of bat species are present at Wemen Liparoo. Bats roots in hollows and fissures in mature River Red Gums and Black Box during the day. The increased floodplain productivity that follows inundation of the wetlands and forest understorey will increase insect abundance and hence food supply for bats.
9. Fallen woody debris provide feeding sites for the Brown Tree-creeper and White-browed Treecreeper as they forage for insects from the ground to the canopy. Appropriate inundation frequencies will support tree health and long-term woody debris supply on the ground.
10. River regulation and water extraction have reduced the frequency, extent and duration of inundation at Wemen-Liparoo.
11. Reduced floodplain and wetland inundation has contributed to reductions in the diversity and productivity of riparian vegetation communities and a reduction in habitat availability and structural complexity for aquatic and terrestrial fauna.
    Improved inundation regimes are expected to increase the health and productivity of the wetland woodland vegetation mosaic and aid in nutrient cycling.
12. Previous environmental watering following prolonged dry conditions has resulted in improved River Red Gum health and recruitment within the wetlands.
13. The wide wetlands support a mosaic of Shallow Freshwater Marsh and Floodway Pond Herbland EVCs. Floodway Pond Herbland contains a range of ephemeral species whose vegetation communities flourish during and after inundation.
    The local evaporation rate of approximately 2.2m per year causes a gradual drawdown of water in the wetlands, gradually exposing the banks and mud flats and supporting herb species and a perimeter of drought tolerant macrophytes such as *Cyperus gymocaulos* and *Juncus* species.

Graphics developed using software provided by the Integration and Application Network, University of Maryland Centre for Environmental Science (ian.umces.edu/symbols/).

2.5 Land status and management

Several agencies and individuals are involved in managing the land and water at Wemen-Liparoo (Table 1). Land management boundaries are shown in Figure 2.

Wemen-Liparoo is within the Murray-Kulkyne Park. Parks Victoria is the land manager at WemenLiparoo.

Table 1 - Stakeholders for the Wemen-Liparoo EWMP

Group	Role
Parks Victoria	Land Manager
Mallee CMA	Regional waterway and environmental management
Department of Environment, Land, Water and Planning (DELWP)	State level environmental management planning, land manager, threatened species manager
Victorian Environmental Water Holder	Manager of Victoria's environmental water entitlements
Nyeri Nyeri and Latji Latji community	Indigenous representation

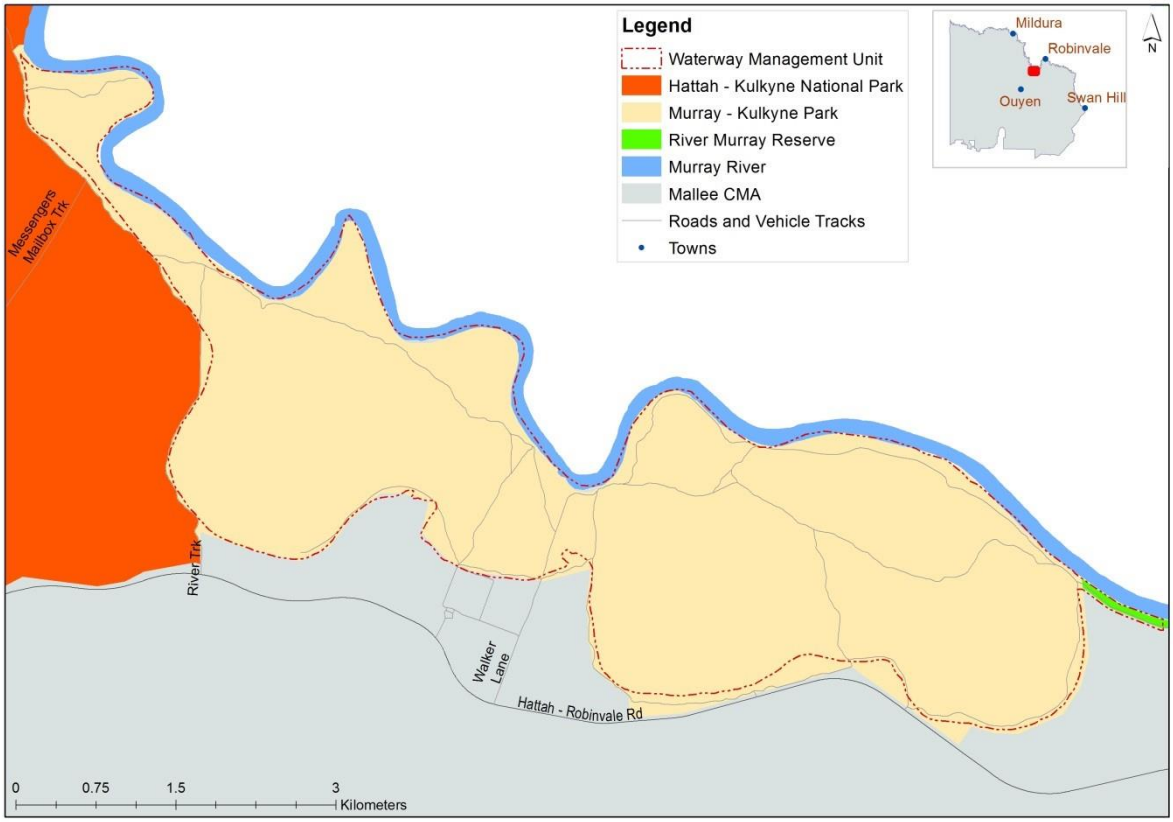


Figure 2 - Land management boundaries within Wemen-Liparoo

A brief overview of the main characteristics of the wetlands at Wemen-Liparoo is provided in Table 2. Wetland types found with Wemen-Liparoo are shown in Figure 3.

Table 2 - Wetland characteristics at Wemen-Liparoo

Characteristics	Description
Name	Wemen-Liparoo
Mapping ID (Wetland Current layer)	**Liparoo West Billabong:** 12154 (36.7ha) **Liparoo East Billabong:** 12157 (23.7ha) **Unnamed:** 12156 (16.7ha)
Area of wetlands in target area	252.57 ha (includes floodplain and channels)
Bioregion	Robinvale Plains
Conservation status	Bioregion conservation status: areas of EVCs listed as Vulnerable, Depleted and Least Concern
Land status	Public Land: Murray-Kulkyne National Park and River Murray Reserve
Land manager	Parks Victoria, DELWP
Surrounding land use	Dryland cropping, irrigation agriculture (almonds), town of Wemen
Water supply	Natural inflows from the Murray River and local catchment runoff
Wetland classification	The wetlands are currently classified as unknown type, however Corrick previously classified them as: **Liparoo West Billabong:** Deep Freshwater Marsh **Liparoo East Billabong:** Shallow Freshwater Marsh **Unnamed: 12156:** Shallow Freshwater Marsh
Wetland depth at capacity	3–4m at the deepest points

2.6 Wetland characteristics

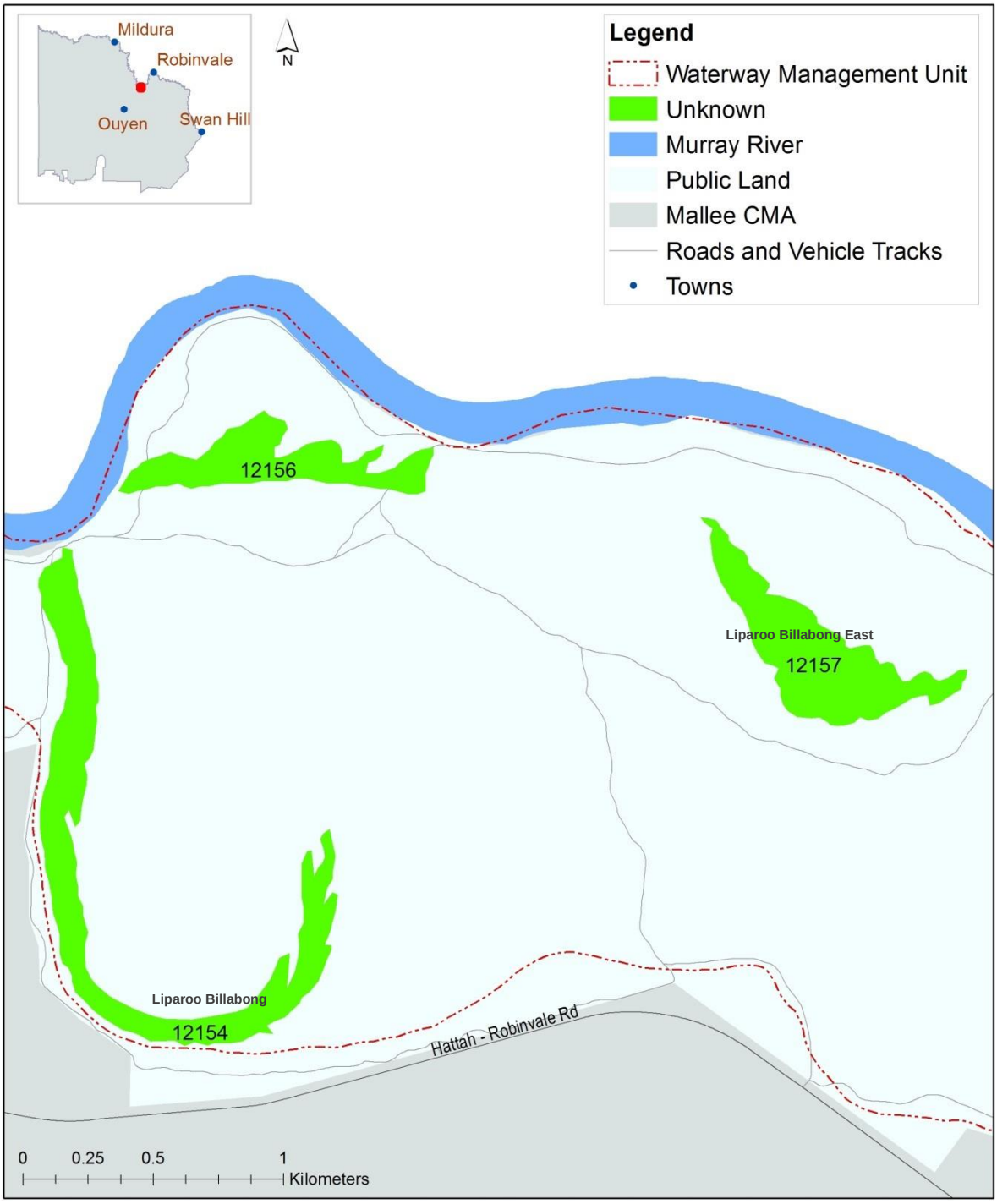


Figure 3 - Wetland types at Wemen-Liparoo

2.7 Management scale

The whole of Wemen-Liparoo has a water requirement as a floodplain complex, but the focus of this plan is restricted to a target area of 252.57 ha, as shown as the maximum inundation extent in Figure 4.

This target area consists of Liparoo East and Liparoo West Billabongs a connecting floodplain channel and a shallow depression hosting Lignum Swampy Woodland. This is the area of Wemen-Liparoo that is able to be managed with environmental water following the construction of infrastructure proposed in this EWMP. The infrastructure significantly increases the area able to be watered by allowing watering to reach up to 45.7m AHD, rather than the current level of 44.1m AHD Figure 4.

Expansion of the target area is possible only with significant alterations to Murray River operations such as large releases from storage. This is beyond the scope of this plan but is being addressed at the Murray-Darling Basin scale.

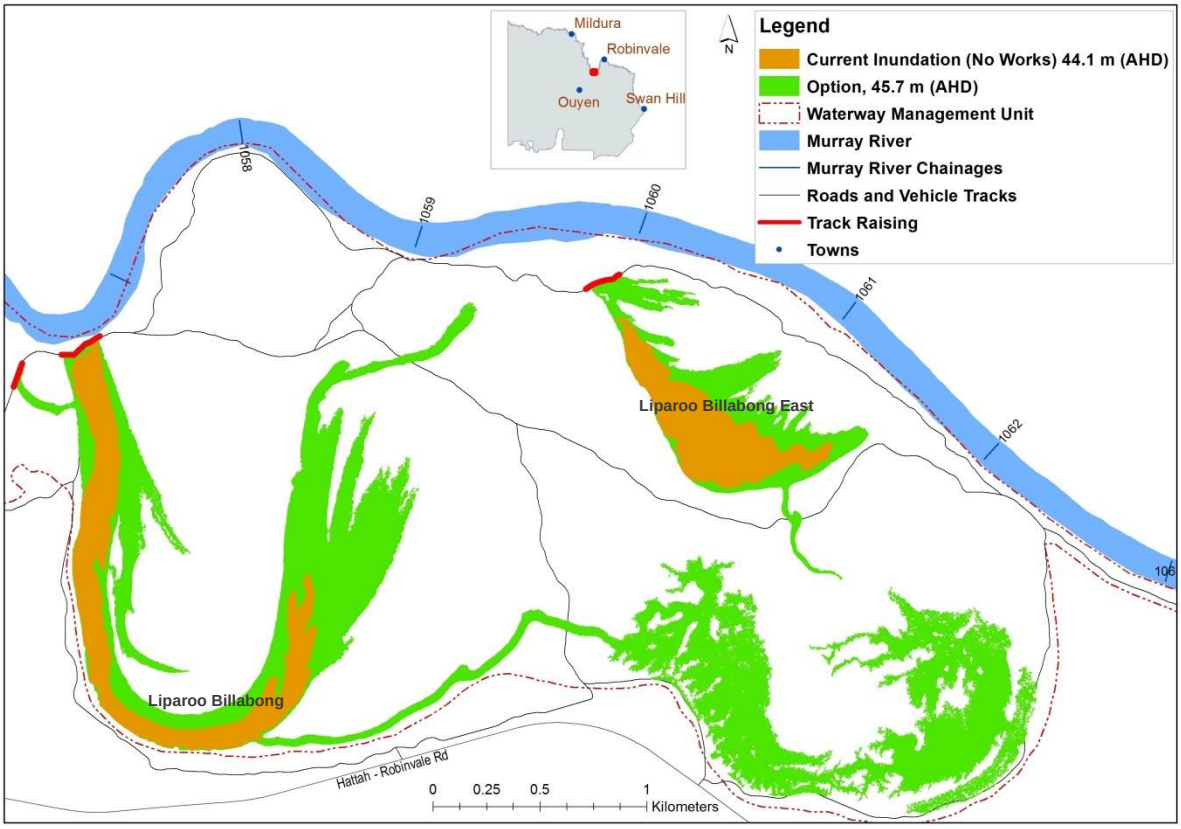


Figure 4 - Target area for the Wemen-Liparoo EWMP consisting of the areas shown in the maximum inundation extent.

2.8 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 Environmental Water Holder (VEWH) is responsible for holding and managing Victoria's environmental water entitlements, and making decisions on their use.

Environmental water for the target area may be sourced from the water entitlements and their responsible agencies listed in Table 3. Further information on water delivery arrangements is provided in the Regional Context Document (North, 2014). Previous environmental watering at Wemen-Liparoo is outlined in the Environmental Watering section of this EWMP.

Table 3 - Summary of environmental water sources available to Wemen-Liparoo

Water entitlement	Responsible agency
Murray River unregulated flows Murray River surplus flows	Murray-Darling Basin Authority
Victorian Murray River Flora and Fauna Bulk Entitlement	Victorian Environmental Water Holder
Commonwealth water	Commonwealth Environmental Water Holder
Donated water	Victorian Environmental Water Holder

2.9 Related agreements, policy, plans and activities

There is a range of international treaties, conventions and initiatives, as well as National and State Acts, policies and strategies that direct management of the target area. Those with particular relevance to the site and the management of its environmental and cultural values are listed in Table 4. For the functions and major elements of each refer to the Regional Context Document (North, 2014).

Table 4 - International conservation conventions, and national and state legislation relevant to management of the target area

Jurisdiction	Legislation, agreement or convention
National	Environment Protection and Biodiversity Conservation Act 1999 (EPBC)
State	Flora and Fauna Guarantee Act 1988 (FFG)
State	DELWP Advisory Lists of Rare or Threatened Flora and Threatened Vertebrate Fauna (VROT advisory lists)

The Wemen-Liparoo EWMP was first drafted in 2012. This document is a full revision of the 2012 EWMP.

The Mallee Waterway Strategy (2014) identifies both Liparoo East and Liparoo West Billabongs as medium priority wetlands in the Mallee CMA region.

The Strategy identifies a number of specific management activities for Wemen-Liparoo. These activities are:

- Deliver water as per the Wemen Liparoo EWMP (Management Action C1.2)
- Establish and review EWMPs across the WMU (F1.2)
- Install depth gauges and conduct survey in the Wemen Liparoo EWMP area using LiDAR (F1.5)
- Assess Murray River pump sites to make recommendations for removal, maintenance, upgrade or relocation (F1.6).

The activities identified in the Mallee Waterway Strategy have been considered in the development of this EWMP.

A number of earlier investigations into the Murray River floodplain are relevant to Wemen-Liparoo and have been considered in the development of this EWMP. These include salinity management plans, flow studies, and an investigation into River Red Gum health by the Land Conservation Council (LCC, 1989) and the Victorian Environmental Assessment Council (VEAC, 2008) which resulted in the Murray River Reserve being changed to the Murray-Kulkyne Park (DSE, 2012).

Wemen-Liparoo was also one of the areas included in the Investigation of Water Management Options for the Murray River – Robinvale to Walpolla (Ecological Associates, 2007c). The Mallee CMA has invested resources into the area in recent years in both environmental watering and complementary on ground works.

4 Hydrology 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) are the main components of the hydrological regime for wetlands and rivers.

The hydrology at Wemen-Liparoo is best described using gauge #414203 (Murray River @ downstream of Euston Weir).

4.1 Hydrology

Murray River hydrology

Murray River hydrology has been altered significantly by regulation and diversion upstream. Storages in Victoria and New South Wales are managed to capture water in winter and spring and to deliver this water at manageable flow rates to consumers (primarily irrigators) during the summer. The impact on river hydrology has been a reduction in large winter and spring flow peaks and enhancement of low summer flows.
The hydrology of the river at Wemen-Liparoo has been characterised by analysing the MSM_Bigmod daily flow series for Natural and Current (Baseline scenarios, using data from 1891 to 2009 (Figure 5).

The river now spends more time fluctuating at very low flows, less than 10,000 ML/d, than under natural conditions as indicated by higher than natural spell frequency but much shorter spell duration. Events that inundate low-lying wetlands, between 30,000 and 60,000 ML/d, now occur at almost half the frequency of natural conditions. The duration of these events, when they do occur, has also been reduced by almost 60%. The impact on floodplain inundation is also significant. While the duration of spells exceeding 70,000 ML/d under current conditions is similar to natural, the frequency of these events has declined to as much as 50% of natural. This has resulted in a major increase in the interval between spells for very high flows.

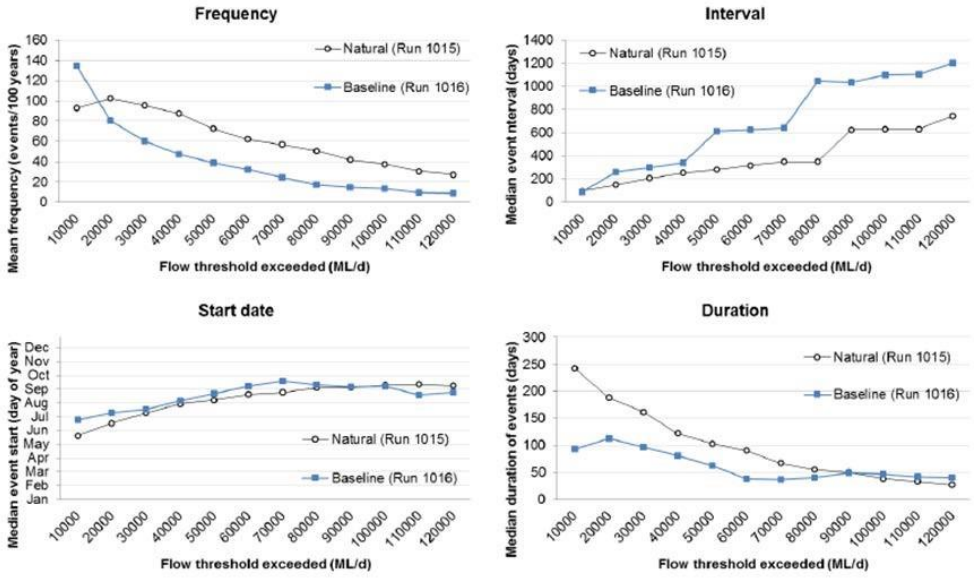


Figure 5 - Spells analysis for the Murray River flows (using data from Euston DS) for Natural and Baseline scenarios over a 114 year modelled period (Gippel, 2014)

Mean annual flows at Euston have been reduced by 49 per cent from natural levels, although seasonality of mean monthly flows is largely unaltered (Maheshwari, Walker and McMahon, 1993; Ecological Associates, 2006a) as shown in Figure 6.

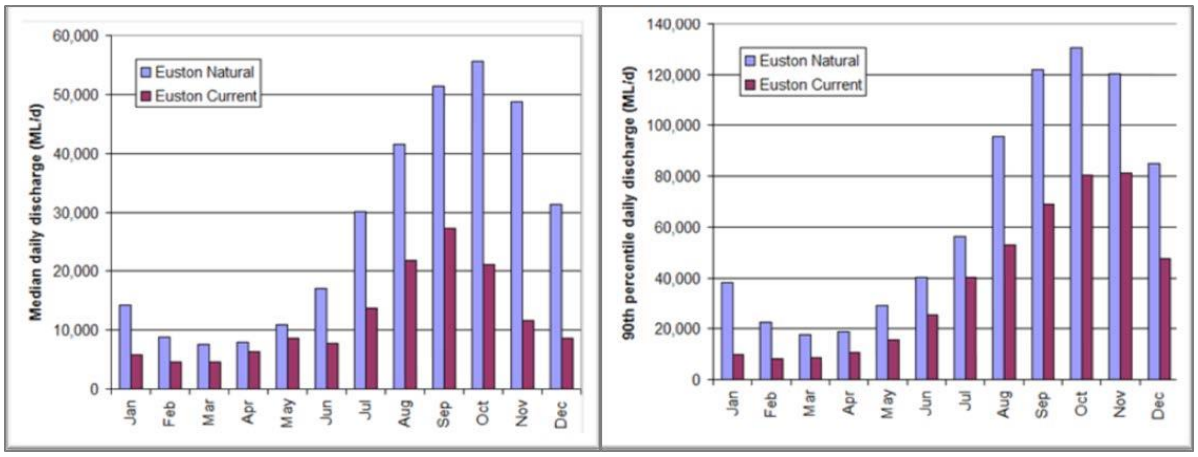


Figure 6 - Distribution of median flows and 90th per centile flows for each month in the Murray River through Euston Weir for pre-regulated and regulated (current) conditions (Ecological Associates, 2006).

In this part of the Murray River, the frequency, duration and magnitude of all but the largest floods have been reduced due to effects of major storages in the Murray and its tributaries (Thoms et al., 2000).

Wetland hydrology and system operations

Liparoo West Billabong is connected to the Murray River at 1056.7 river km at approximately 43.4m AHD.

The wetland extends southwards and then curves to the east, where the bed drops to approximately 43m AHD, and the wetland becomes shallower, along the perimeter of the floodplain (Ecological Associates, 2007b). Until 2008, Liparoo West Billabong was regulated as an irrigation supply channel with an earthen bank used to raise the retention level. At elevated river levels, Liparoo West Billabong is the first wetland within the target area to receive inflows. During very high flows water can enter the floodplain between 1060 and 1062 river km feeding Liparoo East Billabong before spilling into a series of elongated depressions that collectively direct water to the top end of Liparoo West Billabong. The maximum target inundation height for Wemen-Liparoo is 45.7m AHD, making Liparoo Billabong approximately 2.7 metres deep at its maximum depth. The bed of Liparoo East Billabong is at approximately 43.8m AHD, making it approximately 1.9 metres deep at its maximum depth. Unfortunately, there is no elevation data available for the area of Lignum Swampy woodland at the top end of Liparoo West Billabong.

The MWWG wetlands atlas estimated that the commence to flow for Liparoo West Billabong is between 19,300 – 37,900 ML/day. However, local knowledge suggests that the commence to flow is 20,000 ML/day. Flows of 20,000 ML/day occur approximately 20 per cent less frequency under current conditions and these events are approximately 30 per cent shorter in duration.

In 2011 rivers flows of 70,000 ML/day inundated Wemen-Liparoo to 45m AHD (*P.Kelly pers comm. February 2016*), 0.7 metres below the target maximum inundation level. Under pre-regulation flows 70,000 ML/day would have 57 years in 100, with mean event duration of 67 days. Post-regulation conditions have seen a reduction in the inundation threshold being met to 24.6 years in 100, with a reduced mean duration of 37 days.

Lower areas of the floodplain including unnamed wetland #12156, which is not included within the target area, flood when the Murray River reaches approximately 40,000 ML/day. Therefore inundation of this wetland may be possible through the Basin Plan flows.

Environmental watering

A summary of previous environmental watering at Wemen-Liparoo is provided in Table 5. Initial environmental watering, undertaken in 2010 was an 'emergency response' to assist the vegetation during the prolonged dry conditions which had resulted in a decline in River Red Gum health on the Murray River floodplain. The target area for previous watering has been limited to Liparoo East. Anecdotal evidence suggested that the watering was effective in improving the health of trees (through increased foliage vigour) lining the channels and wetlands in the target area, and had the added benefit of providing drought refuge for waterbirds.

Table 5 - A summary of environmental watering at Wemen-Liparoo

Water year	Time of inflow	Environmental Water Source	Source volume (ML)	Total volume (ML)	Area (ha) inundated
2010	Autumn	EWR	329.3	329.3	Liparoo West Billabong - 25.78
2010	Spring	EWR	130.4	130.4	Liparoo West Billabong - 25.78
2010/11	Spring, Summer and Autumn	Natural flows	0	0	Liparoo West Billabong and Liparoo East
2012/13	Spring	Natural flows	0	0	Liparoo West Billabong and Liparoo East
2013/14	Autumn/winter	EWR	472	472	Liparoo East 49.8
2016/17	Spring/Summer	Natural flows	0	0	Liparoo West Billabong and Liparoo East
2017/18	Spring	EWR	400	239.66	Liparoo West Billabong - 25.78
2019/20	Spring	EWR	500	392.42	Liparoo East
2019/20	Spring	EWR	400	271.50	Liparoo West

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 system. 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 erosion, flood mitigation and reducing nutrient input into waterways. Protecting the ecological functioning of wetlands ensures these vital services are maintained.

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

The availability of flora and fauna data for the site is limited. While data from the Victorian Biodiversity Atlas (DELWP, 2016b) has been referenced, it is recommended that flora and fauna surveys are undertaken at the site to improve knowledge of the site's ecological values.

5.1 Environmental values

Listings and significance

Fauna

One hundred and nineteen fauna species have been recorded at Wemen Liparoo, six of which are introduced. Of special interest and management responsibility are the eight water dependent fauna species listed in legislation, agreements or conventions.

Wemen Liparoo supports species listed under the *Commonwealth Environment Protection and Biodiversity Conservation Act (EPBC Act), Victoria's Flora and Fauna Guarantee Act (FFG Act),* and the Advisory List of Threatened Fauna in Victoria (Table 6). A full list of fauna recorded at the site is presented in Appendix 1.

Despite only a limited number of listed fauna being identified in VBA records, it is fair to assume that more listed species are likely to occur due to the availability of habitat and nearby sightings.

Table 6 - Listed water dependent fauna recorded at Wemen Liparoo

Common name	Scientific name	Type	International agreements	EPBC threatened fauna status	FFG status	VROT advisory list status
Eastern Great Egret	Ardea modesta	B	-	-	Listed	Vulnerable
Eastern Snakenecked Turtle	Chelodina longicollis	R	-	-	-	Data deficient
White-browed Treecreeper*	Climacteris affinis	B	-	-	Listed	Vulnerable
Brown Treecreeper* (south-eastern ssp.)	Climacteris picumnus victoriae	B	-	-	-	Near threatened
White-bellied Sea-Eagle	Haliaeetus leucogaster	B	-	-	Listed	Vulnerable
Nankeen Night Heron	Nycticorax caledonicus hillii	B	-	-	-	Near threatened

Regent Parrot*	Polytelis anthopeplus monarchoides	B	-	Vulnerable	Listed	Vulnerable
Lace Monitor*	Varanus varius	R	-	-	-	Endangered

Legend:
Lifeform type: Amphibian, Bird, Fish, Invertebrate, Reptile, Mammal

*Species are included as water dependent due to habitat requirements

Of the eight listed water dependent species at the site, the Regent Parrot (*Polytelis anthopeplus monarchoides*), the White-browed Treecreeper (*Climacteris affinis*), the Brown Tree-creeper (*Climacteris picumnus victoriae*), and the Lace Monitor (*Varanus varius*) are considered indirectly water dependent due to habitat requirements (such as dependent on nesting hollows in riparian trees), and the other five are directly dependent on water due to food, shelter or breeding requirements.

The Regent Parrot is listed as nationally vulnerable under the EPBC Act, with estimates of only 2,900 birds left in the wild. This species has quite specific habitat requirements. It nests almost exclusively in River Red Gum (*Eucalyptus camaldulensis*) forest and woodland, typically in large, old and healthy hollow-bearing trees close to water. They require trees that are a minimum of 160 years old (BakerGabb and Hurley, 2011). However, Regent Parrots have also been known to breed in Black Box
(*Eucalyptus largiflorens*). They mostly feed in large blocks of intact Mallee woodlands usually within 510km (maximum 20km) of nest sites, but also consume flower buds of River Red Gum, Black Box and Buloke (*Allocasuarina leuhmanii*) (Baker-Gabb and Hurley, 2011). Regent Parrots are reluctant to fly through open areas and require corridors of vegetation between nesting and foraging sites.

The White-browed Treecreeper feeds on insects and invertebrates on the rough bark of living or dead trees and amongst logs and leaf litter on the ground in forests and woodlands. They are considered vulnerable in Victoria with populations declining due to habitat loss, fragmentation and degradation (GHD, 2010).

The Brown Tree-creeper (south-eastern spp.) forages for insects on tree trunks and amongst fallen woody debris on the ground. The majority of their diet is comprised of ants, but also includes other insects such as spiders, moths and larvae as well as sap. Hollows in trees (dead or alive) or tree stumps are essential for nest sites (Office of Environment & Heritage, n.d.). Appropriate inundation regimes will support a healthy and productive forest ecosystem and continued supply of habitat resources such as food, hollows and woody debris.

Lace Monitors live in lowland forests and woodland however they only occur in woodland adjacent to rivers in dry areas. Lace Monitors can climb trees when disturbed by people or to prey on nesting birds and eggs. The species is a generalist predator and scavenger that feeds on a wide range of prey including mammals, birds, fish, amphibians, eggs and insects and will forage over large distances (DPIPWE, 2011).

The Eastern Great Egret (Ardea modesta) forage in open water, on exposed banks or flats, particularly in areas with aquatic vegetation rather than emergent vegetation (Marchant and Higgins, 1990). They use overhanging trees for nesting, with River Red Gum being their preferred tree. Egrets feed mainly on fish but also consume shrimp, crayfish, frogs and insects (Rogers and Ralph, 2011). Draining of wetlands is the main cause of habitat loss for Egrets in Victoria (DSE, 2001).

The Eastern Great Egret prefers permanent water bodies on floodplains such as billabongs, creeks or pools but will also use the shallow edges of deep lakes, moist grasslands and wetlands (Marchant and Higgins, 1990). They forage in water approximately 30cm depth as well as from the surface of deeper waters. Flooding stimulates for breeding (Briggs, 1990) and increases breeding success. The species prefers to nest in live trees over floodwaters, but do not seem to have specific depth requirements. The required flood duration (resulting in water being maintained around nests) for

successful breeding is a minimum of six to seven months for the Great Egret, however peak breeding can occur after twelve months (Rogers and Ralph, 2011). Inter-flood dry periods are also important to ensure the supply of food and nesting resources (such as healthy River Red Gum) during breeding seasons (Rogers and Ralph, 2011).

White-bellied Sea Eagles (Haliaeetus leucogaster) nest near water, in tall live or dead trees, forming pairs for life. River Red Gum are commonly used as nest trees. The total Victorian population is thought to consist of only 100 breeding pairs (Emison and Bilney, 1982; DSE, 2003b).

The Nankeen Night Heron (Nycticorax caledonicus hillii) is a piscivorous water bird that also consumes yabbies, frogs, crayfish and insects. It is generally considered to be solitary, though it may occasionally congregate in large groups. In inland areas it prefers permanent water bodies with wooded edges or abundant tall emergent vegetation but will frequent flooded shallow wetlands such as River Red Gum or Lignum swamps. It forages at night next to still or slow flowing water near roost trees (Rogers and Ralph, 2011). Breeding is stimulated by flooding (Briggs, 1990) and is common in central parts of swamps in areas of up to 20 ha, with nests constructed on horizontal tree limbs, in tree forks or on top of Lignum (Marchant and Higgins, 1990). The Nankeen Night Heron does not seem to have a water depth preference for breeding, but requires at least six months of inundation with a slow recession of flood waters. Breeding success is improved if inundation is up to twelve months (Rogers and Ralph, 2011) and if an inter-flood drying period occurs (Crome, 1988).

The Eastern Snake-necked Turtle (Chelodina longicollis) is an opportunistic carnivore, preying on fish, yabbies, frogs, insects and frogs. They occupy a range of freshwater habitats but are more abundant in shallow, ephemeral wetlands with soft sandy banks and logs or rocks for basking. The Eastern Snake-necked Turtle is primarily a bottom-dwelling species but will also occasionally bask by the water's edge. To survive drought, the Eastern Snake-necked Turtle can bury themselves in the mud of dried up waterbodies. They are known to travel long distances to find suitable habitat (Kennett, Roe, Hodges and Georges, 2009).

Vegetation communities

Ecological Vegetation Classes (EVCs) are modelled as present within the target area. Table 7 provides a list of these EVCs, along with their bioregional conservation status, Figure 7 displays the spatial arrangement of the EVCs, and Appendix 2 provides detailed descriptions of the EVCs.

Table 7 - Ecological vegetation classes modelled as present within the Wemen Liparoo target area

EVC no.	EVC name	Area modelled as present within target area (ha)	Bioregional conservation status
103	Riverine Chenopod Woodland	2.92	Depleted
158	Chenopod Mallee	0.04	Vulnerable
200	Shallow Freshwater Marsh	96.40	Vulnerable
295	Riverine Grassy Woodland	5.21	Depleted
808	Lignum Shrubland	1.92	Least concern
810	Floodway Pond Herbland	32.59	Depleted
813	Intermittent Swampy Woodland	7.71	Depleted
818	Shrubby Riverine Woodland	14.77	Least concern
823	Lignum Swampy Woodland	91.01	Depleted

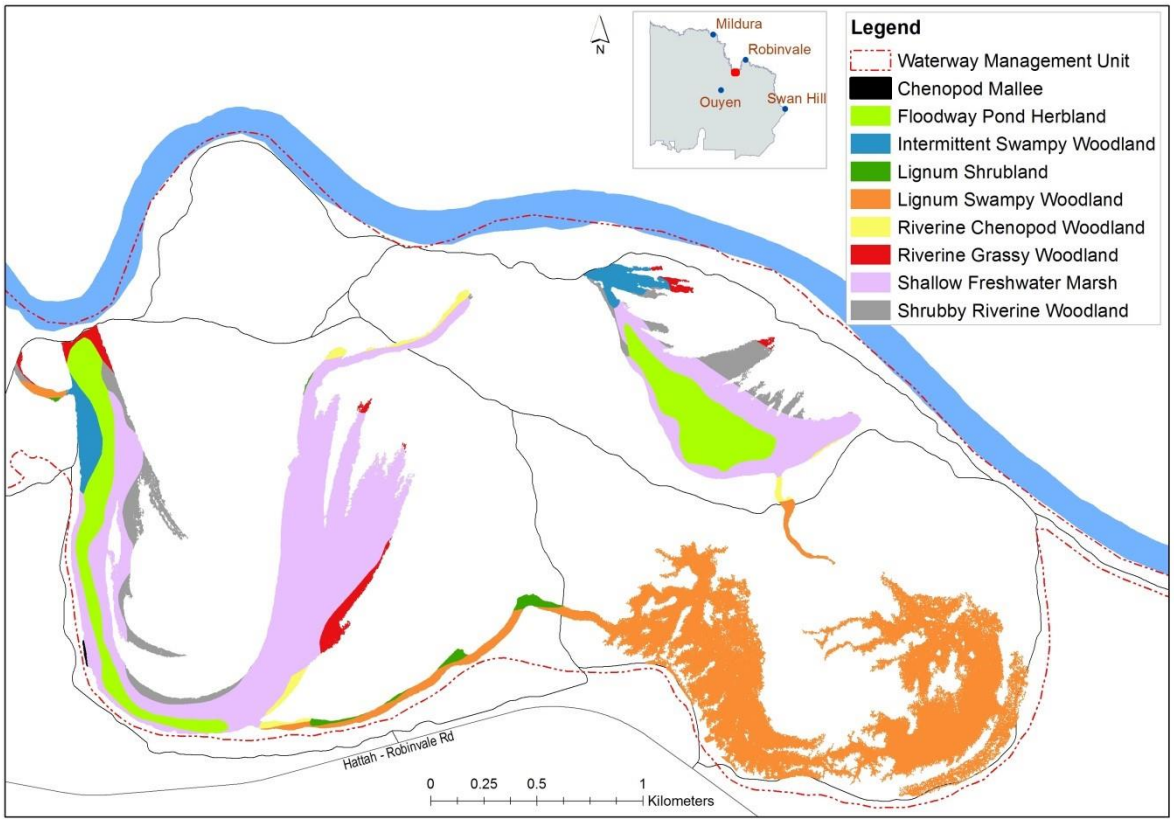


Figure 7 – Ecological Vegetation Classes present in the Wemen-Liparoo target area

Adjacent to the Murray River low terraces support River Red Gum dominated communities such as Grassy Riverine Forest (EVC 106). Grassy Riverine Forest is a River Red Gum forest to 25m tall with an understorey of Eumong (*Acacia stenophylla*), Tangled Lignum (*Muehlenbeckia florulenta*) and a range of tussock grasses and occasional tall shrubs.

Slightly higher, less frequently inundated terraces support communities dominated by a mix of River Red Gum and Black Box such as Intermittent Swampy Woodland (EVC 813), Riverine Grassy Woodland (295), and Shrubby Riverine Woodland (EVC 818). Intermittent Swampy Woodland is comprised of an overstorey of River Red Gum and Black Box to roughly 15m tall, with an understorey of Eumong, scattered shrubs such as Tangled Lignum and a range of grasses and sedges. With frequent inundation it is dominated by flood stimulated species in association with inundation-tolerant flora. Shrubby Riverine Woodland is similar, with an understorey of grasses, chenopods and daisies; and Riverine Grassy Woodland has understorey dominated by grasses with scattered chenopod shrubs.

Healthy River Red Gums provide extensive habitat for a range of fauna, and waterbirds can use these trees for nesting. River Red Gums also deposit organic woody debris to wetlands which provide structural habitat features for wetland fauna such as perching sites for waterbirds and snags for fish (Roberts and Marston, 2011). Ideal flooding for River Red Gum recruitment is late spring to early summer (Johns and et al., 2009), while ideal flood timing for River Red Gum maintenance and survival is winter to spring following the natural flooding pattern (Dalton, 1990).

Higher terraces further away from flow paths support Black Box woodland dominated EVCs such as Riverine Chenopod Woodland (EVC 103), an EVC with a diverse shrubby and grassy understorey that is subject to only extremely infrequent incidental shallow flooding from major events.

Black Box provides essential habitat and foraging opportunities for a range of species including mammals and reptiles and supports a high proportion of ground foraging and hollow-nesting birds. Black Box can tolerate a range of moisture and salinity conditions (Roberts and Marston, 2011), however recruitment and establishment is linked to the elevated and continued soil moisture associated with flood events. Under extended periods of dry conditions Black Box is likely to decline and eventually die (Ecological Associates, 2007a).

The health of Black Box dominated vegetation communities is varied, those close to flow paths are healthy and vigorous, having received access to water through their root zones, even if not recently inundated (**Figure 8**).

Figure 8 - Black Box and Lignum woodland near the entrance to Liparoo West Billabong. Though there is a diversity of species present, the Lignum is lacking vigour (February 2016)

Lignum Shrublands (EVC 808) (Figure 9) are located in depressions higher on the floodplain that will still receive inundation during high river flows and may hold water for extended periods of time. Lignum Shrubland is dominated by Lignum and chenopod shrubs with a ground layer of grasses and herbs that are tolerant of, or able to survive, both periods of inundation and exposure.

Figure 9 – Lignum Shrubland is present between Liparoo West Billabong and wetland 12156 (February 2016)

A significant area of Lignum Swampy Woodland (EVC 823) is present in a depression fed from overflow from Liparoo East Billabong. When flooded, areas of Lignum can provide nesting habitat for platform building birds as well as productive fish habitat (Ecological Associates, 2006b). Tangled Lignum has particular ecological value as waterbird breeding habitat. Wetland birds that breed over water use flooded Lignum Shrubland (Ecological Associates, 2007a) for nesting and other waterbirds use Lignum for nesting (Rogers and Ralph, 2011).

The wide, flat-bottomed Liparoo East and Liparoo West Billabongs support a mosaic of Shallow Freshwater Marsh (EVC 200) and Floodway Pond Herbland (EVC 810) (Figure 10). Floodway Pond Herbland is up to 30cm tall, has a large component of ephemeral grass, sedge and herb species, and is associated with floodway systems with a regular wetting and drying cycle.

Figure 10 - The floors of wide flat wetlands such as Liparoo East and Liparoo West Billabongs (shown above) support Floodway Pond Herbland during and after inundation (December 2019)

Mallee woodland EVCs such as Semi-arid Woodland and Semi-arid Chenopod Woodland are present on the high escarpment bordering the southern end of Wemen-Liparoo (Figure 11).

Figure 11 - Mallee on the high escarpment bordering the southern end of Wemen-Liparoo (February 2016)

Flora

One hundred and sixty species of flora have been recorded at Wemen Liparoo (a full list of flora can be found in Appendix 3). Of these, thirteen are listed under the FFG Act and/or the Advisory List of Rare or Threatened Flora in Victoria, and seven of these are considered inundation dependent as they are found around lakes, waterways or on floodplains and/or propagate more readily with inundation (Table 8). Thirty seven introduced flora species have also been recorded at the site.

Table 8 - Listed flora recorded at Wemen Liparoo

Common name	Scientific name	Inundation dependent	FFG status	VROT advisory list status
Umbrella Wattle	*Acacia oswaldii*	no	Nominated	Vulnerable
Twin-leaf Bedstraw	*Asperula gemella*	yes	-	Rare
Blue Burr-daisy	*Calotis cuneifolia*	unknown	-	Rare
Slender Bitter-cress	*Cardamine tenuifolia*	yes	-	All infraspecific taxa included in Advisory List
Woolly Scurf-pea	*Cullen pallidum*	no	Listed	Endangered
Tough Scurf-pea	*Cullen tenax*	unknown	Listed	Endangered
Spreading Emu-bush	*Eremophila divaricata subsp. divaricata*	yes	-	Rare
Warty Peppercress	*Lepidium papillosum*	yes	-	Poorly known
Native Peppercress	*Lepidium pseudohyssopifolium*	yes	-	Poorly known
Pin Sida	*Sida fibulifera*	yes	-	Vulnerable
Small-leaf Swainson-pea	*Swainsona microphylla*	no	-	Rare
Dwarf Swainson-pea	*Swainsona phacoides*	no	-	Endangered
Sweet Fenugreek	*Trigonella suavissima*	yes	-	Rare

Source: (DEPI, 2014; DELWP, 2015; National Herbarium of New South Wales, n.d.; Atlas of Living Australia, n.d.; Bush Heritage Australia, 2016)

Other fauna

Waterbirds

Waterbird diversity and abundance are influenced by wetland habitat diversity, with different species and feeding guilds using different habitats for breeding and foraging (Haig, Mehlman and Oring, 1998). Water depth in particular influences waterbird diversity due to the specific feeding behaviours of different species (Bancroft, Gawlick and Rutchey, 2002). Managing wetlands to provide diverse habitats such as variable water depth, mud flats, inundated vegetation and areas of deep water increases the likelihood of waterbird diversity (Taft, Colwell, Isola and Safran, 2002).

Recommendations within this EWMP will be directed toward providing the habitat through a watering regime appropriate to providing key habitat needs of the waterbird guilds listed in Table 9. This is based on the habitat types available at the site.

Table 9 - Waterbird functional feeding groups (Roshier, Robertston and Kingsford, 2002) and their resource use

Waterbird Group	Food Resource	Habitat Use
Dabbling and Diving Ducks (e.g. Grey Teal, Pacific Black Duck, Black Swan, Eurasian Coot)	Generalists; plankton, small invertebrates, plant material	Shallow Water (Dabblers)
Grazing Waterfowl (e.g. Australian Wood Duck)	Plant material, seeds, invertebrates	Shallow Water, littoral zone
Fish Eaters (e.g. Grebes, Pelican, Cormorants, Darters Egrets, Heron, Tern)	Fish	Open and deep water
Small Waders (e.g. Black-tailed Native Hen, Purple Swamphen, Masked Lapwing, Blackfronted Dotterel)	Small invertebrates, seeds	Littoral zone, mudflats
Large Waders (e.g. Spoonbill, Ibis)	Macroinvertebrates, fish, amphibians	Littoral zone
Shoreline Foragers (e.g. Lapwings, Hens)	Plant material, seeds, invertebrates,	Littoral zone, mudflats

Providing appropriate water requirements to support the vegetation communities will support habitat for birds that have adapted to the required flooding and drying cycle (Scott, 1997). With an appropriate water regime waterbirds will utilise areas of shallow water, mudflats and the littoral zone in floodplain channels and wetlands.

Bats

Seven bat species have been recorded at Wemen Liparoo: Gould's Wattled Bat (*Chalinolobus gouldii*), Chocolate Wattled Bat (*Chalinolobus morio*), Inland Freetail Bat (*Mormopterus* sp. 3), Southern Freetail Bat (*Mormopterus* sp. 4), Lesser Long-eared Bat (*Nyctophilus geoffroyi*), Southern Forest Bat (*Vespadelus regulus*), and Little Forest Bat (*Vespadelus vulturnus*). These insectivorous microbat species require hollows within living or dead mature trees for nesting (Menkhorst and Knight, 2004) (Figure 12).

Figure 12 - Mature Black Box trees provide habitat for bats and birds (February 2016)

Frogs

Four frog species have been recorded at Wemen Liparoo; Southern Bullfrog (*Limnodynastes dumerilii*), Spotted Marsh Frog (*Limnodynastes tasmaniensis*), Peron's Tree Frog (*Litoria peronii*), and Common Spadefoot Toad (*Neobatrachus sudellae*). Like other flood-dependent species, frogs respond to factors such as inundation timing, length and frequency. Frogs also respond to spatial factors such as the proximity of drought refugia and the extent of flooding across the floodplain. Aquatic vegetation cover and structural complexity are important to many frog species, both in tadpole and adult form. Aquatic vegetation provides the structure for biofilms and organic matter to accumulate, a major food source for tadpoles (Rogers and Ralph, 2011).

Wetland depletion and rarity

The conservation significance of Victorian wetland types has been determined by comparing the estimated extent prior to European settlement with the remaining extent.

Wemen Liparoo contains two wetland types under the Corrick classification, Shallow Freshwater Marsh and Deep Freshwater Shallow Freshwater Marsh and Deep Freshwater Marsh have declined to a much greater extent across the state, (-60% and -70% respectively); within the Mallee CMA (-6% and -45% respectively) and within the Robinvale Plains Bioregion (-4% and -37% respectively) (Table 10).

Table 10 – Regional changes in the area of the wetland type (Corrick classification) represented within the Wemen Liparoo target area

Corrick	Wetland name	Total area (ha) category	Percentage change in wetland area from 1788 to 1994		
			Change in Victoria	Change in Mallee CMA	Change in Robinvale Plains bioregion
Shallow Freshwater Marsh	Liparoo East Unnamed #12156	26.7 16.7	-60%	-6%	-4%
Deep Freshwater Marsh	Liparoo West	36.7	-70%	-45%	-37%

Source: (Mallee CMA, 2006; DELWP, 2016a)

Victoria's wetland classification was updated in 2013 and is now based on the Australian National Aquatic Ecosystem Classification Framework. The 'Wetland Current' layer (Full title: Victorian Wetland Environments and Extent - up to 2013) lists Liparoo East and West Billabong and #432509 as unknown.

Ecosystem functions

Wetland ecosystems support distinctive communities of plants and animals and support numerous ecosystem functions. Floodplain wetlands perform important functions necessary to maintain the hydrological, physical and ecological health of river systems.

Three key broad ecosystem functions have been identified for the Wemen Liparoo EWMP. Each function is interlinked and must be supported in order for the ecosystem to flourish. The functions are briefly described below.

Connections across floodplains, adjacent wetlands and billabongs (lateral)
Water levels that engage flood channels, wetlands and floodplain surfaces will promote nutrient and carbon cycling and return organic material to the river for further processing (Robertston, Bacon and Heagney, 2001).

Waterbird groups also access a variety of habitat types such as mud flats, flooded Lignum and shallow aquatic vegetation which only become available following inundation.

Diversity of habitat for feeding, breeding and nursery
Wetland filling and water recession will increase the extent and species diversity of the band of sedges, rushes and semi-aquatic forbs surrounding wetlands and areas of deeper water will support submerged aquatic macrophytes. This inundation cycle will promote high levels of aquatic productivity and increased habitat complexity for frogs, small native fish, and waterbirds.

Seasonal fluctuations in water levels in the wetlands increase the availability of specific habitat niches for feeding, breeding and nursery areas. The permanent and semi-permanent water bodies will provide a source of food, refuge from predators and nesting sites and materials (Kingsford and Norman, 2002).

When flooded, the ephemeral flora component of Lignum Swampy Woodland and Lignum Shrubland will germinate or expand, providing habitat for frogs, aquatic invertebrates and small native fish and the water birds that prey on these species.

The growth and vigour of River Red Gum and Black Box within or adjacent to inundated areas will increase, increasing their value as habitat for nesting and perch sites and for the input of leaves and coarse woody debris into the wetlands and floodplain.

Transportation and dilution of nutrients and organic matter and increase in macroinvertebrate productivity and biofilm diversity

Drying of wetlands, particularly during summer and autumn, exposes sediments and facilitates decomposition and processing of organic matter. The microbial decay of plant material is an important route for energy and nutrients to enter the aquatic food chain where it becomes available for consumption by bacteria, algae, macrophytes and macroinvertebrates (Young, 2001).

Fluctuations in water levels allow exposure of substrates such as large wood and plant stems through a drying cycle, supporting a mosaic of biofilm species that offer a range of food resources for macroinvertebrates and fish.

5.2 Social values

Cultural value

The Mallee region 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 Mallee's natural landscapes.

Given the semi-arid climate of the region, ready access to more permanent water has been a major determinant of human habitation, and as such the highest densities of identified indigenous cultural heritage sites are located around or close to areas of freshwater sources.

Within the Mallee CMA region, the Murray River and its associated waterways were important habitation 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 concentration and diversity. They include large numbers of burial and hunting sites and middens.

In the south of the region, waterways were focal points for the region's traditional owners, with many lakes being the site for large gatherings of several social clan groups that afforded trade and cultural exchanges.

Waterways also play a large role in the region's more recent non-indigenous heritage due to the historical infrastructure (e.g. buildings, irrigation and river navigation structures) they often contain. These places provide links to early industries and settlements and play a key part in the region's identity.

Cultural heritage

Wemen Liparoo has thousands of years of indigenous cultural history and the site hosts scar trees and is likely to contain burial sites within the sandy rises (P. Kelly 2016, pers. comm., 9 February).

Currently there is no Registered Aboriginal Party (RAP) for the area nor any applications for RAP status (Department of Premier and Cabinet, 2016). Like much of the Murray River riparian woodlands, historically the site has been used as a source of timber and for sheep and cattle grazing (Parks Victoria, 2014).

5.3 Recreation

Wemen Liparoo is only a few kilometres from the township of Wemen and is adjacent to the MurrayKulkyne National Park. Tourists and visitors are encouraged to visit both National Parks together and a series of walking paths and 4WD tracks are provided. Bush camping is allowed and is popular along the Murray River Frontage. The minimal tourist facilities contribute to the peaceful and remote atmosphere of the park and attracts those looking for a low-key nature experience. Swimming

and canoeing are also popular and Wemen Liparoo is a popular fishing site for visitors from the inland town of Ouyen.

5.4 Economic values

The natural beauty of Wemen Liparoo, the Murray-Kulkyne National Park, as well as the adjacent Hattah-Kulkyne National Park attract both locals and tourists. Surrounding land uses include dryland cropping, irrigated agriculture (almonds), and the town of Wemen.

5.5 Significance

Wemen-Liparoo provides habitat for eight-listed water dependent species. Additionally, the diverse wetland and floodplain features provide extensive habitat for small-bodied native fish, waterbirds, frogs and turtles. Wemen-Liparoo is located within the Murray-Kulkyne Park and offers good conservation outcomes through land management and implementation of an appropriate environmental water regime.

6 Ecological condition and threats

6.1 Current condition

The condition of the wetlands at Wemen-Liparoo has not been assessed using the state-wide Index of Wetland Condition. The condition information described below is based on brief field observations and limited existing literature. It should be considered high priority to undertake a condition assessment using the Index of Wetland Condition.

Initial field inspections undertaken in February 2016 found wetlands at Wemen-Liparoo to be in a dry phase. Currently, healthy mature River Red Gums line the channel resulting in abundant leaf litter, however understorey diversity continues to remain low (Figure 13). Simultaneously, River Red Gum recruitment has continued to increase and age in association with inundation events (Figure 14).

Figure 13 - Liparoo West showing healthy mature River Red Gums lining the channel (October 2019)

Figure 14 - Liparoo West showing evidence of River Red Gum recruitment and accumulated leaf litter associated with inundation events (December 2019)

Areas of Black Box and Lignum woodland that have received less frequent inundation are showing evidence of declining vigour and health (Figure 15).

Figure 15 - Flow path linking Liparoo West to the area of Lignum Swampy Woodland. River Red Gum recruitment is evident following earlier inundation, but mature Black Box and River Red Gum are in poor health or dead and the understorey is lacking diversity (February 2016)

Figure 16 - Lignum and Black Box in the northern most section of Liparoo Billabong show reduced health and vigour (February 2016)

6.2 Condition trajectory

The poor tree health and lack of understorey through parts of the target area will continue without an appropriate environmental watering regime. Areas of Lignum and Blackbox are particularly at risk of further decline.

6.4 Water related threats

The Aquatic Value Identification and Risk Assessment (AVIRA) database is an on-line tool used by Victorian waterway managers to store data about the values, threats and risks to waterway health in their region. The database evaluates threats for a range of sub-indices including water regime, invasive fauna and acid sulphate soils (Peters, 2009).

Invasive fauna aquatic

Although no aquatic species records are available for the site, feral aquatic fauna are likely to include Common Carp (*Cyprinus carpio*). Carp would be prevalent in the target area wetlands when inundated. Carp have been found to contribute to the loss of aquatic vegetation and increased turbidity, resulting in loss of habitat for waterfowl (Purdey and Loyn, 2008) and native fish species. This species also competes with the native fish for habitat and food, as well as having a detrimental effect on water quality (Mallee CMA, 2003). The presence of Carp can also have a detrimental impact on recruitment for frogs due to predation (Spencer and Wassens, 2009).

Invasive fauna terrestrial

Introduced terrestrial species recorded at the site include Pig (*Sus scrofa*), Red Fox (*Vulpes vulpes*), European Rabbit (*Oryctolagus cuniculus*), Cat (*Felis catus*), House mouse (*Mus musculus*), and Common Starling (*Sturnus vulgaris*).

Feral pigs are known to pug and dig wetland soil, destroy macrophyte beds, increase nutrient levels and reduce water clarity. Foxes and Cats predate on native birds and mammals and both are listed as potentially threatening processes under the *Flora and Fauna Guarantee Act 1988* (DSE, 2002, 2004). High nest predation by foxes is a threat to the Eastern Long-necked Turtle (Kennett et al., 2009). Rabbits can over-browse flora species and reduce survival and recruitment success, cause erosion, compete with native herbivores for food and burrows and support high populations of introduced predators such as foxes and cats (Office of Environment & Heritage, 2015). The Dwarf Swainson Pea (*Swainsona phacoides)*, listed as rare on the VROT advisory list is considered to be especially threatened by high rabbit numbers (DSE, 2003a).

Changed water regime

As discussed in the hydrology section of this EWMP, the hydrology of the target area has been greatly impacted by the regulation of the Murray River. The changed water regime assessment takes into account the impacts of regulation of the primary water source of the wetland (Murray River), other activities which may impact the wetlands water regime, impacts to seasonality, duration and frequency of the water regime and the severity of the effects of these activities.

7 Management objectives

7.1 Management goal

The management goal for the Wemen-Liparoo EWMP is:

“To provide a water regime for the Wemen-Liparoo target area that will maintain perennial, droughttolerant vegetation, provide seasonal habitat for small-bodied native fish, large waders and waterfowl and maintain an area of Lignum Swampy Woodland as an intermittent waterbird breeding habitat.

7.2 Ecological objectives

Ecological objectives represent the desired ecological outcomes of the site based on the management goal which has been framed around the key values outlined in the Water Dependent Values section of this EWMP. In line with policy in the Victorian Waterway Management Strategy (VWMS) the ecological objectives are expressed as the target condition or functionality of each key value.

The ecological objectives for Wemen-Liparoo are: *Liparoo*

and Liparoo East Billabongs

- Support seasonal habitat for small native fish
- Provide seasonal feeding habitat for large waders and waterfowl
- Maintain a community of drought-tolerant emergent aquatic macrophytes at the wetland edge

Liparoo - Lignum Swampy Woodland area

- Healthy and productive Lignum Swampy Woodland community that supports frogs and small native fish when flooded
- Maintain Lignum Shrubland and provide occasional breeding events by platformbuilding waterbirds including Ibis and Spoonbill

Table 11 - Ecological objectives for Wemen-Liparoo

Ecological objective	Justification	Wetland area
Support seasonal habitat for small native fish	Small native fish such as Gudgeon and Rainbowfish will visit the wetlands when flooded and may breed. In turn, these fish will be an important food source for some birds and turtles.	Liparoo West and Liparoo East Billabongs
Provide seasonal feeding habitat for large waders and waterfowl	Dabbling ducks, shoreline foragers and large waders will feed in shallow water and littoral zone areas of the wetlands on a seasonal basis.	Liparoo West and Liparoo East Billabongs
Maintain a community of drought-tolerant emergent aquatic macrophytes at the wetland edge	Emergent plant species *Eleocharis acuta* and *Cyperus gymnocaulos* provide a range of habitat values. Flooded emergent macrophytes are important waterbird breeding habitats that may be used by waterfowl, Grebes, Dotterel and Stilts.	Liparoo West and Liparoo East Billabongs

Healthy and productive Lignum Swampy Woodland community that supports frogs and small native fish when flooded	Inundation of Lignum woodlands will allow colonisation by native fish including Gudgeon and Murray-Darling Rainbowfish. Habitat for frogs will expand to cover the whole of the flooded depression. Eastern Snake-necked Turtle a listed species has also been found at Wemen-Liparoo and will be supported by this habitat.	Liparoo West Billabong – Lignum Swampy Woodland area
Maintain Lignum Shrubland and provide occasional breeding events by platform building waterbirds including Ibis and Spoonbill	Lignum shrublands are important habitat and feeding habitat for fauna species within the target area. They are particularly important for roosting and nesting for species such as Ibis and Spoonbill (Ecological Associates, 2006). Healthy Lignum can also provide shelter and feeding sites for Carpet Python and Woodland birds such as Brown Treecreeper.	Liparoo West Billabong – Lignum Swampy Woodland area

7.3 Hydrological objectives

Hydrological objectives describe the components of the water regime required to achieve the ecological objectives for the target area. The hydrological requirements to achieve each of the ecological objectives are presented in Table 12 and are described below.

Large wading birds depend on broad areas of shallow flooding over spring and summer, ideally where there is emergent and submerged aquatic vegetation. Regular drying, partially or entirely of the wetland will encourage food sources for waders including small fish, frogs and macroinvertebrates.

Flooding of wetland and floodplain vegetation in spring and summer provides a source of food, refuge and nesting sites and materials for waterbirds (Kingsford and Norman, 2002). Receding waters levels over summer provide shallow open water and mudflats which are important foraging habitat for wading birds (Ecological Associates, 2013).

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 plants in this state do not accommodate nesting by birds. Durations of three to seven months sustain vigorous canopy, but longer term waterlogging is detrimental. Although timing of flooding is not crucial for Lignum, following natural seasonality is encouraged to provide for understorey and wetland plants and to support fauna outcomes (Roberts and Marston, 2011).

Emergent macrophytes, such as *Eleocharis acuta* and *Cyprus gymnocaulos,* should be inundated to a depth of between 0.1 and 1 metre for a period of one to six months with a frequency of one in one to one in two years (Ecological Associates, 2007b).

Table 12 - Hydrological objectives for Wemen-Liparoo

Level	Zone	Frequency	Duration	Timing
44.5	Aquatic habitat	1:2	Up to 12 months	winter/spring
45.3	Emergent macrophyte/ Littoral zone	1:2	4-6 months	late winter/early summer
45.7	Lignum Swampy Woodland	1:4	3-7 months	early spring/ summer

7.4 Watering regime

The wetland watering regime has been derived from the ecological and hydrological objectives. To allow for adaptive and integrated management, the hydrological objectives have been framed using the seasonally adaptive approach. This means that a watering regime is identified for optimal conditions, as well as the maximum and minimum tolerable watering scenarios. The minimum watering regime is likely to be provided in drought or dry years, the optimum watering regime in average conditions and the maximum watering regime in wet or flood years.

The optimal watering regime is described below. Due to the inter-annual variability of these estimates (particularly the 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. The watering regime has been derived following review of the pre-regulation hydrology data.

Optimal watering regime

Fill Liparoo West Billabong and Liparoo East Billabongs to 45.3m AHD every second year in winter and allow natural recession of water levels resulting in a seasonal drying or partial drying of the wetland. In every fourth year fill inundate target area to 45.7m AHD in September to flood the Lignum Swampy Woodland area. Top up by pumping to maintain inundation of Lignum Swampy Woodland for up to six months and then allow natural recession of water levels.

Minimum watering regime

Fill Liparoo West Billabong and Liparoo East Billabongs to 45.3m AHD every second year in winter and allow natural recession of water levels resulting in a seasonal drying or partial drying of the wetland.

Maximum watering regime

Fill Liparoo West Billabong and Liparoo East Billabongs to 45.3m AHD every year in winter and allow natural recession of water levels resulting in a seasonal drying or partial drying of the wetland. In every fourth year fill inundate target area to 45.7m AHD in September to flood the Lignum Swampy Woodland area. Top up by pumping to maintain inundation of Lignum Swampy Woodland for six months and then allow natural recession of water levels.

8 Managing risks to achieving objectives

Threat	Likelihood	Consequence	Risk – H, M, L (likelihood x consequence)	Management measure	Residual risk
Failure to meet ecological objectives	Possible	High	H	Monitoring program in place. Adaptive approach.	L
Species, communities or ecological functions have been overlooked in water regime due to lack of data	Possible	High	H	Review ecological survey results and update objectives if significant gaps are found.	L
Inundation duration too long or too short	Possible	High	H	Monitoring program in place. Adaptive approach as additional baseline and monitoring outcome data is available.	L
Water regime significantly enhances habitat for Carp	Likely	Moderate	M	Monitoring of Carp populations. Review of inlet and pumping equipment to screen Carp. Dry wetland out when Carp abundance reaches critical levels.	L
Criminal damage or theft of water delivery infrastructure	Possible	Moderate	M	Utilise appropriate security devices on equipment and proactively engage with the community prior to watering event to gain support for the program.	L
Damage to infrastructure, particularly temporary stopbanks leading to loss of water from target area	Likely	Moderate	M	Appropriate engagement and site management in place. Regular monitoring and staff presence during watering events.	L
Maintenance required to delivery infrastructure (pump/channel etc.) during proposed watering event	Likely	High	VH	Include maintenance of channel on annual inspection checklist. Ensure pump contractors are appropriately inducted and experienced and have appropriate quality assurance processes in place.	L

Threat	Likelihood	Consequence	Risk – H, M, L (likelihood x consequence)	Management measure	Residual risk
Monitoring program is unable to detect improvement in short to medium term	Possible	High	H	Engagement with key stakeholders confirming expected outcomes, timeframes and assumptions.	L
Damage to cultural heritage sites through construction of temporary infrastructure and equipment	Possible	High	H	Site risk assessments undertaken and mitigations in place prior to any works occurring. Cultural Heritage Management Plans in place.	L

9 Environmental water delivery infrastructure

9.1 Constraints

The infrastructure to allow inundation of the target area needs to be planned and implemented. As the target area is within the Murray-Kulkyne Park, there are no other constraints to implementing the recommended water regime.

The area able to be inundated without the proposed infrastructure is shown in Figure 17.

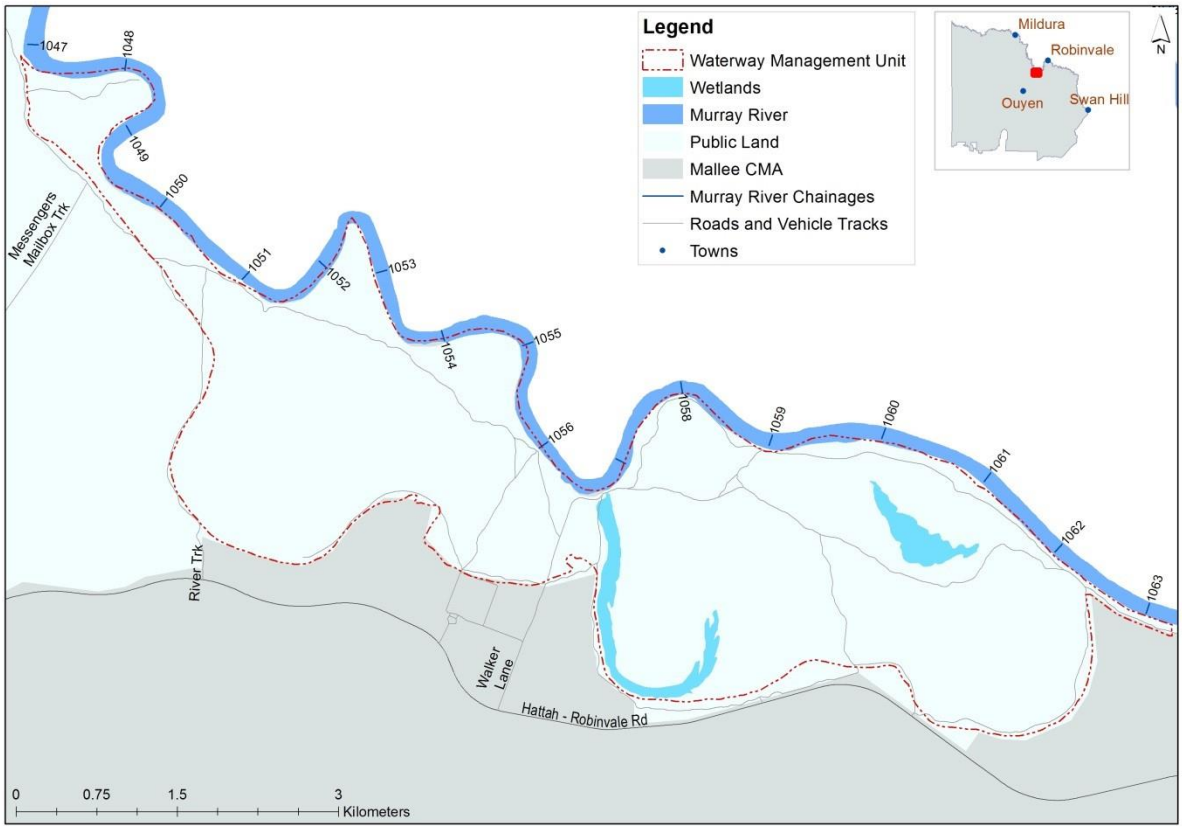


Figure 17 - Current inundation extent without proposed infrastructure

9.2 Infrastructure or complementary works recommendations

It is recommended that track raising is undertaken in three locations, as shown in Figure 18. The tracks would need to be raised by approximately 50 cm. Conceptual designs and then detailed designs would need to be undertaken to implement the works and determine whether the works would be limited to track raising or would include the provision of regulators at the two main river connections of the Liparoo West and Liparoo East billabongs. Additionally, Cultural Heritage investigations would be required. Filling of the wetland would be undertaken using temporary pumps located near the track raising points.

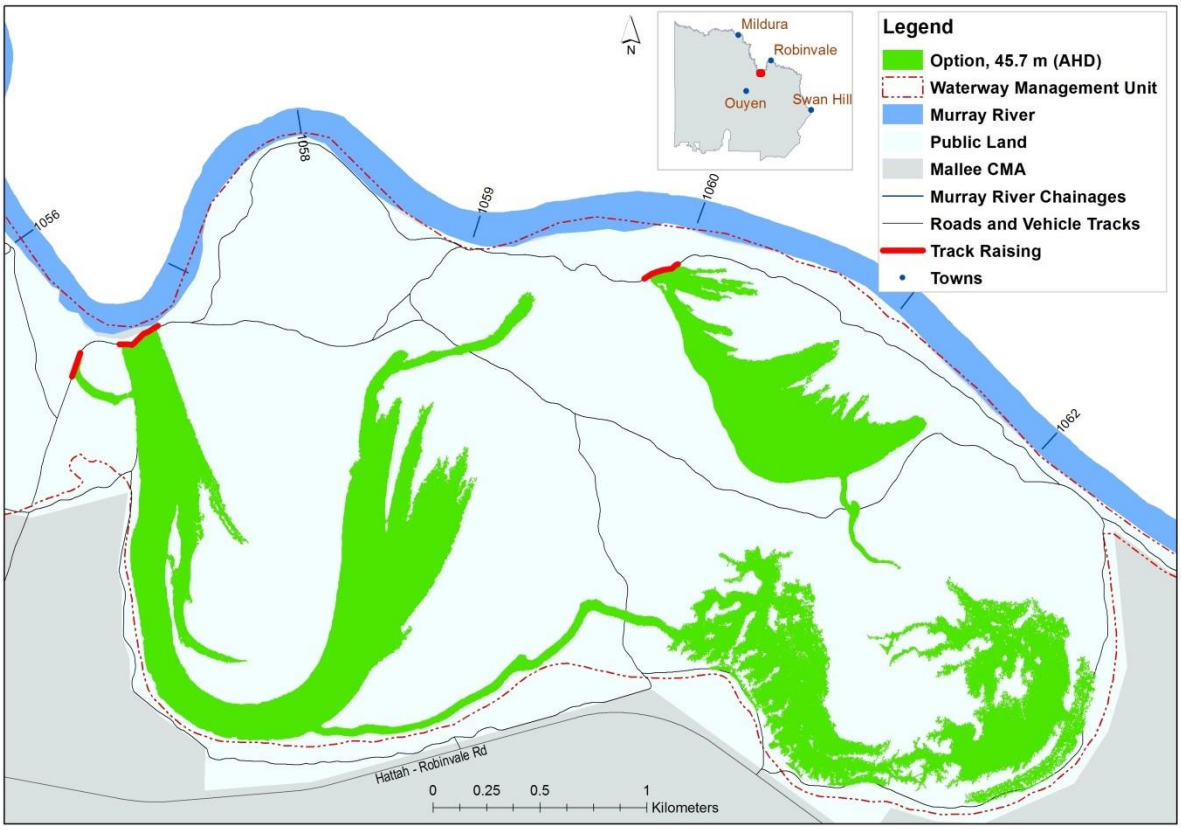


Figure 18 - Proposed infrastructure locations for Wemen-Liparoo

11 Demonstrating outcomes

11.1 Monitoring priorities at the site

The following priorities for monitoring have been identified for the Wemen-Liparoo target area:

- Monitor extent and length of inundation of Intermittent Swampy Woodland area to ensure that there is enough time for target large wading bird species to recruit.
- Telemetry on depth gauges should be used to continuously monitor depth through the wetting and drying phases of the water regime.
- Photo point monitoring of tree health within the woodlands should be undertaken.

12 Consultation

This Plan was developed in collaboration with key stakeholders namely Parks Victoria, Nyeri Nyeri and Latji Latji community, the Department of Environment, Land, Water and Planning, and local interest groups.

Table 13 - Consultation for development of Wemen-Liparoo EWMP

Meeting Date	Stakeholders	Details
May 2012 & June 2016	Department of Environment Land Water and Planning	Site visit and discussion of options. Plan presentation.
Sept 2012 & June 2016	Parks Victoria	Discussion of concept and content of draft (2012) plan. Plan presentation.
Oct 2012 & June 2016	Wemen Progress Association	
June 2016	Murray Lower Darling Rivers Indigenous Nations	Plan presentation
June 2016	Landholder and pump site owners	Plan presentation

13 Knowledge gaps and recommendations

- Index of Wetland Condition monitoring is required to set a baseline for condition within the target area prior to the recommended watering regime being implemented.
- The commence to flow for each of the wetland areas within the target area should be confirmed. There is currently a range given which is 19,300 – 37,900 which was identified through the Murray Wetland Working Group data.
- Survey of fish, frog and turtle populations would be useful when the wetland has been inundated.

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Abbreviations and acronyms

CAMBA	China-Australia Migratory Bird Agreement
CMAs	Catchment Management Authorities
DELWP	Department of Environment, Land, Water and Planning
EVC	Ecological Vegetation Class
EWMP	Environmental Water Management Plan
FSL	Full Supply Level
MDBA	Murray-Darling Basin Authority (formally Murray-Darling Basin Commission, MDBC)
TSL	Targeted Supply Level
VEWH	Victorian Environmental Water Holder

Appendix 1 – Fauna species list

Common name	Scientific name	Type
Southern Bullfrog	*Limnodynastes dumerilii*	A
Spotted Marsh Frog (race unknown)	*Limnodynastes tasmaniensis*	A
Peron's Tree Frog	*Litoria peronii*	A
Common Spadefoot Toad	*Neobatrachus sudellae*	A
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*	B
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	B
Yellow Thornbill	*Acanthiza nana*	B
Chestnut-rumped Thornbill	*Acanthiza uropygialis*	B
Brown Goshawk	*Accipiter fasciatus*	B
Australian Owlet-nightjar	*Aegotheles cristatus*	B
Grey Teal	*Anas gracilis*	B
Pacific Black Duck	*Anas superciliosa*	B
Red Wattlebird	*Anthochaera carunculata*	B
Australasian Pipit	*Anthus novaeseelandiae*	B
Southern Whiteface	*Aphelocephala leucopsis*	B
Wedge-tailed Eagle	*Aquila audax*	B
Eastern Great Egret	*Ardea modesta*	B
Dusky Woodswallow	*Artamus cyanopterus*	B
Mallee Ringneck	*Barnardius zonarius barnardi*	B
Sulphur-crested Cockatoo	*Cacatua galerita*	B
Little Corella	*Cacatua sanguinea*	B
Australian Wood Duck	*Chenonetta jubata*	B
Black-eared Cuckoo	*Chrysococcyx osculans*	B
Brown Songlark	*Cincloramphus cruralis*	B
Rufous Songlark	*Cincloramphus mathewsi*	B
White-browed Treecreeper	*Climacteris affinis*	B
Brown Treecreeper (south-eastern ssp.)	*Climacteris picumnus victoriae*	B
Grey Shrike-thrush	*Colluricincla harmonica*	B
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	B
White-winged Chough	*Corcorax melanorhamphos*	B
Australian Raven	*Corvus coronoides*	B
Pied Butcherbird	*Cracticus nigrogularis*	B
Grey Butcherbird	*Cracticus torquatus*	B
Pallid Cuckoo	*Cuculus pallidus*	B
Laughing Kookaburra	*Dacelo novaeguineae*	B
Varied Sittella	*Daphoenositta chrysoptera*	B
Mistletoebird	*Dicaeum hirundinaceum*	B
White-faced Heron	*Egretta novaehollandiae*	B
Black-fronted Dotterel	*Elseyornis melanops*	B
Blue-faced Honeyeater	*Entomyzon cyanotis*	B
Galah	*Eolophus roseicapilla*	B

Peregrine Falcon	*Falco peregrinus*	B

Common name	Scientific name	Type
Crested Shrike-tit	*Falcunculus frontatus*	B
Peaceful Dove	*Geopelia striata*	B
Western Gerygone	*Gerygone fusca*	B
Magpie-lark	*Grallina cyanoleuca*	B
Painted Honeyeater	*Grantiella picta*	B
Australian Magpie	*Gymnorhina tibicen*	B
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	B
Whistling Kite	*Haliastur sphenurus*	B
Little Eagle	*Hieraaetus morphnoides*	B
White-winged Triller	*Lalage sueurii*	B
White-plumed Honeyeater	*Lichenostomus penicillatus*	B
Singing Honeyeater	*Lichenostomus virescens*	B
Square-tailed Kite	*Lophoictinia isura*	B
Superb Fairy-wren	*Malurus cyaneus*	B
Variegated Fairy-wren	*Malurus lamberti*	B
Splendid Fairy-wren	*Malurus splendens*	B
Noisy Miner	*Manorina melanocephala*	B
Brown-headed Honeyeater	*Melithreptus brevirostris*	B
Rainbow Bee-eater	*Merops ornatus*	B
Little Pied Cormorant	*Microcarbo melanoleucos*	B
Jacky Winter	*Microeca fascinans*	B
Restless Flycatcher	*Myiagra inquieta*	B
Southern Boobook	*Ninox novaeseelandiae*	B
Blue Bonnet	*Northiella haematogaster*	B
Nankeen Night Heron	*Nycticorax caledonicus hillii*	B
Cockatiel	*Nymphicus hollandicus*	B
Crested Bellbird	*Oreoica gutturalis gutturalis*	B
Rufous Whistler	*Pachycephala rufiventris*	B
Spotted Pardalote	*Pardalotus punctatus punctatus*	B
Striated Pardalote	*Pardalotus striatus*	B
Australian Pelican	*Pelecanus conspicillatus*	B
Fairy Martin	*Petrochelidon ariel*	B
Welcome Swallow	*Petrochelidon neoxena*	B
Tree Martin	*Petrochelidon nigricans*	B
Red-capped Robin	*Petroica goodenovii*	B
Little Black Cormorant	*Phalacrocorax sulcirostris*	B
Little Friarbird	*Philemon citreogularis*	B
Noisy Friarbird	*Philemon corniculatus*	B
Crimson Rosella	*Platycercus elegans*	B
Yellow Rosella	*Platycercus elegans flaveolus*	B

Common name	Scientific name	Type
Tawny Frogmouth	*Podargus strigoides*	B
Regent Parrot	*Polytelis anthopeplus monarchoides*	B
Chestnut-crowned Babbler	*Pomatostomus ruficeps*	B
White-browed Babbler	*Pomatostomus superciliosus*	B
Red-rumped Parrot	*Psephotus haematonotus*	B
Grey Fantail	*Rhipidura albiscarpa*	B
Willie Wagtail	*Rhipidura leucophrys*	B
Weebill	*Smicrornis brevirostris*	B
Apostlebird	*Struthidea cinerea*	B
Common Starling*	*Sturnus vulgaris*	B
Sacred Kingfisher	*Todiramphus sanctus*	B
Masked Lapwing	*Vanellus miles*	B
Silvereye	*Zosterops lateralis*	B
Gould's Wattled Bat	*Chalinolobus gouldii*	M
Chocolate Wattled Bat	*Chalinolobus morio*	M
Cat*	*Felis catus*	M
Water Rat	*Hydromys chrysogaster*	M
Western Grey Kangaroo	*Macropus fuliginosus*	M
Inland Freetail Bat	*Mormopterus* sp. 3	M
Southern Freetail Bat	*Mormopterus* sp. 4	M
House Mouse*	*Mus musculus*	M
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	M
European Rabbit*	*Oryctolagus cuniculus*	M
Pig (feral)*	*Sus scrofa*	M
Short-beaked Echidna	*Tachyglossus aculeatus*	M
Common Brushtail Possum	*Trichosurus vulpecula*	M
Southern Forest Bat	*Vespadelus regulus*	M
Little Forest Bat	*Vespadelus vulturnus*	M
Red Fox*	*Vulpes vulpes*	M
Eastern Snake-necked Turtle	*Chelodina longicollis*	R
Marbled Gecko	*Christinus marmoratus*	R
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*	R
Carnaby's Wall Skink	*Cryptoblepharus pannosus*	R
Tessellated Gecko	*Diplodactylus tessellatus*	R
Grey's Skink	*Menetia greyii*	R
Boulenger's Skink	*Morethia boulengeri*	R
Lace Monitor	*Varanus varius*	R

Lifeform type: Invertebrate, Fish, Amphibian, Reptile, Bird, Mammal
*Introduced species

Lifeform type: Invertebrate (I), Fish (F), Amphibian (A), Reptile (R), Bird (B), Mammal (M)

Source: (DELWP, 2016b; unpublished fish survey data - Mallee CMA)

Appendix 2 – Ecological vegetation classes (EVCs)

EVC no.	EVC name	Bioregional conservation status	Description
103	Riverine Chenopod Woodland	Depleted	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.
158	Chenopod Mallee	Vulnerable	Open to very open mallee woodland to 12 m tall (almost invariably dominated by Eucalyptus gracilis) supported by thin Woorinen deposits typically overlying gypsiferous and sodic clays. Characterised by the dominance of saltbushes and semi- succulent understorey shrubs.
200	Shallow Freshwater Marsh	Vulnerable	Wetland EVC
295	Riverine Grassy Woodland	Depleted	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.
808	Lignum Shrubland	Least concern	Relatively open shrubland of species of divaricate growth form. The ground-layer is typically herbaceous or a turf grassland, rich in annual/ephemeral herbs and small chenopods. Characterised by the open and even distribution of relatively small Lignum shrubs. Occupies heavy soil plains along Murray River, low-lying areas on higher-level (but still potentially flood-prone) terraces.
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.
813	Intermittent Swampy Woodland	Depleted	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 of pointbar 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	Eucalypt woodland to open forest to 15 m tall of less floodprone (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	Depleted	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.

Source: (DSE, 2013; DELWP, 2016a)

Appendix 3 – Flora species list

Common name	Scientific name
Umbrella Wattle	*Acacia oswaldii*
Eumong	*Acacia stenophylla*
Flannel Cudweed	*Actinobole uliginosum*
Cattle Bush	*Alectryon oleifolius* subsp. *canescens*
Marsh Fox-tail*	*Alopecurus geniculatus*
Box Mistletoe	*Amyema miquelii*
Common Woodruff	*Asperula conferta*
Twin-leaf Bedstraw	*Asperula gemella*
Onion Weed*	*Asphodelus fistulosus*
Small Saltbush	*Atriplex eardleyae*
Slender-fruit Saltbush	*Atriplex leptocarpa*
Mat Saltbush	*Atriplex pumilio*
Rough Spear-grass	*Austrostipa scabra* subsp. *falcata*
Tah-vine	*Boerhavia dominii*
Variable Daisy	*Brachyscome ciliaris*
Dwarf Daisy	*Brachyscome goniocarpa*
Hard-head Daisy	*Brachyscome lineariloba*
Mediterranean Turnip*	*Brassica tournefortii*
Red Brome*	*Bromus rubens*
Leek Lily	*Bulbine semibarbata*
Small Purslane	*Calandrinia eremaea*
Slender Cypress-pine	*Callitris gracilis*
Pale Beauty-heads	*Calocephalus sonderi*
Blue Burr-daisy	*Calotis cuneifolia*
Tangled Burr-daisy	*Calotis erinacea*
Hairy Burr-daisy	*Calotis hispidula*
Rough Burr-daisy	*Calotis scabiosifolia*
Rough Burr-daisy	*Calotis scabiosifolia* var. *scabiosifolia*
Slender Bitter-cress	*Cardamine tenuifolia*
Saffron Thistle*	*Carthamus lanatus*
Malta Thistle*	*Centaurea melitensis*
Common Sneezeweed	*Centipeda cunninghamii*
Spreading Sneezeweed	*Centipeda minima* s.l.
Desert Sneezeweed	*Centipeda thespidioides* s.l.
Frosted Goosefoot	*Chenopodium desertorum*
Nitre Goosefoot	*Chenopodium nitrariaceum*
Skeleton Weed*	*Chondrilla juncea*
Common Everlasting	*Chrysocephalum apiculatum* s.l.
Annual Everlasting	*Chrysocephalum vitellinum*
Spear Thistle*	*Cirsium vulgare*

Pink Bindweed	*Convolvulus erubescens* s.l.
Flaxleaf Fleabane*	*Conyza bonariensis*

Common name	Scientific name
Common Cotula	*Cotula australis*
Ferny Cotula*	*Cotula bipinnata*
Dense Crassula	*Crassula colorata*
Sieber Crassula	*Crassula sieberiana* s.l.
Woolly Scurf-pea	*Cullen pallidum*
Tough Scurf-pea	*Cullen tenax*
Couch	*Cynodon dactylon*
Australian Hound's-tongue	*Cynoglossum australe*
Wallaby Grass	*Danthonia* s.l. *spp.*
Australian Carrot	*Daucus glochidiatus*
Slender Hop-bush	*Dodonaea viscosa* subsp. *angustissima*
Tangled Lignum	*Duma florulenta*
Crested Goosefoot	*Dysphania cristata*
Yellow Twin-heads	*Eclipta platyglossa* subsp. *platyglossa*
Nodding Saltbush	*Einadia nutans*
Common Spike-sedge	*Eleocharis acuta*
Ruby Saltbush	*Enchylaena tomentosa* var. *tomentosa*
Common Bottle-washers	*Enneapogon avenaceus*
Spider Grass	*Enteropogon acicularis*
Spreading Emu-bush	*Eremophila divaricata* subsp. *divaricata*
Common Emu-bush	*Eremophila glabra*
Berrigan	*Eremophila longifolia*
Common Heron's-bill*	*Erodium cicutarium*
Blue Heron's-bill	*Erodium crinitum*
River Red-gum	*Eucalyptus camaldulensis*
Black Box	*Eucalyptus largiflorens*
Annual Cudweed	*Euchiton sphaericus*
Flat Spurge	*Euphorbia drummondii* s.l.
Terracina Spurge*	*Euphorbia terracina*
Earth Cress	*Geococcus pusillus*
Silky Goodenia	*Goodenia fascicularis*
Jersey Cudweed	*Helichrysum luteoalbum*
Common Heliotrope*	*Heliotropium europaeum*
Mat Grass	*Hemarthria uncinata* var. *uncinata*
Northern Barley-grass*	*Hordeum glaucum*
Smooth Cat's-ear*	*Hypochaeris glabra*
Grass Cushion	*Isoetopsis graminifolia*
Prickly Lettuce*	*Lactuca serriola*
Warty Peppercress	*Lepidium papillosum*

Native Peppercress	*Lepidium pseudohyssopifolium*
Notch-leaf Sea-lavender*	*Limonium sinuatum*
Poison Pratia	*Lobelia concolor*
Darnel*	*Lolium temulentum*
Red Bird's-foot Trefoil	*Lotus cruentus*

Common name	Scientific name
Black Cotton-bush	*Maireana decalvans* s.l.
Hairy Bluebush	*Maireana pentagona*
Horehound*	*Marrubium vulgare*
Short-fruit Nardoo	*Marsilea hirsuta*
Little Medic*	*Medicago minima*
River Mint	*Mentha australis*
Common Ice-plant*	*Mesembryanthemum crystallinum* s.l.
Broad-leaf Millotia	*Millotia myosotidifolia*
Mousetail	*Myosurus australis*
Pimelea Daisy-bush	*Olearia pimeleoides*
Yellow Wood-sorrel	*Oxalis corniculata* s.l.
Grassland Wood-sorrel	*Oxalis perennans*
Warrego Summer-grass	*Paspalidium jubiflorum*
False Hair-grass*	*Pentameris airoides* subsp. *airoides*
Native Picris	*Picris angustifolia*
Clay Plantain	*Plantago cunninghamii*
Plantain	*Plantago* spp.
Wiry Podolepis	*Podolepis capillaris*
Poached-eggs Daisy	*Polycalymma stuartii*
Pussy Tails	*Ptilotus spathulatus*
Ferny Small-flower Buttercup	*Ranunculus pumilio*
Buttercup	*Ranunculus* spp.
Paper Sunray	*Rhodanthe corymbiflora*
Clay Sunray	*Rhodanthe stuartiana*
Small-flower Onion-grass*	*Romulea minutiflora*
Slender Dock	*Rumex brownii*
Common Wallaby-grass	*Rytidosperma caespitosum*
Bristly Wallaby-grass	*Rytidosperma setaceum*
Prickly Saltwort	*Salsola tragus subsp. tragus*
Arabian Grass*	*Schismus barbatus*
Cushion Knawel	*Scleranthus minusculus*
Knawel	*Scleranthus* spp.
Starry Goosefoot	*Scleroblitum atriplicinum*
Short-wing Saltbush	*Sclerochlamys brachyptera*
Grey Copperburr	*Sclerolaena diacantha*
Black Roly-poly	*Sclerolaena muricata*

Common name	Scientific name
Limestone Copperburr	*Sclerolaena obliquicuspis*
Slender Groundsel	*Senecio glossanthus* s.l.
Cotton Fireweed	*Senecio quadridentatus*
Tall Fireweed	*Senecio runcinifolius*
Variable Sida	*Sida corrugata*
Pin Sida	*Sida fibulifera*
Mallee Catchfly*	*Silene apetala* var. *apetala*
Portuguese Catchfly*	*Silene longicaulis*
Mediterranean Catchfly*	*Silene nocturna*
Catchfly*	*Silene* spp.
London Rocket*	*Sisymbrium irio*
Black Nightshade*	*Solanum nigrum* s.l.
Rough Sow-thistle*	*Sonchus asper* s.l.
Common Sow-thistle*	*Sonchus oleraceus*
Star Bluebush	*Stelligera endecaspinis*
Blue Rod	*Stemodia glabella* s.l.
Small-leaf Swainson-pea	*Swainsona microphylla*
Dwarf Swainson-pea	*Swainsona phacoides*
Grey Germander	*Teucrium racemosum* s.l.
Coast Bonefruit	*Threlkeldia diffusa*
Hare's-foot Clover*	*Trifolium arvense* var. *arvense*
Woolly Clover*	*Trifolium tomentosum* var. *tomentosum*
Sweet Fenugreek	*Trigonella suavissima*
Common Sunray	*Triptilodiscus pygmaeus*
Trailing Verbena*	*Verbena supina*
Fuzzy New Holland Daisy	*Vittadinia cuneata*
Dissected New Holland Daisy	*Vittadinia dissecta* s.l.
Dissected New Holland Daisy	*Vittadinia dissecta* var. *hirta*
Woolly New Holland Daisy	*Vittadinia gracilis*
New Holland Daisy	*Vittadinia* spp.
Squirrel-tail Fescue*	*Vulpia bromoides*
Rat's-tail Fescue*	*Vulpia myuros*
River Bluebell	*Wahlenbergia fluminalis*
Annual Bluebell	*Wahlenbergia gracilenta s.l.*
Sprawling Bluebell	*Wahlenbergia gracilis*
Common Early Nancy	*Wurmbea dioica*
Golden Everlasting	*Xerochrysum bracteatum*
Pointed Twin-leaf	*Zygophyllum apiculatum*

*Introduced species

Source: (DELWP, 2016)