Environmental Water Management Plan

Photo: Cokum Bushland Reserve, Wimmera Mallee Pipeline

Wimmera Mallee Pipeline

mallee
catchment management authority

Document Control

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Cover image: Cokum Bushland Reserve, Wimmera Mallee Pipeline.

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.

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 2014a) covers 216 identified waterways which have been grouped into 23 planning units according to hydrological interconnectedness and commonality of threats impacting on the waterways values. This EWMP has been developed for the 'Dispersed Wetlands – Freshwater' Waterway Management Unit (WMU), which includes 32 sites serviced via the Wimmera Mallee Pipeline (WMP). The 32 WMP sites are located in Mallee Catchment Management Authority (CMA) region amid dryland cropping and grazing land, and are spread over an area of 600,000 hectares.

Between 2006 and 2010, the WMP and tank and reticulation systems replaced a channel and dam system that had previously provided stock and domestic water supply across this semi-arid landscape. This significantly reduced the availability of open water across the landscape. To address the lack of open water, 52 sites consisting of either (1) dams within terrestrial vegetation or (2) dams constructed within wetlands, were connected to the pipeline to enable delivery of environmental water. The 52 sites are spread across three Catchment Management Authority (CMA) regions: Wimmera (13 sites), North Central (7 sites) and Mallee (32 sites).

The 32 WMP sites covered by this EWMP include a number of Freshwater Meadows and Deep Open Freshwater wetlands, and sites that are largely terrestrial but encompass dam structures, which provide important refuge habitat. This plan focuses on environmental watering events to help maintain flora and fauna values within the Wimmera Mallee and provides a guideline for watering frequency for each of the WMP sites according to their values.

Values of particular significance are the Black box, Lignum and Cane grass communities that line many of the temporary wetlands and creeks throughout the WMP sites, and the many species of woodland birds and waterbirds recorded at terrestrial dam sites. Watering points at terrestrial dam sites provide refuge for aquatic and terrestrial woodland birds and other fauna and are a primary focus for this EWMP.

13 species of flora of conservation significance (listed in State or Federal legislation) have been recorded at the WMP sites, including six listed wetland species. These species, within the Black box, Lignum and Cane grass communities offer perching, feeding and breeding habitat for many species of native aquatic and terrestrial fauna.

Several water-dependent species were recorded, including the listed Freshwater catfish (*Tandanus tandanus*) the Murray River turtle (*Emydura macquarii*), Hardhead (*Aythya australis*) and Eastern great egret (*Ardea modesta*). Among the 28 listed fauna recorded at the WMP sites are the indirectly water-dependent Regent parrot (*Polytelis anthopeplus*) and the Carpet python (*Morelia spilota metcalfei*).

The local community has a strong connection to the wetlands in the Wimmera Mallee, valuing the ecological and social functions supported by the wetlands. The local Indigenous community also have strong connections to the landscape area. The values central to the management of the WMP sites are the diversity of flora and fauna and the significant number of listed species the area supports.

The long-term management goal for WMP sites is to maintain and enhance a network of both wetland habitats and refuges for aquatic and terrestrial fauna across the Wimmera Mallee landscape.

Ecological and hydrological objectives were designed with the consideration of four climate scenarios, drought, dry, average, and wet years. These have been developed to sustain the various ecological components of the WMP sites and have been incorporated into the watering regimes. The ecological objectives for WMP sites are outlined below:

WMP2a: By 2030, maintain self-sustaining population of turtles at Wimmera Pipeline wetlands in 80% of years in which water is present.

WMP2b: By 2030, maintain self-sustain population of frogs at Wimmera Mallee Pipeline wetlands in 80% of years in which water is present.

WMP3: By 2030, improve condition and maintain extent from baseline levels of River red gum (*Eucalyptus camaldulensis*), Black box (*E. largiflorens*) and Lignum (*Duma florulenta*) to sustain communities and processes typical of such communities at Wimmera Mallee Pipeline assets.

WMP4a: By 2030, maintain representative populations of shallow-water and deep-water feeding guilds of waterbird (F2 and F3, respectively, after Jaensch 2002) at the Wimmera-Mallee Pipeline wetlands asset, by maintaining a mixture of shallow and deep-water habitats.

WMP4b: By 2030, maintain nesting and recruitment of non-colonial waterbirds (N1, N2, N3 and N4, after Jaensch 2002) at the Wimmera-Mallee Pipeline wetlands asset, by maintaining a mixture of tree, low vegetation/shrubs, and ground/islet nesting habitat.

To achieve these objectives, hydrological requirements have been determined for each site and the sites prioritised. Water will be delivered to selected sites between April and November (in line with operational requirements of the pipeline) under four climatic scenarios.

Environmental watering requirements

	Drought	Dry	Average	Wet
Inflow Scenario	0%	10%	50%	75%
Expected climatic conditions and water availability (ML)	0	0	250	1000
Ecological Objectives	Provide watering points for terrestrial fauna and woodland birds	Provide watering points for terrestrial fauna and woodland birds Provide foraging, refuge and breeding habitat for turtles and frogs Maintain the health of fringing Lignum and Black box communities	Provide watering points for terrestrial fauna and woodland birds Provide foraging, refuge and breeding habitat for turtles and frogs Maintain the health of fringing Lignum and Black box communities Provide suitable feeding and breeding habitat for waterbird guilds	Provide watering points for terrestrial fauna and woodland birds Provide foraging, refuge and breeding habitat for turtles and frogs Maintain the health of fringing Lignum and Black box communities Provide suitable feeding and breeding habitat for waterbird guilds
Estimated Environmental Water requirement (total ML)	59	93.5	194.5	340.5

Minimum, optimum and maximum watering regimes, to support environmental watering requirements are shown below:

Environmental Objective	Wetlands *Terrestrial environment water contained within the dam area	Frequency of events (per 10 years)			Duration of events (months)			Timing
		Min	Opt	Max	Min	Opt	Max	
By 2030, maintain self-sustaining population of frogs at WMP wetlands	Barbers Swamp, Broom Tank, Cokum BR, Considine*, Lake Danaher BR, Pam Juergens, Roselyn Wetland, Tchum Lakes Wetland and Dam, Uttiwillock*	8	10	10	11	12	12	Fill dams May to November (due to pipeline delivery constraints) in all climate scenarios, and allow natural drawdown through evaporation. For vegetation provide overbank flow into surrounding floodplain May to November during average to wet years only, and allow natural drawdown.
By 2030, maintain self-sustaining population of turtles at WMP wetlands	Barbers, Bull Swamp, Clinton Shire Dam, Cokum BR, Considine*, Coundon Wetland, Cronomby Tanks*, Greens Wetland, Lake Danaher BR, Mahoods Corner*, R Ferrier, Rickard Glenys*, Roselyn Wetland, Shannons Wayside, Tchum Lakes wetland and Dam, Towma (Lake Marlbed) FFR, Uttiwillock*	8	10	10	11	12	12	
By 2030, improve condition and maintain extent from baseline levels of River red gum (*Eucalyptus camaldulensis*), Black box (*E. largiflorens*) and Lignum (*Duma florulenta*) to sustain communities and processes typical of such communities at Wimmera Mallee Pipeline assets	Barbers Swamp, Broom Tank, Bull Swamp, Clinton Shire Dam, Cokum BR, Goulds Reserve, Greens Wetland, J Ferrier Wetland, Lake Danaher BR, Morton Plains Reserve, Part of Gap Reserve, Poyner, Roselyn Wetland, Round Swamp BR, Tchum Lakes Reserve (Wetland), Tchum Lakes Pool (Dam), Towma (Lake Marlbed) FFR, Uttiwillock*	1	2	3	2	4	4	
By 2030, maintain representative populations of shallow-water and deep-water feeding guilds of waterbird (F2 and F3, respectively, after Jaensch 2002) at the Wimmera-Mallee Pipeline wetlands asset, by maintaining a mixture of shallow and deep-water habitats.	Barbers Swamp, Bull Swamp, Cokum BR, Goulds Reserve, Greens Wetland, Mahoods Corner*, Morton Plains Reserve, R Ferrier*, Rickard Glenys*, Roselyn Wetland, Shannons Wayside*, Tchum Lakes Reserve (Wetland), Tchum Lakes Pool (Dam), Uttiwillock*	2	5	10	1	6	7	
By 2030, maintain nesting and recruitment of non-colonial waterbirds (N1, N2, N3 and N4, after Jaensch 2002) at the Wimmera Mallee Pipeline wetlands asset, by maintaining a mixture of tree, low vegetation/shrubs, and ground/islet nesting habitat	Barbers Swamp, Bull Swamp, Cokum BR, Goulds Reserve, Greens Wetland, Mahoods Corner*, Morton Plains Reserve, R Ferrier*, Rickard Glenys*, Roselyn Wetland, Shannons Wayside*, Tchum Lakes Reserve (Wetland), Tchum Lakes Pool (Dam), Uttiwillock*	2	5	10	1	6	7	

Environmental water is delivered to the sites via the Wimmera-Glenelg and Murray supply systems of the WMP. The constraints on the current ability to water the WMP sites include limitations imposed by the pipeline system as to delivery schedules and rates, the number of sites connected to the system, and the allocation of water in any given year.

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EWMP abbreviations and acronyms

ACHRIS	Aboriginal Cultural Heritage Register and Information System
ANCA	Australian Nature Conservation Agency
Bonn	The Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
BR	Bushland Reserve
BWS	Basin-wide Environmental Watering Strategy
CAMBA	China-Australia Migratory Bird Agreement
CMA	Catchment Management Authority
DEECA	Department of Energy, Environment and Climate Action (formerly DELWP)
DELWP	Department of Environment, Land, Water and Planning
DNRE	Department of Natural Resources and Environment
DSE	Department of Sustainability and Environment
EA	Ecological Associates
EPBC	Environment Protection and Biodiversity Conservation
EVC	Ecological Vegetation Class
EWMP	Environmental Water Management Plan
EWH	Environmental Water Holder
EWP	Basin Plan Environmental Watering Plan
EWR	Environmental Water Reserve
FFG	Flora and Fauna Guarantee
FFR	Flora and Fauna Reserve
FM	Freshwater Meadow
GIS	Geographic Information Systems
G-MW	Goulburn-Murray Water
GWM Water	Grampians Wimmera Mallee Water
IAP2	International Association for Public Participation
JAMBA	Japan-Australia Migratory Bird Agreement
LTWP	Long Term Watering Plan
MCMA	Mallee Catchment Management Authority
MDBA	Murray-Darling Basin Authority (formally Murray-Darling Basin Commission, MDBC)
ML	Megalitres
POF	Permanent Open Freshwater
QEEO	Quantified Environmental Expected Outcomes

Ramsar	Global treaty adopted in the Iranian city of Ramsar in 1971 that focuses on the conservation of internationally important wetlands
RAP	Registered Aboriginal Party
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
RRG	River Red Gum
SHW	Seasonal herbaceous wetlands of the lowland temperate plains
SMART	Specific, Measurable, Achievable, Relevant and Time-bound
SWP	Seasonal Watering Proposal
VEWH	Victorian Environmental Water Holder
Vol	Volume
VWMS	Victorian Waterway Management Strategy
WMP	Wimmera Mallee Pipeline
WMU	Waterway Management Unit

1 Introduction

Environmental Water Management Plans (EWMPs) set long-term (8–10 years) environmental objectives for wetlands or rivers that receive environmental water. EWMPs are an important part of the Victorian Environmental Water Planning Framework and inform the development of annual seasonal watering proposals.

This Environmental Water Management Plan (EWMP) has been prepared by the Mallee Catchment Management Authority (CMA) to establish the long-term management goals of the Wimmera Mallee Pipeline (WMP) sites. As the pipeline sites manager, Mallee Catchment Management Authority (Mallee CMA) is responsible for developing and updating this EWMP, in partnership with Traditional Owners and consultation with landowners, land managers and other stakeholders such as community groups.

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 purpose of EWMPs and how they relate to other plans, strategies and policies is provided in Appendix 1.

This EWMP focuses on environmental watering events to help maintain flora and fauna values within the Wimmera Mallee and provides a guide for the Mallee CMA to plan watering events for each of the Mallee WMP sites according to the requirements of each site's values.

The WMP sites are located in the Wimmera-Mallee region, amid dryland cropping and grazing land. Between 2006 and 2010, a channel and dam system that historically provided stock and domestic water supply across this semi-arid landscape was removed and replaced with the WMP and tank and reticulation systems. This significantly reduced the availability of open water across the landscape, both in extent and frequency of inundation. To address this lack of open water, 52 priority sites consisting of either dams within terrestrial vegetation, or wetlands with dams constructed within them, were connected to the pipeline to enable delivery of environmental water. A 1000 ML entitlement of environmental water was created to supply these sites.

The 52 sites area spread across the areas of three CMAs: Wimmera (13 sites), North Central (seven sites) and Mallee (32 sites), as shown in Figure 1.

The target areas for this EWMP are 32 sites located within the Mallee CMA Region (Figure 1), which form the Dispersed Wetlands – Freshwater Waterway Management Unit (WMU). These 32 sites include several Freshwater Meadows and Deep Open Freshwater wetlands, along with sites that are largely terrestrial but encompass dam structures, which can provide important refuge habitat. The individual wetlands and dams are separated from each other by farming land, residential areas, and/or roads.

The Wimmera Mallee Pipeline EWMP was developed in 2014 and updated in 2017, 2020 and 2021 to incorporate new information and align with new government guidelines. The ecological objectives were reviewed and updated in 2020. The latest version of the EWMP (2023) has been updated to incorporate new information and align with the former Department of Environment, Land, Water and Planning (DELWP, now the Department of Energy, Environment and Climate Action – DEECA) Draft EWMP Guidelines (Version 6, DELWP, 2022).

The Wimmera Mallee Pipeline Wetlands Context Document (Sunraysia Environmental, 2014a) provides overview information that applies to all 52WMP sites in three CMA regions and should be read in conjunction with this EWMP.

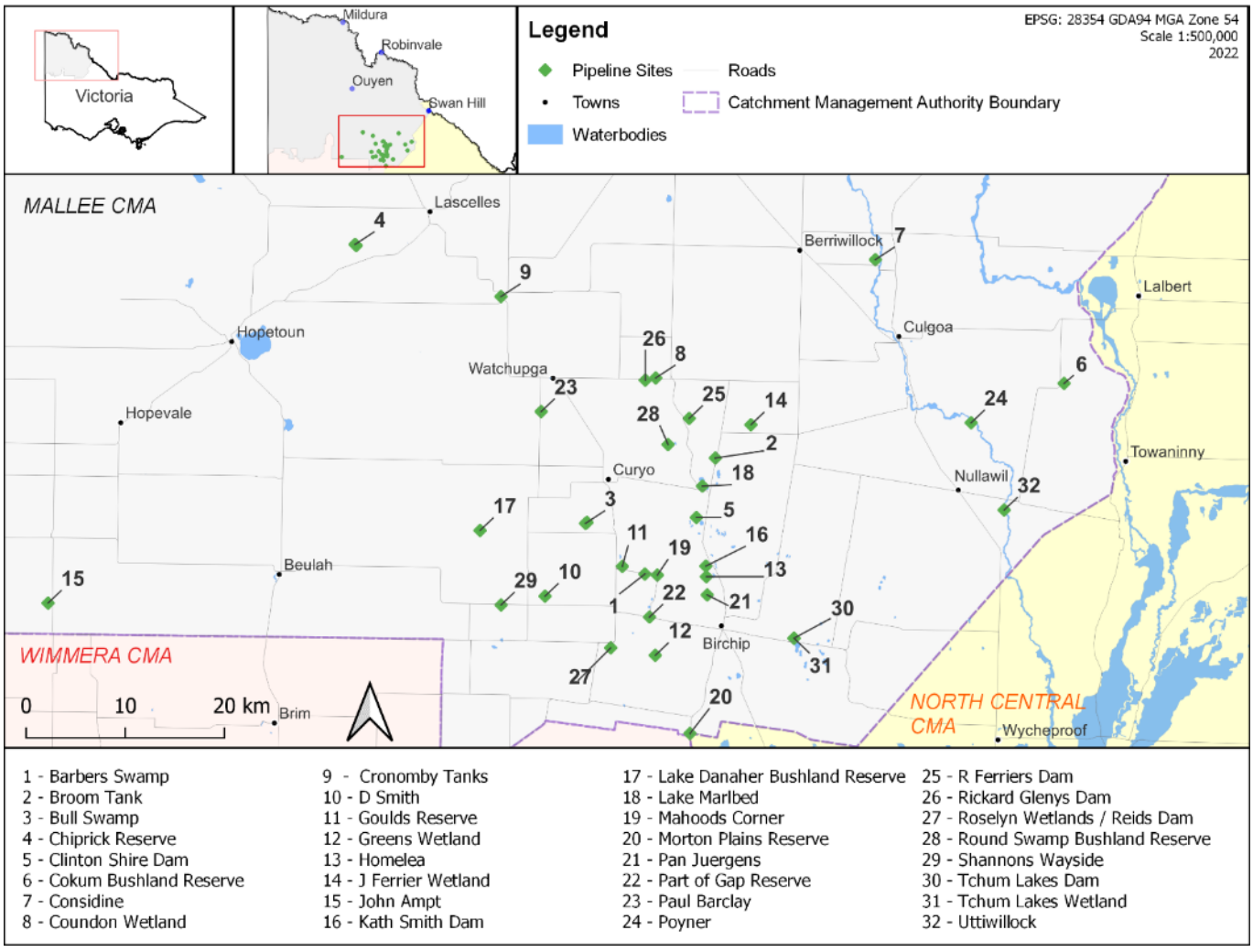


Figure 1 – 32 Wimmera Mallee Pipeline Sites covered by this EWMP

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), the Department of Energy, Environment and Climate Action (DEECA), land managers including Parks Victoria and local councils, water corporations, Traditional Owner groups, and interstate agencies including the Commonwealth Environmental Water Office (CEWO) and the Murray–Darling Basin Authority (MDBA).

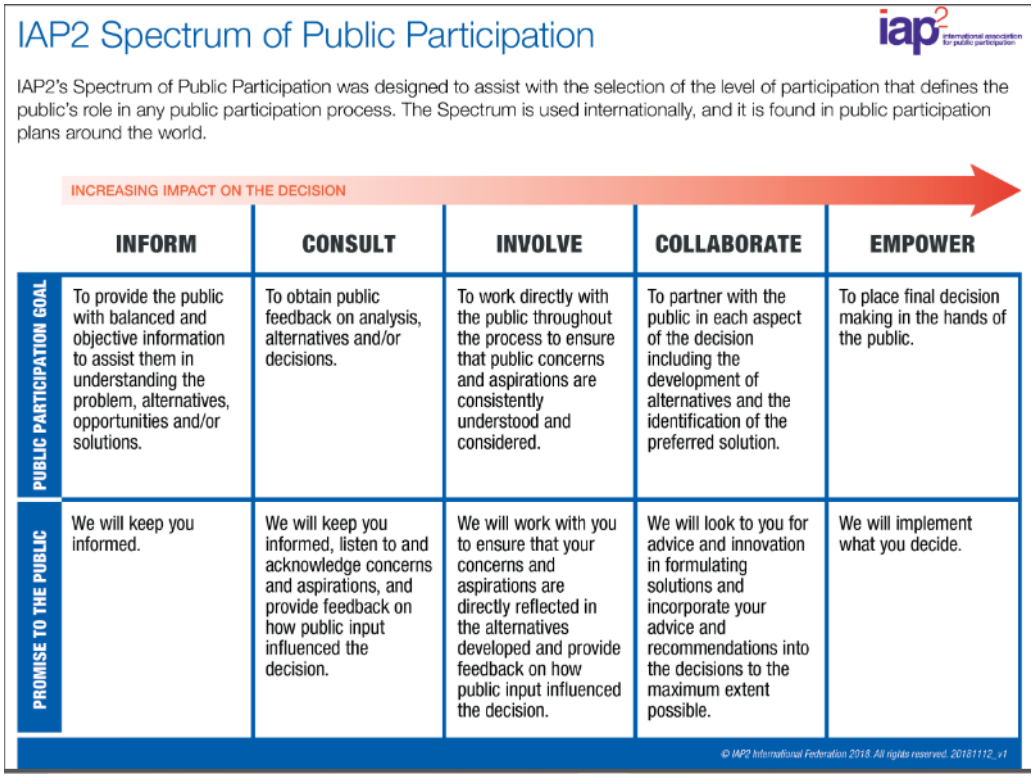
Environmental watering in Victoria has historically been supported by management plans such as EWMPs, that document key information including the watering requirements of an asset, predicted ecological responses and water delivery arrangements. These plans support annual decisions about which sites should receive water and help managers evaluate how well those assets responded to the water they received or what could be done better. Appendix 1 describes EWMP policy context in more detail.

Barbers Swamp Autumn Environmental Water delivery. ***Source: Mallee CMA***

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 2).



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 2 - IAP2 Spectrum

(*Source: International Association for Public Participation www.iap2.org)*

Table 1 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 overseeing environmental water at WMP sites, refer to Section 3.2. Of note, several WMP sites are located on private property.

Table 1 – Stakeholder groups with an interest in environmental water at the Wimmera Mallee Pipeline

Stakeholder groups	Stakeholders	Needs and interest	IAP2 level	Consultation modes
Traditional Owners and Interested Parties	Barengi Gadjin Land Council See Section 2.4	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.	Collaborate	Via Mallee CMA's Traditional Owner engagement team. Consultation is largely undertaken in-person and, where possible, on Country.
Victorian water holders	VEWH	Water holder. Make decisions about annual environmental water usage.	Collaborate	Via formal meetings.
Pipeline operator	Grampians Wimmera Mallee Water	Manage water supply	Collaborate	Via formal meetings.
Scientists	Arthur Rylah Institute, consultancies	Floodplain health, biodiversity and use of environmental water.	Involve	Workshops, meetings, phone calls.
Public land managers	Parks Victoria, DEECA	Managing impacts from watering such as access. Parks Victoria is the land manager for several sites (Figure 3). DEECA is the land manager for Morton Plains Reserve	Collaborate	Via monthly meetings.
Private landowners and managers	Twenty private landholders of WMP sites. Trust for Nature oversees Bullock Swamp north in accordance with the conditions of the management covenant.	Possible access to properties during operation as defined in landholder agreements.	Collaborate	Directly affected landholders will be informed of watering proposals and asked to provide feedback if relevant.

Stakeholder groups	Stakeholders	Needs and interest	IAP2 level	Consultation modes
Local government	Buloke Shire Council (all sites except those listed below) Hindmarsh Shire Council (John Ampt) Yarriambiack Shire Council (Chiprick and Cronomby Tanks)	Access during watering events.	Involve	Meetings, phone calls, correspondence.
Basin-wide river management	MDBA	River Murray operations.	Involve	Via formal meetings.
Community (interest groups)	Landcare groups (Birchip, Curyo Watchupga, Hopetoun, Woomelang Lascelles, Berriwillock, Nullawil, Lalbert, Rainbow and Districts) Community Advisory Groups Environmental, recreational and social groups	Watering benefits and impacts on local communities such as access to parks and river during watering events. Partner with private individuals and government agencies to work towards sustainable land management and environmental outcomes	Inform	Via existing groups such as the Mallee CMA Land and Water Committee. Via Mallee CMA social media and news.
Media	Local, state and national media outlets	Across issues that interest the local community.	Inform	Media packs and media releases.

2.2 Developing / Updating the EWMP

Mallee CMA carried out community consultation through the following channels:

- Mallee CMA Land and Water Advisory Committee
- surveys at community events such as farmers' markets
- workshops and on-country visits with Traditional Owners (see Section 3)
- campaign emails
- meeting with landholders
- social media channels.

Relevant government agencies were invited to participate in the consultation process via a formal letter. They have also been engaged through existing channels, with discussions and presentations.

The key outcomes from this engagement were:

- ensuring that Traditional Owner values were represented in the ecological outcomes

- building more frequent initial watering into the proposed watering regime to help the landscape recover and monitoring outcomes to determine future water needs, in response to Traditional Owner feedback.

2.2.1 *Verifying asset values*

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 Ownersand private and public landholders.

2.2.2 *Informing proposed management objectives, target and approaches*

Mallee CMA has long worked with those who have an extensive knowledge of Wimmera Mallee Pipeline sites. 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 will guide future watering events, as part of the adaptive management approach (see Section 11: Adaptive Management).

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 (see Section 11: Adaptive Management).

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 via an online survey, which was hosted on the Mallee CMA website in January-February 2023 (Appendix 2). The survey was designed to enable community, landholders, recreational users, Landcare groups, environmental groups and other interested parties to provide input to the plans.

The Wimmera Mallee Pipeline community survey was completed by 6 respondents, some of whom visit multiple WMP sites. The survey asked the community to rank values at the site. Rankings are shown in Table 2. For further detail about the outcomes of the 2023 community engagement please refer to Appendix 3.

Table 2 - Community values rankings at Wimmera Mallee Pipeline Sites (where 5 = extremely important, 1 = not important)

Location	Chiprick Reserve	Cronomby Tanks	Goulds Reserve	Cronomby Tanks	Round Swamp	Lake Marlbed
Unique landscape features and natural beauty	5	4	5	5	2	3
Recreational opportunities (birdwatching, fishing etc.)	4	4	5	5	2	5
Traditional Owner Values	4	3	4	5	2	4
Exercise (trails for walking, running, cycling)	5	3	-	5	2	4
Work or education opportunities	5	3	5	5	2	2
Commercial or business opportunities	2	2	-	5	2	4

2.4 Traditional Owners

Twenty-four WMP sites are located within the formally recognised Country of the Barengi Gadjin Land Council Aboriginal Corporation, and seven sites are located on the Country of Traditional Owner groups with non-Registered Aboriginal Party (RAP) status (Figure 3). Engagement with Traditional Owner groups, and Indigenous individuals is ongoing. Engagement occurs on a one-on-one basis at the COLLABORATE level of the IAP2 framework, with the level of interest in the site and participation in engagement self-determined by each group. Annual consultation is also undertaken with Traditional Owner groups during the development of the Seasonal Water Proposal for the WMP.

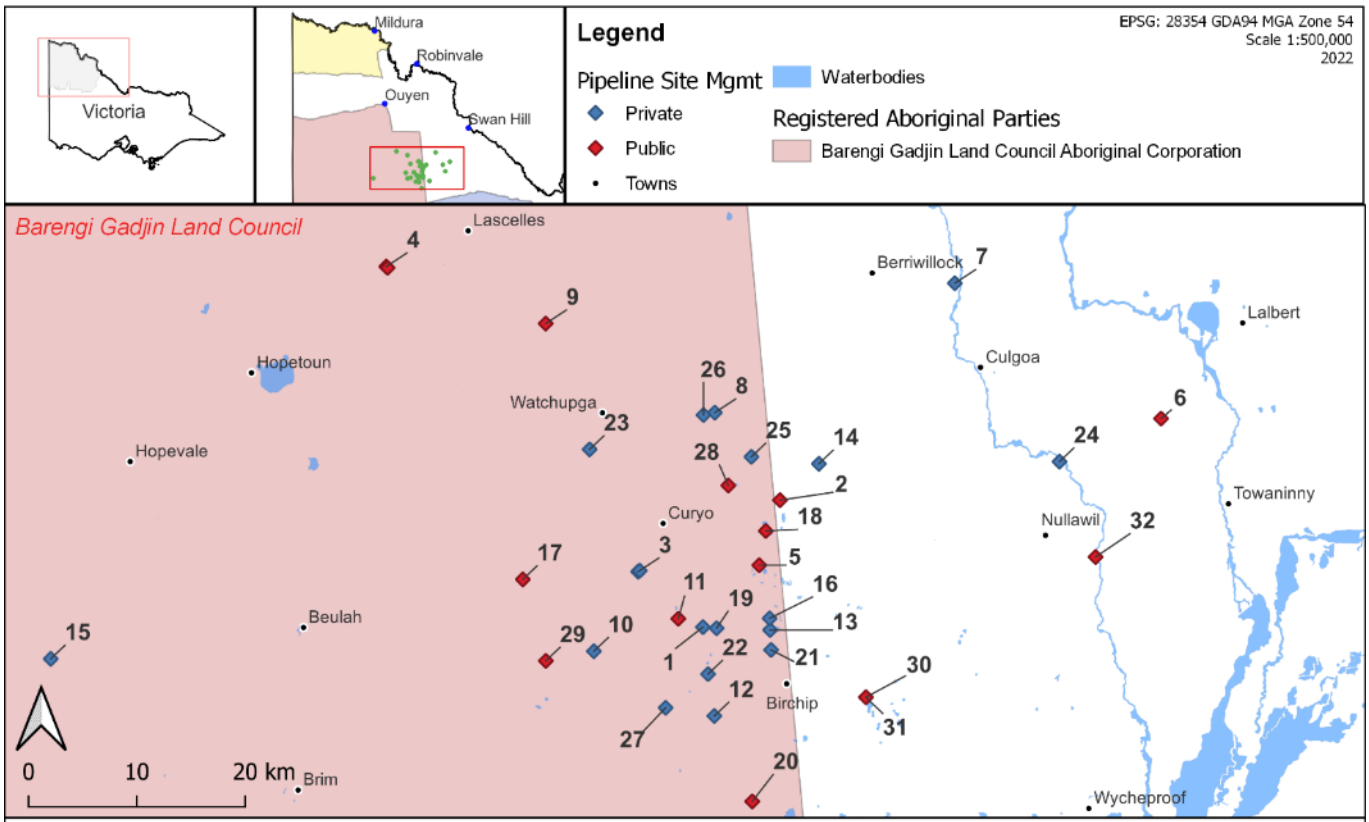


Figure 3 - Registered Aboriginal Party boundary and management of WMP sites

3 Asset overview

The Mallee CMA is situated in the north-west of Victoria. The area of responsibility is close to 39,000km2 (3.9 million ha), and 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 Catchment Management Authority in the state.

Approximately 40% of the land area within the Mallee CMA boundary is public land, consisting mainly of National Parks, reserves, wilderness areas and large tracts of riverine and dryland forests. The other 60% is predominantly dryland cropping by area, but there is also a significant investment in irrigation of grapes,

citrus, almonds, olives, and vegetables along the Murray River corridor which contributes over 40% of the value of agricultural production for the region.

The Wimmera Mallee Pipeline (WMP) sites are situated in the Wimmera Mallee area in the south of the Mallee CMA region (Mallee CMA 2014b). The WMP sites are spread across a large study area of 676,000 ha. Consistent with the broader Mallee region, land use in the district is predominantly broad acre cropping (canola, wheat and barley) and grazing (sheep). Many of the townships are located along the intermittently wet creek lines.

3.1 Catchment setting

3.1.1 Physical features

The landforms present in the Wimmera Mallee region reflect the present semi-arid climate with permanent streams, dry or salinised lakes and localised areas of semi-active dunes. However much of the landscape is relict, reflecting former fluvial, aeolian and lacustrine processes (White et. al 2003).

Prior to European settlement, drainage systems in the Wimmera Mallee region comprised intermittent north-flowing creeks and dryland areas. The study area is divided into two basins, Wimmera to the west and Avoca to the east and the Wimmera and Avoca Rivers Catchment Areas divide the landscape. Yarriambiack, Tyrrell and Lalbert Creeks and Lake Coorong are the main waterbodies in the Wimmera Mallee region.

Yarriambiack, Tyrrell and Lalbert Creeks are episodic distributaries of the Wimmera and Avoca Rivers. High flow events in the Wimmera River allow Yarriambiack Creek to flow northerly and drain into Lake Coorong (Wimmera CMA 2013). From its head waters Yarriambiack Creek feeds a series of weir pools used for recreational purposes in the Wimmera Mallee (Wimmera CMA 2013). On average every two to three years the Avoca River also experiences sufficiently high flows to push water into and along Tyrrell and Lalbert Creeks (Mallee CMA 2014b). Water flows along the creeks and eventually drains into the saline lakes Tyrrell and Timboram.

The surface drainage pattern mainly consists of small, separated local catchments due to the relatively level topography, the presence of dunes and ridges, porous soils, and the semi-arid climate. It is these types of catchments that feed many of the small wetlands in the study area. These wetlands rely on local catchment runoff, and fill episodically, typically during wet winter and spring periods, however runoff has been reduced.

The natural flow regime for the Wimmera River, which feeds the Yarriambiack Creek, has been altered through large diversions for agriculture (Mallee CMA 2012). The Avoca River, which feeds Tyrrell and Lalbert Creeks, has also been subject to modifications to catchment runoff characteristics and the construction of levee banks (Mallee CMA 2012). These ephemeral streams therefore have reduced capacity to fill nearby wetlands under natural flow conditions.

3.1.2 Climate

This is a dry landscape. Mean temperatures range from a maximum of ~ 30°C in summer to a minimum of ~4°C in winter, with the median rainfall in Birchip approximately 373mm (BOM 2023). Rainfall during the colder months (May-October) usually exceeds the warmer months, with September and January being the wettest and driest months respectively (BOM, 2023). The average rainfall in the region is significantly exceeded by evaporation rates (Duncan et al [n.d.]).

3.1.3 Bioregions

The WMP sites are spread across two distinct bioregions, the Murray Mallee and Wimmera (Figure 4).

Murray Mallee

The Murray Mallee bioregion is typified by calcareous material in the form of undulating sandy plains that is often associated with linear, east-west aligned, low sand dunes with intervening heavier textured swales developed from Cainozoic deposits of alluvial, aeolian and swampy deposits. The vegetation is dominated by East/West-dune Mallee with some Chenopod Mallee and Shallow Sand Mallee.

The plains, drainage lines and groundwater discharge landscapes are dispersed with salt lakes and gypsum flats with lunettes developed on the eastern margins of the lakes. The Cainozoic deposits give rise to calcareous earths (Calcarosols), cracking clays (Vertosols), and red sands (Rudosols). The vegetation is dominated by Gypseous Plains Shrubland, Saline Shrubland (Raak), Plains Grassland and Drainage-line Grassy Woodland.

The bioregion has few surface water bodies due to highly permeable soils and climatic conditions. The Murray River forms the north edge for the bioregion and the Avoca River roughly defines the eastern edge (DEPI 2014).

Wimmera

The Wimmera bioregion is typified by flat to gently undulating plains in the east, with black and grey cracking clay soils (Vertosols). Plains Woodland, Plains Grassy Woodland, Plains Grassland, Red Gum Wetland and Grassy Woodland are the dominant vegetation types. The western part is typified by ancient, stranded beach ridges interspersed with clay plains (where there are a mixture of swamp, lakes, lagoons and lunettes in the south) with cracking clay soils and red texture contrast soils (Vertosols and Sodosols). The vegetation on these less fertile plains is dominated by Heathy Woodland and Shallow Sands Woodland (DEPI 2014).

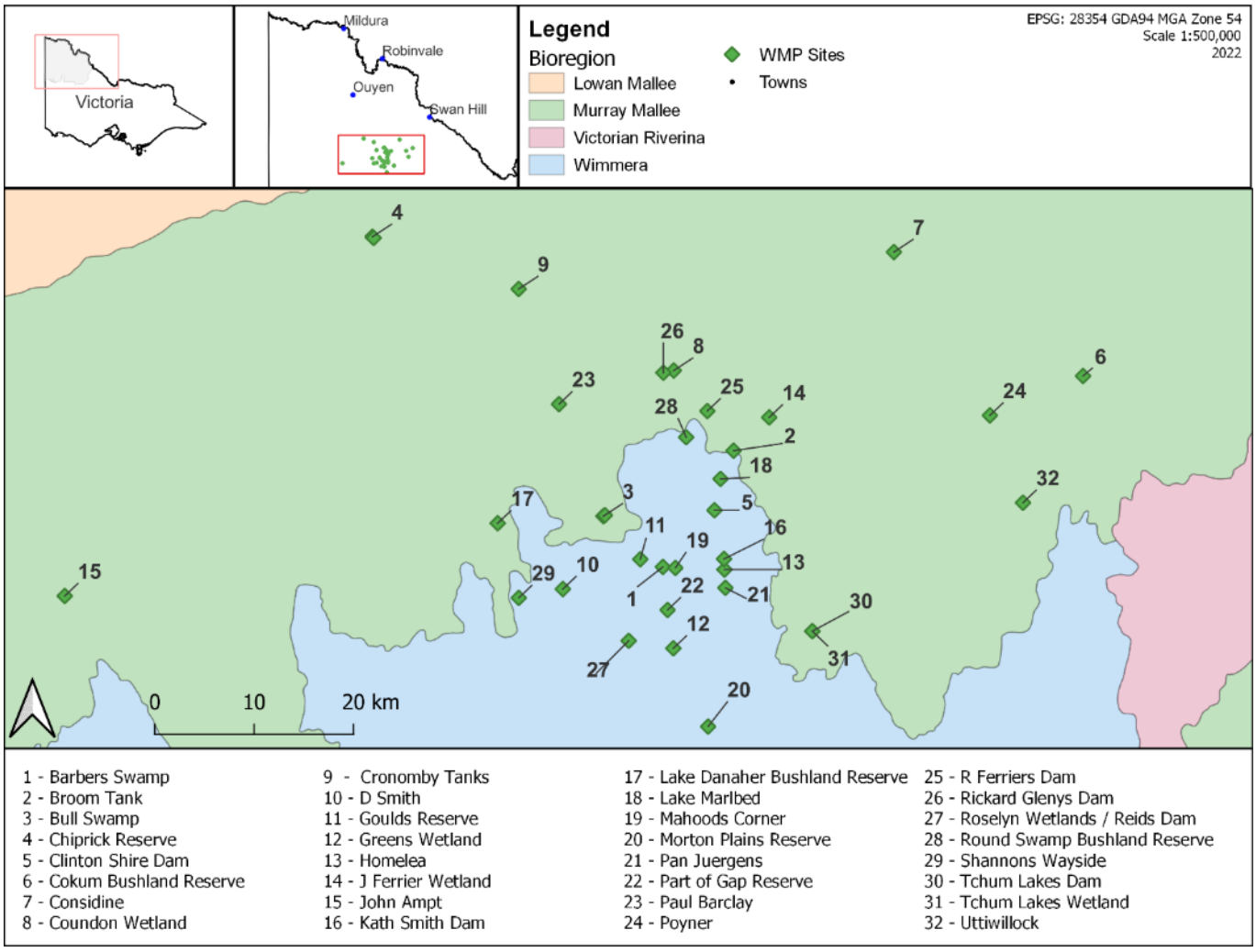


Figure 4 - Mallee CMA WMP sites and bioregions of the Wimmera Mallee

3.1.4 *Wimmera Mallee Pipeline*

Since European settlement, significant hydrological alterations have occurred in the Wimmera Mallee, including the construction of an extensive channel and dam system that supplied stock and domestic water, commencing in the late 19th century. This infrastructure delivered water widely throughout the landscape, creating new intermittent and permanent aquatic habitats that provided important refugia for aquatic and terrestrial wildlife. Due to the inefficiencies of the earthen channel system, it was decommissioned between 2006 and 2010, and the Wimmera Mallee Pipeline was constructed, supplying water to approximately 9,000 farms and 34 townships (GWM Water, 2016).

3.1.5 *Wimmera Mallee Pipeline Wetlands*

Installation of the WMP removed a large amount of open and easily accessible water from the local environment that had previously been available to wildlife and native vegetation. Many naturally occurring wetlands in the region now have dry dams within them. As a consequence, the wetlands are no longer subjected to regular inundation as dams must fill from run-off before the wetland can receive water, and

rainfall is highly variable. Due to the altered hydrology and a reduction in runoff (BRS 2008), the frequency, extent and duration of natural flooding has reduced within these wetlands. Previously, dams excavated in terrestrial (non-wetland) surroundings also provided a much-needed refuge and watering point in an otherwise arid landscape for woodland birds and terrestrial fauna.

Historically, frogs and turtles, waterbirds, woodland birds, reptiles and mammals have been recorded at many of the WMP sites. The removal of a significant number of man-made sources of open water from the local landscape has threatened many of the native fauna that had once thrived at these sites. Vegetation health and significant vegetation communities such as the federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) - listed Seasonal Herbaceous Wetlands have also suffered.

In order to preserve some of the aquatic habitats associated with the previous channel system, an environmental water allocation of 1000 ML was created to maintain habitat at high priority sites. Sites for watering were selected via the expression of interest and criterion-based prioritisation process described below. Further information on this is provided in Appendix 2 of the Wimmera Mallee Pipeline Context Document (Sunraysia Environmental, 2014a).

3.1.6 WMP site selection

WMP sites were selected using the following approach:

(1) Expressions of interest for the connection of wetlands to the pipeline were called

(2) A three-step prioritisation process was undertaken to select wetlands (Mallee CMA, 2009).

(a) In the first step of assessment, wetlands must:

- have had a historical connection to the channel system;
- be 'off-stream' and not receiving water from another source;
- be freshwater;
- be surface water dominated;
- not be licenced for grazing or cropping;
- have a conservation covenant or management agreement in place; and
- have an agreement to undertake ecological monitoring

(b) If the above seven eligibility criteria were met, sites proceeded to the second step and assessed against four ecological criteria:

- level of modification (i.e. change in wetland type);
- presence of listed threatened flora and/or fauna;
- level of threat listing for flora and/or fauna; and
- connectivity to adjacent native vegetation.

(c) The third step was an assessment of feasibility for the use of infrastructure to deliver environmental water. Assessment was based on cost, volume of water able to be delivered compared to volume required, capacity of wetland and the role of the wetland in supporting locally significant species.

31 discrete sites within the Mallee CMA region were initially connected to the Wimmera Mallee Pipeline to enable the delivery of environmental water. An extra site (Uttiwillock) was added to the pipeline system from 2019/2020, bringing the total number of sites covered by the EWMP to 32.

Local interest and concern about the region's flora and fauna led to a high number of sites being situated on private land: eighteen sites are located on private land and fourteen are on public land (Figure 3). Some of the sites had not previously been supplied by the channel system but were selected for pipeline supply during the Wetlands Connection project (K Wilson (GWM Water), pers. comm., 13 July 2016). The majority of the WMP sites are fed from the Wimmera-Glenelg system (supply system #4 - Wycheproof line), with three sites (Cokum Reserve, Considine, Poyner and) fed from the Murray system (supply system #5 - Culgoa line, Figure 5).

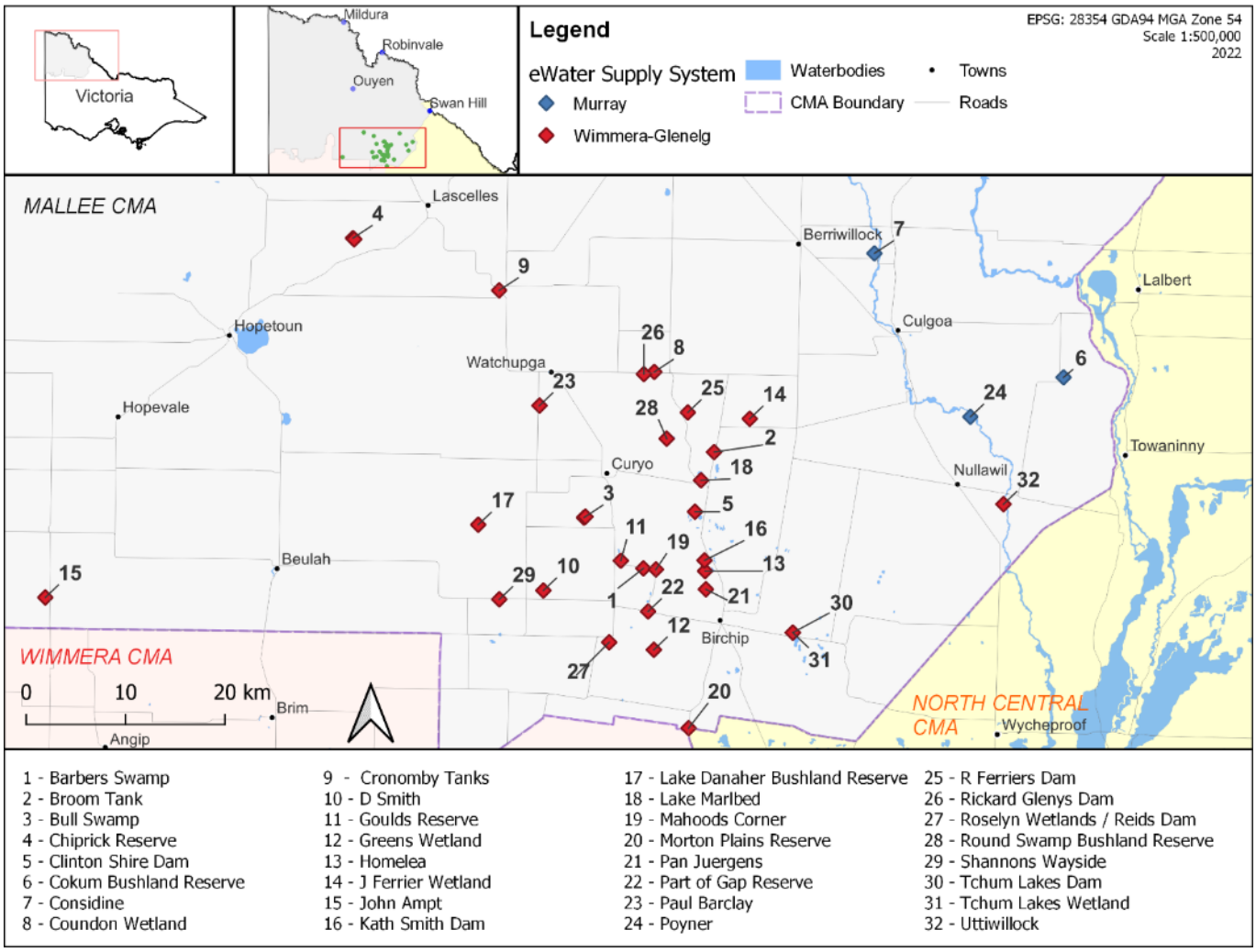


Figure 5 - WMP wetland sites environmental water supply systems

3.2 Land status and management

Parks Victoria, DEECA, Grampians Wimmera Mallee Water and 20 landholders are involved in the management of the WMP sites. 19 sites are located among cropping and grazing land that has been farmed since the 1900s.

Each of the 32 sites are discrete and water regimes can be managed largely independently of each other. The WMP sites are managed as a collective to provide refuge across the landscape and support significant

flora and fauna. Currently delivery of environmental water to unconnected locations within the WMP sites is not possible. Connection of additional sites and expansion of current inundation area is feasible only with significant investment in infrastructure or heavy modification to surrounding land respectively. Water holdings may not be sufficient to expand the number of existing WMP sites.

Key land managers and Government agencies with responsibilities for the Wimmera Mallee Pipeline Wetlands EWMP are shown in **Table** 3. Environmental water sign-off and delivery occurs by the Victorian Environmental Water Holder, in partnership with the Mallee CMA.

Environmental Water Supply, Tenure, Land Manager, Registered Aboriginal Party and 2017 surrounding land use, for each site, are shown in Table 4.

Table **3 - Environmental Water Management at WMP sites**

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.
Parks Victoria	• The land manager for the Crown land under the *National Parks Act 1975* (Vic) and *Crown Land (Reserves) Act 1978* (Vic), in this case, 11 WMP sites (See Table 4) where the environmental water will be delivered. • 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.
Traditional Owners and Interested Parties (Barengi Gadjin Land Council)	Mallee CMA partners with Traditional Owners in environmental water management at WMP sites by: • inviting Traditional Owners to be involved in water planning and management as per Water is Life and Northern Victoria Resource Plan, Water for Victoria, through: 1) collaborating on ways environmental water deliveries can complement/support/promote cultural values and uses. 2) working together to determine annual watering actions and priorities. 3) monitoring and assessing water deliveries, where possible.
Private landowners	• Directly affected landowners approve watering and/or access on their land.
Grampians Wimmera Mallee Water	• Manages the operation of the WMP.
MDBA	• Management and operation of the Murray River on behalf of the Basin States in accordance with the *Water Act 2007* (Commonwealth).
VEWH	• Responsible for statewide planning for the use of Victoria's environmental water and allocating its water to seasonal environmental watering actions.
CEWO	• Provides water across the Murray–Darling Basin to meet environmental priorities and targets in accordance with the requirements of the Basin Plan.
SCBEWC	• An advisory body established by the Murray–Darling Basin Ministerial Council, with environmental water and river operations representatives from the Commonwealth, New South Wales, South Australian and Victorian governments. • Supports the coordination of the delivery of all environmental water in the Southern Connected Murray–Darling Basin, consistent with the Basin Plan.

Table 4 - Water supply system , tenure, land management, Registered Aboriginal Party (RAP), and 2017 surrounding land use

#	Site Name	Wetland ID	Supply System	Tenure	Land Manager	RAP	2017 Surrounding Land Use	Landcare Group
1	Barbers Swamp	11659	Wimmera-Glenelg	Private	Landholder	Barengi Gadgin Land Council	General Cropping	Birchip
2	Broom Tank Reserve	11677	Wimmera-Glenelg	Public	Parks Victoria	N/A	Broom Tank Nature Reserve	Curyo Watchupga
3	Bull Swamp	11720_ 11721	Wimmera-Glenelg	Private	Landholders	Barengi Gadgin Land Council	General Cropping	Curyo Watchupga
4	Chiprick Reserve	10810	Wimmera-Glenelg	Public	Parks Victoria	Barengi Gadgin Land Council	Nature Reserve. Nearby Mixed farming and Grazing	Hopetoun
5	Clinton Shire dam	11711	Wimmera-Glenelg	Public	Parks Victoria	Barengi Gadgin Land Council	Nature Reserve	Curyo Watchupga
6	Cokum Bushland Reserve	12473	Murray	Public	Parks Victoria	N/A	Nature Reserve	Lalbert
7	Considine	12475	Murray	Private	Private	N/A	General Cropping	Berriwillock
8	Coundon Wetland	11725	Wimmera-Glenelg	Private	Private	Barengi Gadgin Land Council	General Cropping	Curyo Watchupga
9	Cronomby Tanks	11718	Wimmera-Glenelg	Public	Parks Victoria	Barengi Gadgin Land Council	Nature Reserve and Reserved Land	Woomelang Lascelles
10	D Smith	11704	Wimmera-Glenelg	Private	Private	Barengi Gadgin Land Council	General Cropping	Birchip
11	Goulds Reserve	11722	Wimmera-Glenelg	Public	Parks Victoria	Barengi Gadgin Land Council	Nature Reserve	Birchip
12	Greens Wetland	11602	Wimmera-Glenelg	Private	Private	Barengi Gadgin Land Council	General Cropping	Birchip
13	Homelea	11707	Wimmera-Glenelg	Private	Private	Barengi Gadgin Land Council	General Cropping	Birchip
14	J Ferrier	11712	Wimmera-Glenelg	Private	Private	N/A	General Cropping	Birchip
15	John Ampt	10847	Wimmera-Glenelg	Private	Private	Barengi Gadgin Land Council	General Cropping	Rainbow and Districts
16	Kath Smith	11708	Wimmera-Glenelg	Private	Private	Barengi Gadgin Land Council	General Cropping	Birchip
17	Lake Danaher Bushland Reserve	11696	Wimmera-Glenelg	Public	Parks Victoria	Barengi Gadgin Land Council	Nature Reserve	Curyo Watchupga
18	Lake Marlbed	11724	Wimmera-Glenelg	Public	Parks Victoria	Barengi Gadgin Land Council	Conservation Area	Curyo Watchupga
19	Mahoods Corner	11706	Wimmera-Glenelg	Private	Private	Barengi Gadgin Land Council	General Cropping	Birchip
20	Morton Plains Reserve	11609	Wimmera-Glenelg	Public	DEECA	Barengi Gadgin Land Council	Reserved Land	Birchip
21	Pam Juergens	11723	Wimmera-Glenelg	Private	Private	Barengi Gadgin Land Council	General Cropping	Birchip
22	Part of Gap Reserve	11702	Wimmera-Glenelg	Private	Private	Barengi Gadgin Land Council	General Cropping	Birchip
23	Paul Barclay	11714	Wimmera-Glenelg	Private	Private	Barengi Gadgin Land Council	General Cropping	Curyo Watchupga
24	Poyner	12472	Murray	Private	Private	N/A	General Cropping	Nullawil
25	R Ferrier	11713	Wimmera-Glenelg	Private	Private	Barengi Gadgin Land Council	General Cropping	Curyo Watchupga
26	Rickard	11715	Wimmera-Glenelg	Private	Private	Barengi Gadgin Land Council	General Cropping	Curyo Watchupga
27	Roselyn Wetland/Reids Dam	11608	Wimmera-Glenelg	Private	Private	Barengi Gadgin Land Council	General Cropping	Birchip
28	Round Swamp Bushland Reserve	11663	Wimmera-Glenelg	Public	Parks Victoria	Barengi Gadgin Land Council	Nature Reserve	Curyo Watchupga
29	Shannons Wayside	11703	Wimmera-Glenelg	Public	Grampians Wimmera Mallee Water	Barengi Gadgin Land Council	Reserved Land	Birchip
30	Tchum Lakes Dam	11693	Wimmera-Glenelg	Public	Parks Victoria	N/A	Nature Reserve	Birchip
31	Tchum Lakes Wetland	11693	Wimmera-Glenelg	Public	Parks Victoria	N/A	Nature Reserve	Birchip
32	Uttiwillock	12476	Wimmera-Glenelg	Public	DEECA	N/A	Nature Reserve	Nullawil

RAP = Registered Aboriginal Party. N/A = Not applicable

3.3 Asset Characteristics

Overviews of the main characteristics of the WMP sites are provided in Table 5, which summarises WMP site area, aquatic system and inundation pattern.

Hydrological characteristics of WMP sites are detailed in Section 4.

Ecological characteristics of WMP sites are detailed in Section 5.

Table 5 – Wetland ID, wetland/dam area, aquatic system and inundation pattern

#	Site Name	Wetland ID (current)	Area (Ha)	Aquatic system	Inundation
1	Barbers Swamp	11659	0.58	Palustrine or Lacustrine	Periodically Inundated - Seasonal Or Episodic
2	Broom Tank Reserve	11677	0.04	Lacustrine	Periodically Inundated - Episodic
3	Bull Swamp	11720_11721	0.23	Palustrine	Unknown
4	Chiprick Reserve	10810	0.04	Palustrine or Lacustrine	Periodically Inundated - Episodic
5	Clinton Shire dam	11711	0.15	Palustrine	Periodically Inundated - Unknown
6	Cokum Bushland Reserve	12473	0.29	Palustrine	Periodically Inundated - Episodic
7	Considine	12475	0.20	Palustrine	Periodically Inundated - Intermittent
8	Coundon Wetland	11725	0.05	Palustrine	Unknown
9	Cronomby Tanks	11718	0.72	Palustrine	Periodically Inundated - Seasonal Or Intermittent
10	D Smith	11704	0.04	Lacustrine	Periodically Inundated - Episodic
11	Goulds Reserve	11722	0.16	Palustrine	Permanent
12	Greens Wetland	11602	0.12	Palustrine	Periodically Inundated - Episodic
13	Homelea	11707	0.02	Palustrine	Periodically Inundated - Unknown
14	J Ferrier	11712	0.13	Palustrine	Periodically Inundated - Unknown
15	John Ampt	10847	0.18	Palustrine	Periodically Inundated - Seasonal Or Episodic
16	Kath Smith	11708	0.01	Lacustrine	Periodically Inundated - Episodic
17	Lake Danaher Bushland Reserve	11696	0.78	Palustrine or Lacustrine	Periodically Inundated - Episodic
18	Lake Marlbed	11724	0.03	Palustrine	Unknown
19	Mahoods Corner	11706	0.06	Palustrine	Periodically Inundated - Unknown
20	Morton Plains Reserve	11609	0.04	Palustrine	Unknown
21	Pam Juergens	11723	0.26	Palustrine	Unknown
22	Part of Gap Reserve	11702	0.12	Palustrine	Periodically Inundated - Episodic
23	Paul Barclay	11714	0.68	Palustrine	Periodically Inundated - Unknown
24	Poyner	12472	0.09	Palustrine	Periodically Inundated - Unknown
25	R Ferrier	11713	0.30	Palustrine	Periodically Inundated - Episodic
26	Rickard	11715	0.09	Palustrine	Periodically Inundated - Unknown
27	Roselyn Wetland/Reids Dam	11608	0.20	Palustrine	Periodically Inundated - Seasonal Or Episodic
28	Round Swamp Bushland Reserve	11663	0.18	Palustrine	Periodically Inundated - Episodic
29	Shannons Wayside	11703	0.09	Palustrine	Periodically Inundated - Unknown
30	Tchum Lakes Wetland	11693	0.60	Palustrine	Periodically Inundated - Seasonal Or Episodic
31	Tchum Lakes Dam	11693	NA	Palustrine	NA
32	Uttiwillock	12476	0.50	Palustrine	Unknown

NA = Not available

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 WMP sites. Those with particular relevance to the management of the sites' environmental and cultural values are listed in Table 6. Policies, strategies and plans related to environmental water are shown in Appendix 1. Selected strategies and plans pertaining to WMP sites are also included below.

Table 6 - 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)*
National (international agreements administered under the federal EPBC Act)	China-Australia Migratory Bird Agreement (CAMBA) Japan- Australia Migratory Bird Agreement (JAMBA) Convention on Migratory Species (Bonn)
State (Victoria)	*Flora and Fauna Guarantee Act 1988 (FFG)*

Mallee Waterway Strategy 2014-22

The Mallee Waterway Strategy 2014-22 (Mallee CMA, 2014) sets regional goals for waterway management that align with the Mallee Regional Catchment Strategy's broader objectives; identifies high value waterways; details strategic work programs for priority waterways; identifies the roles and responsibilities of regional stakeholders; and establishes principles to guide the implementation. Sites within the Dispersed Wetlands – Freshwater management unit are listed in the Mallee Waterway Strategy as high priority, with the exceptions of Morton Plains Reserve and D. Smith dam, listed as medium and no priority, respectively.

Wimmera Mallee Pipeline sites

Several Management Plans relate to parts of the WMP sites:

• Yarriambiack Waterway Action Plan (Alluvium 2018)

• Dunmunkle Creek Waterway Action Plan (Water Technology, WCMA 2020)

Further information on related plans and frameworks is outlined in section 8.0 of the Wimmera Mallee Pipeline Wetlands documents (Sunraysia Environmental, 2014a, 2014b).

3.4 Environmental water sources

Water for the Wimmera Mallee Pipeline wetlands is sourced from the Wimmera and Glenelg Rivers Environmental Entitlement 2010 (Wetland product). The entitlement includes 1,000 ML shared across the WMP sites.

4 Current/historical hydrological regime and system operations

4.1 Wetland hydrology, Water Management and Delivery

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 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.

4.1.1 Pre-pipeline

Since European settlement, significant hydrological alterations have occurred in the Wimmera Mallee landscape. Catchment scale changes such as clearing of vegetation, construction of roads (which can act as artificial levees), dams, drains and channels and the use of gypsum in cropping areas (which increases water infiltration into the soil) have reduced the frequency, depth, season and duration of wetland flooding events (Cook, Bayes and Jolly, 2014).

Surface water drainage in the local catchments and flows in the Wimmera and Avoca Rivers has been modified. The Avoca River, which feeds Tyrrell and Lalbert Creeks, has been subject to modifications to catchment runoff characteristics and the construction of levee banks (Mallee CMA 2012). This has reduced surface water runoff and affected the Avoca's capacity to feed its episodic distributaries. Large agricultural diversions from the Wimmera River have altered its natural flow regime (Mallee CMA 2012). This has reduced the higher flow peaks required to feed the Yarriambiack Creek (Mallee CMA 2012). The hydrological changes experienced in the Avoca and Wimmera Rivers had a cascading effect on flow into their distributaries and therefore the ephemeral streams capacity to fill nearby wetlands.

Construction of an extensive channel system commenced in the late 19th century and enabled delivery of water throughout the semi-arid landscape. Water was harvested into storages to supply the channel system, heavily reducing flows in some waterways (K Wilson (GWM Water), pers. comm., 13 July 2016). Dams were excavated in natural depressions and storm water runoff supplemented the channel supply. In dry years, it would have been possible to maintain dams by water delivered through the channel system. In wet years, these dams may have had additional water to inundate some of the surrounding area.

Channel infrastructure delivered water widely throughout the landscape, creating new intermittent and permanent aquatic habitats that became important refugia for both aquatic and terrestrial wildlife. The channel system supplied an estimated 100 GL of water per year to an estimated 20,000 farm dams, providing year-round water supply at some sites and intermittent supply at others, with wetlands drying out over summer (Wimmera Mallee Pipeline Project, 2003).

The historical water regime shown in Table 7 has been derived anecdotally from local landholder and GWM Water observations. In general, the water received from the open channel supply system kept sites almost permanently inundated. The inundation extent was confined to the dam or wetland basin and did not extend into the floodplain. Water delivery to several Crown Land sites was discontinued long ago when the channel system was expanded for water to be delivered to individual properties.

Table 7 - A summary of historical regimes and recent environmental watering events for the WMP sites

(Source: Mallee CMA (2022))

Site	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23
Barbers Swamp	O	E	E	E	E	E	U	E	E/U	U	E*	E*	N/A
Broom Tank	U	U	U	E	U	E	E/U	E	E	U	E	E	N/A
Bull Swamp	U	U	U	E	U	E	E/U	E	E/U	U	E	N/A	E
Chiprick	U	U	U	E	U	E	E/U	E	E	U	N/A	N/A	E
Clinton Shire Dam	U	U	U	E	U	E	E	E	E/U	E	N/A	E	E
Cokum Bushland Reserve	U	U	U	E	U	E	U	E	E/U	E	E	E	E
Considine	U	U	U	E	U/E	E	U	E	E/U	E	E	E	E
Coundon Wetland	U	U	U	E	U	U	U	E	U	E	E*	N/A	E
Cronomby Tanks	U	U	U	E	U	E	U	E	E/U	U	E	E	E
D Smith	R	R	U	E	U	E	E/U	E	E	U	E	E	E
Goulds Reserve	U	U	U	E	U	U	E	E	U	U	E	N/A	E
Greens Wetland	U	U	U	E	U	E	E/U	E	E/U	U	E	E*	E
Homelea	U	U	U	U	U	U	E/U	U	U	E	E	N/A	E
J Ferrier Wetland	U	U	U	E	E	E	E/U	E	E	U	E	E	E
John Ampt	U	U	U	E	E	E	E/U	E	E	U	N/A	E	E
Kath Smith	U	U	U	U	U	E	U	U	U	E	E	N/A	N/A
Lake Danaher Bushland Reserve	N/A	N/A	N/A	E	U	E	E/U	E	E/U	U	N/A	N/A	E
Mahoods Corner	U	U	U	E	U	E	E/U	E	E/U	E	E	E	E
Morton Plains Reserve	U	U	U	E	E	E	U	E	E/U	U	E	E	E
Pam Juergens	U	U	U	E	U	U	U	U	E/U	E	E*	N/A	E
Part of Gap Reserve	U	U	U	E	U	E	E/U	U	E/U	U	E	N/A	E
Paul Barclay	U	U	U	E	U	E	E/U	E	E/U	E	E*	E*	E
Poyner	U	U	U	E	E	E	U	E	E	U	E	E*	E
R Ferrier	U	U	U	E	U	E	E/U	E	E/U	U	E	E	N/A
Rickard Glenys	U	U	U	E	U	E	U	E	E/U	E	E*	E*	N/A
Roselyn Wetland/ Reids Dam	U	E	E	E	U	E	E/U	E	E/U	U	E	E	E
Newer Tank (Round Swamp)	U	U	U	E	U	E	E/U	E	E/U	U	N/A	N/A	E
Shannons Wayside	U	U	U	E	U	E	E/U	E	E	U	N/A	N/A	E
Tchum Lakes Wetland	U	U	U	N/A	N/A	N/A	E/U	E	U	U	N/A	N/A	N/A
Tchum Lakes Pool	U	U	U	E	U	N/A	E/U	E	E	E	N/A	N/A	E
Towma (Lake Marlbed)	U	U	U	E	U	E	E/U	E	E/U	E	N/A	E	E
Uttiwillock	U	U	U	N/A	N/A	N/A	U	U	O/U	U	E	E	E/U

Key:

	Dry
	Drying
	Wetting
E	Managed environmental water release
O	Consumptive water (mostly pre-pipeline)
U	Unregulated Flows
N/A	No watering

4.1.2 Post-pipeline

Due to the inefficiencies of the earthen channel system and its associated large water losses through evaporation and infiltration along its more than 17,500 km length, between 2006 and 2010, Grampians Wimmera Mallee Water (GWM Water) decommissioned the channel system and installed the largest water infrastructure in Australia, the Wimmera Mallee Pipeline (Figure 6). Over 9,000 km of pressurised pipeline now supplies up to 20 GL of water per year to approximately 9,000 farms and 34 townships (GWM Water, 2016). Additionally, landholders invested in reticulation systems including tanks, troughs and pipes to replace on farm channels and dams.

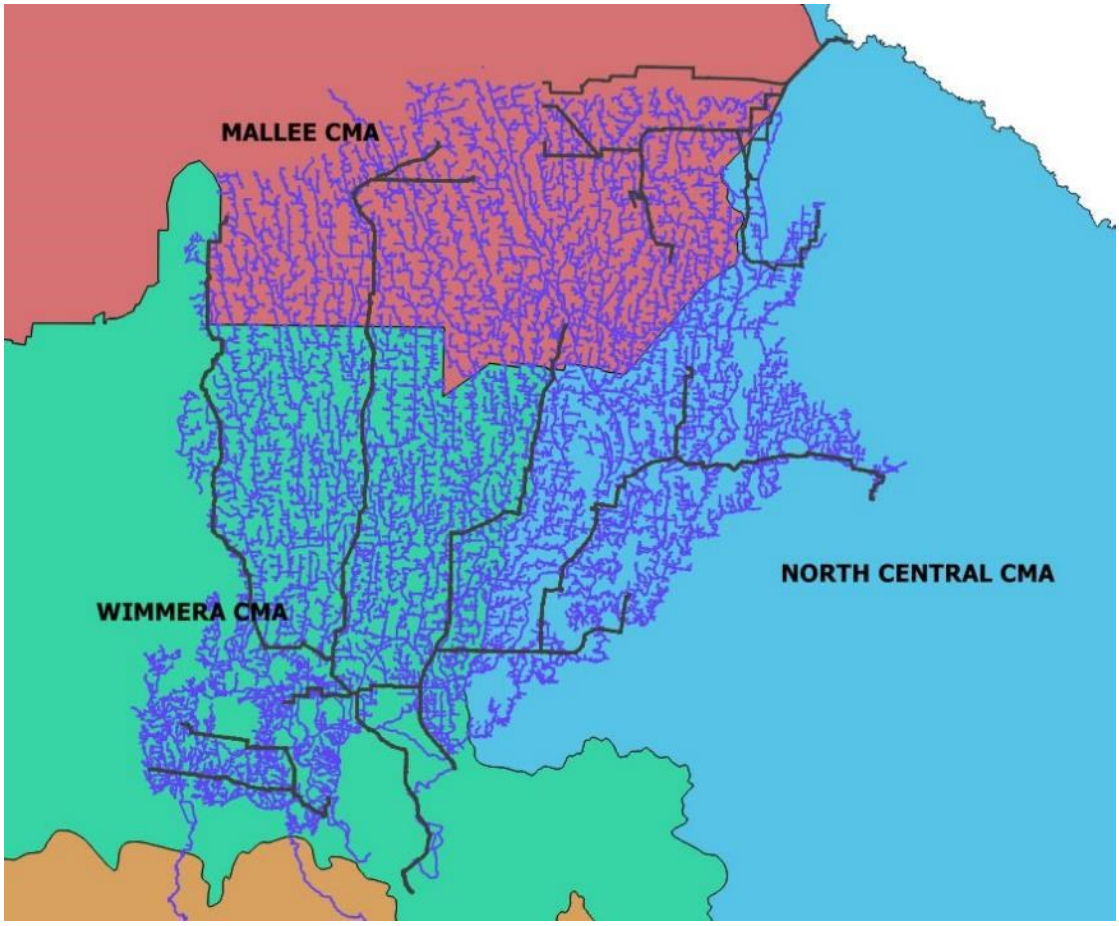


Figure 6 - Channel system prior to the construction of the Wimmera Mallee Pipeline (purple) and the WMP main trunks (black)

Following construction of the pipeline in 2010, delivery to WMP sites on private land ceased. Inflows from rainfall runoff continued to fill natural wetland sites sporadically. However, wetlands that included excavated dam sites required additional water to fill the dam before inundating the surrounding wetland (Cook, Bayes & Jolly 2014). Dams occurring in natural wetland depressions can be overtopped to inundate the surrounding wetland vegetation.

Savings from the WMP project has secured water for wetlands and vegetation stressed from the millennium drought through environmental flows and water entitlements (GWM Water 2014).

4.1.3 Wetland morphologies and landscape setting

A range of wetland morphologies are represented within the 32 WMP sites, across a range of landscape settings (see also Table 5).

Dams excavated in dryland settings

Seven of the WMP sites are dams excavated in dryland settings amongst terrestrial vegetation on farms. Prior to construction of the WMP, these dams would have been fed by the extensive channel system with a small contribution from rainfall or runoff. While dams in dryland settings don't support wetland EVCs they do provide a source of water for terrestrial species such as birds, reptiles and mammals. Kath Smith, Homelea, D Smith, R Ferrier, Cronomby Tanks, Pam Juergens, and Shannons Wayside are examples of this type of wetland. Following decommissioning of the channel system, these sites rely on environmental water to be filled. Watering could potentially occur in any season and at any frequency, but there would be no environmental benefit from allowing these dams to overflow (Cook, Bayes and Jolly, 2014).

Dams excavated in wetlands

The majority of WMP sites are dams excavated within existing wetlands that have their own local catchments. Historically these wetlands would have filled in response to heavy rainfall and localised runoff. Wetlands in this category may be isolated or part of a broader drainage system. Two of these wetlands (Clinton Shire Dam and Greens Wetland) support areas of EVCs which meet the criteria for the EPBC listed Seasonal Herbaceous Wetlands (Plains Grassy Wetland and Herb-rich Gilgai Wetland, see Section 5).

The excavation of dams within wetlands reduces the spread of water across the broader wetland bed as water must first fill the deeper dam area. This reduces the wetted area and thus the range and variability of available microhabitats for wetland flora and fauna.

A benefit of delivering environmental water to the dams within these wetlands is that the airspace within the dam is filled, allowing the wetland to fill naturally following local rainfall and runoff. These dams could be filled annually with no negative ecological side effects.

Water delivery happens between autumn and early spring, with a draw down over summer. Water allocations could also be used to fill or partially fill the volume of the natural wetlands beyond the dam, but must be consistent with natural flooding regime timing and frequency. Flooding too frequently or in the wrong season can lead to a decline in health of tree species such as River red gum and Black box, change the species composition, and favour the growth of weeds (Cook, Bayes and Jolly, 2014).

Dams in wetlands adjacent to watercourses

Three of the WMP sites, Considine and Poyner, and the new Uttiwillock site, occur along the Tyrrell Creek which can overflow, providing water to the wetlands. These sites support areas of episodically productive Black box dominated EVCs such as Black Box Wetlands and Lignum Swampy Woodlands. Historically the wetlands would have experienced intermittent flooding of short duration after heavy rainfall, runoff and occasional flooding of the Tyrrell Creek, however wetland hydrology has been changed by dam construction and landscape modification (Cook, Bayes and Jolly, 2014).

4.1.4 Groundwater Interactions

To our knowledge assessments of groundwater, salinity and other interactions between groundwater and surface water have not been conducted at WMP sites. Groundwater interactions therefore remain a knowledge gap.

4.1.5 Environmental watering of pipeline sites

Since 2011 water has been supplied to the WMP sites for ecological outcomes as they became connected to the WMP network (Table 7 and Table 8). Barbers Swamp and Roselyn Wetland were the first two sites to receive environmental water in 2011-12. The majority of the sites then entered the program in 2013-14 (Table 7 and Table 8). Uttiwillock (the newest site) has been included in the watering program since 2019-20. Details of watering events at each site are provided in Table 8.

Table 8 - Environmental Water deliveries to Wimmera Mallee Pipeline Sites

WMP site	2011/2012		2012/2013		2013/2014		2014/2015		2015/2016		2016/2017		2017/2018		2018/2019		2019/2020		2020/2021		2021/2022		2022/2023	
	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)
Barbers Swamp	May	15.3	Nov - Feb	15	Aug-Sep, Apr	12.82 4.35	Jun	4.69	Sep-Oct, May-Jun	6.34 11.74	na	0	Jul, Apr-May	5 11.12	Sep	4.27	Apr-May	2	na	0	May	3.94	na	0
Broom Tank	na	0	na	0	Apr-Jun	9.2	na	0	Sep-Oct	1.53	Sep-Oct	1.1	Jul-Aug	8.1	Aug-Sep	1	na	0	Sep	1.11	Sep, May	0.97	na	0
Bull Swamp	na	0	Jan - Feb	25(?)	Aug, Oct-Nov, Apr-Jun	1.47 3.68 7.11	na	0	Sep-Oct	3.41	Sep-Oct	1.29	Jul-Aug	8.82	Aug-Sep	3.94	na	0	Sep	4.08	na	0	Sep	2.89
Chiprick	na	0	na	0	Apr-Jun	7.44	na	0	Sep, May	1.92 2.06	Sep-Oct	3.01	Jul-Sep	9.19	Aug-Oct	4.75	na	0	na	0	na	0	Oct	5.14 9
Clinton Shire Dam	na	0	na	0	Apr-Jun	5.11	na	0	Sep-Oct	2.95	Sep-Nov	3.12	Jul-Aug	2.25	Sep-Oct	1.83	Sep-Oct Apr-May	0.48 3	na	0	Aug, May	2.65	Oct	1.65
Cokum BR	na	0	na	0	Dec-Jan, Apr-Jun	1.31 2.48	na	0	Sep, Jun	3.99 4.11	na	0	Oct	5.09	Mar (rec w)	3	Apr-May	4	Apr	2	Nov	3.55	Sep-Oct	5.65
Considine	na	0	na	0	Dec, Apr-Jun	1.07 7.5	Jun	0.42	Sep-Nov, Jun	3.53 1.25	na	0	Oct-Dec, May-Jun	3.51 3.1	May-Jun	1.83	Oct-Dec	4	Aug - Nov	3.95	Sep – Nov, Feb - Mar	4.20	Aug – Oct, Mar - May	7.65
Coundons Wetland	na	0	na	0	Apr-Jun	0.62	na	0	na	0	na	0	Jul	2.03	na	0	Oct	0.53	Apr	0.37	na	0	Sep	0.36

WMP site	2011/2012		2012/2013		2013/2014		2014/2015		2015/2016		2016/2017		2017/2018		2018/2019		2019/2020		2020/2021		2021/2022		2022/2023	
	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)
Cronomby Tanks	na	0	na	0	Apr-Jun	5.51	na	0	Sep-Nov, May-Jun	7.27 5.77	na	0	Jul	2.06	Aug-Oct	7.23	na	0	Sep - Oct	4	Sep - Nov	6.14	Sep -Oct	5.91
D Smith	na	0	na	0	Apr-Jun	1.48	na	0	Sep-Oct	0.9	May-Jun	1.54	Oct	0.48	Aug-Sep May	0.96 1.03	na	0	Oct - Nov	0.78	Oct	0.69	Sep	0.66
Goulds Reserve	na	0	na	0	Apr-Jun	4.5	na	0	na	0	May-Jun	16.1 6	Oct-Nov	13.7	na	0	na	0	Sep	1.95	na	0	Sep	3.48
Greens Wetland	na	0	na	0	Nov-Dec, Apr-Jun	1.4 2.18	na	0	Sep-Nov, May-Jun	1.63 2.05	Oct	1.34	Oct	1.25	Sep-Oct	1.11	na	0	Sep -Oct	2	Apr - May	1.37	May - June	0.74
Homelea	na	0	na	0	na	0	na	0	na	0	Oct	1.5	na	0	na	0	Sep -Oct	0.83	Sep - Oct	0.78	na	0	Sep, May	1.08
J Ferrier Wetland	na	0	na	0	Nov-Mar, Apr	13.84 0.01	Jun	1.41	Sep-Oct, May	1.64 1.4	Sep-Nov	3	Jul-Nov	7.22	Sep-Nov May	4 1.32	na	0	Sep ,Apr	1.71	Oct	2.29	Sep	3.55
John Ampt	na	0	na	0	Nov-Dec, Jan-Mar, Apr-Jun	2 2.6 2.8	Jun	1.01	Sep, May-Jun	1.61 2.3	Sep-Oct	1.98	Oct-Nov, Mar-Apr	2.13 2.11	May	3.94	na	0	na	0	Sep - Oct	2.12	Apr - May	2.84
Kath Smith	na	0	na	0	na	0	na	0	Sep	1.2	na	0	na	0	na	0	Sep -Oct	0.61	Mar	0.75	na	0	na	0
Lake Danaher BR	na	0	na	0	Nov-Mar, Apr-Jun	3.51 1.46	na	0	Sep-Oct	2.04	Sep-Nov, May-Jun	0.71 0.32	Jul-Nov, Apr-Jun	2.85 4.7	Apr-Jun	2.35	na	0	na	0	na	0	Sep-Nov, Mar - May	4.32
Mahoods Corner	na	0	na	0	Nov-Dec, Apr-Jun	0.67 1.96	na	0	Sep-Oct	1.38	Sep-Oct	1.42	Jul	1.08	Sep-Oct	1.58	Sep -Oct	0.85	Sep , Apr	2.03	Oct	1.19	Oct	0.76

WMP site	2011/2012		2012/2013		2013/2014		2014/2015		2015/2016		2016/2017		2017/2018		2018/2019		2019/2020		2020/2021		2021/2022		2022/2023	
	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)
Morton Plains Reserve	na	0	Jan-Feb	16	Nov-Dec, Apr-Jun	1.48 4.38	Jun	4.86	Oct May	0.75 1.21	na	0	Jul	2.89	Aug	1.97	na	0	Sep	1.41	Sep	1.61	Sep	1.52
Pam Juergens	na	0	na	0	Apr-May	1.14	na	0	na	0	na	0	na	0	Aug-Sep	0.97	Sep	0.42	Apr	0.50	na	0	Sep	0.86
Part of Gap Reserve	na	0	na	0	Apr-Jun	3.44	na	0	Sep-Oct	1.54	Oct, May-Jun	1.15 2.7	na	0	Aug-Sep	1.77	na	0	Sep	1.82	na	0	Sep	1.43
Paul Barclay	na	0	na	0	Apr-Jun	9.07	na	0	Sep-Oct	2.60	Sep-Oct	3.33	Jul	4.75	Aug Apr-May	3.38 0.97	Apr-May	4	Mar - Apr	4.1	May	2.99	May - June	5.70
Poyner	na	0	na	0	Dec-Feb, Apr-Jun	1.85 1.38	Jun	0.04	Sep-Oct, Jun	2.7 0.66	na	0	Oct-Nov	1.4	May-Jun	0.72	na	0	Aug - Dec	1.2	May - Jun	0.97	Aug – Sep	2.18
R Ferrier	na	0	na	0	Apr-Jun	6.88	na	0	Sep-Nov, May-Jun	5.8 1.11	May-Jun	1.31	Oct-Nov	3.43	Sep-Oct Apr-May	4.16 2.03	na	0	Sep - Nov	3.73	Oct - Nov	6.33	na	0
Rickard Glenys	na	0	na	0	Apr-May	2.56	na	0	Sep-Oct, May	2.89 1.99	na	0	Jul-Aug	3.37	Sep-Nov Apr-May	2.19 1.79	Apr-May	3	Apr	1.62	May	0.32 8	na	0
Roselyn Wetland	May	6.7	Jan-Feb	20(?)	Aug-Dec, Apr-Jun	13.93 5.74	na	0	Sep-Oct	6.73	May-Jun	9.63	Oct	2.87	Aug-Sep May	4.74 3.68	na	0	Aug - Sep	3.74	Sep – Oct	2.87	Sep	4.83
Newer Tank (Round Swamp BR)	na	0	na	0	Apr-Jun	8.89	na	0	Sep-Oct	3.54	Oct	3.54	Oct-Nov	6.33	Sep-Oct	2.61	na	0	na	0	na	0	Sep	2.28

WMP site	2011/2012		2012/2013		2013/2014		2014/2015		2015/2016		2016/2017		2017/2018		2018/2019		2019/2020		2020/2021		2021/2022		2022/2023	
	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)	Time	Vol (ML)
Shannons Wayside	na	0	na	0	Apr-Jun	3.13	na	0	Sep-Oct	1.26	Sep-Oct	1.42	Oct	1.66	Sep Apr-May	1.31 0.95	na	0	na	0	na	0	Sep - Feb	14.89 over delivery
Tchum Lakes Dam	na	0	na	0	Nov-Mar, Apr-Jun	7.21 3.81	na	0	na	0	May-Jun	6.86	Oct	0.46	Aug-Sep	2.91	Sep -Oct	3.64	na	0	na	0	Sep - May	6.1
Tchum Lakes Wetland	na	0	na	0	na	0	na	0	na	0	May-Jun	24.46	Jul-Dec	90.81	na	0	na	0	na	0	na	0	na	0
Towma (Lake Marlbed) FFR	na	0	na	0	Apr-May	1.75	na	0	Sep-Oct, May	2.37 1.74	May-Jun	1.93	Oct	1.76	Aug-Sep	1.3	Sep -Oct	0.68	na	0	Sep - Oct	1.21	Sep	1.46
Uttiwillock	na	0	na	0	na	0	na	0	na	0	na	0	na	0	na	0	na	0	Oct - Dec, Mar	4.89	Sep - Nov	4.64	Sep - Oct	3.65

5 Water-dependant values

5.1 Environmental Values

Wetlands are a vital component of the landscape which support a variety of flora and fauna which may vary greatly 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. The WMP sites support a wide range of flora and fauna, and a diversity of species are known to be present in the local area. The wetlands and dams provide both a water source and food source for many terrestrial fauna species occurring locally. The wetlands also provide valuable refuge for aquatic species. Healthy wetlands support healthy vegetation that can in turn offer perching, nesting and foraging sites for a wide range of terrestrial fauna.

Cokum Bushland Reserve. ***Source: Mallee CMA***

5.1.1 Ecosystem type

Vegetation communities

A complete list of all EVCs recorded at each WMP site is shown in Table 9. The bioregional conservation status of each EVC is provided in Table 10.

Table 9 - Dominant vegetation, surrounding ecological Vegetation class (EVC), and bioregion of each WMP site

#	Site Name	Wetland ID	Dominant Vegetation (WETLAND_CURRENT)	EVC (Cook, Bayes and Jolly, 2014)	Bioregion
1	Barbers Swamp	11659	Unknown	Black Box Wetland (EVC 369)* Plains Woodland (EVC 803)	Wimmera
2	Broom Tank Reserve	11677	No emergent vegetation	Lignum Shrubland (EVC 808)* Lignum Swampy Woodland (EVC 823) Plains Savannah EVC 826) Riverine Chenopod Woodland (EVC 103)	Murray Mallee
3	Bull Swamp	11720_11721	Forest/woodland	Black Box Wetland (EVC 369) Ridged Plains Mallee (EVC 96) Riverine Chenopod Woodland (EVC 103)	Murray Mallee
4	Chiprick Reserve	10810	Unknown	Lake Bed Herbland (EVC 107) Northern Wimmera Riverine Chenopod Woodland (EVC 103_62) Ridged Plains Mallee (EVC 96)	Murray Mallee
5	Clinton Shire dam	11711	Shrub	Black Box Wetland (EVC 369) Lake Bed Herbland (EVC 107) Lignum Shrubland (EVC 808) Low Rises Woodland (EVC 66) Plains woodland / Herb-rich Gilgai Wetland Complex (EVC 235)	Wimmera
6	Cokum Bushland Reserve	12473	Shrub	Black Box Wetland (EVC 369)* Plains Savannah (EVC 826) Riverine Chenopod Woodland (EVC 103)	Murray Mallee
7	Considine	12475	Forest/woodland	Lignum Swampy Woodland (EVC 823)	Murray Mallee
8	Coundon Wetland	11725	Forest/woodland	Ridged Plains Mallee (EVC 96) Riverine Chenopod Woodland (EVC 103)	Murray Mallee
9	Cronomby Tanks	11718	Shrub	Ridged Plains Mallee (EVC 96) Tall Marsh (EVC 821)	Murray Mallee
10	D Smith	11704	No emergent vegetation	Ridged Plains Mallee (EVC 96)	Wimmera
11	Goulds Reserve	11722	Sedge/grass/forb	Black Box Wetland (EVC 369) Lake Bed Herbland (EVC 107) Norther Wimmera Riverine Chenopod Woodland (EVC 103_62) Plains Savannah (EVC 826)	Wimmera
12	Greens Wetland	11602	Unknown	Black Box Wetland (EVC 369) Plains Grassy Wetland (EVC 125) Plains Woodland / Herb-rich Gilgai Wetland Complex (EVC 235)	Wimmera
13	Homelea	11707	Forest/woodland	Ridged Plains Mallee (EVC 96)	Wimmera
14	J Ferrier	11712	Shrub	Black Box Wetland (EVC 369) Ridged Plains Mallee (EVC 96)	Murray Mallee
15	John Ampt	10847	Shrub	#	Murray Mallee
16	Kath Smith	11708	No emergent vegetation	Ridged Plains Mallee (EVC 96)	Wimmera
17	Lake Danaher Bushland Reserve	11696	Unknown	Intermittent Swampy Woodland (EVC 813) Lake Bed Herbland (EVC 107) Ridged Plains Mallee (EVC 96)	Murray Mallee
18	Lake Marlbed	11724	Sedge/grass/forb	Black Box Wetland (EVC 369) Lignum Swamp (EVC 104) Lunette Woodland (EVC 652)	Wimmera

				Riverine Chenopod Woodland (EVC 103)	
19	Mahoods Corner	11706	Sedge/grass/forb	Black Box Wetland (EVC 369) Riverine Chenopod Woodland (EVC 103)	Wimmera
20	Morton Plains Reserve	11609	Sedge/grass/forb	Lignum Shrubland (EVC 808) Lignum Swampy Woodland (EVC 823) Plains Savannah (EVC 826)	Wimmera
21	Pam Juergens	11723	Sedge/grass/forb	Chenopod Grassland (EVC 829) Lignum Shrubland (EVC 808) Ridged Plains Mallee (EVC 96)	Wimmera
22	Part of Gap Reserve	11702	Unknown	Black Box Wetland (EVC 369)	Wimmera
23	Paul Barclay	11714	Shrub	Low Rises Woodland (EVC 66) Plains Woodland (EVC 803)	Murray Mallee
24	Poyner	12472	Shrub	Black Box Wetland (EVC 369) Lignum Swampy Woodland (EVC 823)	Murray Mallee
25	R Ferrier	11713	Sedge/grass/forb	Ridged Plains Mallee (EVC 96)	Murray Mallee
26	Rickard	11715	Sedge/grass/forb	Ridged Plains Mallee (EVC 96) Riverine Chenopod Woodland (EVC 103)* Aquatic Herbland (IWC EVC 653)	Murray Mallee
27	Roselyn Wetland/Reids Dam	11608	Sedge/grass/forb	Black Box Wetland (EVC 369) Plains Woodland (EVC 803) Ridged Plains Mallee (EVC 96) Riverine Chenopod Woodland (EVC 103)	Wimmera
28	Round Swamp Bushland Reserve	11663	Shrub	Black Box Wetland (EVC 369) Lignum Swampy Woodland (EVC 823) Plains Savannah (EVC 826)	Wimmera
29	Shannons Wayside	11703	Sedge/grass/forb	Ridged Plains Mallee (EVC 96)	Wimmera
30	Tchum Lakes Dam	11693	Unknown	Lake Bed Herbland (EVC 107) Lignum Swampy Woodland (EVC 823) Plains Savannah (EVC 826)	Murray Mallee
31	Tchum Lakes Wetland	11693	Unknown	Lignum Swampy Woodland (EVC 823)	Murray Mallee
32	Uttiwillock	12476	Forest/woodland	Aquatic Herbland (EVC 653) Floodway Pond Herbland (EVC 810) Lignum Swampy Woodland (EVC 823) Ridged Plains Mallee (EVC 96) Plains Savannah (EVC 826)	Murray Mallee

= no remnant native vegetation on-site

Asterisks (*) and red text denote EVCs observed by Ecology Australia, 2023

Table 10 - Bioregional conservation status of EVCs at WMP sites

EVC	EVC Name	Bioregion	Conservation Status
369	Black Box Wetland	Murray Mallee	Not in bioregion**
		Wimmera	Not in bioregion**
829	Chenopod Grassland	Wimmera	Endangered
813	Intermittent Swampy Woodland	Murray Mallee	Vulnerable
107	Lake Bed Herbland	Murray Mallee	Depleted
		Wimmera	Not in bioregion
808	Lignum Shrubland	Murray Mallee	Least Concern
		Wimmera	Not in bioregion
823	Lignum Swampy Woodland	Murray Mallee	Vulnerable
		Wimmera	Vulnerable
66	Low Rises Woodland	Murray Mallee	Endangered
562	Lunette Woodland	Wimmera	Not in bioregion
103_62	Northern Wimmera Riverine Chenopod Woodland	Murray Mallee	Depleted
		Wimmera	Endangered
125	Plains Grassy Wetland*	Wimmera	Endangered
826	Plains Savannah	Murray Mallee	Endangered
		Wimmera	Endangered
803	Plains Woodland	Murray Mallee	Endangered
		Wimmera	Endangered
235	Plains Woodland / Herb-rich Gilgai Wetland Complex*	Wimmera	Not in bioregion
96	Ridged Plains Mallee	Murray Mallee	Endangered
		Wimmera	Endangered
103	Riverine Chenopod Woodland	Murray Mallee	Depleted
		Wimmera	Endangered
810	Floodway Pond Herbland	Murray Mallee	Vulnerable
653	Aquatic Herbland	Murray Mallee	Not in bioregion

* denotes EVCs that meet the definition of Seasonal Herbaceous Wetlands, which are listed as critically endangered under the federal *EPBC Act 1999*.

** Black Box Wetland has been recorded at a number of WMP sites in both bioregions

EVCs

The most commonly recorded wetland ecological vegetation class (EVC) at the WMP sites is Black Box Wetland. Black Box Wetland is recorded at nine WMP wetland sites located within the Wimmera bioregion. The conservation status of this EVC is not listed for the Wimmera or Murray Mallee bioregions, however it is recorded at nine WMP sites in the Wimmera bioregion, and four connected wetland sites located in the Murray Mallee bioregion.

Riverine Chenopod Woodland or Northern Wimmera Riverine Chenopod Woodland occurs at 10 sites. The dominant tree species of many of these EVC is Black box (*Eucalyptus largiflorens*). The condition of black box can be dependent on the frequency of inundation events, which in turn can impact on bud size and abundance of flowering (Roberts & Marston 2011). Within the study area, Black box is generally found in natural depressions in the landscape, and 23 of the WMP sites are dams constructed within natural wetlands.

Black box trees provide habitat including feeding, breeding and refuge areas for reptiles, mammals and birds (West n.d; DEC 2011). These trees can provide shelter for hollow-seeking native birds such as the Regent

parrot and Barking owl, and provide perching and nesting sites for other birdlife. Fallen limbs can provide hollow logs as harbour and nesting sites for reptiles such as the carpet python, and basking sites for the eastern long-necked turtle. Fallen timber also provides shelter for nesting sites for the state listed Bush stone-curlew (*Burhinus grallarius*).

Healthy Black box helps provide important vegetative corridors to other areas for a range of transient native fauna. Many of the WMP sites with Black box EVCs are associated with terrestrial EVCs including Plains Savannah and Ridged Plains Mallee, offering a diversity of habitat for native fauna.

Also important in Black box communities and present at the WMP sites are Lignum species (*Duma spp.*). Lignum communities become an extensive aquatic habitat for fish and macroinvertebrates when inundated (Ecological Associates 2007). Lignum swamps and shrublands are also used as a nesting site by waterbirds, and as a feeding area by raptors, owls, and predatory reptiles (Ecological Associates 2007). Healthy Lignum provides shelter for a range of birdlife, nesting sites for smaller birds, and cover for frogs and reptiles.

To promote vigorous growth in Black box, inundation every 3-7 years is needed. Lignum requirements vary from 1-5 years (Roberts & Marston 2011).

Black Box Wetland – Roselyn Wetland. ***Source: Mallee CMA***

Seasonal Herbaceous Wetlands

Plains Grassy Wetlands and Herb-rich Gilgai Wetlands are Seasonal Herbaceous Wetlands. The Seasonal Herbaceous wetlands (Freshwater) of the Temperate Lowland Plains ecological community (SHW) are temporary freshwater wetlands that receive seasonal inundation, typically after winter and spring rainfall, then dry out. The treeless vegetation is dominated by an herbaceous ground layer, mostly graminoids but also including forb species. The herbaceous species of SHW are characteristic of wetter locations than the

dryland grasslands and woodlands that typically surround them. They typically occur on isolated drainage lines or depressions over poorly draining clays and are limited to temperate south-eastern Australia (Threatened Species Scientific Committee, 2012). SHW are listed as critically endangered under the federal *EPBC Act 1999*.

5.1.2 *Ecosystem function:*

Aquatic refuge

The majority of the WMP sites are wetlands, though many of these have been modified with a dam constructed within the wetland boundary. When inundated, these wetlands act as refugia for water dependent species such as waterbirds, turtles, and frogs as well as terrestrial fauna such as woodland birds and reptiles. This is especially important during periods of extended drought in this arid landscape. Inundation of areas of the wetland woodland mosaic provides a diversity of feeding, breeding and nursery sites for native water-dependent biota.

Maintenance of vegetation communities and habitat structure

Within the WMP sites are significant areas of inundation dependent and wetland EVCs dominated by Black Box, Lignum, herb species or tussock grasses. These vegetation classes require intermittent inundation (at a range of intervals) to ensure survival of existing perennials and recruitment of perennial and annual flora species. Appropriate watering regimes will support the survival and growth of mature trees that provide hollows, providing critical nesting and shelter habitat for Regent parrots, Carpet pythons and Barking owls.

Water source for terrestrial fauna

WMP sites where dams have been constructed within areas of terrestrial vegetation do not have intrinsic wetland values but do provide a critical source of drinking water to terrestrial fauna species such as woodland birds, mammals and reptiles. Prior to construction of the WMP and decommissioning of the channel system, many more sources of water would have been available across the landscape. Now, during drought and dry summers, these dams may be the only accessible water for fauna for kilometres.

Habitat for fauna

The habitat provided by vegetation communities around wetlands is essential for maintaining populations of water dependent fauna species. Wetland ecosystems support distinctive communities of plants and animals and provide numerous ecosystem services to the community (DEPI 2005). Sixteen of the WMP wetlands have been categorised as Freshwater Meadow or Permanent Open Freshwater (refer Table 11). Altered water regimes at the WMP sites due to river regulation, removal of the channel and dam system, altered wetland hydrology and prolonged dry conditions have seen a decrease in the frequency of inundation of these dams and wetlands and therefore a decrease in the ability of these wetlands to perform these valuable ecosystem functions.

Image: Female White-winged triller. Coundon Wetland. *Source: Mallee CMA*

Wetland depletion and rarity

Victoria's wetlands are currently mapped and are contained within a state wetland database, using an accepted state-wide wetland classification system, developed by Andrew Corrick from the Arthur Rylah Institute. Mapping was undertaken from 1981 using 1:25,000 colour aerial photographs, along with field checking. This database is commonly known as the 1994 wetland layer and contains the following information:

- categories (primary) based on water regime and
- subcategories based on dominant vegetation

At the same time, an attempt was made to categorise and map wetland areas occupied prior to European settlement. This was largely interpretive work and uses only the primary category, based on water regime. This is known as the 1788 layer.

It has been possible to determine the depletion of wetland types across the state using the primary category only, based on a comparison of wetland extent between the 1788 and 1994 wetland layers.

Comparison between the wetland layers has demonstrated the impact of European settlement and development on Victorian wetlands. This has been severe, with approximately one-third of the state's wetlands being lost since European settlement; many of those remaining are threatened by continuing degradation from salinity, drainage and agricultural practices (ANCA, 1996).

Of the thirty-two WMP sites, sixteen have been classified using the Corrick and Norman classification system. Of these sixteen sites, seven are classified Permanent Open Freshwater and nine are Freshwater Meadows.

In the Mallee CMA, the Wimmera bioregion contains almost a quarter of the Mallee's most depleted wetland type, which is Freshwater Meadow (Mallee CMA 2006). This makes wetlands at the WMP sites significant in the region (Table 11).

Table 11 - Corrick classification of Wimmera Mallee Pipeline wetlands

Corrick Category	No of Wetlands at WMP sites	Percentage change in wetland area from 1788 to 1994		
		% Change in area in Victoria	% Change in area In Mallee CMA	% Change in Robinvale Plains Bioregion
Permanent Open Freshwater	7	-6	5	-1
Freshwater Meadow	9	-43	-80	-1

5.1.3 Flora and fauna values

WMP sites substantially differ in the number, type (i.e. birds, reptiles, amphibians, fish) of origin (native, exotic) of flora and faunal species present. The species diversity at each WMP site is shown in **Table** 12.

Table 12 - Flora and Fauna species summary table

Site	Indigenous Flora	Exotic Flora	Total Bird	Total Native Bird	Total Native Wetland Bird	Total Reptile	Total Frog	Total Native Mammal	Total Microbats	Total Butterfly	Number of threatened fauna*
Barbers swamp	54	34	105	101	38	9	4	4	4	4	18
Broom Tank	40	18	21	21	9	1	3	≥3	≥3	0	1
Bull Swamp	44	19	49	48	15	3	0	6	4	0	6
Chiprick Reserve	21	10	10	10	0	0	0	0	0	1	1
Clinton Shire Dam	48	23	15	15	4	0	0	0	0	0	1
Cokum Bushland Reserve	60	26	34	34	9	2	4	≥9	≥8	5	2
Considines	30	22	50	46	6	3	2	2	0	0	8
Coundons	18	7	9	9	0	1	0	0	0	0	3
Cronomby Tanks	27	27	41	38	7	2	3	≥7	≥7	0	3
D Smith	11	8	2	2	0	0	0	0	0	0	1
Gap reserve	30	19	12	12	0	0	0	0	0	0	0
Goulds Reserve	53	24	44	44	15	1	0	1	0	4	3
Greens Wetland	58	26	43	43	10	1	0	1	0	0	2
Homelea	-	-	0	0	0	0	0	0	0	0	0
J Ferrier	14	12	5	5	3	0	0	0	0	0	0
John Ampt	3	6	5	3	3	0	0	0	0	0	0
Kath Smith	-	-	15	15	4	1	0	1	0	0	1
Lake Danaher Bushland Reserve	23	13	25	25	1	3	1	0	0	0	4
Mahoods Corner	33	13	23	23	11	3	0	0	0	0	5
Moreton Plains Reserve	73	30	22	22	16	0	0	1	0	0	1
Pam Juergens	79	31	16	16	0	0	5	1	0	0	5
Paul Barclay	19	9	6	6	0	0	0	0	0	0	0
Poyner	16	15	20	20	1	1	0	0	0	0	2
R Ferrier	18	8	67	67	21	7	0	0	0	0	12
Rickard Glenys	34	16	42	42	9	0	3	≥8	≥8	0	1
Roselyn Wetland	71	28	61	60	20	6	3	2	0	0	6
Round Swamp Bushland Reserve	34	15	0	0	0	0	0	0	0	0	0
Shannons Wayside	11	7	84	81	33	3	0	0	0	0	10
Tchum Lakes Reserve (Wetland and dam)	49	17	58	57	17	6	1	4	0	0	6
Lake Marlbed FFR	42	36	43	41	3	4	0	3	0	0	5
Uttiwillock	77	32	131	NA	NA	6	4	4	>=9	NA	18

* Species include those listed under FFG Act 1988, EPBC Act 1999 and those on the former Victorian Advisory List

Data from Cook et al., 2014, except for cells with red text, where numbers represent combined data from Cook et al., 2014, and Ewing et al, 2023.

Fauna

28 listed species of fauna have been recorded across WMP sites, which are summarised in Table 13. This includes 12 directly water-dependent species listed in legislation, agreements or conventions that will benefit

from WMP sites receiving water more regularly. Water-dependent species forage or nest in or on water, inhabit, or breed in water, or require flooding to trigger breeding and fledging. The list also includes several species that are indirectly dependent on water), as they require riparian trees, vigorous ground cover and/or fallen timber. In order to provide breeding opportunities, habitat elements within the WMP sites such as temporary wetlands and Black box communities must be maintained in good condition.

Table 13 - Listed fauna recorded at Wimmera Mallee Pipeline sites

Common name	Scientific name	Type	Hollow dependent	International convention	EPBC Status	FFG status
Australasian shoveler*	*Anas rhynchotis*	B			NL	Vu
Eastern great egret*	*Ardea modesta*	B			NL	Vu
Australian bustard	*Ardeotis australis*	B			NL	CE
Hardhead*	*Aythya australis*	B			NL	Vu
Musk duck*	*Biziura lobata*	B			NL	Vu
Australasian bittern*	*Botaurus poiciloptilus*	B			EN	CE
Bush stone-curlew	*Burhinus grallarius*	B			NL	CE
Inland dotterel	*Charadrius australis*	B			NL	Vu
Murray River (short-necked) turtle*	*Emydura macquarii*	R			NL	CE
Black falcon	*Falco subniger*	B			NL	CE
Diamond dove	*Geopelia cuneata*	B			NL	Vu
Hooded robin	*Melanodryas cucullata*	B			NL	Vu
Carpet python	*Morelia spilota ssp. metcalfei*	R	Y		NL	EN
Barking owl	*Ninox connivens*	B	Y		NL	CE
Blue-billed duck*	*Oxyura australis*	B			NL	Vu
Plains-wanderer	*Pedionomus torquatus*	B			CE	CE
Glossy ibis*	*Plegadis falcinellus*	B		Bonn, CAMBA	NL	NL
Eastern bearded dragon	*Pogona barbata*	R			NL	Vu
Regent parrot	*Polytelis anthopeplus*	B	Y		Vu	Vu
Grey-crowned babbler	*Pomatostomus temporalis temporalis*	B			NL	Vu
Hooded scalyfoot	*Pygopus schraderi*	R			NL	CE
Australian painted snipe*	*Rostratula australis*	B			EN	CE
Diamond firetail	*Stagonopleura guttata*	B			NL	Vu
Freckled duck*	*Stictonetta naevosa*	B			NL	EN
Apostlebird	*Struthidea cinerea*	B			NL	Vu
Lace monitor	*Varanus varius*	R			NL	EN
Australian little bittern*	*Ixobrychus dubius*	B			NL	EN
Freshwater catfish*	*Tandanus tandanus*	F			NL	EN

EPBC threatened status/Victorian Status - FFG: Vu = Vulnerable, EN = Endangered, CE = Critically Endangered, NL = Never listed * water-dependent species Y=Yes

JAMBA: Japan-Australia Migratory Bird Agreement CAMBA: China-Australia Migratory Bird Agreement

Bonn = Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)

Fish

No fish species were recorded at any in the 2014 assessments by Cook et al., 2014. A recent biodiversity assessment by Ecology Australia identified several fish species at three of the five assessed WMP sites (Ewing et al., 2023). A significant, self-sustaining population of Freshwater catfish (*Tandanus tandanus* endangered, FFG Act) was recorded at Cronomby Tanks. The origin of the population is unclear, but is thought to be due to stocking. Maintaining suitable habitat to support Freshwater catfish at Cronomby Tanks was highlighted by Ecology Australia as a priority. Native Flat-headed gudgeon (*Philypnodon grandiceps*) and Carp gudgeon (*Hypseleotris sp.)* and exotic Redfin (*Perca fluviatilis*) were also found at Cronomby

Tanks. Golden perch (*Macquaria ambigua ambigua*) were recorded at Cokum Bushland reserve. Eastern gambusia (*Gambusia holbrooki*, exotic) were recorded at Barbers Swamp.

Freshwater catfish. *Source: Mallee CMA*

Frogs

Several frog species have been observed at WMP sites, including Barbers Swamp, Broom Tank, Cokum Bushland Reserve, Cronomby Tanks and Pam Juergens Dam (**Table** 12). Species include the Spotted marsh frog (*Limnodynastes tasmaniensis*), Common eastern froglet (*Crinia signifera*), Eastern sign-bearing froglet (*Crinia parainsignifera*), Pobblebonk/Southern bullfrog/Eastern banjo frog (*Limnodynastes dumerili*), Peron's tree frog (*Litoria Peronii*) and Sudell's frog (*Neobatrachus sudellae*) were measured via audio recordings, the presence of tadpoles or incidental observations while conducting other assessments. Although these species differ in their breeding preference (for example, eggs laid singly or as a foamy mass on the water's surface) and seasonality, all species are dependent on the presence of water in the landscape

Waterbirds

Good waterbird diversity has been observed at several wetland sites, including listed species of conservation importance (**Table** 12, Table 13). Waterbird diversity and abundance are influenced by wetland habitat diversity, with different species and feeding guilds using different habitats for breeding and foraging (Haig et al. 1998 cited in MDBA 2009). Water depth in particular influences waterbird diversity due to the specific

feeding behaviours of different species (Bancroft et al. 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 et al. 2002). The habitat uses and food requirements of the waterbird guilds recorded in the WMP sites are shown in Table 14. Species from all waterbird groups have been recorded across the WMP wetland sites, suggesting a spread of water depths, food sources and opportunities for breeding. **Image: Red-kneed dotterel at Barbers Wetland following flood event. *Source: Brian Lea***

Table 14 - Waterbird functional groups and their resource use

Waterbird Group	Food Resource	Habitat Use	Waterbird Group
Dabbling and Diving Ducks	Generalists; plankton, small invertebrates, plant material	Shallow Water (Dabblers)	Solitary
Grazing Waterfowl	Plant material, seeds, invertebrates	Shallow Water, littoral zone	Colonial or solitary
Piscivores (Fish Eaters)	Fish	Open and deep water	Colonial
Small Waders	Small invertebrates, seeds	Littoral zone, mudflats	Solitary
Large Waders	Macroinvertebrates, fish, amphibians	Littoral zone	Colonial or solitary
Shoreline Foragers	Plant material, seeds, invertebrates	Littoral zone, mudflats	Solitary or small groups

Turtles

Eastern long-necked turtles (*Chelodina longicollis)* and Murray River turtles (*Emydura macquarii)* have been recorded at WMP sites. Watering requirements for turtles are not well-studied (Ecology Australia, 2023). Broadly, the delivery of environmental watering promotes diversity of aquatic vegetation, increases aquatic macroinvertebrates, and provides habitat and forage areas, refuge and breeding sites for turtles. Watering events must be managed to ensure that drawdown or recession of floodwaters does not occur rapidly during the hatchling season to ensure sufficient shelter opportunities for juveniles. **Image: Murray River turtle. *Source: Mallee CMA***

Indirectly water-dependent species

WMP sites are home to several species that are indirectly water-dependent due to their reliance upon hollows in water-dependent vegetation e.g., Inland carpet python (*Morelia spilota ssp. Metcalfei*), microbats, Regent parrot (*Polytelis anthopeplus monarchoides*) and Barking owl (*Ninox connivens*). Black box is a principal source of hollows, while surrounding vegetation provides important forage habitat. Trees surrounding these wetland sites must be maintained in good condition to provide habitat and breeding opportunities for such fauna species.

Flora

WMP sites differed substantially in the number of flora species, the proportion of native versus exotic species and the number of listed species (**Table** 12).

13 listed flora species have been recorded across 16 WMP sites (Table 15). The nationally significant Chariot wheels (*Maireana cheelii*) has been recorded at 5 sites. Chariot wheels is listed as vulnerable under the *EPBC Act 1999*. Refer to Appendix 4 for details of sites and listed species.

Table 15 - Listed flora recorded at Wimmera Mallee Pipeline sites

Scientific Name	Common Name	EPBC Status	FFG Status
Acacia oswaldii	Umbrella wattle	-	CE
Acacia melvillei	Yarran	-	CE
Allocasuarina luehmannii	Buloke	-	CE
Amyema linophylla subsp. orientalis	Buloke mistletoe	-	CE
Centipeda thespidioides s.s.*	Desert sneezeweed	-	EN
*Eragrostis australasica**	Cane grass	-	CE
*Eragrostis setifolia**	Bristly love-grass	-	EN
Eriochlamys squamata	Scaly mantle	-	EN
*Maireana cheelii**	Chariot wheels	Vu	EN
Melaleuca halmaturorum subsp. halmaturorum	Salt paperbark	-	EN
Minuria cunninghamii	Bush minuria	-	Vu
*Duma horrida subsp. horrida**	Spiny lignum	-	CE
Vittadinia pterochaeta	Winged New Holland daisy	-	EN

*indicates water dependence

Several water-dependent species of flora have been observed at WMP sites (Table 15, Table 16). Water-dependent listed species included Cane grass (*Eragrostis australasica*), which was recorded at seven sites. Cane grass, when part of a flooded swamp environment, provide habitat for ground nesting birds including stilts, avocets and brolgas (Roberts & Marston 2011). Flowering can be triggered by flooding, and Cane grass requires frequent shallow flooding, every 1-2 years, to a depth of less than 0.5 m, for up to six months' duration.

Buloke (*Allocasuarina luehmannii*), listed under the *Flora and Fauna Guarantee Act 1988*, is a character species of the EPBC-listed endangered community Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions. Of the listed species recorded, it was the most frequently observed species, recorded at eleven sites. Whilst this plan does not recommend delivery of environmental water to inundate these trees, it has been suggested that Buloke seed germination is restricted to successive high rainfall summers that provide damp soil (Williams et al. and Macaulay and Westbrooke, both cited in Cheal, Lucas & Macaulay 2011). The range of flora recorded at the WMP sites provides support for improving the quality and diversity of flora through environmental watering, which will in turn benefit a range of native fauna and contribute to healthy ecosystems.

Aquatic vegetation at Cokum Bushland Reserve. ***Source: Mallee CMA***

Table 16 – Native Aquatic and amphibious flora recorded by Ecology Australia at selected Wimmera Mallee Pipeline sites (Ewing et al., 2023)

Scientific name	Common name	Arp	Ate	Atl	Atw	S	WMP Site
Carex bichenoviana	Plains sedge		✓				Barbers
Centipeda spp.	Genus of daisy family			✓			Barbers, Rickard
Crassula helmsii	Swamp crassula			✓			Barbers, Rickard
Elatine gratioloides	Waterwort			✓			Cokum, Rickard
Eleocharis spp.	Spike rushes / spike sedges		✓				Barbers
Eucalyptus largiflorens	Black box				✓		Barbers, Cokum, Rickard
Isolepis victoriensis	-		✓				Barbers
Isolepis spp.	Sedge spp.		✓				Rickard
Juncus amabilis	Hollow rush		✓				Barbers
Limosella australis	Austral mudwort			✓			Barbers
Limosella curdieana	Large mudwort			✓			Rickard
Ludwigia peploides subsp. montevidensis	Water primrose	✓					Rickard
Marsilea drummondii	Common nardoo	✓					Cokum, Rickard
Myriophyllum spp.	Water milfoil spp.	✓					Barbers, Rickard
Myriophyllum verrucosum	Red water milfoil	✓					Barbers
Potamogeton ochreatus	Blunt pondweed					✓	Rickard
Duma florulenta	Tangled lignum				✓		Broom, Cronomby
Duma horrida subsp. horrida	Spiny lignum				✓		Broom
Eragrostis australasica	Cane grass		✓				Broom
Typha domingensis	Narrowleaf cumbungi		✓				Cronomby

Arp – Amphibious, fluctuation-responder, floating species, with various growth characteristics, that feature morphological plasticity in response to water level fluctuations.

Ate – Amphibious, fluctuation-tolerant, emergent species which are mostly monocotyledons (emergent plants that tolerate wetting and drying).

Atl – amphibious fluctuation-tolerators – low growing.

Atw – Amphibious, fluctuation-tolerant, emergent plants which are woody (trees and shrubs that tolerate wetting and drying).

S – Aquatic submerged species (established plants do not tolerate drying)

Sites: Barbers = Barbers Swamp, Broom = Broom Tank, Cokum = Cokum Bushland Reserve, Cronomby = Cronomby Tanks, Rickard = Rickard Glenys

As shown above, the environmental values at each WMP site differ. Table 17 provides a summary of the significant environmental values at each site that will be targeted in this environmental water management plan.

Table 17 – Targeted EVCs and Ecological Values at each WMP site

Site Name	Type	Targeted EVCs	Targeted Ecological Values
Barbers Swamp	POF	Black Box Wetland	Black box, waterbirds, frogs, Eastern long-necked turtle
Broom Tank	FM	Lignum Swampy Woodland, Lignum Shrubland (Riverine Chenopod Woodland nearby)	Black box, Spiny lignum, Cane grass, Carpet python, frogs, microbats
Bull Swamp	FM	Black Box Wetland (Riverine Chenopod Woodland nearby)	Black box, waterbirds, Eastern long-necked turtle
Chiprick Reserve	POF	Lake Bed Herbland, Riverine Chenopod Woodland	woodland birds
Clinton Shire Dam	N/C	Seasonal Herbaceous Wetland, Black Box Wetland	Black box, Cane grass, woodland birds
Cokum BR	N/C	Black Box Wetland (Riverine Chenopod Woodland nearby)	Black box, waterbirds, Eastern long-necked turtles, frogs, fish
Considine	N/C	Lignum Swampy Woodland	Carpet python, Eastern long-necked turtles, woodland birds, frogs
Coundon Wetland	N/C	Riverine Chenopod Woodland	Cane grass, Eastern long-necked turtles, woodland birds,
Cronomby Tanks	N/C	Ridged Plains Mallee (with understorey of nitre goosefoot & lignum (flood tolerant species))	woodland birds, Eastern long-necked turtles, Murray River turtles, Freshwater catfish
D Smith	T	(Ridged Plains Mallee nearby)	woodland birds, drought refuge
Goulds Reserve	FM	Black Box Wetland, Riverine Chenopod Woodland	Black box, Cane grass, Spiny lignum, waterbirds, woodland birds
Greens Wetland	FM	Seasonal Herbaceous Wetland, Black Box Wetland, Plains Grassy Wetland	Black box, waterbirds, woodland birds, Eastern long-necked turtle
Homelea	T	Ridged Plains Mallee	woodland birds, drought refuge
J Ferrier Wetland	N/C	Black Box Wetland	Black box, wetland birds
John Ampt	T	Nil	wetland birds, drought refuge
Kath Smith	T	Ridged Plains Mallee	woodland birds, drought refuge
Lake Danaher BR	POF	Lake Bed Herbland, Intermittent Swampy Woodland, Ridged Plains Mallee	Lake bed herbs, Salt paperbark, woodland birds, Eastern long-necked turtles, frogs
Mahoods Corner	N/C	Riverine Chenopod Woodland	Carpet python, waterbirds, woodland birds, Eastern long-necked turtles
Morton Plains Reserve	FM	Lignum Shrubland, Lignum Swampy Woodland	Black box, Spiny lignum, Cane grass, waterbirds
Pam Juergens	T	Ridged Plains Mallee, (Chenopod Grassland nearby)	woodland birds, frogs
Part of Gap Reserve	N/C	Black Box Wetland	Black box, woodland birds
Paul Barclay	T	Plains Woodland	woodland birds, drought refuge
Poyner	N/C	Black Box Wetland (Lignum Swampy Woodland nearby)	woodland birds
R Ferrier	T	(Ridged Plains Mallee nearby)	waterbirds, woodland birds, drought refuge, Eastern long-necked turtles
Rickard Glenys	N/C	Riverine Chenopod Woodland	Eastern long-necked turtles, waterbirds, woodland birds
Roselyn Wetland	N/C	Black Box Wetland, Riverine Chenopod Woodland	Black box, Eastern long-necked turtles, waterbirds, woodland birds, frogs
Round Swamp BR	FM	Black Box Wetland, Lignum Swampy Woodland	Black box, Spiny lignum, Cane grass
Shannons Wayside	T	Ridged Plains Mallee	waterbirds, woodland birds, Eastern long-necked turtles
Tchum Lakes Pool (Dam) Tchum Lakes Reserve (Wetland)	POF	Lake Bed Herbland, Lignum Swampy Woodland	Black box, Spiny lignum, Cane grass, waterbirds, woodland birds, Eastern long-necked turtles, frogs
Lake Marlbed (Towma) FFR	POF FM	Riverine Chenopod Woodland (Lignum Swamp and Black Box Wetland nearby)	Black box, Tangled lignum, Carpet python, Eastern long-necked turtles, woodland birds
Uttiwillock Wetland	N/C	Lignum Swampy Woodland, Plains Savannah, (Ridged Plains Mallee nearby)	Black box, Pale spike-sedge, waterbirds, woodland birds, Carpet python

Legend: POF - Permanent Open Freshwater, FM - Freshwater Meadow, T - Terrestrial, N/C - Not Classified

5.1.4 Current ecological condition

The condition of wetlands at 16 WMP sites was assessed using the Index of Wetland Condition (IWC) methodology (Sunraysia Environmental 2014a) in 2013 and 2014 to benchmark their environmental condition. Note that the assessments were of the wetlands that surround the constructed dams and did not include the condition of the dams themselves. Details of individual wetland sub-indices scores are provided in Cook, Bayes & Jolly (2014).

The average IWC score of WMP wetlands assessed in 2013/14 was 7.2 indicating good condition. Five wetlands were assessed as moderate condition and 11 as good condition. The overall IWC score for each wetland assessed in the Wimmera Mallee in 2013/14 is provided in Table 18. Altered hydrology and changed water regime is considered the major threat for the WMP sites and is the primary factor behind the development of this Environmental Water Management Plan.

The IWC methodology was also used to assess the new Uttiwillock wetland site in 2018, which recorded a score of 8 indicating good condition. Details of wetland sub-indices scores for the site are provided in Rakali Ecological Consulting (2019). A rapid assessment process was developed from the IWC methodology and used to score 27 of the WMP sites (Table 18). Vegetation quadrats from the initial 2013-14 benchmark were reassessed where possible, otherwise the vegetation around the perimeter of the dam was used, to produce an overall score. Seven sites were scored as moderate condition, 14 as good condition, and 6 as in very good condition.

Uttiwillock dam when full. ***Source: Mallee CMA***

Table 18 - Index of wetland condition (IWC) and rapid assessment of wetland condition overall scores for WMP wetland sites

Site Name	IWC Date of Assessment	IWC Condition Score	Condition Category	Rapid Asst. Date of Assessment	Rapid Asst. Condition Category
Barbers Swamp	Dec-13	7	Good	Nov-18	V. Good
Broom Tank	Nov-13	8	Good	Oct-18	Good
Bull Swamp	Nov-13	8	Good	Nov-18	Moderate
Chiprick Reserve	Sep-12	8	Good	Oct-18	Good
Clinton Shire Dam	Nov-13	8	Good	Oct-18	Good
Cokum Bushland Reserve	Nov-13	8	Good	Oct-18	Good
Considine	T	-	-	Nov-18	Good
Coundons Wetland	T	-	-	Nov-18	Good
Cronomby Tanks	T	-	-	#	#
D Smith	T	-	-	Nov-18	Moderate
Goulds Reserve	Jan-14	8	Good	Oct-18	Moderate
Greens Wetland	Nov-13	8	Good	#	#
Homelea	T	-	-	#	#
J Ferrier Wetland	Jan-14	6	Moderate	Nov-18	Moderate
John Ampt	T	-	-	Oct-18	V. Good
Kath Smith	T	-	-	#	#
Lake Danaher Bushland Reserve	Jan-14	5	Moderate	Oct-18	Good
Mahoods Corner	-	-	-	Nov-18	V. Good
Morton Plains Reserve	Nov-13	8	Good	Oct-18	V. Good
Pam Juergens	T	-	-	Nov-18	Good
Part of Gap Reserve	Jan-14	6	Moderate	Oct-18	Good
Paul Barclay	T	-	-	Nov-18	V. Good
Poyner	Nov-13	7	Good	Nov-18	Good
R Ferrier	T	-	-	Nov-18	Good
Rickard Glenys	T	-	-	Nov-18	V. Good
Roselyn Wetland/Reids Dam	Dec-13	8	Good	Oct-18	Good
Round Swamp Bushland Reserve	Oct-13	6	Moderate	Oct-18	Moderate
Shannons Wayside	T	-	-	Oct-18	Good
Tchum Lakes Reserve (Wetland)	Oct-13	6	Moderate	Oct-18	Good
Tchum Lakes Pool (Dam)					Moderate
Lake Marlbed (Towma) FFR	Nov-13	8	Good	Oct-18	Moderate
Uttiwillock Wetland	Nov-18	8	Good	#	#

= not assessed

FFR = Flora and fauna reserve

T = Not assessed, terrestrial environment or no benefit to overtopping dam to inundate EVC

5.2 Shared Benefits

Although the primary requirement of environmental watering is to achieve environmental objectives and outcomes, environmental water can provide benefits beyond environmental objectives. Shared benefits will be considered where they are compatible with the environmental objectives of the site.

5.2.1 Traditional Owner cultural values

The Mallee region has been occupied by hundreds of generations of 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 and enduring connection Traditional Owners have with the Mallee's natural landscapes.

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.

Waterways and waterbodies in the Mallee Region continue to be culturally significant habitation areas for many Aboriginal groups. 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) confirmed that Considines, Poyner, Tchum Lakes Wetland, Tchum Lakes Dam and Uttiwillock are defined as areas of cultural heritage sensitivity. It is also possible that some of the species supported by the wetlands will be of significance to Traditional Owners even if the wetlands have been artificially created.

The current Registered Aboriginal Party (RAP) for twenty-four WMP sites is the Barengi Gadjin Land Council Aboriginal Corporation (Figure 3). Eight WMP sites are located outside of formal RAP boundaries. Several non-RAPs have contested Country in the Mallee region and have interest in WMP sites. The Mallee CMA have engaged with Traditional Owner groups of the Wimmera-Mallee region about this EWMP and is committed to working with these groups to ensure that tangible and intangible Aboriginal culture and heritage is protected, and that Traditional Owner led practices are imbedded in the management and healing of Country (Mallee CMA 2022b).

5.2.2 Recreational values

The value to the community of wetlands and dams in this semi-arid region is immense. Sites are used for bird watching, picnics, photography and nature walks, some larger sites are also used for fishing, swimming and camping. Locals have noticed increases in passing traffic stopping to view the wetlands and wildlife since delivery of environmental water during 2013-14 (Mallee CMA 2014a).

For many in the community, the recovery of a wetland and improved ecological values embody that which is naturally beautiful in the local landscape, and is intrinsically valued. Noted health effects of degraded wetland ecosystems include depression and 'grieving over loss of place' whilst healthy ecosystems allow meaningful interactions with wetland environments (Horwitz, Finlayson & Weinstein 2014). Weir pools are established on the Yarriambiack Creek providing a focus for water-based recreation (Wimmera CMA 2013).

An interview of a local farmer in 2017 credited the implementation of environmental watering at one of the Wimmera Mallee Pipeline wetlands with encouraging breeding of the inland Carpet python. The farmer, participated in a Carpet python identification and survey workshop with the Mallee CMA and said he enjoyed

using what he learnt to look for Carpet python snakes at a wetland on his property, receiving environmental water. He believes he has observed breeding among the reptiles living in bushland around the wetland on his property.

In 2019 residents of Woomelang were asked what role they believed 'Cronomby Tanks' played in their community. The residents said that the wetlands played an important role in generating economic activity, as well as providing important outdoor recreational opportunities for the locals. Economic activity includes 1000 vans and camper vehicles visiting the Cronomby tanks each year, which supports the local Woomelang General Store. Recreational activity includes a Heart Foundation walking group who use the wetlands as a place to participate in a gentle walking.

In early 2023 a community survey was conducted to identify values associated with WMP sites. Respondents often used the sites for aforementioned recreational purposes, exercise opportunities, and to appreciate unique landscape features and natural beauty of the sites. Respondents ranked work and education opportunities of extremely high importance at Goulds Reserve and Cronomby Tanks (see Table 2). No new water-dependent values were identified by survey respondents.

5.3 Trajectory of change

Management intervention in the form of environmental watering at the WMP sites has occurred annually since 2011. Photographic and anecdotal evidence indicates an improvement in vegetation condition with increased foliage vigour, emergence of native vegetation and a reduction in exotic flora. The watering actions have been successful in supporting wetland values, as evidenced by examples such as a population of Australian painted snipe (*Rostratula australis*), listed as vulnerable under the Commonwealth EPBC Act, inhabiting Barbers Swamp. Waterbird activity and breeding has been pronounced with a range of guilds observed across the wetland depth zones. Activity of Carpet python has been significant with numerous sightings at sites such as Mahoods Corner (Mallee CMA 2014b) and Considine (T. Considine, pers. obs, 2018). Motion sensing cameras have identified fauna utilising the WMP sites for watering points in both 2013 and 2019.

If this intervention to maintain these critical refuges is not continued the benefits from these watering events such as increased native bird and reptile activity and native vegetation recovery may not be sustained. The landscape will remain dry, resulting in reduced productivity and loss of wetland values as well as the terrestrial values that depend on the water provision. This was especially the case during 2018 with almost no rainfall in the Birchip area until the flooding storm event in December 2018. A drier landscape is likely to result in fewer watering points for terrestrial fauna, and reduced feeding and breeding opportunities for aquatic fauna. Due to the altered hydrology at many of these sites, rainfall alone may not be enough to sustain these communities.

6 Managing water-related threats

The values for the WMP sites are described in the Environmental Values section of this EWMP and identified for each site in Appendix 4. Threats to these values are the result of such factors as human intervention and climate variability. Some of the threats which may have an impact on the WMP sites include:

- Changed water regime
- Loss or reduction of wetland connectivity
- Loss of vegetation corridors and/or reduction in vegetation quality
- Water quality

- Introduction/increase of exotic flora and fauna

The removal of the channel and dam system and replacement with pipelines and reticulation systems has seen the water regime throughout the region altered. Woodland fauna that once benefited from the availability of water in the channel system is now restricted to dispersed sites, and rainfall runoff alone is likely to be insufficient to support a healthy diversity of species. The change from open channels and dams to the reticulation system, combined with dry conditions over the last decade has also affected the condition and resilience of the pre-existing vegetation communities, affecting the productivity and functioning of ecosystems. This will be particularly relevant for species of plant that require flow to disperse seeds (hydrochory).

Pest plants and animals are an ongoing threat and management issue observed during environmental water delivery at the WMP sites. Mallee CMA on-ground works programs have included weed and pest animal control at a number of the wetland properties concurrent to the delivery of the environmental watering program. The most frequent weeds recorded during the rapid assessments of wetland condition in 2018 were grasses and thistles. Most sites recorded low abundance and diversity of weed species. Foxes and rabbits are the main pest animals observed.

Assessing risks.

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 their region, for the VEWH it is Victoria and the CEWH it is the MDB. 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 WMP sites has been developed through consultation with various experts and stakeholders including Parks Victoria, landholders, Dr Marcus Cooling (Ecological Associates), local Landcare Groups and local residents. The goal considers the values the sites support and the potential threats that need to be managed. This includes consideration of the values the sites have historically supported and the likely values it could support into the future.

The overall management goal for the WMP sites is:

> To maintain and enhance a network of wetland habitats and refuges for aquatic and terrestrial fauna across the Wimmera Mallee landscape

7.2 Ecological objectives and targets

Ecological objectives represent the desired ecological 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 Wimmera Mallee Pipeline Wetlands can be found in Section 5.29.1 of Butcher et al. (2020), Appendix 6, and shown in Table 19. The numbering of the environmental objectives in this EWMP have been adopted directly from the Butcher et al. (2020) assessment.

Table 19 - Updated ecological objectives for the Wimmera Mallee Pipeline Wetlands

Ecological Objective	Target	Applicable WMP Site
WMP2a: By 2030, maintain self-sustaining population of frogs at WMP wetlands	Maintain self-sustaining populations of frogs at Wimmera Mallee Pipeline wetlands in 80% of years in which water is present by 2030 including 80% of commonly encountered species: Spotted marsh frog (*Limnodynastes tasmaniensis*), Common froglet (*Crinia signifera*), Eastern-sign bearing froglet (*Crinia parainsignifera*), and Pobblebonk (*Limnodynastes dumerili*) (species and assets to be confirmed)	Barbers Swamp, Broom Tank, Cokum BR, Considine*, Lake Danaher BR, Pam Juergens, Roselyn Wetland, Tchum Lakes Wetland and Dam, Uttiwillock*
WMP2b: By 2030, maintain self-sustaining population of turtles at WMP wetlands	By 2030 maintain presence of Eastern long-necked turtle (*Chelodina longicollis*) and Murray River turtle (*Emydura macquarii*) at 70% of Wimmera Mallee pipeline assets in 7 out of any 10 year period.	Barbers, Bull Swamp, Clinton Shire Dam, Cokum BR, Considine*, SCoundon Wetland, Cronomby Tanks*, Greens Wetland, Lake Danaher BR, Mahoods Corner*, R Ferrier, Rickard Glenys*, Roselyn Wetland, Shannons Wayside, Tchum Lakes wetland and Dam, Towma (Lake Marlbed) FFR, Uttiwillock*
WMP3: By 2030, improve condition and maintain extent from baseline levels of River red gum (*Eucalyptus camaldulensis*), Black box (*E. largiflorens*) and Lignum (*Duma florulenta*) to sustain communities and processes typical of such communities	**WMP3 Target**: By 2030, condition in standardised transects that span the floodplain elevation gradient and existing spatial distribution at Wimmera Mallee Pipeline assets, ≥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 Wimmera Mallee Pipeline assets at 80% of sites over the 10 year period	Barbers Swamp, Broom Tank, Bull Swamp, Clinton Shire Dam, Cokum BR, Goulds Reserve, Greens Wetland, J Ferrier Wetland, Lake Danaher BR, Morton Plains Reserve, Part of Gap Reserve, Poyner, Roselyn Wetland, Round Swamp BR, Tchum Lakes Reserve (Wetland), Tchum Lakes Pool (Dam), Towma (Lake Marlbed) FFR, Uttiwillock*

at Wimmera Mallee Pipeline assets	OR By 2030, at stressed sites (see Wallace et al. 2020) Wimmera Mallee Pipeline assets: 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	
WMP4a: By 2030, maintain representative populations of shallow-water and deep-water feeding guilds of waterbird (F2 and F3, respectively, after Jaensch 2002) at the Wimmera-Mallee Pipeline wetlands asset, by maintaining a mixture of shallow and deep-water habitats.	**WMP4a Target:** By 2030, 80% of representative F2 and F3 species recorded at Wimmera-Mallee Pipeline wetlands in 8 in any 10-year period where conditions are suitable: Representative F2 species include: Australasian grebe (*Tachybaptus novaehollandiae*), Pacific black duck (*Anas superciliosa*), White-necked heron (*Ardea pacifica*), Australian white ibis (*Threskiornis molucca*), Masked lapwing (*Vanellus miles*). Representative F3 species include: Australian pelican (*Pelecanus conspicillatus*), Great cormorant (*Phalacrocorax carbo*), Little black cormorant (*Phalacrocorax sulcirostris*) and Australasian darter (*Anhinga novaehollandiae*) Feeding habitat defined as a mixture of deep feeding areas (water >1 m) and shallow feeding areas (<0.5 m depth and or drying mud) with intermittent inundation of densely vegetated shrublands.	Barbers Swamp, Bull Swamp, Cokum BR, Goulds Reserve, Greens Wetland, Mahoods Corner*, Morton Plains Reserve, R Ferrier*, Rickard Glenys*, Roselyn Wetland, Shannons Wayside*, Tchum Lakes Reserve (Wetland), Tchum Lakes Pool (Dam), Uttiwillock*
WMP4b: By 2030, maintain nesting and recruitment of non-colonial waterbirds (N1, N2, N3 and N4, after Jaensch 2002) at the Wimmera Mallee Pipeline wetlands asset, by maintaining a mixture of tree, low vegetation/shrubs, and ground/islet nesting habitat	By 2030, at least two of the following species to be recorded as nesting and/or breeding at the Wimmera-Mallee Pipeline wetlands asset in 7 out of any 10-year period in which nesting/breeding conditions are suitable: Representative N1 and N2 species include: Australian shelduck (*Tadorna tadornoides*), Eurasian coot (*Fulica atra*) Representative N3 and N4 species include: Australasian grebe (*Tachybaptus novaehollandiae*), Masked lapwing (*Vanellus miles*), Pacific black duck (*Anas supercilliosa*).	Barbers Swamp, Bull Swamp, Cokum BR, Goulds Reserve, Greens Wetland, Mahoods Corner*, Morton Plains Reserve, R Ferrier*, Rickard Glenys*, Roselyn Wetland, Shannons Wayside*, Tchum Lakes Reserve (Wetland), Tchum Lakes Pool (Dam), Uttiwillock*

	There is a lack of data on species that breed at each site. The expectation is that the list of species commonly nesting at Wimmera-Mallee Pipeline wetlands will be confirmed over time.	

* = terrestrial environment contained within the dam area

Note: Inundation of Cane grass should only occur following a two-year consecutive drying period. This includes Broom Tank, Clinton Shire Dam, Coundons Wetland, Goulds Reserve, and Morton Plains Reserve. Clinton Shire Dam and Coundons Wetland should not be flooded beyond the wetland perimeter (to provide refuge) to ensure that the drying regime for Cane grass is met.

Broom Tank Wetland. ***Source: Mallee CMA***

7.3 Regional significance

The environmental, social and economic values outlined (Section 5) indicate the significance of the WMP sites. While these values do not render the WMP sites as unique or pristine, the terrestrial and floodplain communities of the Wimmera Mallee region are important to the functioning of the broader ecosystem and its sustainability. The area is rich in biodiversity, and the wetlands provide essential habitat and water to native species and act as refuge for listed and native flora and fauna species.

Two WMP sites, Greens Wetland and Clinton Shire Dam, support areas of EVCs (Plains Grassy Wetland and Herb-rich Gilgai Wetland) that meet the criteria for being examples of Seasonal Herbaceous Wetlands of the Lowland Temperate Plains (SHW). SHWs are listed as a critically endangered community under the EPBC Act as they have a very restricted geographic distribution, are subject to multiple threats and have undergone very severe change in their ecological integrity (Threatened Species Scientific Committee, 2012). This community is afforded special protection under the EPBC Act and may be eligible for federally funded protection and restoration programs (Cook, Bayes and Jolly, 2014).

The Black box, Lignum and Cane grass communities which line many of the temporary wetlands and creeks at the WMP sites, and the many species of woodland birds and terrestrial fauna recorded at terrestrial dam sites are also of significance. Watering points at terrestrial dam sites provide refuge for woodland birds and other fauna and are a primary focus for this EWMP.

13 listed species of flora have been recorded within the vegetation communities at the Wimmera Mallee Pipeline sites in the Mallee CMA region, including six listed wetland species. These flora species offer perching, feeding and breeding habitat for many native aquatic and terrestrial fauna species.

Among the 28 listed species of fauna recorded at WMP sites are fish, reptiles and birds. 12 water-dependent species are recorded, including the Freshwater catfish, Murray River turtle, Hardhead duck, Glossy ibis and Australian painted snipe. Indirectly water-dependent listed species including the Regent parrot and Carpet python are also found at WMP sites.

17 EVCs were recorded at the WMP sites, indicating excellent diversity and highlighting the importance of this area. Vegetation communities of particular significance include:

- the occurrence of EVCs that are included within the *EPBC* listed Seasonal Herbaceous Wetlands category;
- the four terrestrial EVCs that include Buloke as a character species.

All of these values combined raise the significance of the WMP sites in the Wimmera Mallee. The careful planning and delivery of environmental water may help protect, enhance or improve local ecosystems and support key species of flora and fauna and/or the quality, extent and diversity of ecological communities.

The cultural importance of the area is also considered significant, with a long history of agriculture and significant ongoing Indigenous connection to the land. The values contained at the WMP sites make this area a priority for protection and enhancement through environmental water management.

7.4 Alignment to Basin Plan and other legislative and policy instruments

Alignment to the Murray-Darling Basin Plan

Key elements of the Basin Plan have been integrated into the WMP EWMP objectives, including adopting the same conceptual framework. The EWMP objectives were also developed based on the same ecological knowledge about how wetlands and floodplains work.

Under the Basin Plan, the overall environmental objectives for the water-dependent ecosystems of the Murray–Darling Basin are:

- to protect and restore water-dependent ecosystems of the Murray–Darling Basin (8.05)
- to protect and restore the ecosystem functions of water-dependent ecosystems (8.06)
- to ensure that water-dependent ecosystems are resilient to climate change and other risks and threats (8.07).

The WMP EWMP objectives were developed to align with these overall objectives and to integrate and encode the intent of Basin Plan. Table 20 shows the alignment between the EWMP objectives and the Basin Plan's overall environmental objectives and subobjectives under 8.05, 8.06 and 8.07. Refer to Appendix 7 for mapping of WMP ecological objectives against the Wimmera Mallee Long-Term Watering Plans (LTWP, DELWP 2020), the Basin-wide Environmental Watering Strategy (BWS) and annual Basin environmental watering priorities.

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Table 20 – Alignment between WMP EWMP ecological objectives and overall objectives (8.05-8.07) and subobjectives in the Murray-Darling Basin Environmental Watering Plan.

EWMP objective	Alignment with Basin Plan		
	8.05 Ecosystem and biodiversity	8.06 Ecosystem function	8.07 Ecosystem resilience
WMP2a: By 2030, maintain self-sustaining population of frogs at WMP wetlands	3b	6b	3
WMP2b: By 2030, maintain self-sustaining population of turtles at WMP wetlands	3a,3b	6b	3
WMP3: By 2030, improve condition and maintain extent from baseline levels of River red gum (*Eucalyptus camaldulensis*), Black box (*E. largiflorens*) and Lignum (*Duma florulenta*) to sustain communities and processes typical of such communities at Wimmera Mallee Pipeline assets.	3b	6b	
WMP4a: By 2030, maintain representative populations of shallow-water and deep-water feeding guilds of waterbird (F2 and F3, respectively, after Jaensch 2002) at the Wimmera-Mallee Pipeline wetlands asset, by maintaining a mixture of shallow and deep-water habitats.	3b	6b	
WMP4b: By 2030, maintain nesting and recruitment of non-colonial waterbirds (N1, N2, N3 and N4, after Jaensch 2002) at the Wimmera Mallee Pipeline wetlands asset, by maintaining a mixture of tree, low vegetation/shrubs, and ground/islet nesting habitat.	3b	6b	

8 Environmental water requirements and intended water regime

8.1 Environmental water requirements and intended water regime

Hydrological objectives describe the components of the water regime required to achieve the ecological objectives at each site. The ecological objectives at each site are centred on maintaining the health of the wetland sites and providing fauna watering points at terrestrial dam sites. The specific values to be targeted by the environmental watering have been outlined earlier in Section 5, Table 17, and the ecological objectives and targets listed in Table 19. The hydrological objectives to achieve each of these ecological objectives are presented in Table 21. Table 22 provides the optimal inundation extent (area) and the maximum volume of environmental water required at each site.

Black box woodlands require flooding to occur every 3 to 7 years with inundation durations of 2 to 6 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 the understorey and other woodland biota. Black box trees may survive prolonged periods of 12 to 16 years with no flooding but tree health will suffer and woodland will become dysfunctional (Roberts and Marston, 2000). For EVCs with a chenopod understorey, flood duration of no longer than 1 month is preferred (Cook, Bayes & Jolly 2014).

A flooding regime dominated by spring, rather than summer, flooding promotes higher macrophyte diversity and abundance (Robertston, Bacon and Heagney, 2001). Semi-emergent macrophytes occupy shallower water that is generally flooded from one to two metres (Ecological Associates, 2006).

Tangled 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).

In wetlands that include Cane grass, environmental watering should only occur if it has been naturally dry for two consecutive years; inundation should not persist for longer than six months. Cane grasslands respond well to frequent shallow flooding. This can trigger flowering and improve species richness by allowing development of aquatic understorey species. It can tolerate dry conditions, however clumps tend to be sparse. For abundance and good vigour, cane grass requires shallow flooding of less than 0.5 m for durations of up to six months every one to two years (Roberts & Marston 2011).

Eastern long-necked turtle habitat includes swamps, billabongs and slow-flowing waterways with soft, sandy areas and logs or rocks for basking. The turtle can aestivate (lower its metabolic rate and lie ‘dormant’) in soil during dry periods, but is also known to travel large distances in search of permanent waterbodies. Adults breed from December to February and eggs incubate for four months. Rapid drawdown can impact on survival of hatchlings. Egg predation by foxes is a common threat.

Despite the arid conditions, the region supports a range of frog species that rely on wetlands to complete their life cycle. The species are primarily cued to breed by inundation (e.g., Eastern sign-bearing froglet) or rainfall (e.g., Sudell’s frog), but all require wetland habitats to ensure egg and tadpole recruitment. While burrowing frogs can withstand dry periods, non-burrowing ground frogs (e.g., Spotted marsh frog) require water or at least a moist refuge to survive extended dry periods.

Table 21 - Hydrological requirements (frequency and duration of watering) to achieve ecological objectives.

Environmental Objective	Wetlands *Terrestrial environment water contained within the dam area	Frequency of events (per 10 years)			Duration of events (months)			Timing
		Min	Opt	Max	Min	Opt	Max	
By 2030, maintain self-sustaining population of frogs at WMP wetlands	Barbers Swamp, Broom Tank, Cokum BR, Considine*, Lake Danaher BR, Pam Juergens, Roselyn Wetland, Tchum Lakes Wetland and Dam, Uttiwillock*	8	10	10	11	12	12	For all fill dams May to November (due to pipeline delivery constraints) in all climate scenarios, and allow natural drawdown through evaporation. For vegetation provide overbank flow into surrounding floodplain May to November during average to wet years only, and allow natural drawdown.
By 2030, maintain self-sustaining population of turtles at WMP wetlands	Barbers, Bull Swamp, Clinton Shire Dam Cokum BR, Considine*, Coundon Wetland, Cronomby Tanks*, Greens Wetland, Lake Danaher BR, Mahoods Corner*, R Ferrier, Rickard Glenys*, Roselyn Wetland, Shannons Wayside, Tchum Lakes wetland and Dam, Towma (Lake Marlbed) FFR, Uttiwillock*	8	10	10	11	12	12	
By 2030, improve condition and maintain extent from baseline levels of River red gum (Eucalyptus camaldulensis), Black box (E. largiflorens) and Lignum (Duma florulenta) to sustain communities and processes typical of such communities at Wimmera Mallee Pipeline assets	Barbers Swamp, Broom Tank, Bull Swamp, Clinton Shire Dam, Cokum BR, Goulds Reserve, Greens Wetland, J Ferrier Wetland, Lake Danaher BR, Morton Plains Reserve, Part of Gap Reserve, Poyner, Roselyn Wetland, Round Swamp BR, Tchum Lakes Reserve (Wetland), Tchum Lakes Pool (Dam), Towma (Lake Marlbed) FFR, Uttiwillock*	1	2	3	2	4	4	
By 2030, maintain representative populations of shallow-water and deep-water feeding guilds of waterbird (F2 and F3, respectively, after Jaensch 2002) at the Wimmera-Mallee Pipeline wetlands asset, by maintaining a mixture of shallow and deep-water habitats.	Barbers Swamp, Bull Swamp, Cokum BR, Goulds Reserve, Greens Wetland, Mahoods Corner*, Morton Plains Reserve, R Ferrier*, Rickard Glenys*, Roselyn Wetland, Shannons Wayside*, Tchum Lakes Reserve (Wetland), Tchum Lakes Pool (Dam), Uttiwillock*	2	5	10	1	6	7	
By 2030, maintain nesting and recruitment of non-colonial waterbirds (N1, N2, N3 and N4, after Jaensch 2002) at the Wimmera Mallee Pipeline wetlands asset, by maintaining a mixture of tree, low vegetation/shrubs, and ground/islet nesting habitat	Barbers Swamp, Bull Swamp, Cokum BR, Goulds Reserve, Greens Wetland, Mahoods Corner*, Morton Plains Reserve, R Ferrier*, Rickard Glenys*, Roselyn Wetland, Shannons Wayside*, Tchum Lakes Reserve (Wetland), Tchum Lakes Pool (Dam), Uttiwillock*	2	5	10	1	6	7	

Note: Inundation of Cane grass should only occur following a two-year consecutive drying period. Cane grass sites include Broom Tank, Clinton Shire Dam Coundons Wetland, Goulds Reserve, and Morton Plains Reserve. Clinton Shire Dam and Coundons Wetland should not be flooded beyond the wetland perimeter (to provide refuge) to ensure that the drying regime for Cane grass is met.

Table 22 – Optimum inundation extents and volumes at each WMP site

Site Name *Terrestrial environment water contained within the dam area	Optimum inundation extent (ha)	Optimum volume required (ML)
Barbers Swamp	2.1	15
Broom Tank	2.1	10
Bull Swamp	15.2	10
Chiprick BR	2.0	9
Clinton Shire Dam	5.5	10
Cokum BR	3.7	8
Considine*	0.4	5
Coundon Wetland	2.0	4
Cronomby Tanks*	1.0	8
D Smith*	0.1	1
Goulds Reserve	15.8	40
Greens Wetland	4.7	10
Homelea*	0.1	1
J Ferrier Wetland	1.9	10
John Ampt*	0.2	4
Kath Smith*	0.1	1
Lake Danaher*	2.8	2
Mahoods Corner*	0.2	3
Morton Plains Reserve	0.5	5
Pam Juergens*	0.1	0.5
Part of Gap Reserve	5.2	10
Paul Barclay*	0.2	5
Poyner*	0.2	4
R Ferrier*	0.4	8
Rickard Glenys*	0.3	3
Roselyn Wetland	2.6	20
Round Swamp BR	2.9	10
Shannons Wayside*	0.2	3
Tchum Lakes Reserve (Wetland)	37.2	100
Tchum Lakes Pool (Dam)	12.6	11
Towma (Lake Marlbed)*	0.2	2
Uttiwillock*	2.0	15

8.2 Expected watering effects

Potential watering Actions and expected watering effects are shown in Table 23.

Table 23 - Potential watering actions and expected watering effects

Objective Code	Environmental Objective	Potential Watering Action	Expected watering effects
WMP2a	By 2030, maintain self-sustaining population of frogs at WMP wetlands	Site and seasonally dependent. See Table 25-Table 28	Maintain appropriate seasonal variation in water levels to provide suitable habitat, food resources and refugia for frogs.

Objective Code	Environmental Objective	Potential Watering Action	Expected watering effects
WMP2b	By 2030, maintain self-sustaining population of turtles at WMP wetlands	Site and seasonally dependent. See Table 25-Table 28	Maintain appropriate seasonal variation in water levels to provide suitable habitat, food resources and refugia for turtles.
WMP3	By 2030, improve condition and maintain extent from baseline levels of River red gum (*Eucalyptus camaldulensis*), Black box (*E. largiflorens*) and Lignum (*Duma florulenta*) to sustain communities and processes typical of such communities at Wimmera Mallee Pipeline assets	Site and seasonally dependent. See Table 25-Table 28	To maintain and improve the health of fringing River red gum, Black box and Lignum communities
WMP4a	By 2030, maintain representative populations of shallow-water and deep-water feeding guilds of waterbird (F2 and F3, respectively, after Jaensch 2002) at the Wimmera-Mallee Pipeline wetlands asset, by maintaining a mixture of shallow and deep-water habitats.	Site and seasonally dependent. See Table 25-Table 28	Provide suitable habitat (food, refuge) in flooded wetland vegetation in spring and summer. Provide foraging habitat in shallow open water (<0.5m depth) and mudflats as water recedes over autumn and winter.
WMP4b	By 2030, maintain nesting and recruitment of non-colonial waterbirds (N1, N2, N3 and N4, after Jaensch 2002) at the Wimmera Mallee Pipeline wetlands asset, by maintaining a mixture of tree, low vegetation/shrubs, and ground/islet nesting habitat	Site and seasonally dependent. See Table 25-Table 28	Provide suitable habitat (food, refuge) during all seasons, for example, nesting habitat in inundated trees, shrubs, low vegetation or on the ground next to water or an island/islet

8.3 Seasonally adaptive approach

The annual environmental water planning process in Victoria uses a seasonally adaptive approach, which identifies the priorities for environmental watering under different climatic conditions such as drought, dry, average and wet. This means that watering events can be tailored to current conditions and be easily adapted in response to short-term climatic variability, as conditions can change quickly during a water year.

Seasonal conditions can vary considerably between years, which affects both the environmental water needs of particular sites and/or assets (the demand) and the volume of water available (the supply).

Annual water planning includes a flexible decision framework to guide prioritisation of allocation of water for the environment, as well as site environmental watering proposals, water availability forecasts and management objectives for water resource scenarios.

The broad ranging values and ecological significance of the WMP sites requires environmental water delivery annually for many of the sites, with the depth and the associated volume varying depending on climatic conditions and the period since the last inundation. A seasonally adaptive approach for environmental watering at WMP sites has been developed based on the VEWH framework (Table 24). Ecological objectives, inflow scenarios, expected water availability and estimated environmental water requirements are identified for four different seasonal conditions – drought, dry, average and wet conditions. Seasonally adaptive management objectives and watering actions are shown in Figure 7.

Table 24 – Seasonally adaptive approach to watering at WMP sites

Climate Scenario	Drought	Dry	Average	Wet
Inflow Scenario	**0%**	**10%**	**50%**	**75%**
Expected climatic conditions and water availability (ML)	0	0	250	1000
Ecological Objectives	Provide watering points for terrestrial fauna and woodland birds	Provide watering points for terrestrial fauna and woodland birds Provide foraging, refuge and breeding habitat for turtles and frogs Maintain the health of fringing Lignum and Black box communities	Provide watering points for terrestrial fauna and woodland birds Provide foraging, refuge and breeding habitat for turtles and frogs Maintain the health of fringing Lignum and Black box communities Provide suitable feeding and breeding habitat for waterbird guilds	All
Estimated environmental water requirement (total ML)	59	93.5	194.5	340.5

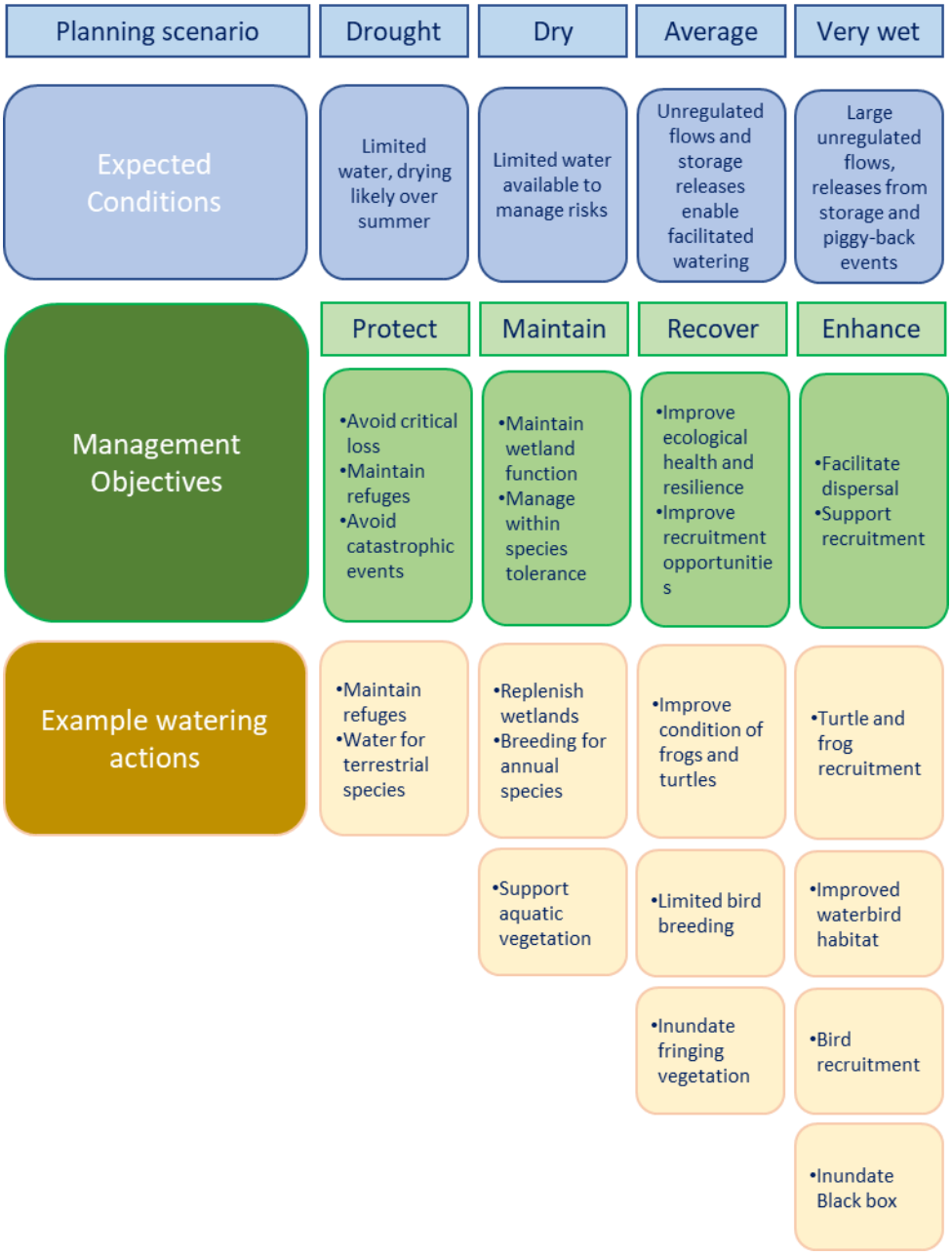

Figure 7 - Seasonally adaptive management objectives and example watering actions

In a drought scenario, the water allocation is likely to be restricted, impacting on the number of sites able to be watered, and the depth to which each site can be watered. The watering action seeks to provide watering points for local fauna and as such the inundation extents would be retained within the dam/wetland perimeter. The water allocation against the environmental entitlement is likely to be zero in a drought and in a dry scenario, carryover the only source available. 19 sites have been given 'very high' priority status for watering in a drought scenario, with a volume of 59ML required. The 'very high' priority sites should receive the recommended volumes first through allocation of carryover. This recognises the importance of these sites in providing refuge to aquatic and terrestrial fauna during drier years.

In a dry scenario the number of priority watering actions increases to 29 and the volume of water required to 93.5ML. The watering actions centre on provision of watering points for local fauna as well as aquatic

vegetation objectives, the inundation extent would be retained to the dam area. Site priorities have been identified using a tiered approach.

In an average scenario, allocations against the entitlement are expected and watering actions expanded to include growth, reproduction and small-scale recruitment of flora. The inundation extent would extend beyond the dam into the surrounding vegetation for some of the sites. All 32 WMP sites are priority watering actions in an average scenario requiring 194.5ML (Table 24).

For wet years, when additional water is likely to be available, some sites are recommended to be overtopped to inundate surrounding vegetation such as Black box, Lignum and Cane grass and to improve the health of aquatic ecosystems. In a wet scenario 340.5ML of environmental water is required to achieve all ecological objectives (Table 24) although the watering regime may be met by natural inflows at some sites.

Depending on the ecological objective being targeted, water may be delivered to fill the dam/wetland to the perimeter, or further water may be delivered to overtop the dam and inundate the surrounding floodplain. Ongoing field monitoring and adaptive management may see changes to the ecological and hydrological objectives, and the volumes assigned to the WMP sites.

The hydrological regime for each of 32 WMP sites under drought, dry, average and wet scenarios is seen below in Table 25 - Table 28. The watering regime has been derived from the ecological and hydrological objectives. All water deliveries are planned to occur between May and November, due to constraints around WMP system demand peaks, minimising impacts on other users and achieving more efficient delivery rates to each site. Therefore, the watering regime for each site involves filling the sites between May and November and allowing natural drawdown through evaporation.

The priority setting for each wetland is based on the capacity to deliver to both the wetland and the adjacent floodplain area, the topography of the wetland and its ability to retain water over the summer months (high water holding capacity), environmental values at the site, the proximity to other wetlands, and the amount of water required to fill the floodplain area of the wetland. Sites have been prioritised based on ecological values recorded and their proximity to other water bodies. Importantly, refuge sites are considered the highest priority during drought and dry conditions.

Table 25 - Very High Priority Sites

Site Name	Capacity	Target Delivery Volumes (ML) Seasonally Adaptive Approach			
		Drought	Dry	Average	Wet
Barbers Swamp	Can be overtopped	4	6	10	15
Bull Swamp	Can be overtopped	4	4	8	10
Clinton Shire Dam*	Can be overtopped	3	3	4	10
Cokum BR	Can be overtopped	3	4	8	8
Considine*	Do not overtop	4	4	4	5
Cronomby Tanks*	Do not overtop	6	8	8	8
D Smith*	Do not overtop	1	1	1	1
Greens Wetland	Can be overtopped	2	2	4	10
J Ferrier Wetland	Can be overtopped	2	3	7	10
John Ampt*	Do not overtop	2	4	4	4
Mahoods Corner*	Do not overtop	2	3	3	3
Morton Plains Reserve	Can be overtopped	1	2	5	5
Paul Barclay*	Do not overtop	3	4	5	5
Poyner	Do not overtop	3	3	4	4
R Ferrier*	Do not overtop	6	8	8	8
Rickard Glenys*	Do not overtop	3	3	3	3
Roselyn Wetland	Can be overtopped	3	5	10	20
Towma (Lake Marlbed) FFR	Do not overtop	2	2	2	2
Uttiwillock	Can be overtopped	5	6	8	10

Wetland inundation: = Inundation contained within wetland/dam =Inundation of surrounding floodplain/wetland

Table 26 - High Priority Sites

Site Name	Capacity	Target Delivery Volumes (ML) Seasonally Adaptive Approach			
		Drought	Dry	Average	Wet
Broom Tank	8ML, overtopped	0	1	10	10
Chiprick*	Can be overtopped	0	5	9	9
Coundon Wetland*	6 ML leaves space for runoff	0	1	2	4
Homelea*	Do not overtop	0	1	1	1
Kath Smith*	Do not overtop	0	1	1	1
Pam Juergens*	Do not overtop	0	0.5	0.5	0.5
Tchum Lakes Swimming Pool (North Lake - Dam)	11 ML (full) can be overtopped, or wetland watered from South connection	0	3	4	11

Wetland inundation: = Inundation contained within wetland/dam =Inundation of surrounding floodplain/wetland

Table 27 - Medium Priority Sites

Site Name	Capacity	Target Delivery Volumes (ML) Seasonally Adaptive Approach			
		Drought	Dry	Average	Wet
Goulds Reserve	Can be overtopped	0	0	20	40
Newer Tank (Round Swamp BR)	Can be overtopped	0	0	10	10
Tchum Lakes Lake Reserve (North Lake - Wetland)	Outlet releases to wetland, can inundate entire wetland extent	0	0	20	100

Wetland inundation: = Inundation contained within wetland/dam =Inundation of surrounding floodplain/wetland

Table 28 - Low Priority Sites

Site Name	Capacity	Target Delivery Volumes (ML) Seasonally Adaptive Approach			
		Drought	Dry	Average	Wet
Lake Danaher BR	Do not overtop	0	2	0	0
Part of Gap Reserve	Can be overtopped	0	2	8	10
Shannons Wayside	Do not overtop	0	2	3	3

Wetland inundation: = Inundation contained within wetland/dam =Inundation of surrounding floodplain/wetland

9 Environmental water delivery infrastructure

9.1 Water delivery infrastructure

Water is delivered to WMP sites via the Wimmera Mallee Pipeline, which was described in Section 4. Infrastructure and/or earthworks may assist in the inundation of the surrounding vegetation and floodplain. This will require further investigation and has been noted as a knowledge gap.

Opportunities to remove any earthworks within natural wetlands, that would benefit wetland health and that would be supported by the appropriate land manager/land holder should be investigated. Priority should be given to sites that have limited inundation due to the need for the dam to be filled prior to inundating the surrounding wetland area.

9.2 Constraints

Environmental Entitlement water up to 1,000 ML is available for the 52 WMP sites across the three CMAs, however the volume of water available in any particular year is dependent on storage inflows and subsequent seasonal allocations managed by GWM Water, plus any available carry-over.

System constraints dictate the timing of delivery of environmental water; water is best delivered while system demand for stock and domestic use is low, generally May to November. Collaboration with GWM Water is required to manage delivery constraints.

Management Agreements and Deeds of Agreement are required to be in place with the landholder/s before water is delivered to a WMP site.

At some sites and where objectives support the action, dams are able to be over-topped to inundate the surrounding vegetation (Table 29). Some sites are not suitable for overtopping due to the landscape and/or a vegetation type that would not benefit from prolonged inundation, such as a terrestrial EVC. Some wetlands have headspace to receive slightly more water than the intended capacity due to excavations rising above ground level. In these cases, additional water could be delivered without flooding surrounding terrestrial vegetation. The benefits of this are assessed on a case-by-case basis. Delivery rates vary considerably across the WMP sites, and may constrain environmental watering (Table 29).

Table 29 - WMP delivery constraints

Site Name	Constraints	Delivery rate kL/day
Barbers Swamp	Can be overtopped. Long retention time.	950
Broom Tank	8ML, overtopped. Short retention time.	130
Bull Swamp	Can be overtopped. A second connected wetland can be filled via culvert under the roadway.	177-190
Chiprick Reserve	Can be overtopped. Roadway between 2 wetlands, limiting watering to the one wetland. Short retention time.	100-117
Clinton Shire Dam	Can be overtopped	60-110
Cokum BR	Can be overtopped. Long retention time.	190-200
Considine	Do not overtop. Slow delivery rate.	25-50
Coundon Wetland	6 ML fill to leave headspace for rainfall runoff. Risk of flooding in wet year. Short retention time.	120-185
Cronomby Tanks	Do not overtop. Long retention time.	150
D Smith	Do not overtop	50-63
Goulds Reserve	In a wet year dam site can be overtopped and allowed to flow into surrounding floodplain.	195-230
Greens Wetland	Can be overtopped. Slow delivery rate. Long retention time.	62-66
Homelea	Do not overtop	50-71
J Ferrier Wetland	Can be overtopped. Slow delivery rate.	135-165
John Ampt	Do not overtop	75-100
Kath Smith	Do not overtop	57
Lake Danaher BR	Do not overtop. Sandy bed and limited delivery rate from pipeline.	100
Mahoods Corner	Do not overtop. Slow delivery rate.	150
Morton Plains Reserve	Can be overtopped	450-800
Pam Juergens	Do not overtop. Short retention time.	80-130
Part of Gap Reserve	Can be overtopped. Long retention time.	95
Paul Barclay	Do not overtop. Short retention time.	600
Poyner	Do not overtop. Slow delivery rate. Minor works may be required to prevent water reaching the road.	22-40
R Ferrier	Do not overtop.	180
Rickard Glenys	Do not overtop. Slow delivery rate.	150
Roselyn Wetland	Can be overtopped	200-700
Round Swamp BR	Can be overtopped	110-150
Shannons Wayside	Do not overtop	60-150
Tchum Lakes Reserve (Wetland)	Outlet releases to wetland, can inundate entire wetland extent	500
Tchum Lakes Pool (Dam)	11 ML (full) can be overtopped, or wetland watered from South connection	140-160
Towma (Lake Marlbed) FFR	Do not overtop. This has a large floodplain adjacent within crown land. Need to work with Parks Victoria re: possible increase to overflow deliveries.	110
Uttiwillock	Can be overtopped	100

10 Demonstrating outcomes – monitoring and assessment

10.1 Environmental Monitoring

The watering program at WMP sites has been designed to optimise ecological outcomes based on environmental water requirements (Table 30).

Table 30 - Links between environmental objectives, monitoring questions and survey methods

Objective	Monitoring focus	Monitoring question	Method	When
WMP2a	Frogs	Does environmental water increase frog abundance at targeted sites?	Audiomoth call analysis	When flooded
WMP2b	Turtles	Does environmental water increase turtle abundance at targeted sites?	Visual observation of basking sites and populations	Basking sites in spring. Population counts in summer
WMP3	River red gum, Black box and Lignum stand condition	Has environmental water increased River red gum, Black box and Lignum condition? Does stand extent meet targets?	Remote sensing and stand condition modelling	Continuous data collection by satellite. Annual reporting with five yearly trend assessment
WMP4a	Waterbirds	Does environmental water increase waterbird abundance and diversity.	Waterbird counts at WMP sites	When flooded
WMP4b	Waterbirds	Does environmental water increase the nesting and breeding of non-colonial waterbirds?	Woodland bird counts	Four times annually

10.2 Monitoring Opportunities at WMP sites

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 habitat for:
    - Vegetation - River red gum, Black box and Lignum
    - Turtles and frogs
    - Shallow- and deep-water feeding guilds of waterbird
    - Woodland birds
- Outcomes
    - condition and distribution of long-lived vegetation
    - self-sustaining populations – frogs and turtles
    - bird species richness

The monitoring priorities at WMP sites are the monitoring questions which 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:

- 3.2.1 The condition of high value aquatic and riparian habitat is improved

Monitoring opportunities at WMP sites are shown in Table 31.

Table 31 - Monitoring opportunities at WMP sites

Monitoring opportunity	Reason for priority
Water Quality	Driver of wetland condition.
Environmental Water delivery	Major management lever to protect wetland
Frog abundance and diversity	Sound recordings of WMP sites and a range of apps support effective community/landowner-based monitoring
Turtle basking sites, numbers and species	Observations of basking sites in spring, and populations during summer drawdown, are straightforward for community members and WMP site landowners
Lignum and Black box population, quality and extent	Important habitat, food resource and indicator of the success of environmental water for improving WMP vegetation communities.
Non-colonial waterbirds and woodland birds abundance, breeding and diversity	Some listed species utilise WMP sites. Amenable to citizen science and use of trial cameras.

11 Adaptive management

Mallee CMA uses an adaptive management approach in planning, delivering 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 the goals of the activity are being reached 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 8 shows an illustration of the adaptive management cycle for environmental water delivery.

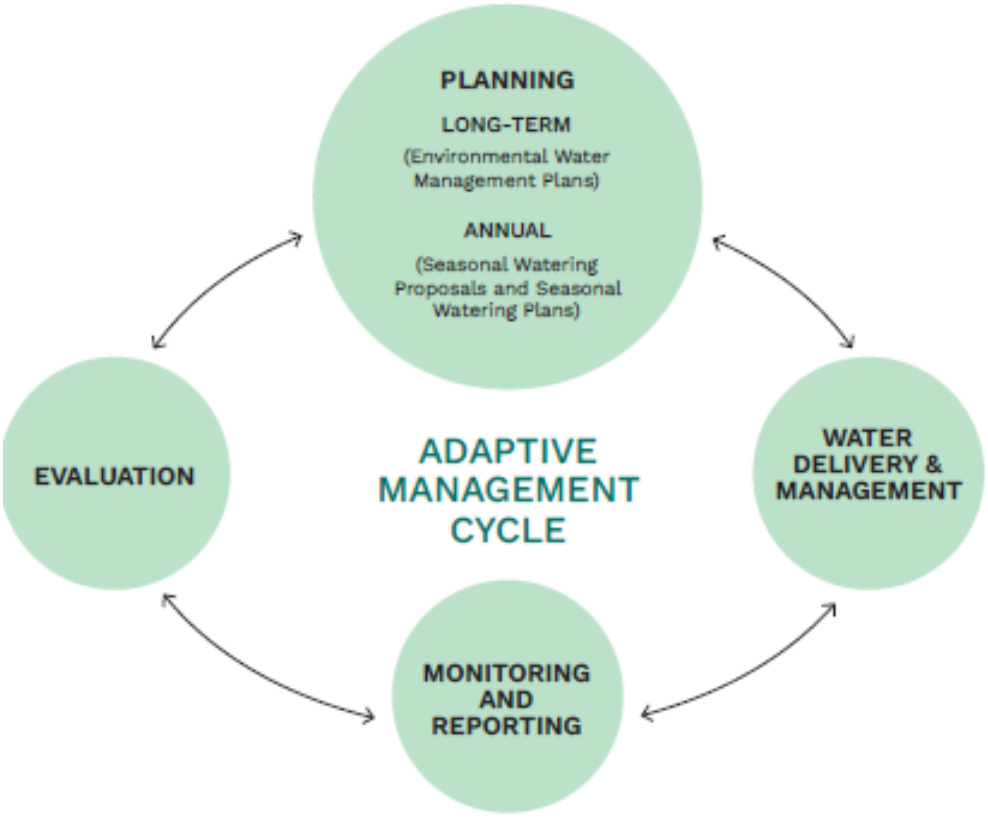

Figure 8 - Adaptive management cycle for environmental water delivery and management

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.

In 2022, Mallee CMA further refined its adaptive management approach, implementing the Environmental Watering Adaptive Management Framework (Mallee CMA 2022c).

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.

Mallee CMA's 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. In this way, we iteratively improve 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.

11.1 Adaptive management program components

The four main components of this framework are as follows:

11.1.1 Environmental watering database

Mallee CMA uses an Environmental Watering Database for storage of watering information. It stores hydrological details, expected environmental outcomes, and ecological responses, including data for informing adaptive management decisions.

Annual adaptive management checkpoint

An annual adaptive management checkpoint (AM Checkpoint) for each of Mallee CMA's Seasonal Watering Proposal provides a structured and formalised forum for evaluation and review.

The outcomes from each AM Checkpoint:

- informs the annual reporting to relevant stakeholders, including VEWH and DEECA
- identifies the key lessons from environmental water delivery events throughout the year, to be documented into the Watering Event Lessons (WEL) Record (below)
- informs Mallee CMA environment water annual planning for subsequent years.

Watering Event Lessons (WEL) record

Key decisions and justifications, new knowledge and lessons learned are documented in a 'live', site-specific, centralised, document called a Watering Event Lessons (WEL) Record. The WEL Record provides an opportunity for planning and delivery information to be systematically recorded and retained for subsequent evaluation at the AM Checkpoint (see above).

The WEL Record is also used to capture outcomes and knowledge generated from lesson review at the AM Checkpoint.

WEL Records are updated at the end of each watering event providing an accessible library of lessons ready to be uploaded into the CMA's organisational knowledge base via the EWMP update process.

Seasonal watering proposal presentation adaptive management section

The annual seasonal watering proposals presentation to Mallee CMA Chief Executive Officer and Executive Management includes a section on adaptive management.

This section explicitly focuses on outcomes and observations from previous events and any subsequent changes being made as a response within that years' Seasonal Watering Proposal. This promotes for the broader dissemination of findings and outcomes within Mallee CMA.

Monitoring consultant's findings summary

Monitoring consultants are required to synthesise their results and describe the implications of results for ongoing environmental watering programs. This promotes the transfer and uptake of knowledge from monitoring and other investigations into Mallee CMA water planning and management.

Figure 9 shows how adaptive management processes are integrated with Mallee CMA's environmental watering program.

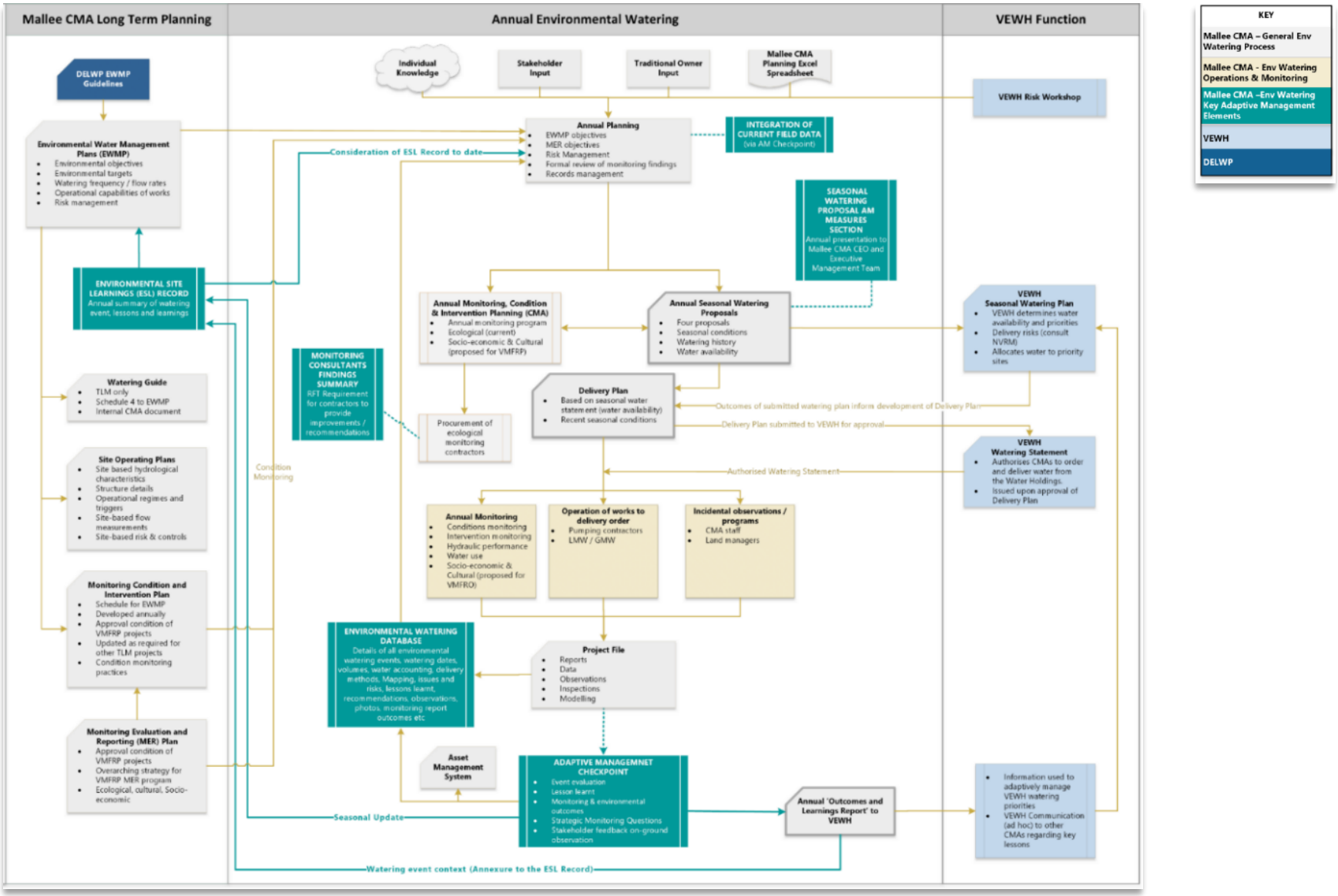

Figure 9 - Mallee CMA environmental watering program with adaptive management processes (green boxes)

12 Knowledge gaps and recommendations

This plan is based on best information at the time of writing. In some cases, this information is scarce or outdated. Further investigation and information collection will continue and the results of this work will continue to build a better picture of the WMP sites and add rigor to future planning. Some areas where further knowledge would be beneficial are outlined in Table 32.

Not all sites have been ecologically surveyed, which limits the knowledge on wetland birds and fauna at these sites. Knowledge of these sites is needed to be included in the prioritisation process if limited water is available.

Table 32 - knowledge gaps and recommendations for the WMP sites

Knowledge and data gaps	Action Recommended	Priority Level	Responsibility
Accurate depth and volumes for all sites (including surrounding inundation zones)	Collate and compile relevant data, monitor sites not previously watered	1	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
The need for earthworks (levees etc.) to improve the distribution of water or prevent undesirable flooding at individual sites	Review previous inundation events with landholders, monitor during environmental watering	1	
Wetland condition following delivery of environmental water	IWC or vegetation quality assessments following watering activities	2	
Relationship between volumes delivered and habitat provided	Mapping of habitat condition and extent. Review previous studies from region to infer.	3	
Fauna use of the site in response to environmental watering	Data collection and monitoring	3	
Nesting habits of birds at the site	Data collection and monitoring	4	
Relationship between volumes delivered and frog and turtle population diversity	Data collection and monitoring	5	
Identification of location of critical refuge points in the landscape	Analysis of GIS data to ascertain proximity of WMP sites to reserves and or alternate refuge areas	6	
Impact on pest plant and animal populations	Assessment of pest plant and animal proliferation before and after watering event	7	

The following monitoring is recommended:

Water

- Detailed monitoring of environmental water delivery would be dependent on funding from the State or Commonwealth governments.

Vegetation

- Photo point monitoring before and after watering events to measure the success of environmental water in improving wetland and riparian vegetation communities.

Fauna

- Birds: The isolated nature of the WMP wetlands will make waterbird numbers highly variable and managers can be confident that allocating environmental flows will be associated with an increase in waterbird numbers and species, although which species is uncertain.
- Frogs: Different species have different cues which may make the timing of monitoring difficult, however, sound recording of wetlands and a range of apps both support effective community-based monitoring.
- Turtles: Given the limited resources, there may be two options here. First would be if there are basking sites within the wetland, then it is relatively straightforward for community members to make observations in spring when turtles regularly bask in the morning. The second would be to sample as the residual pool dries. This information could inform management assessments of the risks to maintaining self-sustaining turtle populations.

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14 EWMP appendices

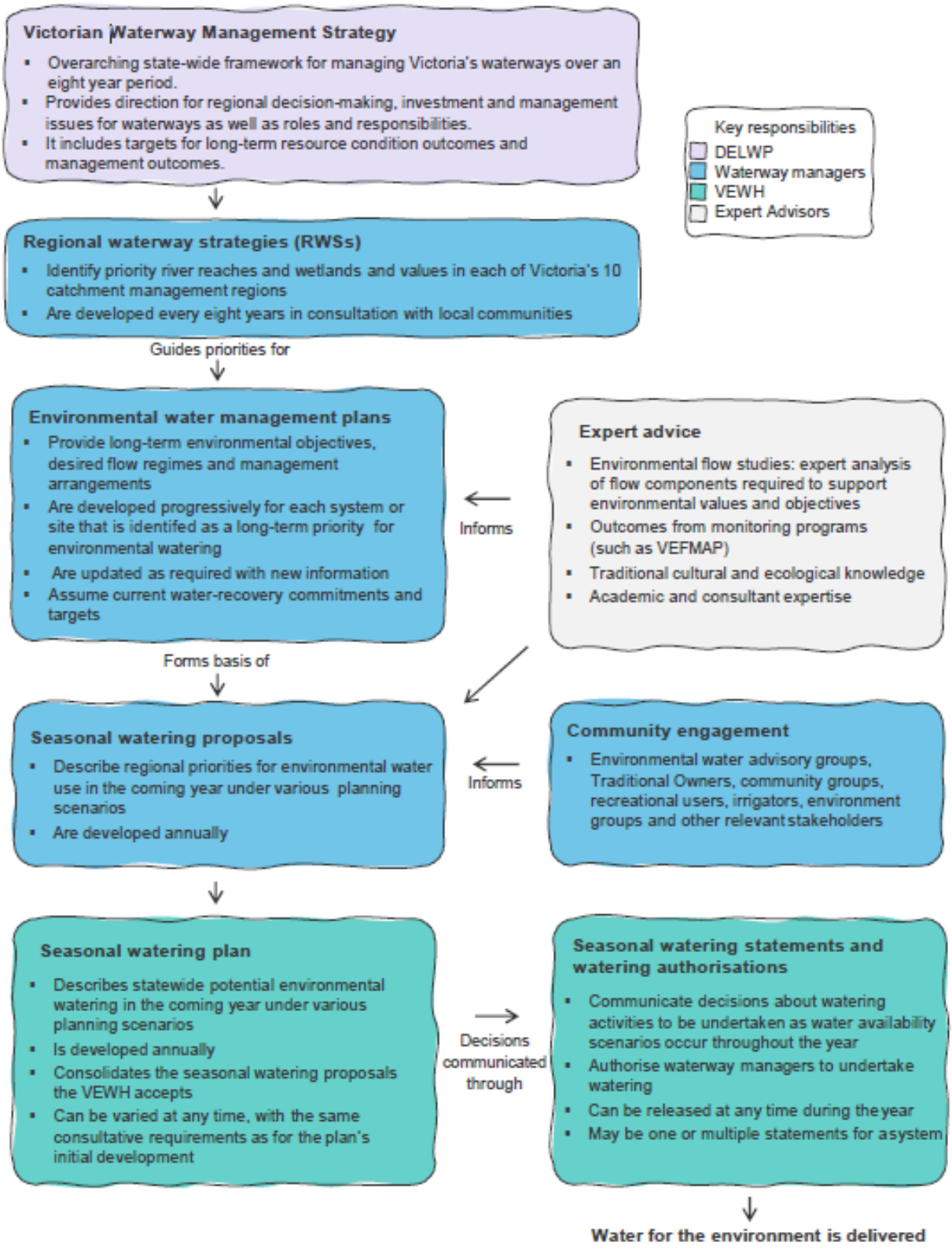
14.1 Appendix 1 – EWMP context

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 the Wimmera Mallee Pipeline wetlands 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 the Wimmera Mallee Pipeline sites 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 Wimmera-Mallee Water Resource Plan and Wimmera-Mallee Long-Term Watering Plan, which apply at the Wimmera Mallee Pipeline sites.

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.


Victorian Waterway Management Strategy
Overarching state-wide framework for managing Victoria's waterways over an eight year period.
Provides direction for regional decision-making, investment and management issues for waterways as well as roles and responsibilities.
It includes targets for long-term resource condition outcomes and management outcomes.
Key responsibilities
DELWP
Waterway managers
VEWH
Expert Advisors
Regional waterway strategies (RWSs)
Identify priority river reaches and wetlands and values in each of Victoria's 10 catchment management regions
Are developed every eight years in consultation with local communities
Guides priorities for
Environmental water management plans
Provide long-term environmental objectives, desired flow regimes and management arrangements
Are developed progressively for each system or site that is identifed as a long-term priority for environmental watering
Are updated as required with new information
Assume current water-recovery commitments and targets
Informs
Expert advice
Environmental flow studies: expert analysis of flow components required to support environmental values and objectives
Outcomes from monitoring programs (such as VEFMAP)
Traditional cultural and ecological knowledge
Academic and consultant expertise
Forms basis of
Seasonal watering proposals
Describe regional priorities for environmental water use in the coming year under various planning scenarios
Are developed annually
Informs
Community engagement
Environmental water advisory groups, Traditional Owners, community groups, recreational users, irrigators, environment groups and other relevant stakeholders
Seasonal watering plan
Describes statewide potential environmental watering in the coming year under various planning scenarios
Is developed annually
Consolidates the seasonal watering proposals the VEWH accepts
Can be varied at any time, with the same consultative requirements as for the plan's initial development
Decisions communicated through
Seasonal watering statements and watering authorisations
Communicate decisions about watering activities to be undertaken as water availability scenarios occur throughout the year
Authorise waterway managers to undertake watering
Can be released at any time during the year
May be one or multiple statements for a system
Water for the environment is delivered

14.2 Appendix 2 – 2023 Stakeholder and community engagement process

Online community survey

The content of an online community survey for each site was designed by Alluvium in late 2022, with review by Mallee CMA. The survey was designed to enable community, landholders, recreational users, Landcare groups, environmental groups and other interested parties to provide input to the plans. The online survey itself was designed by Mallee CMA and hosted on their website in January and February of 2023. Specifically, the survey aimed to:

1. Understand the purpose(s) for which respondents use each wetland complex,

2. Understand the sub-location (within a complex), frequency and seasonality of visits,

3. Confirm existing, and identify new, water-dependent values at each site, and

4. Understand the importance of values at a given site to the community member

This method of engagement was at the Consult and Involve level of the International Association for Public Participation (IAP2) spectrum.

Traditional Owner Engagement

Twenty-four Wimmera Mallee Pipeline sites are located on recognised Country of the Barengi Gadjin Land Council Aboriginal Corporation. Eight Wimmera-Mallee Pipeline sites are located on the Country of non-Registered Aboriginal Parties (RAP). Several non-RAP groups have contested Country in the Mallee region and have interest in Mallee Wetlands.

Alluvium Consulting Australia made recommendations for engagement with Traditional Owner groups in the Stakeholder Engagement plan, including that the engagement with each group be held on a one-to-one basis, with the level, place and style of engagement self-determined by the Traditional Owners. Engagement was to be help at the IAP2 level of collaborate, if wished by the Traditional Owner Group.

Engagement with non-RAP groups and the Barengi Gadjin Land Council in relation to the EWMP updates has not yet commenced. Alluvium recognises that Mallee CMA is committed to working with Traditional Owners from across the Mallee Region to ensure that tangible and intangible Aboriginal culture and heritage is protected, and that Traditional Owner led practices are imbedded in the management and healing of Country (Mallee RCS, 2022).

As consultations with Traditional Owners are incomplete and ongoing, no additional specific cultural values for EWMP sites have been included in the key values summaries. Information regarding Traditional Owner values that are contained in the previous EWMPs are included in the key value in Section 5.

Environmental Management Agencies

Mallee CMA facilitated meetings of with key environmental management agencies as part of annual discussions about the seasonal watering proposals. Agencies included:

- Parks Victoria
- Lower Murray Water
- Goulburn Murray Water
- Mildura Rural City Council
- DEECA
- VEWH

Discussions at the agency collaboration group meetings generally related to watering infrastructure and site access.

14.3 Appendix 3 – Community values survey and agency meeting outcomes

14.3.1 Community values survey

The Wimmera Mallee Pipeline survey was completed by 6 respondents, some of whom visit multiple WMP sites. Their survey responses are summarised below.

Respondent 1:

Respondent 1 visits:

- Chiprick reserve (ranking),
- Cronomby tanks (ranking), and
- Tchum Lakes/Dam (not ranked).

The respondent describes themselves as a resident, recreational user, community environmental group member and a researcher/citizen scientist. The respondent visits the Wimmera Mallee Pipeline (WMP) sites monthly, in all seasons. They use the sites for Walking/Running, birdwatching, Nature appreciation and education purposes. The respondent identified **photography** as an additional use of the pipeline sites. The respondent noted Chiprick reserve as the most important site to them, and completed value ranking information for Chiprick Reserve and Cronomby Tanks. No new water-dependent values were identified for visited sites.

Respondent 2:

Respondent 2 visits Chiprick Reserve, but answered that Cronomby Tanks was the most meaningful important site to them. The respondent was a visitor to the region, visiting daily in Autumn, for education purposes. The respondent did not complete any additional information in the survey. No new water-dependent values were identified by the respondent.

Respondent 3:

Respondent 3 visits several private and public WMP sites:

- Lake Danaher
- Shannons Wayside
- Goulds Reserve – most important wetland (completed ranking)
- Tchum Lakes
- Clinton Shire
- Morton Plains
- Barber wetland
- Mahoods Corner
- Bull Swamp (response to ‘Other (please specify)’)

The respondent describes their connection to the sites as a resident, community environmental group member and environmentalist (new self-description). The respondent visits daily, in all seasons. The respondent uses the sites for birdwatching, socialising and nature appreciation, and nominated Gould Reserve as the most important site to them (value ranking completed for Goulds Reserve). No new water-dependent values were listed by the respondent.

Respondent 4:

The respondent visits Cronomby Tanks. They are a self-described resident, and visit the site monthly in all seasons. The respondent uses Cronomby Tanks for walking/running, socialising and nature appreciation. The respondent completed the values ranking survey for Cronomby Tanks (the most important site to them). No new water-dependent values were identified for Cronomby Tanks.

Respondent 5:

The respondent visits Round Swamp Bushland Reserve, and nominates the site as the most important to them. The respondent is a visitor to the region and visits every few months in all seasons. The respondent uses Round Swamp for walking/running, fishing and socialising. No new water-dependent values were identified for Round Swamp.

Respondent 6:

The respondent visits Lake Marlbed, and answered that Lake Marlbed is the most important site to them. The respondent is a self-described visitor to the region, vising every few months in Summer, Autumn and Winter. The respondent uses the site for birdwatching, fishing, socialising and nature appreciation.

Value Ranking at WMP sites (5 = Extremely Important, 1 = not important at all)

Respondent number	1	1	3	4	5	6
Location	Chiprick Reserve	Cronomby Tanks	Goulds Reserve	Cronomby Tanks	Round Swamp	Lake Marlbed
Unique landscape features and natural beauty	5	4	5	5	2	3
Recreational opportunities (birdwatching, fishing etc.)	4	4	5	5	2	5
Traditional Owner Values	4	3	4	5	2	4
Exercise (trails for walking, running, cycling)	5	3	-	5	2	4
Work or education opportunities	5	3	5	5	2	2
Commercial or business opportunities	2	2	-	5	2	4
Respondent Age	65+	65+	65+	18-24yr	25-34yr	Under 18

Site Values Ranking Summary

At Chiprick reserve, unique landscape features, exercise opportunities and work or education were extremely important to the respondent (all scored 5/5). Recreational opportunities and Traditional Owner values of the site were of high importance (score 4/5). Commercial or business opportunities were of low importance to the respondent (score 2/5).

At Cronomby Tanks, unique landscape features, and recreational opportunities values were of very high importance to respondents (weighted score 4.5/5). Exercise, work and education and Traditional Owner values at the site were of moderate to extremely high importance (weighted score 4/5) to respondents. Commercial or business opportunities were also of mixed importance, with one respondent considering them extremely important (5/5), while the other considered them of low importance (2/5).

At Goulds Reserve, Unique landscape features, recreational opportunities and work or education values were of extremely high importance to the respondent. Traditional Owner values were of high importance (4/5). Rankings were not provided for exercise or commercial or business opportunities at the site.

The respondent for Round Swamp ranked all listed water-dependent values as of low importance (score 2/5).

The respondent for Lake Marlbed considered the recreational opportunities to be of extremely high importance. Traditional Owner values, Exercise values and business/commercial values were of high importance (score 4/5). Unique landscape features were of moderate importance (3/5), and work or education values of low importance (2/5).

Summary

The community values survey captured visitors to 13 of 32 WMP sites (* indicates completion of a community water-dependent values survey). No new water-dependent values were identified through the survey.

Visited sites:

- Barbers wetland
- Lake Danaher
- Shannons Wayside
- Goulds Reserve*
- Tchum Lakes
- Clinton Shire
- Morton Plains
- Mahoods Corner
- Bull Swamp
- Chiprick Reserve*
- Cronomby Tanks*
- Round Swamp*
- Lake Marlbed*

14.3.2 Agency Consultation Meeting Comments

The Wimmera Mallee Pipeline was not mentioned by any agency in the Agency consultation meeting notes.

14.4 Appendix 4 – Species lists

14.5 Appendix 5 – Assessing Risk - Consequence

When prioritizing wetland watering, it is often difficult because there is no framework by which you can compare the fate of different species. To support prioritization, we have developed a guide that seeks to put each wetland and its associated species within a regional context. It is likely that managers already consider the issues presented here. The process may also be useful when communicating the rationale behind decisions or support engagement by providing a framework for discussion. The process is presented in the accompanying Figure A5.1, with a more detailed explanation provided in Tables A5.11 and Table A5.22.

Table A5.1

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 A5.2

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	

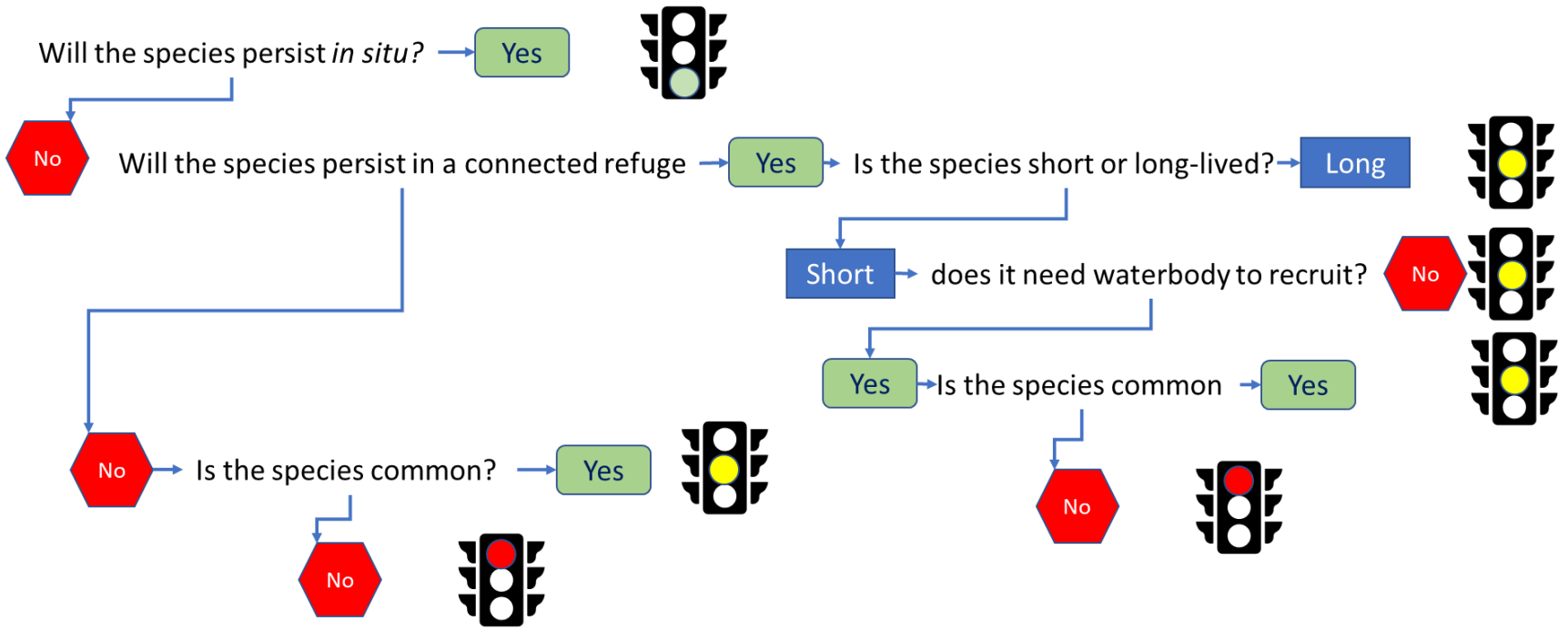

Will the species persist *in situ*?
Yes
No
Will the species persist in a connected refuge
Yes
Is the species short or long-lived?
Long
Short
does it need waterbody to recruit?
No
Yes
Is the species common
Yes
No
No
Is the species common?
Yes
No

Figure A5.1

14.6 Appendix 6 – SMARTness of ecological objectives and mapping to basin plan (Butcher et al., 2020)

5.29 Wimmera Mallee Pipeline Wetlands

5.29.1 SMARTness and rationalisation

Site-specific environmental objectives for the Wimmera Mallee Pipeline Wetlands EWMP (Mallee CMA 2016e).

EWMP objectives
WMP1: Provide watering points for terrestrial fauna and woodland birds – (WMP Sites: Broom Tank, Chiprick BR, Clinton Shire Dam, Considine*, Coundon Wetland, Cronomby Tanks*, D Smith*, Greens Wetland, Homelea*, J Ferrier Wetland, John Ampt*, Kath Smith*, Mahoods Corner*, Pam Juergens*, Paul Barclay*, Poyner, R Ferrier*, Rickard Glenys*, Roselyn Wetland, Shannons Wayside*, Tchum Lakes Pool (Dam), Towma (Lake Marlbed) FFR, Uttiwillock*)
WMP2: Provide foraging, refuge and breeding habitat for turtles and frogs – (WMP Sites: Cokum BR, Considine*, Cronomby Tanks*, Mahoods Corner*, Part of Gap Reserve, Rickard Glenys*, Roselyn Wetland, Towma (Lake Marlbed) FFR, Uttiwillock*)
WMP3: Maintain the health of fringing lignum and Black Box communities and wetland EVCs – (WMP Sites: Barbers Swamp, Broom Tank, Bull Swamp, Clinton Shire Dam, Cokum BR, Goulds Reserve, Greens Wetland, J Ferrier Wetland, Lake Danaher BR, Morton Plains Reserve, Part of Gap Reserve, Poyner, Roselyn Wetland, Round Swamp BR, Tchum Lakes Reserve (Wetland), Tchum Lakes Pool (Dam), Towma (Lake Marlbed) FFR, Uttiwillock*)
WMP4: Provide suitable feeding and breeding habitat for various waterbird guilds – (WMP Sites: Barbers Swamp, Bull Swamp, Cokum BR, Goulds Reserve, Mahoods Corner*, Morton Plains Reserve, R Ferrier*, Rickard Glenys*, Roselyn Wetland, Shannons Wayside*, Tchum Lakes Reserve (Wetland), Tchum Lakes Pool (Dam), Uttiwillock*)

Assessment of SMARTness of current Wimmera Mallee Pipeline Wetlands 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
WMP1	0	0	0	0	1	0.5	1	1	0	0	0
WMP2	0	0	1	1	1	0.5	1	0.5	0	0	0
WMP3	0	0.5	1	1	1	0.5	1	0.5	1	0	0
WMP4	0	0	1	1	1	0.5	1	0.5	1	0	0

Rationalised environmental objectives for the Wimmera Mallee Pipeline Wetlands EWMP (Mallee CMA 2016e).

Objective	Issue	Outcome
WMP1	EWMPs are for water-dependent values only – watering for terrestrial species should not be an objective but it will be achieved by other watering actions	Delete
WMP2	Objective contains two ecosystem functions and a resilience attribute – split. Have refugia as separate objective. Foraging and breeding can be in the one objective to maintain frog species but have target specific to breeding and species richness.	Objectives split into frogs and turtles, refugia and maintaining populations of frogs and turtles.
WMP3	No issue with objective other than its not fully SMART and no baseline data	updated to align with Basin Plan language
WMP4	No issue with objective other than its not fully SMART and no baseline data	Objective split to deal with feeding and breeding separately - updated to align with Basin Plan language. Need breeding species

5.29.2 Mapping to Basin Plan

Basin Plan Schedule 8 and 9 criteria.

Schedule 8 criteria met	Schedule 9 criteria met
From DELWP (2015b)^	
2: Shallow freshwater marsh, DIRWA listed (e.g. Creswick Swamp) **3:** Important drought refuge, Breeding and nursery habitat, Pathways for dispersal **4:** EPBC Act, FFG Act, DSE list **5:** High biodiversity, Number of EVCs in the region – Lunette Woodland – Endangered, EVC 652, Black-Box Wetland – Endangered, EVC 369^	**1:** Supports the creation and maintenance of vital habitats and populations; supports the creation and maintenance of vital habitats and populations; supports the creation and maintenance of vital habitats **2:** Supports the transportation and dilution of nutrients, organic matter and sediment **3:** Longitudinal hydrological connectivity – ecosystem processes provides connections along a watercourse (longitudinal connections)
Updated assessment	
3(a)i: Vital habitat - refugium during dry spells and drought **3(b):** Prevents declines in native biota	**1(a):** Vital habitat - refugium during dry spells and drought **1(c):** Vital habitat - feeding, breeding, nursery sites **1(e):** Vital habitat - preventing decline of native biota

^The Wimmera Mallee LTWP indicates that these are examples of asset characteristics from across the Wimmera-Mallee pipeline wetlands and do not represent the full list of characteristics for these assets
^ Mapping PEA criteria 5 to EVC is not appropriate

Mapping Wimmera Mallee Pipeline Wetlands EWMP objectives to Basin Plan EWP objectives, Schedule 7 targets, BWS QEEO, and LTWP Wimmera Mallee objective.

EWMP objectives	Relevant Basin Plan EWP objective	Relevant Schedule 7 target	Relevant BWS QEEO	LTWP objective
WMP1: Provide watering points for terrestrial fauna and woodland birds – (WMP Sites: Broom Tank, Chiprick BR, Clinton Shire Dam, Considine*, Coundon Wetland, Cronomby Tanks*, D Smith*, Greens Wetland, Homelea*, J Ferrier Wetland, John Ampt*, Kath Smith*, Mahoods Corner*, Pam Juergens*, Paul Barclay*, Poyner, R Ferrier*, Rickard Glenys*, Roselyn Wetland, Shannons Wayside*, Tchum Lakes Pool (Dam), Towma (Lake Marlbed) FFR, Uttiwillock*)	Not applicable	Not applicable	Not applicable	Not applicable
WMP2: Provide foraging, refuge and breeding habitat for turtles and frogs – (WMP Sites: Cokum BR, Considine*, Cronomby Tanks*, Mahoods	8.05,3(b) 8.05,3(a) 8.06,6(b)	Recruitment and populations of other native water-dependent biota	None specified	LTWPWM16 LTWPWM15

EWMP objectives	Relevant Basin Plan EWP objective	Relevant Schedule 7 target	Relevant BWS QEEO	LTWP objective
Corner*, Part of Gap Reserve, Rickard Glenys*, Roselyn Wetland, Towma (Lake Marlbed) FFR, Uttiwillock*)		Condition of priority ecosystem functions – creation of vital habitat for refugia Condition of priority asset – supports listed species		
WMP3: Maintain the health of fringing lignum and Black Box communities and wetland EVCs – (WMP Sites: Barbers Swamp, Broom Tank, Bull Swamp, Clinton Shire Dam, Cokum BR, Goulds Reserve, Greens Wetland, J Ferrier Wetland, Lake Danaher BR, Morton Plains Reserve, Part of Gap Reserve, Poyner, Roselyn Wetland, Round Swamp BR, Tchum Lakes Reserve (Wetland), Tchum Lakes Pool (Dam), Towma (Lake Marlbed) FFR, Uttiwillock*)	8.05,3(b)	Condition of native water dependent vegetation	B2.8	LTWPVM5 LTWPVM6 LTWPVM8
WMP4: Provide suitable feeding and breeding habitat for various waterbird guilds – (WMP Sites: Barbers Swamp, Bull Swamp, Cokum BR, Goulds Reserve, Mahoods Corner*, Morton Plains Reserve, R Ferrier*, Rickard Glenys*, Roselyn Wetland, Shannons Wayside*, Tchum Lakes Reserve (Wetland), Tchum Lakes Pool (Dam), Uttiwillock*)	8.05,3(b)	Recruitment and populations of native water-dependent birds Condition of priority ecosystem functions - creation of vital habitat - feeding, breeding, nursery	B3.2	LTWPVM11

5.29.3 Updated objectives for Wimmera Mallee Pipeline Wetlands

Current objective	**WMP1: Provide watering points for terrestrial fauna and woodland birds** – (WMP Sites: Broom Tank, Chiprick BR, Clinton Shire Dam, Considine*, Coundon Wetland, Cronomby Tanks*, D Smith*, Greens Wetland, Homelea*, J Ferrier Wetland, John Ampt*, Kath Smith*, Mahoods Corner*, Pam Juergens*, Paul Barclay*, Poyner, R Ferrier*, Rickard Glenys*, Roselyn Wetland, Shannons Wayside*, Tchum Lakes Pool (Dam), Towma (Lake Marlbed) FFR, Uttiwillock*)
Comments	Deleted

Current objective	**WMP2: Provide foraging, refuge and breeding habitat for turtles and frogs** – (WMP Sites: Cokum BR, Considine*, Cronomby Tanks*, Mahoods Corner*, Part of Gap Reserve, Rickard Glenys*, Roselyn Wetland, Towma (Lake Marlbed) FFR, Uttiwillock*)
Comments	For turtles, the species of concern is the Eastern long necked turtle (*Chelodina longicollis*) is said to occur at 12 assets. CMA indicated that Murray Short-necked Turtle (*Emydura macquarii*) is present and to be included in target.
EWP objective(s)	8.05,3(b) 8.06,6(b) 8.07,3
Schedule 7 targets	Recruitment and populations of other native water-dependent biota Condition of priority ecosystem functions – creation of vital habitat for refugia
PEA/PEF criteria met	PEA 3(b) Prevents declines in native biota PEA 3(a)i Vital habitat - refugium during dry spells and drought PEF 1(a) Vital habitat - refugium during dry spells and drought PEF 1(e) Vital habitat - preventing decline of native biota
BEWS QEEO	None specified
LTWP objective	LTWPWM15 Maintain habitat for turtle communities
LTWP target	None specified
2020 Objective WMP2a:	By 2030, maintain self-sustain population of turtles at Wimmera Pipeline wetlands in 80% of years in which water is present.
2020 Targets WMP2a:	By 2030 maintain presence of Eastern long necked turtle (*Chelodina longicollis*) and Murray Short-necked Turtle (*Emydura macquarii*) at 70% of Wimmera Mallee pipeline assets in 7 out of any 10 year period.
Comments	Need species list – also a suggestion that there are listed species at the site – not included here
EWP objective(s)	8.05,3(b) 8.06,6(b) 8.07,3
Schedule 7 targets	Recruitment and populations of other native water-dependent biota Condition of priority ecosystem functions – creation of vital habitat for refugia
PEA/PEF criteria met	PEA 3(b) Prevents declines in native biota PEA 3(a)i Vital habitat - refugium during dry spells and drought PEF 1(a) Vital habitat - refugium during dry spells and drought PEF 1(e) Vital habitat - preventing decline of native biota
BWS QEEO	None specified

LTWP objective	LTWPWM16 Maintain habitat for frog communities
LTWP target	None specified for other biota
2020 Objective WMP2b:	By 2030, maintain self-sustain population of frogs at Wimmera Pipeline wetlands in 80% of years in which water is present.
2020 Targets WMP2b:	Maintain self-sustaining populations of frogs at Wimmera Pipeline wetlands in 80% of years in which water is present by 2030 including 80% of commonly encountered species: • Spotted Marsh Frog (*Limnodynastes tasmaniensis*), Common Froglet (*Crinia signifera*), Plains froglet (*Crinia parainsignifera*), and Pobblebonk (*Limnodynastes dumerili*) (species and assets to be confirmed)

Current objective	**WMP3: Maintain the health of fringing lignum and Black Box communities and wetland EVCs** – (WMP Sites: Barbers Swamp, Broom Tank, Bull Swamp, Clinton Shire Dam, Cokum BR, Goulds Reserve, Greens Wetland, J Ferrier Wetland, Lake Danaher BR, Morton Plains Reserve, Part of Gap Reserve, Poyner, Roselyn Wetland, Round Swamp BR, Tchum Lakes Reserve (Wetland), Tchum Lakes Pool (Dam), Towma (Lake Marlbed) FFR, Uttiwillock*)
Comments	
EWP objective(s)	8.05,3(b)
Schedule 7 targets	Condition of native water dependent vegetation
PEA/PEF criteria met	PEA 3(b) Prevents declines in native biota
BEWS QEEO	B2.8 By 2024 improve condition of Black Box and river red gum
LTWP objective	LTWPVM5 Improve the condition of river red gum dominated EVCs LTWPVM6 Improve the condition of Black Box dominated EVCs LTWPVM8 Improve the condition of shrub and lignum 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 River Red Gum (*Eucalyptus camaldulensis*), Black Box (*E. largiflorens*) and Lignum (*Duma florulenta*) to sustain communities and processes typical of such communities at Wimmera Mallee Pipeline assets
2020 Targets:	By 2030, condition in standardised transects that span the floodplain elevation gradient and existing spatial distribution at Wimmera Mallee Pipeline assets, ≥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 Wimmera Mallee Pipeline assets at 80% of sites over the 10 year period OR By 2030, at stressed sites (see Wallace et al. 2020) Wimmera Mallee Pipeline assets: 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

Current objective	**WMP4: Provide suitable feeding and breeding habitat for various waterbird guilds** – (WMP Sites: Barbers Swamp, Bull Swamp, Cokum BR, Goulds Reserve, Mahoods Corner*, Morton Plains Reserve, R Ferrier*, Rickard Glenys*, Roselyn Wetland, Shannons Wayside*, Tchum Lakes Reserve (Wetland), Tchum Lakes Pool (Dam), Uttiwillock*)
Comments	
EWP objective(s)	8.05,3(b)
Schedule 7 targets	Condition of priority asset - Vital habitat - feeding, breeding, nursery
PEA/PEF criteria met	PEA 3(a) iii Vital habitat - feeding, breeding, nursery sites PEF 1 (c) Vital habitat - feeding, breeding, nursery sites
BWS QEEO	B3.1 That the number and type of water bird species present in the Basin will not fall below current observations
LTWP objective	LTWPVM12: Improve habitat for waterbirds LTWPVM13: Improve feeding areas for waterbirds
LTWP target	Appropriate water regime to support feeding and habitat areas for guilds of waterbirds delivered at 50% of sites, 8 years in 10
2020 Objective WMP4a:	By 2030, maintain representative populations of shallow-water and deep-water feeding guilds of waterbird (F2 and F3, respectively, after Jaensch 2002) at the Wimmera-Mallee Pipeline wetlands asset, by maintaining a mixture of shallow and deep-water habitats.
2020 Targets WMP4a:	By 2030, 80% of representative F2 and F3 species recorded at Wimmera-Mallee Pipeline wetlands in 8 in any 10-year period where conditions are suitable: • Representative F2 species include: Australasian Grebe (*Tachybaptus novaehollandiae*), Pacific Black Duck (*Anas superciliosa*), White-necked Heron (*Ardea pacifica*), Australian White Ibis (*Threskiornis molucca*), Masked Lapwing (*Vanellus miles*) • Representative F3 species include: Australian Pelican (*Pelecanus conspicillatus*), Great Cormorant (*Phalacrocorax carbo*), Little Black Cormorant (*Phalacrocorax sulcirostris*), Australian Darter () • Feeding habitat defined as a mixture of deep feeding areas (water >1 m) and shallow feeding areas (<0.5 m depth and or drying mud) with intermittent inundation of densely vegetated shrublands.

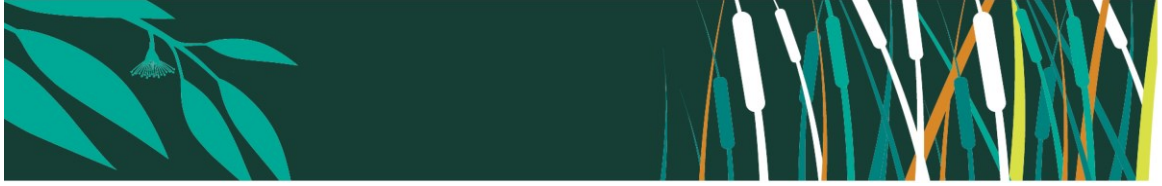
Comments	
EWP objective(s)	8.05,3(b)
Schedule 7 targets	Recruitment and populations of native water-dependent birds Condition of priority ecosystem functions - creation of vital habitat - feeding, breeding, nursery
PEA/PEF criteria met	PEA 3(a) iii Vital habitat - feeding, breeding, nursery sites PEF 1 (c) Vital habitat - feeding, breeding, nursery sites
BWS QEEO	B3.2 A significant improvement in waterbird populations in the order of 20 to 25% over the baseline scenario, with increases in all waterbird functional groups
LTWP objective	LTWPVM11: Improve breeding opportunities for waterbirds
LTWP target	None specified for non-colonial species
2020 Objective WMP4b:	By 2030, maintain nesting and recruitment of non-colonial waterbirds (N1, N2, N3 and N4, after Jaensch 2002) at the Wimmera-Mallee Pipeline wetlands asset, by maintaining a mixture of tree, low vegetation/shrubs, and ground/islet nesting habitat.
2020 Targets WMP4b:	There is a lack of data on species that breed at the site. The expectation is that the list of species commonly nesting at Wimmera-Mallee Pipeline wetlands will be confirmed over time. By 2030, at least two of the following species to be recorded as nesting and/or breeding at the Wimmera-Mallee Pipeline wetlands asset in 7 out of any 10-year period in which nesting/breeding conditions are suitable: • Representative N1 and N2 species include: White-bellied Sea Eagle (*Haliaeetus leucogaster*), • Representative N3 and N4 species include: Australasian Grebe (*Tachybaptus novaehollandiae*), Masked Lapwing (*Vanellus miles*), Pacific Black Duck (*Anas supercilliosa*)

14.7 Appendix 7 – Alignment of WMP ecological objectives with policy instruments

Mapping of EWMP objectives to the Basin plan and other legislative and policy instruments

EWMP Objective	Relevant Basin Plan EWP Objective	Relevant schedule 7 targets	Relevant BWS QEEO	LTWP Objective
WMP2a	8.05,3(b) 8.06,6(b) 8.07,3	Recruitment and populations of other native water-dependent biota Condition of priority ecosystem functions – creation of vital habitat for refugia Condition of priority asset – supports listed species	None specified	L5.2
WMP2b	8.05,3(a) 8.05,3(b) 8.06,6(b) 8.07,3	Recruitment and populations of other native water-dependent biota Condition of priority ecosystem functions – creation of vital habitat for refugia Condition of priority asset – supports listed species	None specified	L5.2
WMP3	8.05,3(b) 8.06,6(b)	Condition of native water dependent vegetation	B2.2, B2.8 B2.9 B2.11	L2.1, L2.3, L2.4
WMP4a	8.05,3(b) 8.06,6(b)	Recruitment and populations of native water-dependent birds Condition of priority ecosystem functions - creation of vital habitat - feeding, breeding, nursery	B3.1 B3.2	L3.1
WMP4b	8.05,3(b) 8.06,6(b)	Recruitment and populations of native water-dependent birds Condition of priority ecosystem functions - creation of vital habitat - feeding, breeding, nursery	B3.1 B3.2	L3.1

EWP = Basin Plan Environmental Watering Plan objectives, BWS = Basin wide Environmental Watering strategy, QEEO = quantified environmental expected outcomes LTWP = Wimmera-Mallee Long Term Watering Plan



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