Environmental Water Management Plan – Wimmera Mallee Pipeline Wetlands – Wimmera CMA Region

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Wimmera CMA acknowledges the region's traditional owners and respects their continued connection to water land and community.

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However, it is acknowledged that the contents and views expressed within this report are those of the Wimmera Catchment Management Authority

and do not necessarily reflect the views of the parties acknowledged below.

GWMWater
VEWH
DELWP

Figures for conceptual models from University of Maryland, Center fro Environmental Scence (ian.umces.edu/imagelibrary)

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Executive Summary

Following the completion of the Wimmera Mallee Pipeline, a 1000 ML entitlement was created from water savings to supply 51 small wetlands within the pipeline footprint. These wetlands contained dams that were historically supplied by the former channel system. Given the large expanse of the Wimmera Mallee Pipeline, they are spread across the Mallee, North Central and Wimmera CMA regions. A total of 13 wetlands supplied by the pipeline are located in the Wimmera CMA region.

Most of these wetlands are located on Crown Land managed by Parks Victoria, having being set aside as public reserves for water or timber supply in the late 1800's. They contain wetland habitats of varying quality. Some contain a high diversity of native flora and fauna, including a number of threatened species and are localised centres of biodiversity in what is otherwise a largely cleared broadacre cropping and grazing landscape. Others have been more severely impacted by threats such as drainage and invasive flora and fauna and so their values have somewhat diminished, although they are still of local significance. Several are located on freehold land and once again have a broad spectrum of environmental values depending on the legacy of past management practices.

Anecdotal evidence exists that when these wetlands contain water (i.e. during wet conditions) they provide very good habitat for fauna, in particular waterbirds. In dry times, the water in dams provides important watering points for local terrestrial species, particularly during hot, dry weather experienced during summer and autumn.

This Environmental Water Management Plan (EWMP) outlines the physical settings, environmental attributes, ecological processes and watering history of each of the 13 wetlands. Based on the environmental values and physical configuration of the water supply at each site an environmental watering regime for the next 10 years is recommended. Other key considerations for the plan include risk management and monitoring needs which will influence the ongoing adaptive management of these wetlands.

The information provided by Damien Cook and his colleagues at Australian Ecosystems and Rakali Consulting has been invaluable for developing this EWMP as well as from local landholders who have seen these wetlands experience conditions from the very wet to very dry and everything in between.

For most of these wetlands the key objective is the retention of surface water in the dams to support local fauna as well as enhancing some flora values. Also in many cases where pipeline capacity is sufficient, environmental watering will include the adjacent wetland vegetation once every several years at least, depending on the wetland vegetation type. This should lead to the improvement of wetland vegetation condition and increase the likelihood of wetland bird, frog and turtle breeding events, without risking vegetation condition declines from overwatering.

Positive social outcomes, namely increased opportunities for yabbying, bird watching and duck hunting will also take place. The presence of more open water bodies also provides an additional resource for firefighting.

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1. Introduction

Within south-east Australia, whilst being a comparatively new concept, environmental water management has advanced significantly in the last decade following the completion of various water recovery and purchase programs. Perhaps this is most obvious in the Wimmera River System, where for decades there has been a concensus that the volume of water harvested to supply towns and farms using open earthen channels and farm dams was having a major detrimental impact on the condition on the region's waterways.

Pioneering work in the late 1980's involved trial 'environmental flows' along the lower Wimmera River and monitoring their effectiveness (Anderson & Morison, 1989) to demonstrate the need for and value of additional water for this reach. There were also some other operational releases that took place outside of drought conditions that had environmental benefits. However, the system was heavily over-allocated and so there simply was not the ongoing water available to supply to the region's regulated waterways to protect their social, environmental and economic values.

It was not until the 1990's that action began to take place to redress this with the progressive construction of several stages of the Northern Mallee Pipeline, meaning that a proportion of water savings from replacing channels and dams with pipes and tanks became available for environmental flows. In the early-2000's further stages of the pipeline were completed, increasing the entitlements available for the environment although the record drought conditions at the time greatly restricted allocations.

The severe water shortages brought about by the drought provided the trigger for the ramping up of pipeline works with the enormous Wimmera Mallee Pipeline Project completed by 2010. This in turn led to further substantial increases to environmental water availability to the Wimmera and Glenelg River systems as well as the creation of a 1000 ML entitlement to supply off-stream wetlands connected to the Wimmera-Mallee Pipeline. Thirteen of these wetlands are located in the Wimmera CMA region. Community members in the northern Wimmera and southern Mallee were instrumental in lobbying government for this entitlement to retain a proportion of the local flora and fauna values that had benefitted for decades from the additional local surface water provided by the channel system.

Within that same period there have also been many improvements to environmental water management institutions and policy. Wimmera CMA took responsibility for planning for environmental water management in the Wimmera in the early 2000's on behalf of the Minister for Environment. Wimmera Mallee Water, the storage manager responsible for environmental water delivery merged with Grampians Water to create GWMWater in 2004. In 2011 and 2008 respectively the Victorian and Commonwealth Environmental Water Holders (VEWH, CEWH) were created to manage the now substantial environmental water portfolios across multiple river and wetland systems.

Policy documents developed in consultation with the community such as *Our Water Our Future* (DSE, 2004), *Western Region Sustainable Water Strategy* (DSE, 2011), *Victorian River Health Strategy* (DSE, 2002) and *Murray Darling Basin Plan* (Australian Government, 2012) progressed the development of water sharing

arrangements to ensure that it is used effectively and productively to benefit the region. The *Water for Victoria* plan which was still being drafted at the time of publication of this document will continue this progression.

In the meantime initial investigations were undertaken to identify the values and optimal watering regimes for these wetlands as well as works undertaken to improve future environmental watering outcomes.

The development of the Environmental Water Management Plan (EWMP) for Wimmera Mallee Pipeline Wetlands in the Wimmera CMA region provides an opportunity to consolidate on these changes and develop a solid foundation document for local environmental water management for the next decade.

1.1. Purpose and Scope of the *Wimmera Mallee Pipeline Wetlands EWMP - Wimmera CMA Region*

The EWMP establishes long-term management objectives for the Wimmera Mallee Pipeline wetlands in the Wimmera CMA region. The objectives are based on the environmental watering opportunities at each wetland.

The EWMP is a 10 year management plan that for 13 wetlands;

- describes the ecological values present;
- sets long-term ecological objectives;
- provides the recommended and feasible watering regimes required to attain the objectives;
- lists the risks and influences involved in environmental watering as well as mitigation strategies; and
- identifies the necessary monitoring to determine the progress towards attaining the objectives.

It has been developed in consultation with the community as well as involving input from experts in environmental water management to provide a robust and thorough planning document for the next decade. It will form the basis for future Seasonal Watering Proposals developed for the Wimmera Mallee Pipeline Wetlands in the Wimmera CMA region and inform the Long-term Watering Plan for the Wimmera-Mallee, as required under the *Murray-Darling Basin Plan* (Chapter 8). The spatial scope of the EWMP is illustrated in Figure 1-1.

Wimmera CMA has been funded through the Department of Environment, Land Water and Planning (DELWP) 'Victorian Basin Plan Environmental Water Management Plan (EWMP) Program' to develop this EWMP.

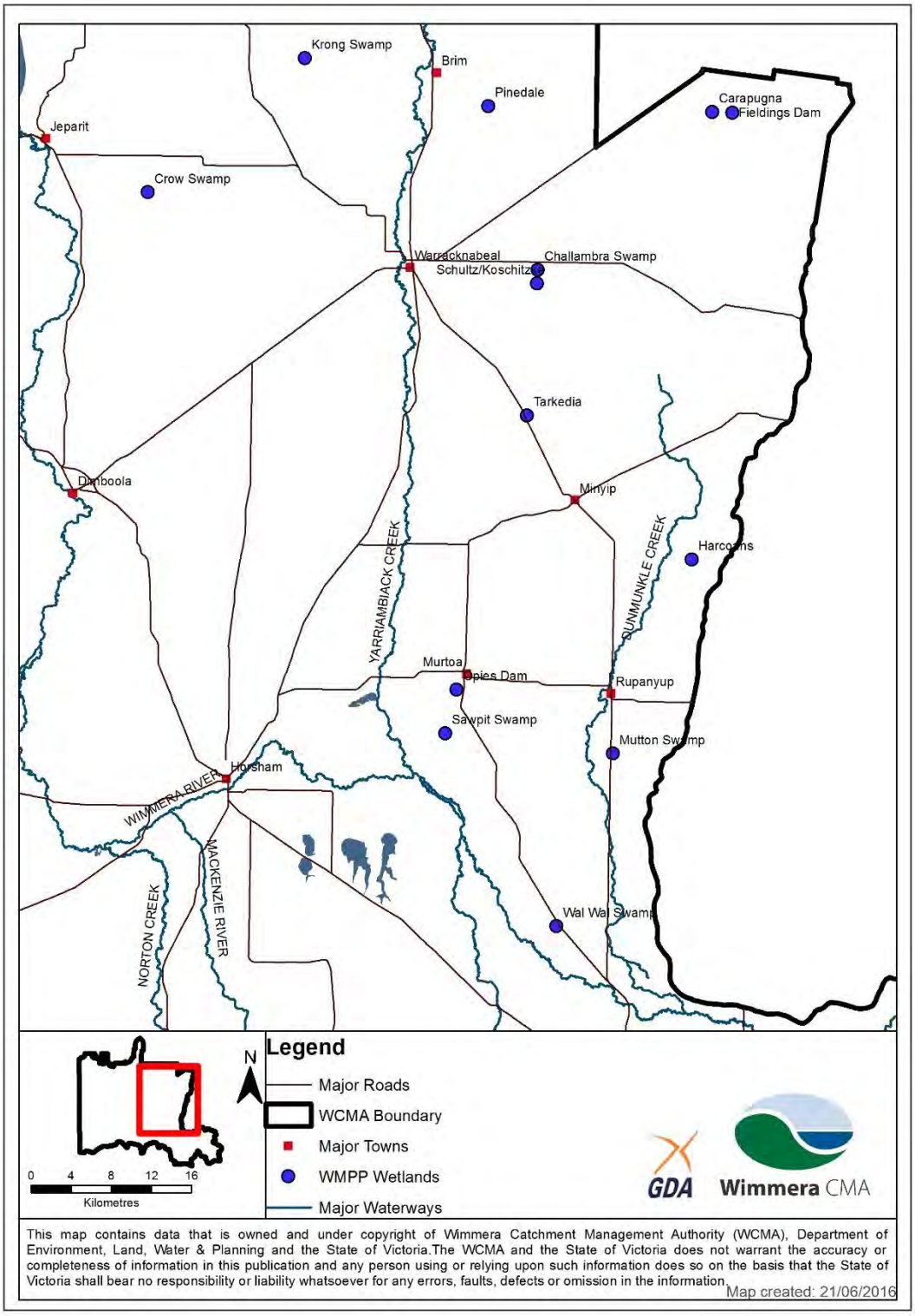


Figure 1-1 Wimmera Mallee Wetlands in the Wimmera CMA Region covered in this EWMP

1.1.1. Policy links: *Victorian Waterway Management Strategy* and *Wimmera Waterway Strategy*

The *Victorian Waterway Management Strategy* (*VWMS*) (DEPI , 2013) provides a single and updated framework for managing waterway health in Victoria. The focus of the *VWMS* is to improve the environmental condition of waterways so that they can support community needs, and to strengthen partnerships between the Government and the community.

A guiding principle regarding environmental water outlined in the *VWMS* is to promote more efficient and effective use. EWMPs for rivers and wetlands implements this principle through setting objectives and targets for priority sites for environmental water delivery. This includes setting environmental water objectives, defining ecological tolerances, and providing additional information regarding management arrangements and delivery constraints.

Following the launch of the *VWMS*, the *Wimmera Waterway Strategy 2014-2022* (*WWS*) (Wimmera CMA, 2014) was developed. The *WWS* is one of 10 regional waterway strategies across Victoria and prescribes a range of local management activities to improve and maintain waterways within the region over eight years. One of the the management activities is the development of an EWMP for the Wimmera Mallee Pipeline Wetlands. This EWMP complements the regional target setting and management activities set out in the *WWS* to facilitiate the integrated planning regarding waterway management in the Wimmera.

The context of EWMPs in the broader environmental water planning framework in Victoria is illustrated in Figure 1-2.

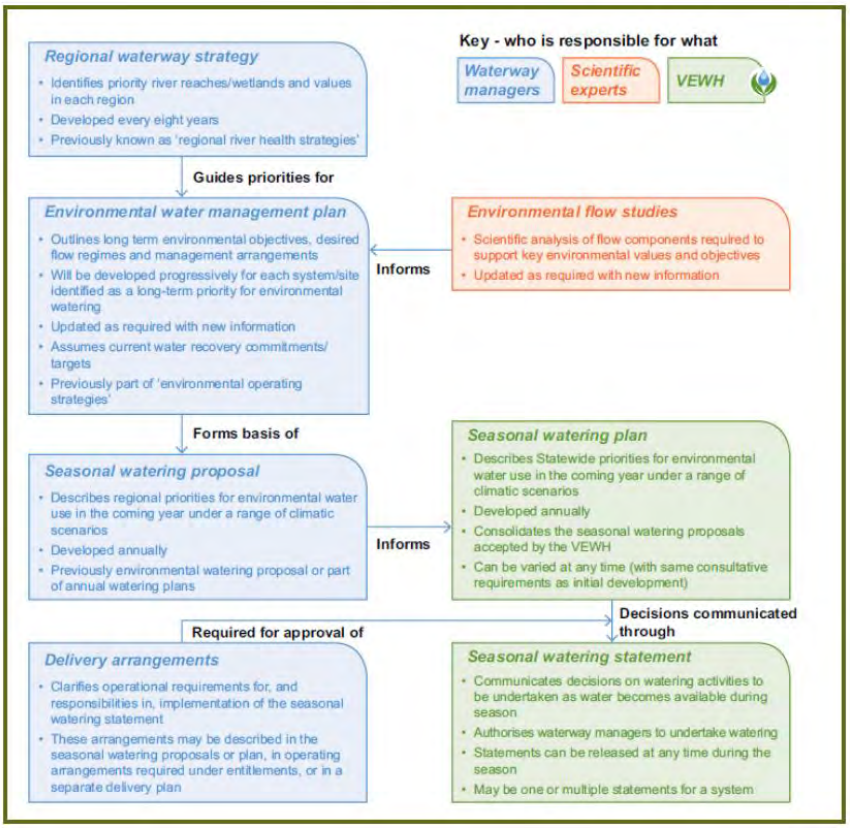


Figure 1-2 **Victorian Environmental Planning Framework**

It should be noted that the scope of the *EWMP* relates to undertaking environmental watering actions to maintain and improve the environmental values of these waterways that rely on watering. It is of course acknowledged that water in the landscape provides recreational values and many of these values (e.g. yabbying) are aligned with appropriate environmental watering. Although environmental water is to achieve environmental outcomes first and foremost, state policy encourages consideration of social and cultural values when undertaking environmental water planning (DEPI , 2013).

1.2.Development Process

This EWMP has been developed in collaboration with relevant stakeholders and community members. A number of tasks were undertaken to develop the EWMP, including using previous information to describe:

- **Water dependent values.** Environmental values have been identified for each wetland. These wetlands are vital habitat for a wide number of water-dependent flora and fauna, however in a largely cleared, agricultural region they are also important habitat for a number of terrestrial species. Social, cultural and economic values have been described where relevant.
- **Current ecological condition and trajectory without environmental water.** The current condition of the wetlands is described based on assessments of the ecologicla and phsyical characteristics. There is also discussion of the trajectory of the wetlands under a “do-nothing scenario” which assumes no environmental water would be delivered and these wetlands would only fill due to localised runoff or flood flows. Note that many wetlands have been to some extent disconnected from their natural catchment or had their hydrology altered by the construction of dams and that without environmental water their condition would decline under a do nothing scenario.
- **Management objectives.** This EWMP develops the ecological objectives for the wetlands based on monitoring information, hydraulic modelling and community consultation. The objectives are also aligned with other strategic documents such as the *Wimmera Regional Catchment Strategy 2013-2019* (Wimmera CMA, 2013), *WWS* and long-term watering plans developed under the Murray Darling Basin Plan.
- **Managing risks.** Long-term risks to achieving management objectives have been identified and assessed. Management activities to mitigate these risks have been developed. Risks associated with delivering environmental water and actions to mitigate risks are prescribed in Seasonal Watering Proposals (or more frequently if required).
- **Environmental water delivery infrastructure.** The infrastructure used to deliver environmental water to these wetlands have been described (including constraints).
- **Demonstrating outcomes.** The EWMP identifies monitoring activities to enable the demonstration of outcomes of environmental watering. Monitoring information is also critical in enabling adaptive management to occur which

will enable environmental water to be used as efficiently and effectively as possible.

- **Knowledge gaps and recommendations.** Whilst a lot of work has been undertaken to improve the collective understanding of physical and ecological responses to environmental water there are still a number of key knowledge gaps that need to be filled to improve environmental water management.

A key element of the devevlopment of the EWMP was community consultation. Community and stakeholder involvement in and understanding of environmental water management can only be seen as a positive. Community input on these wetlands' environmental values as well as ecological and physical responses of the system to environmental watering (or lack thereof) has been invaluable.

This EWMP has also undergone a series of internal and external reviews including by an independent external reviewer prior to finalisation for submission to DEWLP.

2. Wimmera Mallee Pipeline Wetlands

2.1.Site Location and Region

Wimmera Mallee Pipeline wetlands are located in the Wimmera CMA region which is in western Victoria (Figure 2-1), as well as the Mallee and North Central CMA regions. The Wimmera CMA region covers approximately 23,500 km or 13% of Victoria. The landscape is largely cleared agricultural land although there are large tracts of uncleared public land including the Grampians and Little Desert National Parks, the Black Range and Mt Arapiles-Tooan State Parks as well as the Pyrenees and Mt Cole State Forests. Around 50,000 people live in the region with most of the region's income derived from agriculture (dryland cropping and sheep grazing). The Wimmera Mallee Pipeline wetlands are located in the north-eastern portion of the Wimmera CMA region. The main land uses in this area are cropping and grazing with small pockets of native vegetation retained in wildlife and bushland reserves.

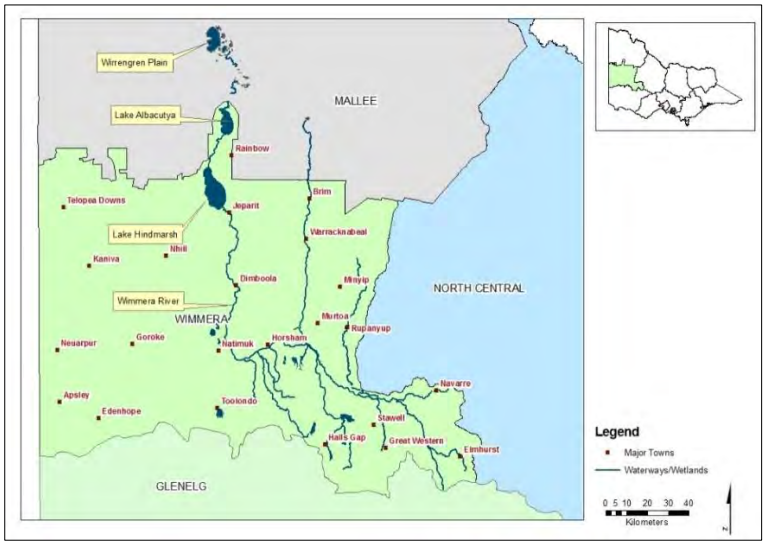


Figure 2-1 **Wimmera CMA Region**

The region's main waterway, the Wimmera River originates in the Pyrenees Ranges near Elmhurst and receives flow from a number of tributaries in the Pyrenees and Grampians whilst heading west through Glenorchy and Horsham. Just east of Mt Arapiles, the Wimmera River swings to the north and continues through Dimboola and Jeparit to Lake Hindmarsh, Victoria's largest freshwater lake. During exceptionally wet periods, Lake Hindmarsh overflows into the episodic Outlet Creek and on to Lake Albacutya, a Ramsar-listed wetland, extending to the Wirrengren Plain in the southern Mallee.

2.2.Catchment Setting

2.1.1.Climate

The Wimmera region's climate is typically semi-arid. Based on rainfall information across the region, average annual rainfall trends from about 580 mm in the south to 380 mm in the north. However in elevated areas (Grampians and Pyrenees) average annual rainfall is higher (1150 mm for Mt William) although a changing climate has led to dry conditions dominating since the late 1990's which subsequently led to annual rainfall totals typically being well below average across the region.

Rainfall, and in turn streamflows are extremely variable with frequent, heavy rainfall events required to generate sufficient runoff to cause waterways to flow in wet years. Little to no overland flows take place in years of below average rainfall.

2.1.2.Physical Features

The headwaters of the Wimmera River are located in the Mt Cole State Forest which is part of the Pyrenees Range. A number of tributaries such as Mt Cole Creek and Glenlofty Creek contribute streamflows as the river heads north-west. A number of other tributaries including Concongella and Heifer Station Creek flow into the river near Stawell from the hill country from Great Western in the south to Navarre and Landsborough in the west. The Wimmera River flows west across a broad floodplain through Glenorchy and towards Horsham, receiving substantial inflows from Mt William Creek which picks up flow from a number of creeks draining the north-eastern Grampians, Black Range (eastern) and hill country near Moyston.

Dunmunkle Creek and Yarriambiack Creek are distributaries which takes flow from the Wimmera River to the north. The Dunmunkle Creek, located near Glenorchy, only flows during bankfull flows in the Wimmera River. Yarriambiack Creek, upstream of Horsham, has been modified so that it flows when the Wimmera River flows. It heads north into a series of terminal lakes near Hopetoun in the Mallee including Lake Lascelles and Lake Corrong.

As it heads west through Horsham the Wimmera River receives flows from a number of waterways which drain the north-western slopes of the Grampians and Black Range (western) such as the MacKenzie River, Burnt Creek and Norton Creek. The Wimmera River then flows north from near Natimuk through Dimboola and Jeparit where it enters Lake Hindmarsh.

Water harvesting and delivery in the Wimmera River system is complex, with numerous channels, pipelines and waterways used to harvests and transfer water to and from storages and to towns, customers and the environment (Figure 2-2). In the

Wimmera River catchment on-stream water storages exist on the MacKenzie River (Lake Wartook), Mount William Creek (Lake Lonsdale) and Fyans Creek (Lake Bellfield). Off-stream storages can harvest water via channels from the Wimmera River and Mount William Creek (Taylor's Lake) and Fyans Creek (Lake Fyans). Notably, transfers are made from storages in the Glenelg River catchment (Rocklands and Moora Moora Reservoirs) to Wimmera River catchment storages (Taylor's Lake and Lake Toolondo). Diversion structures on the headwaters of the Wannon River are also used to transfer water into the Wimmera basin at Lake Bellfield. The system is very efficient at harvesting low-medium streamflows and consequently prior to the change from a channel to pipeline distribution system, the lower Wimmera River received the smallest proportion of flow of any major river system in the Murray-Darling Basin (CSIRO, 2008). However, a proportion of water harvested into this system is in turn returned to the Wimmera and Glenelg River systems via environmental water releases from headworks infrastructure. Water harvested is also supplied to towns, farms, recreation lakes, industry and wetlands.

Figure 2-2 Storage and delivery system – note irrigation demands are no longer present

This EWMP relates to the 13 wetlands supplied by the Wimmera Mallee Pipeline in the Wimmera CMA region (Table 2-1). Typically the pipeline supply involves a small pipe (25mm to 90mm diameter) connected to an adjacent water main that outfalls in or next to the wetland. The wetlands supplied this way include:

Table 2-1 Wimmera Mallee Pipeline Wetlands in the Wimmera CMA region

Crow Swamp	Challambra Swamp
Opie's Dam	Krong Swamp
Sawpit Swamp	Tarkedia
Wal Wal Swamp	Mutton Swamp
Carapugna	Schultz/Koschitzke

Fielding's Dam	Pinedale
Harcoan's Swamp	

Historically, wost of these wetlands relied on local catchment run-off to fill and so this can be episodic – typically during wet winter/spring periods, although very heavy rainfall in summer/autumn can lead to substaintial inflows into these wetlands. A handful are also able to be filled during flooding from local waterways. Their hydrology is discussed in more detail later in the EWMP.

The wetlands have a variety of geomorphic origins. Most are deflation basins which have an associated lunette created by Aeolian (wind-driven) processes moving and depositing sand on the eastern side due to prevailing westerly winds. They are located in swales between ancient north-south trending shoreline ridges created by the transgression and regression of seawater over long periods of time. A couple are floodplain wetlands located in flood-runners that once were the main channel of waterways but have been abandoned due to channel movement across the floodplain over time. The remainder are not so much obvious wetlands but rather local low points in the landscape and have been excavated out to create stock and domestic dams. Dams are present at all wetlands as they were previously supplied by the stock and domestic channel system, the location of the dams in relation to the wetland (if present) are described in the relevant sections of the EWMP that relate to each wetland (Section 7).

2.3.Land status and waterway management

2.3.1.Waterway land status

Waterway land ownership and management across Victoria is an inherently complex issue, with there being combinations of freehold and Crown land often depending on the history of settlement by pastoralists in the 1800's. Therefore for some of the Wimmera Mallee Pipeline wetlands there is a mosaic of land management and tenure, for example Challambra Swamp (Figure 2-3).

Some wetlands are completely located on freehold land (Pinedale, Fielding's Dam and Opie's Dam). Schultz/Koschitzke is mostly located on freehold land although there is a public road bisecting the wetland. The remainder of wetlands (listed below) are located on Crown land managed by Parks Victoria as either Bushland or Wildlife Reserves. The key difference between Wildlife and Bushland Reserves is the fact that hunting is permitted at Wildlife Reserves (subject to conditions).

Wildlife Reserves – Crow Swamp, Mutton Swamp, Sawpit Swamp, Wal Wal Swamp
Bushland Reserves – Harcoans, Krong Swamp, Tarkedia, Carapugna.

For Challambra Swamp, the north-western section (including the dam) is located on freehold land whilst the rests is Crown land (Bangerang Bushland Reserve).

When undertaking environmental watering of freehold land two agreements are entered into to provide appropriate guarantees around the outcomes of environmental watering;

Deed/Letter of Agreement: Describes the requirements for supplying and using water as well as issues around indemnity and access to the wetland. It is signed by the landholder, CMA, GWMWater and VEWH.

Management Agreement: Describes the obligations on the landholder around appropriate management of the wetland to not compromise ecological outcomes (e.g. not clearing native vegetation, allowing duck shooting etc.). It is signed by the landholder and CMA.

Pinedale has a conservation covenants placed on its land title as well by Trust for Nature.

Crow Swamp, May 2016

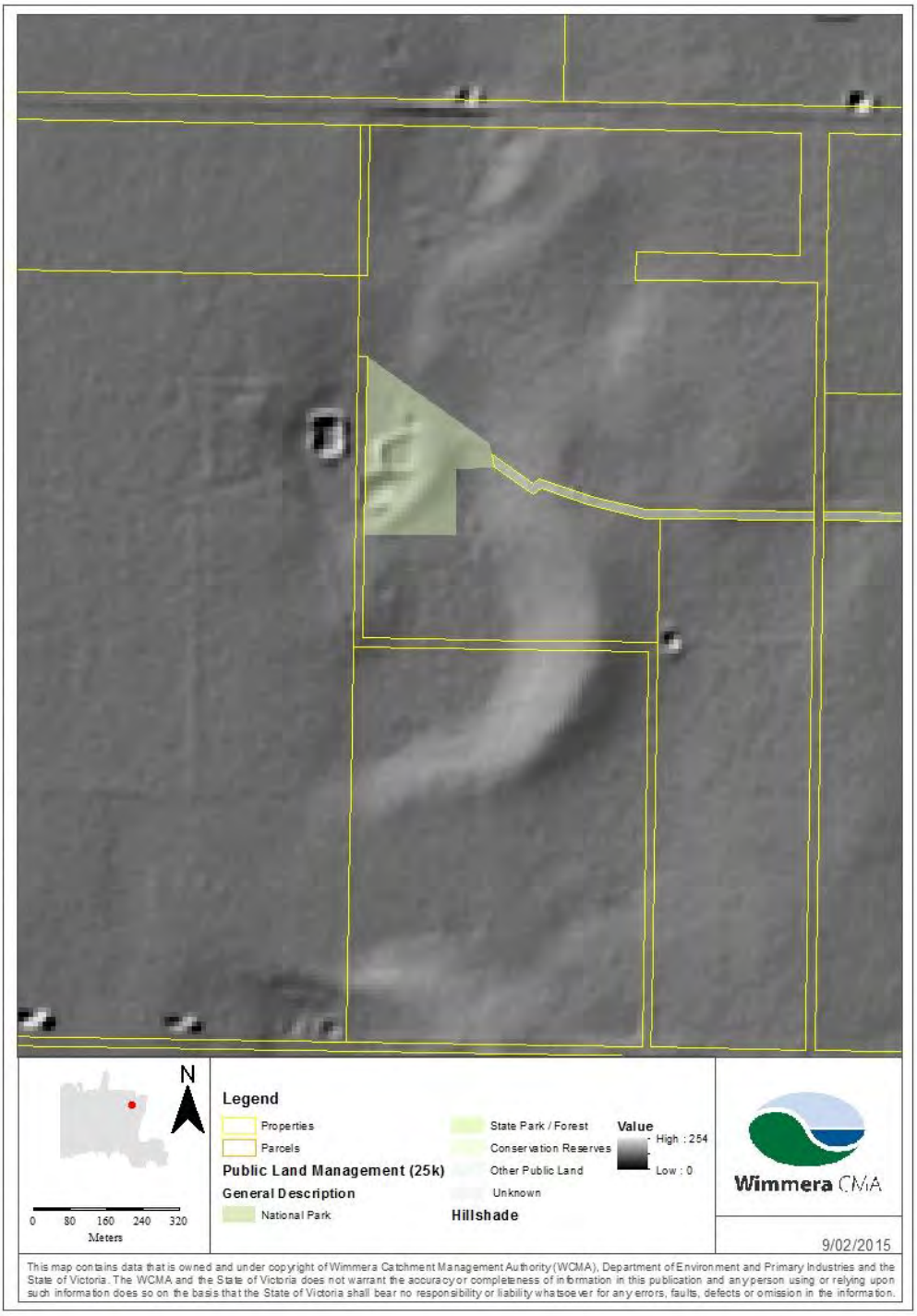


Figure 2-3 Land management arrangements at Challambra.

2.3.2.Roles and Responsibilities for Waterway Management

There are a number of agencies, departments and individuals involved in waterway management in the Wimmera CMA region (Table 2-2).

Table 2-2 Roles and responsibilities for waterway management of the Wimmera Mallee Pipeline wetlands system with respect to environmental water.

Partners	Roles and responsibilities/links with waterways
Department of Environment, Land, Water and Planning (DELWP)	• DELWP is the lead agency for waterway management. It is responsible for the development of waterway policy, co-ordination of regional delivery and prioritisation of Government investment in waterways. DELWP is also responsible for other aspects of natural resource management that are of relevance to environmental water management, including: ▪ sustainable management of Victoria's water resources through managing the water allocation and entitlements framework ▪ developing state policy for water resource and waterway management • DELWP also has a number of other responsibilities that relate to broader waterway management such as oversight of Crown Land and integrated catchment management.
Victorian Environmental Water Holder (VEWH)	• The Victorian Environmental Water Holder is appointed under the Water Act (1989) to manage Victoria's environmental water entitlements. The Victorian Environmental Water Holder works with the waterway managers, Commonwealth Environmental Water Holder, Murray–Darling Basin Authority, storage operators and land managers to ensure environmental water entitlements are used to achieve the best environmental outcomes.
Murray–Darling Basin Authority (MDBA)	• The Murray–Darling Basin Authority was established under the Federal *Water Act (2007)* as an independent, expertise based statutory agency. The primary roles of the Authority as outlined in the *Water Act (2007)* include: ▪ preparing and reviewing the Basin Plan ▪ measuring, monitoring and recording the quality and quantity of the Basin's Water resources ▪ supporting, encouraging and conducting research and investigations about the Basin's Water Resources ▪ promoting equitable and sustainable use of Basin water resources ▪ disseminating information about the Basin's water resources ▪ engaging and educating the Australian community about the Basin's water resources.
GWMWater	Water corporations in Victoria are established under the Water Act (1989) and provide a range of water services to customers within their service areas. GWMWater provide a combination of irrigation services, domestic and stock services, bulk water supply services and urban water and wastewater services in most of the Wimmera CMA Region. Their link with environmental water management is in their role as resource and storage manager – responsible for determining and delivering allocations to holders of environmental water entitlements. Regionally they are also responsible for Blue Green Algae regional coordination and water licencing. They also manage land on which their infrastructure is located (e.g. weirs and storages).
Barengi Gadjin Land Council Aboriginal Council (BGLC)	BGLC can provide advice on how environmental water management may improve or maintain cultural values.
Community members/ representatives	Community members who have a detailed understanding of these waterways can provide advice and feedback on the effect of environmental water management on local waterways.Often they are responsible for managing land adjacent to or including waterways either as a freehold landowner or a licensee of Crown land.
Parks Victoria	Parks Victoria is the responsible land manager for a number of the Wimmera Malee Pipeline wetlands listed in Section 2.2.
Local government	Local government administer planning schemes where the wetlands are located.

Key characteristics of each of the wetlands are summarised in Table 2-3 including size, wetland type, water source and land manager.

Table 2-3 Wetland site details and characterstics

Characteristics	Site Description						
Name	Crow Swamp	Krong Swamp	Fielding's Dam	Carapugna	Mutton Swamp	Pinedale	Opie's Dam
Approx. Wetland Area	5.8 Ha	2.6 Ha	10.8 Ha	37.2 Ha	12.5 Ha	12.4 Ha	NA
Approx. Dam Area	1100 m^2	750 m^2	750 m^2	3,400 m^2	1,700 m^2	2,000 m^2	380 m^2
Bioregion	Wimmera	Murray Mallee	Wimmera	Wimmera	Wimmera	Wimmera	Wimmera
Local Government Area	Hindmarsh Shire	Yarriambiack Shire	Buloke Shire	Buloke Shire	Northern Grampians Shire	Yarriambiack Shire	Yarriambiack Shire
Land Status	Wildlife Reserve	Bushland Reserve	Freehold	Bushland Reserve	Wildlife Reserve	Freehold	Freehold
Land Manager	Parks Victoria	Parks Victoria	Freehold	Parks Victoria	Parks Victoria	Freehold	Freehold
Surrounding Land Use	Cropping/ Grazing	Cropping/ Grazing, Roadmaking gravel storage	Cropping/ Grazing	Cropping/ Grazing	Cropping/ Grazing	Cropping/ Grazing, Residential	Cropping/ Grazing, Residential, Racecourse
Natural Water Supply	Local catchment runoff	Local catchment runoff	Local catchment runoff	Local catchment runoff	Local catchment runoff, flood flows from Dunmunkle Creek	Local catchment runoff	Local catchment runoff
Pipeline Water Supply	Supply System 1 63 mm pipe from 50 mm meter	Supply System 2 63 mm pipe from 50 mm meter	Supply System 3 50 mm meter from 25 mm pipe	Supply System 3 63 mm pipe from 50 mm meter	Supply System 3 50 mm meter from 90 mm pipe	Supply System 2 50 mm meter from 63 mm pipe	Supply System 2 63 mm pipe from 50 mm meter
Corrick Wetland Category	Shallow Freshwater Marsh	Freshwater Meadow	NA	NA	Freshwater Meadow	Shallow Freshwater Marsh	NA
Estimated Wetland Capacity	37.5 ML	11 ML	10 ML	50.4 ML	39 ML	12.9 ML	2 ML

Characteristics	Site Description					
Name	Tarkedia	Schultz/Koschitzke	Sawpit Swamp	Wal Wal Swamp	Harcoans	Challambra Swamp
Approx. Wetland Area	6.7 Ha	6.7 Ha	5.1 Ha	9.5 Ha	8.5 Ha	5.8 Ha
Approx. Dam Area	1700 m^2	550 m^2	1,600 m^2	3,900 m^2	1,700 m^2	2,600 m^2
Bioregion	Wimmera	Wimmera	Wimmera	Wimmera	Wimmera	Wimmera
Local Government Area	Yarriambiack Shire	Yarriambiack Shire	Yarriambiack Shire	Northern Grampians Shire	Yarriambiack Shire	Yarriambiack Shire
Land Status	Wildlife Reserve	Freehold	Wildlife Reserve	Wildlife Reserve	Bushland Reserve	Freehold/Bushland Reserve
Land Manager	Parks Victoria	Freehold	Parks Victoria	Parks Victoria	Parks Victoria	Freehold
Surrounding Land Use	Cropping/Grazing	Cropping/Grazing	Cropping/Grazing	Cropping/Grazing	Cropping/Grazing	Cropping/Grazing
Natural Water Supply	Local catchment runoff	Local catchment runoff	Flood flows from the Wimmera River via Corkers Creek	Local catchment runoff and flood flows from the Wimmera River	Local catchment runoff	Local catchment runoff
Pipeline Water Supply	Supply System 3 63 mm pipe from 50 mm meter	Supply System 2 63 mm pipe from 50 mm meter	Supply System 2 90 mm pipe from 50 mm meter	Supply System 3 63 mm pipe from 50 mm meter	Supply System 3 63 mm pipe from 50 mm meter	Supply System 2 90 mm pipe from 50 mm meter
Corrick Wetland Category	NA	Freshwater Meadow	Shallow Freshwater Marsh	Shallow Freshwater Marsh	Shallow Freshwater Marsh	Freshwater Meadow
Estimated Wetland Capacity	12.5 ML	50 ML	83.5 ML	16.5 ML	40 ML	46.4 ML

2.4.Environmental Water Sources

Under the *Water Act (1989)*, the Environmental Water Reserve (EWR) is the legally recognised amount of water set aside to meet environmental needs. The Reserve can include minimum river flows, unregulated flows and specific environmental entitlements. Allocations within environmental entitlements can be called out of storage when needed and delivered to wetlands or streams to protect their environmental values and health. In this case, allocations from the environmental entitlement are supplied to these wetlands via outlets from the Wimmera Mallee Pipeline.

The Victorian Minister for Environment and Climate Change has appointed Commissioners to Victoria's independent body for holding and managing environmental water – the Victorian Environmental Water Holder (VEWH) to be responsible for holding and managing Victoria's environmental water entitlements, and making decisions on their use.

Environmental Water for these wetlands may be sourced from the water entitlements and agency listed in Table 2-4 (below).

Table 2-4 Summary of environmental water sources available for the Wimmera Mallee Pipeline Wetlands in the Wimmera CMA region.

Water Entitlement	Volume (ML)	Responsible Agency
Wimmera and Glenelg Rivers Environmental Entitlement*	**1,000 ML high reliability**	**Victorian Environmental Water Holder**

*Note this entitlement is shared with wetlands in the Mallee and North Central CMAs.

The reliability of this entitlement is slightly less than the environmental entitlement for the Wimmera and Glenelg Rivers in drought conditions, reflecting the more modest environmental values and watering requirements compared to the river systems. It is of a similar reliability as GWMWater's entitlements for recreational lakes and the Glenelg Compensation Flow.

2.5.Legislative and policy framework

2.5.1.State

The *VWMS* (DEPI , 2013) provides the framework for government, in partnership with the community, to manage rivers, estuaries and wetlands so they can support environmental, social, cultural and economic values now and into the future. The *VWMS* updates the *Victorian River Health Strategy* (DSE, 2002) (*VRHS*) which was a significant milestone for river management in Victoria. It outlined clear principles for making regional decisions on river protection and restoration, identifying regional priorities for management activities and state-wide direction on important management issues affecting waterway health.

Victoria's water allocation framework provides the basis for the management of Victoria's water resources. Under the *Water Act 1989*, the Victorian Government retains the overall right to the use, flow and control of all surface water and

groundwater on behalf of all Victorians. All water taken for consumptive purposes is done so under entitlements set out in the *Water Act 1989*. Victoria's water allocation framework takes a whole-of-system water management approach and considers all water resources (surface water and groundwater) for both consumptive and environmental purposes at all phases of the water cycle. Like surface water, groundwater is allocated for commercial and irrigation purposes under strict licensing arrangements under the *Water Act 1989*.

The key state-wide policy framework for water quality protection in Victoria is the *State Environment Protection Policy (Waters of Victoria) 2003 (SEPP WoV)*. It provides a statutory framework for State and local government agencies, businesses and communities to work together to protect and rehabilitate Victoria's surface water environments. The *SEPP WoV* identifies beneficial uses of water and sets the environmental water quality objectives and policy directions required to address higher risk impacts and activities.

The *Flora and Fauna Guarantee Act 1988* (*FFG Act*) is the key piece of Victorian legislation for the conservation of threatened species and communities and for the management of potentially threatening processes. The *FFG Act* lists threatened species and ecological communities and threatening processes.

The *Catchment and Land Protection Act 1994* (*CaLP Act*) establishes Regional Catchment Strategies (RCSs) as the primary framework for integrated management of land, water and biodiversity in each of the ten catchment regions of Victoria. The Wimmera CMA is responsible for preparing and revising the Wimmera Regional Catchment Strategy and co-ordinating and monitoring its implementation. Regulations made under the *CaLP Act* set out obligations of land managers with respect to invasive plant and animal control.

2.5.2. Regional

The *Wimmera Regional Catchment Strategy (2013-2019)* (*Wimmera RCS*) (Wimmera CMA, 2013) is the overarching strategy for natural resource management in the Wimmera region, under which sit a range of sub-strategies and action plans. It contains a long-term vision for the region, identifies regionally significant natural assets and sets 20 year condition objectives and six year management measures. The *Wimmera RCS* involved extensive community consultation to ensure that the document reflects contemporary community values and aspirations.

Regional planning processes for waterway management were established in 2002 under the *VRHS* and implemented through the ten Regional River Health Strategies (RRHSs). In the case of the Wimmera CMA region, given the importance of wetlands in the region, it was called the *Wimmera Waterway Health Strategy 2006-2011* (Wimmera CMA, 2006) (*Wimmera WHS*) which includes creeks, rivers and wetlands under the definition of 'waterway'. Community input and participation in these regional planning processes was a critical element to ensure that regional planning reflected the community values of waterways in each region. Following the elapsing of the *Wimmera WHS*'s timeframe, the *Wimmera Waterway Strategy 2014-2022* (WWS) was developed to be the current strategic waterway planning document for the region

Water resource planning in Victoria is addressed through the development of regional Sustainable Water Strategies (SWSs) that set out long-term regional plans

to secure water for regional growth, while safeguarding the future of its rivers and other natural water sources. They investigate the range of potential changes to water availability under several climate change scenarios. The regional SWSs examine future consumptive demand and environmental needs and set out proposed options to balance and secure water for all users. The SWSs are where the Victorian Government, in partnership with regional communities, decides whether additional water is required for environmental or consumptive needs. In the Wimmera, the *Western Region Sustainable Water Strategy* (DSE, 2011) (*Western Region SWS)* provided a number of actions and policies with respect to water resource management in the region.

2.5.3.National

At the federal level, water reform has been guided by the National Water Initiative (NWI) since 2004. Under this agreement, state and territory governments across Australia have committed to actions to achieve a more cohesive national approach to the way Australia manages, measures, plans for, prices, and trades water. The NWI recognises the need to build on the water reforms of the 1994 Council of Australian Government (COAG) agreement to ensure increased productivity and efficiency of Australia's water use. It includes clear steps to return river and groundwater systems to environmentally sustainable levels of extraction and achieve integrated management of environmental water.

There has also been significant legislative reform in water resource management at the federal level. The Water Act 2007 *(Cth)* established the Murray-Darling Basin Authority (MDBA) and required the MDBA to prepare the *Basin Plan* – a strategic plan for the integrated and sustainable management of water resources in the Murray-Darling Basin. The Act also established the Commonwealth Environmental Water Holder to manage the Commonwealth's environmental water. The Water Amendment Act 2008 *(Cth)* transferred the functions of the former Murray-Darling Basin Commission to the new Murray-Darling Basin Authority (MDBA). The MDBA is now the single body responsible for overseeing water resource planning in the Murray-Darling Basin. The *Basin Plan 2012*, a strategic plan for the integrated and sustainable management of water resources, was signed into law in November 2012. The *Basin Plan* sets legal limits on the amount of surface water and groundwater that can be taken from Victoria's share of the Murray-Darling Basin from 1 July 2019 onwards.

The *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* (Australian Government, 1999) (*EPBC Act*) is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect matters of national environmental significance (NES) which include wetlands of international importance (Ramsar sites), nationally threated species and ecological communities, listed migratory species (those listed under international migratory bird agreements and the Bonn Convention) and heritage places defined in the Act as matters of NES. Waterway related matters of NES in the Wimmera region include Lake Albacutya Ramsar Site, several nationally threatened and listed migratory species and a nationally threatened ecological community (Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains).

The *Native Title Act 1993 (Cth)* provides a framework for the protection and recognition of native title. The *Native Title Act* gives Indigenous Australians who hold native title rights and interests or who have made a native title claim the right to be

consulted and, in some cases, to participate in decisions about activities proposed to be undertaken on the land where rights exist.

2.5.4. International

The Australian Government has ratified several international human rights instruments that recognise and protect Indigenous peoples' special connection to land and waters and provide for the right to practice, revitalise, teach and develop culture, customs and spiritual practices and to utilise natural resources (for example, the *United Nations Declaration of Rights of Indigenous Peoples*).

The Convention on Wetlands of International Importance (the Ramsar Convention) provides the framework for national action and international co-operation for the conservation and wise use of wetlands and their resources. The Convention encourages contracting parties such as Australia to nominate sites containing representative, rare or unique wetlands, or that are important for conserving biological diversity, and to the List of Wetlands of International Importance, for example Lake Albacutya Ramsar Site.

International treaties have been made with the nations of Japan, China and the Republic of Korea for the protection of migratory birds that travel between these countries and Australia and their habitat. International migratory species are also protected under the *Convention on Migratory Species*. Wetlands in the region can provide habitat for these bird species.

3. Hydrology and System Operations

3.1. Waterway Hydrology

Prior to European settlement, most of these wetlands would rely on very wet conditions to generate sufficient local run-off from adjacent higher areas in the surrounding catchments. These local high points are typically defined by the ridges on either side of the swale the wetland was located in and sometimes the local catchments are quite large in area. In the case of Sawpit, Wal Wal and Mutton Swamps, flood flows in adjacent waterways would also lead to these wetlands filling.

As the Wimmera Mallee Stock and Domestic Channel system grew in size in the early 20th century, the gravity-fed channels would often terminate in wetlands given they were local low points in the landscape The filling of wetlands and/or dams via the channel system could be done deliberately during wet years if there was a lot of water in storages and waterways. Once the dams along the channel were filled, sometimes the remaining water in the channel was emptied into these wetlands. Also if there was a heavy rainfall event local inflows could also enter via the channel. Filling the wetlands would assist landowners by providing another watering point for stock as well as being a haven for local wildlife as conditions dried out. Changes in the landscape such as raised roads and channel embankments as well as cropping practices created impacts on local hydrology in some cases – preventing water from reaching these wetlands.

It should be noted that the channel stock and domestic supply system was comparatively unreliable (e.g. restrictions were in place about 30% of the time) and so the filling of these wetlands and dams was never an annual occurrence for long

periods of time. The reason for this is that the Wimmera has a highly variable flow regime. The headworks system is operated to harvest large volumes during wet years which can then be released in subsequent dry years. Enormous losses were incurred in running earthen channels, as well as storing water in dams in such a dry climate. Therefore water storages were drawn down very quickly when drier conditions prevailed.

The issues with the channel supply system culminated in the Millennium Drought, where below average rainfall from 1997 to 2009 led to ongoing shortfalls in water supply. With insufficient water to supply farm and house dams, most wetlands located on Crown land remained dry whilst ones on freehold land were filled more frequently. However as the drought worsened, annual dam fills were replaced by water carting.

A very wet six month period from mid-2010 to early-2011 was a drastic contrast to the previous drought conditions. Heavy rainfall in August-September 2010, December 2010 and January 2011 led to these wetlands receiving substantial inflows and in many cases filling. Since that time, dry conditions have returned and inflows have been minimal or non-existent in most cases apart from supplies from the Wimmera Mallee Pipeline.

3.1.1.Groundwater – surface water interaction

Given the height above regional groundwater levels, there are no known interactions with groundwater for these wetlands. For example Crow Swamp is probably the closest to the regional groundwater level given its proximity to the Wimmera River at Jeparit which is prone to saline groundwater intrusions however data for the nearest groundwater bores to the wetland indicates a depth to groundwater of between 10m and 20m.

3.2.System Operations – History of Use

3.2.1.Water Management and Delivery

As part of the business case for the construction of the Wimmera Mallee Pipeline, a 1000 ML entitlement was established from the project's water savings to water off-stream wetlands within the footprint of the pipeline. This arose due to community concerns around the potential consequences the loss of a significant number of surface water bodies would have on local fauna once stock and domestic dams were replaced by tanks and troughs.

Following the completion of the Wimmera Mallee Pipeline, a Wetland Evaluation Team (WET) was formed consisting of representatives of Birchip Landcare Group, Mallee CMA and GWMWater. This group determined criteria to prioritise the wetlands to be connected to the Wimmera Mallee Pipeline for supply. Advertisements in local media asked community members to nominate wetlands. Wetlands were prioritised for connection based on the criteria determined by the WET. The criteria included environmental values, proximity to the pipeline and impact on water pressure to adjacent properties. Eligible wetlands had to have been previously connected to the stock and domestic channel system.

Initially nine wetlands in the Wimmera CMA were listed for connection to the pipeline with Sawpit Swamp being one of several fast-tracked for connection as a trial site. After the initial connections works were undertaken, there was still scope within the connection budget to connect a small number of additional sites and so an additional four were connected in the Wimmera CMA region bringing the combined total up to 13.

Therefore the process led to a total of 51 wetlands across the Wimmera, Mallee and North Central CMAs being connected for supply. Since these works were undertaken a number of landholders have expressed interest in having wetlands on their properties connected, however additional funding will need to be sourced to connect them. Mallee CMA is compiling a list of interested landholders on behalf of the three CMAs should the opportunity arise.

Initially wetlands were connected to the Wimmera Mallee Pipeline with small diameter (23mm - 90mm) pipes that would outfall in either the dam itself or the remnant channel that supplied the dam. In a number of cases the physical configuration of the dam in relation to the wetland meant that the wetland would not be able to be watered once the dam filled. In response to this Wimmera CMA engaged RPS in 2014 to investigate options for enhancing the hydrology of these wetlands through modifying some wetlands through cutting channels between the dam and wetland or installing additional pipes and outlets. Details around this are outlined in the relevant sections about each wetland as well as in *Wimmera Mallee Pipeline Wetlands Hydrological Enhancement Project* (RPS, 2014).

3.2.2.Environmental Watering History

Details around watering of these wetlands at the time of the drafting of this EWMP is in the discussion for each wetland in Section 7.

4. Water Dependent Values

4.1.Water Dependent Environmental Values

4.1.1.Listings and Significance

The Wimmera Mallee Pipeline wetlands in the Wimmera CMA support a wide variety of flora and fauna species, several of high conservation significance. It is expected that when these other wetlands contain water, more species of significance may be identified.

Due to the small size of the wetlands, none are listed in the directory of important wetlands or recognised as having international or national significance. However locally they represent important pockets of biodiversity in a largely cleared agricultural landscape.

Table 4-1 Lists developed under legislation, agreements or conventions that apply to the Wimmera Mallee Pipeline wetlands in the Wimmera CMA region

List	Jurisdiction	Lakes
Japan Australia Migratory Birds Agreement (JAMBA)	International	X

China Australia Migratory Birds Agreement (CAMBA)	International	X
Republic of Korea Australia Migratory Birds Agreement (ROKAMBA)	International	X
Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)	International	X
Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)	National	✓
Flora and Fauna Guarantee Act 1988 (FFG Act)	State	✓
DELWP Advisory Lists	State	✓

* whilst migratory species have not been observed at these wetlands – monitoring has not taken place when they contained large volumes of water when they are likely to support these species (Damien Cook, *pers. comm*).

4.1.2.Fauna

The following section outlines the various fauna species that have been observed in and around the Wimmera Mallee Pipeline wetlands in the Wimmera CMA, in particular threatened species. A complete list of fauna species is in Appendix 3 whilst threatened species are listed in Section 7 for each wetland.

Growling Grass Frogs are known to live at Opie's Dam (Evelyn Nicholson, DELWP, *pers. comm.*) A Lace Monitor has been observed at Fielding's Dam by a motion sensor camera. Eastern Long-necked Turtles have been observed at Opie's Dam (Rakali Consulting, 2014) and they have been recently added to the Victorian Advisory List as 'data deficient'. Further details are listed in Table 4-2.

Table 4-2 Threatened frog and reptile Species observed at Wimmera Mallee Pipeline Wetlands in the Wimmera CMA region and associated status

Species name	Common name	EPBC Act status	FFG Act Status	Vic Advisory List Status
Varanus varius	Lace Monitor			**Endangered**
Litoria raniformis	Growling Grass Frog	**Vulnerable**	**Threatened**	**Endangered**
Chelodina longicollis	Eastern Long-Necked Turtle			**Data Deficient**

Figure 4-1 Eastern Long-necked Turtle hatchling at Opie's Dam (Rakali Consulting, 2014)

These wetlands have been anecdotally known to support high value bird communities through a range of climatic conditions. In dry conditions, a number of species that are part of the threatened Victorian Temperate Woodland Bird Community listed under the FFG Act (e.g. Jacky Winters, Dusky Woodswallows, Hooded Robins and Brown Treecreepers) rely on these wetlands areas for habitat. When they contain water they are havens for a number of wetland bird species. Most information around bird values of these wetlands has been derived from *Wetland Condition Monitoring along the Wimmera Mallee Pipeline* (Australian Ecosystems, 2013, Rakali Consulting, 2014).

Table 4-3 Threatened Bird Species observed at Wimmera Mallee Pipeline wetlands in the Wimmera CMA region and associated status

Species name	Common name	EPBC Act status	FFG Act Status	Vic Advisory List Status
Rostratula australis	Australian Painted Snipe	**Vulnerable**	**Threatened**	**Critically Endangered**
Falco subniger	Black Falcon			**Vulnerable**
Melithreptus gularis	Black-chinned Honeyeater			**Near Threatened**
Ardea modesta	Eastern Great Egret		**Threatened**	**Vulnerable**
Aythya australis	Hardhead			**Vulnerable**
Melanodryas cucullata	Hooded Robin		**Threatened**	**Near Threatened**
Circus assimilius	Spotted Harrier			**Near Threatened**
Lophioctinia isura	Square-tailed Kite		**Threatened**	**Vulnerable**

4.1.3.Flora and Vegetation Communities

Little was known of the vegetation values of these wetlands until they were assessed as part of the *Wetland Condition Monitoring along the Wimmera Mallee Pipeline* reports (Australian Ecosystems, 2013, Rakali Consulting, 2014) which involved assessing the wetlands to determine an Index of Wetland Condition (IWC) score as well as establish vegetation transects for future monitoring. A comprehensive list of flora species identified in these wetlands in this EWMP is listed in Appendix 2.

Table 4-4 list the wide variety of Ecological Vegetation Classes (EVCs) that have been identified for the various Wimmera Mallee Pipeline wetlands in the Wimmera CMA region.

Table 4-4 Ecological Vegetation Classes (EVCs) for the Wimmera Mallee Pipeline wetlands in the Wimmera CMA region and their Bioregional Conservation Status

EVC Name	Bioregion	Bioregional Conservation Status	Wetlands
Black Box Wetland	Wimmera	Endangered	Carapugna, Challambra, Harcoans, Mutton, Pinedale, Schultz/Koschitzke
Black Box Wetland	Murray Mallee	Not recognised in the Mallee bioregion, probably endangered	Krong
Cane Grass Wetland – Aquatic Herbland Complex	Wimmera	Vulnerable	Wal Wal
Floodway Pond Herbland	Wimmera	Not recognised in the Wimmera bioregion, probably endangered	Sawpit
Floodway Pond Herbland – Riverine Swamp Forest Complex	Wimmera	Not recognised in the Wimmera bioregion, probably endangered	Sawpit
Intermittent Swampy Woodland	Wimmera	Vulnerable	Crow, Sawpit
Lake Bed Herbland	Wimmera	Rare	Challambra, Crow, Harcoans, Mutton
Lignum Shrubland	Murray Mallee	Endangered	Krong
Lignum Swampy Woodland	Murray Mallee	Vulnerable	Krong
Lignum Swampy Woodland	Wimmera	Vulnerable	Tarkedia
Plains Woodland – Gilgai Wetland Mosaic	Wimmera	Endangered	Wal Wal, Fielding's Dam
Plains Grassy Wetland – Spike-sedge Wetland Complex	Wimmera	Not recognised in the Wimmera bioregion, probably endangered	Schultz/Koschitzke
Red Gum Swamp – Cane Grass Wetland Complex	Lowan Mallee	Vulnerable	Wal Wal
Riverine Chenopod Woodland	Wimmera	Depleted	Carapugna, Crow, Pinedale
Riverine Swamp Woodland	Wimmera	Least Concern	Wal Wal

A number of threatened plant species were identified in (Australian Ecosystems, 2013) (Rakali Consulting, 2014), most of them are wetland species.

Table 4-5 Threatened Flora Species for the Wimmera Mallee Pipeline wetlands in the

Wimmera CMA region and associated status

Species name	Common name	EPBC Act status	FFG Act Status	Vic Adv List Status	Wetland
Callirtriche umbonata	Winged Water-starwort			Rare	Carapugna, Mutton, Sawpit, Wal Wal
Cardamine lineariloba	Western Bitter-cress			Vulnerable	Carapugna
Myriophyllum porcatum	Ridged Water-milfoil	Vulnerable	Threatened	Endangered	Carapugna, Schultz/ Koschitzke
Ranunculus pumilio var. politus	Ferny Small-flower Buttercup			Poorly Known	Carapugna, Pinedale, Wal Wal
Ranunculus sessiliflrous var. pilulifier	Annual Buttercup			Poorly Known	Carapugna
Teucrium albicaule	Scurfy Germander			Poorly Known	Carapugna, Crow, Krong
Duma horrida subsp. horrida	Spiny Lignum			Rare	Challambra, Krong, Mutton, Tarkedia, Schultz/ Koschitzke
Eragrostis australasica	Cane Grass			Vulnerable	Krong
Sclerolaena napiformis	Turnip Copperburr	Endangered	Endangered	Endangered	Mutton, Sawpit
Wurmbea dioica subsp. lacunaria	Swamp Early Nancy			Poorly Known	Mutton
Amphibromus fluitans	River Swamp Wallaby-grass			Poorly Known	Sawpit, Wal Wal
Asperula wimmerana	Wimmera Woodruff			Rare	Sawpit
Cardamine moirensis	Riverina Bitter-cress			Poorly Known	Sawpit
Eragrostis lacunaria	Purple Love-grass			Vulnerable	Sawpit
Eucalyptus X oxyporna	Deniliquin Box			Poorly Known	Sawpit
Geranium sp. 3	Pale-flower Crane's Bill			Rare	Sawpit
Ptilotus erubescens	Hairy Tails			Endangered	Sawpit
Cardamine paucijuga s.s. (type form)	Annual Bitter-cress			Endangered	Wal Wal
Amyema linophylla subsp. orientale	Buloke Mistletoe			Vulnerable	Fielding's
Gratiola pumilo	Dwarf Brooklime			Rare	Fielding's
Isolepis australiensis	Inland Club-sedge			Poorly Known	Fielding's

Species name	Common name	EPBC Act status	FFG Act Status	Vic Adv List Status	Wetland
Allocasuarina luehmannii	Buloke		**Threatened**		**Carapugna, Harcoans, Crow, Wal Wal, Fielding's**

Figure 4-2 Ridged Water-milfoil at Carapugna (Australian Ecosystems, 2013)

4.1.4.Wetland Type Depletion and Rarity

A large number of wetlands have been modified in the Wimmera CMA region due to activities such cropping, drainage and dam excavation. In 2004, it was determined that around 18% of wetlands have been modified to such an extent that they are no longer functioning as wetlands. Of these wetlands lost, 92% are either freshwater meadows or shallow freshwater marshes (Wimmera CMA, 2011) – the two types of wetlands covered in this EWMP. This loss of wetlands is potentially greater in the north-west section of the Wimmera CMA region where the drier climate makes draining and cropping wetlands less of a financial risk than in other parts of the region such as the south-west Wimmera.

The completion of the Wimmera Mallee Pipeline has reduced the extent of surface water across some parts of the region. This gives the pipeline wetlands increased significance. The wetlands are havens for local fauna and kangaroos, wallabies, turtles and birds seek out these locations, especially in summer/autumn.

Individuals and Landcare groups have been installing wildlife ponds across the region, an initiative of the Birchip Cropping Group. These ponds are very small; guidelines on their construction indicate that they should contain 5,000 litres and typically use around 18,000 litres a year (BCG, 2015). Additional information on wildlife ponds and the mapped location of certain surface water points in the landscape is on the Birchip Cropping Group's website (**HTTP://WWW.BCG.ORG.AU/WILDLIFE_PONDS/INDEX.PHP**).

Therefore the presence of wetlands and surface water across the landscape is important for local fauna. Table 4-6 highlights the distance from other locations that are likely to contain water under most climatic circumstances.

Table 4-6 Name and proximity of surface water bodies likely to contain water under most conditions to Wimmera Mallee Pipeline wetlands in the Wimmera CMA region

Wetland	Nearest location likely to contain water	Straight Line Distance
Crow Swamp	Wimmera River	8.1 km
Krong Swamp	Brim Weir Pool	11.2 km
Pinedale	Brim Weir Pool	7.9 km
Tarkedia	Minyip Wetlands	9.3 km
Opie's Dam	Lake Marma	1 km
Sawpit Swamp	Wimmera River/Lake Marma	5 km/5.75km
Mutton Swamp	Jack Emmett Lagoon	6.8 km
Harcoans	Minyip Wetlands	13.5 km
Fielding's Dam	Watchem Lake	9.1 km
Carapugna	Watchem Lake	11 km
Challambra	Warracknabeal Weir Pool	14 km
Schultz/Koschitzke	Warracknabeal Weir Pool	13.8 km
Wal Wal Swamp	Wimmera River	3.1 km

4.2.Ecosystem Functions

'Ecosystem function' is the term used to define the biological, geochemical and physical processes and components that take place or occur within an ecosystem. Ecosystem functions relate to the structural components of an ecosystem (e.g. vegetation, water, soil, atmosphere and biota) and how they interact with each other, within ecosystems and across ecosystems (Maynard, James, & Davidson, 2012). Ecosystem functions that are critical to the primary water dependent environmental values of wetlands connected to the Wimmera Mallee Pipeline include the following:

- **Food Production** – a critical function is the conversion of matter to energy for uptake by biota. Structural components include substrate surfaces (e.g. large woody habitat and rocks) for biofilms, and plant matter. Interactions between primary producers and consumers such as zooplankton and macroinvertebrates break down the carbon and nutrients required for higher order consumers.
- **Reproduction** – recruitment of new individuals is important for wetlands' primary values such as waterbirds, frogs, turtles and wetland and aquatic vegetation.

  Waterbirds take advantage of times when large volumes of water are in the wetlands to breed. Frogs and turtles only require enough water to rear and raise young. Wetland and aquatic vegetation species simply require the presence of water of for sufficient time to compete life-cycles.
- **Movement/Dispersal** – movement of individuals between wetlands in this case would only be related to waterbirds. Large areas of cleared agricultural land between these wetlands would prevent or serverely restrict the movement of other species.

The *Basin Plan* specifies the need to "identify priority environmental assets and priority ecosystem functions, and their environmental water requirements (Australian Government, 2012). Section 8.50 of the Basin Plan outlines the

method for identifying ecosystem functions that require environmental watering and their environmental watering requirements (Schedule 9 – Criteria for identifying an ecosystem function).

The ecosystem functions that are provided by the sites are described in Table 4-7.

Common Nardoo, Mutton Swamp, May 2016

Table 4-7 Ecosystem Functions listed in Schedule 9 of the Basin Plan compared to those in Wimmera Mallee Pipeline Wetlands

Criteria		Meets criterion	Explanation
1.	The ecosystem function supports the creation and maintenance of vital habitats and populations		
	Assessment indicator: An ecosystem function requires environmental watering to sustain it if it provides vital habitat including:		
	(a) A refugium for native water-dependent biota during dry periods and drought; or	✓	The supply of water to wetlands in dry conditions will be critical given the lack of other surface water locations across the region.
	(b) Pathways for the dispersal, migration and movement of native water dependent biota; or	✓	Wetlands are almost all non-floodplain and are not physically connected so water dependent biota would not use these wetlands as a pathway for movement etc. However waterbirds could use these wetlands as stopover points during migrationary movements.
	(c) A diversity of important feeding, breeding and nursery sites for native water-dependent biota; or	✓	These wetlands would support a diversity of wetland flora and fauna when wet, including threatened species like Growling Grass Frogs and Ridged Water-milfoil.
	(d) A diversity of aquatic environments including pools, riffle and run environments; or	×	Wetlands will vary in depth as they fill and dry out with deep water remaining longest in dams.
	(e) A vital habitat this is essential for preventing the decline of native water-dependent biota.	✓	Watering these wetlands will be important for the preservation of a number of water-dependent species such as Growling Grass Frogs and Ridged Water-milfoil at a local scale
2	The ecosystem function supports the transportation and dilution of nutrients, organic matter and sediment		
	Assessment indicator: An ecosystem function requires environmental watering to sustain it if it provides for the transportation and dilution of nutrients, organic matter and sediment, including:		
	(a) Pathways for the dispersal and movement of organic and inorganic sediment, delivery to downstream reaches and the ocean, and to and from the floodplain; or	×	These wetlands are located in local low points and apart from Mutton, Sawpit and Wal Wal Swamps are not connected to riparian/floodplain systems.
	(b) The dilution of carbon and nutrients from the floodplain to the river systems.	×	As stated above, there is limited connectivity with these wetlands and riparian/floodplain systems.
3	The ecosystem function provides connections along a watercourse (longitudinal connections)		
	Assessment indicator: An ecosystem function requires environmental watering to sustain it if it provides connections along a watercourse or to the ocean, including longitudinal connections:		
	(a) For dispersal and re-colonisation of native water-dependent communities; or	✓	Retaining water in these wetlands could assist in re-colonisation of water-dependent species such as frogs and turtles.

Criteria		Meets criterion	Explanation
	(b) For migration to fulfil requirements of life history stages; or	×	Whilst water-dependent species such as waterbirds, turtles etc. will use these wetlands to breed, they are opportunistic rather than obligatory.
	(c) For in-stream primary production	✓	Having a wetting-drying regime implemented will increase primary production
4	The ecosystem function provides connections across floodplains, adjacent wetlands and billabongs (lateral connections)		
	Assessment indicator: An ecosystem function required environmental watering to sustain it if it provides connections across floodplains, adjacent wetlands and billabongs, including:		
	(a) Lateral connections for foraging, migration and re-colonisation of native water dependent species and communities; or	×	As stated above, there is limited connectivity with these wetlands and riparian/floodplain systems.
	(b) Lateral connections for off-stream primary production	×	As stated above, there is limited connectivity with these wetlands and riparian/floodplain systems.

Left: Carapugna, Right: Fielding's Dam, May 2016

4.3.Cultural Values

The Aboriginal cultural values associated with these wetlands were assessed by Barengi Gadjin Land Council (BGLC) as part of the *Wimmera Mallee Pipeline Wetlands Hydrological Enhancement Project* (RPS, 2014), including a site visit to Sawpit Swamp by cultural heritage experts and desktop assessment of other wetlands.

Most were not noted to be in areas of Aboriginal cultural heritage sensitivity although Carapugna, Sawpit Swamp and Wal Wal Swamp were noted to have a number of registered Aboriginal Places in or close to them including scar trees, artefact scatters and a mound. However, it was noted that there are sites of Aboriginal cultural heritage that are not currently recorded on databases (e.g. Figure 4-3). Watering activities will not negatively affect culturally significant sites due to the low rates of delivery to locations that have been previously disturbed as well as the implementation of a watering regime required to maintain/improve wetland vegetation (including scar trees where applicable).

Figure 4-3. Very large, old Black Box that is culturally scarred at Fielding's Dam.

4.4.Social Values

The wetlands have a high social value due to the environmental values they support. Community members have shown strong support for the delivery of water to pipeline wetlands to provide surface water in a semi-arid landscape. This was demonstrated by their efforts in securing environmental water entitlements during the development of the business case for the Wimmera Mallee Pipeline.

The wetlands provide other social values including supporting duck hunting at Wildlife Reserves (subject to regulations) as well as yabbying and bird watching.

4.5.Economic Values

These wetlands provide some economic values, being a drawcard for recreation, for example bird watchers have come to the region to visit Sawpit Swamp. The wetlands are a potential water source for firefighting. There are minor indirect economic benefits that are provided by ecosystem services such as flood mitigation, nutrient and carbon storage. There are opportunities to promote the enhanced environmental conditions brought on by environmental watering to increase the economic and social values currently attached to these wetlands.

4.6.Significance

These wetlands support a number of threatened plant species as well as providing vital habitat to a wide range of native fauna. These wetlands are critical to sustain local fauna as there is limited surface water in that part of the region (only present in waterways after very wet conditions or in recreation lakes under most conditions). More information on how the environmental values of these wetlands align with indicators in Schedule 8 of the Basin Plan is included in Table 4-7.

5. Ecological Condition and Threats

5.1.Threats

The wetlands have been affected by a number of threats over the years, in particular invasive plants and animals. Weedy grass species (e.g. Wimmera Rye-grass) are often prevalent and rabbits and foxes are attracted to wetlands given they provide a ready source of food and drinking water. The wetlands have also been modified by having channels and dams excavated in them as part of their former role for stock and domestic water supply. Grazing has impacted some wetlands, for example Challambra Swamp was a watering point for stock as part of a stock droving route. In the past, trees have been cleared from a number of wetlands, for example at Sawpit Swamp which once was a timber reserve.

Other threats include their isolation being surrounded by agricultural land, which limits their resilience to ecological stresses through preventing re-colonisation by some species. Agricultural and other land uses (e.g. roads) also affect the quantity and quality of water reaching these wetlands during wet conditions. Finally, climate change impacts will increasingly manifest themselves upon these wetlands through changing the hydrology with respect the timing and volume of local inflows.

Despite these historic and ongoing threats, these wetlands remain in comparatively good condition and there is reasonable scope to improve them through environmental watering and other complementary management activities such as invasive plant and animal control.

5.2.Current Condition

In spring 2012, Australian Ecosystems was commissioned by Wimmera CMA to undertake ecological assessments of nine wetlands that were to be connected to the Wimmera Mallee Pipeline for supply. Following the decision to connect another four wetlands in the Wimmera CMA region to the pipeline, they were assessed by Rakali Consulting in spring 2013 as part of a larger project assessing the pipeline-supplied wetlands in the North Central and Mallee CMA regions.

The assessment applied the Index of Wetland Condition (IWC) method and recorded incidental observations of flora and threatened fauna species. Vegetation quadrats were established to provide a benchmark and enable comparisons to take place in future years following a series of wet-dry events. The IWC scores obtained as part of the assessment are listed in Table 5-1 and more details are provided in the relevant chapters for each wetland.

Table 5-1 Available information regarding Index of Wetland Condition scoring (Australian Ecosystems, 2012) (Rakali Consulting, 2014)

Wetland	Overall IWC Rating (Score)	IWC Biota Rating (Score)
Carapugna	Good (8)	Good (16.15)
Challambra Swamp	Moderate (6)	Moderate (13.1)
Crow Swamp	Moderate (6)	Poor (9.95)
Harcoans	Good (7)	Poor (11.2)
Krong Swamp	Good (7.5)	Moderate (15.7)
Mutton	Good (7)	Moderate (13.7)
Pinedale	Good (8)	Moderate (14.47)
Sawpit Swamp	Good (8)	Good (16.5)
Wal Wal Swamp	Good (7)	Moderate (14.8)
Opie's Dam	NA (dam only)	NA
Tarkedia	Good (7)	Moderate (14)
Fielding's Dam	Excellent (9)	Excellent (18.6)
Schultz/Koschitzke	Good (7.5)	Good (12.2)

The dams at each wetland have also qualitatively assessed by Wimmera CMA staff based on several factors; size, steepness of banks and surrounding vegetation quality and quantity in terms of its potential to provide habitat values, in particular for local fauna. Large dams with shallow banks surrounded by high quality vegetation are assumed to provide greater values for waterbirds, frogs etc. than small dams with steep banks in cleared paddocks.

5.3.Condition Trajectory – Do Nothing Option

The values these wetlands support would reduce if environmental watering was not to take place. The wetlands are now the remnant subset of thousands of open water bodies (mainly dams) that proliferated the region when the stock and domestic channel system was operating. These open water bodies once supported an abundance of frogs, yabbies, turtles, birds and other fauna and now they have been replaced by tanks and troughs. By maintaining water supply to a selection of high value wetlands, important environmental values across the northern Wimmera can be maintained.

Current catchment modifications such as improved cropping practices, drainage and other earthworks (e.g. raised roads) can lead to reduced inflows into these wetlands. Into the future, the main risk will be the reduced rainfall and warmer weather forecasted for the region under climate change (Timbal, et al., 2015). Therefore appropriate environmental watering of these wetlands will assist in mitigating the threats from changes in climate and the surrounding catchment.

The fact that if it was not for the pipeline supplying recreation lakes and these wetlands, there would only be surface water present during very wet conditions. So if these wetlands were not watered then they would also lose their high social value to the local community.

6. Management Objectives

6.1. Management Goal

Long-term (20+ year) goals for the region's waterways were developed with community, partner and stakeholder feedback to inform the preparation of the *WWS*. They are:

Maintaining and improving the values and condition of waterways that have formally recognised significance;

Improve connectivity and condition along priority wetland systems and riparian corridors;

Improved water quality in priority areas for; water supply, environmental condition and recreation;

Waterways with high social, cultural and economic values are maintained in a state that continues to support those values in line with climatic conditions.

The 50 year visions of the *Wimmera Regional Catchment Strategy (2013-2019)* and *Victorian Waterway Management Strategy* that are listed as follows:

A healthy Wimmera catchment where a resilient landscape supports a sustainable and profitable community (Wimmera CMA, 2013).

Victoria's rivers, estuaries and wetlands are healthy and well-managed; supporting environmental, social, cultural and economic values that are able to be enjoyed by all communities (DEPI , 2013).

Environmental watering of the wetlands connected to the Wimmera Mallee Pipeline will be critical to achieving these outcomes.

6.2.Ecological Objectives

Ecological objectives for the Wimmera Mallee Pipeline wetland in the Wimmera CMA region are to:

- **Maintain or improve the condition of wetlands;**
- **Increase the abundance and diversity of threatened flora and fauna present; and**
- **Provide a surface water point for local native fauna in dry times.**

These objectives have been tested with stakeholders and will be the driver of specific environmental watering actions for each wetland within the EWMP. Complementary

management activities such as invasive plant and animal control will assist in achieving and maintaining these objectives.

6.3.Long-term water regime and hydrological objectives

Watering regime recommendations were developed following the ecological assessments undertaken by Australian Ecosystems (2013) and Rakali Consulting (2014). The watering regimes are based on the EVC present and on information contained in *Water and Salinity Regime and Depth Preferences for Victorian Wetland Ecological Vegetation Classes* (Frood, 2012).

Implementing these recommendations will assist in achieving the objectives around wetland condition and threatened flora and fauna. Beyond this is the provision of surface water for native fauna which simply involves providing sufficient water to fill the dam located at each wetland. More detail around these environmental watering recommendations is provided in Section 7. Their implementation will be contingent on the availability of water in the entitlement, capacity constraints and relative priority among the more than 50 Wimmera Mallee Pipeline Wetlands across three CMA regions.

6.4.Constraints in watering Wimmera Mallee Pipeline wetlands

Although the entitlement to supply these wetlands is over 90% reliable (SKM, 2014), after a series of dry years there will be shortfalls in water availability. Therefore prioritisation of environmental watering actions will take place on the following basis:

- **Water will be provided to supply dams located at each wetland.**

This achieves the ecological objective around providing surface water for native fauna in dry years and is likely to require a nominally small volume to achieve for all wetlands (< 50 ML for all 13 wetlands combined).

- **Wetlands with better environmental values will be targeted for watering**

This improves the likelihood of meeting the objectives of maintaining or improving their condition and maintaining or increasing the abundance of threatened flora and fauna.

- **Wetlands with the longest duration since recommended watering has taken place will be targeted**

For wetlands with comparable environmental values, the risk to their environmental values increases in the interval since the last recommended inundation event took place. So through watering the wetland that has had longer since its last recommended inundation event, this will remove the risk and assist in the objective of maintaining or improving wetland condition. Risks to wetland flora from dry conditions should be contextualised by the fact that most of the wetland EVCs only require inundation every few years to maintain their condition.

Should shortfalls in environmental water availability take place, the planned long-term environmental watering regime would be delayed. Conversely wet conditions would

enable the long-term environmental watering regime to be brought forward as some, if not all wetlands would fill from local runoff and there would be full allocation for the wetland watering entitlement. Ideally environmental watering of wetlands can be undertaken in a cyclical fashion (i.e. whilst dams are filled at these wetlands every year, the wetland EVCs for two or three wetlands are targeted for watering on a rotating annual basis).

7. Wimmera Mallee Pipeline Wetlands

7.1. Carapugna

7.1.1. Catchment Setting

Carapugna is a shallow wetland complex approximately 43 Ha in area and is surrounded by a mixture of cropping/grazing land and remnant native vegetation on freehold land. The site features threel elongated shallow wetlands separated by low ridges. A large dam has been excavated in the wetland basin in the south-west. A channel that used to supply the dam bisects the wetland/ridge complex from the north-east and partially blocks overland flows into the shallow wetlands. A hard pan area has been constructed (illegally) east of the dam to increase runoff into the dam (Figure 7-4).

7.1.2. Land Status

Carapugna was initially reserved as Crown Land in 1899 under Section 110 of the *Land Act (1869)* as can be seen in a 1930 map of the Parish of Watchem prepared by the then Department of Lands and Survey (Figure 7-1). Typically these land parcels were set aside for water supply reasons (Graham Campbell, DELWP Public Lands, *pers. comm.*) and this is evidenced by the presence of a channel and dam on the reserve. It is administered by Parks Victoria and is designated as Watchem I120 Bushland Reserve. For many years the reserve was leased to the adjoining landholder for grazing. However the licence was surrendered just prior to connection to the Wimmera Mallee Pipeline as a condition of its connection.

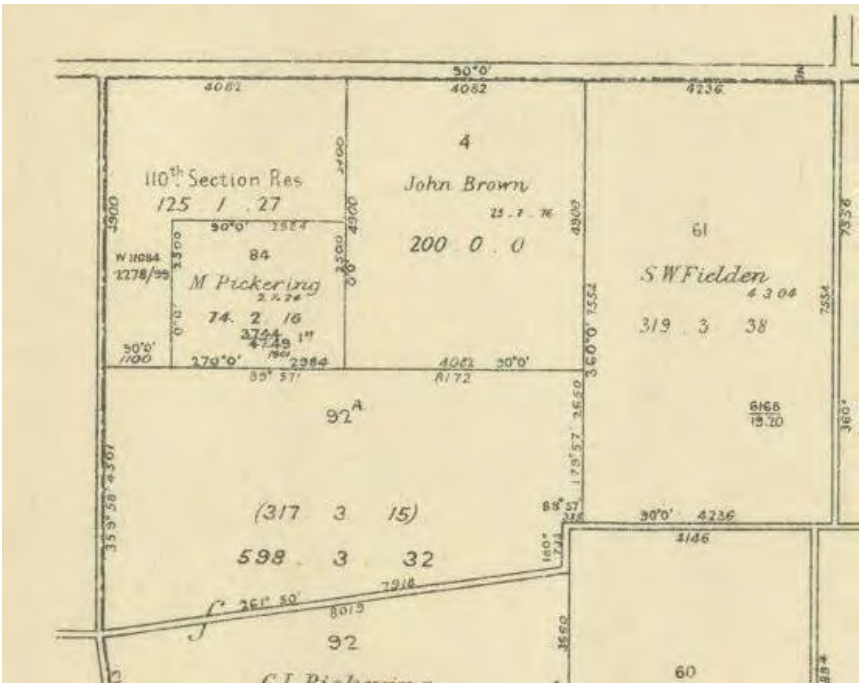


Figure 7-1. Parish of Watchem Map, Lands Department 1930, Carapugna is the 110th Section Reserve in the top left corner.

7.1.3.Hydrology

Carapugna has several small, shallow wetland areas located in the slight depressions located between the low rises. In a wet winter/spring these shallow wetlands typically contain some standing water (<10 cm) and dry out in late spring/early summer. An intense summer storm would also provide a brief period of inundation. In exceptionally wet conditions (such as the January 2011 floods) these shallow wetlands would contain greater depths of water (< 50cm) and persist for several months. The channel bisecting the reserve would prevent some flows from reaching the southern wetlands apart from during very wet conditions due to its embankment.

The dam in the south-west of the reserve would have been filled by the stock and domestic channel system. Given limitations with the former stock and domestic channel system's reliability it would not have been filled every year. However it was probably the main stock and domestic supply for the house on the adjoining property so would have been prioritised for supply above farm dams for just stock water in dry conditions.

Although water supply channels are decommissioned, a remant runs through Carapugna. It only runs when there is runoff from the South Boundary Road following very heavy rain. There has been a hard pan surface created (illegally) to the east of the dam with the intent being that it would improve the volume of runoff entering the dam.

The watering history of Carapugna is not well known, it is assumed that during the Millenium Drought the dam would have been filled most years until about 2004-5 when the drought worsened (an aerial photo in winter 2004 shows that the dam is full). It would have gradually reduced in volume until very wet conditions from spring 2010 to summer 2011 would have filled the dam and the other wetland areas (Figure

7-3). In wet months since then, such as during August 2013, small parts of the wetlands would contain water for several weeks (Figure 7-2). The dam has gradually dried out completely towards the end of 2014 but was refilled in mid-2015.

Table 7-1 Estimated watering history of Carapugna

Watering History	Season											
	2010-11		2011-12		2012-13		2013-14		2013-14		2014-15	
	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam
Status	W-D	W	S	W	S	W	S	W	D	W-D	D	S
Water Source	L	L	L		L		L					P
Volume (ML)	U	U	U		U		U					2
Notes	Inundation in spring 2010 to summer 2011		Dam contained water (drying). Small pools in wetland for several weeks.		Dam contained water (drying). Small pools in wetland for several weeks.		Dam contained water (drying). Small pools in wetland for several weeks.		Dam dried out		Wetland dry, dam contained shallow water from pipeline supply	
Status: Wet/Wet-Dry/Dry-Wet/Shallow inundation/Dry **Water source: Local runoff inundation/Flooding from waterways/Pipeline supply** **Volume: Unknown**												

Figure 7-2. Shallow inundation of wetland at Carapugna, August 2013.

Figure 7-3. Dam at Carapugna, April 2012.

7.1.4.Water Dependent Values

Fauna

A total of 41 bird, one frog, two invertebrate, four mammal and one reptile species have been recorded at Carapugna and are listed in Appendix 2 (Australian Ecosystems, 2013, BCG, 2015). Two of these species were exotic (Red Fox and European Rabbit).The presence of large numbers of Brown Treecreepers and a breeding pair of Hooded Robins indicates that a *FFG Act*-listed Temperate Woodland Bird Community is represented at the site (Australian Ecosystems, 2013). Two threatened species, Hardhead and Hooded Robin were observed at Carapugna. Depending on the timing and water availability, the waterbird species that frequent Carapugna include Australian Wood Ducks, Hardhead, Little Pied Cormorants and large numbers of Black-tailed Native Hens. Most of these species would take advantage of the presence of water in the dam although the native hens would also use the shallow wetlands for habitat.

Table 7-2 Threatened fauna observed at Carapugna (Source: Australian Ecosystems (2013))

Common Name	Scientific Name	Fauna Type	Type	Last Record	EPBC Status	FFG Status	DELWP Status
Hardhead	*Aythya australis*	B	W	2012			V
Hooded Robin	*Melanodryas cucullata*	B	T	2012		T	N
Fauna Type: Amphibian, Reptile, Bird, Mammal **Type:** Wetland dependent, Terrestrial **Status:** Endangered, Vulnerable, Threatened, Rare, Near Threatened, Data Deficient, Poorly Known							

Flora

The wetland area at Carapugna is a Black Box Wetland (EVC 369) surrounded by Northern Wimmera Riverine Chenopod Woodland (EVC 103_62) and on the rises is Plains Savannah vegetation (EVC 826). The Black Box Wetland contains a number of threatened vegetation species, most notably Ridged Water-milfoil – a nationally vulnerable species. Other threatened species observed at Carapugna are listed in Table 7-3 include Winged Water-starwort, Western Bitter-Cress, Annual Buttercup, Cane grass and Ferny Small-flower Buttercup. Scurfy Germander and Buloke are non-wetland threatened species that were observed on higher ground.

The overstorey of the wetland is relatively open woodland of Black Box (*Eucalyptus largiflorens*) with a sedgy-herbaceous understorey. A mosaic of species were observed as the wetland dried with species such as Common Nardoo (*Marsilea drummondii*) and Common Spike-sedge (*Eleocharis acuta*) thriving where inundation had occurred. Where water was present species like the Ridged Water-milfoil, Annual Buttercup, Western Bitter-Cress and Winged Water-starwort were observed. A notable feature observed was the gilgai; small undulations created by cracking clay soils. The gilgai creates treeless areas with native grasses colonising the puffs (tops) of the gilgais whilst the hollows were mostly bare but contained occasional native annual species. Figure 7-4 shows the EVCs and threatened species monitored at Carapugna and another version is included in Appendix 1.

Table 7-3 Threatened flora observed at Carapugna (Source: Australian Ecosystems (2013), G Fletcher (WCMA), *pers. obs.* 2013)

Common Name	Scientific Name	Type	Last Record	EPBC Status	FFG Status	DELWP Status	EVC found
Ridged Water-milfoil	*Myriophyllum porcatum*	W	2013	V	T	V	369
Winged Water-starwort	*Callitriche umbonata*	W	2012			R	369
Western Bitter-Cress	*Cardamine lineariloba*	W	2012			V	369
Annual Buttercup	*Ranunculus sassiliflorus var. pilulifer*	W	2012			P	369
Cane grass	*Eragrostis australisica*	W	2012			V	369
Ferny Small-flower Buttercup	*Rananculus pumilio var. politus*	W	2012			P	369
Scurfy Germander	*Teucrium albicaule*	T	2012			P	826
Buloke	Allocasuarina luehmannii	T	2013		T	E	826
Type: Wetland dependent, Terrestrial **Status:** Endangered, Vulnerable, Rare, Near Threatened, Data Deficient, Poorly Known							

Table 7-4 Ecological Vegetation Classes observed at Carapugna (Source: Australian Ecosystems (2013), DEPI (2013))

EVC No.	EVC Name	Wimmera Bioregional Conservation Status	Water dependent (Y/N)
369	Black Box Wetland	Endangered	Y
103_62	Northern Wimmera Riverine Chenopod Woodland	Endangered	Y
826	Plains Savannah	Endangered	N

7.1.5.Current Condition

Wetland Values

The IWC assessment of Carapugna was undertaken in 2012 by Australian Ecosystems and assessed to in Good condition overall. Scores for all sub-indices except for *Wetland Catchment* were either 'good' or 'excellent'. The Wetland Catchment score was 'poor' due to modifications to the local catchment through with a very narrow wetland vegetation buffer and surrounding landuse being largely cropping/grazing. The results are summarised in Table 7-5.

Table 7-5 Index of Wetland Condition Scoring at Carapugna (Source: Australian Ecosystems (2013))

IWC sub-index	Wetland Catchment	Physical Form	Hydrology	Water properties	Soils	Biota	Overall Score
Score / 20	7	19.5	15	17	19.5	16.15	8
Category	Poor	Excellent	Good	Excellent	Excellent	Good	Good

Dam Values

The value of the dam has been assessed qualitatively (Table 7-6). The dam at Carapugna rated moderate scores for steepness and the quality of fringing and adjacent vegetation. The overall score for the dam is moderate.

Table 7-6 Dam Habitat Values at Carapugna

Indicator	Size	Steepness	Fringing Vegetation	Adjacent Vegetation	Overall
Category	Good	Moderate	Moderate	Moderate	Moderate

7.1.6.Threats and Site Trajectory

Threats

Until recently the main threat to Carapugna was overgrazing by livestock as the then adjacent landholder had a grazing licence for the reserve which was surrendered just prior to the connection of the wetland to the Wimmera Mallee Pipeline. Despite this there have been observations of sheep grazing on the reserve and illegal firewood collection, although now the adjacent property has changed owners these risks have reduced. Furthermore, there are a number of invasive plant and animal species present, with a number of exotic annual plant species as well as African Boxthorn (*Lycium ferocissimum*). Rabbits and foxes are present (Australian Ecosystems, 2013).

Trajectory

Following the removal of the livestock grazing from the reserve, the condition of the wetland is likely to improve. The targeted watering of the wetlands and dam at appropriate times will further improve condition. There is also piles of rubbish dumped many years ago scattered around the site.

Do Nothing Option

Local runoff will still provide varying levels of inundation to the shallow wetland areas however these sort of events are likely to become less frequent under climate change forecasts for the region. Therefore without environmental watering there is an increased risk of the loss of wetland plant species. The dam dried out in 2014 after a series of dry years and so without environmental watering it is likely to be dry more often than not thereby impacting on the local fauna, in particular wetland birds and potentially the breeding population of woodland birds.

Carapugna, January 2015

7.1.7.Conceptualisation of Carapugna

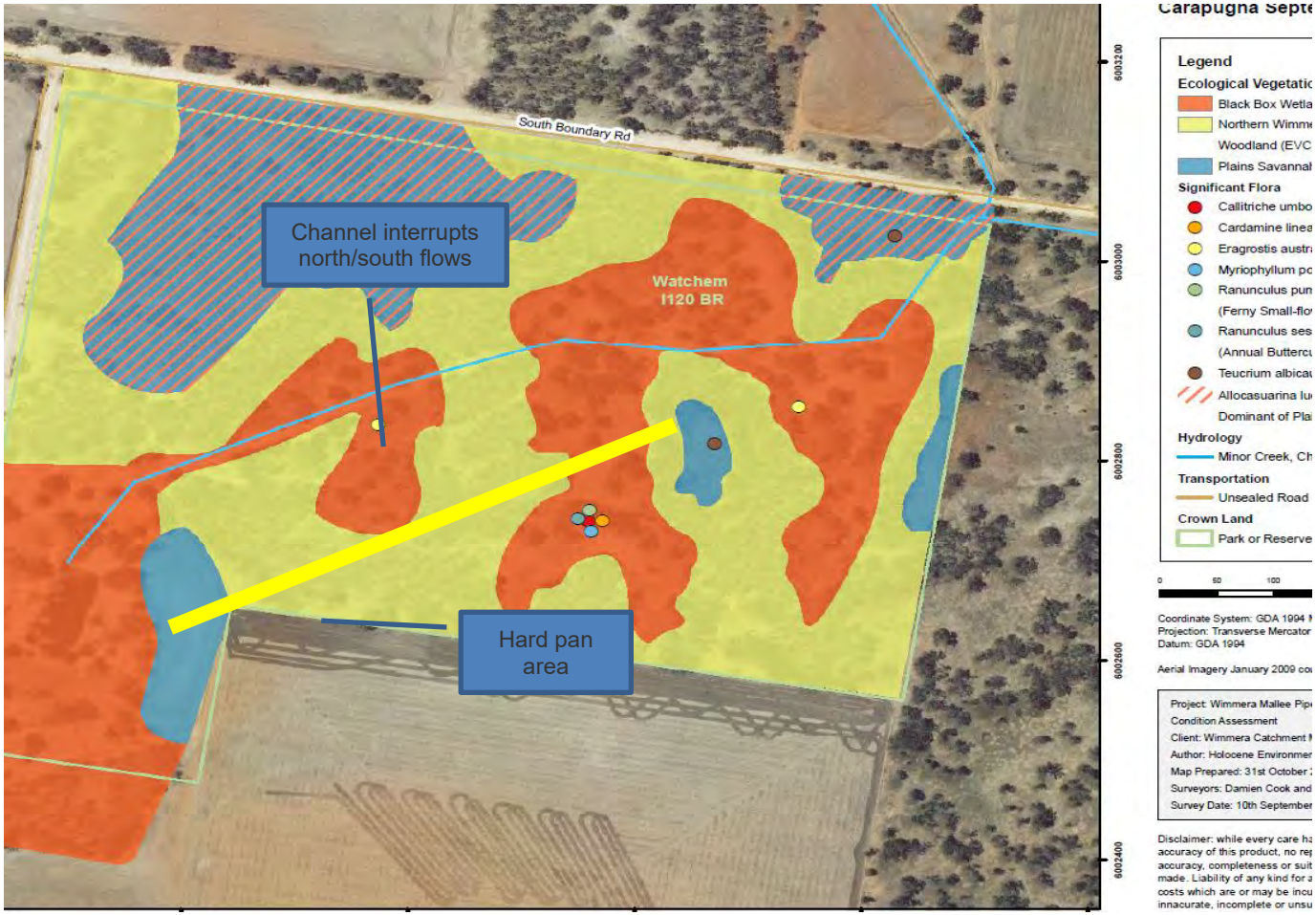
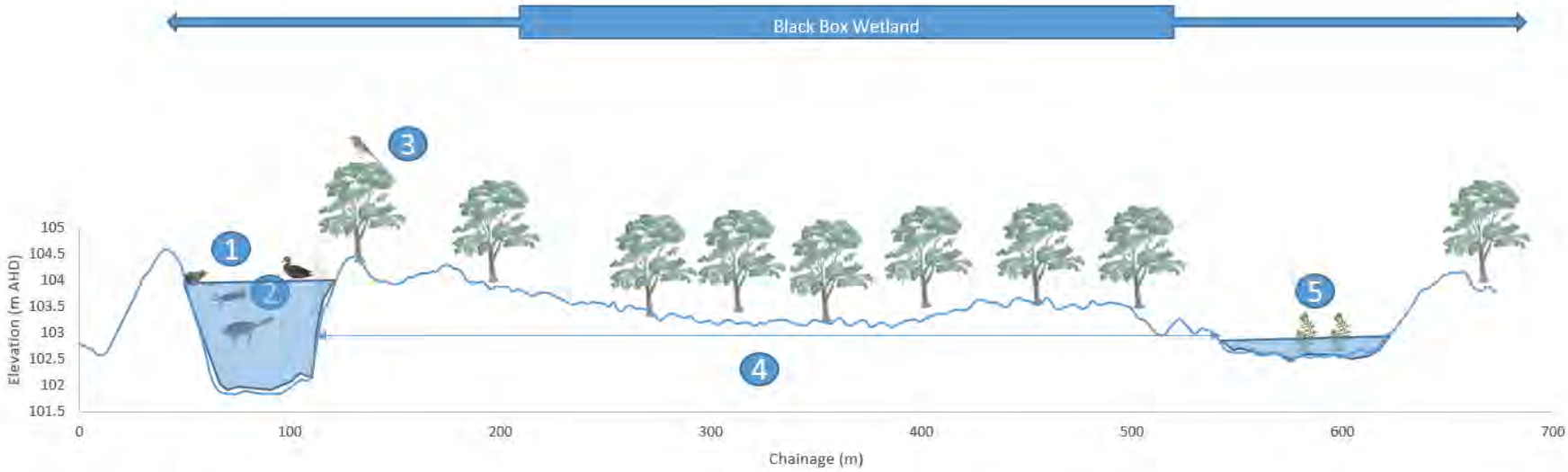


Figure 7-4. EVC and significant flora mapping at Carapugna. Yellow line is the cross-section for conceptual model.



Notes:

1. Dam at Carapugna provides a refuge for waterbirds and species with low mobility during dry phases such as frogs and turtles
2. Wetting and drying of the dam banks will support an increased diversity of macroinvertebrates and wetland vegetation through providing a range of habitats for the various parts of their lifecycles
3. A water source will help support the healthy woodland bird population through providing a drinking water source
4. A pipeline constructed in early 2015 enables watering of the dam or wetland (or both)
5. Shallow inundation of the wetland in winter/spring will enable the recruitment of emergent wetland vegetation such as the threatened Ridged Water-Milfoil as well as maintaining Black Box condition.

7.1.8.Management Objectives

The management objectives for Carapugna are:

- Retain water in the dam to sustain fauna, especially frogs and wetland and woodland birds.
- Sustaining and increasing the extent of wetland flora, especially threatened species.

Ecological Objectives

The ecological objectives for Carapugna are listed in Table 7-7 below and relate to watering both the dam and the wetland areas.

Table 7-7 Ecological Objectives at Carapugna

Ecological Objective	Justification
Maintain/Improve abundance of wetland flora	• Protects threatened species • Assists with nutrient cycling • Habitat and resources for macroinvertebrates, birds, frogs etc.
Achieve self-sustaining frog and turtle populations	• Frogs provide a food source for wetland birds • Key component of functioning wetland ecosystem through consumption of macroinvertebrates and yabbies • Limited distribution of these species in the northern Wimmera following the decommissioning of the stock and domestic channel system.
Diverse macroinvertebrate population	• Provides a food source for wetland birds, frogs and turtles • Cycles nutrients
Support wetland birds	• Protects threatened species • Refuge for ducks, cormorants etc. during dry conditions
Watering point for terrestrial species	• Supports woodland birds and other local native fauna during dry conditions

Hydrological Objectives

Australian Ecosystems (2013) provides recommendations for a watering regime to maximise the condition of the EVCs observed at Carapugna (Table 7-8).The depths and durations are informed by Frood (2012).

Table 7-8 Hydrological Objectives at Carapugna Wetland (Source: Australian Ecosystems (2013))

EVC No.	EVC Name	Environmental Watering Frequency	Duration	Depth (m)	Estimated Volume (ML)
826	Plains Savannah	NA	NA	NA	NA
103_62	Northern Wimmera Riverine Chenopod Woodland	Sporadic therefore not to be artificially watered	< 1 month	0.1	20 ML
369	Black Box	If not inundated within the last 5 years	1 < 4 months	0.3	50.4 ML

Watering Regime

The watering regime for Carapugna is derived from the ecological and hydrological objectives listed above. This regime will be subject to water availability and seasonal conditions. Works undertaken in 2015 following an investigation into infrastructure

works to enhance the hydrology of these wetlands involved the construction of 3 outfalls into the shallow wetlands as well as into the dam itself (RPS, 2014).

The recommended regime is:

- Keep dam at Carapugna above 0.5m deep by filling dam during winter/spring and allowing evaporative drawdown over summer/autumn.
- Water wetlands to shallow levels (<0.3m) if they have been dry for five years. Given there are three separate wetlands this can be done sequentially over three years using the three separate outlets constructed in 2015 (Figure 7-5).

Figure 7-5. Photo of pipeline outlet works into various wetland areas at Carapugna.

7.2. Challambra Swamp

7.2.1.Catchment Setting

Challambra Swamp is a deflation basin/lunette wetland complex. The deepest point is a circular wetland where three dams have been excavated. The shallower outer part of the wetland extends south and east. The far eastern portion is cropped and so has lost most of its environmental values. It is approximately 48 Ha in area and is surrounded by cropping/grazing land. The former Minyip Channel enters the wetland from the east and ends at the largest dam in the north-west of the wetland.

7.2.2.Land Status

The landholder of most of Challambra Swamp (Brian Koschitzke) indicates that since the area was surveyed the swamp was partly a water reserve and partly freehold land. This is illustrated in a 1939 map of the Parish of Bangerang prepared by the then Lands Department (Figure 7-6) which indicates it was partly set aside as Crown Land as a site for conservation of water in 1882. The water reserve section was used for livestock driven to markets or other properties for access to drinking water. It is administered by Parks Victoria and is now designated as Bangerang I101 Bushland Reserve.

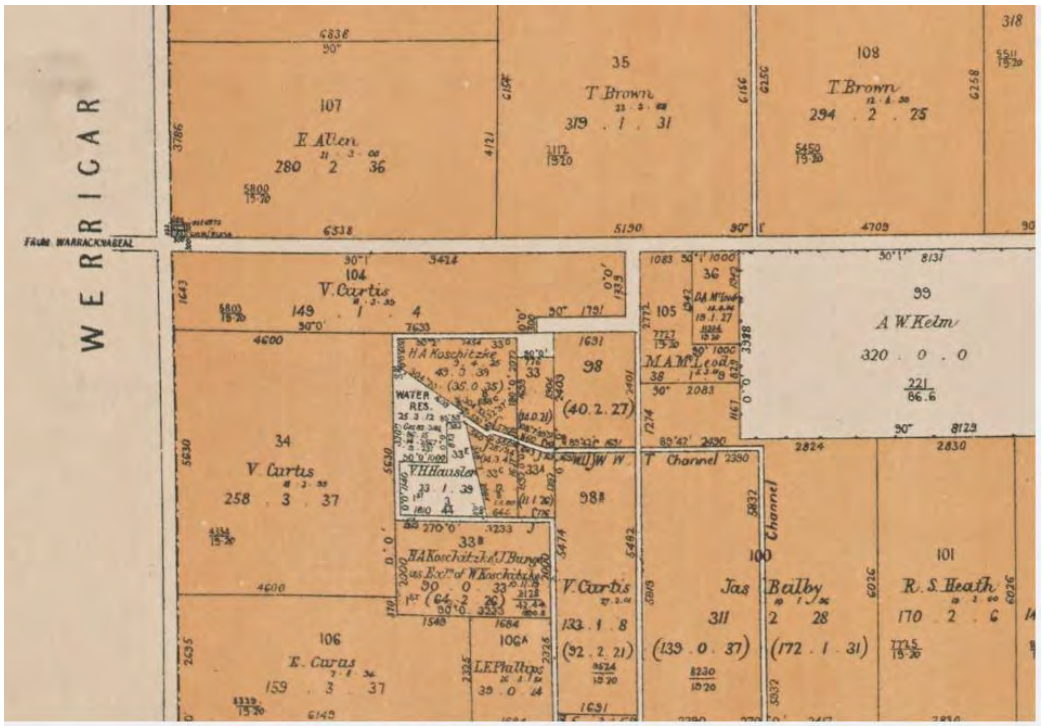


Figure 7-6. Parish of Bangerang Map Lands Department 1939, Challambra Swamp is in the centre.

7.2.3.Hydrology

Challambra comprises a nested series of lunette wetlands of varying shape and size. During exceptionally wet years they would sequentially fill and overflow. In this case runoff from the north of Challambra would fill the smaller circular wetland with the dams excavated in them and spill out into the larger kidney-shaped wetland to the south (Figure 7-7). The soil would require substantial rainfall to wet up and have standing water present and so it is unlikely that there would be much standing water in all but the wettest of winter/springs. In exceptionally wet conditions (such as the January 2011 floods or early 1970's) the wetlands will fill to over 1m depth and so retain water for some months, or years if there was a series of wet years.

Challambra Swamp was located at the end of the former Minyip Channel and so substantial volumes would be delivered to the wetland in most years for stock and domestic supply and as the channel was drawn down. However, during drought conditions this was not possible, for example during the Millennium Drought, water was only provided to the dams excavated in the north of the wetland rather than the wetland itself. The fact that it was for domestic rather than just stock supply meant

that it was a higher priority for supply during water shortages. Now the channel system has been decommissioned the only sources of water are the natural catchment and the Wimmera Mallee Pipeline.

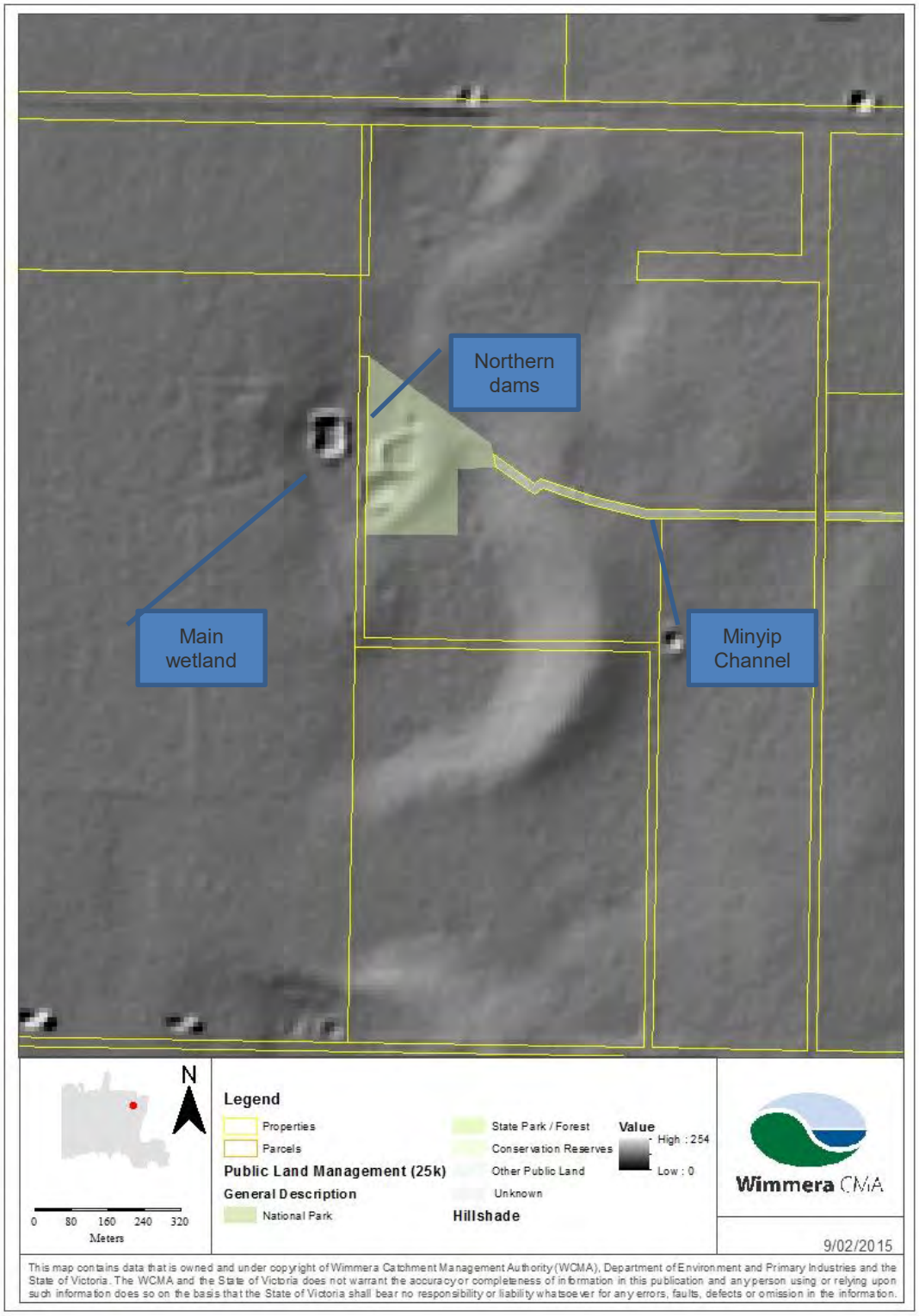


Figure 7-7. Challambra Swamp complex showing cadastral boundaries and terrain

The watering history of Challambra Swamp is reasonably well known. During the Millennium Drought the dam would have been filled most years until about 2004-5 when the drought worsened. An aerial photo from 2004 shows that the two northern dams were full. The dams would have gradually reduced in volume until they dried in 2010 until very wet conditions from spring 2010 to summer 2011 would have filled the dams (Figure 7-8) and the other wetland areas. The dam gradually dried out and was empty in mid-2015 and was refilled later in 2015.

Table 7-9 Estimated watering history of Challambra Swamp

Watering History	Season											
	2010-11		2011-12		2012-13		2013-14		2013-14		2014-15	
	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam
Status	W-D	W	D	W	D	W	D	W	D	S	D	S
Water Source	L	L	L		L		L					
Volume	U	U										
Notes	Inundation in spring 2010 to summer 2011		Dam contained water. Wetland remained dry.		Dam contained water. Wetland remained dry.		Dam contained water. Wetland remained dry.		Dam drying out. Wetland remained dry.		Dam drying out. Wetland remained dry.	
Status: Wet/Wet-Dry/Dry-Wet/Shallow inundation/Dry **Water source: Local runoff inundation/Flooding from waterways/Pipeline supply** **Volume: Unknown**												

Figure 7-8. Challambra Swamp dam, April 2012

7.2.4.Water Dependent Values

Fauna

A total of 31 bird and two mammal species have been recorded at Challambra Swamp and are listed in Appendix 2 (Australian Ecosystems, 2013). Three species were exotic (Common Starling, House Sparrow and European Rabbit). It was noted that there was a large number of hollow-bearing Black Box trees and so habitat values for birds and bats is high (Australian Ecosystems, 2013). When the dam contains water, water bird species frequent Challambra including Grey Teal (*Anas gracilis*), Pacific Black Ducks (*Anas superciliosa*), Masked Lapwings (*Vanellus spinosus*) and Australasian Grebes (*Tachybaptus novaehollandiae*). Historically when the swamp contained water for extended periods there was prolific breeding of White-faced Herons (*Ardea alba*) (B. Koschitzke, *pers. comm*).

Flora

The wetland complex at Challambra Swamp supports two wetland EVCs, the deep circular wetland in the north consists of a Lake Bed Herbland (EVC 107) (Figure 7-9) and the kidney-shaped wetland to the south is Black Box Wetland (EVC 369) although the eastern section has been cleared and is cropped. On the rises there is Plains Savannah vegetation (EVC 826). The Black Box wetland contains threatened Spiny Lignum (*Duma horrida subsp. horrida*) in the south-eastern section.

The Black Box Wetland vegetation varies in quality. The northern portion near the Lake Bed Herbland is dominated by groundcover weeds, whereas the southern portion has a good coverage of large Black Box (*Eucalyptus largiflorens*) trees and a higher proportion of native species compsing a herbaceous-grassy understorey such as Common Nardoo (*Marsilea drummondii*), Dense Crassula (*Crassula colorata*), Leek Lily (*Bulbine semibarbata*) and Bristly Wallaby Grass (*Rytidosperma setaceum var. setcaceum*). A slight gilgai soil profile was observed supporting the combination of wetland and dryland plants (Australian Ecosystems, 2013).

Figure 7-9. North-east of Challambra Swamp (Lake Bed Herbland EVC) April 2012

The Lake Bed Herbland is typically a low herbland occurring on recently inundated to dry wetlands across northern and western Victoria. At this site the herbland was largely dominated by weed species with a few native wetland species such as Common Spike Sedge (Eleocharis acuta) and Starry Goosefoot (*Scleroblitum atriplicinum*). During wet phases it is predicted that an Aquatic Herbland/Spike-sedge Wetland Complex would be the dominant EVC (Australian Ecosystems, 2013). A map showing the location of threatened species and EVCs at Challambra Swamp is included in Figure 7-10 and Appendix 1 with details included in Table 7-10 and Table 7-11.

Table 7-10 Threatened flora observed at Challambra Swamp (Source: Australian Ecosystems (2013))

Common Name	Scientific Name	Type	Last Record	EPBC Status	FFG Status	DELWP Status	EVC found
Spiny Lignum	*Duma horrida subs. horrida*	W	2012			R	369
Type: Wetland dependent, Terrestrial **Status:** Endangered, Vulnerable, Rare, Near Threatened, Data Deficient, Poorly Known							

Table 7-11 Ecological Vegetation Classes observed at Challambra Swamp (Source: Australian Ecosystems (2013))

EVC No.	EVC Name	Wimmera Bioregional Conservation Status	Water dependent (Y/N)
369	Black Box Wetland	Endangered	Y
107	Lake Bed Herbland	Rare	Y
826	Plains Savannah	Endangered	N

7.2.5.Current Condition

Wetland Values

The IWC assessment of Challambra Swamp was undertaken in 2012 by Australian Ecosystems. The wetland was assessed to be in 'Moderate' condition overall (Table 7-12). The lack of soil disturbance and absence of major drainage works led to 'excellent' scores for the Soils and Physical Form sub-indices. The Wetland Catchment score was 'poor' due to the fact that the eastern portion is cropped, the wetland has a very narrow wetland vegetation buffer and the cropping/grazing in the surrounding land. The cover of invasive weeds and modifications to the catchment's hydrology due to earthworks led to 'Moderate' classifications.

Table 7-12 Index of Wetland Condition Scoring at Challambra Swamp (Source: Australian Ecosystems (2013))

IWC sub-index	Wetland Catchment	Physical Form	Hydrology	Water properties	Soils	Biota	Overall Score
Score / 20	8	17.5	10	15	19.5	13.1	6
Category	Poor	Excellent	Moderate	Good	Excellent	Moderate	Moderate

Dam Values

The habitat value of the dam has been assessed qualitatively (Table 7-13). The dam at Challambra rated moderate scores for steepness, fringing vegetation and adjacent vegetation. The overall score for the dam is moderate.

Table 7-13 Dam Habitat Values at Challambra Swamp

Indicator	Size	Steepness	Fringing Vegetation	Adjacent Vegetation	Overall
Category	Good	Moderate	Moderate	Moderate	Moderate

7.2.6.Threats and Site Trajectory

Threats

Historically, grazing would have been the main threat to the wetland given its former role as a water reserve. However this has not been the case for decades and now the main threat is the presence of invasive plants and animals. Foxes will impact on wetland bird populations through predation. Weeds may affect wetland plant growth and recruitment although experience in watering other sites shows that weed species do not persist following inundation and native wetland species thrive.

Trajectory

Given the relatively frequent inundation of the wetland due to supplies from the channel system, the vegetation would be used to more regular watering than would be the case following the decommissioning of the channel system. Therefore declines in vegetation condition would be expected to take place over time without environmental watering especially given forecasts for a hotter and drier climate going forward. The absence of water in the dam would also impact on the populations of local fauna who rely on it for habitat/drinking water.

Do Nothing Option

If no environmental water was to be delivered then in the short-term it is expected to see some diminishing of local fauna values as the dam would dry out completely in dry years. In the longer term there may be some impact on the condition and diversity of wetland flora (such as Black Box) at Challambra Swamp as it was used to

more frequent inundation than would be the case. The impacts of climate change will also exacerbate this.

Challambra Swamp, January 2015

7.2.7.Conceptualisation of Challambra Swamp

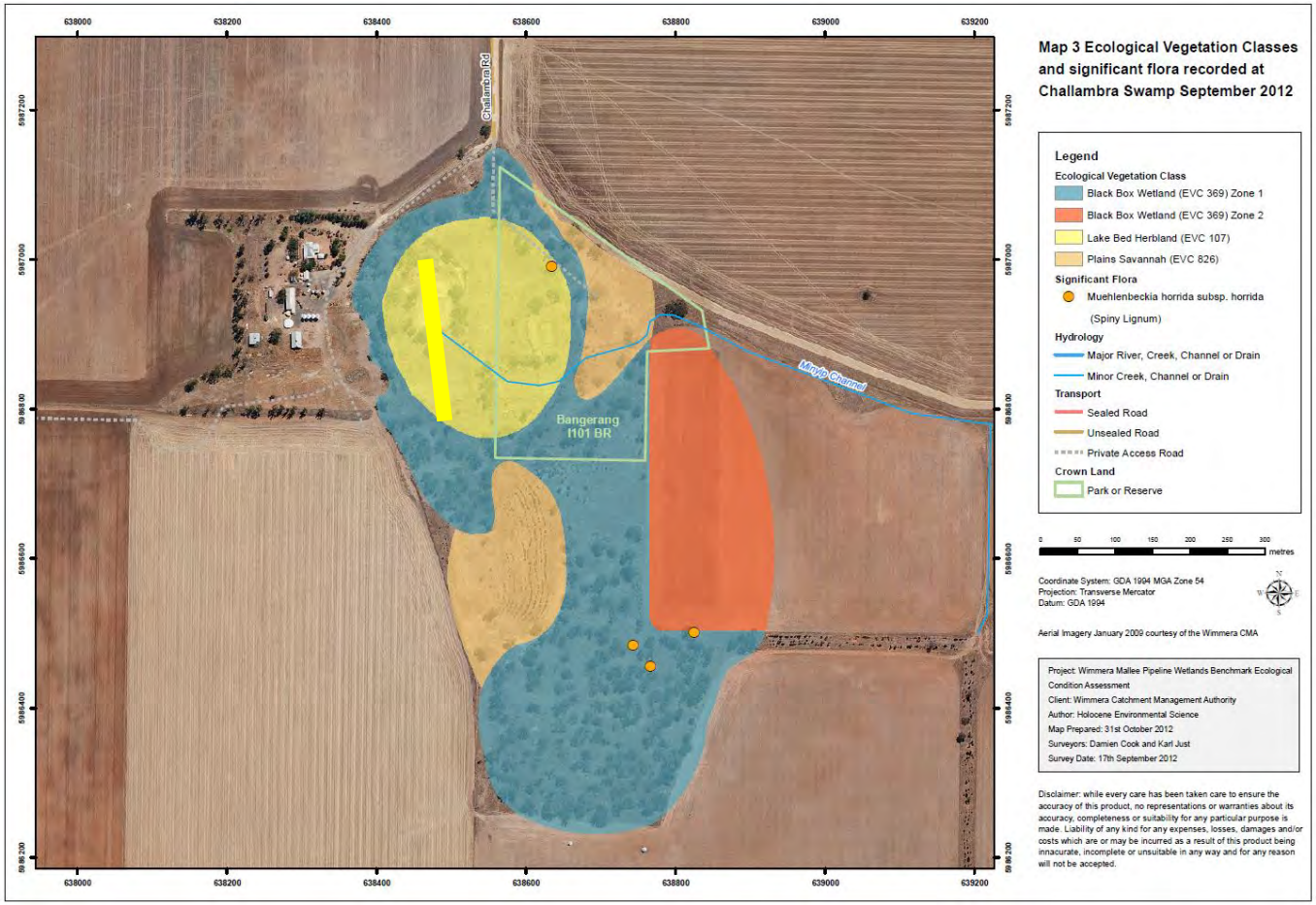
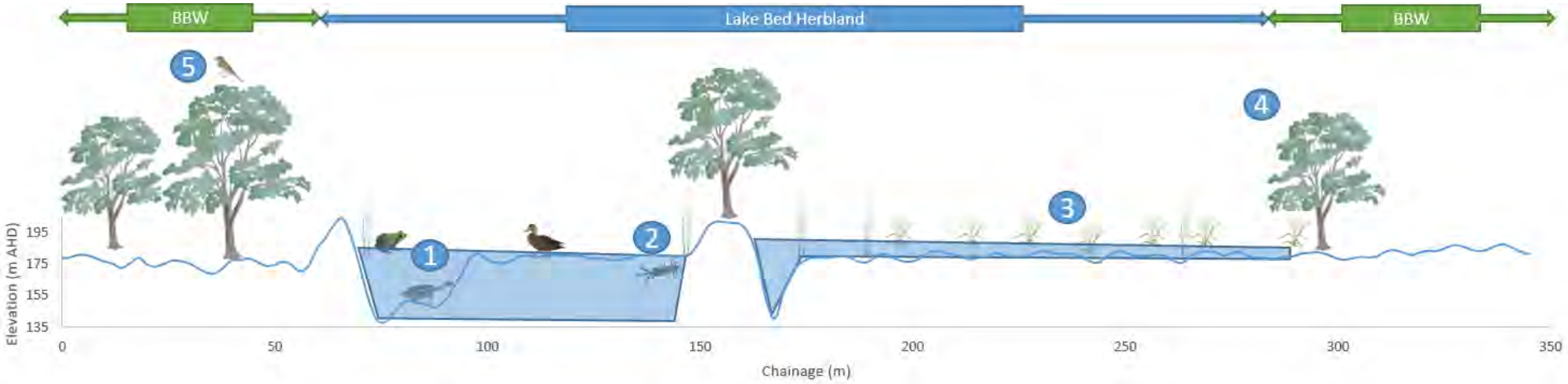


Figure 7-10. EVC and significant flora mapping at Challambra. Yellow line is the cross-section for conceptual model.



Notes:

1. Dam at Challambra provides a refuge for waterbirds and species with low mobility during dry phases such as frogs and turtles
2. Wetting and drying of the dam banks will support an increased diversity of macroinvertebrates and wetland vegetation through providing a range of habitats for the various parts of their lifecycles
3. Occasional shallow inundation will maintain Common Nardoo and other native wetland vegetation
4. Increased water in the dam/wetland increases likelihood of watering Black Box due to natural heavy rainfall events
5. Dam provides a drinking water source for woodland birds

BBW = Black Box Wetland

7.2.8.Management Objectives for Challambra Swamp

The management objectives for Challambra Swamp are:

- Retain water in the dam to sustain fauna, especially frogs and wetland and woodland birds.
- Sustain and increase the extent of wetland flora, especially threatened species.

Ecological Objectives

The ecological objectives for Challambra Swamp are listed in Table 7-14 below and relate to watering both the dam and the wetland areas.

Table 7-14 Ecological Objectives at Challambra Swamp

Ecological Objective	Justification
Maintain/Improve abundance of wetland flora	• Protects threatened species • Assists with nutrient cycling • Habitat and resources for macroinvertebrates, birds, frogs etc.
Achieve self-sustaining frog and turtle populations	• Frogs provide a food source for wetland birds • Key component of functioning wetland ecosystem through consumption of macroinvertebrates and yabbies • Limited distribution of these species in the northern Wimmera following the decommissioning of the stock and domestic channel system.
Diverse macroinvertebrate population	• Provides a food source for wetland birds, frogs and turtles • Cycles nutrients
Supports wetland birds	• Protects threatened species • Refuge for ducks, cormorants, grebes etc. during dry conditions
Watering point for terrestrial species	• Supports woodland birds and other local native fauna during dry conditions

Hydrological Objectives

Australian Ecosystems (2013) provides recommendations for a watering regime to maximise the condition of the EVCs observed at Challambra Swamp. The depths and durations are informed by Frood (2012).

Table 7-15 Hydrological Objectives at Challambra Swamp (Source: Australian Ecosystems (2013))

EVC No.	EVC Name	Environmental Watering Frequency	Duration	Depth (m)	Estimated Volume (ML)
826	Plains Savannah	NA	NA	NA	NA
107	Lake Bed Herbland	3 to 7 years in 10	> 1 month	0.8	46.6 ML
369	Black Box	If not inundated within the last 5 years	1 < 4 months	0.3	32.2 ML

Watering Regime

The watering regime for Challambra Swamp is derived from the ecological and hydrological objectives listed above. This regime will be subject to water availability and seasonal conditions. The modelled delivery rate by pipeline to the wetland is

between 4.7 ML/month to 7.7 ML/month (Greg Embleton, GWMWater, *pers. comm.*). A maximum supply of 45 ML/year was modelled for Challambra Swamp (GWMWater, 2012). Therefore watering will be typically only feasible for the Lake Bed Herbland EVC (the round northern wetland) and may only fill a portion of the wetland given seepage and evaporative losses as well as other demands on the pipeline potentially reducing delivery rates. However if the round, northern wetland contains water more frequently then this increases the likelihood of water from localised runoff during wet conditions inundating the black box wetland in the southern, kidney-shaped wetland.

The recommended regime subject to water availability is:

- Keep Challambra Swamp's northern dam above 0.5m deep by filling dam during winter/spring and allowing evaporative drawdown over summer/autumn. This will promote a more diverse aquatic flora communities (Australian Ecosystems, 2013).
- Water Lake Bed Herbland EVC area by every alternate year by filling and overtopping northern dam.

7.3.Crow Swamp

7.3.1.Catchment Setting

Crow Swamp is an oval deflation basin wetland with an associated lunette. It is approximately 5.8 Ha in area and is mostly surrounded by a mixture of cropping/grazing land with a small native vegetation buffers to the north and west. The former Crow Tank Channel used to direct water from the nearby Rainbow Channel into a dam in the north-east of the wetland.

7.3.2.Land Status

Crow Swamp was formerly a water reserve as illustrated in a 1946 map of the Parish of Tarranyurk (Figure 7-11). It was originally set aside for water supply purposes in 1889. A tender for the excavation of a tank (dam) at the site was accepted in July 1898 (The Horsham Times, 1898). The water reserve section was used for livestock driven to markets or other properties. It is now administered by Parks Victoria, now designated as Crow Swamp (Phillips Dam) Bushland Reserve. Given the adjacent landholder is noted in the survey map as 'Crow' it is presumed that the name Crow Swamp was derived from there rather the presence of crows.

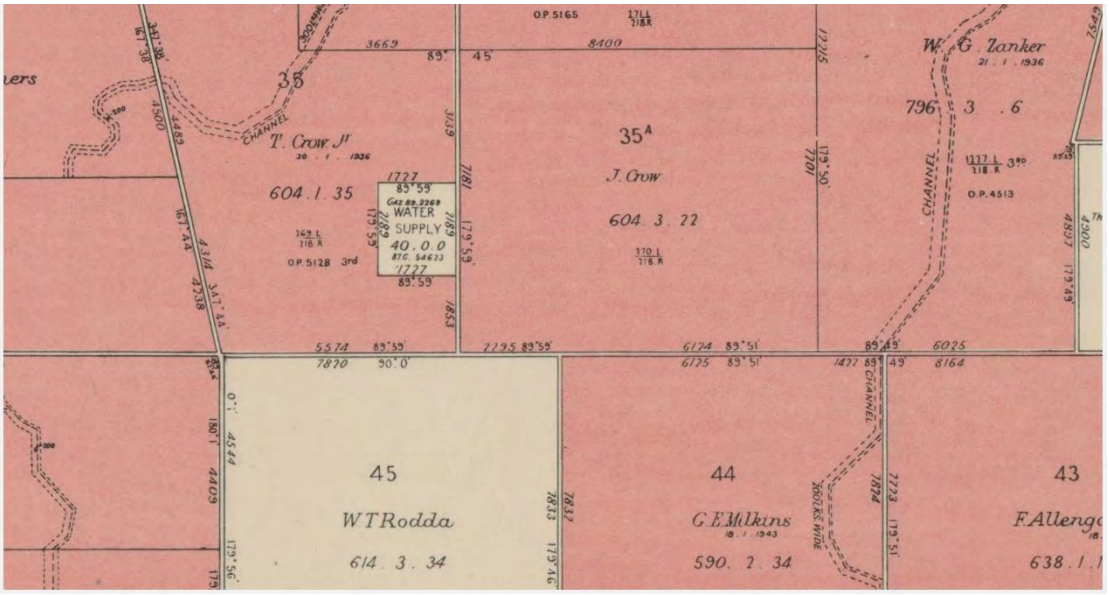


Figure 7-11. Parish of Tarranyurk Map Lands Department 1946, Crow Swamp is in the centre, designated 'Water Supply'.

7.3.3.Hydrology

Crow Swamp is a comparatively deep deflation basin wetland that would naturally fill from runoff from its local catchment during very wet seasons and is located at the end of the former Crow Tank Channel. In wet years water would be supplied to the wetland once the dam filled. However the filling of the dam and wetland did not occur during dry years, especially in later years when it was no longer a water reserve but managed for conservation values as a Bushland Reserve.

The dam and wetland would have been dry through much of the Millenium Drought. An aerial photo of the site in 2004 showed that the dam was empty.

Crow Swamp, August 2013

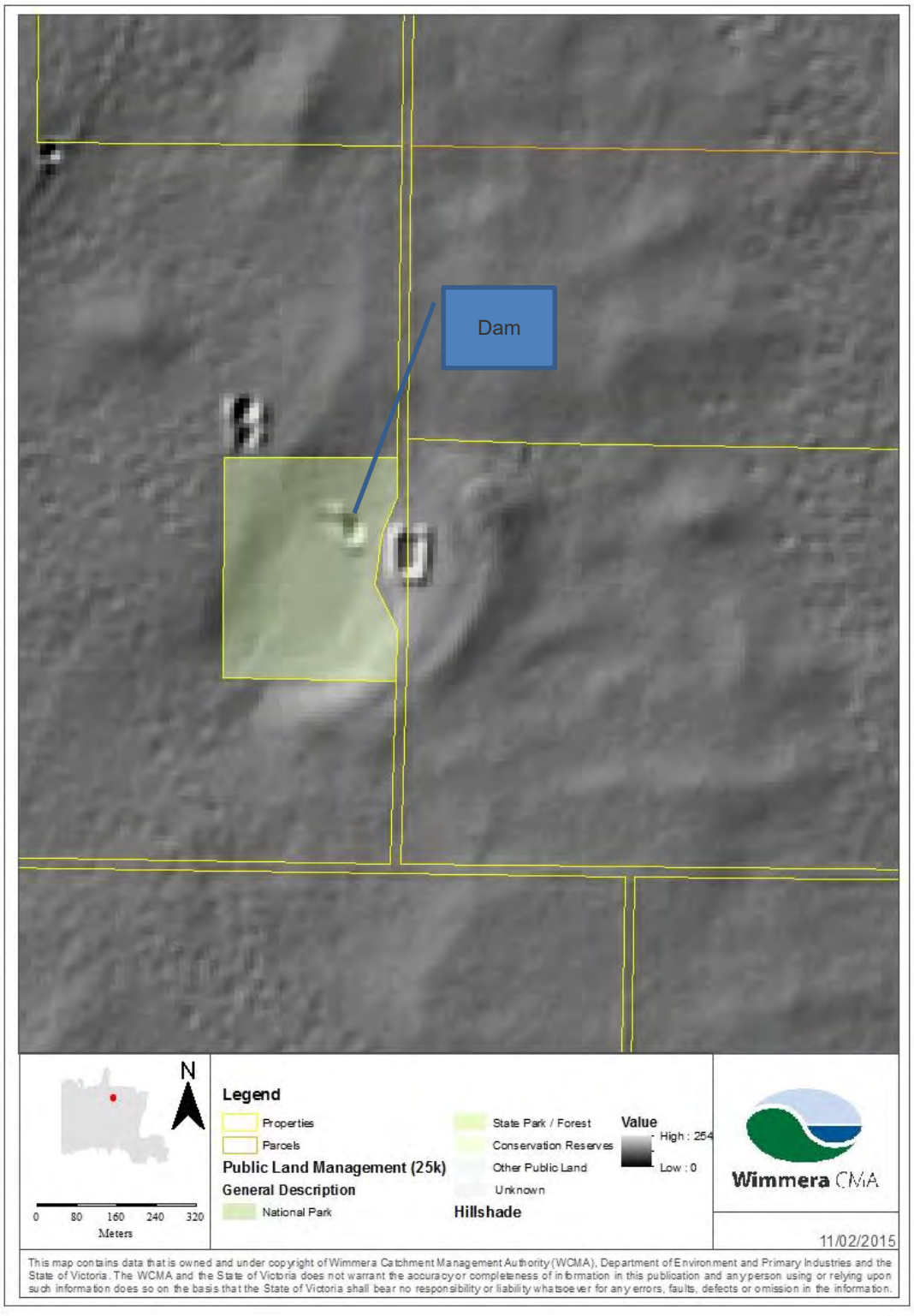


Figure 7-12. Crow Swamp complex showing land tenure and terrain

The watering history of Crow Swamp is not well known. Given the long-dead overstorey trees near the base of the wetland, it might have been artificially inundated for long periods. It would have been unlikely to be supplied by channel since the mid to late 1990's as drought conditions worsened. With no paying customer or need for stock and domestic use it would have been one of the first dams to drop off the list for supply. Small volumes may have entered the dam as once adjacent dams were filled and the channel was drawn down. Jeparit, near Crow Swamp received record rainfall in January 2011 however even this was not enough to inundate the wetland (M. Rodda, *pers. comm.*, 2016). The dam was filled by pipeline supply in mid-2015 with water overtopping and providing shallow inundation in the north-western part of the wetland for less than one month.

Table 7-16 Estimated watering history of Crow Swamp

Watering History	Season											
	2010-11		2011-12		2012-13		2013-14		2013-14		2014-15	
	Wetld	Dam	Wetld	Dam	Wetld	Wetld	Dam	Dam	Wetld	Dam	Wetld	Dam
Status	D-W-D	D-W	D	W-D	D	D	D	D	D	D	D	S
Water Source	L	L										P
Volume (ML)	U	U										1
Notes	Inundation in spring 2010 to summer 2011		Dam dried out, wetland remained dry.		Dam and wetland dry.		Dam and wetland dry		Dam and wetland dry		Dam and wetland dry	
Status: Wet/Dry-Wet-Dry/Dry-Wet/Shallow inundation/Dry Water source: Local runoff inundation/Flooding from waterways/Pipeline supply Volume: Unknown												

7.3.4.Water Dependent Values

Fauna

A total of 14 bird and one mammal species (European Rabbit) have been recorded at Challambra Swamp and are listed in Appendix 2 (Australian Ecosystems, 2013). The site was completely dry at the time of the survey and only terrestrial bird species were observed. However since water has been supplied to the dam, it has been frequented by a number of waterbird species such as Australian Wood Ducks, Grey Teal and Hoary-headed Grebes (G. Fletcher, WCMA, *pers. comm*.).

Flora

The wetland complex supports three wetland EVCs, albeit quite degraded, in a series of concentric circles. The deepest point in the centre of the wetland consists of a Lake Bed Herbland (EVC 107) and higher on the edge of the wetland is an Intermittent Swampy Woodland (EVC 813). Beyond this is the Northern Wimmera Riverine Chenopod Woodland (EVC 103_62), the most elevated and infrequently inundated of the wetland EVCs. Ridged Plains Mallee (EVC 96) is a terrestrial EVC that surrounds the wetland in all directions apart from the eastern section where it has been cleared and is cropped. On the rises there is Plains Savannah vegetation (EVC 826). The northern part of the Intermittent Swampy Woodland section supports a very large specimen of Spiny Lignum (*Duma horrida subsp. horrida*). Maps showing the locations of EVCs and threatened flora are Figure 7-15 and in Appendix 1.

The Lake Bed Herbland has been dry for a long time (Figure 7-13) and as a result had been colonised by a number of weed species such as Wimmera Rye-grass (*Lolium rigidum*) and Barley-grass (*Hordeum leporinum*) and native species that are not typical of the EVC including Nodding Saltbush (*Einadia nutans*) and Variable Groundsel (*Senecio pinnatifolius* var. 1). Given these circumstances it is considered to be in poor condition. The Intermittent Swampy Woodland is also in very poor condition with the overstorey trees (River Red Gum) dead and the groundcover mostly comprised again of Wimmera Rye-grass (*Lolium rigidum*) and Barley-grass (*Hordeum leporinum*). Some native species present include Dense Crassula (*Crassula colorata*) and Hedge Saltbush (*Rhagodia spinescens*) (Australian Ecosystems, 2013).

The Northern Wimmera Riverine Chenopod Woodland is in comparatively better (Moderate) condition. The Black Box overstorey is present along with a number of groundcover species including Berry Saltbush (*Atriplex semibaccata*) and Small-leaf Goosefoot (*Chenopodium desertorum* subsp. *microphyllum*). The weed cover is again comparatively high with Wimmera Rye-grass (*Lolium rigidum*) and Barley-grass (*Hordeum leporinum*) being the dominant species (Australian Ecosystems, 2013).

Figure 7-13. Crow Swamp looking south-west, April 2012

Table 7-17 Threatened flora observed at Crow Swamp (Source: Australian Ecosystems (2013))

Common Name	Scientific Name	Type	Last Record	EPBC Status	FFG Status	DELWP Status	EVC found

Spiny Lignum	*Duma horrida subs. horrida*	W	2012			R	813
Scurfy Germander	*Teucrium albicaule*	T	2012			P	103
Type: Wetland dependent, Terrestrial **Status:** Endangered, Vulnerable, Threatened, Rare, Near Threatened, Data Deficient, Poorly Known							

Table 7-18 Ecological Vegetation Classes observed at Crow Swamp (Source: Australian Ecosystems (2013))

EVC No.	EVC Name	Wimmera Bioregional Conservation Status	Water dependent (Y/N)
813	Intermittent Swampy Woodland	Vulnerable	Y
107	Lake Bed Herbland	Rare	Y
103_62	Northern Wimmera Riverine Chenopod Woodland	Depleted	Y
96	Ridged Plains Mallee	Endangered	N

7.3.5.Current Condition

Wetland Values

The IWC assessment of Crow Swamp was undertaken in 2012 by Australian Ecosystems (Table 7-19). The wetland was assessed to be in 'moderate' condition overall. The lack of soil disturbance and absence of major drainage works led to 'excellent' scores for the Soils and Physical Form sub-indices. The Wetland Catchment score was 'moderate' due to modifications to the local catchment with there being a narrow to no terrestrial vegetation buffer around the wetland in various directions and surrounding landuse being largely cropping/grazing. The high cover of invasive weeds and lack of overstorey vegetation meant that biota was classified as 'poor'. Impacts of nutrient runoff into the wetland led to a 'moderate' score for this wetland. Modifications to the catchment's hydrology due to earthworks were comparatively minor and led to a 'good' classification.

Table 7-19 Index of Wetland Condition Scoring at Crow Swamp (Source: Australian Ecosystems (2013))

IWC sub-index	Wetland Catchment	Physical Form	Hydrology	Water properties	Soils	Biota	Overall Score
Score / 20	12.5	19.5	15	10	19.95	9.95	6
Category	Moderate	Excellent	Good	Moderate	Excellent	poor	Moderate

Dam Values

The results for the qualitative habitat assessment for the dam at Crow Swamp are outlined in Table 7-20. Its comparatively poor habitat values can also been seen in Figure 7-14 being small and with no meaningful surrounding vegetation.

Table 7-20 Dam Habitat Values at Crow Swamp

Indicator	Size	Steepness	Fringing Vegetation	Adjacent Vegetation	Overall
Category	Poor	Good	Poor	Poor	Poor

Figure 7-14. Dam at Crow Swamp soon after pipeline supply commenced, April 2015

7.3.6.Threats and Site Trajectory

Threats

Historically grazing and vegetation clearing (e.g. firewood collection) would have been the main threat to the wetland given its former role as a water reserve. However this has not been the case for decades and now the main threat is the presence of invasive plants and animals. The cover of invasive plants is very extensive, however environmental watering is reducing the weed cover through providing more favourable conditions for the growth and recruitment of wetland species as opposed to the agricultural weeds (e.g. *Amsinckia spp.*) that dominate the wetland. Anecdotal evidence of the wetland not containing water despite the record rainfall in January 2011 indicates that local land use changes (i.e. cropping practices) is having an effect on its hydrology, this will be further exacerbated by climate change impacts.

Trajectory

A lot of the vegetation values have been lost due tot the threats listed above. However further declines in vegetation condition would be expected to take place over time without environmental watering, especially given climate and land use changes. The absence of water in the dam would also impact on the populations of local fauna who can use it for habitat/drinking water.

Do Nothing Option

If no environmental water was to be delivered then the abundance and diversity of local fauna is expected to remain static. In the longer term there may be some impact on the condition and diversity of wetland flora at Crow Swamp as it was used to more frequent inundation than would otherwise be the case, although comparatively limited wetland flora values remain.

7.3.7.Conceptualisation of Crow Swamp

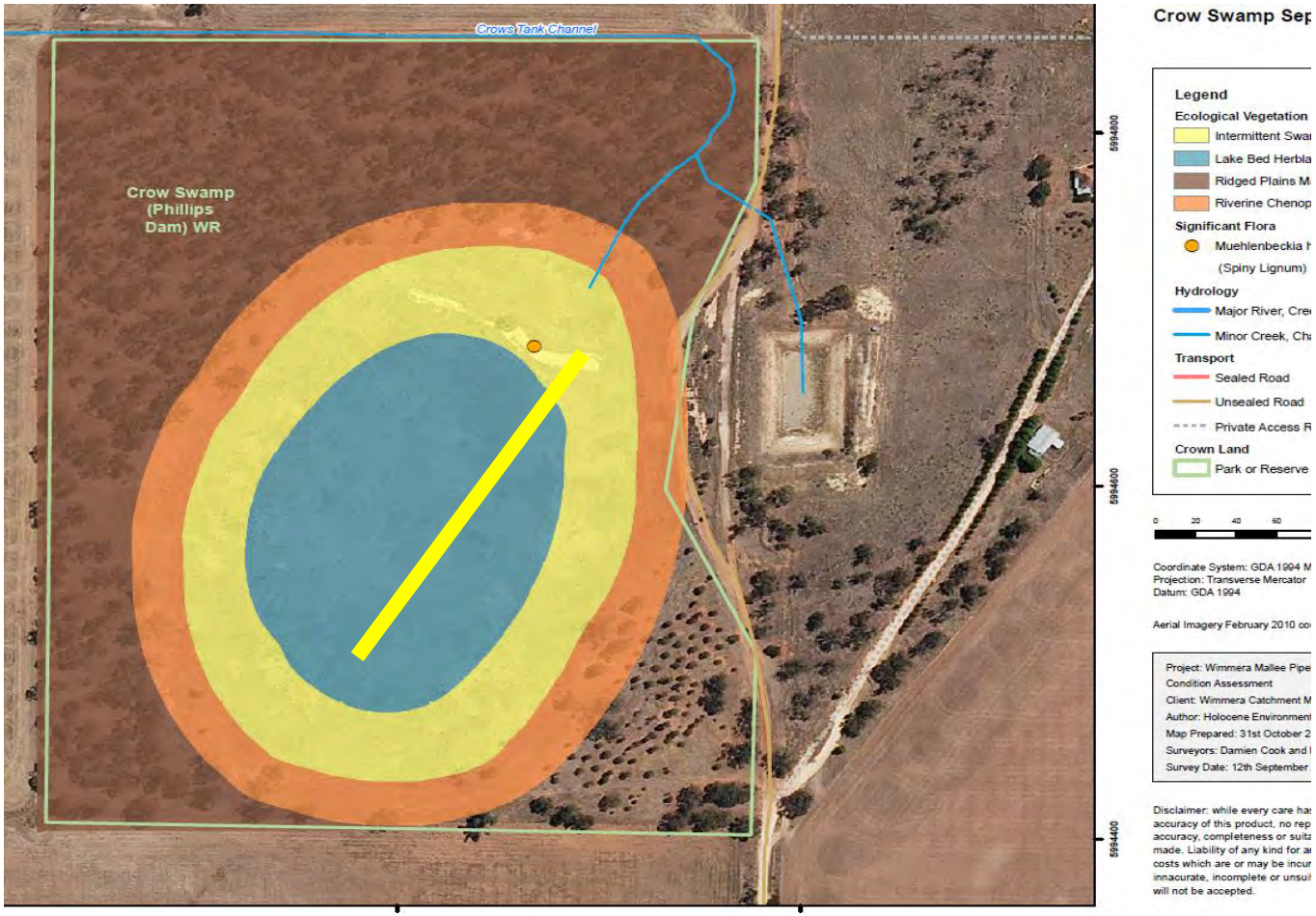
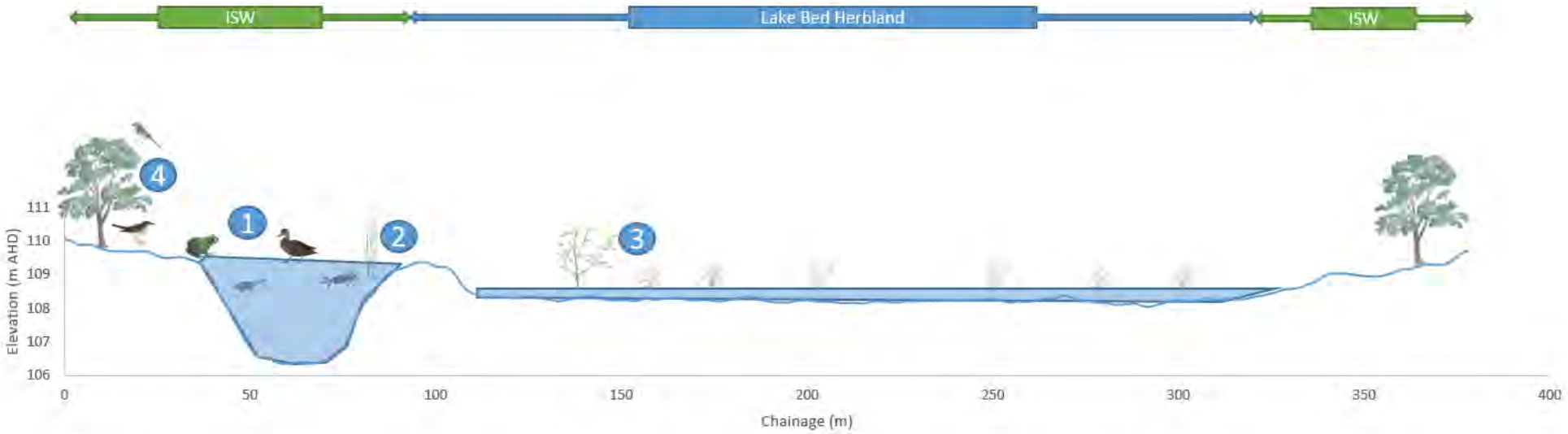


Figure 7-15. EVC and significant flora mapping at Crow. Yellow line is the cross-section for conceptual model.



Notes:

1. Dam at Crow provides a refuge for waterbirds and species with low mobility during dry phases such as frogs and turtles
2. Wetting and drying of the dam banks will support an increased diversity of macroinvertebrates through providing a range of habitats for the various parts of their lifecycles
3. Occasional shallow inundation will maintain Spiny Lignum and other native wetland vegetation
4. Dam provides a drinking water source for woodland birds, quail etc.

ISW = Intermittent Swampy Woodland

7.3.8.Management Objectives for Crow Swamp

The management objectives for Crow Swamp are:

- Retain water in the dam to sustain fauna, especially frogs and wetland and woodland birds.
- Maintaining and where possible increasing the distribution of wetland flora, especially threatened species.

Ecological Objectives

The ecological objectives for Crow Swamp are listed in Table 7-21 below and relate to watering both the dam and the wetland areas.

Table 7-21 Ecological Objectives at Crow Swamp

Ecological Objective	Justification
Maintain/Improve abundance of wetland flora	• Protects threatened species • Assists with nutrient cycling • Habitat and resources for macroinvertebrates, birds, frogs etc.
Achieve self-sustaining frog and turtle populations	• Frogs provide a food source for wetland birds • Key component of functioning wetland ecosystem through consumption of macroinvertebrates and yabbies • Limited distribution of these species in the northern Wimmera following the decommissioning of the stock and domestic channel system.
Diverse macroinvertebrate population	• Provides a food source for wetland birds, frogs and turtles • Cycles nutrients
Supports wetland birds	• Protects threatened species • Key refuge for ducks, cormorants, grebes etc. during dry conditions
Watering point for terrestrial species	• Supports woodland birds and other local native fauna during dry conditions

Hydrological Objectives

Australian Ecosystems (2013) provides recommendations for a watering regime to maximise the condition of the EVCs observed at Crow Swamp. The depths and durations are informed by Frood (2012).

Table 7-22 Hydrological Objectives at Crow Swamp (Source: Australian Ecosystems (2013))

EVC No.	EVC Name	Environmental Watering Frequency	Duration	Depth (m)	Estimated Volume (ML)
86	Ridged Plains Mallee	NA	NA	NA	NA
107	Lake Bed Herbland	3 to 7 years in 10	> 6 months	1.5	37.5
813	Intermittent Swampy Woodland	3 to 7 years in 10	1 < 6 months	0.5	14
103_62	Northern Wimmera Riverine Chenopod Woodland	Sporadic therefore not to be artificially watered	< 1 month	0.1	2.4

Watering Regime

The watering regime for Crow Swamp is derived from the ecological and hydrological objectives listed above. This regime will be subject to water availability and seasonal

conditions. The modelled delivery rate by pipeline to the wetland is 12 ML/y (GWMWater, 2012). Therefore watering will be typically only feasible for the dam and the lowest part of the Lake Bed Herbland EVC. The comparatively low rate of delivery in contrast to the volume required to inundate the Lake Bed Herbland means that pipeline supplies are unlikely to exceed evaporation and seepage losses and so watering of the Intermittent Swampy Woodland is unfeasible. That being said, the environmental values of the Intermittent Swampy Woodland are comparatively poor so the benefits of watering this EVC would be minor.

The recommended regime subject to water availability is:

- Keep dam at Crow Swamp's above 0.5m deep by filling during winter/spring and allowing evaporative drawdown over summer/autumn.
- Water Lake Bed Herbland every alternate year through letting water overtop the dam and spill out into the surrounding wetland.

7.4.Fielding's Dam

7.4.1.Catchment Setting

Fielding's Dam is a small former stock watering dam located in some relatively flat terrain exhibiting a gilgai soil profile. It is located in the south-east corner of a larger property containing reasonably intact native vegetation.

7.4.2.Land Status

Fielding's Dam is located on freehold land belonging to Mary Fielding.

7.4.3.Hydrology

Fielding's Dam is located in a Herb-rich Gilgai Wetland within a Plains Woodland – Herb-rich Gilgai Wetland Mosaic. The dam would have been filled by a channel leading from the nearby former Carapugna Channel along South Boundary Road and south into the dam. During wet winter/springs or following very heavy summer/autumn rainfall events low lying depressions would contain water for short periods. Local modifications, namely roads and channels has led to major changes in surface water flows given the flat terrain, for example intercepting overland flows during extremely wet conditions.

As the Millennium Drought worsened through the 2000's the dam would not have been supplied annually, and not since 2005, as the region was undergoing severe water restrictions and the pipeline replace the channel system in 2009-10.

The watering history of the dam itself is well known. However, the history of the inundation of the gilgai depressions is less well known given the infrequent and short duration of these events.

Table 7-23 Estimated watering history of Fielding's Dam

Watering History	Season											
	2010-11		2011-12		2012-13		2013-14		2013-14		2014-15	
	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam
Status	D-W-D	D-W	D	W-D	D	D	D	D	D	D	D	D-W
Water Source	L	L										P

Volume (ML)	U	U								R		1.6
Notes	Inundation in spring 2010 to summer 2011		Dam dried out. Wetland remained dry.		Wetland and dam remained dry.		Wetland and dam remained dry.		Wetland and dam remained dry.		Wetland remained dry, dam was filled by pipeline.	
Status: Wet/Dry-Wet-Dry/Dry-Wet/Shallow inundation/Dry **Water source: Local runoff inundation/Flooding from waterways/Pipeline supply** **Volume: Unknown**												

7.4.4.Water Dependent Values

Fauna

A total of 37 bird, four reptile and one mammal species have been recorded at Fielding's Dam and ale listed in Appendix 2 (Rakali Consulting, 2014). Two threatened species, Hooded Robin and Lace Monitor, have been observed at the dam (Draper *et al.*, 2006). A Lace Monitor was also photographed by a motion-sensing camera at the dam in 2014.

Table 7-24 Threatened fauna observed at Fielding's Dam (Source: (Rakali Consulting, 2014))

Common Name	Scientific Name	Fauna Type	Type	Last Record	EPBC Status	FFG Status	DELWP Status
Hooded Robin	*Melanodryas cucullata*	B	T	2006		T	N
Lace Monitor	*Varanus varius*	R	T	2014			E
Fauna Type: Amphibian, Reptile, Bird, Mammal **Type:** Wetland dependent, Terrestrial **Status:** Endangered, Vulnerable, Threatened, Rare, Near Threatened, Data Deficient, Poorly Known							

Flora

The EVC at Fielding's Dam is a Plains Woodland-Herb-rich Gilgai Wetland Complex which has a high conservation significance. It has a canopy of Black Box (*Eucalyptus largiflorens*) including a very large tree that has a cultural scar on it adjacent to the dam (Figure 7-17).

Fielding's Dam, August 2013

Figure 7-16. Scar tree at Fielding's Dam, January 2015

Figure 7-17. High diversity of indigenous plant species in shallow gilgai wetlands during spring 2014

There is a very good diversity of flora at the site, with groundcover species including Knotty Spear-grass (*Austrastipa nodosa*) and Grassland Wood-sorrel (*Oxalis perennans*) and wetland species including several species of Swamp Wallaby-grass. The dam was noted to have a comparatively large number of different native wetland species (Rakali Consulting, 2014). There were also a number of exotic species present including Wimmera Rye-grass (*Lolium rigidum*) and Sea Barley-grass (*Hordeum marinum*). Figure 7-19 shows the EVC at Fielding's Dam and a map showing the location of threatened flora is in Appendix 1.

Table 7-25 Threatened flora observed at Fielding's Dam (Source: (Rakali Consulting, 2014))

Common Name	Scientific Name	Type	Last Record	EPBC Status	FFG Status	DELWP Status	EVC found
Buloke Mistletoe	Amyeama linophylla	T	2013			V	235
Dwarf Brooklime	*Gratiola pumilo*	W	2013			R	235
Inland Club-sedge	*Isolepis australiensis*	W	2013			P	235
Type: Wetland dependent, Terrestrial **Status:** Endangered, Vulnerable, Threatened, Rare, Near Threatened, Data Deficient, Poorly Known							

Table 7-26 Ecological Vegetation Classes observed at Fielding's Dam (Source: (Rakali Consulting, 2014), (DEPI, 2013))

EVC No.	EVC Name	Wimmera Bioregional Conservation Status	Water dependent (Y/N)

235	Plains Woodland – Herb-rich Gilgai Wetland Mosaic	Endangered	Y

7.4.5.Current Condition

Wetland Values

The IWC assessment of Fielding's Dam was undertaken in 2014 by Rakali Consulting and assessed to be in 'Excellent' condition overall. The lack of soil disturbance and absence of major drainage works led to scores for the Soils and Physical Form sub-indices being in the 'Excellent' category. The wetland's catchment was in 'excellent' condition and largely unmodified, the largely intact vegetation also led to an 'Excellent' score for the Biota sub-index and assisted in having an 'Excellent' score for the Water Properties sub-index score through the filtering of nutrients and sediment. Changes to the catchment's hydrology due to earthworks were comparatively minor and led to a 'Good' classification. The results are summarised in Table 7-27.

Table 7-27 Index of Wetland Condition Scoring at Fielding's Dam (Source: (Rakali Consulting, 2014))

IWC sub-index	Wetland Catchment	Physical Form	Hydrology	Water properties	Soils	Biota	Overall Score
Score / 20	20	19.9	15	20	20	18.6	9
Category	Excellent	Excellent	Good	Excellent	Excellent	Excellent	Excellent

Figure 7-18. Fielding's Dam gilgai wetland during a dry phase, with dam in background January 2015

Dam Values

The habitat valued of Fielding's Dam are outlined in Table 7-28. The landholder has introduced large woody debris to provide habitat. A motion sensor camera deployed in late 2014 when the dam was filled highlighted a diverse range of fauna such as terrertrial birds that take advantage of the presence of water in the dam.

Table 7-28 Dam Habitat Values at Fielding's Dam

Indicator	Size	Steepness	Fringing Vegetation	Adjacent Vegetation	Overall
Category	Poor	Moderate	Good	Good	Good

7.4.6.Threats and Site Trajectory

Threats

The fact that the wetland has been assessed to be in 'Excellent' condition is testament to the fact that the site has been well-managed for many years now and threat levels are comparatively low. The main threats are the presence of invasive plants and animals, in particular foxes that will predate on native fauna and rabbits that consume wetland vegetation.

Trajectory

The impact of climate change there is likely to be less frequent inundation events which will affect the condition and diversity of wetland vegetation. It will also lead to increased durations of time when the dam would be empty which will also impact on local fauna given the lack of locations for drinking water.

Do Nothing Option

If no environmental water was to be delivered then the abundance and diversity of local fauna is expected to remain static or decline slightly. In the longer term there may be some impact on the condition and diversity of wetland flora at Fielding's Dam with a drying climate.

7.4.7.Conceptualisation of Fielding's Dam

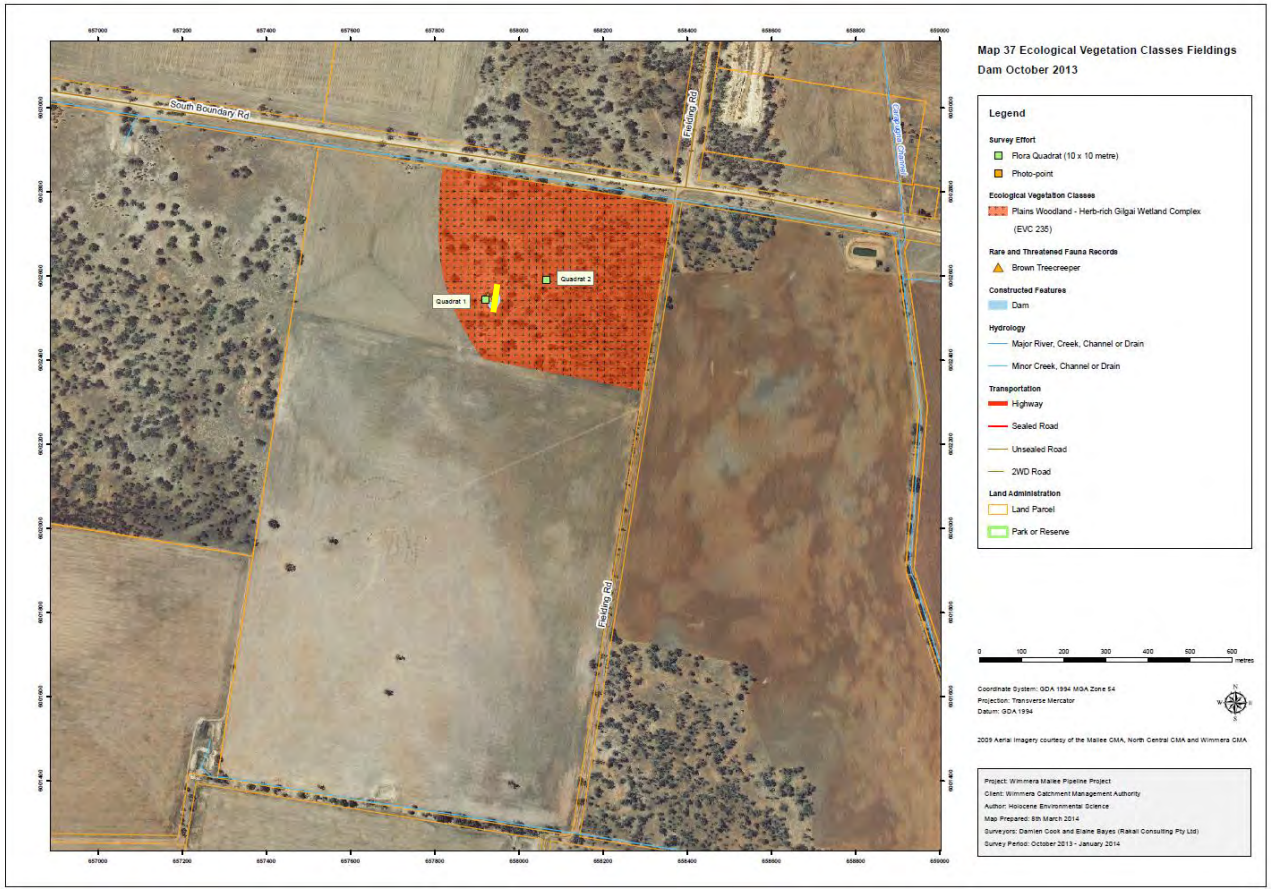
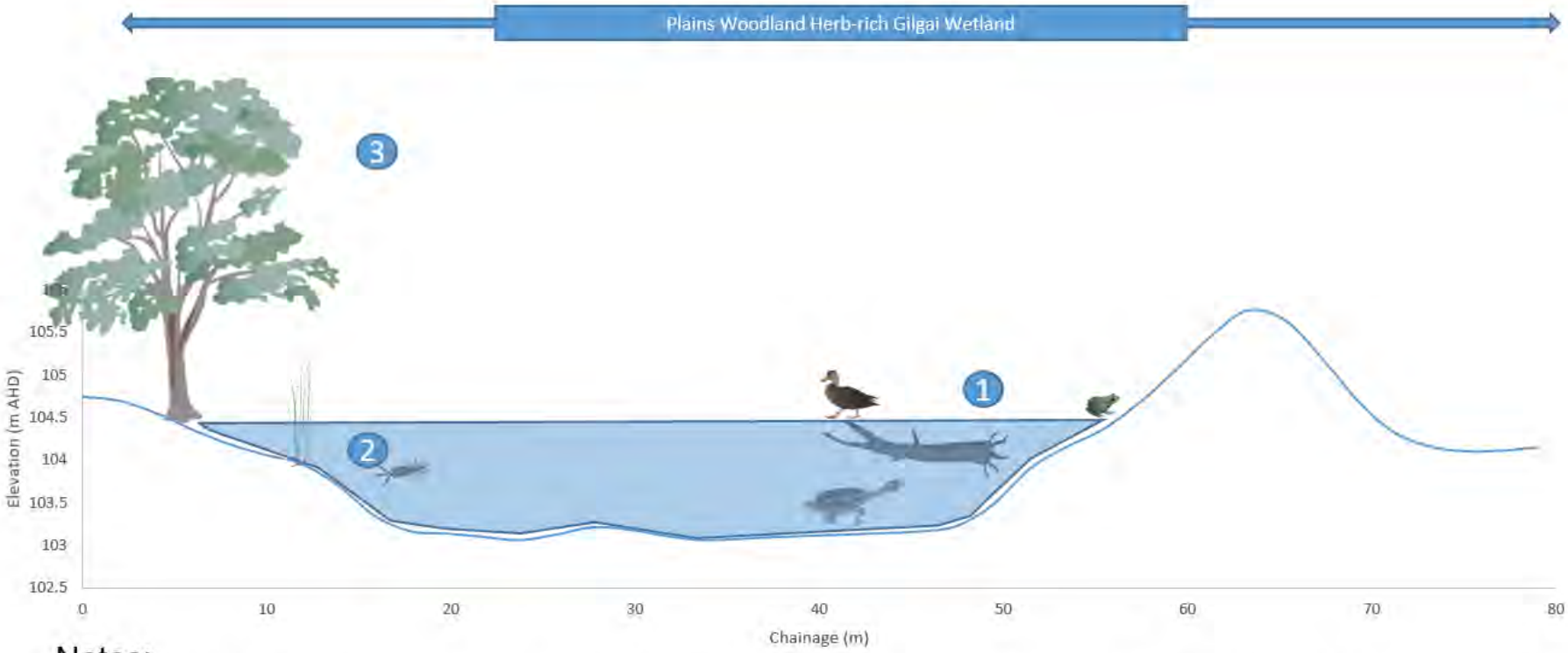


Figure 7-19. EVC and significant flora mapping at Fielding's Dam. Yellow line is the cross-section for conceptual model.



Notes:

1. Fielding's Dam provides a refuge for waterbirds species with low mobility during dry phases such as frogs and turtles (habitat has been improved by addition of large logs) Wetting and drying of the dam banks will support an increased diversity of macroinvertebrates and wetland vegetation through providing a range of habitats for the various parts of their lifecycles
2. Periodic inundation (but not over-watering) will maintain the condition of Black Box trees

7.4.8.Management Objectives for Fielding's Dam

The management objectives for Fielding's Dam are:

- Retain water in the dam to sustain fauna, especially frogs and wetland and woodland birds.
- Maintaining the condition of wetland flora.

Ecological Objectives

The ecological objectives for Fielding's Dam are listed in Table 7-29 below and relate to watering both the dam and the wetland areas.

Table 7-29 Ecological Objectives at Fielding's Dam

Ecological Objective	Justification
Maintain/Improve abundance of wetland flora	• Protects threatened species • Assists with nutrient cycling • Habitat and resources for macroinvertebrates, birds, frogs etc.
Achieve self-sustaining frog population	• Frogs provide a food source for wetland birds • Key component of functioning wetland ecosystem through consumption of macroinvertebrates and yabbies • Limited distribution of these species in the northern Wimmera following the decommissioning of the stock and domestic channel system.
Diverse macroinvertebrate population	• Provides a food source for wetland birds and frogs • Cycles nutrients
Supports wetland birds	• Protects threatened species • Key refuge for ducks, cormorants, grebes etc. during dry conditions
Watering point for terrestrial species	• Supports woodland birds and other local native fauna during dry conditions

Hydrological Objectives

Rakali Consulting (2014) provides recommendations for a watering regime to maximise the condition of the Plains Woodland – Herb-rich Gilgai Wetland Mosaic observed at Fielding's Dam.

Table 7-30 Hydrological Objectives at Fielding's Dam (Source: (Rakali Consulting, 2014))

EVC No.	EVC Name	Environmental Watering Frequency	Duration	Depth (m)	Estimated Volume (ML)
235	Plains Woodland – Herb-rich Gilgai Wetland Complex	3 to 8 years in 10	< 3 months	0.1	10.8

Watering Regime

The watering regime for Fielding's Dam, whilst informed by ecological and hydrological objectives, will be subject to water availability and seasonal conditions. The modelled delivery rate by pipeline to the wetland is 4 ML/y (GWMWater, 2013). Therefore watering will be typically only feasible for the dam itself, which required 1.6 ML to fill in 2014. Given the comparatively slow rates of delivery in contrast to the recommended duration of inundation (< 3 months), watering of the EVC beyond the dam is unfeasible and places at risk flora such as a notable scar tree on the edge of the dam through over-inundation.

The recommended regime subject to water availability is:

- Keep Fielding's Dam above 0.5m deep by filling during winter/spring and allowing evaporative drawdown over summer/autumn.

7.5.Harcoan's Swamp (Burrereo Bushland Reserve)

7.5.1.Catchment Setting

Harcoan's Swamp is a kidney-shaped deflation basin wetland with an associated lunette. It is approximately 8.4 Ha in area and is surrounded by a mixture of cropping/grazing land. A small distribution channel from the former Main Eastern Channel enters the wetland from the east and was used to fill the dam in the south-west of the wetland.

7.5.2.Land Status

Harcoan's Swamp was formerly a camping and water reserve set aside in 1881 and is illustrated in an 1888 map of the Parish of Lallat prepared by the then Department of Crown Lands and Survey (Figure 7-20). A small township (Burrereo) was planned for the elevated area immediately to the west of the wetland probably with the intent being that the water reserve would act as the location of the township's water supply. Although subdivided, the township never eventuated so the water reserve section may have been used for livestock driven to markets or other properties as a source of drinking water. Parts of the original reserve have been converted to freehold land although the swamp itself remains Crown Land. It is administered by Parks Victoria and the site is now designated as Burrereo Bushland Reserve.

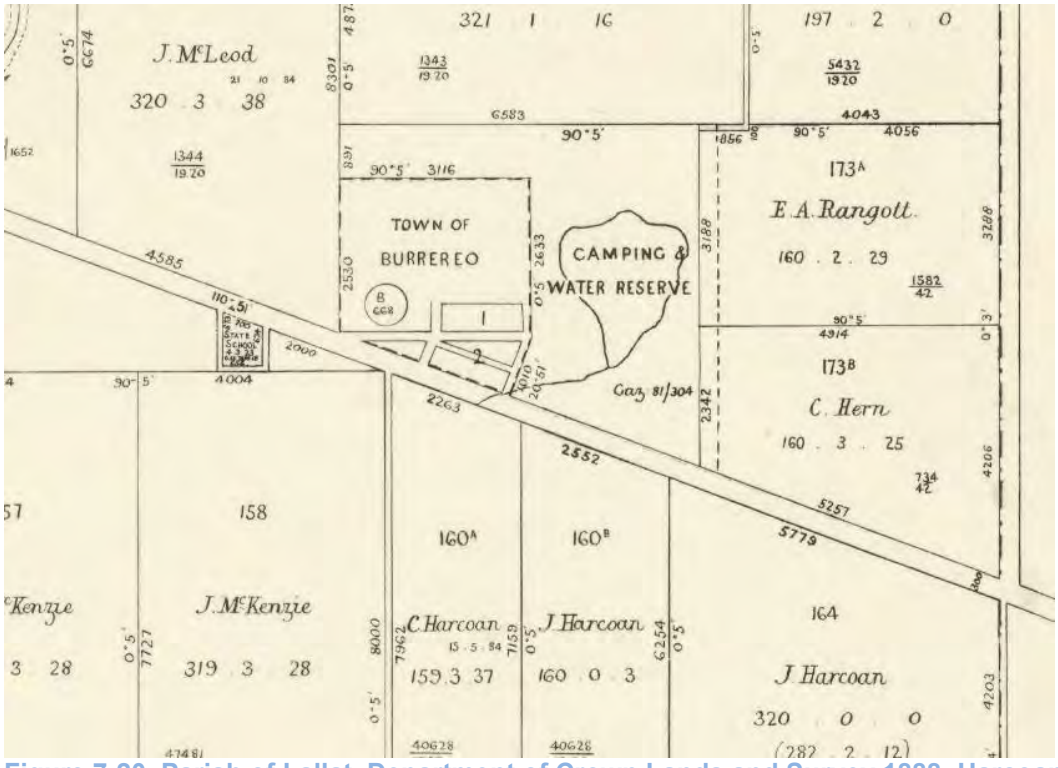


Figure 7-20. Parish of Lallat, Department of Crown Lands and Survey 1888, Harcoan's

Swamp is the 'Camping & Water Reserve'.

7.5.3.Hydrology

Harcoan's Swamp is a shallow deflation basin wetland that would naturally fill from runoff from its local catchment during very wet conditions (Figure 7-21). It is also at the end of a small channel supplied from the former Main Eastern Channel which supplied water to the dam for stock watering purposes in all but very dry years.

As the Millennium Drought worsened through the 2000's the dam would not have been supplied frequently especially given the fact that it had changed to a Bushland Reserve and was not required for stock watering. However, an aerial photo from 2004 shows that there was water in the dam.

Wedge-Tailed Eagle fledgling, Harcoan's Swamp, November 2015

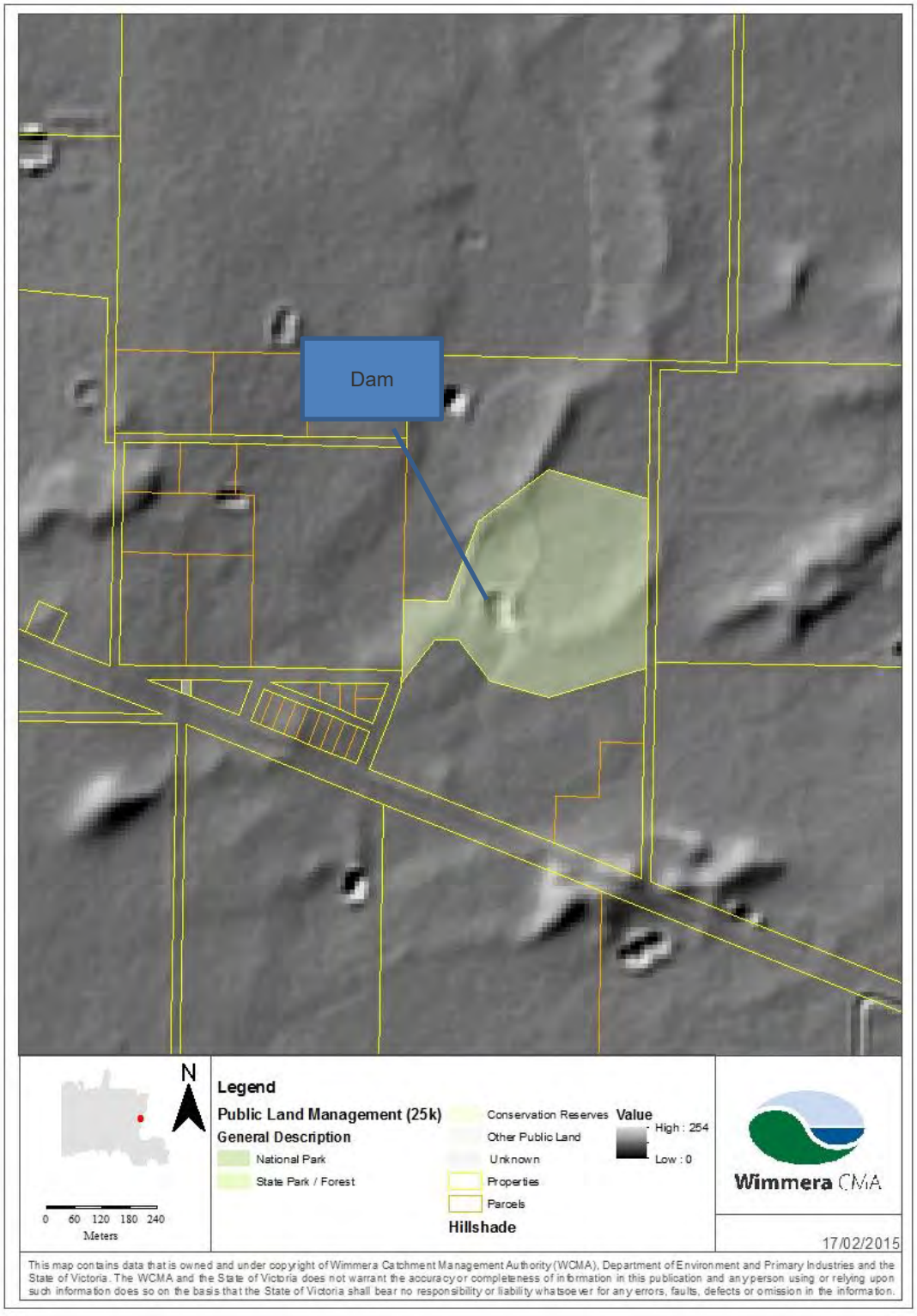


Figure 7-21. Harcoan's Swamp complex showing land tenure and terrain

The watering history of Harcoan's Swamp is not well known. In most years the dam would have been supplied with water, although as it was not a stock and domestic dam for a paying customer it would have been a lower priority for supply during

drought conditions. It would have been unlikely to be frequently supplied by the channel since the mid to late 1990's as drought conditions worsened. The physical configuration of the site indicates that only the dam and not the surrounding wetland would be filled by the channel. Therefore the wetland would only fill once there were very wet conditions generating large volumes of runoff from adjacent rises. Wet conditions led to the dam filling in September 2010 (Figure 7-24) and additional heavy rainfall in January 2011 led to the wetland being filled. The wetland and dam dried out completely in late 2012 following the return of dry conditions (Figure 7-23). Watering of the dam in 2015 showed that it does not hold water well, drying out within weeks of the cessation of water supplies.

In early 2015 earthworks were undertaken implementing recommendations in RPS (2014) which involved the construction of a channel leading from the dam to the wetland itself. This means that when the dam fills, it will overtop into the wetland (**Error! Reference source not found.**).

Figure 7-22. Channel leading from dam into wetland at Harcoan's Swamp, April 2015

Table 7-31 Estimated watering history of Harcoan's Swamp

Watering History	Season											
	2010-11		2011-12		2012-13		2013-14		2013-14		2014-15	
	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam
Status	D-W	D-W	W	W-D	W-D	D	D	D	D	D	D	D
Water Source	L	L										
Volume	U	U										
Notes	Inundation in spring 2010 to		Dam contained water.		Dam contained water.		Dam contained water.		Dam drying out. Wetland		Dam drying out. Wetland	

	summer 2011	Wetland remained dry.	Wetland remained dry.	Wetland remained dry.	remained dry.	remained dry
Status: Wet/Wet-Dry/Dry-Wet/Shallow inundation/Dry Water source: Local runoff inundation/Flooding from waterways/Pipeline supply Volume: Unknown						

Figure 7-23. Harcoan's Swamp, April 2012, note shallow inundation in the distance.

7.5.4.Water Dependent Values

Fauna

A total of 18 bird, one reptile and one invertebrate species have been recorded at Harcoan's Swamp and are listed in Appendix 2 with the reptile being a deceased Olive Legless Lizard (*Delma inornata*), (Australian Ecosystems, 2013). Eastern Grey Kangaroos (*Macropus giganteus*) have also been observed at the site as well as Wedge-Tailed Eagles nesting (G. Fletcher, *pers. comm.*).

Flora

Harcoan's Swamp supports three EVCs with the elevated areas around the wetland supporting Plains Savannah (EVC 826). Most of the wetland area is covered by Lake Bed Herbland (EVC 107) with small portions on the periphery supporting Black Box Wetland (EVC 369).The vegetation is quite degraded with only a handful of remnant Black Box and Buloke scattered around the reserve. Much of the site (including the wetland area) was deep ripped and planted with native terrestrial species. Most of the revegetation died during the wet conditions in 2011.

The Lake Bed Herbland has been affected by the deep ripping and is also mostly covered by weed species such as Wimmera Rye-grass (*Lolium rigidum*) and Prickly Lettuce (*Lactuca serriola*). The dam itself is also largely covered by groundcover

weeds. Only a handful of native species were observed there including Ferny Small-flower Buttercup (*Ranunculus pumilio var. pumilio*) and Narrow-lead Dock (Rumex tenax). Given these observations, it is considered to be in poor condition. The Black Box Wetland is also in poor condition with the understorey dominated by weed species including Wimmera Rye-grass (*Lolium rigidum*) and Sow Thistle (*Sonchus oleraceus*) (Australian Ecosystems, 2013). Apart from Bulokes located in the Plains Savannah EVC, no threatened flora species were observed at Harcoan's Swamp. Maps showing the location of EVCs and threatened flora at Harcoan's Swamp is included in Figure 7-25 and Appendix 1 and they are listed in Table 7-32.

Table 7-32 Ecological Vegetation Classes observed at Crow Swamp (Source: Australian Ecosystems (2013))

EVC No.	EVC Name	Wimmera Bioregional Conservation Status	Water dependent (Y/N)
107	Lake Bed Herbland	Rare	Y
369	Black Box Wetland	Endangered	Y
826	Plains Savannah	Endangered	N

7.5.5.Current Condition

Wetland Values

The IWC assessment of Harcoan's Swamp was undertaken in 2012 by Australian Ecosystems and assessed to be in 'Good' condition overall. The lack of soil disturbance and absence of major drainage works led to scores for the Soils and Physical Form sub-indices being in the 'Excellent' category. The Wetland Catchment score was 'Good' due to modifications to the local catchment with surrounding landuse being cropping/grazing. The high cover of invasive weeds and lack of overstorey vegetation meant that the Biota sub-index was classified as 'poor'. No visible impacts of salinity or nutrient runoff meant that the Water Properties sub-index received a 'Good' score. Modifications to the catchment's hydrology due to earthworks were comparatively minor and led to a 'Good' classification. The results are summarised in Table 7-33.

Table 7-33 Index of Wetland Condition Scoring at Harcoan's Swamp (Source: Australian Ecosystems (2013))

IWC sub-index	Wetland Catchment	Physical Form	Hydrology	Water properties	Soils	Biota	Overall Score
Score / 20	15.5	19.5	15	15	19.5	11.2	7
Category	Good	Excellent	Good	Good	Excellent	Poor	Good

Figure 7-24. Dam at Harcoan's Swamp, December 2010

Dam Values

The qualitative habitat assessment results for the dam at Harcoan's Swamp are outlined in Table 7-34, the trees observed growing in the dam in Figure 7-24 have subsequently died due to the long period of inundation. Based on watering from the pipeline in 2015 the dam is noted to have poor water holding properties with a lot of seepage losses.

Table 7-34 Dam Habitat Values at Harcoan's Swamp

Indicator	Size	Steepness	Fringing Vegetation	Adjacent Vegetation	Overall
Category	Moderate	Good	Moderate	Poor	Moderate

7.5.6. Threats and Site Trajectory

Threats

Historically grazing would have been the main threat to the wetland given its former role as a water reserve. As mentioned previously, deep ripping for revegetation works has impacted on large parts of the wetland. Currently the main threat is the presence of invasive plants and animals.

Trajectory

The impact of invasive plants and animals will continue to be an issue at Harcoan's Swamp. Climate change may lead to impacts on some of the wetland plant species with reduced inundation events likely to be the case. The absence of water in the dam would also impact on the populations of local fauna who would use it for habitat/drinking water.

Do Nothing Option

If no environmental water was to be delivered then the abundance and diversity of local fauna is expected to remain static. In the longer term there is likely to be continued declines in the condition of wetland vegetation without additional watering due to climate change impacts.

7.5.7.Conceptualisation of Harcoan's Swamp

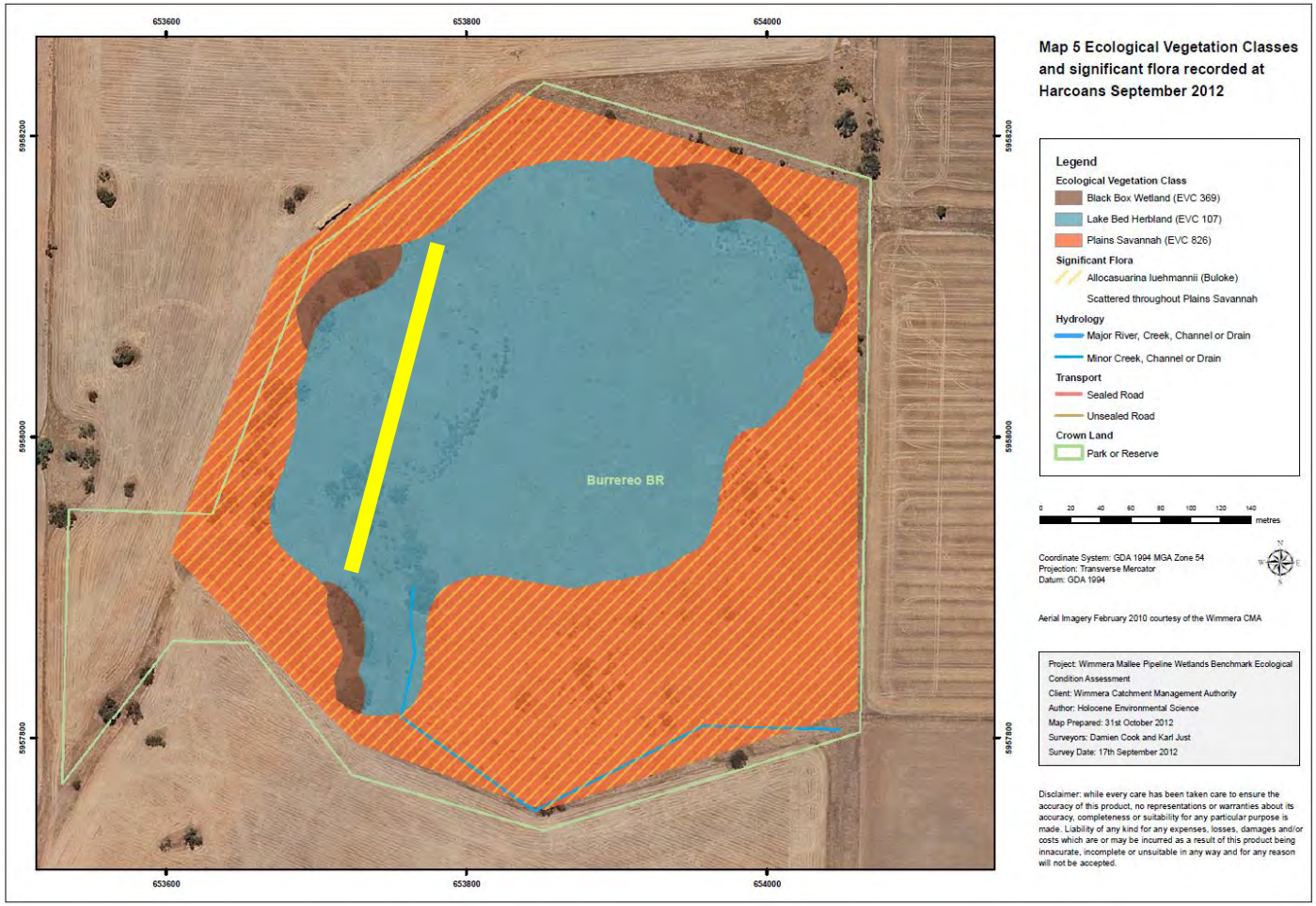
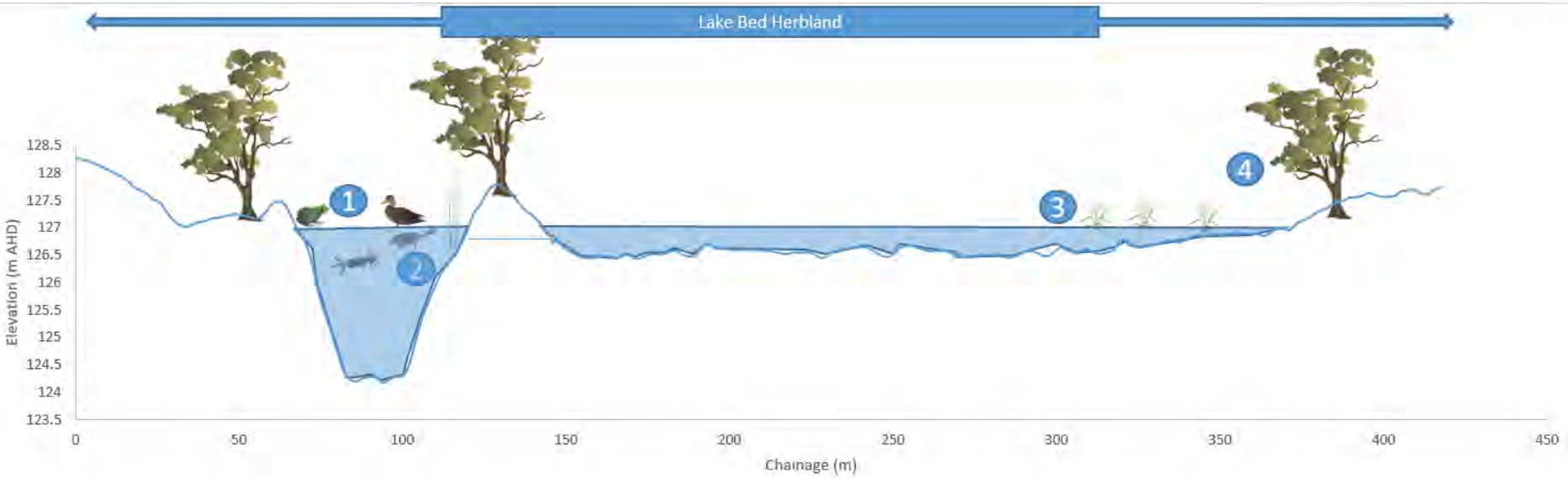


Figure 7-25. EVC and significant flora mapping at Harcoan's. Yellow line is the cross-section for conceptual model.



Notes:

1. Dam at Harcoans provides a refuge for waterbirds and species with low mobility during dry phases such as frogs and turtles
2. Wetting and drying of the dam banks will support an increased diversity of macroinvertebrates and wetland vegetation through providing a range of habitats for the various parts of their lifecycles
3. Occasional shallow inundation will maintain Shiny Dock and other native wetland vegetation
4. Increased water in the dam/wetland increases likelihood of watering Black Box due to natural heavy rainfall events

7.5.8.Management Objectives for Harcoan's Swamp

The management objectives for Harcoan's Swamp are:

- Periodically provide water in the dam to sustain fauna, especially frogs and wetland and woodland birds.
- Maintaining and where possible increasing the distribution of wetland flora.

Ecological Objectives

The ecological objectives for Harcoan's Swamp are listed in Table 7-35 below and relate to watering both the dam and the wetland areas.

Table 7-35 Ecological Objectives at Harcoan's Swamp

Ecological Objective	Justification
Maintain/Improve abundance of wetland flora	• Protects threatened species • Assists with nutrient cycling • Habitat and resources for macroinvertebrates, birds, frogs etc.
Achieve self-sustaining frog populations	• Frogs provide a food source for wetland birds • Key component of functioning wetland ecosystem through consumption of macroinvertebrates • Limited distribution of these species in the northern Wimmera following the decommissioning of the stock and domestic channel system.
Diverse macroinvertebrate population	• Provides a food source for wetland birds, frogs and turtles • Cycles nutrients
Supports wetland birds	• Protects threatened species • Key refuge for ducks, cormorants, grebes etc. during dry conditions
Watering point for terrestrial species	• Supports woodland birds and other local native fauna during dry conditions

Hydrological Objectives

Australian Ecosystems (2013) provides recommendations for a watering regime to maximise the condition of the EVCs observed at Harcoan's Swamp.

Table 7-36 Hydrological Objectives at Harcoan's Swamp (Source: Australian Ecosystems (2013))

EVC No.	EVC Name	Environmental Watering Frequency	Duration	Depth (m)	Estimated Volume (ML)
826	Plains Savannah	NA	NA	NA	NA
107	Lake Bed Herbland	< 3 to 10 years in 10	> 1 year	0.5	40
369	Black Box Wetland	If not inundated within the last 5 years	< 4 months	0.3	2.1

Watering Regime

The watering regime for Harcoan's Swamp is derived from the ecological and hydrological objectives listed above and heavily influenced by water availability and seasonal conditions. The dam's poor water holding properties makes maintaining water in the dam impractical and so should only be filled during wet years. The modelled delivery rate by pipeline to the wetland is 30 ML/y (GWMWater, 2012). Therefore watering will be typically only feasible for the dam and part of the Lake Bed

Herbland EVC. The comparatively low rate of delivery in contrast to the volume required to inundate the Lake Bed Herbland means that pipeline supplies are unlikely to exceed evaporation and seepage losses and so watering of the Black Box Wetland is unfeasible. However increasing the periods of time when the wetland contains water slightly increases the likelihood that if a wet spell occurs that water will reach the outer sections of Harcoan's Swamp including the Black Box wetland.

The recommended regime subject to water availability is:

- Provide water to fill Harcoan's Swamp's dam during wet years.
- Water Lake Bed Herbland every fifth year if a natural inundation event has not occurred through filling and overtopping dam.

7.6.Krong Swamp

7.6.1.Catchment Setting

Krong Swamp is an oval deflation basin wetland with an associated lunette. The deepest point is a circular wetland and to the north there is a Black Box wetland that overland flow would pass through to reach the main wetland. Most of the Black Box wetland is on freehold land and is not considered for environmental watering. The circular wetland is located on Crown Land and is approximately 4.2 Ha in area and is surrounded by cropping/grazing land in every direction apart from the north. A small dam has been excavated about 100 metres west of the wetland. The former Krong Channel enters the dam from the north but does not directly enter the wetland.

7.6.2.Land Status

Krong Swamp (and associated dam) was originally known as Krong Tank and there are references to it being connected to the nearby Crymelon Channel for supply in the late 19th century (The Horsham Times, 1898). Initially it seems that it was administered by the Borung Shire who initially excavated the tank (dam), given its public use it was set aside as a 110th Section Reserve for water supply purposes. The southern part of the wetland is illustrated in a 1927 map of the Parish of Willenabrina (spelled Korong) prepared by the then Lands Department (Figure 7-26). It is presumed that the water reserve section was used for livestock driven to markets or other properties for access to drinking water. It is currently administered by Parks Victoria and now the site is now designated as Willenabrina I86 Bushland Reserve. It should be noted that Yarriambiack Shire are also using a portion of the eastern side of the reserve as a stack site for roadmaking gravel etc.

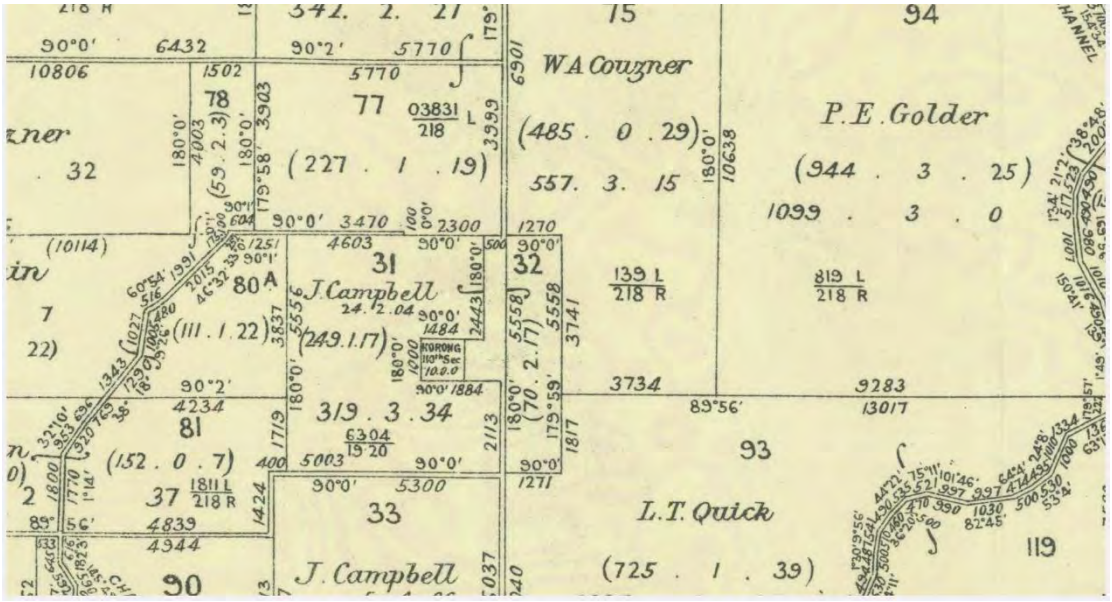


Figure 7-26. Parish of Willenabrina Map Department of Lands and Survey 1927, Krong Swamp is the small square parcel described as 'Korong 110th Sec'.

7.6.3.Hydrology

Krong Swamp is an oval deflation basin wetland. During very wet seasons it would fill to varying degrees and dry out within a number of months. In this case, runoff from all directions would fill the wetland (Figure 7-29). The soil would require substantial rainfall to wet up and have standing water present and so it is unlikely that there would be much standing water in dry-average winters. In exceptionally wet conditions (such as the January 2011 floods or early 1970's) the wetland filled to over 0.5 meters depth and so was able to retain water for some months, going on years if wet conditions persisted.

Krong Swamp is also the end of the fromer Krong Channel and so water would be supplied most years for stock and road making water as well as being an outfall as the channel is drawn down. However, the channel system had a reliability of about 70% and so there were restrictions on the volume of water available for the swamp, for example during the Millennium Drought, water was unlikely to have been supplied given domestic needs and paying customers would have had a higher priority. Now the channel system has been decommissioned the only sources of water are the natural catchment and the Wimmera Mallee Pipeline.

The watering history of Krong Swamp is not well known. During the Millennium Drought the dam would have been filled sporadically, but this would have ceased from 2004 onwards when the drought worsened. An aerial photo in 2004 shows that the dam is empty at Krong Swamp, although the dam just to the north on freehold land contains water. It would have been empty for a number of years until very wet conditions from spring 2010 to summer 2011 filled the dam and the other wetland areas (Figure 7-30). Both the dam and wetland dried out later in 2011. Water supplied to the dam via the pipeline in 2015 indicates that it is poor at retaining water with very high seepage and dries out within a few weeks of water supplies ceasing.

In early 2015, based on recommendations in RPS (2014) a channel was constructed to enable water to flow from the dam which is adjacent to Brikkle Road, west into the

wetland once it filled. A low-level bund was also built at the southern end of the wetland to prevent water entering adjacent cropping land (Figure 7-27, Figure 7-28).

Figure 7-27. Channel leading from dam to Krong Swamp, April 2015

Figure 7-28. Bund at southern edge of Krong Swamp, April 2015

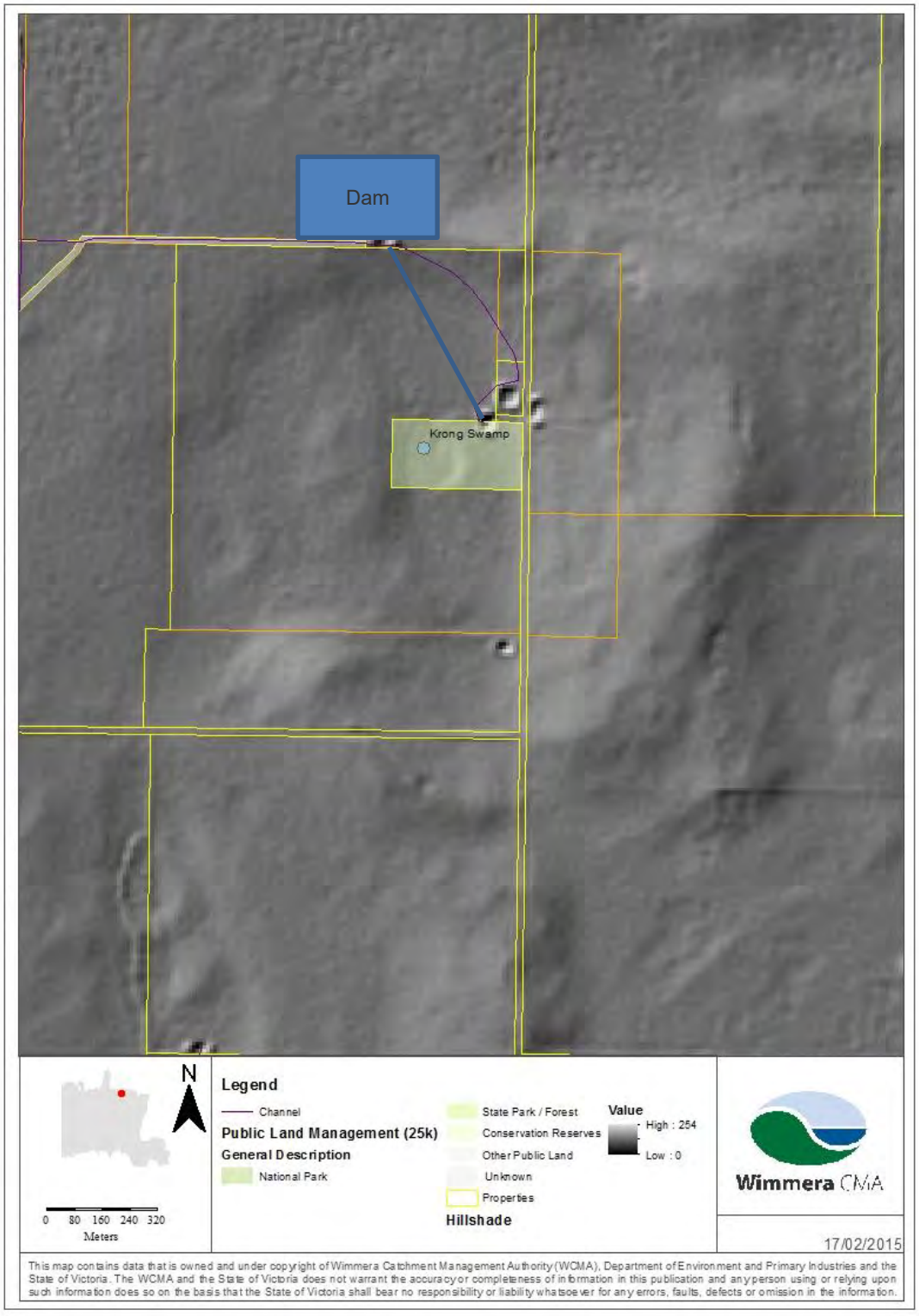


Figure 7-29. Krong Swamp complex showing land tenure and terrain

Figure 7-30. Krong Swamp, December 2010

Table 7-37 Estimated watering history of Krong Swamp

Watering History	Season											
	2010-11		2011-12		2012-13		2013-14		2013-14		2014-15	
	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam
Status	D-W-D	D-W	D	W-D	D	D	D	D	D	D	D	D-W
Water Source	L	L		L								P
Volume (ML)	U	U										2.2
Notes	Inundation in spring 2010 to summer 2011		Dam dried out. Wetland remained dry.		Dam and wetland dry.		Dam and wetland dry.		Dam and wetland dry.		Wetland dry. Dam filled in Autumn 2015	
Status: Wet/Dry-Wet-Dry/Dry-Wet/Shallow inundation/Dry Water source: Local runoff inundation/Flooding from waterways/Pipeline supply Volume: Unknown												

7.6.4.Water Dependent Values

Fauna

A total of 17 bird, five invertebrate and four mammal species have been recorded at Krong Swamp (Australian Ecosystems, 2013) and are listed in Appendix 2. One threatened species, the Black Falcon has been observed. Given the site was dry at the time of the inspection there were no wetland bird species observed. It was noted that the large number of hollow-bearing Black Box trees would provide excellent habitat for a range of fauna (Australian Ecosystems, 2013).

Table 7-38 Threatened fauna observed at Krong Swamp (Source: Australian

Ecosystems (2013))

Common Name	Scientific Name	Fauna Type	Type	Last Record	EPBC Status	FFG Status	DELWP Status
Black Falcon	*Falco subinger*	B	T	2012			V

Fauna Type: Amphibian, Reptile, Bird, Mammal
Type: Wetland dependent, Terrestrial
Status: Endangered, Vulnerable, Threatened, Rare, Near Threatened, Data Deficient, Poorly Known

Flora

The wetland complex at Krong Swamp supports several wetland EVCs, the deepest section of the oval wetland consists of a Lignum Shrubland (EVC 808) and on its margins is a Lignum Swampy Woodland (EVC 823). The southern tip of this wetland extends beyond the boundary of the Bushland Reserve into freehold land and has been cropped. Extending north from the Bushland Reserve into freehold land is a large area of Black Box Wetland (EVC 369). On the western rises of the Bushland Reserve there is Plains Savannah vegetation (EVC 826).

Several threatened flora species were observed at Krong Swamp including Spiny Lignum (*Duma horrida subsp. horrida*), Cane Grass (*Eragrostis australasica*) and Scurfy Germander (*Teucrium albicaule*). These species were found in the southern oval wetland but also further west in the Black Box and Plains Savannah EVCs as well.

The Lignum Shrubland EVC was notable as being a rare Wimmera-specific form of the EVC dominated by Cane Grass (*Eragrostis australasica*) rather than Tangled Lignum (*Muehlenbeckia florulenta*). A high diversity of native species were found in this EVC including Southern Cane Grass (*Eragrostis infecunda*) and Common Swamp Wallaby-grass (*Amphobromus nervosus*). Low to moderate weed cover was present including species like Musky Heron's Bill (*Erodium moschatum*) and Prickly Lettuce (*Lactuca serriola*). Generally it was noted as being in 'Good' condition (Australian Ecosystems, 2013).

The Lignum Swampy Woodland EVC was observed to be in a narrow zone surrounding the Lignum Shrubland and was dominated by Black Box (*Eucalyptus largiflorens*) with an understorey of Tangled Lignum (*Muehlenbeckia florulenta)* and Cane Grass (*Eragrostis australasica*). Groundcover species observed include Common Nardoo (*Marsilea drummondii*) and Salt Sea-spurrey (*Spergularia brevifolia*) with a low cover of weeds, mostly Barley-grass (*Hordeum leporinum*). Therefore this EVC was also classified as 'Good' condition (Australian Ecosystems, 2013).

The Black Box Wetland EVC was dominated by Black Box (*Eucalyptus largiflorens*) trees with an understorey of Tangled Lignum (*Muehlenbeckia florulenta*), Knob Sedge (*Carex inversa*) and Spiny Lignum (*Muehlenbeckia horrida subsp. horrida*). A higher proportion of weeds were noted in this EVC including Wimmera Rye-grass (*Lolium rigidum*) and Hairy Fiddle-neck (*Amsinckia calycina*). Maps showing the distribution of EVCs and threatened flora at the site has been included in Figure 7-32 and Appendix 1 and in Table 7-39 and Table 7-40.

Table 7-39 Threatened flora observed at Krong Swamp (Source: Australian Ecosystems (2013))

Common Name	Scientific Name	Type	Last Record	EPBC Status	FFG Status	DELWP Status	EVC found
Spiny Lignum	*Duma horrida subs. horrida*	W	2012			R	808,826
Cane Grass	*Eragrostis australasica*	W	2012			V	369, 808
Scurfy Germander	*Teucrium albicaule*	T	2012			P	823
Type: Wetland dependent, Terrestrial **Status:** Endangered, Vulnerable, Threatened, Rare, Near Threatened, Data Deficient, Poorly Known							

Table 7-40 Ecological Vegetation Classes observed at Krong Swamp (Source: Australian Ecosystems (2013))

EVC No.	EVC Name	Mallee Bioregional Conservation Status	Water dependent (Y/N)
369	Black Box Wetland	Rare	Y
808	Lignum Shrubland	Endangered	Y
826	Plains Savannah	Endangered	N
823	Lignum Swampy Woodland	Vulnerable	Y

7.6.5.Current Condition

Wetland Values

The IWC assessment of Krong Swamp was undertaken in 2012 by Australian Ecosystems and assessed to be in 'Good' condition overall. The lack of soil disturbance and absence of major drainage works led to scores for the Soils and Physical Form sub-indices being in the 'Excellent' category. The Wetland Catchment score was 'Moderate' due to modifications to the local catchment, with the southern tip being cropped, a limited native terrestrial vegetation buffer around and surrounding landuse being largely cropping/grazing. The cover of invasive weeds and modifications to the catchment's hydrology due to earthworks led to only 'Moderate' classifications. The results are summarised in Table 7-41.

Table 7-41 Index of Wetland Condition Scoring at Krong Swamp (Source: Australian Ecosystems (2013))

IWC sub-index	Wetland Catchment	Physical Form	Hydrology	Water properties	Soils	Biota	Overall Score
Score / 20	12	17.5	10	15	19.5	15.7	7.5
Category	Moderate	Excellent	Good	Good	Excellent	Moderate	Good

Dam Values

The value of the dam at Krong Swamp has been qualitatively classified (Table 7-42) with the dam itself having comparatively modest values but surrounding vegetation means that there is very good habitat for local fauna (Figure 7-22). Unfortunately the dam has high seepage rates which prevents it from holding water for long periods.

Table 7-42 Dam Habitat Values at Krong Swamp

Indicator	Size	Steepness	Fringing Vegetation	Adjacent Vegetation	Overall
Category	Poor	Poor	Moderate	Good	Moderate

Figure 7-31. Krong Swamp dam, December 2010.

7.6.6.Threats and Site Trajectory

Threats

For the Bushland Reserve, historically grazing would have been the main threat to the wetland given its former role as a water reserve. Anecdotal evidence suggests that the adjacent landholder periodically had stock grazing at the wetland. However this has not been the case since the pipeline was connected to the site and now the main threat is the presence of invasive plants and animals. The Black Box Wetland north of the Bushland Reserve is likely to be grazed periodically, however a new boundary fence will prevent the escape of livestock into the Bushland Reserve.

Trajectory

Gradual declines in vegetation condition would be expected to take place over time without environmental watering, especially given forecasts for a hotter and drier climate going forward. The absence of water in the dam would also impact on the populations of local fauna who rely on it for habitat/drinking water.

Do Nothing Option

If no environmental water was to be delivered it is expected that local fauna values would diminish in the short term, as the dam would remain dry most of the time. In the longer term there may be some impact on the condition and diversity of wetland flora at Krong Swamp as it was adapted more frequent inundation than would be the case.

7.6.7.Conceptualisation of Krong Swamp

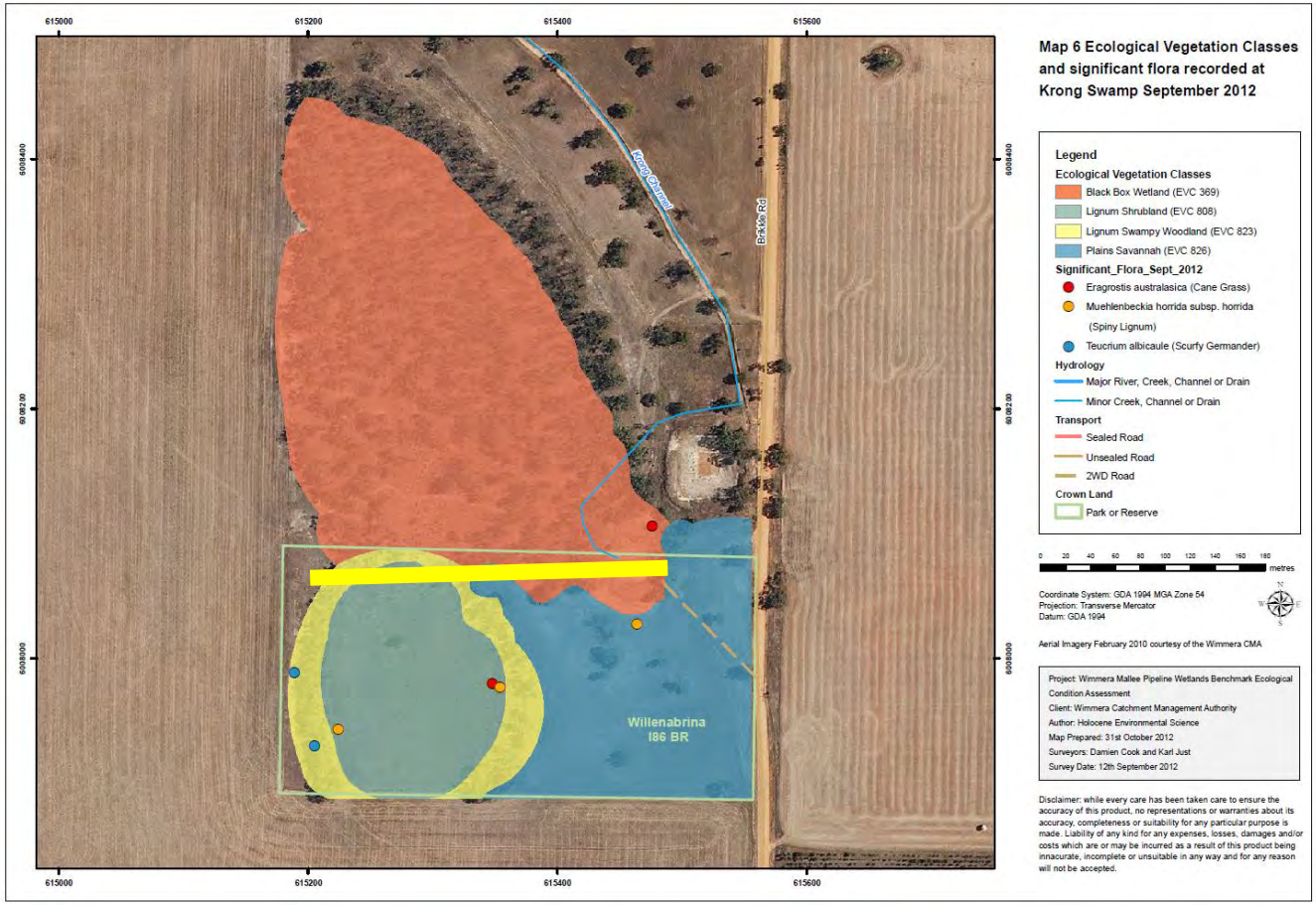
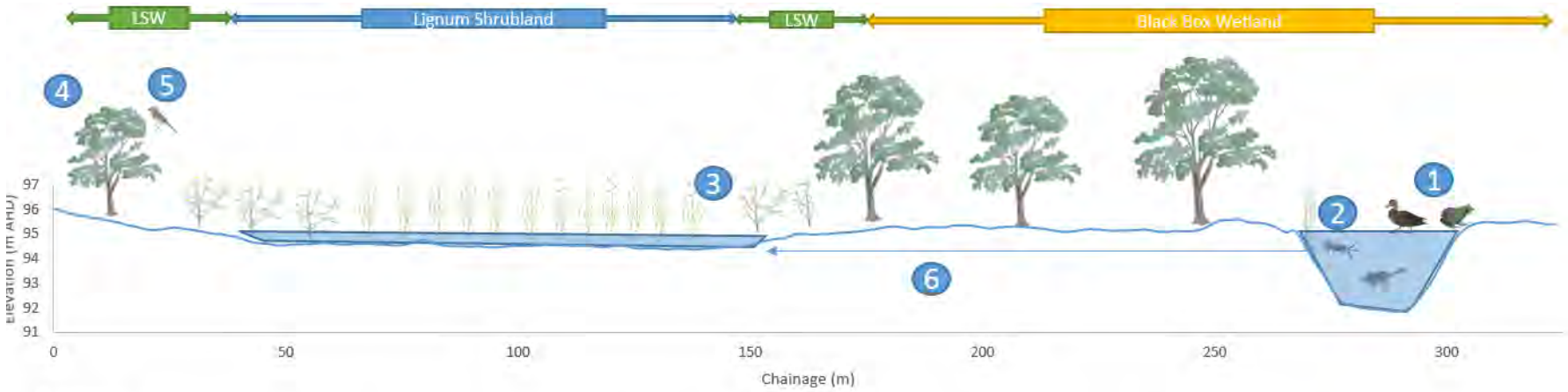


Figure 7-32. EVC and significant flora mapping at Krong. Yellow line is the cross-section for conceptual model.



Notes:

1. Dam at Krong provides a refuge for waterbirds and species with low mobility during dry phases such as frogs and turtles
2. Wetting and drying of the dam banks will support an increased diversity of macroinvertebrates through providing a range of habitats for the various parts of their lifecycles
3. Occasional shallow inundation will maintain Spiny Lignum, Southern Cane-grass and other native wetland vegetation
4. Increased water in the wetland increases likelihood of watering Black Box due to natural heavy rainfall events
5. Dam provides a drinking water source for woodland birds, quail etc.
6. Channel from dam enables water to reach wetland

LSW = Lignum Swampy Woodland

7.6.8.Management Objectives for Krong Swamp

The management objectives for Krong Swamp are:

- Periodically provide water in the dam to sustain fauna, especially frogs and wetland and woodland birds.
- Maintaining and where possible increasing the distribution of wetland flora, especially threatened species.

Ecological Objectives

The ecological objectives for Krong Swamp are listed in Table 7-43 below and relate to watering both the dam and the wetland areas.

Table 7-43 Ecological Objectives at Krong Swamp

Ecological Objective	Justification
Maintain/Improve abundance of wetland flora	• Protects threatened species • Assists with nutrient cycling • Habitat and resources for macroinvertebrates, birds, frogs etc.
Achieve self-sustaining frog populations	• Frogs provide a food source for wetland birds • Key component of functioning wetland ecosystem through consumption of macroinvertebrates • Limited distribution of these species in the northern Wimmera following the decommissioning of the stock and domestic channel system.
Diverse macroinvertebrate population	• Provides a food source for wetland birds, frogs and turtles • Cycles nutrients
Supports wetland birds	• Protects threatened species • Key refuge for ducks, cormorants, grebes etc. during dry conditions
Watering point for terrestrial species	• Supports woodland birds and other local native fauna during dry conditions

Hydrological Objectives

Australian Ecosystems (2013) provides recommendations for a watering regime to maximise the condition of the EVCs observed at Krong Swamp.

Table 7-44 Hydrological Objectives at Krong Swamp (Source: Australian Ecosystems (2013))

EVC No.	EVC Name	Environmental Watering Frequency	Duration	Depth (m)	Estimated Volume (ML)
826	Plains Savannah	NA	NA	NA	NA
808	Lignum Shrubland	If not inundated in the last 2 years	< 6 months	0.5	11
823	Lignum Swampy Woodland	< 3 to 7 years in 10	> 1 month, <6 months	0.2	4
369	Black Box Wetland	If not inundated within the last 5 years	< 4 months	0.2	18.6

Watering Regime

The watering regime for Krong Swamp is derived from the ecological and hydrological objectives listed above. This regime will be subject to water availability

and seasonal conditions. The modelled delivery rate by pipeline to the wetland is 15 ML/y (GWMWater, 2012). Therefore watering will be typically only feasible for the Lignum Shrubland and may only be able to fill a portion of the wetland, given seepage and evaporative losses as well as other demands on the pipeline potentially reducing delivery rates. However if the Lignum Shrubland contains water more frequently then this increases the likelihood of water from localised runoff during wet conditions inundating the Black Box Wetland to the north.

The recommended regime subject to water availability is:

- Provide water to fill Krong Swamp dam during wet years.
- Water Lignum Shrubland every third year if it has been dry in the interim through filling dam, once the dam fills water will flow along the channel into the Lignum Shrubland.

7.7.Mutton Swamp

7.7.1.Catchment Setting

Mutton Swamp is an oval deflation basin wetland with an associated lunette and would receive inflows from its local catchment during very wet conditions. The Dunmunkle Creek also flows north along the very shallow valley that Mutton Swamp is located in. It is approximately 20 Ha in area and is surrounded by cropping/grazing land in every direction apart from the north. A dam has been excavated in the centre of the swamp which was filled by the former Mutton Swamp Channel.

7.7.2.Land Status

Historically Mutton Swamp was set aside as a water reserve in 1877 (Figure 7-33), it appears to be named after the adjacent landholder to the north. During the First World War it was mooted as a potential water storage for nearby Rupanyup with an augmented embankment and channel cut from nearby Dunmunkle Creek, however the fact that it was a ‘natural water storage’ meant that it would be inefficient in this role (Rupanyup Spectator and Lubeck, Banyena, Rich Avon and Lallat Advertiser, 1915) and therefore only received stock water channel supplies. It is presumed that it was used for livestock driven to markets or other properties for access to drinking water. It is administered by Parks Victoria and is now designated as Mutton Swamp Wildlife Reserve.

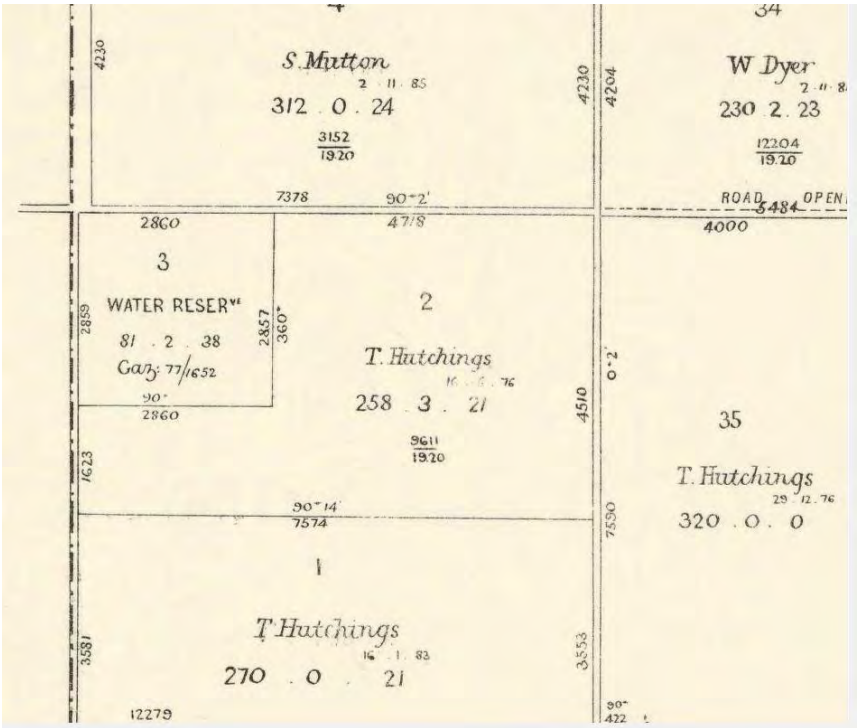


Figure 7-33. Parish of Lallat, County of Borung Map Department of Lands and Survey 1888, Mutton Swamp is the 'Water Reserve' on the left.

7.7.3.Hydrology

Mutton Swamp is an oval deflation basin wetland and during very wet conditions it would fill to varying degrees and dry out within a number of months. In this case runoff from all directions would fill the wetland.The soil would require substantial rainfall to wet up and have standing water present and so it is unlikely that there would be much standing water in dry-average winters. In exceptionally wet conditions (such as the January 2011 floods or early 1970's) the wetlands filled to over 0.5 meters depth and so was able to retain water for some months, going on years if conditions remained wet. The swamp could also fill due to flood flows travelling up the Dunmunkle Creek from the Wimmera River near Glenorchy, Figure 7-35 shows an anabranch of the Dunmunkle Creek north-west of Mutton Swamp.

Mutton Swamp was supplied by the former Mutton Swamp Channel and so water would be supplied most years for stock as well as being a potential outfall as the channel is drawn down. The channel system had a reliability of about 70% and so there were restrictions on the volume of water available for the swamp, for example during the Millennium Drought, water was unlikely to have been supplied given domestic needs and paying customers would have had a higher priority. Now the channel system has been decommissioned the only sources of water are flood flows from the Dunmunkle Creek, runoff from the natural catchment and the Wimmera Mallee Pipeline. The swamp contained some shallow pools after wet conditions in winter/spring 2010 and filled during the floods of January 2011 (Figure 7-34). The dam contained water into early 2013 but dried later that year. Water began to be supplied by the pipeline in autumn 2015, leading to low level inundation in the dam as water flows along a channel leading from the outlet in the south-west of the reserve to the dam.

Figure 7-34. Mutton Swamp, January 2011

The watering history of Mutton Swamp is not well known. During the Millennium Drought the dam would have been filled sporadically but this would have caesed from 2004 onwards, when the drought worsened. It would have been empty for a number of years until very wet conditions from spring 2010 filled the dam and other low lying areas. Significant flooding from the Dunmunkle Creek combined with heavy localised rainfall leading to substantial inflows led to the swamp filling in January 2011. The swamp dried out later in 2011, however the dam contained water for another two years before drying out. Supplies from the pipeline commenced in autumn 2015 which led to low level inundation in the dam via the channel heading from the south-west corner (Figure 7-36).

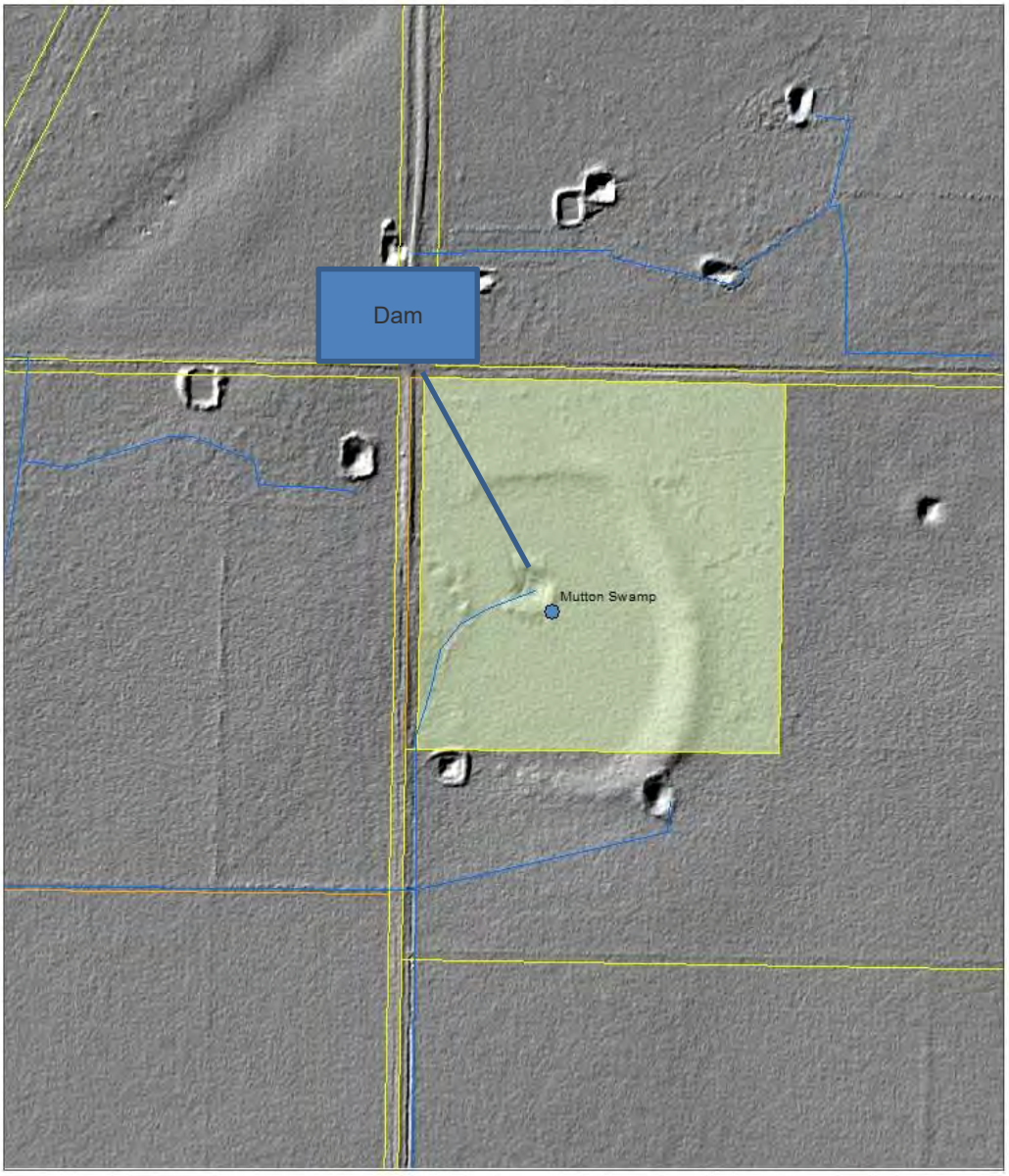


Figure 7-35. Mutton Swamp complex showing land tenure and terrain. Dunmunkle Creek can be seen in the north-west of the image.

Figure 7-36. Water supplied by the pipeline flowing through the channel to the dam in Mutton Swamp, April 2015

Table 7-45 Estimated watering history of Mutton Swamp

Watering History	Season											
	2010-11		2011-12		2012-13		2013-14		2013-14		2014-15	
	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam
Status	D-W	D-W	W-D	W	D	W-D	D	D	D	D	D	S
Water Source	L/F	L/F										P
Volume (ML)	U	U										1.9
Notes	Inundation in spring 2010 to summer 2011		Dam remained wet. Wetland dried out.		Dam dried out. Wetland dry.		Dam and wetland dry.		Dam and wetland dry.		Wetland dry, small volume delivered to dam	
Status: Wet/Dry-Wet-Dry/Dry-Wet/Shallow inundation/Wet-Dry/Dry **Water source: Local runoff inundation/Flooding from waterways/Pipeline supply** **Volume: Unknown**												

7.7.4.Water Dependent Values

Fauna

A total of 26 bird, four frog, two mammal and three reptile species have been recorded at Mutton Swamp, listed in Appendix 2 (Australian Ecosystems, 2013).

Flora

The wetland complex at Mutton Swamp supports two wetland EVCs, the deepest section of the wetland consists of Lakebed Herbland (EVC 107) and surrounding this

is a Black Box Wetland (EVC 369). On the eastern rises of the Wildlife Reserve there is Plains Woodland (EVC 803).

Three threatened flora species were observed at Mutton Swamp including Spiny Lignum (*Muehlenbeckia horrida subsp. horrida*), Winged Water-starwort (*Callitriche umbonata*) and Turnip Copperburr (*Sclerolaena napiformis*). The Spiny Lignum was found near the western edge of the Bushland Reserve in the Black Box Wetland area. Winged Water-starwort was scattered throughout the Lake Bed Herbland and the Turnip Copperburr tended to be located in the areas less prone to inundation (on the eastern edge of the Black Box Wetland and amongst the Plains Woodland).

A moderate number of native species were found in the Lake Bed Herbland EVC including Common Swamp Wallaby-grass (*Amphibromus nervosus*), Purple Crassula (*Crassula peduncularis*) and Austral Mudwort (*Limosella australis*). The presence of a high cover of Common Spike-sedge (*Eleocharis acuta*) in the deepest section indicates that during wet conditions an Aquatic Herbland and Spike-sedge Wetland complex would be present. A high weed cover was present including species like Ox-tongue (*Helminthotheca echioides*) and Awned Club-sedge (*Isolepsis hystrix*). Generally it was noted as being in 'Moderate' condition (Australian Ecosystems, 2013).

The Black Box Wetland EVC was observed to be in a fringe surrounding the Lake Bed Herbland and was dominated by Black Box (*Eucalyptus largiflorens*) with an understorey of scattered Tangled Lignum (*Muehlenbeckia florulenta)* and Spiny Lignum (*Muehlenbeckia horrida subsp. horrida*). Groundcover species observed include Common Nardoo (*Marsilea drummondii*) and Salt Sea-spurrey (*Spergularia brevifolia*) with a low cover of weeds, mostly Barley-grass (*Hordeum leporinum*). Therefore this EVC was also classified as 'Good' condition (Australian Ecosystems, 2013).

Maps showing the location of EVCs and threatened flora species is in Figure 7-37 and Appendix 1 and details are included in Table 7-46 and Table 7-47.

Table 7-46 Threatened flora observed at Mutton Swamp (Source: Australian Ecosystems (2013))

Common Name	Scientific Name	Type	Last Record	EPBC Status	FFG Status	DELWP Status	EVC found
Spiny Lignum	*Duma horrida subs. horrida*	W	2012			R	803
Winged Water-starwort	*Callitriche umbonata*	W	2012			R	107
Swamp Early Nancy	*Wurmbea dioica ssp. lacunaria*	W	2012			P	107
Turnip Copperburr	*Sclerolaena napiformis*	T	2012	E	E	E	803,369
Type: Wetland dependent, Terrestrial **Status:** Endangered, Vulnerable, Rare, Near Threatened, Data Deficient, Poorly Known							

Table 7-47 Ecological Vegetation Classes observed at Mutton Swamp (Source:

Australian Ecosystems (2013))

EVC No.	EVC Name	Wimmera Bioregional Conservation Status	Water dependent (Y/N)
369	Black Box Wetland	Endangered	Y
107	Lake Bed Herbland	Endangered	Y
826	Plains Savannah	Endangered	N

7.7.5.Current Condition

Wetland Values

The IWC assessment of Mutton Swamp was undertaken in 2012 by Australian Ecosystems and assessed to be in 'Good' condition overall. The absence of major drainage works led to scores for the Physical Form sub-index being in the 'Excellent' category. The Wetland Catchment score was 'Moderate' due to modifications to the local catchment through the roads constructed in the northern portion and to the east of the wetland, a limited native terrestrial vegetation buffer around the wetland and surrounding landuse being largely cropping/grazing. The minor soil disturbance as well as changes to the wetland's hydrology and water quality through the construction of roadways led to slightly reduced scores for these sub-indices although they are still classified as 'Good'. The cover of invasive weeds and modifications to the catchment's hydrology due to earthworks led to only 'Moderate' classifications for biota and hydrology. The results are summarised in Table 7-48.

Table 7-48 Index of Wetland Condition Scoring at Mutton Swamp (Source: Australian Ecosystems (2013))

IWC sub-index	Wetland Catchment	Physical Form	Hydrology	Water properties	Soils	Biota	Overall Score
Score / 20	12	19.5	15	15	14	15.7	7.5
Category	Moderate	Excellent	Good	Good	Good	Moderate	Good

Dam Values

The value of the dam at Mutton Swamp has been qualitatively classified in Table 7-49, indicating it would provide reasonable values for local fauna.

Table 7-49 Dam Habitat Values at Mutton Swamp

Indicator	Size	Steepness	Fringing Vegetation	Adjacent Vegetation	Overall
Category	Moderate	Good	Moderate	Good	Good

7.7.6.Threats and Site Trajectory

Threats

For the Wildlife Reserve, historically grazing would have been the main threat to the wetland given its former role as a water reserve. However, this has not been the case for a number of years and now the main threat is the presence of invasive plants and animals. The roads constructed in the north of the wetland area prevent overland flow from reaching the deeper sections of the wetland and culverts should be installed to address this threat.

Trajectory

Gradual declines in vegetation condition would be expected to take place over time without environmental watering especially given forecasts for a hotter and drier climate going forward. The absence of water in the dam would also impact on the populations of local fauna who rely on it for habitat/drinking water.

Do Nothing Option

If no environmental water was to be delivered it is expected that local fauna values would diminish in the short term, as the dam would remain dry most of the time. In the longer term there may be some impact on the condition and diversity of wetland flora at Mutton Swamp as it is adapted to more frequent inundation than would be the case.

7.7.7.Conceptualisation of Mutton Swamp

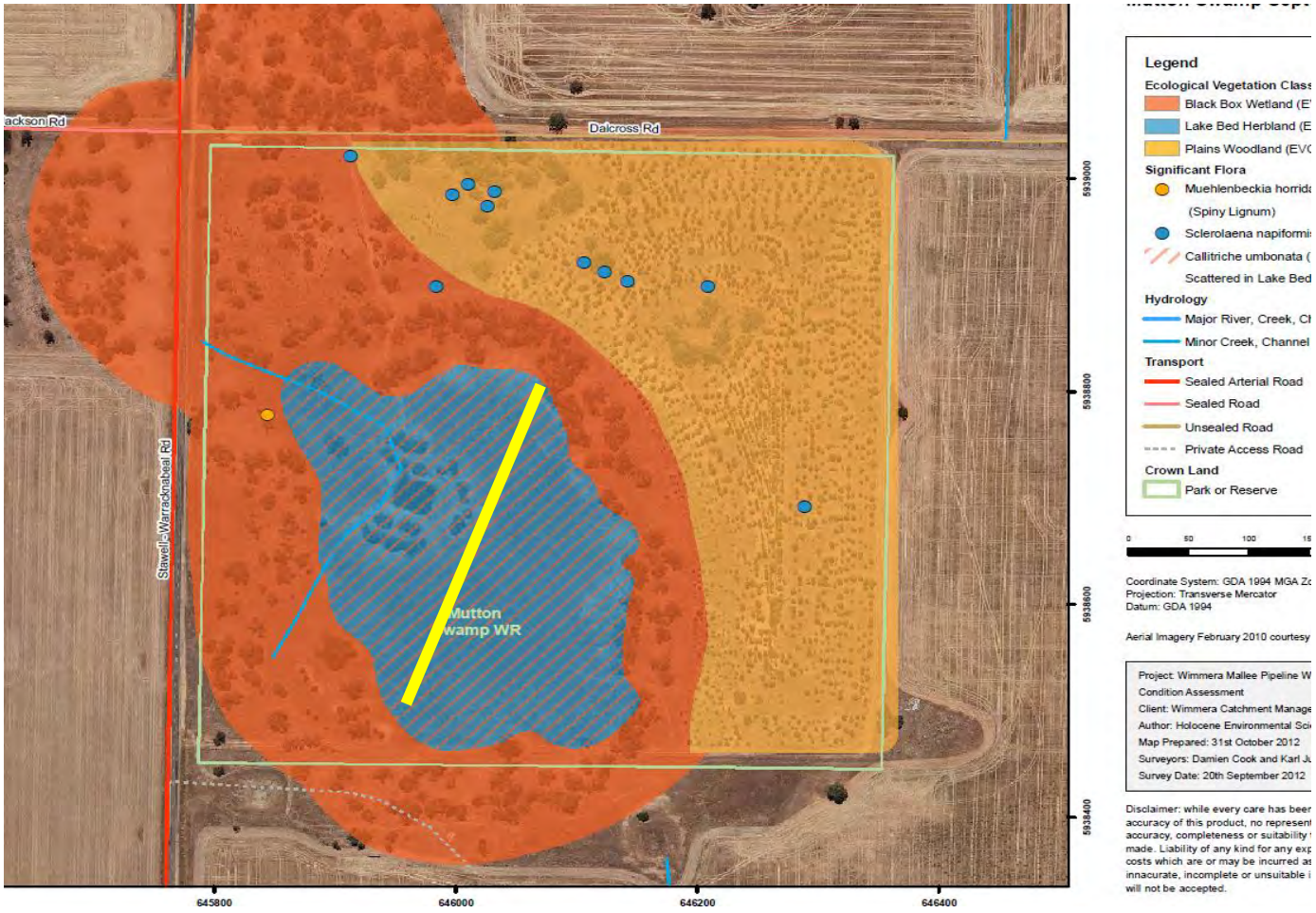
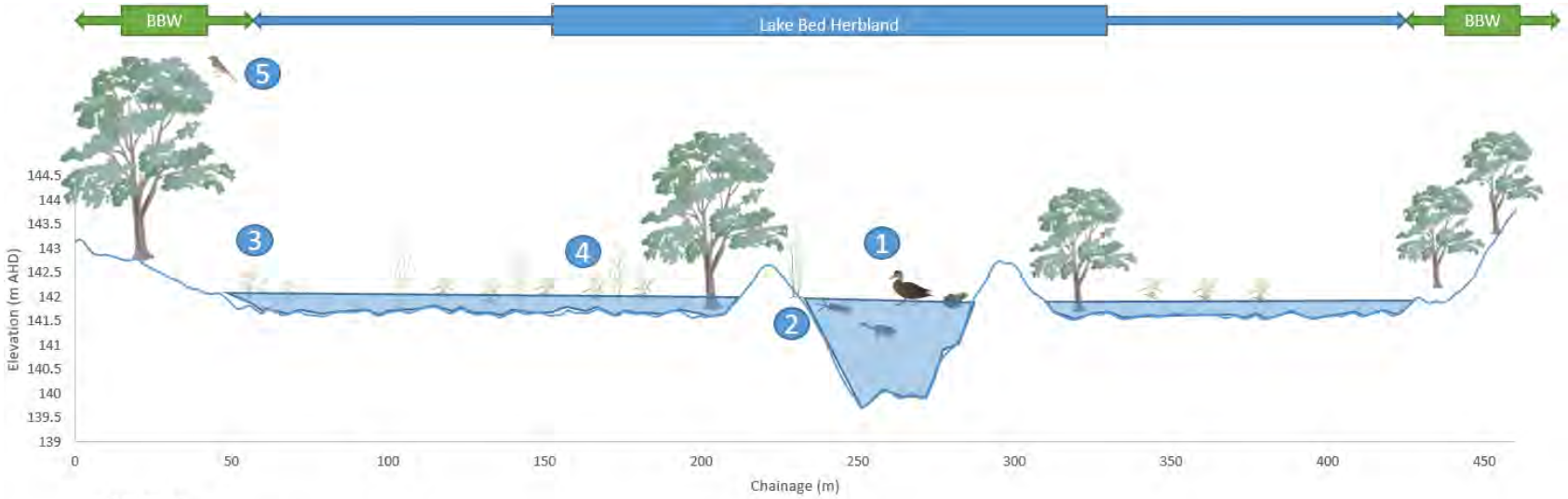


Figure 7-37. EVC and significant flora mapping at Mutton. Yellow line is the cross-section for conceptual model.



Notes:

1. Dam at Mutton provides a refuge for waterbirds and species with low mobility during dry phases such as frogs and turtles Wetting and drying of the dam banks will support an increased diversity of macroinvertebrates and wetland vegetation through providing a range of habitats for the various parts of their lifecycles
2. Occasional shallow inundation will maintain sedges and species like Southern Cane-grass
3. Increased water in the dam/wetland increases likelihood of watering lignum, including Spiny Lignum as well as Black Box from natural heavy rainfall events
4. Water in dam provides drinking water source for woodland bird community

BBW = Black Box Wetland

7.7.8.Management Objectives for Mutton Swamp

The management objectives for Mutton Swamp are:

- Retain water in the dam to sustain fauna, especially frogs, turtles and wetland and woodland birds.
- Maintaining and increasing the coverage of wetland flora, especially threatened species.

Ecological Objectives

The ecological objectives for Mutton Swamp are listed in Table 7-50 below and relate to watering both the dam and the wetland areas.

Table 7-50 Ecological Objectives at Mutton Swamp

Ecological Objective	Justification
Maintain/Improve abundance of wetland flora	• Protects threatened species • Assists with nutrient cycling • Habitat and resources for macroinvertebrates, birds, frogs etc.
Achieve self-sustaining frog and turtle populations	• Frogs provide a food source for wetland birds • Key component of functioning wetland ecosystem through consumption of macroinvertebrates and yabbies • Limited distribution of these species in the northern Wimmera following the decommissioning of the stock and domestic channel system.
Diverse macroinvertebrate population	• Provides a food source for wetland birds, frogs and turtles • Cycles nutrients
Supports wetland birds	• Protects threatened species • Key refuge for ducks, cormorants, grebes etc. during dry conditions
Watering point for terrestrial species	• Supports woodland birds and other local native fauna during dry conditions

Hydrological Objectives

Australian Ecosystems (2013) provides recommendations for a watering regime to maximise the condition of the EVCs observed at Mutton Swamp.

Table 7-51 Hydrological Objectives at Mutton Swamp (Source: Australian Ecosystems (2013))

EVC No.	EVC Name	Environmental Watering Frequency	Duration	Depth (m)	Estimated Volume (ML)
803	Plains Woodland	NA	NA	NA	NA
107	Lake Bed Herbland	If not inundated in the last 2 years	1 < 8 months	0.5	39
369	Black Box Wetland	If not inundated within the last 5 years	1 < 4 months	0.2	40

Watering Regime

The watering regime for Mutton Swamp is derived from the ecological and hydrological objectives listed above. This regime will be subject to water availability and seasonal conditions. The modelled delivery rate by pipeline to the wetland is 50 ML/y (GWMWater, 2012). Therefore watering will be typically only feasible for the Lake Bed Herbland EVC. However if the Lake Bed Herbland contains more

frequently then this increases the likelihood of water from localised runoff during wet conditions Black Box Wetland.

The recommended regime subject to water availability is:

- Keep Mutton Swamp's dam above 0.5m deep by filling it during winter/spring and allowing evaporative drawdown over summer/autumn. This will promote more diverse aquatic flora communities (Australian Ecosystems, 2013).
- Water Lake Bed Herbland every third year if it has been dry in the interim through filling and overtopping the dam.

7.8. Opie's Dam

7.8.1. Catchment Setting

Opie's Dam is a former stock and domestic dam located on the outskirts of Murtoa. It is not a wetland and so would only receive inflows from channel supplies or runoff from roads near the property.

7.8.2. Land Status

Opie's Dam is located on freehold land adjacent to the Murtoa Racecourse (Figure 7-38).

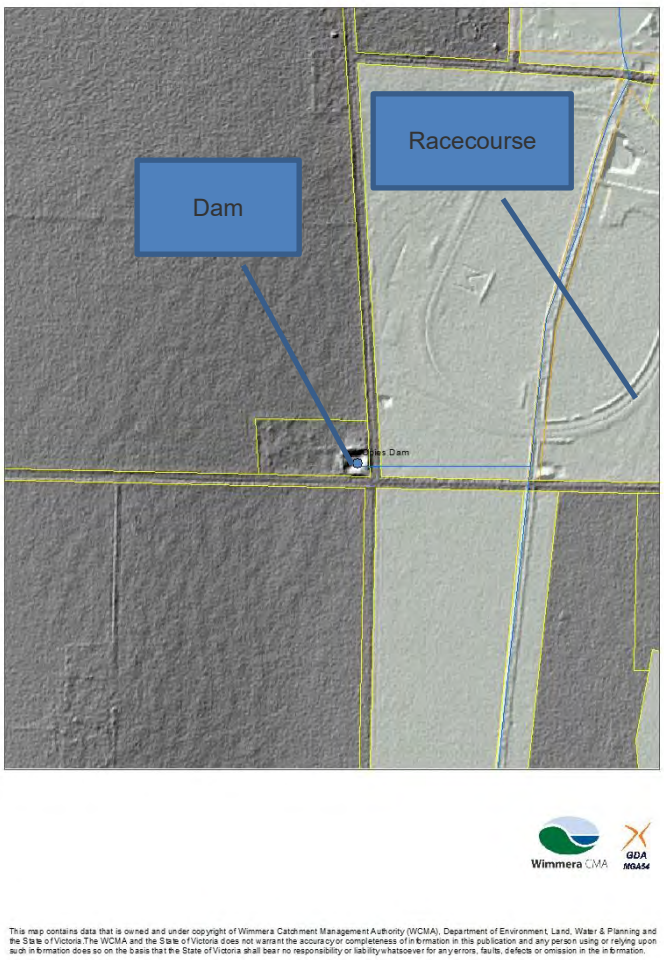


Figure 7-38. Opie's Dam showing land tenure and terrain

7.8.3.Hydrology

Opie's Dam is a stock and domestic dam, typical of thousands across the region. It would be filled annually typically during winter/spring. The channel system had a reliability of about 70% so on average for three years in ten there were restrictions on the volume of water available for the dams. Therefore although the dam was full in 2004, it would have drawn down following this during the Millennium Drought. Given the fact that the dam would have been for domestic water supply it would have been a higher priority for supply than those used solely for stock watering. Heavy rainfall in September 2010 and January 2011 would have led to a replenishing of water levels in the dam. Details are listed in Table 7-52.

Table 7-52 Estimated watering history of Opie's Dam

Watering History	Season					
	2010-11	2011-12	2012-13	2013-14	2013-14	2014-15
	Dam	Dam	Dam	Dam	Dam	Dam
Status	D-W	W	W	W	W	W-D
Water Source	L					
Volume	U					

Notes	Inundation in spring-summer	Dam contains water	Dam contains water	Dam contains water	Dam contains water	Dam dries out
Status: Wet/Dry-Wet-Dry/Dry-Wet/Shallow inundation/Wet-Dry/Dry **Water source: Local runoff inundation/Flooding from waterways/Pipeline supply** **Volume: Unknown**						

7.8.4.Water Dependent Values

Fauna

In 2013 hatching Eastern Long-necked Turtles (*Chelodina longicollis*) were observed at the dam. The most notable fauna value at Opie's Dam is the presence of Growling Grass Frogs (*Litoria raniformis*) which has been communicated by DELWP staff (Evelyn Nicholson, DELWP, *pers. comm.*). Another population is apparently located nearby at the Murtoa Racecourse Dam.

Table 7-53 Threatened fauna observed at Opie's Dam (Source: (Rakali Consulting, 2014))

Common Name	Scientific Name	Fauna Type	Type	Last Record	EPBC Status	FFG Status	DELWP Status
Growling Grass Frog	*Litoria raniformis*	A	W	2012	V	T	E
Fauna Type: Amphibian, Reptile, Bird, Mammal **Type:** Wetland dependent, Terrestrial **Status:** Endangered, Vulnerable, Threatened, Rare, Near Threatened, Data Deficient, Poorly Known							

Flora

No wetland flora assessment was undertaken given the absence of wetland vegetation (Figure 7-39).

Wetland Values

No Index of Wetland condition assessment was undertaken at Opie's Dam given it does not function as a wetland.

Dam Values

The value of Opie's Dam are very limited (Table 7-54) and would support a small range of fauna in dry periods, but critically it supports Growling Grass Frogs, a threatened species.

Table 7-54 Dam Habitat Values at Opie's Dam

Indicator	Size	Steepness	Fringing Vegetation	Adjacent Vegetation	Overall
Category	Poor	Poor	Poor	Poor	Poor

7.8.5.Threats and Site Trajectory

Threats

The main threat to the site is the presence of invasive plants that impact on habitat for Growling Grass Frogs as well invasive animals that may predate on them, especially given its proximity to houses. An ongoing lack of water also threatens the fauna values at the site.

Trajectory

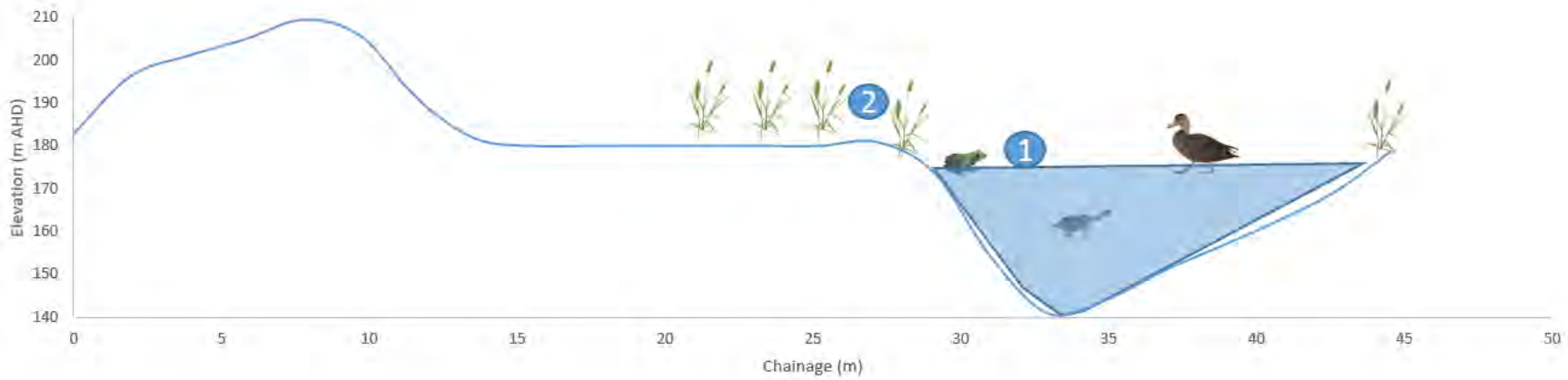
Given the lack of water at the site since 2013, the fauna values will decline into the future, especially given climate change predictions for less rainfall, thereby reducing the frequency of occasions that rainfall events will be sufficient to generate runoff into the dam.

Do Nothing Option

If no environmental water was to be delivered then in the short-term it is expected to see a loss of a localised population of Growling Grass Frogs. With another population located in the Murtoa Racecourse Dam (about 700 m north-east of Opie's Dam) and no confirmed populations in Lake Marma and Rabl Park Lake further north, this population could be lost especially if the Murtoa Racecourse Dam is significantly drawn down to water the racetrack.

Figure 7-39. Opie's Dam showing the presence of annual terrestrial grasses rather than wetland species, March 2013

7.8.6.Conceptualisation of Opie's Dam



Notes:

1. Dam at Opie's provides a refuge for waterbirds and species with low mobility during dry phases such as frogs (including Growling Grass Frogs) and turtles
2. No wetland vegetation at this site limits outcomes

7.8.7.Management Objectives for Opie's Dam

The management objectives for Opie's Dam are:

- Retaining water in the dam to sustain fauna, especially frogs, turtles and wetland birds.

Ecological Objectives

The ecological objectives for Opie's Dam are listed in Table 7-55 below.

Table 7-55 Ecological Objectives at Opie's Dam

Ecological Objective	Justification
Achieve self-sustaining frog and turtle populations	• Frogs provide a food source for wetland birds • Key component of functioning wetland ecosystem through consumption of macroinvertebrates and yabbies • Limited distribution of these species in the northern Wimmera following the decommissioning of the stock and domestic channel system.
Supports wetland birds	• Protects threatened species • Key refuge for ducks, cormorants, grebes etc. during dry conditions
Watering point for terrestrial species	• Supports birds and other local native fauna during dry conditions

Hydrological Objectives

The hydrological objective is to retain sufficient water in the dam to support a population of Growling Grass Frogs as well as other water-dependent fauna.

Watering Regime

The watering regime for Opie's Dam is simply to fill the dam in winter/spring and enable it to draw down in the intervening months to provide wetted habitat and cover for Growling Grass Frogs and other water dependent fauna. There are norisks to native vegetation associated with the timing and duration of filling for Opie's Dam (Rakali Consulting, 2014).

The recommended regime subject to water availability is:

- Keep Opie's Dam above 0.5m deep by filling during winter/spring and allowing evaporative drawdown over summer/autumn. This will promote a more diverse aquatic flora communities (Australian Ecosystems, 2013). A residual pool of at least 0.5m depth will provide habitat to allow the survival and metamorphosis of Growling Grass Frog tadpoles

7.9.Pinedale

7.9.1.Catchment Setting

Pinedale is an oval deflation basin wetland with an associated lunette and is remarkably circular in shape.

7.9.2.Land Status

Pinedale is located on freehold land about 7 km south-east of the township of Brim. The wetland is in the south-west corner of a large cropping/grazing property and is adjacent to the house and sheds associated with the farm. A Trust for Nature Covenant has been established for the wetland (Figure 7-43).

7.9.3.Hydrology

Pinedale is a circular deflation basin wetland and during very wet conditions it fills to varying degrees and then dries out within a number of months. In this case runoff from all directions would fill the wetland. The soil requires substantial rainfall to wet up to allow water to pond and it is unlikely that there would be much standing water in dry-average winters. During wet years there would be standing water of less than 0.5m remaining for several weeks to months, even though the wetland's catchment areas is comparatively small.

There are two dams on the eastern edge of the wetland, and they would have been supplied by a channel branching off from the former Bennett's Channel nearby. Water would be supplied most years to the dams, and the wetland was a potential outfall as the channel was drawn down. The channel system was impacted by drought conditons in terms of being able to supply all of dams and this was especially the case during the Millennium Drought when the dam would have drawn down after 2004. The dry conditions that persisted from the mid-1990's until 2010 meant that they wetland itself remained dry. Heavy rainfall in January 2011 led to shallow inundation across the wetland, as well as partially filling of the northern dam. The wetland dried out within a few weeks whilst the dam and wildlife pond (Figure 7-40) continued to retain water due to top-ups from local runoff and the Wimmera Mallee Pipeline respectively.
The pipeline outlet to Pinedale is west of the wetland with water flowing down a table drain towards the dam/wetland. In late 2014 water began to be delivered to Pinedale, continuing to mid-2015, filling the southern dam and providing shallow inundation to the southern portion of the wetland. Details are listed in Table 7-52.

Figure 7-40. Wildlife pond at Pinedale, August 2012

Figure 7-41. Pinedale during environmental watering, January 2015

Figure 7-42. Pinedale dam during environmental watering, January 2015

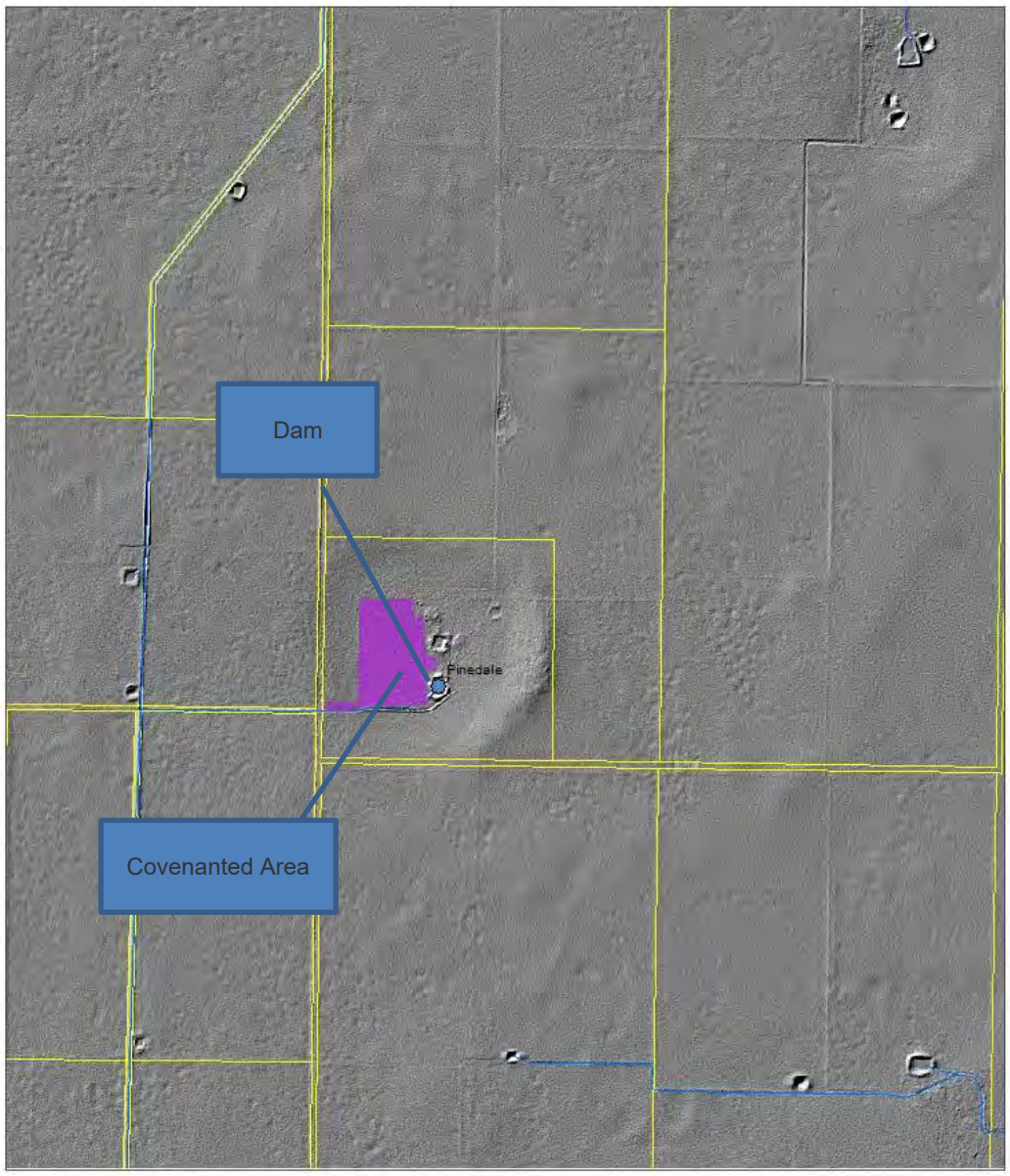


Figure 7-43. Pinedale showing land tenure and terrain

Table 7-56 Estimated watering history of Pinedale

Watering History	Season											
	2010-11		2011-12		2012-13		2013-14		2013-14		2014-15	
	WL	Dm	WL	Dm	WL	Dm	WL	Dm	WL	Dm	WL	Dm
Status	D-W	W	W-D	W	D	W	D	W	D	W	D-W	W
Water Source	L	L										P
Volume	U	U										15
Notes	Inundation in summer 2011. North dam contained water		Wetland dry. North dam contained water		Wetland dry. North dam contained water		Wetland dry. North dam contained water		Wetland dry. North dam contained water		South dam filled. Southern wetland inundated by pipeline	
Status: Wet/Dry-Wet-Dry/Dry-Wet/Shallow inundation/Wet-Dry/Dry Water source: Local runoff inundation/Flooding from waterways/Pipeline supply Volume: Unknown												

7.9.4.Water Dependent Values

Fauna

A total of 23 bird, one frog, three mammal and one reptile species have been recorded at Pinedale (Australian Ecosystems, 2013) and are listed in Appendix 2.

Flora

The wetland complex at Pinedale supports two wetland EVCs, the deepest section of the wetland consists of Black Box Wetland (EVC 369), surrounding this is a section of Northern Wimmera Riverine Chenopod Woodland (EVC 103_62).One threatened flora species were observed at Pinedale – Ferny Small-flower Buttercup (Ranunculus pumilio var. politus), in the centre of the Black Box Wetland area.

The Black Box Wetland was noted to have a relatively open understorey containing a number of species that are stimulated by inundation such as Common Swamp Wallaby-grass (*Amphibromus nervosus*), Common Nardoo (*Marsilea drummondii*) and Common Blown-grass (*Lachnagrostis filiformis* var .1). The wetland was notable for its low to moderate weed cover with species like Wimmera Rye-grass (*Lolium rigidum*) and Prickly Lettuce (*Lactuca serriola*). Generally it was noted as being in 'Moderate' condition (Australian Ecosystems, 2013).

The Northern Wimmera Riverine Chenopod Wetland EVC is located on the higher ground surrounding the Black Box Wetland. Again Black Box (*Eucalyptus largiflorens*) was the dominant overstorey species with more of a shrubby understorey including saltbush species such as Nodding Saltbush (*Einadia nutans*) as well as grasses including Rough Spear-grass (*Austrostipa scabra subsp. falcata*). Thhis EVC was classified as being in 'Good' condition according to the IWC methodology (Australian Ecosystems, 2013). Details concerning the location of EVCs and threatened flora at Pinedale are included in Figure 7-44 and a map in Appendix 1 and in Table 7-57 and Table 7-58.

Table 7-57 Threatened flora observed at Pinedale (Source: Australian Ecosystems (2013))

Common Name	Scientific Name	Type	Last Record	EPBC Status	FFG Status	DELWP Status	EVC found
Ferny Small-	*Rananculus pumilio var. politus*	W	2012			P	369

flower Buttercup							
Type: Wetland dependent, Terrestrial **Status:** Endangered, Vulnerable, Rare, Near Threatened, Data Deficient, Poorly Known							

Table 7-58 Ecological Vegetation Classes observed at Pinedale (Source: Australian Ecosystems (2013))

EVC No.	EVC Name	Wimmera Bioregional Conservation Status	Water dependent (Y/N)
369	Black Box Wetland	Endangered	Y
103_62	Northern Wimmera Riverine Chenopod Woodland	Endangered	Y

7.9.5.Current Condition

Wetland Values

The IWC assessment of Pinedale was undertaken in 2012 by Australian Ecosystems and assessed to be in 'Good' condition overall. Many of the sub-indices were in 'Excellent' condition due to the limited modification to the wetland area itself including the Physical Form, Hydrology, Water Properties and Soils. The lack of a native terrestrial vegetation buffer around some sections of the wetland reduced the Wetland Catchment sub-index rating to 'Moderate', similarly a 'Moderate' rating was given for the Biota sub-index due to the weed coverage. The results are summarised in Table 7-59.

Table 7-59 Index of Wetland Condition Scoring at Pinedale (Source: Australian Ecosystems (2013))

IWC sub-index	Wetland Catchment	Physical Form	Hydrology	Water properties	Soils	Biota	Overall Score
Score / 20	12	19.9	20	17	19.95	14.47	8
Category	Moderate	Excellent	Excellent	Excellent	Excellent	Excellent	Moderate

Dam Values

The value of the dam in that can be filled by the pipeline (southern dam) (Figure 7-41) has been classified in Table 7-54. The environmental values are good and would support a wide range of fauna in dry periods. The Wildlife Pond installed by the landholders and filled by the pipeline (from the stock and domestic entitlement for the farm) (Figure 7-40) also provided valuable habitat for frogs and a surface water source for local wildlife.

Table 7-60 Dam Habitat Values at Pinedale

Indicator	Size	Steepness	Fringing Vegetation	Adjacent Vegetation	Overall
Dam	Good	Poor	Poor	Good	Moderate
Wildlife Pond	Very Poor	Good	Good	Good	Good

7.9.6.Threats and Site Trajectory

Threats

The main threat to the site is the presence of invasive plants and animals. The wetland has a history of being well managed for environmental values and has a Trust for Nature covenant. Historically the wetland would have extended slightly further west however this area is now part of a cropped paddock and so has lost its wetland values.

Trajectory

Gradual declines in vegetation condition would be expected to take place over time without environmental watering especially given forecasts for a hotter and drier climate going forward. The absence of water in the dam would also impact on the populations of local waterbird populations who would use the open water as habitat. The presence of the wildlife pond would support other local fauna although in smaller numbers than would be the case if water was not supplied to the adjacent dam and wetland.

Do Nothing Option

If no environmental water was to be delivered it is expected that local fauna values would diminish in the short term, as the dam would remain dry most of the time. In the longer term there may be some impact on the condition and diversity of wetland flora at Pinedale, as it shifts to more of a terrestrial vegetation composition than wetland vegetation as the climate gets hotter and drier.

Pinedale, January 2016

7.9.7.Conceptualisation of Pinedale

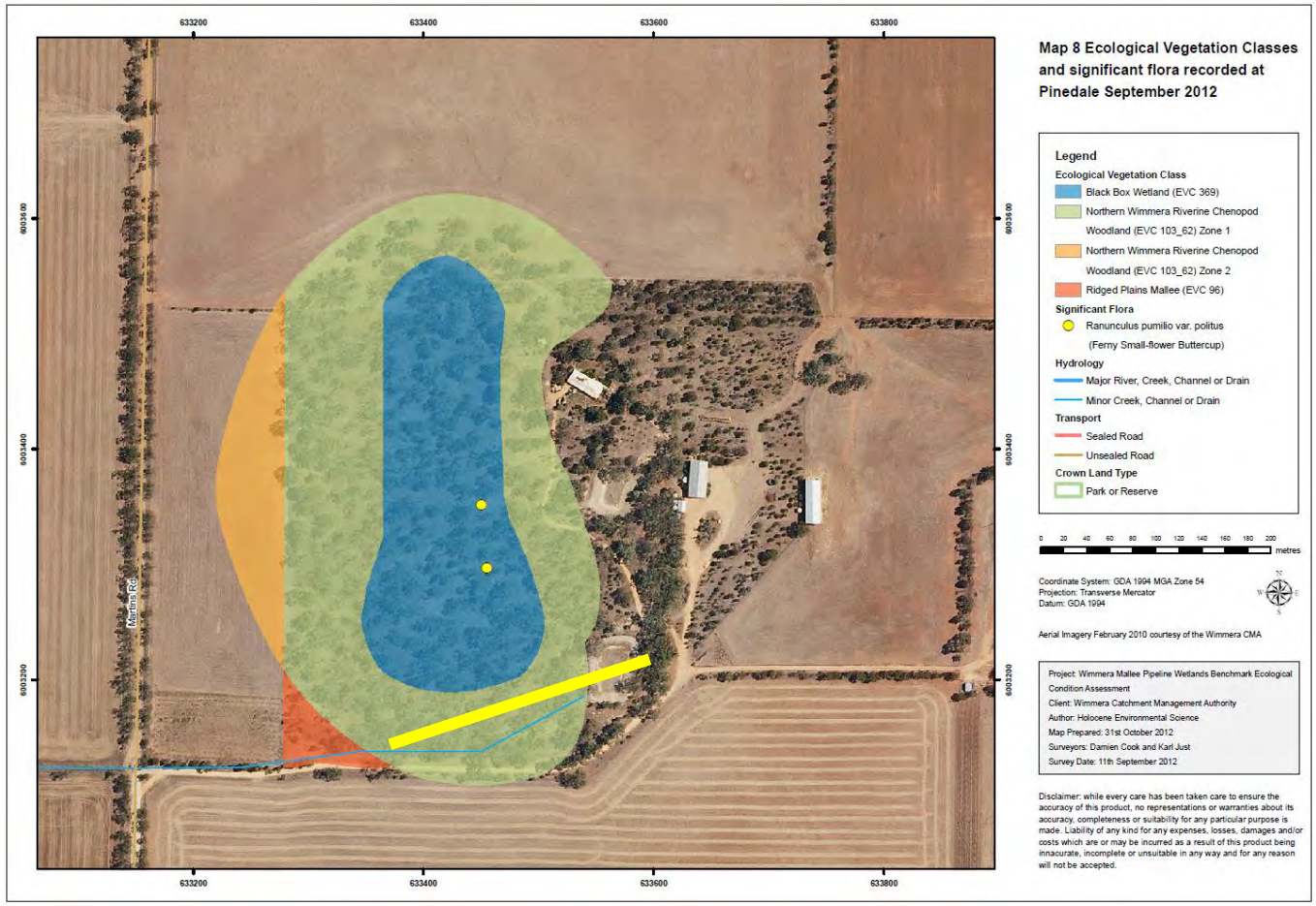


Figure 7-44. EVC and significant flora mapping at Pinedale. Yellow line is the cross-section for conceptual model.

Notes:

1. Dam at Pinedale provides a refuge for waterbirds and species with low mobility during dry phases such as frogs and turtles
2. Wetting and drying of the dam banks will support an increased diversity of macroinvertebrates through providing a range of habitats for the various parts of their lifecycles
3. Occasional shallow inundation will maintain Rough Spear-grass and other native wetland vegetation
4. Increased water in the wetland increases likelihood of watering Black Box due to natural heavy rainfall events
5. Dam provides a drinking water source for woodland birds

7.9.8.Management Objectives for Pinedale

The management objectives for Pinedale are:

- Retaining water in the dam to sustain fauna, especially frogs, wetland and woodland birds.
- Sustaining and where possible increasing the abundance of wetland flora, especially threatened species.

Ecological Objectives

The ecological objectives for Pinedale are listed in Table 7-61 below and relate to watering both the dam and the wetland areas.

Table 7-61 Ecological Objectives at Pinedale

Ecological Objective	Justification
Maintain/Improve abundance of wetland flora	• Protects threatened species • Assists with nutrient cycling • Habitat and resources for macroinvertebrates, birds, frogs etc.
Achieve self-sustaining frog and turtle populations	• Frogs provide a food source for wetland birds • Key component of functioning wetland ecosystem through consumption of macroinvertebrates and yabbies • Limited distribution of these species in the northern Wimmera following the decommissioning of the stock and domestic channel system.
Diverse macroinvertebrate population	• Provides a food source for wetland birds, frogs and turtles • Cycles nutrients
Supports wetland birds	• Protects threatened species • Key refuge for ducks, cormorants, grebes etc. during dry conditions
Watering point for terrestrial species	• Supports woodland birds and other local native fauna during dry conditions

Hydrological Objectives

Australian Ecosystems (2013) provides recommendations for a watering regime to maximise the condition of the EVCs observed at Pinedale (Table 7-62).

Table 7-62 Hydrological Objectives at Pinedale (Source: Australian Ecosystems (2013))

EVC No.	EVC Name	Environmental Watering Frequency	Duration	Depth (m)	Estimated Volume (ML)
103-62	Northern Wimmera Riverine Chenopod Woodland	Should not be artificially watered	< 1 months	0.1	8.9
369	Black Box Wetland	If not inundated within the last 5 years	< 4 months	0.2	12.9

Watering Regime

The watering regime for Pinedale is derived from the ecological and hydrological objectives listed above. This regime will be subject to water availability and seasonal conditions. The modelled delivery rate by pipeline to the wetland is 25 ML/y (GWMWater, 2012). Therefore watering may be feasible for the Black Box Wetland (contingent on delivery time/rates compared to seepage and evaporation). The more frequent presence of water in the Black Box Wetland increases the likelihood of

inundating the Riverine Chenopod Woodland although it should not be artificially watered.

The recommended regime subject to water availability is:

- Keep Pinedale's southern dam above 0.5 m deep by filling during winter/spring and allowing evaporative drawdown over summer/autumn. This will promote a more diverse aquatic flora communities (Australian Ecosystems, 2013).
- Water Black Box Wetland every fifth year if it has been dry in the interim through redirecting water into the low-lying areas between the pipeline outlet and dam.

7.10.Sawpit Swamp

7.10.1.Catchment Setting

Sawpit Swamp is part of an abandoned channel (paleochannel) of the Wimmera River or Yarriambiack Creek called Ashens Creek. Currently Ashens Creek acts as a flood runner of the Wimmera River, with water breaking out at Ashens and flowing across to the Yarriambiack Creek at Longerenong. During wet conditions, local runoff can also contribute reasonable volumes to the swamp. It is an ox-bow wetland, with a remnant of it being an active stream before the river abandoned that course rather than a flat, ovoid shape of the deflation basin wetlands covered in this EWMP.

7.10.2.Land Status

Historically Sawpit Swamp was set aside as a timber reserve, as evidenced from an 1884 survey map (Figure 7-45) and this explains the origin of the wetland's name. In the 19th century works were undertaken to divert water from the Wimmera River at Ashens through the Ashens Creek to Sawpit Swamp and from there it would flow along channels to Jung and Murtoa. Parks Victoria currently administers the site and it is now designated as Sawpit Swamp Wildlife Reserve. The former Taylor's Lake Outlet Channel was located to the west of the wetland with cropping/grazing land surrounding Sawpit Swamp. A couple of farmhouses and associated shedding are located directly north (Figure 7-46).

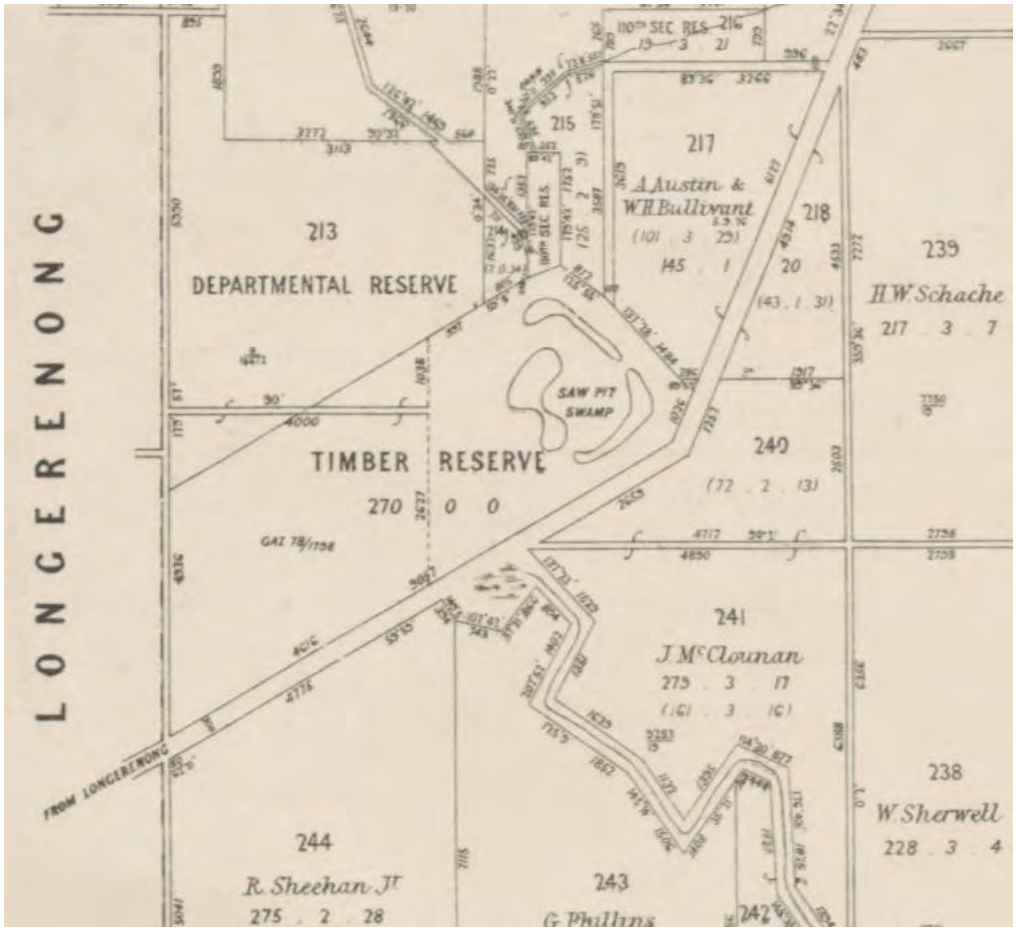


Figure 7-45. Parish of Ashens, County of Borung Map Department of Lands and Survey 1884, Sawpit Swamp is in the 'Timber Reserve' in the centre.

7.10.3.Hydrology

Sawpit Swamp is a remnant billabong from an ancient course of the Wimmera River or Yarriambiack Creek which is currently called Ashens Creek. Ashens Creek is engaged in a 1 in 10 year flood or greater, breaking out from the Wimmera River at Ashens and heading to the Yarriambiack Creek at Jung (Water Technology , 2009). From approximately the 1890's until the 1930's the swamp was filled with regulated flows along the Corkers Creek as part of a small channel system transferring water from the Wimmera River to Murtoa and Jung. A newspaper account from 1908 records the unfortunate case of a 14 year old girl drowning in 8 to 10 feet of water there (The Horsham Times, 1908). In the 1920's with the completion of Taylor's and Pine Lakes, the much larger Taylor's Lake Outlet Channel (Figure 7-47) replaced this channel and so it was no longer required to be filled for water supply purposes although it would have received water in most years supplied by the Ashens Creek Channel as well as filling during floods (Figure 7-46).

The outlet from the Wimmera Mallee Pipeline is located in the south-west corner of the Wildlife Reserve area with water flowing north into the wetland. Following the RPS (2014) investigation, another pipeline outlet was constructed closer the centre thereby providing the ability to water either/both the central deeper part (dam) or the outer ox-bow section. Prior to this the ox-bow section would have had to fill up to direct water into the deeper section in the centre.

Figure 7-46. Aerial photo of Sawpit Swamp, January 2011

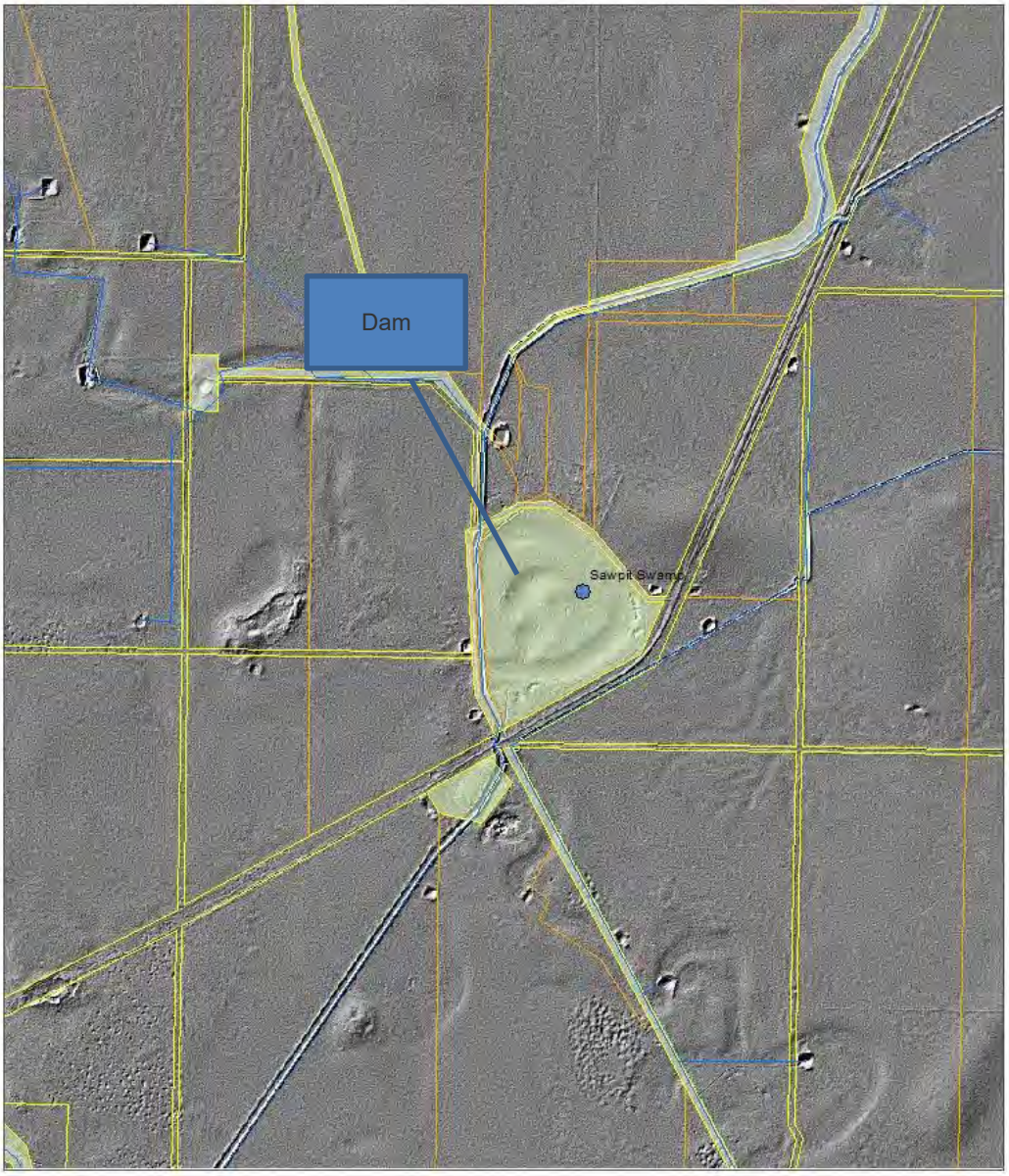


Figure 7-47. Sawpit Swamp showing land tenure and terrain

The watering history of Sawpit Swamp is not well known. During the Millennium Drought the dam would have been filled sporadically from the Taylor's Lake Outlet Channel but this would have ceased in the late 1990's or early 2000's when the

drought worsened. An aerial photo in 2004 showed that the wetland and dam was completely dry. It would have been empty for a number of years until very wet conditions from spring 2010 led to the significant volumes entering the swamp and this was augmented by the January 2011 flood. The wetland dried out later in 2011, however the deepest section of the wetland contained water until late 2012. In April 2013 water was provided to the wetland via the Wimmera Mallee Pipeline. As mentioned previously, given the original outlet was only located in the south-west of the wetland, water flowed out into the crescent-shaped eastern section. However the watering created water pressure issues for neighbouring properties and so only lasted several weeks. Once works were undertaken to address the pressure issues watering took place in spring 2013 which provided a larger volume to the wetland and watering recommenced briefly between April and June 2014. During summer and early autumn, the losses from seepage and evaporation would rival or exceed the delivery rate and so watering is not planned for that time of year. Watering of the central deeper section using the new outlet in 2015 indicated that it did not hold water well, with high rates of seepage and so is not able to be a permanent surface water location.

Figure 7-48. Sawpit Swamp, December 2010

Figure 7-49. Sawpit Swamp ‘dam’, April 2012

Figure 7-50. Sawpit Swamp, December 2013

Table 7-63 Estimated watering history of Sawpit Swamp

Watering History	Season											
	2010-11		2011-12		2012-13		2013-14		2013-14		2014-15	
	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam
Status	D-W	D-W	W-D	W	D	W-D	D-W-D	D	D-W-D	D	D	S
Water Source	L/F	L/F					P		P			P
Volume	U	U					11		33			3
Notes	Inundation in spring 2010 to summer 2011		Dam remained wet. Wetland dried out.		Dam dried out. Wetland dry.		Dam dry. Parts of the wetland inundated for several weeks.		Dam dry. Parts of the wetland inundated for several weeks.		Wetland dry, low level inundation in dam.	
Status: Wet/Dry-Wet-Dry/Dry-Wet/Shallow inundation/Wet-Dry/Dry **Water source: Local runoff inundation/Flooding from waterways/Pipeline supply** **Volume: Unknown**												

7.10.4.Water Dependent Values

Fauna

A total of 23 bird, two frog, three mammal and two reptile species have been recorded at Sawpit Swamp and are listed in Appendix 2 (Australian Ecosystems, 2013). The records includes one threatened species, the Black-chinned Honeyeater (*Meltihreptus gularis*) (Table 7-64) although it is not a wetland dependent species.

Table 7-64 Threatened fauna observed at Mutton Swamp (Source: Australian Ecosystems (2013))

Common Name	Scientific Name	Fauna Type	Type	Last Record	EPBC Status	FFG Status	DELWP Status
Black-chinned Honeyeater	*Melithreptus gularis*	B	T	2012			N
Fauna Type: Amphibian, Reptile, Bird, Mammal **Type:** Wetland dependent, Terrestrial **Status:** Endangered, Vulnerable, Threatened, Rare, Near Threatened, Data Deficient, Poorly Known							

Flora

The wetland complex at Sawpit Swamp supports three wetland EVCs, the deepest section of the wetland supports Floodway Pond Herbland, rising slightly to a Floodway Pond Herbland/Riverine Swamp Forest Complex (EVC 945). On the higher ground surrounding these EVCs is an Intermittent Swamp Woodland (EVC 813). Beyond the wetland in a narrow band around Sawpit Swamp is a Plains Woodland (EVC 803).

Nine threatened flora species were observed at Sawpit Swamp including Deniliquin Box (*Eucalyptus X oxypoma*), River Swamp Wallaby-grass (*Amphibromus fluitans*), Wimmera Woodruff (*Apserula wimmerana*), Winged Water-starwort (*Callitriche umbonata*), Riverina Bitter-cress (*Cardamine moirensis*) and Purple Love-grass (*Eragrostis lacuaria*). Deniliquin Box is a rare hybrid of Black Box (*Eucalyptus largiflorens*) and River Red Gum and occurs adjacent to the deepest section of the wetland.

In the Plains Woodland surrounding the swamp, Turnip Copperburr (*Sclerolaena napiformis*), Hairy Tails (*Ptilotus erubescens*), and Pale-flower Crane's-bill (*Geranium sp. 3*) were found but they are not wetland species.

The Floodway Pond Herbland has a good diversity of small herbs, sedges and grasses including Common Swamp Wallaby-grass (*Amphibromus nervosus*), Common spike-sedge (*Eleocharis acuta*) and Matted Water-starwort (*Callitriche sonderi*). Only a low coverage of weeds was present including species such as Ox-tongue (*Helminthotheca echioides*) and Fleabane (*Conyza bonariensis*). As a result it was classified as being in 'Excellent' condition (Australian Ecosystems, 2013).

The Intermittent Swamp Woodland was dominated by River Red Gums (*Eucalyptus camaldulensis*) with a few native understorey species including Plains Sedge (*Carex bichenoviana*). However the understorey was mostly dominated by weed species such as Wild Oats (*Avena fatua*) and Annual Veldt-gress (*Ehrhata longiflora*) Therefore this EVC was only classified as 'moderate' condition (Australian Ecosystems, 2013).

The Floodway Pond Herbland – Riverine Swamp Forest Complex was also dominated by River Red Gums with an understorey including Common Blown-grass (*Lachnagrostis filiformis* var. 1) and Common Sneezeweed (*Centipeda cunninghamii*). There were similar weed species as those observed in the Intermittent Swampy Woodland although the coverage was not as high and so it was classified as being in a 'Good' condition. Details regarding the location of threatened flora observed at Sawpit Swamp as well as the distribution of EVCs is included on Figure 7-51 and a map in Appendix 1 and in Table 7-65 and Table 7-66.

Table 7-65 Threatened flora observed at Sawpit Swamp (Source: Australian Ecosystems (2013))

Common Name	Scientific Name	Type	Last Record	EPBC Status	FFG Status	DELWP Status	EVC found
River Swamp Wallaby Grass	Amphibromus fluitans	W	2012	V		P	945
Riverina Bitter-cress	*Cardamine moirensis*	W	2012			R	945
Purple Love-grass	*Eragrostis lacunaria*	W	2012			V	810
Deniliquin Box	*Eucalyptus X oxypoma*	W				R	810
Winged Water-starwort	*Callitriche umbonata*	W	2012			R	810
Wimmera Woodruff	*Asperula wimmerana*	T	2012			R	803
Turnip Copperburr	*Sclerolaena napiformis*	T	2012	E	T	E	803
Hairy Tails	*Ptilotus erubescens*	T	2012		T	V	803
Pale-flower Crane's Bill	*Geranium sp. 3*	T	2012			R	803
Type: Wetland dependent, Terrestrial **Status:** Endangered, Vulnerable, Rare, Threatened, Near Threatened, Data Deficient, Poorly Known							

Table 7-66 Ecological Vegetation Classes observed at Sawpit Swamp (Source: Australian Ecosystems (2013), (DEPI, 2013))

EVC No.	EVC Name	Wimmera Bioregional Conservation Status	Water dependent (Y/N)
810	Floodway Pond Herbland	Not recognised in the Wimmera bioregion, probably endangered	Y
945	Floodway Pond Herbland/ Riverine Swamp Forest Complex	Not recognised in the Wimmera bioregion, probably endangered	Y
813	Intermittent Swampy Woodland	Endangered	Y
803	Plains Woodland	Endangered	N

7.10.5.Current Condition

Wetland Values

The IWC assessment of Sawpit Swamp was undertaken in 2012 by Australian Ecosystems and assessed to be in 'Good' condition overall. The absence of major drainage works led to scores for the Physical Form sub-index being in the 'Excellent' category. The Wetland Catchment score was 'Good' due to modifications to the local catchment through the roads constructed around the wetland having culverts to enable flows to reach the wetland, there was a reasonable native terrestrial vegetation buffer around the wetland and surrounding landuse is largely cropping/grazing. Changes to the wetland's hydrology and water quality through the construction of roadways led to slightly reduced scores for these sub-indices although they are still classified as 'Good'. The modest cover of invasive weeds in some sections led to a 'Good' score for biota and a lack of soil disturbance led to it receiving an 'Excellent' classification for that sub-index. The results are summarised in Table 7-67.

Table 7-67 Index of Wetland Condition Scoring at Sawpit Swamp (Source: Australian Ecosystems (2013))

IWC sub-index	Wetland Catchment	Physical Form	Hydrology	Water properties	Soils	Biota	Overall Score
Score / 20	15.5	17.5	15	17	19.6	16.5	8
Category	Good	Excellent	Good	Good	Excellent	Good	Good

Dam Values

The 'dam' at Sawpit Swamp is different to the rest of the dams supplied by the Wimmera Mallee Pipeline in that it is not a noticeable excavation but rather more of a large natural low point (Figure 7-49) that has potentially been augmented. Its habitat value has been summarised in Table 7-68. It should be noted however that it does not appear to hold water well from pipeline supplies.

Table 7-68 Dam Habitat Values at Sawpit Swamp

Indicator	Size	Steepness	Fringing Vegetation	Adjacent Vegetation	Overall
Category	Excellent	Excellent	Excellent	Excellent	Excellent

7.10.6.Threats and Site Trajectory

Threats

Historically removal of timber would have been the main threat to the wetland given its former role as a timber reserve. However, this has not been the case for a number of years and now the main threat is the presence of invasive plants and animals, although some illegal firewood removal has been noted.

Trajectory

Gradual declines in vegetation condition would be expected to take place over time without environmental watering especially given forecasts for a hotter and drier climate going forward and a reduced likelihood of floodwaters entering the swamp. The absence of water in the natural depression in the deepest part of the wetland would also impact on the populations of local fauna who rely on it for habitat/drinking water.

Do Nothing Option

If no environmental water was to be delivered it is expected that local fauna values would diminish in the short term, as the dam would remain dry most of the time. In the longer term there may be some impact on the condition and diversity of wetland flora at Sawpit Swamp as it is adapted to more frequent inundation than would be the case.

Watering Sawpit Swamp, April 2013

7.10.7.Conceptualisation of Sawpit Swamp

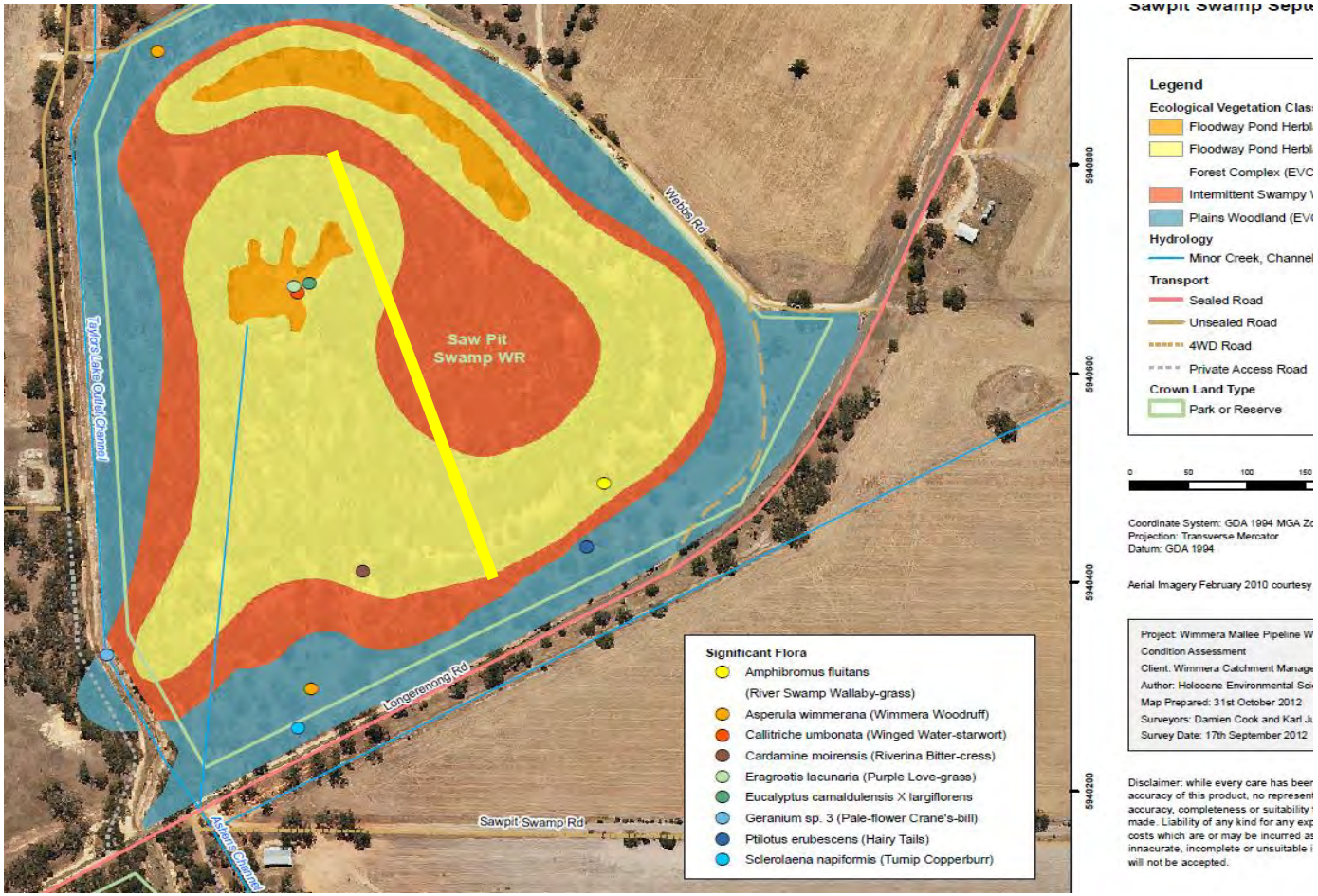
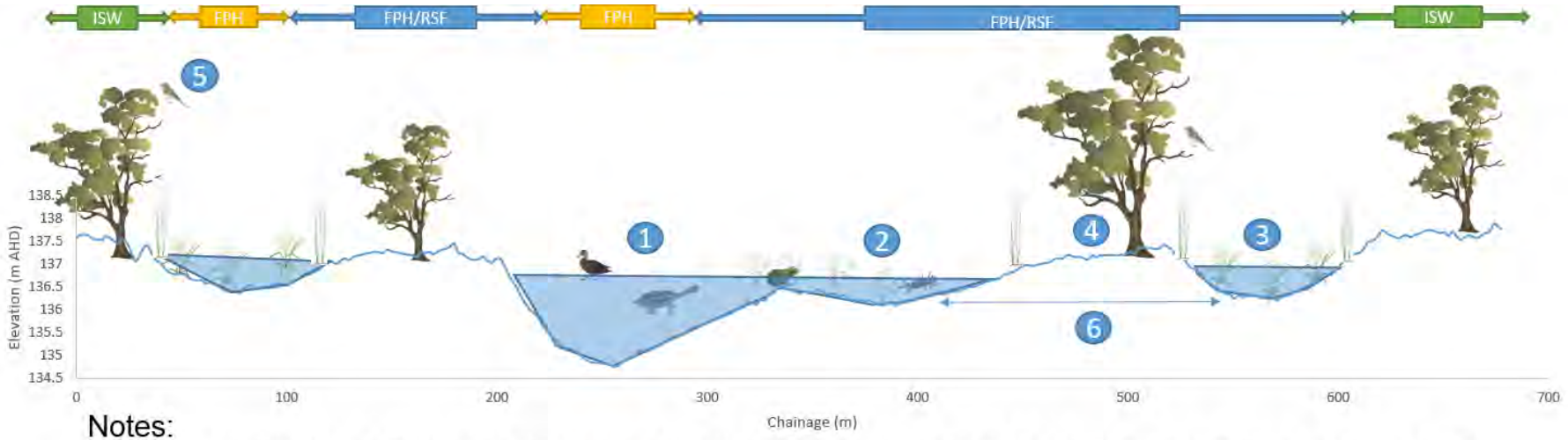


Figure 7-51. EVC and significant flora mapping at Sawpit. Yellow line is the cross-section for conceptual model.



Notes:

1. Inner dam/wetland at Sawpit provides a refuge for waterbirds and species with low mobility during dry phases such as frogs and turtles
2. Wetting and drying of the dam/wetland banks will support an increased diversity of macroinvertebrates through providing a range of habitats for the various parts of their lifecycles
3. Occasional shallow inundation of outer wetland will maintain Common Blown-grass and other native wetland vegetation
4. Increased water in the wetland increases likelihood of watering River Red Gums due to natural heavy rainfall events
5. Dam provides a drinking water source for woodland birds
6. Pipeline enables water to be directed to inner dam/wetland or outer wetland

ISW = Intermittent Swampy Woodland, FPH = Floodway Pond Herbland, RSF = Riverine Swamp Forest

7.10.8.Management Objectives for Sawpit Swamp

The management objectives for Sawpit Swamp are:

- Periodically provide water to the dam to sustain fauna, especially frogs, wetland and woodland birds.
- Sustaining and where possible increasing the abundance of wetland flora, especially water-dependent threatened species.

Ecological Objectives

The ecological objectives for Sawpit Swamp are listed in Table 7-69 below and relate to watering both the dam and the wetland areas.

Table 7-69 Ecological Objectives at Sawpit Swamp

Ecological Objective	Justification
Maintain/Improve abundance of wetland flora	• Protects threatened species • Assists with nutrient cycling • Habitat and resources for macroinvertebrates, birds, frogs etc.
Achieve self-sustaining frog population	• Frogs provide a food source for wetland birds • Key component of functioning wetland ecosystem through consumption of macroinvertebrates • Limited distribution of these species in the northern Wimmera following the decommissioning of the stock and domestic channel system.
Diverse macroinvertebrate population	• Provides a food source for wetland birds, frogs and turtles • Cycles nutrients
Supports wetland birds	• Protects threatened species • Key refuge for ducks, cormorants, grebes etc. during dry conditions
Watering point for terrestrial species	• Supports woodland birds and other local native fauna during dry conditions

Hydrological Objectives

Australian Ecosystems (2013) provides recommendations for a watering regime to maximise the condition of the EVCs observed at Sawpit Swamp.

Table 7-70 Hydrological Objectives at Sawpit Swamp (Source: Australian Ecosystems (2013))

EVC No.	EVC Name	Environmental Watering Frequency	Duration	Depth (m)	Estimated Volume (ML)
803	Plains Woodland	NA	NA	NA	NA
945	Floodway Pond Herbland- Riverine Swamp Forest Complex	If not inundated in the last 2 years	< 4 months	0.5	65.5
810	Floodway Pond Herbland	If it has been dry for > 6 months	< 12 months	01.2	40
813	Intermittent Swampy Woodland	If not inundated in the last 2 years	< 2 months	0.2	17.4

Watering Regime

The watering regime for Sawpit Swamp is derived from the ecological and hydrological objectives listed above. This regime will be subject to water availability and seasonal conditions. The modelled delivery rate by pipeline to the wetland is 50

ML/y (GWMWater, 2012). However, the installation of delivery points that would water the Floodway Pond Herbland – Riverine Swamp Forest Complex or the Floodway Pond Herbland provides the flexibility to water either wetland each year (Figure 7-52).

The recommended regime subject to water availability is:

- During wet years provide water to central low level dam area. This will promote a more diverse aquatic flora communities (Australian Ecosystems, 2013).
- Water Floodway Pond Herbland – Riverine Swamp Forest Complex every third year if it has been dry in the interim (outer horseshoe shaped part of wetland).

Figure 7-52. Outlet to Floodway Pond Herbland-Riverine Swamp Forest Complex at Sawpit Swamp and valve for pipeline leading to Floodway Pond Herbland, April 2015.

7.11. Schultz/Koschitzke

7.11.1.Catchment Setting

Schultz/Koschitzke is an oval deflation basin wetland with an associated lunette. This wetland about a kilometre south of Challambra Swamp. Like Challambra Swamp, it would fill during very wet conditions due to localised runoff from elevated areas around the wetland.

7.11.2.Land Status

Schultz/Koschitzke is located on largely freehold land about 12 km east of Warracknabeal in the midst of broadacre cropping/grazing country. The wetland is located on two freehold properties owned by Brian Koschitzke in the north and Russell Schultz in the south (hence it is called Schultz/Koschitzke). A small dirt road (Beilby Road) also traverses east-west across the northern section of the wetland which is managed by Yarriambiack Shire Council.

7.11.3.Hydrology

Schultz/Koschitzke is an oval deflation basin wetland and during very wet conditions it would fill to varying degrees and dry out within a number of months. In this case runoff from all directions would fill the wetland. The soil would require substantial rainfall to wet up and have standing water present and so it is unlikely that there would be much standing water in dry-average winters. In exceptionally wet conditions (such as the January 2011 floods or early 1970's) the wetland would retain water for some months, going on years if the wet conditions continued.

Two small dams are located on Brian Koschitzke's property. A channel to these dams cannot be discerned from spatial data and it is assumed that they would fill due to localised runoff, in particular from the road.

Schultz/Koschitzke, January 2016

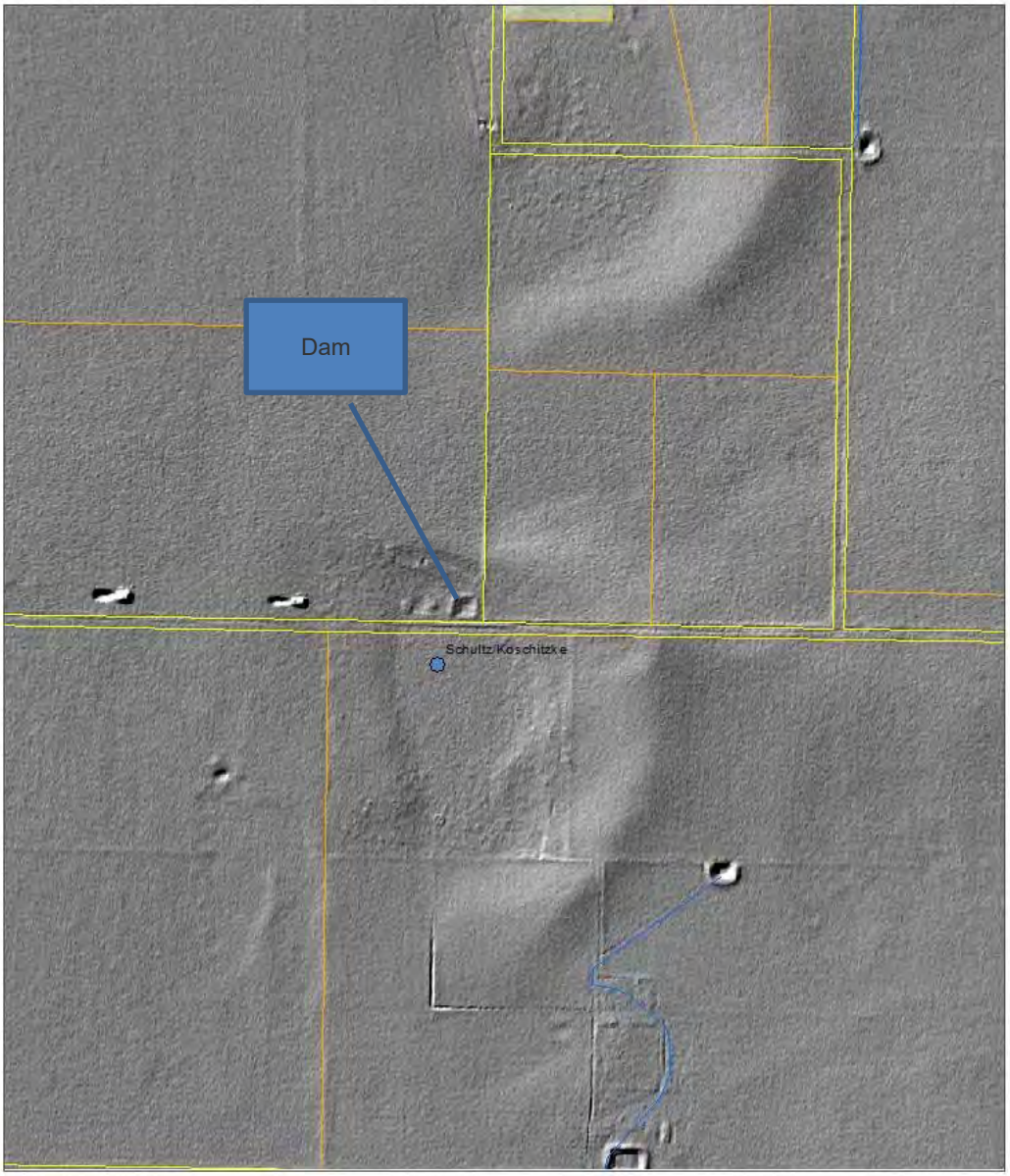


Figure 7-53. Schultz/Koschitzke showing land tenure and terrain

The dams were not connected to the channel system and relied on local runoff, and so would have been largely dry during the Millennium Drought. According to the landowner, Russell Schultz the wet conditions in 2010 and 2011 resulted in

inundation of up to 2 metres when the wetland was full and full and it contained water for over a year. A flood height marker from 2011 can be seen in Figure 7-57. The dams are comparatively shallow and so would have dried out in late 2012.

Table 7-71 Estimated watering history of Schultz/Koschitzke

Watering History	Season											
	2010-11		2011-12		2012-13		2013-14		2013-14		2014-15	
	WL	Dm	WL	Dm	WL	Dm	WL	Dm	WL	Dm	WL	Dm
Status	D-W	W-D	D	W-D	D	D	D	D	D	D	D	D
Water Source	L	L										
Volume	U	U										
Notes	Inundation in summer 2011.		Wetland dry and dam dries out.		Wetland and dam dry		Wetland and dam dry		Wetland and dam dry		Wetland and dam dry	
Status: Wet/ Wet-Dry/Dry-Wet/Shallow inundation/Wet-Dry/Dry **Water source: Local runoff inundation/Flooding from waterways/Pipeline supply** **Volume: Unknown**												

7.11.4.Water Dependent Values

Fauna

A total of 13 bird have been recorded at Schultz/Koschitzke and are listed in Appendix 2 (Rakali Consulting, 2014). This includes one threatened species the Black Falcon (*Falco subinger*). Although not water dependent, this species is often observed hunting over and near wetlands (Table 7-72).

Table 7-72 Threatened fauna observed at Schultz/Koschitzke (Source: (Rakali Consulting, 2014))

Common Name	Scientific Name	Fauna Type	Type	Last Record	EPBC Status	FFG Status	DELWP Status
Black Falcon	*Falco subinger*	B	T	2013			V
Fauna Type: Amphibian, Reptile, Bird, Mammal **Type:** Wetland dependent, Terrestrial **Status:** Endangered, Vulnerable, Threatened, Rare, Near Threatened, Data Deficient, Poorly Known							

Flora

The wetland complex at Schultz/Koschitzke supports two wetland EVCs; the deepest section of the wetland consists of a distinctive form of Lignum Shrubland (EVC 808) that is dominated by the rare Spiny Lignum (*Duma horrida subsp. horrida*), surrounding this is a section of Black Box Wetland (EVC 369). Remnants of a Plains Woodland (EVC 803) also fringe the wetland vegetation.

Two threatened flora species were observed at Schultz/Koschitzke – Spiny Lignum (*Duma horrida subsp. horrida*) which was present in large numbers, (Rakali Consulting, 2014) as well as the nationally vulnerable Ridged Water-milfoil (*Myriophyllum porcatum).*

Figure 7-54. Looking south to Schultz/Koschitzke wetland, March 2013

Looking south to Schultz/Koschitzke wetland, September 2012, with Spiny Lignum flowering in the foreground.

The Lignum Shrubland at Schultz/Koschitzke wetland is distinctive in that it is dominated by Spiny Lignum (*Duma horrida subsp. horrida*). Since being discovered at this site in 2012 this variant of this EVC has been found at a few other localities near Boort and Kerang (D. Cook pers. obs.). Species associated with the Spiny Lignum include Common Swamp Wallaby-grass (*Amphibromus nervosus*), Common spike-sedge (*Eleocharis acuta*) and Red Water-milfoil (*Myriophyllum verrucosum*). Generally it was noted as being in 'Good' condition (Rakali Consulting, 2014).

The Black Box Wetland was noted to have a relatively open understorey containing a number of species that are stimulated by inundation such as Spiny Lignum (*Duma horrida subsp. horrida*), Common Nardoo (*Marsilea drummondii*), Narrow-leaf Dock (*Rumex tenax*) and Common Blown-grass (*Lachnagrostis filiformis* var .1). The wetland was notable for its low to moderate weed cover with species like Wimmera Rye-grass (*Lolium rigidum*) and Prickly Lettuce (*Lactuca serriola*). Generally it was noted as being in 'Good' condition (Rakali Consulting, 2014).

Maps showing the location of the EVCs as well threatened flora species is included in Figure 7-56 and Appendix 1 as well in Table 7-73 and Table 7-74.

Table 7-73 Threatened flora observed at Schultz/Koschitzke (Source: (Rakali Consulting, 2014))

Common Name	Scientific Name	Type	Last Record	EPBC Status	FFG Status	DELWP Status	EVC found
Spiny Lignum	*Duma horrida subsp. horrida*	W	2013			P	
Ridged Water-milfoil	*Myriophyllum porcatum*	W	2013	V	V	V	960
Type: Wetland dependent, Terrestrial **Status:** Endangered, Vulnerable, Threatened, Rare, Near Threatened, Data Deficient, Poorly Known							

Table 7-74 Ecological Vegetation Classes observed at Schultz/Koschitzke (Source: (Rakali Consulting, 2014)

EVC No.	EVC Name	Wimmera Bioregional Conservation Status	Water dependent (Y/N)
369	Black Box Wetland	Endangered	Y
808	Lignum Shrubland	Endangered	Y
803	Plains Woodland	Endangered	N

7.11.5.Current Condition

Wetland Values

The IWC assessment of Schultz/Koschitzke was undertaken in 2013 by Rakali Consulting and assessed to be in 'Good' condition overall. Two sub-indices were in 'Excellent' condition due to the limited modification to the wetland area itself, namely the Physical Form and Soils. The presence of a road affecting overland flow and clearing of vegetation around the wetland reduced the Wetland Catchment sub-index rating to 'Poor'. The Hydrology, Water Properties and Biota sub-indices each were classified as 'Good' due to the effects of neighbouring land use and weed cover respectively. The results are summarised in Table 7-75.

Table 7-75 Index of Wetland Condition Scoring at Schultz/Koschitzke (Source: (Rakali Consulting, 2014))

IWC sub-index	Wetland Catchment	Physical Form	Hydrology	Water properties	Soils	Biota	Overall Score

Score / 20	9	19.25	15	15	19	16.7	8
Category	Poor	Excellent	Good	Good	Excellent	Good	Good

Dam Values

The value of the dam connected to the pipeline (eastern dam) at Schultz/Koschitzke has been qualitatively classified in Table 7-76.

Figure 7-55. Eastern dam connected to pipeline at Schultz/Koschitzke, March 2013

Table 7-76 Dam Habitat Values at Schultz/Koschitzke

Indicator	Size	Steepness	Fringing Vegetation	Adjacent Vegetation	Overall
Category	Poor	Good	Poor	Poor	Poor

7.11.6.Threats and Site Trajectory

Threats

The main threat to the site is the presence of invasive plants and animals as well as modifications to inflows into the wetland due to the road bisecting the wetland.

Trajectory

Gradual declines in vegetation condition would be expected to take place over time without environmental watering especially given forecasts for a hotter and drier climate going forward. The absence of water in the dam would also impact on the populations of local waterbird populations who would use the open water as habitat.

Do Nothing Option

If no environmental water was to be delivered it is expected that local fauna values would diminish in the short term, as the dam would remain dry most of the time..In the longer term there may be some impact on the condition and diversity of wetland

flora at Schultz/Koschitzke, as it shifts to more of a terrestrial vegetation composition than wetland vegetation as the climate gets hotter and drier.

7.11.7.Conceptualisation of Schultz/Koschitzke

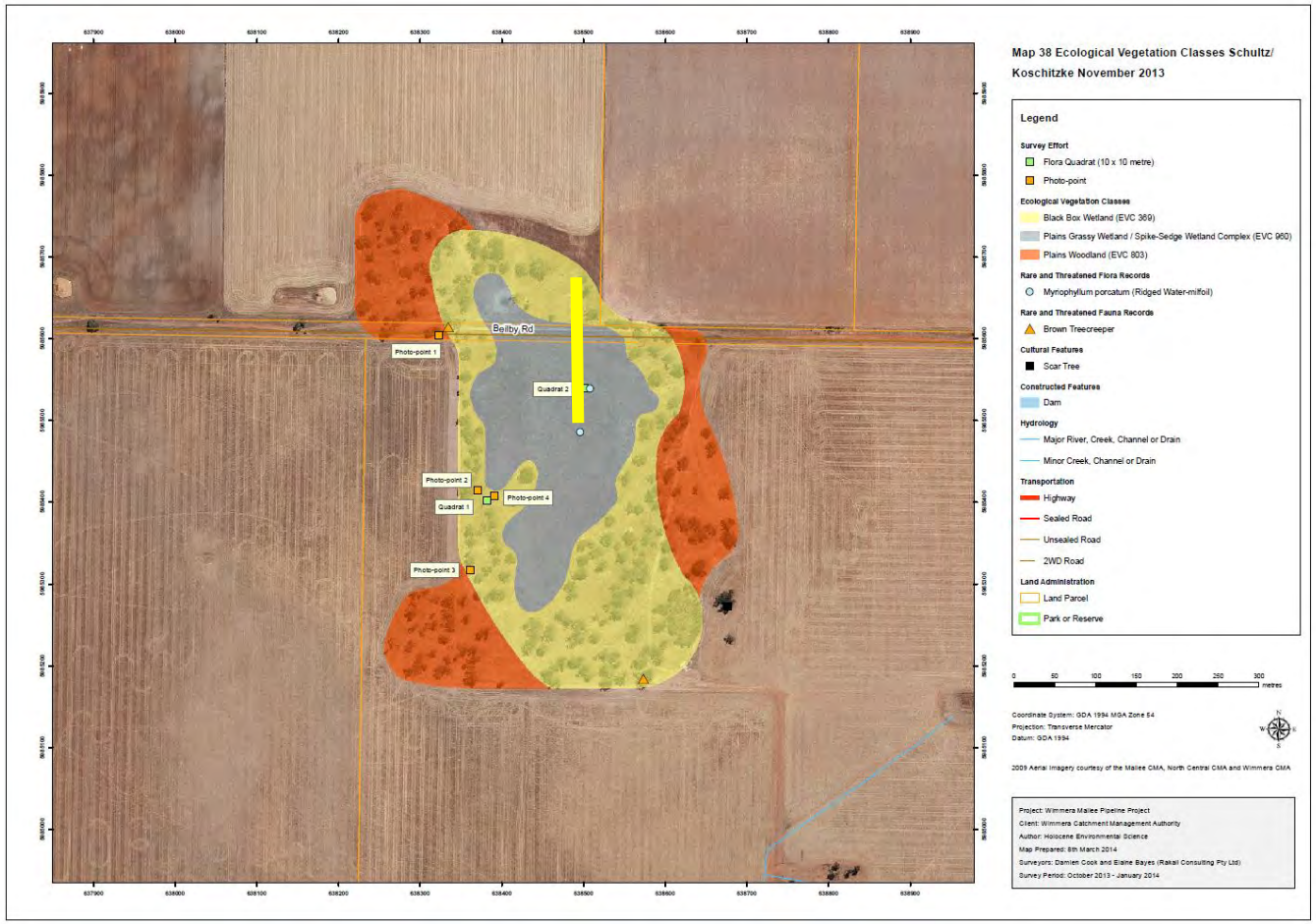
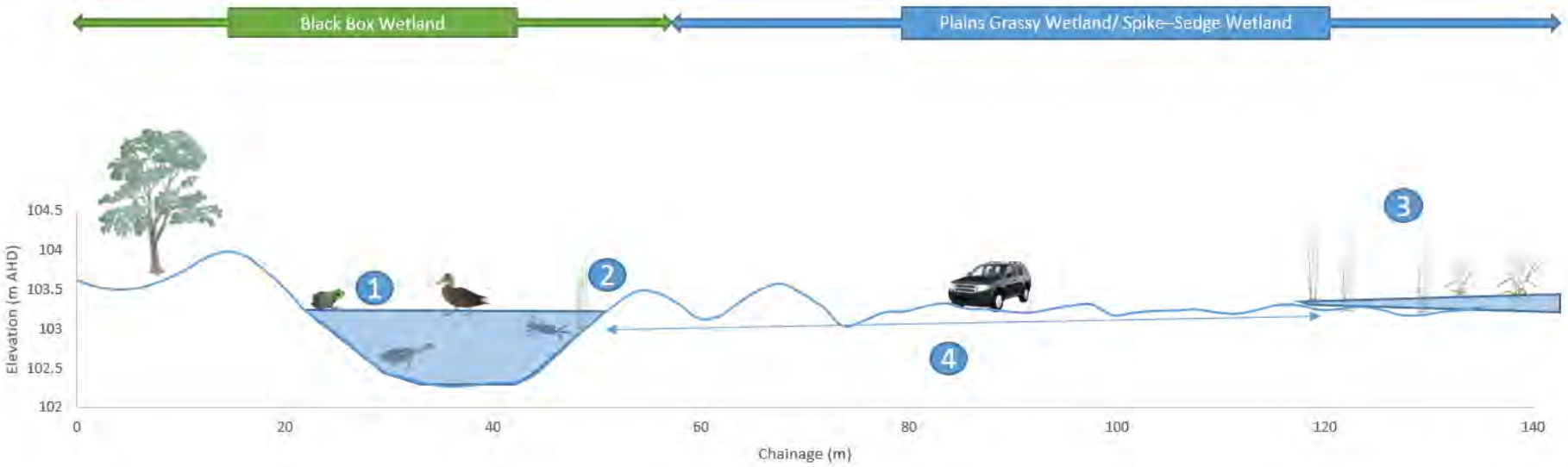


Figure 7-56. EVC and significant flora mapping at Schultz/Koschitzke. Yellow line is the cross-section for conceptual model.



Notes:

1. Dam at Schultz/Koschitzke provides a refuge for waterbirds and species with low mobility during dry phases such as frogs and turtles
2. Wetting and drying of the dam banks will support an increased diversity of macroinvertebrates and wetland vegetation through providing a range of habitats for the various parts of their lifecycles
3. Occasional shallow inundation will maintain Common Swamp Wallaby-grass, Spiny Lignum and other native wetland vegetation
4. Pipeline under road enables watering of shallow wetland and/or dam

7.11.8.Management Objectives of Schultz/Koschitzke

The management objectives for Schultz/Koschitzke are:

- Retaining water in the dam to sustain fauna, especially frogs, wetland and woodland birds.
- Sustaining and where possible increasing the abundance of wetland flora, especially threatened species.

Ecological Objectives

The ecological objectives for Schultz/Koschitzke are listed in Table 7-77 below and relate to watering both the dam and the wetland areas.

Table 7-77 Ecological Objectives at Schultz/Koschitzke

Ecological Objective	Justification
Maintain/Improve abundance of wetland flora	• Protects threatened species • Assists with nutrient cycling • Habitat and resources for macroinvertebrates, birds, frogs etc.
Achieve self-sustaining frog and turtle populations	• Frogs provide a food source for wetland birds • Key component of functioning wetland ecosystem through consumption of macroinvertebrates and yabbies • Limited distribution of these species in the northern Wimmera following the decommissioning of the stock and domestic channel system.
Diverse macroinvertebrate population	• Provides a food source for wetland birds, frogs and turtles • Cycles nutrients
Supports wetland birds	• Protects threatened species • Key refuge for ducks, cormorants, grebes etc. during dry conditions
Watering point for terrestrial species	• Supports woodland birds and other local native fauna during dry conditions

Hydrological Objectives

Rakali Consutling (2014) provides recommendations for a watering regime to maximise the condition of the EVCs observed at Schultz/Koschitzke (Table 7-78).

Table 7-78 Hydrological Objectives at Schultz/Koschitzke (Source: Rakali Consulting (2014))

EVC No.	EVC Name	Environmental Watering Frequency	Duration	Depth (m)	Estimated Volume (ML)
808	Lignum Shrubland	If not inundated within the last 5 years	< 6 months	0.5	50.7
369	Black Box Wetland	If not inundated within the last 5 years	< 4 months	0.2	24.5

Watering Regime

The watering regime for Schultz/Koschitzke is derived from the ecological and hydrological objectives listed above. This regime will be subject to water availability and seasonal conditions. The modelled delivery rate by pipeline to the wetland is 20 ML/y (GWMWater, 2013). Therefore it is not feasible to fill the Lignum Shrubland of the wetland, however the construction of a valve outlet in early 2015 enables targeted watering of this wetland and a reasonable volume can be provided

(approximately 20 ML/y contingent on delivery time/rates compared to seepage and evaporation). The more frequent presence of water in the Lignum Shrubland increases the likelihood of it filling and inundating the Black Box Wetland during wet conditions.

The recommended regime subject to water availability is:

- Keep Schultz/Koschitzke's eastern dam above 0.5m deep by filling during winter/spring and allowing evaporative drawdown over summer/autumn. This will promote a more diverse aquatic flora communities (Australian Ecosystems, 2013).
- Water Lignum Shrubland every fifth year through the other pipe outlet (under Beilby Road) if it has been dry in the interim.

The construction of another pipeline outlet into the southern wetland in accordance with recommendations in the RPS (2014) report provides the flexibility to water the dam and or wetland. Beilby Road would otherwise provide an impediment to this (a culvert under the road was prone to blockages which would impact on the delivery of water to the southern wetland) (Figure 7-57).

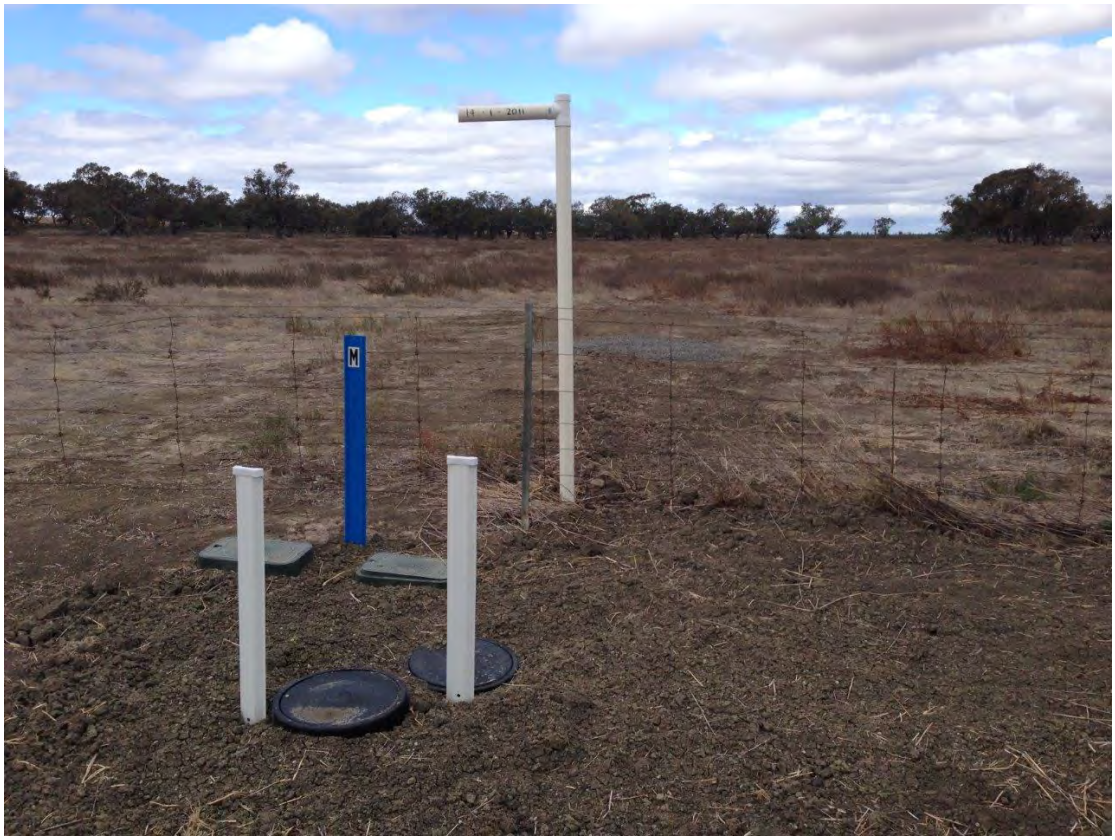


Figure 7-57. Valves to enable watering of the dam and/or wetland at Schultz/Koschitzke, February 2015.

7.12.Tarkedia

7.12.1.Catchment Setting

For Tarkedia, the dam which is connected to the pipeline is in a circular wetland that is mostly located on freehold land east of the dam. A smaller, circular wetland is located further west. This wetland and the dam are located on Crown Land managed by Parks Victoria. An offshoot of the former Sheep Hills Channel enters the dam from the north-west.

7.12.2.Land Status

Historically Tarkedia was set aside as a water and camping reserve in 1876, with parts of it augmented in 1894 (Figure 7-58). Potentially the name Tarkedia was derived from the aboriginal word ‘tarkeeth’ meaning swamp (Blake, 1976). It is presumed that it was used for livestock driven to markets or other properties for access to drinking water. It may also have been earmarked as a potential future water supply for the proposed Township of Tarkedia, which was subdivided slightly further west on the Stawell-Warracknabeal Road. Tarkedia is administered by the Parks Victoria and it is now designated as Nullan I106 Bushland Reserve.

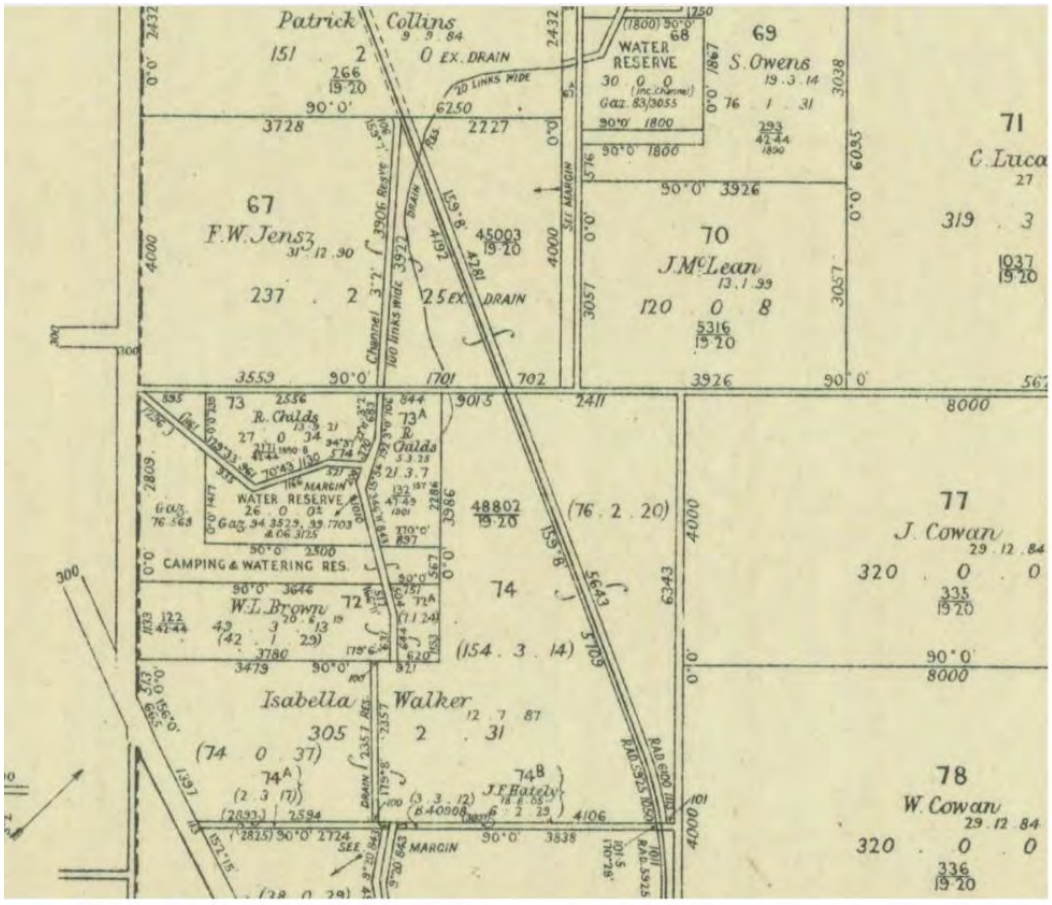


Figure 7-58. Parish of Nullan, County of Borung Map Department of Lands and Survey 1930, Tarkedia is labelled as a ‘Water Reserve’ and ‘Camping and Water Reserve’ on the left.

7.12.3.Hydrology

Tarkedia consists of a shallow wetland in the north-east portion that is physically disconnected from the dam at the site which is located in the south-western section. Another wetland is located on freehold land immediately opposite the dam, on the western side of the Sheep Hills-Minyip Road (Figure 7-62).

In the past the dam was supplied by the Sheep Hills Channel that constitutes the northern boundary of the reserve, so water would be supplied most years for stock, as well as being a potential outfall as the channel was drawn down. The channel system had a reliability of about 70% and there were restrictions on the volume of water available for the swamp around three years in ten on average. During the Millennium Drought water was unlikely to have been supplied given domestic needs and paying customers would have had a higher priority.

An aerial photo from 2004 shows that the dam was empty. Now the channel system has been decommissioned the only sources of water is runoff from the natural catchment and the Wimmera Mallee Pipeline. The wetland and dam contained shallow water levels following heavy rainfall in January 2011 but would have dried out in the subsequent months.

Tarkedia dam, August 2013

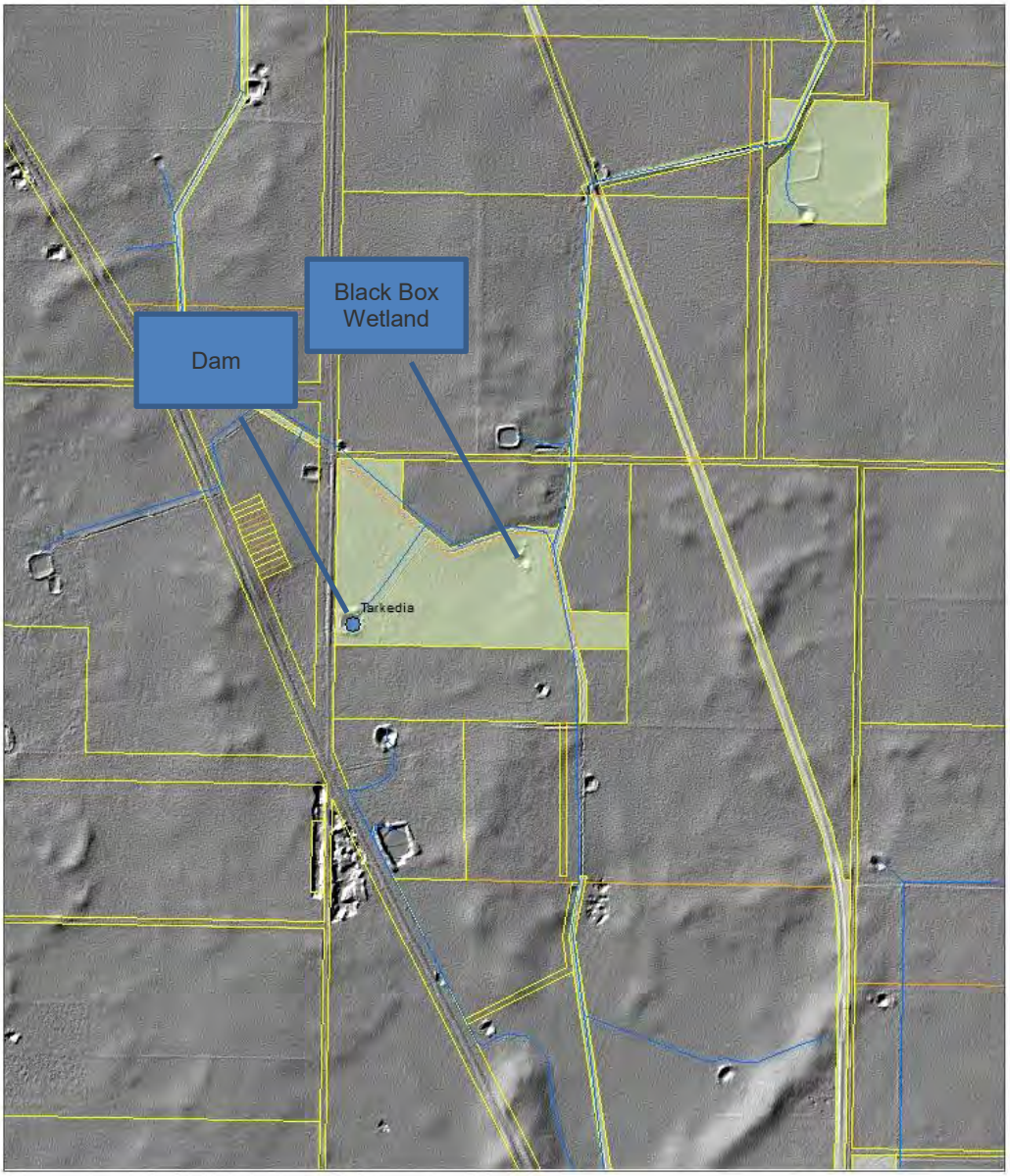


Figure 7-59. Tarkedia showing land tenure and terrain

The watering history of Tarkedia not well known. During the Millennium Drought the dam would have been filled sporadically, but this would have ceased from 2004

onwards when the drought worsened. It would have been empty for a number of years until very wet conditions in January 2011 led to inundation of the dam and wetland. The wetland and dam would have dried out later in 2011. In autumn 2015 and 2016 small volumes were provided to the dam from the pipeline. A pipeline constructed in early 2015 now provides the ability to water the dam and/or the Black Box Wetland to the west which is otherwise physically disconnected from the dam.

Table 7-79 Estimated watering history of Tarkedia

Watering History	Season											
	2010-11		2011-12		2012-13		2013-14		2013-14		2014-15	
	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam
Status	D-W-D	D-W-D	D	D	D	W-D	D	D	D	D	D	D-S
Water Source	L	L										P
Volume	U	U										0.6
Notes	Inundation in summer 2011 and dried out later		Dam and wetland dry.		Dam and wetland dry.		Dam and wetland dry.		Dam and wetland dry.		Wetland dry, shallow inundation of dam.	
Status: Wet/Dry-Wet-Dry/Dry-Wet/Shallow inundation/Wet-Dry/Dry **Water source: Local runoff inundation/Flooding from waterways/Pipeline supply** **Volume: Unknown**												

7.12.4.Water Dependent Values

Fauna

A total of 14 bird, two mammal and four butterfly species have been recorded at Tarkedia and are listed in Appendix 2 (Rakali Consulting, 2014). None of the species observed is noted to be wetland dependant and the site was dry when the inspection took place.

Flora

The wetland complex at Tarkedia supports three wetland EVCs; the eastern wetland in the Bushland Reserve consists of Black Box Wetland (EVC 369), the wetland on freehold land west of the Bushland Reserve is a Spike-Sedge Wetland (EVC 819). Surrounding these wetlands are sections of Lignum Swampy Woodland (EVC 823). On the higher ground around the wetland EVCs are small pockets of Plains Savannah (EVC 826).

Two threatened flora species were observed at Tarkedia including Spiny Lignum (*Duma horrida subsp. horrida*) and Hairy Tails (*Ptilotus erubescens*). The Spiny Lignum was found at the south-western edge of the Bushland Reserve in the Lignum Swampy Woodland. Hairy Tails were found in Plains Savannah as they are not a wetland species.

Figure 7-60. Wetland at Tarkedia, March 2013.

A moderate number of native species were found in the Lignum Swampy Woodland EVC including Tangled Lignum (*Duma florulenta*), Dense Crassula (*Crassula colorata*) and Common Nardoo (*Marsilea drummondii*). A high weed cover was present including species such as Great Brome (*Bromus diandrus*) and Wimmera Rye-grass (*Lolium rigidum*). Generally it was noted as being in 'Moderate' condition

The Black Box Wetland EVC has not been monitored as yet.At the time wetland assessments were undertaken in 2012 and 2013 the wetland was physically disconnected from the dam which was supplied by the Wimmera Mallee Pipeline. As mentioned previously, infrastructure works in early 2015 have now provided the ability to water the Black Box Wetland (Figure 7-62). The Spike-sedge Wetland is on freehold land and not physically connected to a pipeline supply and so is not considered as a watering objective. Maps of the EVCs and location of threatened flora observed at Tarkedia is Figure 7-62 and included in Appendix 1 and listed in Table 7-80 and Table 7-81.

Table 7-80 Threatened flora observed at Tarkedia (Source: (Rakali Consulting, 2014))

Common Name	Scientific Name	Type	Last Record	EPBC Status	FFG Status	DELWP Status	EVC found
Spiny Lignum	*Duma horrida subs. horrida*	W	2013			R	823
Hairy Tails	*Ptilotus erubescens*	T	2013		T	V	823
Type: Wetland dependent, Terrestrial **Status:** Endangered, Vulnerable, Threatened, Rare, Near Threatened, Data Deficient, Poorly Known							

Table 7-81 Ecological Vegetation Classes observed at Tarkedia (Source: (Rakali

Consulting, 2014), (DEPI, 2013))

EVC No.	EVC Name	Wimmera Bioregional Conservation Status	Water dependent (Y/N)
369	Black Box Wetland	Rare	Y
823	Lignum Swampy Woodland	Vulnerable	Y
819	Spike-sedge Wetland	Not recognised in Wimmera bioregion, probably vulnerable	Y
826	Plains Savannah	Endangered	N

7.12.5.Current Condition

Wetland Values

The IWC assessment of Tarkedia was undertaken in 2013 by Rakali and assessed to be in 'Good' condition overall. The limited drainage works led to scores for the Physical Form sub-index being in the 'Good' category. The Wetland Catchment and Hydrology scores were 'Moderate' due to modifications to the local catchment through the roads constructed west of the reserve and the channel to the dam, limited native terrestrial vegetation buffer around the wetland and surrounding landuse being largely cropping/grazing. Negligible soil disturbance meant that this component was classified as 'Excellent'. The cover of invasive weeds led to only a 'Moderate' classification for Biota. The results are summarised in Table 7-82.

Table 7-82 Index of Wetland Condition Scoring at Tarkedia (Source: Rakali Consulting (2014))

IWC sub-index	Wetland Catchment	Physical Form	Hydrology	Water properties	Soils	Biota	Overall Score
Score / 20	10	17	15	15	20	14	7.5
Category	Moderate	Good	Good	Good	Excellent	Moderate	Good

Dam Values

The value of the dam connected to the pipeline at Tarkedia has been qualitatively classified (Table 7-83). It is a moderately large dam (Figure 7-61) and given its situation and form it would support a reasonable range of fauna in dry periods.

Table 7-83 Dam Habitat Values at Tarkedia

Indicator	Size	Steepness	Fringing Vegetation	Adjacent Vegetation	Overall
Category	Moderate	Moderate	Moderate	Moderate	Moderate

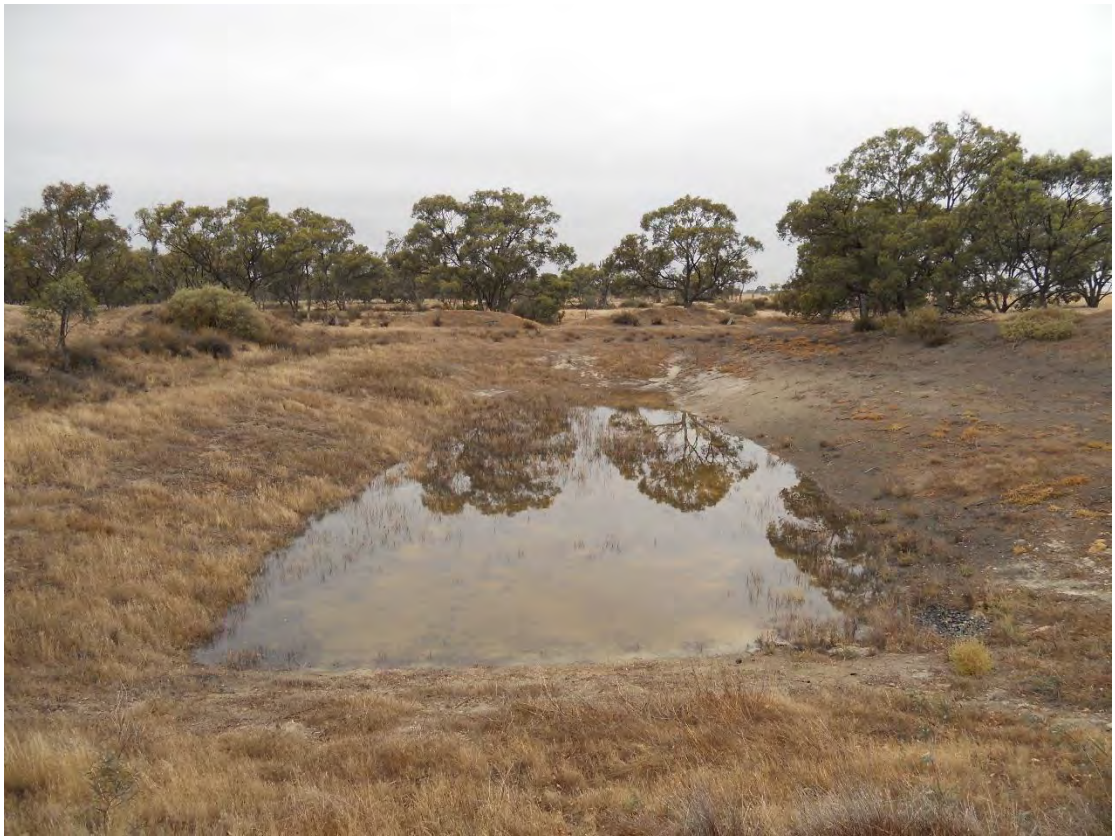


Figure 7-61. Dam at Tarkedia being filled by the pipeline, April 2015.

7.12.6.Threats and Site Trajectory

Threats

For the Bushland Reserve, historically grazing would have been the main threat to the wetland given its former role as a water and camping reserve. The presence of the Sheep Hills Channel may have also prevented overland flows reaching the wetland. However the channel has since been decommissioned and so only the road acts as a blockage to flows from the west and a culvert would address this. The main threat is the presence of invasive plants and animals.

Trajectory

Gradual declines in vegetation condition would be expected to take place over time without environmental watering especially given forecasts for a hotter and drier climate going forward. The absence of water in the dam would also impact on the populations of local fauna who rely on it for habitat/drinking water.

Do Nothing Option

If no environmental water was to be delivered it is expected that local fauna values would diminish in the short term, as the dam would remain dry most of the time..In the longer term there may be some impact on the condition and diversity of wetland flora at Tarkedia, as it shifts to more of a terrestrial vegetation composition than wetland vegetation under climate change.

7.12.7.Conceptualisation of Tarkedia

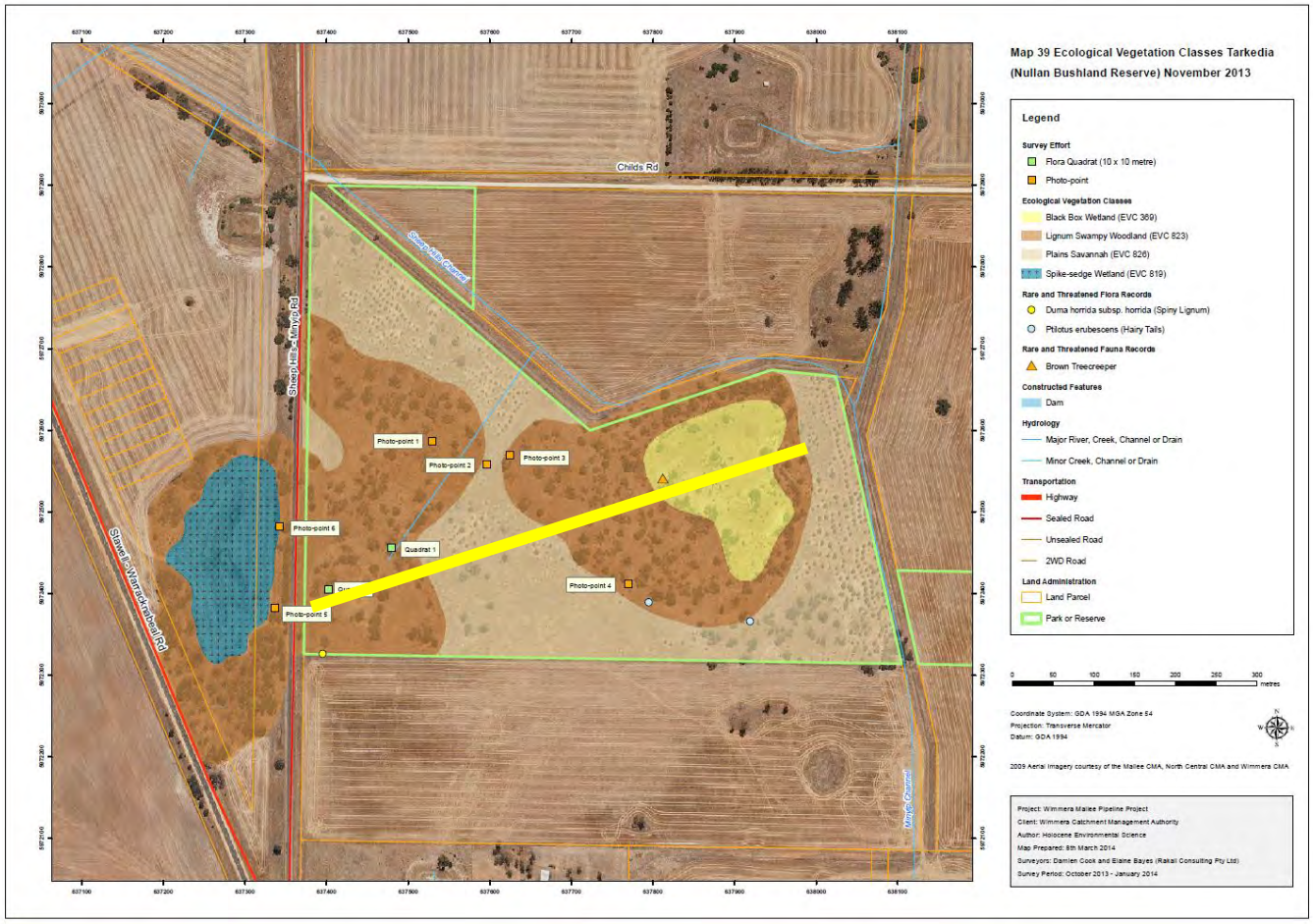


Figure 7-62. EVC and significant flora mapping at Tarkedia. Yellow line is the cross-section for conceptual model.

Notes:

1. Dam at Tarkedia provides a refuge for waterbirds and species with low mobility during dry phases such as frogs and turtles
2. Wetting and drying of the dam banks will support an increased diversity of macroinvertebrates and wetland vegetation through providing a range of habitats for the various parts of their lifecycles
3. Occasional shallow inundation will maintain Spiny Lignum, Common Nardoo and other native wetland vegetation
4. Increased water in the wetland increases likelihood of watering Black Box due to natural heavy rainfall events
5. Pipeline enables watering of shallow wetland and/or dam

LSW = Lignum Swampy Woodland, BBW = Black Box Wetland

7.12.8.Management Objectives for Tarkedia

The management objectives for Tarkedia are:

- Retaining water in the dam to sustain fauna, especially frogs, wetland and woodland birds.
- Sustaining and where possible increasing the abundance of wetland flora, especially threatened species.

Ecological Objectives

The ecological objectives for Tarkedia are listed in Table 7-84 below and relate to watering both the dam and the wetland areas.

Table 7-84 Ecological Objectives at Tarkedia

Ecological Objective	Justification
Maintain/Improve abundance of wetland flora	• Protects threatened species • Assists with nutrient cycling • Habitat and resources for macroinvertebrates, birds, frogs etc.
Achieve self-sustaining frog and turtle populations	• Frogs provide a food source for wetland birds • Key component of functioning wetland ecosystem through consumption of macroinvertebrates and yabbies • Limited distribution of these species in the northern Wimmera following the decommissioning of the stock and domestic channel system.
Diverse macroinvertebrate population	• Provides a food source for wetland birds, frogs and turtles • Cycles nutrients
Supports wetland birds	• Protects threatened species • Key refuge for ducks, cormorants, grebes etc. during dry conditions
Watering point for terrestrial species	• Supports woodland birds and other local native fauna during dry conditions

Hydrological Objectives

Rakali Consulting (2014) provides recommendations for a watering regime to maximise the condition of the Lignum Swampy Woodland EVC at Tarkedia. There is no information specific to the Black Box Wetland at Tarkedia is not available given water was not able to be delivered to it when the wetlands were assessed in 2012 and 2013. The approach of determining the estimated water requirements followed the same methodology with respect to using the average depth for that EVC multiplied by its approximate area.

Table 7-85 Hydrological Objectives at Tarkedia (Source: Rakali Consulting (2014))

EVC No.	EVC Name	Environmental Watering Frequency	Duration	Depth (m)	Estimated Volume (ML)
826	Plains Savannah	NA	NA	NA	NA
819	Spike-sedge Wetland	NA	NA	NA	NA
823	Lignum Swampy Woodland	If not inundated in last 3 years	< 6 months	0.2	13.5
369	Black Box Wetland	If not inundated within the last 5 years	< 4 months	0.2	0.5

Watering Regime

The watering regime for Tarkedia is derived from the ecological and hydrological objectives listed above. This regime will be subject to water availability and seasonal conditions. The modelled delivery rate by pipeline to the wetland is a maximum of 8 ML/y (GWMWater, 2013). Watering the Lignum Swampy Woodland may be limited to the dam and the immediate surrounds as water will continue north-east through the former channel. However watering of the Black Box Wetland is now feasible due to the construction of a pipeline and outlet for the wetland in accordance with the recommendations in RPS (2014) (Figure 7-63).

The recommended regime subject to water availability is:

- Keep Tarkedia's dam above 0.5m deep by filling during winter/spring and allowing evaporative drawdown over summer/autumn. This will promote a more diverse aquatic flora communities (Australian Ecosystems, 2013).
- Water Black Box wetland every fifth year if it has been dry in the interim using the pipeline outlet constructed in ealy 2015 (Figure 7-63).

Figure 7-63. Newly constructed outlet to Black Box wetland at Tarkedia, April 2015.

7.13. Wal Wal Swamp

7.13.1.Catchment Setting

Wal Wal Swamp is located on a drainage line north of the Wimmera River at Wal Wal. Due to the relatively low relief of the area it is located in it also acts as a flood runner from the Wimmera River. Runoff from farmland south of Wal Wal Swamp would flow into the swamp during wet conditions.

7.13.2.Land Status

Historically Wal Wal Swamp was set aside as a water reserve in 1885 as evidenced from a 1957 survey map (Figure 7-64). It is managed by Parks Victoria and called Wal Wal Swamp Wildlife Reserve.

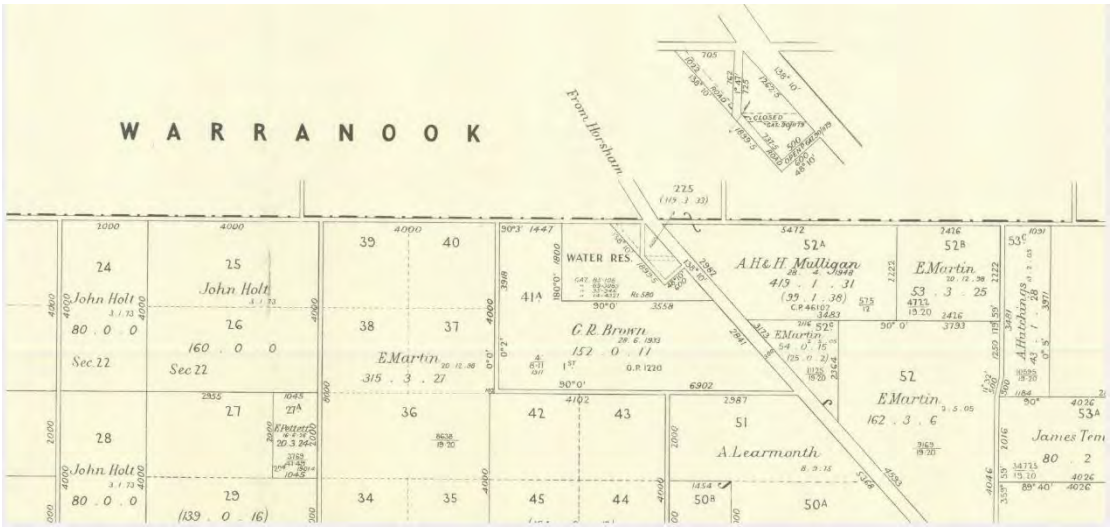


Figure 7-64. Parish of Warra Warra, County of Borung Map Department of Lands and Survey 1957, Wal Wal Swamp is the 'Water Res' in the centre

7.13.3.Hydrology

Wal Wal Swamp is a deep point on a drainage line that collects overland flow to the south of the wetland. In average to wet years there would be sufficient runoff to inundate low points. A dam was excavated in the south-east of the wetland to retain water longer for stock drinking purposes. The drainage line also acts as a flood runner through 1 in 5 year floods and greater (Water Technology , 2009) (Figure 7-65). Unlike most wetlands supplied by the Wimmera Mallee Pipeline it does not appear to have been previously supplied by a channel, although channel-fed dams are very close (<1 km away) (Figure 7-66).

Figure 7-65. Aerial photo of Wal Wal Swamp, January 2011.

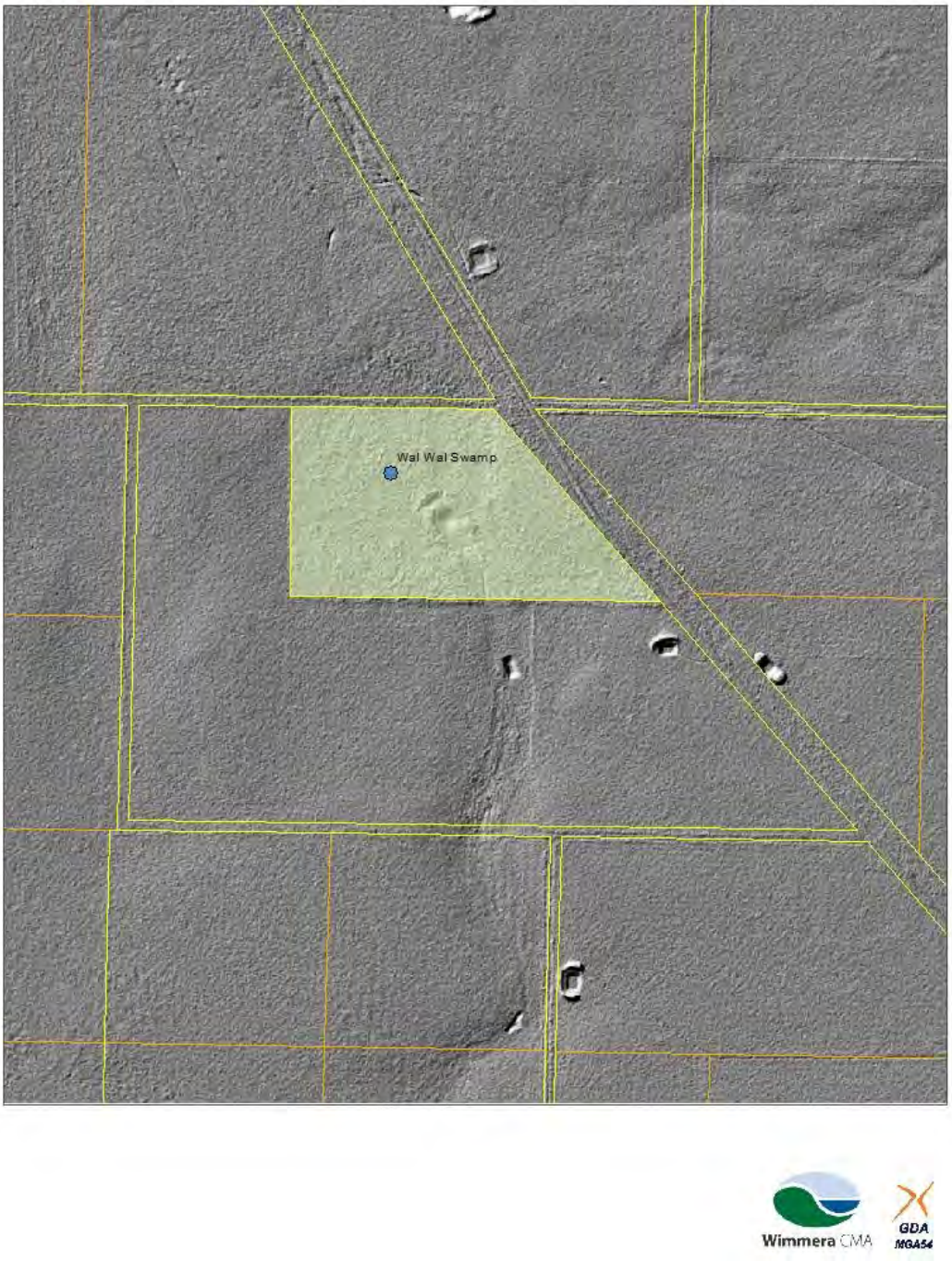


Figure 7-66. Wal Wal Swamp showing land tenure and terrain

The watering history of Wal Wal Swamp is not well known. In wet years it would have filled from local runoff.The fact that it is the most southerly wetland supplied by pipeline increases the frequency of inundation events with higher average rainfall. Throughout much of the Millenium Drought the wetland would have been completely dry, with insufficient rainfall to generate runoff. An aerial photograph in 2004 shows the dam is completely dry. Flooding in September 2010 and January 2011 led to Wal Wal Swamp being completely inundated. Water remained in the excavated dam there for another 2 years (Figure 7-67), drying out in 2013.

Table 7-86 Estimated watering history of Wal Wal Swamp

Watering History	Season											
	2010-11		2011-12		2012-13		2013-14		2013-14		2014-15	
	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam	Wetld	Dam
Status	D-W-D	D-W	D	W	D	W	D	W-D	D	D		
Water Source	L/F	L/F										P
Volume	U	U										1.9
Notes	Inundation in spring 2010 to summer 2011. Wetland dried out mid-2011		Dam remained wet. Wetland dry.		Dam remained wet. Wetland dry.		Dam dried out. Wetland dry.		Dam and wetland dry.		Wetland dry, shallow inundation of dam.	
Status: Wet/Dry-Wet-Dry/Dry-Wet/Shallow inundation/Wet-Dry/Dry **Water source: Local runoff inundation/Flooding from waterways/Pipeline supply** **Volume: Unknown**												

7.13.4.Water Dependent Values

Fauna

A total of 28 bird, two frog, one mammal and one fish species have been recorded at Wal Wal Swamp (Australian Ecosystems, 2013) and are listed in Appendix 2. This includes three threatened species, Eastern Great Egret (*Ardea modesta*), Spotted Harrier (*Circus assimilis*) and Square-tailed Kite (*Lophoictinia isura*) (Table 7-87). The site is noted for the large number of hollows in the River Red Gums which in turn would provide excellent habitat for local fauna.

Table 7-87 Threatened fauna observed at Wal Wal Swamp (Source: Australian Ecosystems (2013))

Common Name	Scientific Name	Fauna Type	Type	Last Record	EPBC Status	FFG Status	DELWP Status
Eastern Great Egret	*Ardea modesta*	B	W	2012		T	V
Spotted Harrier	*Circus assimilis*	B	T	2012			N
Square-tailed Kite	*Lophoictinia isura*	B	T	2012		T	V
Fauna Type: Amphibian, Reptile, Bird, Mammal **Type:** Wetland dependent, Terrestrial **Status:** Endangered, Vulnerable, Threatened, Rare, Near Threatened, Data Deficient, Poorly Known							

Flora

The wetland complex at Wal Wal Swamp supports four wetland EVCs, the deepest section of the wetland consists of a Cane Grass Wetland/Aquatic Herbland Complex

(EVC 602). Surrounding this is a Red Gum Swamp/Cane Grass Wetland Complex (EVC A114). To the south and west of the wetland are Riverine Swamp Woodland (EVC 815) and Plains Woodland/Herb-rich Gilgai Wetland EVCs.

Five threatened flora species were observed at Wal Wal Swamp including River Swamp Wallaby-grass (*Amphibromus fluitans*) at the southern edge of the Cane-Grass Wetland/Aquatic Herbland EVC. Buloke (*Allocasuarina luehmannii*) and Ferny Small-flower Buttercup (*Ranunculus pumilio var. politus*) were observed in the Plains Woodland/Herb-rich Gilgai Wetland Wetland Mosaic EVC. Winged Water-starwort (*Callitriche umbonata*) and Annual Bitter-cress (*Cardamnie paucijuga* s.s.) were located in the Red Gums Swamp/Cane Grass Wetland Complex EVC.

The Cane Grass Wetland - Aquatic Herbland Complex EVC (EVC 602) is a comparatively rare EVC and in this case was located in the deepest section of the wetland, dominated by Southern Cane-grass (*Eragrostis infecunda*) with some wetland herbs and sedges such as Water Ribbons (*Triglochin procera s.l.*), Common Nardoo (*Marsilea drummondii*) and Common Spike-sedge (*Eleocharis acuta*). Weed cover was modest, including Burr Medic (*Medicago polymorpha*) and Curled Dock (*Rumex crispus*). Overall it was assessed to be in 'Moderate' condition (Australian Ecosystems, 2013).

The Red Gum Swamp-Cane Grass Wetland Complex (EVC 114) is also a rare EVC in Victoria and is the dominant EVC at Wal Wal Swamp. The vegetation was notable for the very old scattered River Red Gums (*Eucalyptus camaldulensis*) providing an overstorey above Southern Cane-grass and herbs such as Common Woodruff (*Asperula conferta*), Spreading Goodenia (*Goodenia heteromera*) and Swamp Early Nancy (*Wurmbea dioica ssp. lacunaria*). The weed coverage was variable, ranging from low to moderate weed cover. The most prevalent species included Wimmera Rye-Grass (*Lolium rigidum*) and Rough Sow-thistle (*Sonchus asper s.l.*). Where this EVC was located in the Bushland Reserve it was noted to be in 'Excellent' condition, however where it was located in freehold land north and west of the reserve it was classified as being in 'Poor' and 'Very Poor' condition respectively as it had been largely cleared and was converted to grazing/cropping land (Australian Ecosystems, 2013).

The Riverine Swampy Woodland EVC (EVC 815) was confined to the southern section of the Bushland Reserve. Again, it is dominated by River Red Gums with some Grey Box (*Eucalyptus microcarpa*). The understorey consisted of grasses and herbs including Common Swamp Wallaby-grass (*Amphibromus nervosus*), Prickfoot (*Eryngium vesiculosum*) and Knob Sedge (*Carex inversa*). In some places Toowoomba Canary-grass (*Phalaris aquatica*) dominated the understorey but where this was not the case, the vegetation was in excellent condition, therefore overall it was classified as being in 'Moderate' condition (Australian Ecosystems, 2013).Details around the EVCs and threatened flora is in Table 7-88 and Table 7-89.

Table 7-88 Threatened flora observed at Wal Wal Swamp (Source: Australian Ecosystems (2013))

Common Name	Scientific Name	Type	Last Record	EPBC Status	FFG Status	DELWP Status	EVC found
River Swamp Wallaby Grass	Amphibromus fluitans	W	2012			P	602

Buloke	*Allocasuarina luehmannii*	T	2012		R		235
Ferny Small-flower Buttercup	*Ranunculus pumilio var. politus*	T	2012			P	235
Annual Bitter-cress	*Caradmina paucijuga s.s.*	W				E	114
Winged Water-starwort	*Callitriche umbonata*	W	2012			R	235
Type: Wetland dependent, Terrestrial **Status:** Endangered, Vulnerable, Rare, Near Threatened, Data Deficient, Poorly Known							

Table 7-89 Ecological Vegetation Classes observed at Wal Wal Swamp (Source: Australian Ecosystems (2013))

EVC No.	EVC Name	Wimmera Bioregional Conservation Status	Water dependent (Y/N)
602	Cane Grass Wetland/Aquatic Herbland Complex	Vulnerable	Y
235	Plains Woodland/Herb-rich Gilgai Wetland	Endangered	Y
114	Red Gum Swamp/Cane grass Wetland	Vulnerable	Y
815	Riverine Swampy Woodland	Least concern	Y

7.13.5.Current Condition

Wetland Values

The IWC assessment of Wal Wal Swamp was undertaken in 2012 by Australian Ecosystems and assessed to be in 'Good' condition overall. The clearing of the vegetation around much of the wetland led to it receiving a 'Poor' classification for the Wetland Catchment sub-index. The Physical Form score was 'Good' due to limited modifications to the area that can be inundated, apart from the excavation of the dam. Though the roads constructed around the wetland have culverts to enable flows to reach the wetland, changes to the wetland's hydrology and water quality through the construction of roadways led to slightly reduced scores for these sub-indices although they are still classified as 'Good'. The high cover of invasive weeds in some sections led to a 'Moderate' score for biota and a lack of soil disturbance led to it receiving an 'excellent' classification for that sub-index. The results are summarised in Table 7-90.

Table 7-90 Index of Wetland Condition Scoring at Wal Wal Swamp (Source: Australian Ecosystems (2013))

IWC sub-index	Wetland Catchment	Physical Form	Hydrology	Water properties	Soils	Biota	Overall Score
Score / 20	7	15.5	15	15	19	14.8	7
Category	Poor	Good	Good	Good	Excellent	Moderate	Good

Dam Values

The value of the dam connected to the pipeline at Wal Wal Swamp has been qualitatively classified in Table 7-91. It is a reasonably large dam (Figure 7-67) and given its situation and form it would support a wide range of fauna in dry periods.

Table 7-91 Dam Habitat Values at Wal Wal Swamp

Indicator	Size	Steepness	Fringing Vegetation	Adjacent Vegetation	Overall

Category	Excellent	Excellent	Excellent	Excellent	Excellent

Figure 7-67. Wal Wal Swamp, April 2012.

7.13.6. Threats and Site Trajectory

Threats

Historically the site may have been periodically grazed by stock when they were being driven to different properties or to markets. However, this has not been the case for a number of years and now the main threat is the presence of invasive plants and animals.

Trajectory

Gradual declines in vegetation condition would be expected to take place over time without environmental watering especially given forecasts for a hotter and drier climate going forward and a reduced likelihood of floodwaters entering the swamp. The absence of water in the dam would also impact on the populations of local fauna who rely on it for habitat/drinking water.

Do Nothing Option

If no environmental water was to be delivered it is expected that local fauna values would diminish in the short term, as the dam would remain dry most of the time. In the longer term there may be some impact on the condition and diversity of wetland flora at Wal Wal Swamp as it shifts to more of a terrestrial vegetation composition than wetland vegetation with climate change impacts .

7.13.7.Conceptualisation of Wal Wal Swamp

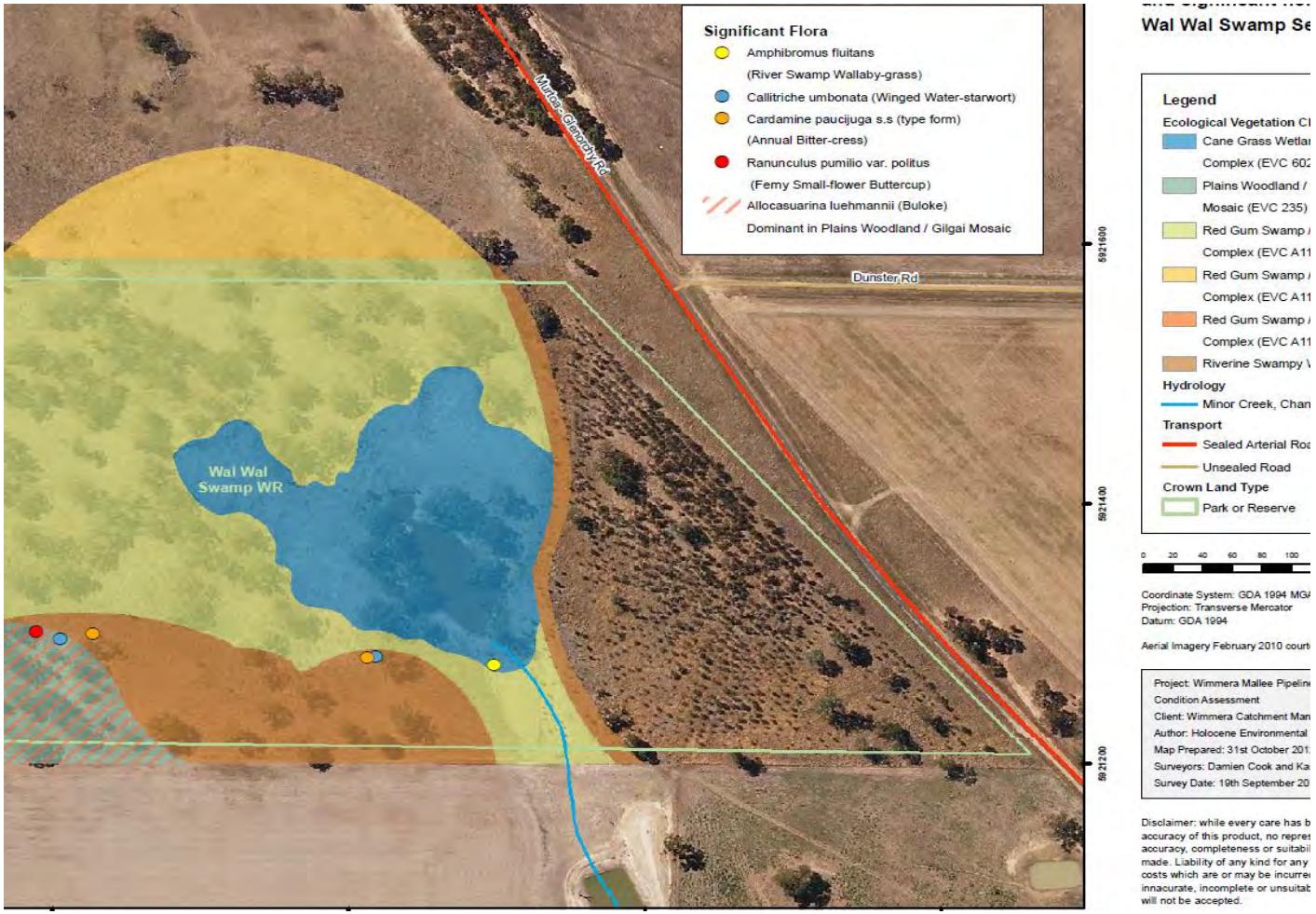


Figure 7-68. EVC and significant flora mapping at Krong. Yellow line is the cross-section for conceptual model.

Notes:

1. Dam at Wal Wal provides a refuge for waterbirds and species with low mobility during dry phases such as frogs and turtles
2. Wetting and drying of the dam banks will support an increased diversity of macroinvertebrates and wetland vegetation through providing a range of habitats for the various parts of their lifecycles
3. Occasional shallow inundation will maintain River Swamp Wallaby-grass, Southern Cane Grass and other native wetland vegetation
4. Increased water in the dam/wetland increases likelihood of watering Red Gum due to natural heavy rainfall events
5. Dam provides a drinking water source for Brown Quail and other birds

7.13.8.Management Objectives for Wal Wal Swamp

The management objectives for Wal Wal Swamp are:

- Retaining water in the dam to sustain fauna, especially frogs, wetland and woodland birds.
- Sustaining and where possible increasing the abundance of wetland flora, especially water-dependent threatened species.

Ecological Objectives

The ecological objectives for Wal Wal Swamp are listed in Table 7-92 below and relate to watering both the dam and the wetland areas.

Table 7-92 Ecological Objectives at Wal Wal Swamp

Ecological Objective	Justification
Maintain/Improve abundance of wetland flora	• Protects threatened species • Assists with nutrient cycling • Habitat and resources for macroinvertebrates, birds, frogs etc.
Achieve self-sustaining frog and turtle populations	• Frogs provide a food source for wetland birds • Key component of functioning wetland ecosystem through consumption of macroinvertebrates and yabbies • Limited distribution of these species in the northern Wimmera following the decommissioning of the stock and domestic channel system.
Diverse macroinvertebrate population	• Provides a food source for wetland birds, frogs and turtles • Cycles nutrients
Supports wetland birds	• Protects threatened species • Key refuge for ducks, cormorants, grebes etc. during dry conditions
Watering point for terrestrial species	• Supports woodland birds and other local native fauna during dry conditions

Hydrological Objectives

Australian Ecosystems (2013) provides recommendations for a watering regime to maximise the condition of the EVCs observed at Wal Wal Swamp.

Table 7-93 Hydrological Objectives at Wal Wal Swamp (Source: Australian Ecosystems (2013))

EVC No.	EVC Name	Environmental Watering Frequency	Duration	Depth (m)	Estimated Volume (ML)
815	Riverine Swampy Woodland	Not recommended to be artificially watered	< 1 month	0.1	2.2
602	Cane Grass Wetland/Aquatic Herbland Complex	If not inundated in the last 2 years	< 8 months	0.5	16.5
235	Plains Woodland/Herb-rich Gilgai Wetland	NA	NA	NA	NA
114	Red Gum Swamp/Cane grass Wetland	If not inundated in the last 2 years	< 6 months	0.3	24

Watering Regime

The watering regime for Wal Wal Swamp is derived from the ecological and hydrological objectives listed above. This regime will be subject to water availability and seasonal conditions. The modelled peak delivery rate by pipeline to the wetland

is 15 ML/y. Therefore only the Cane Grass Wetland/Aquatic Herbland Complex can be feasibly watered, however through increasing the frequency this EVC is watered then the likelihood the other EVCs will be watered by natural inflows during wet conditions.

The recommended regime subject to water availability is:

- Keep water above 0.5m deep in the deeper area located in the dam. It can be kept close to full through top ups in winter/sping and having evaporative drawdown over summer/autumn. This will promote a more diverse aquatic flora communities (Australian Ecosystems, 2013).

Inundation beyond the dam area is not feasible as water will back into the adjacen farming property to the south.

Large River Red Gum at Wal Wal Swamp, April 2012

8. Managing Risks to Achieving Objectives

A qualitative risk assessment has been undertaken to assign the level of long-term risk of achieving the ecological objectives for the Wimmera Mallee Pipeline wetlands in the Wimmera CMA region as well as risks related to the delivery of environmental water through the implementation of this EWMP. The relationship between likelihood (probability of occurrence) and the severity (severity of impact) provide the basis for evaluating the level of risk (Table 8-1).

Table 8-1 Risk matrix

		Severity		
		Major	Moderate	Minor
Likelihood	Probable	High	High	Moderate
	Possible	High	Moderate	Low
	Improbable	Moderate	Low	Low

Table 8-2 Risk assessment and management measures for the Wimmera Mallee Pipeline wetlands in the Wimmera CMA region

Threat	Outcome	Relevant Sites	Likelihood	Severity	Risk	Management Measure	Residual Risk
Threats to achieving ecological objectives							
Insufficient delivery rates from the pipeline to achieve outcomes (e.g. bird, frog breeding events)	The delivery of environmental water to these wetlands is restricted by the pipeline capacity, modelled delivery rates are outlined in GWMWater (2012, 2013).	All apart from Opie's and Fielding's Dams and Wal Wal Swamp	High	High	High	Ensure ecological objectives are feasible based on pipeline delivery rates. Target more substantial watering events for wet years	High
Game hunting	Duck and quail hunting is allowed at Wildlife Reserves which may impact on bird outcomes	Sawpit Swamp, Mutton Swamp, Wal Wal Swamp, Crow Swamp	Probably	Low	Low	Appropriate compliance of game hunting.	Low
Grazing pressures	The sites are protected from grazing pressures being Parks Victoria reserves or having grazing restricted as conditions within a management agreement or Trust	All	Improbable	Low	Low	Ensure compliance with management agreements and land status through inspections, use of motion sensor cameras etc.	Low

Threat	Outcome	Relevant Sites	Likelihood	Severity	Risk	Management Measure	Residual Risk
	for Nature covenant. However several wetlands may be affected as sheep may escape into them (Krong, Carapugna, Harcoan's).						
Lack of connectivity with other wetlands (i.e. absence of vegetated corridors)	All wetlands apart from Sawpit Swamp are largely isolated with no connectivity with other wetland or large areas of native vegetation. This impacts on the ability of species to recolonise these wetlands	All except Sawpit Swamp	High	High	High	Work with Yarrilinks, Project Platypus, Project Hindmarsh etc. to increase vegetation connectivity between wetlands and other areas of native vegetation	High
Carp, goldfish and tench	Carp, goldfish and tench may enter wetland connected to the Wimmera River system during flood events and subsequently impact on wetland vegetation	Sawpit Swamp, Wal Wal Swamp, Mutton Swamp	High	High	High	Undertake exotic fish removal activities for example using carp pod traps and electrofishing. Allow occasional drying events	Low
Foxes	Foxes can predate on waterbirds and turtles and are attracted to dams with water in them to drink and ambush prey.	All	High	Moderate	Moderate	Implementing fox control actions as part of the *Wimmera Invasive Plant and Animal Management Strategy* (Wimmera CMA, 2010) (*WIPAMS*).	Moderate
Weeds	Invasive plant species such as Wimmera Rye-grass and Toowoomba Canary Grass	All	High	Major	High	Implement invasive plant management activities outlined in the *WWS*.	High
Rabbits	Rabbits consume wetland plant species	All	High	Moderate	High	Implement invasive plant and animal management activities outlined in the *WWS and WIPAMS*.	Low
Threat related to the delivery of environmental water							
Changes in frequency, duration and extent of inundation	Change wetland EVC composition, kill vegetation through overwatering, increase abundance of undesirable species.	All apart from Crow Swamp and Opies Dam	Possible	Major	High	Implement recommendations of Australian Ecosystems (2013) and Rakali (2014) regarding inundation frequencies. Use infrastructure constructed according to recommendations of RPS (2014) Implement WETMAP to enhance ecological knowledge of weltand watering requirements.	Moderate
Nuisance effects of wildlife	Through providing an ongoing surface water supply species such as kangaroos and foxes are likely to increase in localised abundance creating problems such as risk	All sites	Probable	High	High	Work with land managers and adjacent landholders to manage nuisance effects including fox baiting, increased signage etc.	High

Threat	Outcome	Relevant Sites	Likelihood	Severity	Risk	Management Measure	Residual Risk
	of car accidents, impacts on adjacent crops and sheep production.						

9. Environmental Water Delivery Infrastructure

9.1. Infrastructure and Operational Constraints

Given these wetlands are supplied by the pipeline, the rate at which the pipeline can outfall water into these wetlands is a constraint. For recreation lakes supplied by the pipeline, their indicative volumes were factored into the design of the pipeline to ensure that appropriate volumes could be delivered, however the selection of wetlands took place after the design and construction of the pipeline. When an initial list of nominated wetlands was developed hydraulic modelling of delivery rates based on maximum pipeline demands was undertaken to ensure that reasonable volumes could be supplied without impacting on water pressure for neighbouring properties. These results are outlined in GWMWater (2012, 2013) and summarised in Table 9-1.

Table 9-1 Modelled maximum demands (from GWMWater (2012, 2013)) and estimated wetland target EVC volumes (not including seepage and evaporation losses (from Australian Ecosystems (2013) and Rakali Consulting (2014). Rows highlighted in yellow shows a significant shortfall in the maximum supply rates compared to the volume required to fill the wetland EVC.

Wetland	Modelled Maximum Demand (ML)	Wetland target EVC Approximate Capacity
Carapugna	20	50.4
Challambra Swamp	45	46.4
Crow Swamp	12	37.5
Harcoans	30	40
Krong Swamp	15	11
Mutton	50	39
Pinedale	25	12.9
Sawpit Swamp	50	83.5
Wal Wal Swamp	15	16.5
Opie's Dam	2	2
Tarkedia	8	13.5
Schultz/Koschitzke	20	50
Fielding's Dam	4	4

Table 9-1 shows that a number of wetlands have significant shortfalls in the delivery rate compared to the estimated volumes required to fill the wetland EVC. However several points should be noted about this:

- The delivery rate assumes the pipeline is also supplying other demands at maximum modelled rates. This is a very precautionary approach and typically actual demands have been much less, therefore delivery rates experienced so far have been above those modelled.

- Whilst filling the wetland to the full extent of the EVC is desirable, providing volumes less than this will still lead to ongoing benefits in vegetation condition. Historically when these wetlands received inflows they were not always sufficient to fill them.

- These wetland are by and large unregulated in the sense that apart from impacts of low-level features of roads and drains there is no extraction and so continue to fill when rainfall is sufficient to generate substantial runoff. Therefore there may be opportunities to temporarily 'top-up' water levels for these wetlands although this will be limited given when they are so full the evaporation and seepage rates will be significant in proportion to the rate of delivery.

The 1000 ML entitlement is of a slightly lower reliability than the reliability of the entitlements for pipeline products (stock and domestic, towns and Wimmera/Glenelg River system). This means that the entitlement is restricted in dry years, for example 2014-15, when flows were only in about the 10th percentile allocations were 0 ML. Given there are 51 wetlands across the Mallee, North Central and Wimmera CMAs, a series of dry years could see significantly reduced allocations for these wetlands. However the VEWH is developing a process whereby the limited resource can be shared across wetlands in the three CMA regions to achieve the greatest environmental outcomes.

Shortfalls in allocations do not pose a high risk to many of these wetland values given their hydrology has been episodic and they are essentially unregulated. Only very modest volumes are required to water the dams to retain fauna values.

9.2.Addressing Delivery Constraints

It was initially identified that there were physical impediments that would prevent the delivery of water to targeted parts of the wetland given the pipeline outlets were located either in the dam or at the edge of the property and used a channel to reach the dam. RPS undertook an assessment of all pipeline wetlands within the Wimmera CMA region in 2014, subsequent to this they recommended works for wetlands where there was a physical impediment to the delivery of environmental water to the wetland. Details of this process are outlined in RPS (2014). The recommended works were undertaken in early 2015 and are summarised as follows:

- Krong Swamp – channel created to enable water from the dam once it fills to enter the wetland and a low level bund constructed at the southern end to prevent water from the wetland from entering adjacent freehold land.

- Carapugna – installing a pipe in the footprint of the channel that crosses the reserve from the north-east to the dam in the south-west with outlets for the dam and wetlands on either side of the channel.

- Harcoan's Swamp – part of the embankment around the dam breached and a channel created to enable water from the dam to enter the wetland once it has filled.

- Sawpit Swamp – installing a pipe along the remnant of the channel that goes from the south-west corner of the reserve to the deep wetland in the north of the reserve with outfall points into that wetland as well as the ox-bow wetland to the east.

- Tarkedia – installing a pipe with an outfall into the Black Box Wetland east of the dam.

- Schultz/Koschitzke – installing a pipe with an outfall to water the wetland on the south side of Beilby Road.

Additional Wetlands
A number of community members have expressed a strong desire to have additional wetlands connected to the pipeline for supply. Given that the initial budget to connect wetlands to the pipeline has been expended, the Mallee CMA is collating a list of wetlands that community members are keen to see connected should additional funding be made available for further connections.

9.3.Complementary Management Activities

The *WWS* has documented a number of complementary management activities to maxmise the outcomes from environmental watering. Typically this includes invasive plant and animal control (e.g. rabbit, bridal creeper, boneseed) as well the establishment of wetland management agreements to remove threats from livestock impacts on wetlands.

Given the isolated nature of these wetlands and lack of connectivity, some reintroduction of wetland-dependent flora and fauna should be considered, in particular threatened species. For example species observed some wetlands like Ridged-water Milfoil and Growling Grass Frogs can be introduced to others given sufficient levels of surety around future watering. Preliminary discussions with North Central CMA have flagged that there is potential for Murray Hardyhead, a threatened fish species outside of the region, to be introduced at several sites as a way of boosting its chances of survival into the long-term.

10.Demonstrating Outcomes

Given the substantial expenditure of public funds that was undertaken to recover water for environmental watering there is a need to demonstrate the outcomes it has achieved. There is a further need to ensure that environmental water is being delivered in an efficient and effective way through adaptive management. Monitoring is critical to both demonstrate the outcomes achieved as well as facilitating ongoing adaptive management.

To assist the development of the *WWS*, program logic models were developed which prescribed a range of actions that would address waterway threats (such as modified flow regimes, degraded water quality and riparian vegetation) (GHD, 2012). Many of these related to provision of additional water, typically through environmental watering actions.

Effective and targeted monitoring can take place over short period to determine if environmental watering has achieved anticipated outcomes (e.g. area of inundation and response of flora and fauna) – intervention monitoring. Over a number of years this and other monitoring data can be collated and aggregated to build a better picture of the effectiveness of environmental watering over the long-term. The type and effort of monitoring should be cognisant of the effect of environmental watering at the site, the volumes involved and confounding factors (e.g. grazing).

10.1.Intervention Monitoring

Various monitoring techniques can be applied to determine the physical and ecological response environmental watering will have at these wetlands and these recommended monitoring programs will vary depending on funding availability.

Vegetation

Monitoring quadrats have been set up at these wetlands as part of the Australian Ecosystems (2013) and Rakali Consulting (2014) projects (Figure 10-1) to form a baseline of vegetation condition prior to the supply of environmental water. Ideally they will be resurveyed periodically, in particular during and following the provision of environmental water. Additional transects may need to be established at these wetland to be able to monitor vegetation outcomes from watering actions (e.g. no transect has been established at the Black Box wetland at Tarkedia that is now connected to the pipeline). Follow up Index of Wetland Conditions assessments can also be used to track the trajectory of the condition of wetland vegetation.

Photo points and threatened species distributions mapped as part of these projects may also provide a useful monitoring baseline to quantify changes brought about by environmental watering or lack thereof.

Figure 10-1. Vegetation monitoring quadrat at Schultz/Koschitzke (Rakali Consulting, 2014)

Birds and other fauna

Motion sensing cameras have been deployed at several wetlands which have captured images of water birds such as Grey Teal, Shelducks, White-faced Herons and Wood Ducks using these wetlands as habitat (Figure 10-2) and birds like Magpies, Magpie Larks, Ravens, Eastern Rosellas, Red-rumped Parrots using them as somewhere to drink. A large Lace Monitor has also been captured frequenting Fielding's Dam. It is planned to continue to deploy motion sensing cameras to get a more definitive picture of the fauna that rely on these wetlands when they contain water. Collating landholder information around fauna observations will also be useful to complement the motion sensing cameras.

Acoustic recorders have been deployed at Pinedale and Sawpit Swamp to determine what frog species are present and have recorded Pobblebonk and Spotted March Frogs..

Almost nothing is known about the presence or absence of turtles at these wetlands, however in the future some trapping using cathedral traps may be desirable to determine their location. Similarly if flood conditions lead to fish entering Sawpit, Mutton and Wal Wal Swamps fish monitoring using bait traps or electrofishing could be used to gain a picture of the fish community. However given these wetlands are not being watered to achieve native fish outcomes this monitoring will be a low priority.

Water quality and habitat

Water quality supplied by the Wimmera Mallee Pipeline is generally excellent (e.g. salinity levels about 200 µS/cm), especially in contrast to water that flows into these wetlands from overland flow, and therefore so water quality monitoring is not a priority. If water quality events such as Blue Green Algae blooms or blackwater events take place little can be done to mitigate against them. However precautions can be made such as undertaking deliveries during winter/spring when risks of algal blooms are lowest. Risks are comparatively low for algal blooms at these wetlands than other open water bodies given the good water quality.

Water depth can be monitored using pressure sensors deployed in the wetlands to determine the changes to water levels over time. The spatial extent of watering can also be mapped by CMA staff and landholders over time.

Figure 10-2. Grey Teal at Pinedale captured on motion sensing camera, January 2015

10.2.Long-term Monitoring

DELWP is establishing the Wetland Monitoring and Assessment Program (WETMAP) which is similar to the concept of the Victorian Environmental Flows Monitoring and Assessment Program (VEFMAP) which had consistent monitoring methods applied to a number of rivers across Victoria that had augmented flows due to Environmental Water Releases to draw conclusions around the effect of flows on fish, vegetation and geomorphology. It is anticipated that a subset of wetlands covered in this EWMP can be incorporated into WetMAP. Vegetation monitoring already undertaken at these wetlands may provide a useful baseline of information to incorporate into the WetMAP program.

11.Consultation

In early 2015 Wimmera CMA launched the 'What have you observed with the Wimmera's Water?' media campaign which involved newspaper ads, Facebook promotions and a display at the Wimmera Machinery Field Days. The objective was to gain information from community members on ecological responses witnessed due to environmental watering. Unfortunately no information was provided on Wimmera Mallee Pipeline supplied wetlands, probably because water had only been supplied to Pinedale, Fielding's Dam and Sawpit Swamp when the campaign took place.

Consultation with landholders with wetlands on their property as well as Parks Victoria and GWMWater has been ongoing through the development of past Seasonal Watering Proposals. Barengi Gadjin Land Council and relevant local councils were consulted around the wetland watering process through the RPS (2014) project. Barengi Gadjin Land Council provided relevant information around indigenous cultural heritage sites associated with several of these wetlands, showing their value to the local indigenous community.

The *WWS* also involved wide consultation, involving a number of agencies and community groups. Furthermore the strategy was released as a public draft for comment. Through the *WWS* development process there was widespread support for the goals, targets and management activities prescribed in the document including many that relate to environmental water management. Consultation details are listed in Appendix 4.

Figure 11-1. Newspaper advertisement promoting the Wimmera EWMP process.

12.Knowledge Gaps and Recommendations

The *Wimmera Mallee Pipelines – Wimmera CMA Region EWMP* has been developed using the best available information to hand. However despite the ongoing improvements in environmental water management through experience in implementation, there are still a number of knowledge gaps and recommendations that remain that can enhance environmental water management in the Wimmera for the benefit of the entire region. Improved processes around water planning for these wetlands need to be developed involving VEWH, North Central CMA, Mallee CMA, landowners and community representatives.

Table 12-1 Knowledge Gaps and Recommendations

Knowledge Gap	Recommendation	Who	Priority
Rate of wetland filling/emptying	Undertake analysis of wetland filling/drying based on metered delivery rates and information on wetland depth/extent using pressure sensor data, mapped extents and wetland bathymetry	GWMWater, Wimmera CMA	High
Fauna values	Use motion sensing cameras, acoustic recorders and observations to build a more complete picture of fauna values at these sites	Wimmera CMA	Mediu m
Flora values	Undertake addition site-wide surveys and surveys of vegetation quadrats, as well as establish additional quadrats. Also undertake surveys for threatened flora species.	Wimmera CMA	High
Social and economic values of waterways	Quantify benefits of waterways to demonstrate the full value of environmental water	Wimmera CMA	High
Water planning process	Develop process for annual planning for wetland watering involving CMAs, VEWH and other stakeholders	Wimmera CMA, VEWH	High

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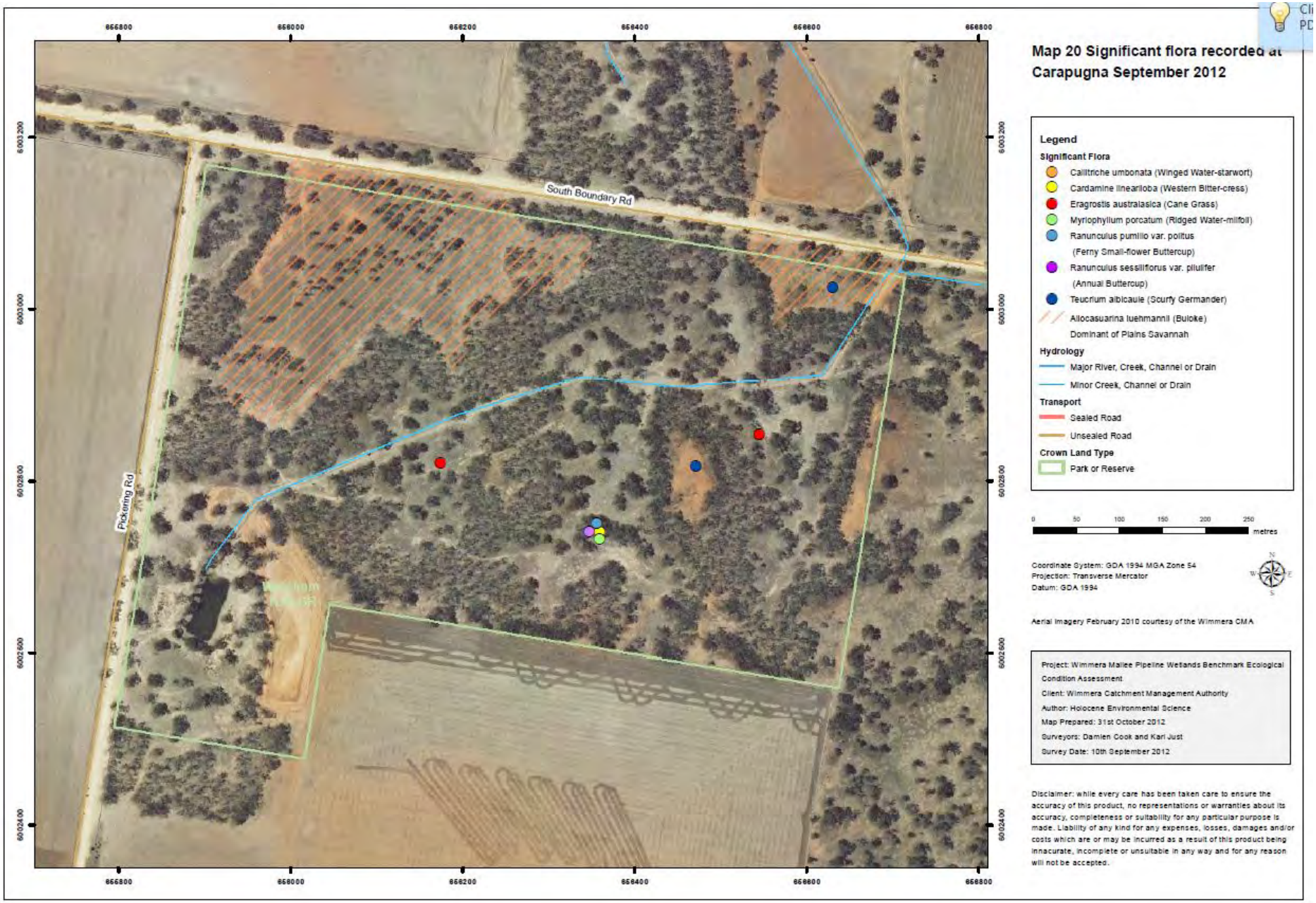
14.Abbreviations and Acronyms

BGLC	Barengi Gadjin Land Council
CEWO	Commonwealth Environmental Water Office
CMA	Catchment Management Authority
COAG	Council of Australian Governments

DELWP	Department of Environment, Water and Planning
EPBC	Environment Protection and Biodiversity Conservation Act
FFG	Flora and Fauna Guarantee Act
IWC	Index of Wetland Condition
GWMWater	Grampians Wimmera Mallee Water Corporation
MDBA	Murray Darling Basin Authority
NES	National Matters of Environmental Significance
NWI	National Water Initiative
RCS	Regional Catchment Strategy
SWS	Sustainable Water Strategy
VEWH	Victorian Environmental Water Holder
VWMS	Victorian Waterway Management Strategy
VRHS	Victorian River Health Strategy
WetMAP	Wetland Monitoring and Assessment Program
WWS	Wimmera Waterway Strategy

Appendix 1 – Maps showing location of Threatened Species


Map 20 Significant flora recorded at Carapugna September 2012
South Boundary Rd
Pickering Rd
656800
658000
658200
658400
658600
656800
6003200
6003000
6002800
6002600
6002400
Legend
Significant Flora
Callitriche umbonata (Winged Water-starwort)
Cardamine linearifoba (Western Bitter-cress)
Eragrostis australasica (Cane Grass)
Myriophyllum porcatum (Ridged Water-milfoil)
Ranunculus pumilio var. politus
(Ferny Small-flower Buttercup)
Ranunculus sessiliflorus var. pilulifer
(Annual Buttercup)
Teucrium albicaule (Scurfy Germander)
Allocasuarina luehmannii (Buloke)
Dominant of Plains Savannah
Hydrology
Major River, Creek, Channel or Drain
Minor Creek, Channel or Drain
Transport
Sealed Road
Unsealed Road
Crown Land Type
Park or Reserve
0 50 100 150 200 250
metres
Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994
Aerial Imagery February 2010 courtesy of the Wimmera CMA
Project: Wimmera Mallee Pipeline Wetlands Benchmark Ecological Condition Assessment
Client: Wimmera Catchment Management Authority
Author: Holocene Environmental Science
Map Prepared: 31st October 2012
Surveyors: Damien Cook and Karl Just
Survey Date: 10th September 2012
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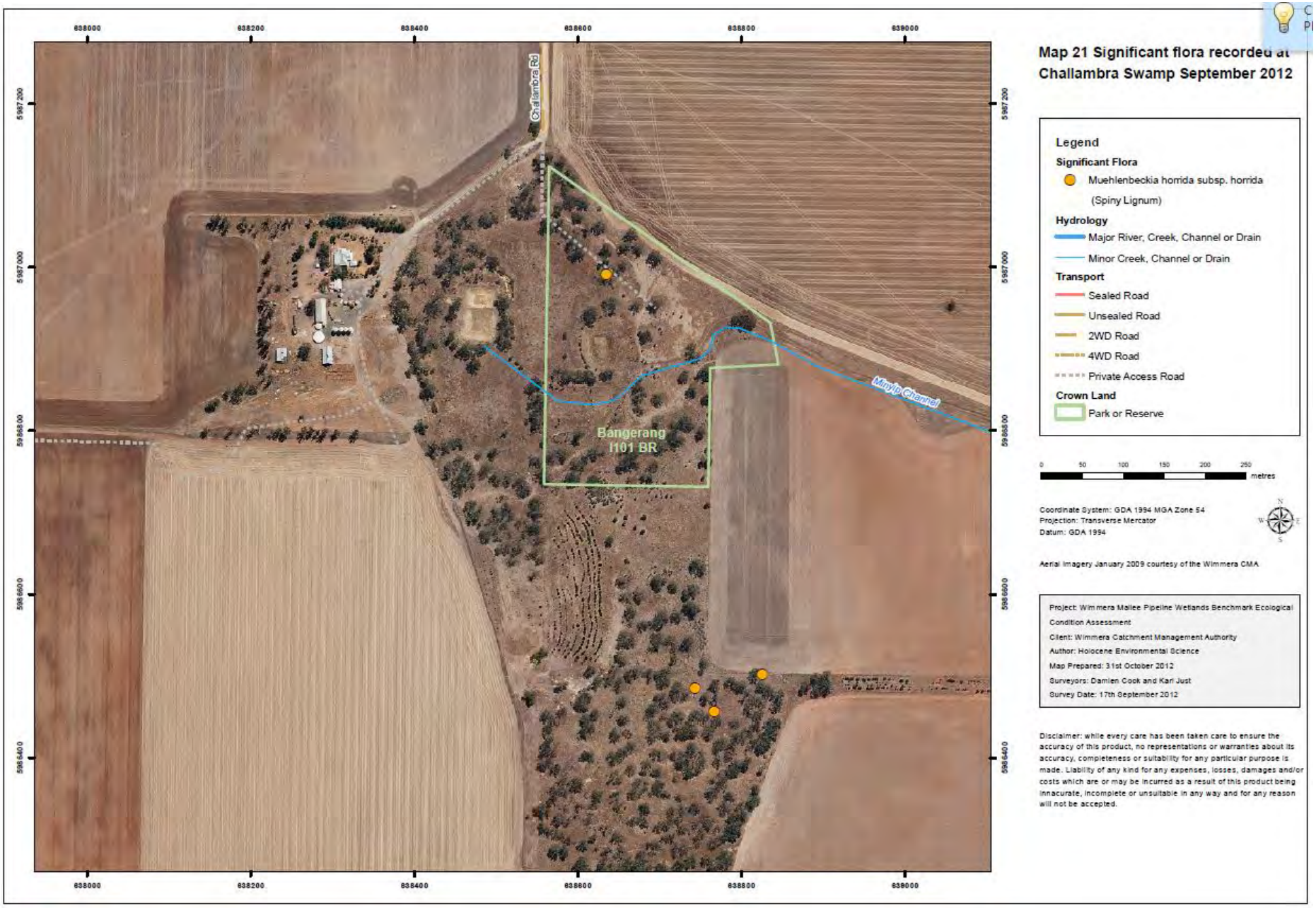
638000
638200
638400
638600
638800
639000
5987200
5987000
5986800
5986600
5986400
Challambra Rd
Minyip Channel
Bangerang
I101 BR
Map 21 Significant flora recorded at
Challambra Swamp September 2012
Legend
Significant Flora
Muehlenbeckia horrida subsp. horrida
(Spiny Lignum)
Hydrology
Major River, Creek, Channel or Drain
Minor Creek, Channel or Drain
Transport
Sealed Road
Unsealed Road
2WD Road
4WD Road
Private Access Road
Crown Land
Park or Reserve
0 50 100 150 200 250
metres
Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994
N
W
E
S
Aerial Imagery January 2009 courtesy of the Wimmera CMA
Project: Wimmera Mallee Pipeline Wetlands Benchmark Ecological Condition Assessment
Client: Wimmera Catchment Management Authority
Author: Holocene Environmental Science
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Survey Date: 17th September 2012
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688400
688600
688800
5944800
5944600
5944400
Crows Tank Channel
Crow Swamp (Phillips Dam) WR
Map 22 Significant flora recorded at Crow Swamp September 2012
Legend
Significant Flora
Muehlenbeckia horrida subsp. horrida (Spiny Lignum)
Hydrology
Major River, Creek, Channel or Drain
Minor Creek, Channel or Drain
Transport
Sealed Road
Unsealed Road
2WD Road
4WD Road
Private Access Road
Crown Land
Park or Reserve
0 20 40 60 80 100 120 140
metres
Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994
N
W
E
S
Aerial Imagery February 2010 courtesy of the Wimmera CMA
Project: Wimmera Mallee Pipeline Wetlands Benchmark Ecological Condition Assessment
Client: Wimmera Catchment Management Authority
Author: Holocene Environmental Science
Map Prepared: 31st October 2012
Surveyors: Damien Cook and Karl Just
Survey Date: 12th September 2012
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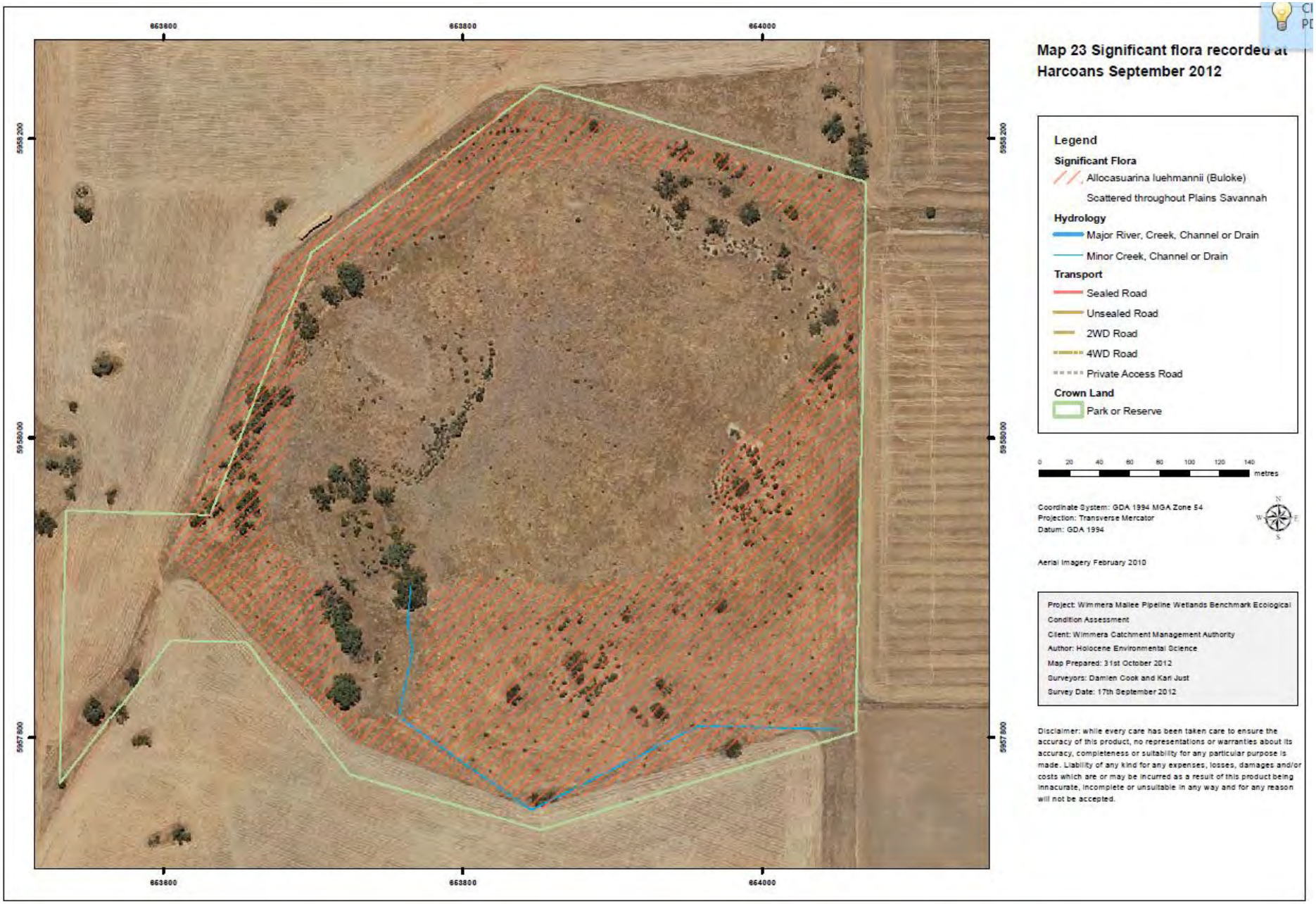
863800
863800
864000
5958200
5958000
5957800
Map 23 Significant flora recorded at Harcoans September 2012
Legend
Significant Flora
Allocasuarina luehmannii (Buloke)
Scattered throughout Plains Savannah
Hydrology
Major River, Creek, Channel or Drain
Minor Creek, Channel or Drain
Transport
Sealed Road
Unsealed Road
2WD Road
4WD Road
Private Access Road
Crown Land
Park or Reserve
0 20 40 60 80 100 120 140
metres
Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994
N
W
E
S
Aerial Imagery February 2010
Project: Wimmera Mallee Pipeline Wetlands Benchmark Ecological Condition Assessment
Client: Wimmera Catchment Management Authority
Author: Holocene Environmental Science
Map Prepared: 31st October 2012
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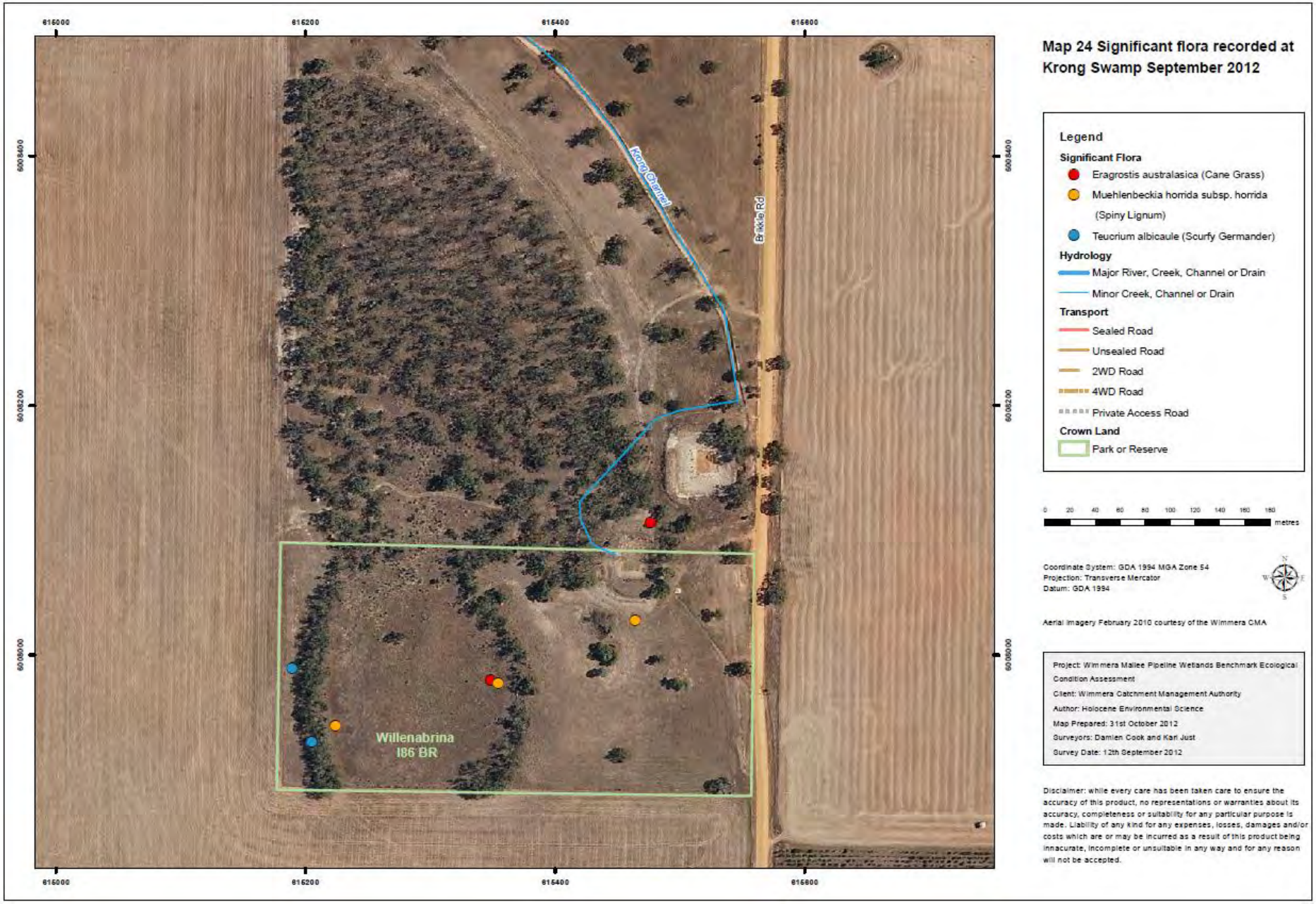
616000
616200
616400
616600
6006400
6006200
6006000
Krong Channel
Brickle Rd
Willenabrina
I86 BR
Map 24 Significant flora recorded at Krong Swamp September 2012
Legend
Significant Flora
Eragrostis australasica (Cane Grass)
Muehlenbeckia horrida subsp. horrida (Spiny Lignum)
Teucrium albicaule (Scurfy Germander)
Hydrology
Major River, Creek, Channel or Drain
Minor Creek, Channel or Drain
Transport
Sealed Road
Unsealed Road
2WD Road
4WD Road
Private Access Road
Crown Land
Park or Reserve
0 20 40 60 80 100 120 140 160 180
metres
Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994
N
W
E
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Aerial Imagery February 2010 courtesy of the Wimmera CMA
Project: Wimmera Mallee Pipeline Wetlands Benchmark Ecological Condition Assessment
Client: Wimmera Catchment Management Authority
Author: Holocene Environmental Science
Map Prepared: 31st October 2012
Surveyors: Damien Cook and Kari Just
Survey Date: 12th September 2012
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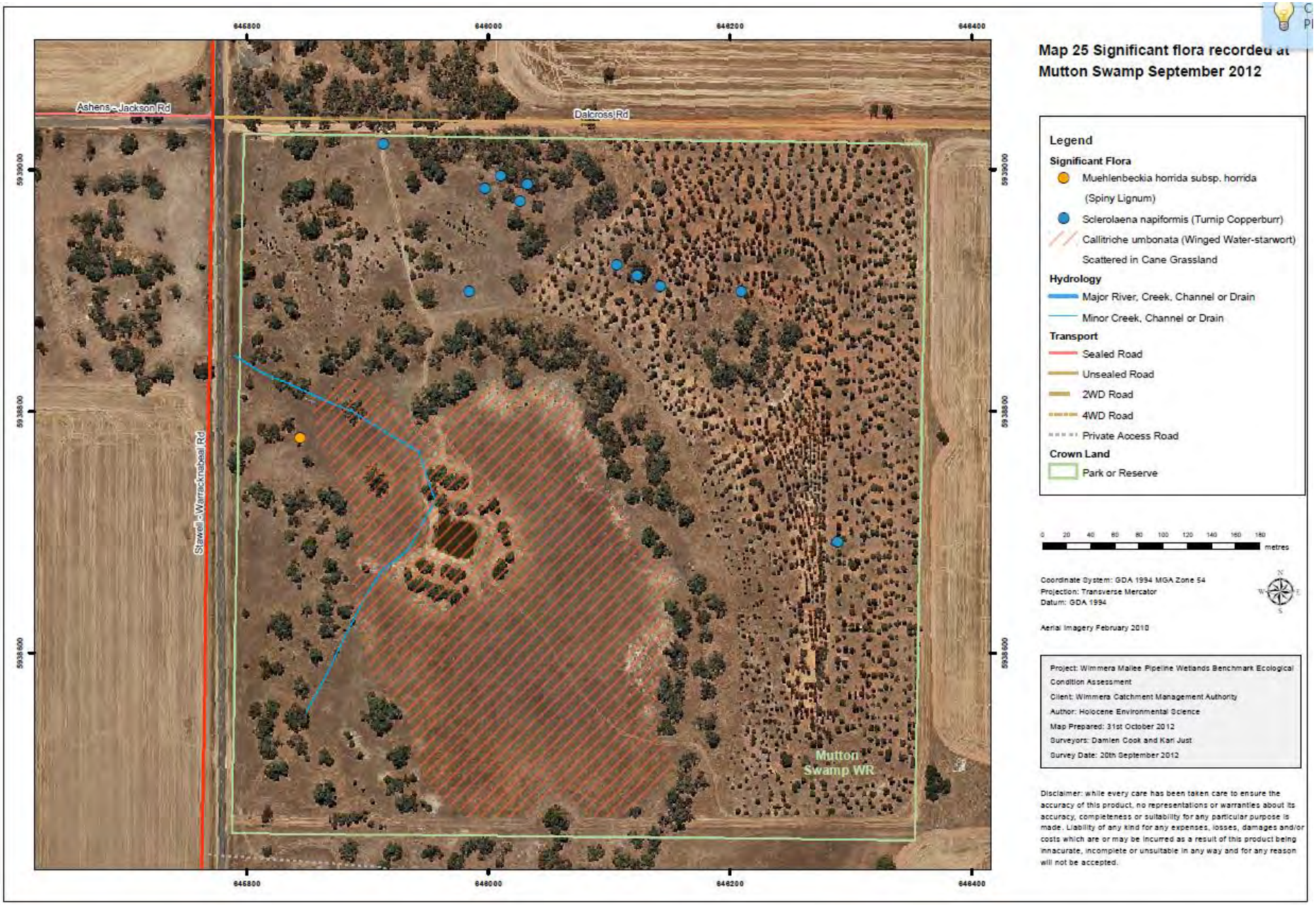
646800
646000
646200
646400
Ashens - Jackson Rd
Dalcross Rd
Stawell - Warracknabeal Rd
5939000
5938800
5938600
Mutton Swamp WR
Map 25 Significant flora recorded at Mutton Swamp September 2012
Legend
Significant Flora
Muehlenbeckia horrida subsp. horrida (Spiny Lignum)
Sclerolaena napiformis (Turnip Copperburr)
Callitriche umbonata (Winged Water-starwort)
Scattered in Cane Grassland
Hydrology
Major River, Creek, Channel or Drain
Minor Creek, Channel or Drain
Transport
Sealed Road
Unsealed Road
2WD Road
4WD Road
Private Access Road
Crown Land
Park or Reserve
0 20 40 60 80 100 120 140 160 180
metres
Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994
Aerial Imagery February 2010
Project: Wimmera Mallee Pipeline Wetlands Benchmark Ecological Condition Assessment
Client: Wimmera Catchment Management Authority
Author: Holocene Environmental Science
Map Prepared: 31st October 2012
Surveyors: Damien Cook and Kari Just
Survey Date: 20th September 2012
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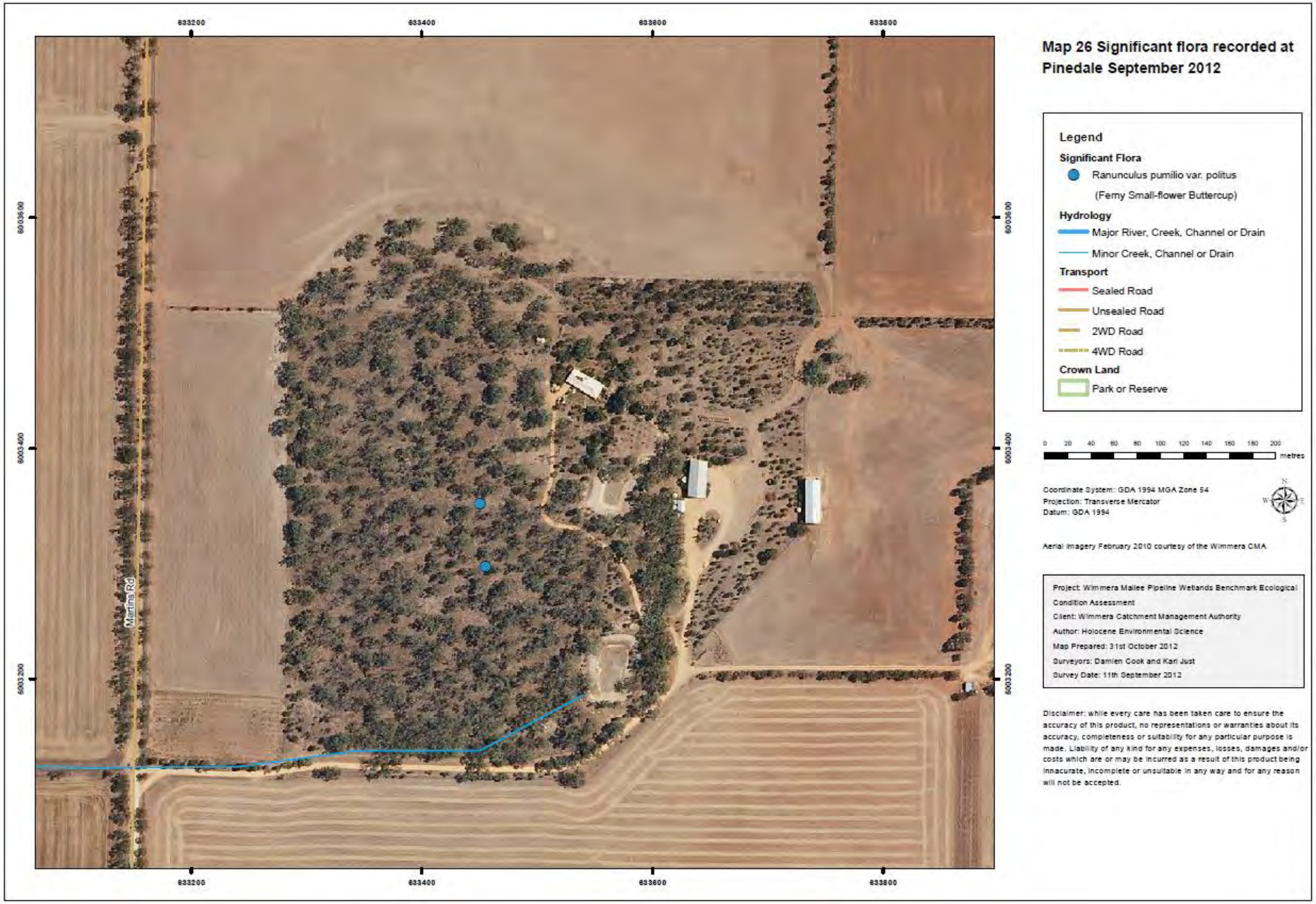
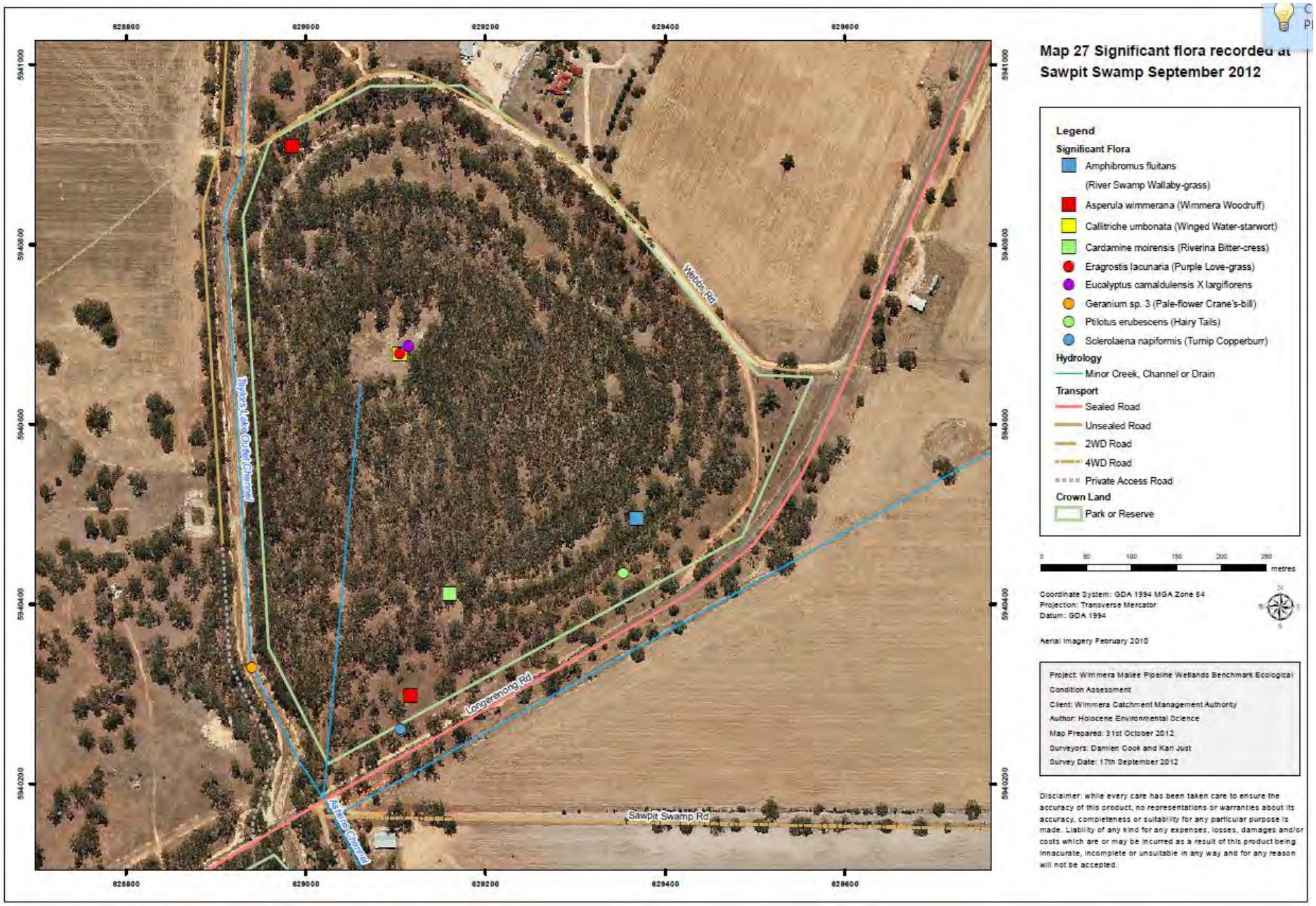
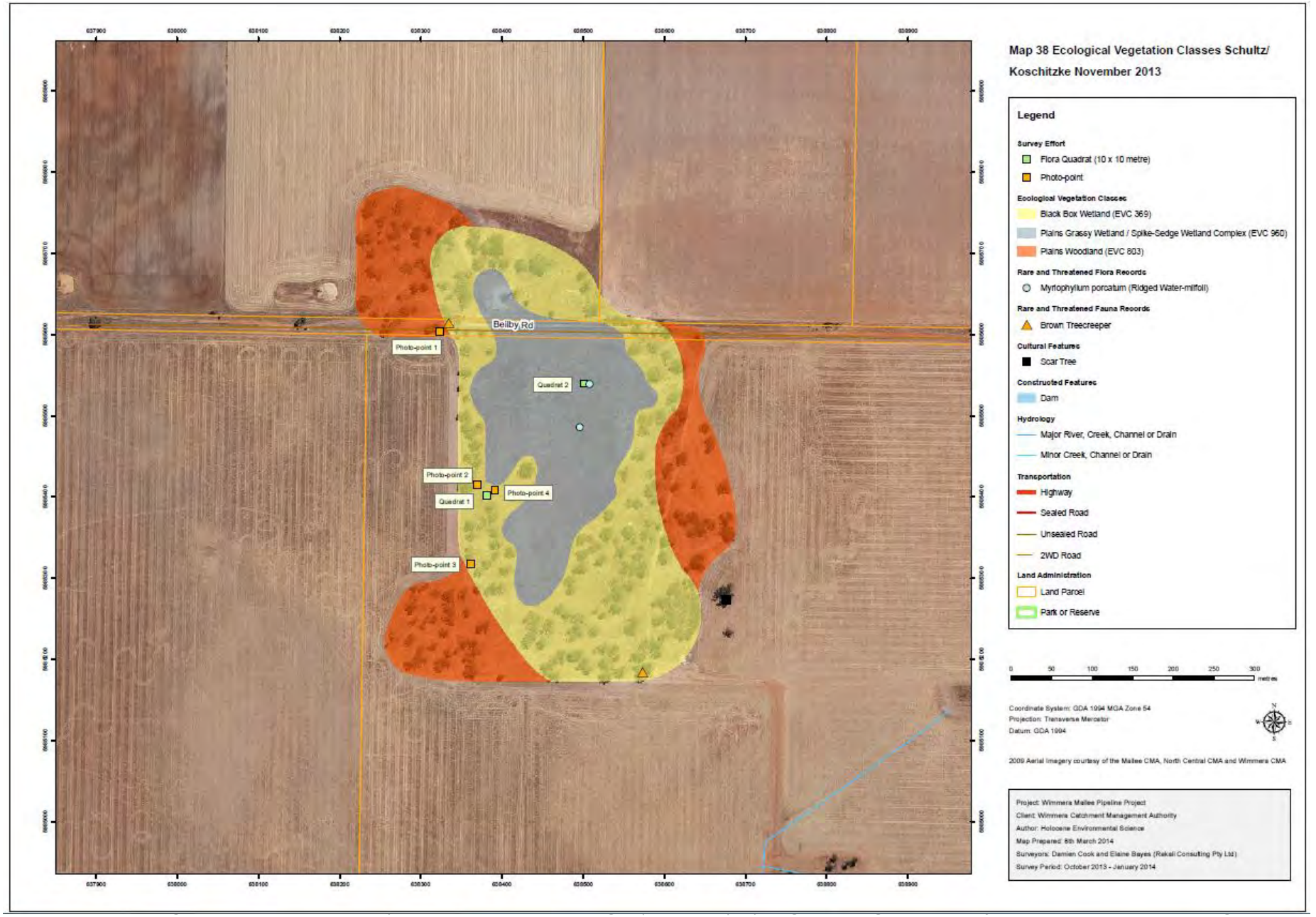
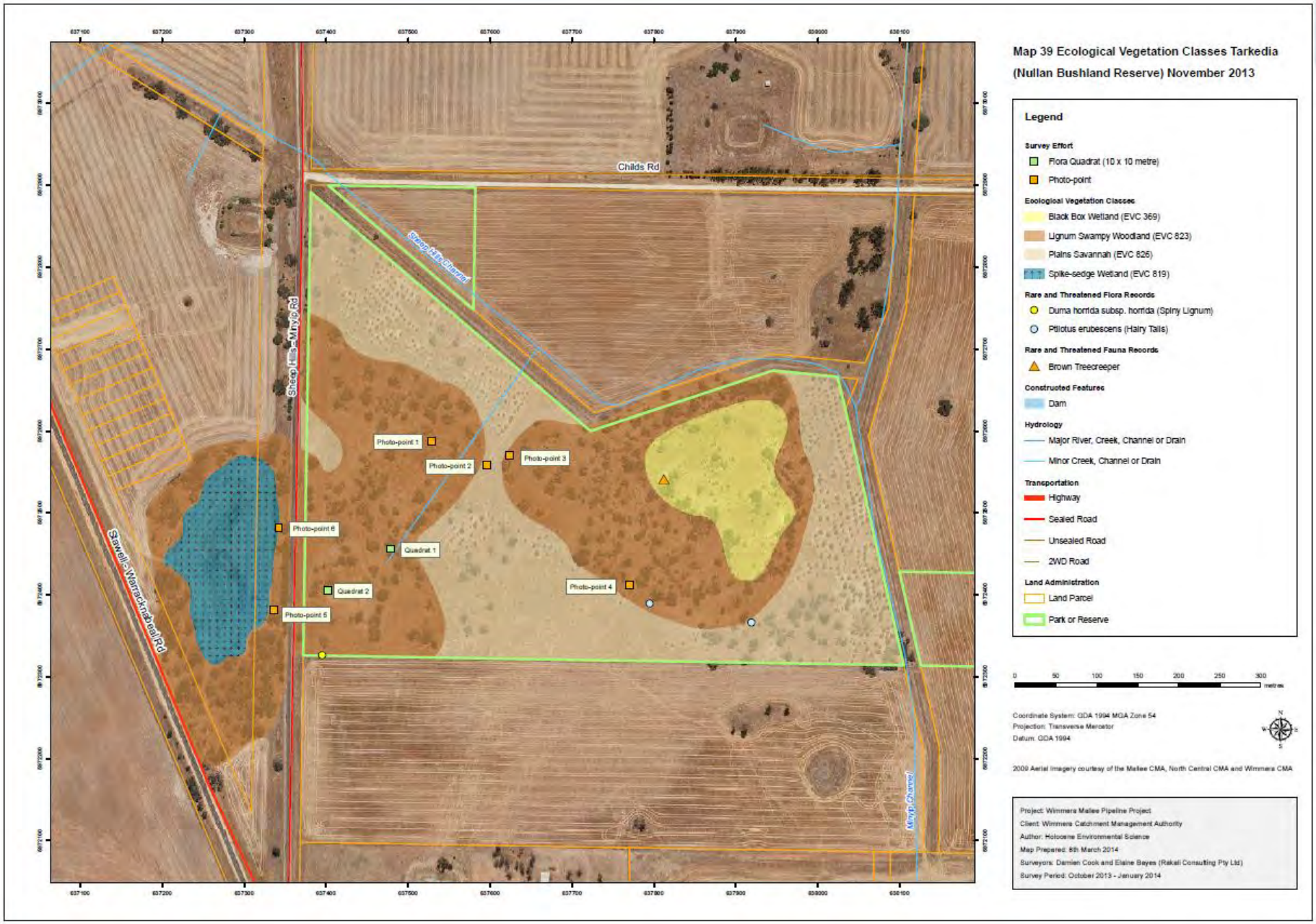
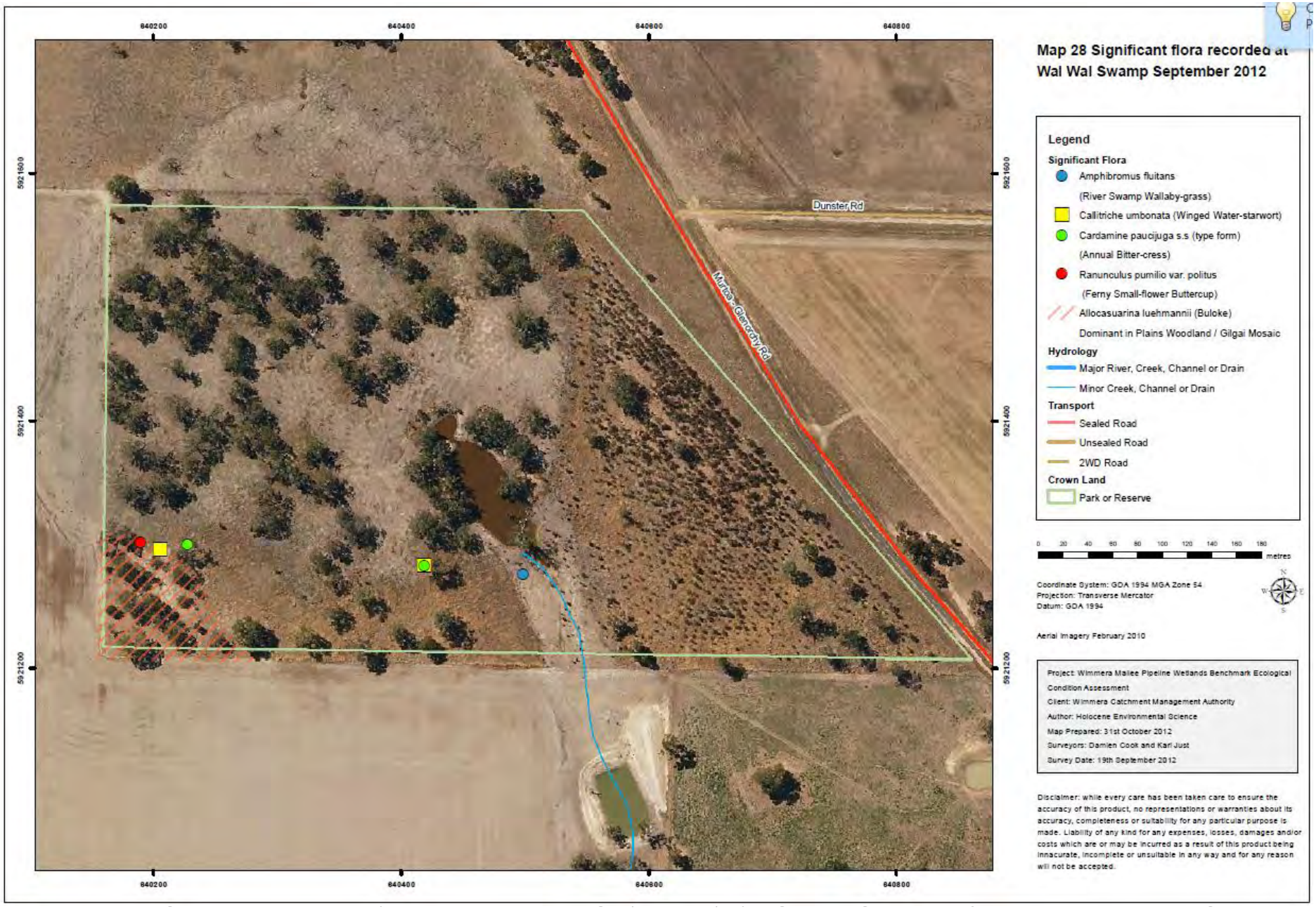

633200
633400
633600
633800
6003600
6003400
6003200
Martins Rd
Map 26 Significant flora recorded at Pinedale September 2012
Legend
Significant Flora
Ranunculus pumilio var. politus
(Ferny Small-flower Buttercup)
Hydrology
Major River, Creek, Channel or Drain
Minor Creek, Channel or Drain
Transport
Sealed Road
Unsealed Road
2WD Road
4WD Road
Crown Land
Park or Reserve
0 20 40 60 80 100 120 140 160 180 200
metres
Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994
N
W
E
S
Aerial imagery February 2010 courtesy of the Wimmera CMA
Project: Wimmera Mallee Pipeline Wetlands Benchmark Ecological Condition Assessment
Client: Wimmera Catchment Management Authority
Author: Holocene Environmental Science
Map Prepared: 31st October 2012
Surveyors: Damien Cook and Karl Just
Survey Date: 11th September 2012
Disclaimer: while every care has been taken care to ensure the accuracy of this product, no representations or warranties about its accuracy, completeness or suitability for any particular purpose is made. Liability of any kind for any expenses, losses, damages and/or costs which are or may be incurred as a result of this product being innacurate, incomplete or unsuitable in any way and for any reason will not be accepted.


828800
829000
829200
829400
829600
5941000
5940800
5940600
5940400
5940200
Webbs Rd
Taylors Lake Outlet Channel
Longerenong Rd
Ashens Channel
Sawpit Swamp Rd
Map 27 Significant flora recorded at Sawpit Swamp September 2012
Legend
Significant Flora
Amphibromus fluitans
(River Swamp Wallaby-grass)
Asperula wimmerana (Wimmera Woodruff)
Callitriche umbonata (Winged Water-starwort)
Cardamine moirensis (Riverina Bitter-cress)
Eragrostis lacunaria (Purple Love-grass)
Eucalyptus camaldulensis X largiflorens
Geranium sp. 3 (Pale-flower Crane's-bill)
Ptilotus erubescens (Hairy Tails)
Sclerolaena napiformis (Turnip Copperburr)
Hydrology
Minor Creek, Channel or Drain
Transport
Sealed Road
Unsealed Road
2WD Road
4WD Road
Private Access Road
Crown Land
Park or Reserve
0 50 100 150 200 250
metres
Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994
Aerial Imagery February 2010
Project: Wimmera Mallee Pipeline Wetlands Benchmark Ecological Condition Assessment
Client: Wimmera Catchment Management Authority
Author: Holocene Environmental Science
Map Prepared: 31st October 2012
Surveyors: Damien Cook and Kari Just
Survey Date: 17th September 2012
Disclaimer: while every care has been taken care to ensure the accuracy of this product, no representations or warranties about its accuracy, completeness or suitability for any particular purpose is made. Liability of any kind for any expenses, losses, damages and/or costs which are or may be incurred as a result of this product being innacurate, incomplete or unsuitable in any way and for any reason will not be accepted.


Map 38 Ecological Vegetation Classes Schultz/ Koschitzke November 2013
Legend
Survey Effort
Flora Quadrat (10 x 10 metre)
Photo-point
Ecological Vegetation Classes
Black Box Wetland (EVC 369)
Plains Grassy Wetland / Spike-Sedge Wetland Complex (EVC 960)
Plains Woodland (EVC 803)
Rare and Threatened Flora Records
Myriophyllum porcatum (Ridged Water-milfoil)
Rare and Threatened Fauna Records
Brown Treecreeper
Cultural Features
Scar Tree
Constructed Features
Dam
Hydrology
Major River, Creek, Channel or Drain
Minor Creek, Channel or Drain
Transportation
Highway
Sealed Road
Unsealed Road
2WD Road
Land Administration
Land Parcel
Park or Reserve
Bellby Rd
Photo-point 1
Quadrat 2
Photo-point 2
Photo-point 4
Quadrat 1
Photo-point 3
0 50 100 150 200 250 300 metres
Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994
2009 Aerial Imagery courtesy of the Mallee CMA, North Central CMA and Wimmera CMA
Project: Wimmera Mallee Pipeline Project
Client: Wimmera Catchment Management Authority
Author: Holocene Environmental Science
Map Prepared: 6th March 2014
Surveyors: Damien Cook and Elaine Bayes (Rekali Consulting Pty Ltd)
Survey Period: October 2013 - January 2014


Childs Rd
Sheep Hills Channel
Sheep Hills-Minyip Rd
Sawells-Warracknabeal Rd
Minyip Channel
Photo-point 1
Photo-point 2
Photo-point 3
Photo-point 4
Photo-point 5
Photo-point 6
Quadrat 1
Quadrat 2
Map 39 Ecological Vegetation Classes Tarkedia
(Nullan Bushland Reserve) November 2013
Legend
Survey Effort
Flora Quadrat (10 x 10 metre)
Photo-point
Ecological Vegetation Classes
Black Box Wetland (EVC 369)
Lignum Swampy Woodland (EVC 823)
Plains Savannah (EVC 826)
Spike-sedge Wetland (EVC 819)
Rare and Threatened Flora Records
Duma horrida subsp. horrida (Spiny Lignum)
Ptilotus erubescens (Hairy Tails)
Rare and Threatened Fauna Records
Brown Treecreeper
Constructed Features
Dam
Hydrology
Major River, Creek, Channel or Drain
Minor Creek, Channel or Drain
Transportation
Highway
Sealed Road
Unsealed Road
2WD Road
Land Administration
Land Parcel
Park or Reserve
0 50 100 150 200 250 300 metres
Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994
2009 Aerial Imagery courtesy of the Mallee CMA, North Central CMA and Wimmera CMA
Project: Wimmera Mallee Pipeline Project
Client: Wimmera Catchment Management Authority
Author: Holocene Environmental Science
Map Prepared: 8th March 2014
Surveyors: Damien Cook and Elaine Bayes (Rakali Consulting Pty Ltd)
Survey Period: October 2013 - January 2014


840200
840400
840600
840800
5921600
5921400
5921200
Dunster Rd
Murtoa - Glenorchy Rd
Map 28 Significant flora recorded at Wal Wal Swamp September 2012
Legend
Significant Flora
Amphibromus fluitans
(River Swamp Wallaby-grass)
Callitriche umbonata (Winged Water-starwort)
Cardamine paucijuga s.s (type form)
(Annual Bitter-cress)
Ranunculus pumilio var. politus
(Ferny Small-flower Buttercup)
Allocasuarina luehmannii (Buloke)
Dominant in Plains Woodland / Gilgai Mosaic
Hydrology
Major River, Creek, Channel or Drain
Minor Creek, Channel or Drain
Transport
Sealed Road
Unsealed Road
2WD Road
Crown Land
Park or Reserve
0 20 40 60 80 100 120 140 160 180
metres
Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994
Aerial Imagery February 2010
Project: Wimmera Mallee Pipeline Wetlands Benchmark Ecological Condition Assessment
Client: Wimmera Catchment Management Authority
Author: Holocene Environmental Science
Map Prepared: 31st October 2012
Surveyors: Damien Cook and Karl Just
Survey Date: 19th September 2012
Disclaimer: while every care has been taken care to ensure the accuracy of this product, no representations or warranties about its accuracy, completeness or suitability for any particular purpose is made. Liability of any kind for any expenses, losses, damages and/or costs which are or may be incurred as a result of this product being innacurate, incomplete or unsuitable in any way and for any reason will not be accepted.

Appendix 2 – Fauna Species List

Information is from Australian Ecosystems (2013) and Rakali Consulting (2014) apart from where specified. Wetland species are highlighted in green – species like Welcome Swallow, Tree Martin and Fairy Martin – whilst not strictly wetland species will benefit from weltand water (Rakali Consulting, 2014).

Carapugna

FFG	EPBC	VROTS	Origin	Common Name	Scientific Name
				Birds	
				Australian Magpie	*Gymnorhina tibicen*
				Australian Owlet-nightjar	*Aegotheles cristatus*
				Australian Raven	*Corvus coronoides*
				Australian Wood Duck	*Chenonetta jubata*
				Black Kite	*Milvus migrans*
				Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
				Black-tailed Native-hen	*Gallinula ventralis*
				Blue Bonnet	*Northiella haematogaster*
				Brown Falcon	*Falco berigora*
				Brown Treecreeper (south-eastern ssp.)	*Climacteris picumnus victoriae*
				Cockatiel	*Nymphicus hollandicus*
				Common Bronzewing	*Phaps chalcoptera*
				Crested Pigeon	*Ocyphaps lophotes*
				Eastern Rosella	*Platycercus eximius*
				Fairy Martin	*Hirundo ariel*
				Galah	*Eolophus roseicapilla*
		v		Hardhead	*Aythya australis*
f		n		Hooded Robin	*Melanodryas cucullata*
				Jacky Winter	*Microeca fascinans*
				Laughing Kookaburra	*Dacelo novaeguineae*
				Little Pied Cormorant	*Microcarbo melanoleucos*
				Magpie-lark	*Grallina cyanoleuca*
				Mistletoebird	*Dicaeum hirundinaceum*
				Noisy Miner	*Manorina melanocephala*
				Pacific Barn Owl	*Tyto javanica*
				Pallid Cuckoo	*Cuculus pallidus*
				Red-rumped Parrot	*Psephotus haematonotus*
				Restless Flycatcher	*Myiagra inquieta*
				Rufous Songlark	*Cincloramphus mathewsi*
				Singing Honeyeater	*Lichenostomus virescens*
				Southern Whiteface	*Aphelocephala leucopsis*
				Striated Pardalote	*Pardalotus striatus*
				Tree Martin	*Hirundo nigricans*
				Welcome Swallow	*Hirundo neoxena*
				White-plumed Honeyeater	*Lichenostomus penicillatus*
				White-winged Chough	*Corcorax melanorhamphos*
				White-winged Triller	*Lalage sueurii*

FFG	EPBC	VROTS	Origin	Common Name	Scientific Name
				Willie Wagtail	*Rhipidura leucophrys*
				Frogs	
				Spotted Marsh-frog	*Limnodynastes tasmaniensis*
				Invertebrates	
				Common Grass Blue	*Zizina labradus*
				Saltbush Blue	*Theclinesthes serpentata*
				Mammals	
				Brush-tail Possum	*Trichosurus vulpecula*
			*	European Rabbit	*Oryctolagus cuniculus*
			*	Red Fox	*Vulpes vulpes*
				White-striped Free-tail Bat	*Tadarida australis*
				Reptiles	
				Boulenger's Skink	*Morethia boulengeri*

Challambra

FFG	EPBC	VROTS	Origin	Common Name	Scientific Name
				Birds	
				Australasian Grebe	*Tachybaptus novaehollandiae*
				Australian Magpie	*Gymnorhina tibicen*
				Australian Owlet-nightjar	*Aegotheles cristatus*
				Australian Raven	*Corvus coronoides*
				Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
				Black-fronted Dotterel	*Elseyornis melanops*
				Blue Bonnet	*Northiella haematogaster*
				Brown Songlark	*Cincloramphus cruralis*
				Brown Treecreeper (south-eastern ssp.)	*Climacteris picumnus victoriae*
			*	Common Starling	*Sturnus vulgaris*
				Crested Pigeon	*Ocyphaps lophotes*
				Eastern Rosella	*Platycercus eximius*
				Galah	*Eolophus roseicapilla*
				Grey Teal	*Anas gracilis*
				Horsfield's Bronze Cuckoo	*Chrysococcyx basalis*
			*	House Sparrow	*Passer domesticus*
				Jacky Winter	*Microeca fascinans*
				Laughing Kookaburra	*Dacelo novaeguineae*
				Magpie-lark	*Grallina cyanoleuca*
				Noisy Miner	*Manorina melanocephala*
				Pacific Black Duck	*Anas superciliosa*
				Pied Butcherbird	*Cracticus nigrogularis*
				Red-rumped Parrot	*Psephotus haematonotus*
				Rufous Songlark	*Cincloramphus mathewsi*
				Rufous Whistler	*Pachycephala rufiventris*
				Spur-wing Plover	*Vanellus spinosus*
				Striated Pardalote	*Pardalotus striatus*
				Welcome Swallow	*Hirundo neoxena*

FFG	EPBC	VROTS	Origin	Common Name	Scientific Name
				White-plumed Honeyeater	*Lichenostomus penicillatus*
				White-winged Triller	*Lalage sueurii*
				Willie Wagtail	*Rhipidura leucophrys*
				Mammals	
				Common Brushtail Possum	*Trichosurus vulpecula*
			*	European Rabbit	*Oryctolagus cuniculus*

Crow Swamp

FFG	EPBC	VROTS	Origin	Common Name	Scientific Name
				Birds	
				Australian Magpie	*Gymnorhina tibicen*
				Magpie-lark	*Grallina cyanoleuca*
				Noisy Miner	*Manorina melanocephala*
				Red-rumped Parrot	*Psephotus haematonotus*
				Rufous Songlark	*Cincloramphus mathewsi*
				Striated Pardalote	*Pardalotus striatus*
				Blue Bonnet	*Northiella haematogaster*
				Nankeen Kestrel	*Falco cenchroides*
				Galah	*Eolophus roseicapilla*
			*	House Sparrow	*Passer domesticus*
				Crested Pigeon	*Ocyphaps lophotes*
				Dusky Woodswallow	*Artamus cyanopterus*
				Stubble Quail	*Coturnix pectoralis*
				Willie Wagtail	*Rhipidura leucophrys*
				Mammals	
			*	European Rabbit	*Oryctolagus cuniculus*

Fielding's Dam

FFG	EPBC	VROTS	Origin	Common Name	Scientific Name
				Birds	
				Red-rumped Parrot	Psephotus haematonotus
				Rufous Whistler	Pachycephala rufiventris*
				Satin Flycatcher	Myiagra cyanoleucaz*
				Shining Bronze Cuckoo	Chrysococcyx lucidus*
				Southern Whiteface	Aphelocephala leucopsis*
				Spotted Pardalote	Pardalotus punctatus*
				Striated Pardalote	Pardalotus striatus
				Wedge-tailed Eagle	Aquila audax*
				Welcome Swallow	Hirundo neoxena
				White-browed Woodswallow	Artamus superciliosus
				White-faced Heron	Egretta novaehollandiae*
				White-plumed Honeyeater	Lichenostomus penicillatus*
				White-throated Needletail	Hirundapus caudacutus*
				White-winged Chough	Corcorax melanorhamphos*
				Willie Wagtail	Rhipidura leucophrys

				Yellow-rumped Thornbill	Acanthiza chrysorrhoa*
				Reptiles	
				Garden Skink	Lampropholis guichenoti*
		e		Lace Monitor	Varanus varius*
				Marbled Gecko	Phyllodactylus marmoratus*
				Stumpy-tailed Lizard	Trachydosurus rugosus*
				Mammals	
				Eastern Grey Kangaroo	Macropus giganteus*

** Observed by Draper et al. (2006)*

Harcoans Swamp

FFG	EPBC	VROTS	Origin	Common Name	Scientific Name
				Birds	
				Australian Magpie	Gymnorhina tibicen
				Australian Raven	Corvus coronoides
				Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
				Black-shouldered Kite	*Elanus axillaris*
				Blue Bonnet	*Northiella haematogaster*
				Brown Falcon	*Falco berigora*
				Chestnut-rumped Thornbill	*Acanthiza uropygialis*
				Galah	*Eolophus roseicapilla*
				Grey Fantail	*Rhipidura albiscarpa*
				Magpie-lark	*Grallina cyanoleuca*
				Noisy Miner	*Manorina melanocephala*
				Pallid Cuckoo	*Cuculus pallidus*
				Red-rumped Parrot	*Psephotus haematonotus*
				Rufous Songlark	*Cincloramphus mathewsi*
				Striated Pardalote	*Pardalotus striatus*
				Weebill	*Smicrornis brevirostris*
				Willie Wagtail	*Rhipidura leucophrys*
				Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*
				Invertebrates	
				Common Grass Blue	*Zizina labradus*
				Reptiles	
				Olive Legless Lizard (dec.)	*Delma iinornata*

Krong Swamp

FFG	EPBC	VROTS	Origin	Common Name	Scientific Name
				Birds	
				Australian Magpie	*Gymnorhina tibicen*
				Australian Raven	*Corvus coronoides*
		v		Black Falcon	*Falco subniger*
				Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
				Brown Treecreeper (south-eastern ssp.)	*Climacteris picumnus victoriae*
				Crested Pigeon	*Ocyphaps lophotes*

FFG	EPBC	VROTS	Origin	Common Name	Scientific Name
				Galah	*Eolophus roseicapilla*
				Noisy Miner	*Manorina melanocephala*
				Pallid Cuckoo	*Cuculus pallidus*
				Red-capped Robin	*Petroica goodenovii*
				Red-rumped Parrot	*Psephotus haematonotus*
				Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*
				Striated Pardalote	*Pardalotus striatus*
				Welcome Swallow	*Hirundo neoxena*
				White-plumed Honeyeater	*Lichenostomus penicillatus*
				White-winged Fairywren	*Malurus leucopterus*
				Willie Wagtail	*Rhipidura leucophrys*
				Invertebrates	
				Cabbage White	*Pieris brassicae*
				Common Grass Blue	*Zizina labradus*
				Meadow Argus	*Junonia villida*
				Painted Lady	*Vanessa cardui*
				Saltbush Blue	*Theclinesthes serpentinata*
				Mammals	
				Common Brushtail Possum	*Trichosurus vulpecula*
				Eastern Grey Kangaroo	*Macropus giganteus*
			*	European Hare	*Lepus europeaus*
			*	European Rabbit	*Oryctolagus cuniculus*

Mutton Swamp

FFG	EPBC	VROTS	Origin	Common Name	Scientific Name
				Birds	
				Australian Magpie	*Gymnorhina tibicen*
				Australian Owlet-nightjar	*Aegotheles cristatus*
				Australian Raven	*Corvus coronoides*
				Australian Shelduck	*Tadorna tadornoides*
				Black-fronted Dotterel	*Elseyornis melanops*
				Brown Falcon	*Falco berigora*
				Brown Treecreeper (south-eastern ssp.)	*Climacteris picumnus victoriae*
				Eastern Rosella	*Platycercus eximius*
				Fairy Martin	*Hirundo ariel*
				Galah	*Eolophus roseicapilla*
				Grey Shrike-thrush	*Colluricincla harmonica*
				Grey Teal	*Anas gracilis*
				Horsfield's Bronze Cuckoo	*Chrysococcyx basalis*
				Laughing Kookaburra	*Dacelo novaeguineae*
				Little Lorikeet	*Glossopsitta pusilla*
				Musk Lorikeet	*Glossopsitta concinna*
				Pacific Black Duck	*Anas superciliosa*
				Pied Butcherbird	*Cracticus nigrogularis*
				Rufous Songlark	*Cincloramphus mathewsi*

FFG	EPBC	VROTS	Origin	Common Name	Scientific Name
				Striated Pardalote	*Pardalotus striatus*
				Stubble Quail	*Coturnix pectoralis*
				Welcome Swallow	*Hirundo neoxena*
				White-necked Heron	*Ardea pacifica*
				White-plumed Honeyeater	*Lichenostomus penicillatus*
				Willie Wagtail	*Rhipidura leucophrys*
				Frogs	
				Common Froglet	*Crinia signifera*
				Plains Froglet	*Crinia parinsignifera*
				Pobblebonk	*Limnodynastes dumerili*
				Spotted Marsh Frog	*Limnodynastes tasmaniensis*
				Mammals	
				Common Brushtail Possum	*Trichosurus vulpecula*
				Eastern Grey Kangaroo	*Macropus giganteus*
				Reptiles	
				Boulenger's Skink	*Morethia boulengeri*
				Olive Legless Lizard	*Delma inornata*
				Stumpy-tailed Lizard	*Tiliqua rugosa*

Opie's Dam

FFG	EPBC	VROTS	Origin	Common Name	Scientific Name
				Frogs	
VU	*L*	*e*		*Growling Grass Frog ***	Litoria raniformis
				Reptiles	
		d		*Eastern Long-necked Turtle*	Chelodina longicollis

*** Evelyn Nicholson, DELWP, pers. comm*

Pinedale

FFG	EPBC	VROTS	Origin	Common Name	Scientific Name
				Birds	
				Australian Magpie	*Gymnorhina tibicen*
				Australian Owlet-nightjar	*Aegotheles cristatus*
				Australian Raven	*Corvus coronoides*
				Australian Wood Duck	*Chenonetta jubata*
				Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
				Brown Falcon	*Falco berigora*
				Brown Treecreeper (south-eastern ssp.)	*Climacteris picumnus victoriae*
			*	Common Starling	*Sturnus vulgaris*
				Crested Pigeon	*Ocyphaps lophotes*
				Eastern Rosella	*Platycercus eximius*
				Fairy Martin	*Hirundo ariel*
				Galah	*Eolophus roseicapilla*
				Laughing Kookaburra	*Dacelo novaeguineae*
				Magpie-lark	*Grallina cyanoleuca*

FFG	EPBC	VROTS	Origin	Common Name	Scientific Name
				Noisy Miner	*Manorina melanocephala*
				Red Wattlebird	*Anthochaera carunculata*
				Red-rumped Parrot	*Psephotus haematonotus*
				Singing Honeyeater	*Lichenostomus virescens*
				Striated Pardalote	*Pardalotus striatus*
				Welcome Swallow	*Hirundo neoxena*
				White-plumed Honeyeater	*Lichenostomus penicillatus*
				Willie Wagtail	*Rhipidura leucophrys*
				Frogs	
				Common Froglet	*Crinia signifera*
				Invertebrates	
				Common Grass Blue	*Zizina labradus*
				Saltbush Blue	*Theclinesthes serpentata*
				Mammals	
				Brush-tail Possum	*Trichosurus vulpecula*
			*	European Rabbit	*Oryctolagus cuniculus*
			*	Red Fox	*Vulpes vulpes*

Sawpit Swamp

FFG	EPBC	VROTS	Origin	Common Name	Scientific Name
				Birds	
				Australian Magpie	*Gymnorhina tibicen*
				Australian Owlet-nightjar	*Aegotheles cristatus*
				Australian Raven	*Corvus coronoides*
		n		Black-chinned Honeyeater	*Melithreptus gularis*
				Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
				Brown Treecreeper (south-eastern ssp.)	*Climacteris picumnus victoriae*
				Eastern Rosella	*Platycercus eximius*
				Fairy Martin	*Hirundo ariel*
				Grey Shrike-thrush	*Colluricincla harmonica*
				Laughing Kookaburra	*Dacelo novaeguineae*
				Long-billed Corella	*Cacatua tenuirostris*
				Magpie-lark	*Grallina cyanoleuca*
				Musk Lorikeet	*Glossopsitta concinna*
				New Holland Honeyeater	*Phylidonyris novaehollandiae*
				Noisy Miner	*Manorina melanocephala*
				Red Wattlebird	*Anthochaera carunculata*
				Red-rumped Parrot	*Psephotus haematonotus*
				Restless Flycatcher	*Myiagra inquieta*
				Rufous Songlark	*Cincloramphus mathewsi*
				Striated Pardalote	*Pardalotus striatus*
				White-plumed Honeyeater	*Lichenostomus penicillatus*
				Willie Wagtail	*Rhipidura leucophrys*
				Welcome Swallow	*Hirundo neoxena*
				Frogs	

FFG	EPBC	VROTS	Origin	Common Name	Scientific Name
				Common Froglet	*Crinia signifera*
				Plains Froglet	*Crinia parinsignifera*
				Mammals	
				Brush-tail Possum	*Trichosurus vulpecula*
			*	European Rabbit	*Oryctolagus cuniculus*
			*	Red Fox	*Vulpes vulpes*
				Reptiles	
				Boulenger's Skink	*Morethia boulengeri*
				Stumpy-tailed Lizard	*Tiliqua rugosa*

Schultz/Koschitzke

EPBC	FFG	VROTS	Origin	Common Name	Scientific Name
				Birds	
				Australian Magpie	*Cracticus tibicen*
				Black-shouldered Kite (BR)	*Elanus axillaris*
		v		Black Falcon	*Falco subniger*
				Blue Bonnet	*Northiella haematogaster*
				Brown Treecreeper	*Climacteris picumnus victoriae*
				Galah	*Eolophus roseicapillus*
				Red-rumped Parrot	*Psephotus haematonotus*
				Stubble Quail	*Coturnix pectoralis*
				Tree Martin	*Petrochelidon nigricans*
				White-fronted Chat	*Epthianura albifrons*
				White-browed Woodswallow	*Artamus superciliosus*
				Willie Wagtail	*Rhipidura leucophrys*
				White-winged Triller	*Lalage sueurii*

Tarkedia

EPBC	FFG	VROTS	Origin	Common Name	Scientific Name
				Birds	
				Australian Magpie	*Cracticus tibicen*
				Australian Raven	*Corvus coronoides*
				Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
				Blue Bonnet	*Northiella haematogaster*
				Brown Treecreeper	*Climacteris picumnus victoriae*
				Chestnut-rumped Thornbill	*Acanthiza uropygialis*
				Crested Pigeon	*Ocyphaps lophotes*
				Eastern Rosella	*Platycercus eximius*
				Jacky Winter	*Microeca fascinans*
				Laughing Kookaburra	*Dacelo novaeguineae*
				Pied Butcherbird	*Cracticus nigrogularis*
				Red-rumped Parrot	*Psephotus haematonotus*
				Rufous Songlark	*Cincloramphus mathewsi*
				Weebill	*Smicrornis brevirostris*

				Mammals	
				Western Grey Kangaroo	*Macropus fuliginosus*
			*	European Rabbit	*Oryctolagus cuniculus*
				Butterflies	
				Australian Painted Lady	*Vanessa kershawi*
				MeadowArgus	*Junonia villida calybe*
				Small Grass Yellow	*Eurema smilax*
				Common Grass Blue	*Zizina otis labradus*

Wal Wal Swamp

FFG	EPBC	VROTS	Origin	Common Name	Scientific Name
				Birds	
				Australian Magpie	*Gymnorhina tibicen*
				Australian Raven	*Corvus coronoides*
				Australian Wood Duck	*Chenonetta jubata*
				Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
				Black-fronted Dotterel	*Elseyornis melanops*
				Black-shouldered Kite	*Elanus axillaris*
				Brown Quail	*Coturnix ypsilophora*
			*	Common Starling	*Sturnus vulgaris*
f		v		Eastern Great Egret	*Ardea modesta*
				Eastern Rosella	*Platycercus eximius*
				Grey Shrike-thrush	*Colluricincla harmonica*
				Grey Teal	*Anas gracilis*
				Little Raven	*Corvus mellori*
				Long-billed Corella	*Cacatua tenuirostris*
				Musk Lorikeet	*Glossopsitta concinna*
				Noisy Miner	*Manorina melanocephala*
				Pacific Black Duck	*Anas superciliosa*
				Red-rumped Parrot	*Psephotus haematonotus*
				Rufous Songlark	*Cincloramphus mathewsi*
		n		Spotted Harrier	*Circus assimilis*
		n		Square-tailed Kite	*Lophoictinia isura*
				Striated Pardalote	*Pardalotus striatus*
				Sulphur-crested Cockatoo	*Cacatua galerita*
				Tree Martin	*Hirundo nigricans*
				Welcome Swallow	*Hirundo neoxena*
				White-plumed Honeyeater	*Lichenostomus penicillatus*
				Willie Wagtail	*Rhipidura leucophrys*
				Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*
				Frogs	
				Common Froglet	*Crinia signifera*
				Spotted Marsh Frog	*Limnodynastes tasmaniensis*
				Mammals	
				Eastern Grey Kangaroo	*Macropus giganteus*

Appendix 3 – Flora Species List

Information is from Australian Ecosystems (2013) and Rakali Consulting (2014). Wetland species are highlighted in green. # indicates indigenous species that may occur outside their natural range.

Carapugna

EVC 369 – Black Box Wetland

EVC 103 – Riverine Chenopod Woodland

EVC 862 – Plains Savannah

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 369	EVC 103	EVC 862
				Acacia oswaldii	Umbrella Wattle			x
				Actinobole uliginosum	Flannel Cudweed			x
f				*Allocasuarina luehmannii*	Buloke			x
			*	*Alopecurus aequalis*	Orange Fox-tail	x		
			*	*Alopecurus geniculatus*	Marsh Fox-tail	x		
				Alternanthera denticulata s.l.	Lesser Joyweed	x		
				Amphibromus nervosus	Common Swamp Wallaby-grass	x		
			*	*Amsinckia calycina*	Hairy Fiddle-neck	x		
		v		*Amyema linophylla subsp. orientale*	Buloke Mistletoe			x
				Amyema miquelii	Box Mistletoe	x		
				Aphanes australiana	Australian Piert	x		
			*	*Arctotheca calendula*	Cape Weed	x		
				Arthropodium fimbriatum	Nodding Chocolate-lily		x	x
				Arthropodium minus	Small Vanilla-lily			x
				Asperula conferta	Common Woodruff			x
				Atriplex leptocarpa	Slender-fruit Saltbush	x		x
				Atriplex semibaccata	Berry Saltbush	x	x	
				Atriplex suberecta	Sprawling Saltbush	x		
				Austrostipa blackii	Crested Spear-grass			x
				Austrostipa scabra subsp. falcata	Rough Spear-grass	x	x	
				Brachyscome lineariloba	Hard-head Daisy	x	x	x
			*	*Bromus diandrus*	Great Brome	x		
			*	*Bromus rubens*	Red Brome		x	x
				Calandrinia eremaea	Small Purslane	x	x	
		r		*Callitriche umbonata*	Winged Water-starwort	x		
				Calotis hispidula	Bogan Flea	x		
			*	*Capsella bursa-pastoris*	Shepherd's Purse	x		
		v		*Cardamine lineariloba*	Western Bitter-cress	x		
				Carex bichenoviana	Plains Sedge	x		
				Carex inversa	Knob Sedge	x		
			*	*Centaurea melitensis*	Malta Thistle	x		
				Centaurium spicatum	Spike Centaury	x		
				Centipeda cunninghamii	Common Sneezeweed	x		

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 369	EVC 103	EVC 862
				Chenopodium desertorum subsp. microphyllum	Small-leaf Goosefoot		x	x
			*	*Cirsium vulgare*	Spear Thistle	x		
			*	*Conyza bonariensis*	Flaxleaf Fleabane	x		
				Cotula australis	Common Cotula	x		
			*	*Cotula bipinnata*	Ferny Cotula	x		
				Crassula closiana	Stalked Crassula	x		
				Crassula colorata	Dense Crassula	x	x	
				Crassula decumbens var. decumbens	Spreading Crassula	x		
				Crassula peduncularis	Purple Crassula	x		
				Crassula sieberiana s.l.	Sieber Crassula	x		
			*	*Cucumis myriocarpus*	Paddy Melon	x		
			*	*Cynodon dactylon var. dactylon*	Couch	x		
				Daucus glochidiatus	Australian Carrot			x
				Dissocarpus paradoxus	Cannon Balls			x
			*	*Dittrichia graveolens*	Stinkwort	x		
				Dysphania pumilio	Clammy Goosefoot	x		
				Einadia nutans	Nodding Saltbush	x	x	
				Elatine gratioloides	Waterwort			x
				Eleocharis acuta (Wimmera form)	Common Spike-sedge	x		
				Enchylaena tomentosa var. tomentosa	Ruby Saltbush	x	x	x
				Enteropogon acicularis	Spider Grass	x		x
				Epilobium billardierianum subsp. cinereum	Grey Willow-herb	x		
		v		*Eragrostis australasica*	Cane Grass	x		
			*	*Erodium botrys*	Big Heron's-bill	x		
			*	*Erodium cicutarium*	Common Heron's-bill	x		
				Eucalyptus largiflorens	Black Box	x	x	
				Euphorbia drummondii	Flat Spurge	x		
				Geococcus pusillus	Earth Cress	x		
				Goodenia glauca	Pale Goodenia	x		x
				Goodenia heteromera	Spreading Goodenia	x		
				Goodenia pinnatifida	Cut-leaf Goodenia		x	
				Hakea tethrosperma	Hooked Needlewood			x
				Haloragis aspera	Rough Raspwort			x
				Pseudognaphalium luteoalbum	Jersey Cudweed	x		
			*	*Hordeum leporinum*	Barley-grass	x		
				Hyalosperma semisterile	Orange Sunray		x	x
				Hypoxis glabella var. glabella	Tiny Star	x		
				Hypoxis vaginata	Yellow Star	x		x
				Isoetopsis graminifolia	Grass Cushion			x
				Juncus flavidus	Gold Rush	x		
				Lachnagrostis filiformis var. 1	Common Blown-grass	x		
			*	*Lactuca serriola*	Prickly Lettuce	x		

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 369	EVC 103	EVC 862
			*	*Lepidium africanum*	Common Peppercress	x		
				Limosella australis	Austral Mudwort	x		
				Limosella curdieana	Large Mudwort	x		
			*	*Lolium rigidum*	Wimmera Rye-grass	x	x	
			*	*Lycium ferocissimum*	African Box-thorn			x
				Lythrum hyssopifolia	Small Loosestrife	x		
				Maireana brevifolia	Short-leaf Bluebush	x	x	x
				Maireana decalvans	Black Cotton-bush		x	
				Maireana excavata	Bottle Bluebush			x
				Maireana pentagona	Hairy Bluebush	x	x	
			*	*Malva parviflora*	Small-flower Mallow	x		
			*	*Marrubium vulgare*	Horehound	x		
				Marsilea drummondii	Common Nardoo	x		
			*	*Medicago minima*	Little Medic	x		
			*	*Medicago polymorpha*	Burr Medic	x		
			*	*Medicago truncatula*	Barrel Medic	x		
				Muehlenbeckia florulenta	Tangled Lignum	x		
				Myosurus australis	Mousetail	x		
				Myriocephalus rhizocephalus	Woolly-heads	x		
f	V	v		*Myriophyllum porcatum*	RidgedWater-milfoil	x		
			*	*Onopordum acaulon*	Stemless Thistle	x		
				Oxalis perennans	Grassland Wood-sorrel	x		
				Plagiobothrys elachanthus	Hairy Forget-me-not	x		
				Plantago drummondii	Dark Plantain	x		
				Plantago turrifera	Crowned Plantain	x		
			*	*Poa annua*	Annual Meadow-grass	x		
			*	*Poa bulbosa*	Bulbous Meadow-grass		x	
				Pogonolepis muelleriana	Stiff Cup-flower		x	x
			*	*Polygonum aviculare s.l.*	Prostrate Knotweed	x		
		k		*Ranunculus pumilio var. politus*	Ferny Small-flower Buttercup	x		
				Ranunculus pumilio var. pumilio	Ferny Small-flower Buttercup	x		
		k		*Ranunculus sessiliflorus var. pilulifer*	Annual Buttercup	x		
				Rhagodia spinescens	Hedge Saltbush			x
				Rhodanthe corymbiflora	Paper Sunray	x		x
				Rhodanthe pygmaea	Pygmy Sunray		x	
			*	*Rorippa palustris*	Marsh Bitter Cress	x		
				Rumex brownii	Slender Dock	x		x
				Rumex tenax	Narrow-leaf Dock	x		
				Rytidosperma caespitosum	Common Wallaby-grass	x		
				Rytidosperma setaceum	Bristly Wallaby-grass		x	x
				Rytidosperma setaceum var. setaceum	Bristly Wallaby-grass	x		
				Salsola tragus subsp. tragus	Prickly Saltwort	x		x
			*	*Schismus barbatus*	Arabian Grass	x		
				Scleroblitum atriplicinum	Starry Goosefoot	x		x

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 369	EVC 103	EVC 862
				Sclerolaena diacantha	Grey Copperburr	x	x	x
				Sclerolaena muricata var. villosa	Grey Roly-poly	x		
				Senecio pinnatifolius var. 1	Variable Groundsel	x		
				Sida corrugata	Variable Sida			x
			*	*Sisymbrium irio*	London Rocket	x		
			*	*Sonchus asper s.l.*	Rough Sow-thistle	x		
			*	*Sonchus oleraceus*	Common Sow-thistle	x		
				Spergularia brevifolia	Salt Sea-spurrey	x		x
			*	*Stellaria media*	Chickweed	x		
				Stelligera endecaspinis	Starfruit Bassia	x		
				Stuartina muelleri	Spoon Cudweed	x		
			*	*Trifolium arvense var. arvense*	Hare's-foot Clover	x		
			*	*Trifolium repens var. repens*	White Clover	x		
				Triglochin calcitrapa	Spurred Arrowgrass	x		
		k		*Teucrium albicaule*	Scurfy Germander			x
				Teucrium racemosum	Forest Germander		x	
				Triptilodiscus pygmaeus	Dwarf Sunray			x
			*	*Urtica urens*	Small Nettle	x		
			*	*Verbascum virgatum*	Twiggy Mullein			x
			*	*Veronica peregrina*	Wandering Speedwell	x		
				Vittadinia cuneata var. cuneata	Fuzzy New Holland Daisy	x		
				Vittadinia gracilis	Woolly New Holland Daisy	x		
			*	*Vulpia bromoides*	Squirrel-tail Fescue	x		
				Walwhalleya proluta	Rigid Panic	x		
				Wurmbea latifolia subsp. vanessae	Broad-leaf Early Nancy	x	x	x

Challambra

EVC 107 – Lake Bed Herbland

EVC 862 – Plains Savannah

EVC 369 – Black Box Wetland

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 107	EVC 862	EVC 369	Reveg.
				Acacia acinacea s.s.	Gold-dust Wattle				x
				Acacia montana	Mallee Wattle				x
				Acacia pycnantha	Golden Wattle				x
				Actinobole uliginosum	Flannel Cudweed		x		
			*	*Alopecurus geniculatus*	Marsh Fox-tail			x	
				Amphibromus nervosus	Common Swamp Wallaby-grass	x			
			*	*Amsinckia calycina*	Hairy Fiddle-neck			x	
				Aphanes australiana	Australian Piert	x			
			*	*Arctotheca calendula*	Cape Weed		x		
				Atriplex semibaccata	Berry Saltbush			x	
			#	*Atriplex suberecta*	Sprawling Saltbush	x	x		

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 107	EVC 862	EVC 369	Reveg.
				Austrostipa aristiglumis	Plump Spear-grass		x		
				Austrostipa blackii	Crested Spear-grass		x		
				Austrostipa scabra subsp. falcata	Rough Spear-grass		x		
			*	*Avena barbata*	Bearded Oat		x		
			*	*Bromus rubens*	Red Brome		x		
				Bulbine semibarbata	Leek Lily			x	
				Calandrinia calyptrata	Pink Purslane			x	
			*	*Capsella bursa-pastoris*	Shepherd's Purse			x	
				Carex bichenoviana	Plains Sedge	x	x	x	
				Centaurium spicatum	Spike Centaury	x			
				Centipeda cunninghamii	Common Sneezeweed	x			
				Chloris truncata	Windmill Grass		x		
			*	*Cirsium vulgare*	Spear Thistle			x	
				Crassula colorata	Dense Crassula			x	
				Crassula decumbens var. decumbens	Spreading Crassula	x			
				Crassula peduncularis	Purple Crassula	x			
				Crassula sieberiana s.l.	Sieber Crassula		x		
			*	*Cucumis myriocarpus*	Paddy Melon	x			
				Cyperus gymnocaulos	Spiny Flat-sedge	x		x	
				Dysphania pumilio	Clammy Goosefoot	x			
				Einadia nutans	Nodding Saltbush			x	
				Eleocharis acuta	Common Spike-sedge	x			
				Eleocharis acuta (Wimmera form)	Common Spike-sedge	x			
				Enchylaena tomentosa var. tomentosa	Ruby Saltbush		x		
				Enteropogon acicularis	Spider Grass		x		
				Epilobium billardierianum subsp. cinereum	Grey Willow-herb	x			
				Eragrostis infecunda	Southern Cane-grass			x	
			*	*Erodium cicutarium*	Common Heron's-bill			x	
				Erodium crinitum	Blue Heron's-bill			x	
				Eucalyptus largiflorens	Black Box		x	x	
				Euphorbia drummondii	Flat Spurge		x		
				Geococcus pusillus	Earth Cress			x	
				Goodenia glauca	Pale Goodenia			x	
				Haloragis aspera	Rough Raspwort		x		
				Pseudognaphalium luteoalbum	Jersey Cudweed	x			
			*	*Heliotropium supinum*	Creeping Heliotrope	x			
			*	*Helminthotheca echioides*	Ox-tongue			x	
			*	*Hordeum leporinum*	Barley-grass			x	
				Hypoxis vaginata	Yellow Star		x		
				Lachnagrostis filiformis var. 1	Common Blown-grass	x			
			*	*Lactuca serriola*	Prickly Lettuce	x			

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 107	EVC 862	EVC 369	Reveg.
			*	*Lamium amplexicaule*	Dead Nettle			x	
			*	*Lepidium africanum*	Common Peppercress			x	
				Limosella australis	Austral Mudwort	x			
			*	*Lolium rigidum*	Wimmera Rye-grass			x	
			*	*Lycium ferocissimum*	African Box-thorn		x		
				Lythrum hyssopifolia	Small Loosestrife	x			
			*	*Malva parviflora*	Small-flower Mallow	x			
			*	*Marrubium vulgare*	Horehound		x		
				Marsilea drummondii	Common Nardoo	x			
			*	*Medicago minima*	Little Medic			x	
			*	*Medicago truncatula*	Barrel Medic	x			
				Muehlenbeckia florulenta	Tangled Lignum			x	
		r		*Muehlenbeckia horrida subsp. horrida*	Spiny Lignum			x	
				Myriophyllum verrucosum	Red Water-milfoil	x			
			*	*Onopordum acaulon*	Stemless Thistle	x			
				Oxalis perennans	Grassland Wood-sorrel		x		
			*	*Oxalis pes-caprae*	Soursob		x		
				Persicaria prostrata	Creeping Knotweed	x			
				Pittosporum angustifolium	Weeping Pittosporum			x	
			*	*Poa bulbosa*	Bulbous Meadow-grass		x		
			*	*Polypogon monspeliensis*	Annual Beard-grass	x			
				Rhagodia spinescens	Hedge Saltbush		x		
				Rhodanthe corymbiflora	Paper Sunray			x	
			*	*Romulea minutiflora*	Small-flower Onion-grass		x		
				Rumex brownii	Slender Dock		x		
				Rumex tenax	Narrow-leaf Dock			x	
				Rytidosperma setaceum var. setaceum	Bristly Wallaby-grass			x	
				Salsola tragus subsp. tragus	Prickly Saltwort			x	
			*	*Salvia verbenaca var. verbenaca*	Wild Sage		x		
				Scleroblitum atriplicinum	Starry Goosefoot	x			
				Sclerolaena muricata var. villosa	Grey Roly-poly	x	x		
			*	*Scorzonera laciniata*	Scorzonera	x			
				Senecio pinnatifolius var. 1	Variable Groundsel		x		
				Senecio runcinifolius	Tall Fireweed	x			
				Senna artemisioides ssp. filifolia	Silver Cassia				x
				Senna artemisioides ssp. zygophylla	Silver Cassia				x
				Sida corrugata	Variable Sida		x		
			*	*Sisymbrium irio*	London Rocket			x	
			*	*Sonchus asper*	Rough Sow-thistle			x	
			*	*Sonchus oleraceus*	Sow-thistle			x	
				Spergularia brevifolia	Salt Sea-spurrey			x	

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 107	EVC 862	EVC 369	Reveg.
				Teucrium racemosum s.s.	Grey Germander		x		
			*	*Trifolium arvense var. arvense*	Hare's-foot Clover	x			
			*	*Trifolium tomentosum var. tomentosum*	Woolly Clover	x			
			*	*Urtica urens*	Small Nettle			x	
			*	*Verbena supina var. supina*	Trailing Verbena	x		x	
				Vittadinia cuneata var. cuneata	Fuzzy New Holland Daisy		x		
				Vittadinia gracilis	Woolly New Holland Daisy			x	
			*	*Vulpia bromoides*	Squirrel-tail Fescue			x	
				Walwhalleya proluta	Rigid Panic		x		
			*	*Xanthium spinosum*	Bathurst Burr	x			

Crow Swamp

EVC 107 – Lakebed Herbland

EVC 813 – Intermittent Swampy Woodland

EVC 103 – Riverine Chenopod Woodland

EVC 96 – Ridged Plains Mallee

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 107	EVC 813	EVC 103	EVC 96
				Acacia acinacea s.s.	Gold-dust Wattle				x
				Acacia ligulata	Small Cooba				x
				Acacia montana	Mallee Wattle				x
			*	*Amsinckia calycina*	Hairy Fiddle-neck	x			x
				Aphanes australiana	Australian Piert		x		
			*	*Arctotheca calendula*	Cape Weed				x
			*	*Asparagus asparagoides*	Bridal Creeper			x	
				Atriplex semibaccata	Berry Saltbush	x		x	x
				Austrostipa blackii	Crested Spear-grass				x
				Austrostipa elegantissima	Feather Spear-grass				x
				Austrostipa platychaeta	Flat-awned Spear-grass				x
				Austrostipa scabra subsp. falcata	Rough Spear-grass			x	x
				Cassytha melantha	Coarse Dodder-laurel				x
			*	*Centaurea melitensis*	Malta Thistle				x
				Chenopodium desertorum subsp. microphyllum	Small-leaf Goosefoot			x	
			*	*Cirsium vulgare*	Spear Thistle	x			
			*	*Cotula bipinnata*	Ferny Cotula		x		
				Crassula colorata	Dense Crassula		x		
				Crassula decumbens var. decumbens	Spreading Crassula		x		
				Crassula sieberiana	Sieber Crassula				x
				Cressa australis	Rosinweed		x		

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 107	EVC 813	EVC 103	EVC 96
			*	*Cucumis myriocarpus*	Paddy Melon	x			
			*	*Dittrichia graveolens*	Stinkwort	x			
				Dysphania pumilio	Clammy Goosefoot	x			
				Einadia nutans	Nodding Saltbush	x	x		x
				Enchylaena tomentosa var. tomentosa	Ruby Saltbush	x			
				Eremophila deserti	Turkey Bush				x
			*	*Erodium cicutarium*	Common Heron's-bill		x		
				Eucalyptus dumosa	Dumosa Mallee				x
				Eucalyptus largiflorens	Black Box		x	x	
				Eutaxia microphylla var. diffusa	Spreading Eutaxia				x
			*	*Helminthotheca echioides*	Ox-tongue	x			
			*	*Hordeum leporinum*	Barley-grass	x	x		
			*	*Lactuca serriola*	Prickly Lettuce	x			
			*	*Lepidium africanum*	Common Peppercress	x			
			*	*Lolium rigidum*	Wimmera Rye-grass	x			
				Lomandra effusa	Scented Mat-rush				x
			*	*Lycium ferocissimum*	African Box-thorn		x		
				Maireana brevifolia	Short-leaf Bluebush	x		x	x
			*	*Marrubium vulgare*	Horehound	x			x
			*	*Medicago minima*	Little Medic		x		
			*	*Medicago polymorpha*	Burr Medic	x			
		r		*Muehlenbeckia horrida subsp. horrida*	Spiny Lignum	x			
				Myoporum platycarpum subsp. perbellum	Sugarwood				x
			*	*Onopordum acaulon*	Stemless Thistle	x			
				Oxalis perennans	Grassland Wood-sorrel			x	x
				Pittosporum angustifolium	Weeping Pittosporum				x
			*	*Poa bulbosa*	Bulbous Meadow-grass			x	
				Rhagodia spinescens	Hedge Saltbush		x	x	x
			*	*Rumex crispus*	Curled Dock	x			
				Rytidosperma caespitosum	Common Wallaby-grass			x	
				Salsola tragus subsp. tragus	Prickly Saltwort	x			
				Scleroblitum atriplicinum	Starry Goosefoot	x			
				Sclerolaena diacantha	Grey Copperburr			x	x
				Sclerolaena muricata var. villosa	Grey Roly-poly	x			
			*	*Scorzonera laciniata*	Scorzonera	x			
				Senecio glossanthus	Groundsel	x			
				Senecio pinnatifolius var. 1	Variable Groundsel	x			
				Senna artemisioides ssp. filifolia	Silver Cassia				x
				Senna artemisioides ssp. zygophylla	Silver Cassia				x
			*	*Sisymbrium irio*	Rocket Mustard	x			x
			*	*Sonchus asper s.l.*	Rough Sow-thistle	x			

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 107	EVC 813	EVC 103	EVC 96
			*	*Sonchus oleraceus*	Common Sow-thistle	x			
			*	*Suaeda baccifera*	Berry Seablite		x		
		k		*Teucrium albicaule*	Scurfy Germander			x	
				Typha orientalis	Broad-leaf Cumbungi	x			
				Vittadinia cuneata var. cuneata	Fuzzy New Holland Daisy				x
				Vittadinia gracilis	Woolly New Holland Daisy				x
				Wilsonia rotundifolia	Round-leaf Wilsonia		x		
				Zygophyllum apiculatum	Common Twin-leaf			x	x

Fielding's Dam

EVC 235 - Plains Woodland/ Herb-rich Gilgai Wetland Complex

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name
				Allocasuarina luehmannii	*Buloke*
				Amphibromus macrorhinus	*Long-nosed Swamp Wallaby-grass*
				Amphibromus nervosus	*Common Swamp Wallaby-grass*
		v		Amyema linophylla subsp. orientale	*Buloke Mistletoe*
				Amyema miquelii	*Box Mistletoe*
				Aphanes australiana	*Australian Piert*
				Arthropodium fimbriatum	*Nodding Chocolate-lily*
				Arthropodium minus	*Small Vanilla-lily*
				Atriplex leptocarpa	*Slender-fruit Saltbush*
				Atriplex suberecta	*Sprawling Saltbush*
				Austrostipa bigeniculata	*Kneed Spear-grass*
				Austrostipa nodosa	*Knotty Spear-grass*
				Austrostipa scabra	*Rough Spear-grass*
				Bulbine bulbosa	*Bulbine Lily*
				Calandrinia calyptrata	*Pink Purslane*
				Calotis hispidula	*Hairy Burr-daisy*
				Carex inversa	*Knob Sedge*
				Centipeda cunninghamii	*Common Sneezeweed*
				Chenopodium desertorum	*Frosted Goosefoot*
				Convolvulus angustissimus	*Blushing Bindweed*
				Crassula decumbens var. decumbens	*Spreading Crassula*
				Crassula peduncularis	*Purple Crassula*
				Crassula sieberiana s.l.	*Sieber Crassula*
				Daucus glochidiatus	*Australian Carrot*
				Duma florulenta	*Tangled Lignum*
				Einadia nutans subsp. nutans	*Nodding Saltbush*
				Enchylaena tomentosa var. tomentosa	*Ruby Saltbush*
				Enteropogon acicularis	*Spider Grass*
				Eucalyptus largiflorens	*Black Box*
				Euchiton sphaericus	*Annual Cudweed*
				Goodenia glauca	*Pale Goodenia*

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name
				Goodenia pusilliflora	*Small-flower Goodenia*
		r		Gratiola pumilo	*Dwarf Brooklime*
				Hyalosperma semisterile	*Orange Sunray*
				Hypoxis vaginata	*Yellow Star*
				Isoetopsis graminifolia	*Grass Cushion*
		k		Isolepis australiensis	*Inland Club-sedge*
				Juncus bufonius	*Toad Rush*
				Juncus subsecundus	*Finger Rush*
				Leptorhynchos tetrachaetus	*Beauty Buttons*
				Limosella australis	*Austral Mudwort*
				Limosella curdieana	*Large Mudwort*
				Lysiana exocarpi	*Harlequin Mistletoe*
				Lythrum hyssopifolia	*Small Loosestrife*
				Maireana decalvans	*Black Cotton-bush*
				Maireana enchylaenoides	*Wingless Bluebush*
				Maireana humillima	*Dwarf Bluebush*
				Marsilea drummondii	*Common Nardoo*
				Myriocephalus rhizocephalus	*Woolly-heads*
				Myriophyllum verrucosum	*Red Water-milfoil*
				Nitella spp.	*Stonewort*
				Oxalis perennans	*Grassland Wood-sorrel*
				Plagiobothrys elachanthus	*Hairy Forget-me-not*
				Plantago cunninghamii	*Clay Plantain*
				Pogonolepis muelleriana	*Stiff Cup-flower*
				Pseudognaphalium luteoalbum	*Jersey Cudweed*
				Ranunculus pumilio	*Ferny Small-flower Buttercup*
				Rhodanthe corymbiflora	*Paper Sunray*
				Rumex dumosus	*Wiry Dock*
				Rytidosperma caespitosum	*Common Wallaby-grass*
				Rytidosperma duttonianum	*Brown-back Wallaby-grass*
				Rytidosperma setaceum	*Bristly Wallaby-grass*
				Salsola tragus	*Prickly Saltwort*
				Sclerolaena diacantha	*Grey Copperburr*
				Sclerolaena muricata	*Black Roly-poly*
				Senecio runcinifolius	*Tall Fireweed*
				Sida corrugate	*Variable Sida*
				Solanum esuriale	*Quena*
				Spergularia sp. 3	*Native Sea-spurrey*
				Teucrium racemosum	*Grey Germander*
				Triglochin turrifera	*Turret Arrowgrass*
				Triptilodiscus pygmaeus	*Common Sunray*
				Vittadinia cuneata	*Fuzzy New Holland Daisy*
				Wahlenbergia tumidifructa	*Mallee Annual-bluebell*
				Walwhalleya proluta	*Rigid Panic*
				Wurmbea dioica	*Common Early Nancy*
			*	Aira elegantissima	*Delicate Hair-grass*

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name
			*	Amsinckia calycina	*Hairy Fiddle-neck*
			*	Arctotheca calendula	*Cape Weed*
			*	Avena fatua	*Wild Oat*
			*	Brachypodium distachyon	*False Brome*
			*	Bromus rubens	*Red Brome*
			*	Cirsium vulgare	*Spear Thistle*
			*	Cotula bipinnata	*Ferny Cotula*
			*	Erodium cicutarium	*Common Heron's-bill*
			*	Galium murale	*Small Goosegrass*
			*	Hedypnois rhagadioloides subsp. retica	*Cretan Hedypnois*
			*	Hordeum marinum	*Sea Barley-grass*
			*	Hordeum vulgare s.l.	*Barley*
			*	Hypochaeris radicata	*Flatweed*
			*	Lolium rigidum	*Wimmera Rye-grass*
			*	Lycium ferocissimum	*African Box-thorn*
			*	Malva parviflora	*Small-flower Mallow*
			*	Marrubium vulgare	*Horehound*
			*	Medicago minima	*Little Medic*
			*	Medicago polymorpha	*Burr Medic*
			*	Medicago truncatula	*Barrel Medic*
			*	Moraea setifolia	*Thread Iris*
			*	Parapholis incurva	*Coast Barb-grass*
			*	Plantago coronopus	*Buck's-horn Plantain*
			*	Poa bulbosa	*Bulbous Meadow-grass*
			*	Polygonum aviculare s.l.	*Prostrate Knotweed*
			*	Romulea rosea	*Onion Grass*
			*	Rostraria cristata	*Annual Cat's-tail*
			*	Scorzonera laciniata	*Scorzonera*
			*	Sisymbrium irio	*London Rocket*
			*	Sonchus asper s.l.	*Rough Sow-thistle*
			*	Sonchus oleraceus	*Common Sow-thistle*
			*	Vulpia bromoides	*Squirrel-tail Fescue*

Harcoans

EVC 107 – Lake Bed Herbland

EVC 369 – Black Box Wetland

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 107	EVC 369
f				*Allocasuarina luehmannii*	Buloke		x
			*	*Amsinckia calycina*	Hairy Fiddle-neck		x
				Aphanes australiana	Australian Piert	x	
			*	*Arctotheca calendula*	Cape Weed	x	
				Austrostipa aristiglumis	Plump Spear-grass		x
				Austrostipa scabra subsp. falcata	Rough Spear-grass		x

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 107	EVC 369
			*	*Avena fatua*	Wild Oat	x	
			*	*Brassica X napis*	Canola		x
			*	*Capsella bursa-pastoris*	Shepherd's Purse	x	
				Centipeda cunninghamii	Common Sneezeweed	x	
			*	*Chenopodium murale*	Clammy Goosefoot	x	
			*	*Cirsium vulgare*	Spear Thistle	x	
				Crassula decumbens var. decumbens	Spreading Crassula		x
				Enchylaena tomentosa var. tomentosa	Ruby Saltbush		x
				Enteropogon acicularis	Spider Grass		x
				Epilobium hirtigerum	Hairy Willow-herb	x	
		v		*Eriochlamys squamata*	Scaly Mantle		
			*	*Erodium botrys*	Big Heron's-bill		x
			*	*Erodium cicutarium*	Common Heron's-bill	x	
			*	*Erodium moschatum*	Musky Heron's-bill	x	
				Eucalyptus largiflorens	Black Box		x
				Euchiton sphaericus	Annual Cudweed	x	
				Euphorbia drummondii	Flat Spurge	x	
				Goodenia heteromera	Spreading Goodenia	x	
				Pseudognaphalium luteoalbum	Jersey Cudweed	x	
			*	*Heliotropium supinum*	Creeping Heliotrope	x	
			*	*Helminthotheca echioides*	Ox-tongue	x	
			*	*Hordeum hystrix*	Mediterranean Barley-grass	x	
			*	*Lactuca serriola*	Prickly Lettuce	x	
			*	*Lolium rigidum*	Wimmera Rye-grass	x	x
			*	*Lycium ferocissimum*	African Box-thorn		x
				Lythrum hyssopifolia	Small Loosestrife	x	
			*	*Malva parviflora*	Small-flower Mallow	x	x
			*	*Marrubium vulgare*	Horehound		x
			*	*Medicago minima*	Little Medic	x	
			*	*Medicago polymorpha*	Burr Medic	x	
			*	*Medicago truncatula*	Barrel Medic	x	
				Myriophyllum verrucosum	Red Water-milfoil	x	
			*	*Oenothera stricta*	Evening Primrose	x	
			*	*Onopordum acaulon*	Stemless Thistle	x	x
				Oxalis perennans	Grassland Wood-sorrel	x	x
			*	*Oxalis pes-caprae*	Soursob		x
			*	*Polygonum aviculare s.l.*	Prostrate Knotweed	x	
				Ranunculus pumilio var. pumilio	Ferny Small-flower Buttercup	x	
				Rhodanthe corymbiflora	Paper Sunray	x	
				Rumex brownii	Slender Dock		x
				Rumex tenax	Narrow-leaf Dock	x	
				Scleroblitum atriplicinum	Starry Goosefoot	x	
				Sclerolaena muricata var. villosa	Grey Roly-poly		x
			*	*Scorzonera laciniata*	Scorzonera		x
				Senecio pinnatifolius var. 1	Variable Groundsel		x

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 107	EVC 369
				Senecio quadridentatus	Cotton Fireweed	x	
			*	*Sonchus asper s.l.*	Rough Sow-thistle	x	
			*	*Sonchus oleraceus*	Common Sow-thistle	x	
			*	*Sonchus tenerrimus*	Clammy Sow-thistle	x	
				Teucrium racemosum	Forest Germander		x
			*	*Verbena supina var. supina*	Trailing Verbena	x	
				Walwhalleya proluta	Rigid Panic	x	x
			*	*Xanthium spinosum*	Bathurst Burr	x	

Krong Swamp

EVC 808 – Lignum Shrubland

EVC 823 – Lignum Swampy Woodland

EVC 369 – Black Box Wetland

EVC 862 – Plains Savannah

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 808	EVC 823	EVC 369	EVC 862
				Acacia oswaldii	Umbrella Wattle				x
				Amphibromus nervosus	Common Swamp Wallaby-grass	x			
			*	*Amsinckia calycina*	Hairy Fiddle-neck			x	
			*	*Arctotheca calendula*	Cape Weed				x
			#	*Atriplex suberecta*	Sprawling Saltbush	x			
				Austrostipa aristiglumis	Plump Spear-grass				x
				Austrostipa scabra subsp. falcata	Rough Spear-grass				x
			*	*Avena barbata*	Bearded Oat	x			
				Carex inversa	Knob Sedge		x	x	
			*	*Centaurea melitensis*	Malta Thistle				x
				Centipeda cunninghamii	Common Sneezeweed	x			
				Convolvulus erubescens spp. agg.	Pink Bindweed				x
				Crassula decumbens var. decumbens	Spreading Crassula				x
				Crassula sieberiana s.l.	Sieber Crassula				x
			*	*Cucumis myriocarpus*	Paddy Melon				x
				Dysphania pumilio	Clammy Goosefoot	x			
				Einadia nutans	Nodding Saltbush	x			
				Eleocharis acuta	Common Spike-sedge	x			
				Enchylaena tomentosa var. tomentosa	Ruby Saltbush			x	x
				Enteropogon acicularis	Spider Grass				x
				Epilobium billardierianum subsp. cinereum	Grey Willow-herb	x			
		v		*Eragrostis australasica*	Cane Grass	x	x		
			*	*Eragrostis cilianensis*	Stink-grass				x
				Eragrostis infecunda	Southern Cane-grass	x		x	
			*	*Erodium botrys*	Big Heron's-bill				x

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 808	EVC 823	EVC 369	EVC 862
			*	*Erodium cicutarium*	Common Heron's-bill				x
				Erodium crinitum	Blue Heron's-bill				x
			*	*Erodium moschatum*	Musky Heron's-bill	x			x
				Eucalyptus largiflorens	Black Box		x	x	x
				Euchiton sphaericus	Annual Cudweed	x			
				Helichrysum luteoalbum	Jersey Cudweed	x			
			*	*Hordeum leporinum*	Barley-grass		x		
				Hypoxis glabella var. glabella	Tiny Star				x
				Juncus flavidus	Gold Rush	x			
				Lachnagrostis filiformis var. 1	Common Blown-grass	x			
			*	*Lactuca serriola*	Prickly Lettuce	x			
			*	*Lepidium africanum*	Common Peppercress	x			
			*	*Limonium lobatum*	Sea Lavender				x
			*	*Lolium rigidum*	Wimmera Rye-grass	x		x	
			*	*Lycium ferocissimum*	African Box-thorn		x		
				Lythrum hyssopifolia	Small Loosestrife	x			
				Maireana brevifolia	Short-leaf Bluebush				x
				Maireana pentagona	Hairy Bluebush				x
			*	*Malva parviflora*	Small-flower Mallow	x			
			*	*Marrubium vulgare*	Horehound		x		x
				Marsilea drummondii	Common Nardoo	x	x	x	
			*	*Medicago polymorpha*	Burr Medic	x			
			*	*Moraea setifolia*	Thread Iris				x
				Muehlenbeckia florulenta	Tangled Lignum	x	x	x	
		r		*Muehlenbeckia horrida subsp. horrida*	Spiny Lignum		x	x	
			*	*Onopordum acaulon*	Stemless Thistle	x			
				Oxalis perennans	Grassland Wood-sorrel	x		x	x
			*	*Oxalis pes-caprae*	Soursob				x
			*	*Poa bulbosa*	Bulbous Meadow-grass				x
			*	*Polygonum aviculare s.l.*	Prostrate Knotweed	x			
				Ranunculus pumilio var. pumilio	Ferny Small-flower Buttercup	x			
			*	*Rumex crispus*	Curled Dock	x			
				Rumex tenax	Narrow-leaf Dock	x			
				Rytidosperma setaceum var. setaceum	Bristly Wallaby-grass				x
			*	*Salvia verbenaca var. verbenaca*	Wild Sage				x
				Sclerolaena muricata var. villosa	Grey Roly-poly	x			x
				Senecio pinnatifolius var. 1	Variable Groundsel	x			
				Senna artemisioides ssp. zygophylla	Silver Cassia				x
				Sida corrugata	Variable Sida				x
			*	*Sisymbrium irio*	London Rocket	x			
				Solanum simile	Oondoroo				x

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 808	EVC 823	EVC 369	EVC 862
			*	*Sonchus asper s.l.*	Rough Sow-thistle	x			
			*	*Sonchus oleraceus*	Sow-thistle	x			
				Spergularia brevifolia	Salt Sea-spurrey		x		
		k		*Teucrium albicaule*	Scurfy Germander		x		x
				Teucrium racemosum s.s.	Grey Germander				x
			*	*Trifolium subterraneum*	Subterranean Clover	x			
			*	*Veronica peregrina*	Wandering Speedwell	x			
				Vittadinia cuneata var. cuneata	Fuzzy New Holland Daisy				x
				Vittadinia gracilis	Woolly New Holland Daisy				x
			*	*Vulpia bromoides*	Squirrel-tail Fescue				x
				Walwhalleya proluta	Rigid Panic		x		x

Mutton Swamp

EVC 107 – Lake Bed Herbland

EVC 369 – Black Box Wetland

EVC 803 Plains Woodland

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 107	EVC 369	EVC 803
f				*Allocasuarina luehmannii*	Buloke			x
			*	*Alopecurus aequalis*	Orange Fox-tail	x		
				Amphibromus nervosus	Common Swamp Wallaby-grass	x		
				Amyema miquelii	Box Mistletoe			x
				Aphanes australiana	Australian Piert		x	
			*	*Arctotheca calendula*	Cape Weed	x		x
				Asperula conferta	Common Woodruff			x
				Atriplex semibaccata	Berry Saltbush		x	x
				Austrostipa aristiglumis	Plump Spear-grass		x	x
				Austrostipa scabra subsp. falcata	Rough Spear-grass		x	x
			*	*Bromus diandrus*	Great Brome		x	x
			*	*Callitriche brutia subsp. brutia*	Thread Water-starwort	x		
		r		*Callitriche umbonata*	Winged Water-starwort	x		
				Carex bichenoviana	Plains Sedge		x	
				Carex inversa	Knob Sedge		x	
			*	*Cirsium vulgare*	Spear Thistle	x		
				Convolvulus erubescens spp. agg.	Pink Bindweed			x
			*	*Conyza bonariensis*	Flaxleaf Fleabane	x		
			*	*Cotula bipinnata*	Ferny Cotula		x	
				Crassula colorata	Dense Crassula			x
				Crassula decumbens var. decumbens	Spreading Crassula	x	x	
			*	*Crassula natans var. minus*	Water Crassula	x		

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 107	EVC 369	EVC 803
				Crassula peduncularis	Purple Crassula	x		
				Cressa australis	Rosinweed		x	
				Eleocharis acuta	Common Spike-sedge	x	x	
				Enchylaena tomentosa var. tomentosa	Ruby Saltbush		x	x
				Epilobium billardierianum subsp. cinereum	Grey Willow-herb	x		
				Eragrostis infecunda	Southern Cane-grass	x	x	
				Eucalyptus camaldulensis	River Red-gum	x		
				Eucalyptus largiflorens	Black Box		x	x
				Euchiton sphaericus	Annual Cudweed	x		
			#	*Euphorbia drummondii*	Flat Spurge			x
				Goodenia glauca	Pale Goodenia		x	
				Haloragis aspera	Rough Raspwort			x
				Pseudognaphalium luteoalbum	Jersey Cudweed	x		
			*	*Helminthotheca echioides*	Ox-tongue	x		
				Hypoxis glabella var. glabella	Tiny Star			x
				Isolepis cernua var. platycarpa	Broad-fruit Club-sedge	x		
			*	*Isolepis hystrix*	Awned Club-sedge	x		
				Juncus bufonius	Toad Rush	x		
				Juncus flavidus	Gold Rush		x	
				Lachnagrostis filiformis var. 1	Common Blown-grass	x		
			*	*Lactuca saligna*	Willow-leaf Lettuce	x		
			*	*Lactuca serriola*	Prickly Lettuce	x		
			*	*Lepidium draba*	White-top		x	
				Lilaeopsis polyantha	Australian Lilaeopsis	x		
				Limosella australis	Austral Mudwort	x		
			*	*Lolium rigidum*	Wimmera Rye-grass		x	x
				Lythrum hyssopifolia	Small Loosestrife	x		
				Maireana enchylaenoides	Wingless Bluebush			x
				Maireana excavata	Bottle Bluebush		x	
				Maireana pentagona	Hairy Bluebush		x	
			*	*Marrubium vulgare*	Horehound		x	x
				Marsilea drummondii	Common Nardoo		x	
			*	*Medicago minima*	Little Medic		x	
				Muehlenbeckia florulenta	Tangled Lignum		x	
		r		*Muehlenbeckia horrida subsp. horrida*	Spiny Lignum		x	
				Myosurus australis	Mousetail	x		
				Oxalis perennans	Grassland Wood-sorrel		x	
			*	*Oxalis pes-caprae*	Soursob			x
			*	*Phalaris paradoxa*	Paradoxical Canary-grass	x		
				Plagiobothrys elachanthus	Hairy Forget-me-not			x
			*	*Polygonum aviculare s.l.*	Prostrate Knotweed	x		
				Ptilotus nobilis subsp. semilanatus	Lamb Tails			x
				Ranunculus pumilio var. pumilio	Ferny Small-flower Buttercup	x		

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 107	EVC 369	EVC 803
			*	*Romulea minutiflora*	Small-flower Onion-grass			x
			*	*Romulea rosea var. australis s.s.*	Common Onion-grass	x	x	x
			*	*Rumex crispus*	Curled Dock	x		
				Rumex tenax	Narrow-leaf Dock	x	x	
				Rytidosperma duttonianum	Brown-back Wallaby-grass	x	x	
				Rytidosperma setaceum	Bristly Wallaby-grass		x	
			*	*Salvia verbenaca var. verbenaca*	Wild Sage		x	
				Sclerolaena muricata var. villosa	Grey Roly-poly		x	
f	E	e		*Sclerolaena napiformis*	Turnip Copperburr			x
			*	*Scorzonera laciniata*	Scorzonera		x	
				Senecio quadridentatus	Cotton Fireweed			x
				Senecio runcinifolius	Tall Fireweed	x		
				Sida corrugata	Variable Sida			x
			*	*Sonchus oleraceus*	Common Sow-thistle		x	
				Spergularia brevifolia	Salt Sea-spurrey		x	
				Swainsona procumbens	Broughton Pea			x
				Teucrium racemosum s.s.	Grey Germander			x
			*	*Trifolium arvense var. arvense*	Hare's-foot Clover	x	x	
			*	*Trifolium repens var. repens*	White Clover	x		
				Vittadinia gracilis	Woolly New Holland Daisy		x	
			*	*Vulpia bromoides*	Squirrel-tail Fescue		x	
				Walwhalleya proluta	Rigid Panic	x	x	x
				Wilsonia rotundifolia	Round-leaf Wilsonia	x		
				Wurmbea latifolia subsp. vanessae	Broad-leaf Early Nancy	x		

Pinedale

EVC 369 – Black Box Wetland

EVC 96 – Ridged Plains Mallee

EVC 103 – Riverine Chenopod Woodland

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 369	EVC 96	EVC 103
				Acacia acinacea s.s.	Gold-dust Wattle			x
f				*Allocasuarina luehmannii*	Buloke	x	x	
			*	*Alopecurus geniculatus*	Marsh Fox-tail	x		
				Alternanthera denticulata	Lesser Joyweed	x		
				Amphibromus nervosus	Common Swamp Wallaby-grass	x		
			*	*Amsinckia calycina*	Hairy Fiddle Neck	x		
				Atriplex semibaccata	Berry Saltbush	x	x	x
				Austrostipa scabra subsp. falcata	Rough Spear-grass	x	x	x
			*	*Bromus rubens*	Red Brome	x	x	
				Bulbine semibarbata	Leek Lily	x		

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 369	EVC 96	EVC 103
				Carex inversa	Knob Sedge	x		x
			*	*Centaurea melitensis*	Malta Thistle	x		
				Centaurium spicatum	Spike Centaury	x		
				Centipeda cunninghamii	Common Sneezeweed	x		
				Chenopodium desertorum subsp. microphyllum	Small-leaf Goosefoot	x	x	
				Cotula australis	Common Cotula	x		
				Crassula colorata var. acuminata	Dense Crassula	x		
				Crassula decumbens	Spreading Crassula	x		
				Crassula sieberiana s.l.	Sieber Crassula	x		
			*	*Dittrichia graveolens*	Stinkwort	x		
				Eclipta platyglossa	Yellow Twin-heads	x		
				Einadia nutans	Nodding Saltbush			x
				Eleocharis acuta (Wimmera form)	Common Spike-sedge	x		
				Enchylaena tomentosa var. tomentosa	Ruby Saltbush	x	x	x
				Enteropogon acicularis	Spider Grass	x		
				Eucalyptus dumosa	Dumosa Mallee		x	
				Eucalyptus largiflorens	Black Box	x		x
				Euchiton sphaericus	Annual Cudweed	x		
				Euphorbia drummondii	Flat Spurge	x		
				Geococcus pusillus	Earth Cress	x		
				Haloragis aspera	Rough Raspwort	x		
				Pseudognaphalium luteoalbum	Jersey Cudweed	x		
			*	*Helminthotheca echioides*	Ox-tongue	x		
			*	*Hordeum leporinum*	Barley-grass	x		
				Hypoxis glabella var. glabella	Tiny Star	x		
				Isolepis sp.	Club-sedge	x		
				Juncus subsecundus	Finger Rush	x		
				Lachnagrostis filiformis var. 1	Common Blown-grass	x		
			*	*Lactuca serriola*	Prickly Lettuce	x		
			*	*Lamium amplexicaule*	Dead Nettle	x		
			*	*Lepidium africanum*	Common Peppercress	x		
				Limosella australis	Austral Mudwort	x		
			*	*Lolium rigidum*	Wimmera Rye-grass	x		x
				Lythrum hyssopifolia	Small Loosestrife	x		
				Maireana brevifolia	Short-leaf Bluebush		x	x
			*	*Malva parviflora*	Small-flower Mallow	x		
			*	*Marrubium vulgare*	Horehound	x		
				Marsilea drummondii	Common Nardoo	x		
			*	*Medicago minima*	Little Medic	x		
			*	*Medicago polymorpha*	Burr Medic	x		
				Muehlenbeckia florulenta	Tangled Lignum	x		
				Myosurus australis	Mousetail	x		
				Myriophyllum verrucosum	Red Water-milfoil	x		

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 369	EVC 96	EVC 103
				Oxalis perennans	Grassland Wood-sorrel	x		
				Plagiobothrys elachanthus	Hairy Forget-me-not	x		
				Plantago turrifera	Crowned Plantain	x		
			*	*Poa bulbosa var. bulbosa*	Bulbous Meadow-grass	x		
				Poa fordeana	Forde Poa	x		
			*	*Polypogon monspeliensis*	Annual Beard-grass	x		
		k		*Ranunculus pumilio var. politus*	Ferny Small-flower Buttercup	x		
				Rhagodia spinescens	Hedge Saltbush	x	x	x
				Rumex brownii	Slender Dock	x		
				Rumex tenax	Narrow-leaf Dock	x		
				Rytidosperma setaceum	Bristly Wallaby-grass	x	x	
				Salsola tragus subsp. tragus	Prickly Saltwort	x		
				Scleroblitum atriplicinum	Starry Goosefoot	x		
				Senecio glossanthus	Groundsel	x		
				Sida corrugata	Variable Sida	x	x	
			*	*Sisymbrium irio*	London Rocket	x		
				Solanum simile	Oondoroo	x		
			*	*Sonchus asper s.l.*	Rough Sow-thistle	x		
				Spergularia brevifolia	Salt Sea-spurrey	x		x
			*	*Stellaria media*	Chickweed	x		
				Teucrium racemosum s.s.	Grey Germander	x		
			*	*Veronica peregrina*	Wandering Speedwell	x		
			*	*Vicia sativa ssp. sativa*	Common Vetch	x		
				Vittadinia cuneata var. cuneata	Fuzzy New Holland Daisy	x		
			*	*Vulpia bromoides*	Squirrel-tail Fescue	x		
				Walwhalleya proluta	Rigid Panic	x		

Sawpit Swamp

EVC 803 – Plains Woodland

EVC 810 – Floodway Pond Herbland

EVC 813 – Intermittent Swampy Woodland

EVC 945 – Floodway Pond Herbland-Riverine Swamp Forest Complex

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 803	EVC 810	EVC 813	EVC 945
				Acacia acinacea s.s.	Gold-dust Wattle	x			
				Acacia paradoxa	Hedge Wattle			x	
				Acacia pycnantha	Golden Wattle	x			
				Acaena echinata	Sheep's Burr	x			
f				*Allocasuarina luehmannii*	Buloke	x			
			*	*Alopecurus geniculatus*	Marsh Fox-tail				x
		k		*Amphibromus fluitans*	River Swamp Wallaby-grass		x		

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 803	EVC 810	EVC 813	EVC 945
				Amphibromus nervosus	Common Swamp Wallaby-grass		x		x
			*	*Amsinckia calycina*	Hairy Fiddle-neck	x			
				Anthosachne scabra s.l.	Common Wheat-grass	x			
				Aphanes australiana	Australian Piert		x		
				Arthropodium minus	Small Vanilla-lily	x			
				Arthropodium strictum s.s.	Chocolate Lily	x			
		r		*Asperula wimmerana*	Wimmera Woodruff	x			
				Atriplex semibaccata	Berry Saltbush	x			
				Austrostipa aristiglumis	Plump Spear-grass	x			
				Austrostipa scabra subsp. falcata	Rough Spear-grass	x			
			*	*Avena fatua*	Wild Oat			x	x
				Brachyscome ciliaris	Variable Daisy	x			
				Bulbine bulbosa	Bulbine Lily	x			
				Callitriche sonderi	Matted Water-starwort		x		x
		r		*Callitriche umbonata*	Winged Water-starwort		x		
				Calocephalus citreus	Lemon Beauty-heads	x			
				Calotis scabiosifolia	Rough Burr-daisy	x			
		r		*Cardamine moirensis*	Riverina Bitter-cress		x		x
				Carex bichenoviana	Plains Sedge			x	x
				Carex inversa	Knob Sedge	x			x
				Carex tereticaulis	Poong'ort				x
				Centipeda cunninghamii	Common Sneezeweed		x	x	x
				Chenopodium desertorum subsp. microphyllum	Small-leaf Goosefoot	x			x
			*	*Cirsium vulgare*	Spear Thistle			x	
				Convolvulus angustissimus	Blushing Bindweed	x			
			*	*Conyza bonariensis*	Fleabane		x		x
				Cotula australis	Common Cotula			x	x
			*	*Cotula bipinnata*	Ferny Cotula	x			
				Crassula decumbens var. decumbens	Spreading Crassula		x		x
			*	*Crassula natans var. minus*	Water Crassula	x			
				Crassula peduncularis	Purple Crassula	x			
			*	*Cynodon dactylon var. dactylon*	Couch			x	
				Dianella admixta	Black-anther Flax-lily	x			
				Dysphania glomulifera	Globular Crumbweed		x		
			*	*Ehrharta longiflora*	Annual Veldt-grass			x	
				Einadia nutans	Nodding Saltbush	x			
				Eleocharis acuta	Common Spike-sedge		x		x
				Enchylaena tomentosa var. tomentosa	Ruby Saltbush	x			
				Eragrostis infecunda	Southern Cane-grass			x	
		v		*Eragrostis lacunaria*	Purple Love-grass		x		

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 803	EVC 810	EVC 813	EVC 945
				Eucalyptus camaldulensis	River Red Gum			x	x
				Eucalyptus camaldulensis X largiflorens	Hybrid Gum				x
				Eucalyptus largiflorens	Black Box	x		x	x
				Eucalyptus leucoxylon subsp. pruinosa	Waxy Yellow-gum	x			
			#	*Euphorbia drummondii*	Flat Spurge	x			
				Eutaxia microphylla var. diffusa	Spreading Eutaxia	x			
			*	*Fumaria capreolata*	White Fumitory	x			x
		r		*Geranium sp. 3*	Pale-flower Crane's-bill	x			
				Goodenia glauca	Pale Goodenia	x			x
				Goodenia pinnatifida	Cut-leaf Goodenia	x			
				Haloragis aspera	Rough Raspwort	x			x
				Pseudognaphalium luteoalbum	Jersey Cudweed			x	x
			*	*Helminthotheca echioides*	Ox-tongue		x	x	
				Hypoxis glabella var. glabella	Tiny Star	x			
				Isolepis cernua var. platycarpa	Broad-fruit Club-sedge		x		
				Juncus amabilis	Hollow Rush			x	x
				Juncus bufonius	Toad Rush		x		x
				Juncus flavidus	Gold Rush			x	x
				Juncus pallidus	Pale Rush			x	
				Juncus subsecundus	Finger Rush			x	x
				Lachnagrostis filiformis var. 1	Common Blown-grass			x	x
			*	*Lactuca serriola*	Prickly Lettuce		x		x
			*	*Lamium amplexicaule*	Dead Nettle	x			
			*	*Lepidium africanum*	Common Peppercress	x			
				Lilaeopsis polyanthemos	Australian Lilaeopsis		x		x
				Limosella australis	Austral Mudwort		x		x
				Limosella curdieana	Large Mudwort	x			
			*	*Lolium rigidum*	Wimmera Rye-grass	x		x	x
				Lomandra effusa	Scented Mat-rush	x			
			*	*Lycium ferocissimum*	African Box-thorn	x			
				Lythrum hyssopifolia	Small Loosestrife		x		
				Maireana enchylaenoides	Wingless Bluebush	x			
				Marsilea drummondii	Common Nardoo		x		x
			*	*Medicago polymorpha*	Burr Medic			x	
			*	*Moraea setifolia*	Thread Iris	x			
				Muehlenbeckia florulenta	Tangled Lignum			x	x
			*	*Oxalis pes-caprae*	Soursob	x		x	
				Persicaria prostrata	Creeping Knotweed			x	x
				Pimelea micrantha	Silky Rice-flower	x			

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 803	EVC 810	EVC 813	EVC 945
				Plantago gaudichaudii	Narrow Plantain	x			
				Plantago varia	Variable Plantain	x			
			*	*Poa bulbosa*	Bulbous Meadow-grass	x			
				Poa fordeana	Forde Poa			x	
				Polygonum plebeium	Small Knotweed		x		
f				*Ptilotus erubescens*	Hairy Tails	x			
				Ranunculus pumilio var. pumilio	Ferny Small-flower Buttercup		x		x
				Ranunculus sessiliflorus	Annual Buttercup		x		
			*	*Romulea minutiflora*	Small-flower Onion-grass			x	
			*	*Romulea rosea*	Onion Grass			x	
			*	*Rosa rubiginosa*	Sweet Briar			x	
				Rumex brownii	Slender Dock	x			x
				Rumex dumosus	Wiry Dock	x			
				Rumex tenax	Narrow-leaf Dock		x		x
				Rytidosperma bipartitum	Leafy Wallaby-grass	x			
				Rytidosperma caespitosum	Common Wallaby-grass	x			x
				Rytidosperma pilosa	Wallaby-grass	x		x	
				Rytidosperma setaceum	Bristly Wallaby-grass	x			
			*	*Salvia verbenaca*	Wild Sage	x			
f	E	e		*Sclerolaena napiformis*	Turnip Copperburr	x			
				Senecio glomeratus	Annual Fireweed			x	
				Senecio pinnatifolius var. 1	Variable Groundsel	x			
				Senecio quadridentatus	Cotton Fireweed	x	x		
				Senecio runcinifolius	Tall Groundsel		x		
				Sida corrugata	Variable Sida	x			
			*	*Solanum nigrum s.l.*	Black Nightshade			x	
				Solenogyne dominii	Smooth Solenogyne	x			
			*	*Sonchus oleraceus*	Common Sow-thistle		x		
				Spergularia brevifolia	Salt Sea-spurrey	x			
			*	*Stellaria media*	Chickweed	x			
				Swainsona procumbens	Broughton Pea	x		x	
				Teucrium racemosum s.s.	Grey Germander	x			
			*	*Trifolium arvense var. arvense*	Hare's-foot Clover		x		
			*	*Trifolium glomeratum*	Cluster Clover			x	
			*	*Trifolium repens var. repens*	White Clover		x		
				Triglochin procera s.l.	Water Ribbons				
			*	*Vicia sativa subsp. nigra*	Narrow-leaf Vetch			x	
				Vittadinia cuneata var. cuneata	Fuzzy New Holland Daisy	x			
				Vittadinia gracilis	Woolly New Holland Daisy	x			
				Wahlenbergia multicaulis	Branching Bluebell			x	x

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 803	EVC 810	EVC 813	EVC 945
				Walwhalleya proluta	Rigid Panic		x		

Schultz/Koschitzke

EVC 369 – Black Box Wetland

EVC 960 – Plains Grassy Woodland/ Spike-sedge Wetland Complex

EPBC	FFG	VROTS	Origin	Species	Common Name	EVC 369	EVC 960
				Allocasuarina luehmannii	*Buloke*		
				Amphibromus nervosus	*Common Swamp Wallaby-grass*		x
				Atriplex semibaccata	*Berry Saltbush*	x	
				Austrostipa bigeniculata	*Kneed Spear-grass*		
				Austrostipa scabra	*Rough Spear-grass*	x	
				Bulbine semibarbata	*Leek Lily*	x	
				Carex bichenoviana	*Plains Sedge*		
				Chamaesyce drummondii	*Flat Spurge*		
				Chloris truncata	*Windmill Grass*		
				Convolvulus angustissimus	*Blushing Bindweed*		
				Crassula colorata	*Dense Crassula*	x	
				Crassula decumbens var. decumbens	*Spreading Crassula*	x	
				Crassula sieberiana s.l.	*Sieber Crassula*	x	
				Duma florulenta	*Tangled Lignum*		
		r		Duma horrida subsp. horrida	*Spiny Lignum*	x	x
				Einadia nutans subsp. nutans	*Nodding Saltbush*	x	
				Eleocharis acuta	*Common Spike-sedge*		x
				Enchylaena tomentosa var. tomentosa	*Ruby Saltbush*	x	
				Epilobium billardierianum subsp. cinereum	*Grey Willow-herb*		x
				Eragrostis infecunda	*Southern Cane-grass*		
				Eucalyptus dumosa	*Dumosa Mallee*		
				Eucalyptus largiflorens	*Black Box*	x	
				Euchiton sphaericus	*Annual Cudweed*	x	
				Haloragis aspera	*Rough Raspwort*		
				Juncus bufonius	*Toad Rush*		x
				Lachnagrostis filiformis	*Common Blown-grass*	x	x
				Limosella curdieana	*Large Mudwort*		x
				Lythrum hyssopifolia	*Small Loosestrife*		x
				Maireana enchylaenoides	*Wingless Bluebush*		
				Marsilea drummondii	*Common Nardoo*		
				Myosurus australis	*Mousetail*		x
V	L	v		Myriophyllum porcatum	*Ridged Water-milfoil*		x
				Myriophyllum verrucosum	*Red Water-milfoil*		x
				Panicum decompositum ssp. decompositum	*Native Millet*		
				Poa fordeana	*Forde Poa*		

EPBC	FFG	VROTS	Origin	Species	Common Name	EVC 369	EVC 960
				Pseudognaphalium luteoalbum	*Jersey Cudweed*	x	
				Ranunculus pumilio var. pumilio	*Ferny Small-flower Buttercup*		x
				Rhodanthe corymbiflora	*Paper Sunray*		
				Rumex dumosus	*Wiry Dock*		
				Rumex tenax	*Narrow-leaf Dock*	x	x
				Rytidosperma caespitosum	*Common Wallaby-grass*	x	
				Rytidosperma duttonianum	*Brown-back Wallaby-grass*		
				Rytidosperma setaceum	*Bristly Wallaby-grass*	x	
				Salsola tragus subsp. tragus	*Prickly Saltwort*	x	
				Sclerolaena muricata var. villosa	*Grey Roly-poly*		x
				Senecio quadridentatus	*Cotton Fireweed*		
				Sida corrugata	*Variable Sida*		
				Spergularia sp. 3	*Native Sea-spurrey*	x	
				Teucrium racemosum s.l.	*Grey Germander*		
				Vittadinia dissecta s.l.	*Dissected New Holland Daisy*		
				Vittadinia gracilis	*Woolly New Holland Daisy*		
				Walwhalleya proluta	*Rigid Panic*	x	x
				Alopecurus geniculatus	*Marsh Fox-tail*		x
			*	Amsinckia calycina	*Hairy Fiddle-neck*	x	
			*	Arctotheca calendula	*Cape Weed*		
			*	Avena barbata	*Bearded Oat*		
			*	Brachypodium distachyon	*False Brome*		
			*	Bromus diandrus	*Great Brome*		
			*	Bromus hordeaceus subsp. hordeaceus	*Soft Brome*		
			*	Bromus rubens	*Red Brome*	x	
			*	Cirsium vulgare	*Spear Thistle*	x	
			*	Conyza bonariensis	*Flaxleaf Fleabane*	x	
			*	Crassula natans var. minus	*Water Crassula*		
			*	Diplotaxis tenuifolia	*Sand Rocket*		
			*	Erodium botrys	*Big Heron's-bill*		x
			*	Hainardia cylindrica	*Common Barb-grass*		
			*	Helminthotheca echioides	*Ox-tongue*		
			*	Hordeum murinum s.l.	*Barley-grass*	x	
			*	Hypochaeris glabra	*Smooth Cat's-ear*	x	
			*	Hypochaeris radicata	*Flatweed*		
			*	Lactuca serriola	*Prickly Lettuce*	x	
			*	Lepidium africanum	*Common Peppercress*	x	
			*	Lolium rigidum	*Wimmera Rye-grass*	x	x
			*	Malva parviflora	*Small-flower Mallow*	x	
			*	Marrubium vulgare	*Horehound*	x	
			*	Medicago minima	*Little Medic*	x	
			*	Medicago polymorpha	*Burr Medic*	x	x
			*	Medicago truncatula	*Barrel Medic*		
			*	Onopordum acaulon	*Stemless Thistle*		
			*	Phalaris paradoxa	*Paradoxical Canary-grass*		x

EPBC	FFG	VROTS	Origin	Species	Common Name	EVC 369	EVC 960
			*	Polygonum aviculare s.l.	*Prostrate Knotweed*		x
			*	Rumex crispus	*Curled Dock*		
			*	Sisymbrium irio	*London Rocket*		
			*	Sonchus oleraceus	*Common Sow-thistle*	x	x
			*	Trifolium arvense var. arvense	*Hare's-foot Clover*	x	
			*	Trifolium tomentosum var. tomentosum	*Woolly Clover*	x	x
			*	Veronica peregrina	*Wandering Speedwell*		x
			*	Vulpia bromoides	*Squirrel-tail Fescue*	x	

Tarkedia

EVC 369 – Black Box Wetland

EVC 823 – Lignum Swampy Woodland

EPBC	FFG	VROTS	Origin	Species	Common Name	EVC 823
				Allocasuarina luehmannii	*Buloke*	
				Amphibromus nervosus	*Common Swamp Wallaby-grass*	
				Arthropodium fimbriatum	*Nodding Chocolate-lily*	
				Atriplex semibaccata	*Berry Saltbush*	*x*
				Austrostipa aristiglumis	*Plump Spear-grass*	
				Austrostipa bigeniculata	*Kneed Spear-grass*	
				Austrostipa scabra	*Rough Spear-grass*	*x*
				Carex bichenoviana	*Plains Sedge*	*x*
				Centipeda cunninghamii	*Common Sneezeweed*	
				Chenopodium nitrariaceum	*Nitre Goosefoot*	
				Chenopodium pumilio	*Clammy Goosefoot*	
				Convolvulus erubescens spp. agg.	*Pink Bindweed*	
				Crassula colorata	*Dense Crassula*	*x*
				Crassula decumbens var. decumbens	*Spreading Crassula*	*x*
				Crassula sieberiana s.l.	*Sieber Crassula*	
				Cyperus gymnocaulos	*Spiny Flat-sedge*	
				Duma florulenta	*Tangled Lignum*	*x*
		r		Duma horrida subsp. horrida	*Spiny Lignum*	
				Enchylaena tomentosa var. tomentosa	*Ruby Saltbush*	*x*
				Enteropogon acicularis	*Spider Grass*	
				Epilobium billardierianum subsp. cinereum	*Grey Willow-herb*	*x*
				Eucalyptus largiflorens	*Black Box*	*x*
				Goodenia glauca	*Pale Goodenia*	
				Haloragis aspera	*Rough Raspwort*	
				Juncus bufonius	*Toad Rush*	*x*
				Lachnagrostis filiformis	*Common Blown-grass*	*x*
				Limosella australis	*Austral Mudwort*	*x*
				Lomandra effusa	*Scented Mat-rush*	
				Lythrum hyssopifolia	*Small Loosestrife*	*x*
				Maireana decalvans	*Black Cotton-bush*	

EPBC	FFG	VROTS	Origin	Species	Common Name	EVC 823
				Maireana enchylaenoides	*Wingless Bluebush*	
				Maireana excavata	*Bottle Bluebush*	
				Marsilea drummondii	*Common Nardoo*	*x*
				Myriophyllum verrucosum	*Red Water-milfoil*	*x*
				Oxalis perennans	*Grassland Wood-sorrel*	*x*
				Ptilotus macrocephalus	*Feather Heads*	
				Ptilotus nobilis	*Mulla Mulla*	
				Ptilotus spathulatus	*Pussy Tails*	
				Ranunculus pumilio	*Ferny Small-flower Buttercup*	
				Rhagodia spinescens	*Hedge Saltbush*	
				Rhodanthe corymbiflora	*Paper Sunray*	
				Rumex tenax	*Narrow-leaf Dock*	
				Rytidosperma caespitosum	*Common Wallaby-grass*	
				Rytidosperma setaceum	*Bristly Wallaby-grass*	*x*
				Salsola tragus subsp. tragus	*Prickly Saltwort*	*x*
				Senecio quadridentatus	*Cotton Fireweed*	
				Sida corrugata	*Variable Sida*	
				Solanum esuriale	*Quena*	
				Teucrium racemosum s.l.	*Grey Germander*	
				Vittadinia gracilis	*Woolly New Holland Daisy*	
				Wahlenbergia luteola	*Bronze Bluebell*	
				Walwhalleya proluta	*Rigid Panic*	
			*	Aira spp.	*Hair Grass*	
			*	Amsinckia calycina	*Hairy Fiddle-neck*	*x*
			*	Arctotheca calendula	*Cape Weed*	
			*	Avena barbata	*Bearded Oat*	*x*
			*	Brachypodium distachyon	*False Brome*	*x*
			*	Bromus diandrus	*Great Brome*	*x*
			*	Bromus rubens	*Red Brome*	*x*
			*	Cirsium vulgare	*Spear Thistle*	*x*
			*	Conyza bonariensis	*Flaxleaf Fleabane*	
			*	Crassula natans var. minus	*Water Crassula*	*x*
			*	Dittrichia graveolens	*Stinkwort*	*x*
			*	Erodium botrys	*Big Heron's-bill*	
			*	Heliotropium supinum	*Creeping Heliotrope*	
			*	Hordeum murinum s.l.	*Barley-grass*	
			*	Lolium rigidum	*Wimmera Rye-grass*	*x*
			*	Marrubium vulgare	*Horehound*	*x*
			*	Medicago polymorpha	*Burr Medic*	
			*	Medicago truncatula	*Barrel Medic*	*x*
			*	Phalaris paradoxa	*Paradoxical Canary-grass*	
			*	Poa bulbosa	*Bulbous Meadow-grass*	
			*	Polypogon monspeliensis	*Annual Beard-grass*	*x*
			*	Romulea rosea	*Onion Grass*	*x*

EPBC	FFG	VROTS	Origin	Species	Common Name	EVC 823
			*	Rumex crispus	*Curled Dock*	
			*	Sisymbrium irio	*London Rocket*	
			*	Sonchus asper s.l.	*Rough Sow-thistle*	
			*	Sonchus oleraceus	*Common Sow-thistle*	x
			*	Trifolium angustifolium var. angustifolium	*Narrow-leaf Clover*	
			*	Trifolium arvense var. arvense	*Hare's-foot Clover*	x
			*	Trifolium glomeratum	*Cluster Clover*	x
			*	Vulpia bromoides	*Squirrel-tail Fescue*	x

Wal Wal Swamp

EVC 602 – Cane Grass Wetland-Aquatic Herbland Complex

EVC A114 – Red Gum Swamp-Cane Grass Wetland Complex

EVC 815 – Riverine Swampy Woodland

EVC 55 – Plains Grassy Woodland

EVC 235 - Plains Woodland-Herb-rich Gilgai Wetland Mosaic

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 602	EVC A114	EVC 815	EVC 55	EVC 235
				Acacia pycnantha	Golden Wattle				x	
				Acaena echinata	Sheep's Burr				x	
f				*Allocasuarina luehmannii*	Buloke					x
			*	*Alopecurus geniculatus*	Marsh Fox-tail					x
				Alternanthera denticulata s.l.	Lesser Joyweed					x
		k		*Amphibromus fluitans*	River Swamp Wallaby-grass	x				
				Amphibromus nervosus	Common Swamp Wallaby-grass	x		x		x
				Arthropodium minus	Small Vanilla-lily			x		x
				Asperula conferta	Common Woodruff		x	x	x	x
			*	*Aster subulatus*	Aster-weed	x				
				Brachyscome basaltica var. gracilis	Woodland Swamp-daisy					x
			*	*Callitriche brutia subsp. brutia*	Thread Water-starwort	x				
		r		*Callitriche umbonata*	Winged Water-starwort		x			x
		e		*Cardamine paucijuga s.s (type form)*	Annual Bitter-cress		x			x
				Carex inversa	Knob Sedge			x	x	x
				Centipeda cunninghamii	Common Sneezeweed		x			x

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 602	EVC A114	EVC 815	EVC 55	EVC 235
			*	*Cirsium vulgare*	Spear Thistle	x	x			+
				Crassula closiana	Stalked Crassula					x
				Crassula decumbens var. decumbens	Spreading Crassula			x		x
				Crassula peduncularis	Purple Crassula	x		x		x
				Crassula sieberiana s.l.	Sieber Crassula					x
				Dichondra repens	Kidney-weed			x		x
				Eclipta platyglossa	Yellow Twin-heads	x				x
				Elatine gratioloides	Waterwort	x				
				Eleocharis acuta	Common Spike-sedge	x	x	x		x
				Eleocharis pusilla	Small Spike-sedge		x			x
				Epilobium billardierianum subsp. cinereum	Grey Willow-herb		x			x
				Eragrostis infecunda	Southern Cane-grass	x	x			x
			*	*Erodium botrys*	Big Heron's-bill	x				
				Eryngium vesiculosum	Prickfoot		x	x		x
				Eucalyptus camaldulensis	River Red-gum		x	x	x	
				Eucalyptus microcarpa	Grey Box			x	x	x
				Euchiton sphaericus	Annual Cudweed	x				
				Goodenia gracilis	Slender Goodenia					x
				Goodenia heteromera	Spreading Goodenia		x			x
				Haloragis aspera	Rough Raspwort	x	x	x	x	x
				Pseudognaphalium luteoalbum	Jersey Cudweed	x				x
			*	*Helminthotheca echioides*	Ox-tongue					x
			*	*Hypochaeris radicata*	Flatweed					x
				Hypoxis glabella var. glabella	Tiny Star			x		x
			*	*Isolepis hystrix*	Awned Club-sedge					x
				Isoetes drummondii	Plain Quillwort					x
				Isolepis sp.	Club-sedge					x
				Juncus bufonius	Toad Rush	x				
				Juncus flavidus	Gold Rush		x			x
				Juncus holoschoenus	Joint-leaf Rush		x			x
				Juncus subsecundus	Finger Rush					x
				Lachnagrostis filiformis var. 1	Common Blown-grass	x				x

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 602	EVC A114	EVC 815	EVC 55	EVC 235
			*	*Lactuca serriola*	Prickly Lettuce		x			
				Lilaeopsis polyantha	Australian Lilaeopsis		x			x
				Limosella australis	Austral Mudwort	x				x
				Lobelia concolor	Poison Pratia		x	x		x
			*	*Lolium rigidum*	Wimmera Rye-grass	x	x			x
			*	*Lysimachia arvensis (Blue-flowered variant)*	Blue Pimpernel	x				x
				Lythrum hyssopifolia	Small Loosestrife	x				x
				Marsilea drummondii	Common Nardoo		x	x		
				Marsilea hirsuta	Short-fruit Nardoo					x
			*	*Medicago polymorpha*	Burr Medic	x				x
				Mentha saturoides	Creeping Mint			x		
				Myosurus australis	Mousetail					x
				Myriophyllum integrifolium	Tiny Water-milfoil					x
				Neopaxia australasica	White Purselane		x			
				Ophioglossum lusitanicum	Austral Adder's-tongue					x
				Oxalis perennans	Grassland Wood-sorrel			x	x	x
			*	*Oxalis pes-caprae*	Soursob				x	
				Persicaria prostrata	Creeping Knotweed		x			
			*	*Petrorhagia dubia*	Velvety Pink					
			*	*Phalaris aquatica*	Toowoomba Canary-grass		x		x	x
				Plagiobothrys elachanthus	Hairy Forget-me-not					x
				Potamogeton cheesmanii	Floating Pondweed	x	x			
		k		*Ranunculus pumilio var. politus*	Ferny Small-flower Buttercup					x
				Ranunculus pumilio var. pumilio	Ferny Small-flower Buttercup	x	x	x		x
				Ranunculus sessiliflorus	Annual Buttercup					x
			*	*Ranunculus trilobus*	Three-lobe Buttercup		x			x
			*	*Romulea rosea*	Onion Grass					x
				Rumex brownii	Slender Dock		x			x
			*	*Rumex crispus*	Curled Dock	x				
				Rumex dumosus	Wiry Dock			x		x
				Rumex tenax	Narrow-leaf Dock			x		x
				Rytidosperma duttonianum	Brown-back Wallaby-grass			x		x

FFG	EPBC	VROTS	Origin	Scientific Name	Common Name	EVC 602	EVC A114	EVC 815	EVC 55	EVC 235
				Rytidosperma setaceum	Bristly Wallaby-grass				x	
				Senecio quadridentatus	Cotton Fireweed		x			
			*	*Sonchus asper s.l.*	Rough Sow-thistle		x			x
			*	*Sonchus oleraceus*	Common Sow-thistle	x				x
			*	*Sonchus tenerrimus*	Clammy Sow-thistle	x				
			*	*Trifolium arvense var. arvense*	Hare's-foot Clover			x		x
			*	*Trifolium glomeratum*	Cluster Clover					x
			*	*Trifolium repens var. repens*	White Clover	x				x
				Triglochin procera s.l.	Water Ribbons	x				
			*	*Vicia faba*	Broad Bean	x				
			*	*Vicia sativa subsp. nigra*	Narrow-leaf Vetch	x				
				Walwhalleya proluta	Rigid Panic		x		x	x
				Wurmbea dioica	Swamp Early Nancy			x		
				Wurmbea dioica subsp. lacunaria	Swamp Early Nancy					x

Appendix 4 –Wimmera Mallee Pipeline Wetlands EWMP Consultation

Organisation	Person (s)	How
Parks Vic	Evan McDowell, Zoe Wilkinson, Stuart Lardner	Seasonal Watering Proposals, Hydrology enhancement works
GWMWater	Kym Wilson, Bernie Dunn	Seasonal Watering Proposals, Hydrology enhancement works
Barengi Gadjin Land Council	BGLC Board and staff	Specific presentation re. Wimmera EWMPs, Hydrology enhancement works (staff only)
Councils (Buloke, Yarriambiack)	Planning dept. representatives	Hydrology enhancement works
Hindmarsh Shire	Tony Doyle, Doug Gowans	Specific presentation re. Wimmera EWMPs
Landholders	Peter and Bronwyn Martin (Pinedale) Russell Schultz (Schultz/Koschitzke) Richard and Merrilyn Opie (Opie's Dam) Mary Fielding (Fielding's Dam) Brian and Julie Koschitzke (Challambra, Schultz/Koschitzke)	Discussions throughout the Seasonal Watering Plan development process, review of draft EWMP chapters, involvement in hydrology enhancement works (some)
Yarrilinks	Tim Inkster	Discussions re. wetland watering program
Yarriambiack Creek Advisory Committee	Various	Written communication regarding wetland watering program