Wallenjoe Swamp Environmental Water Management Plan 2012

Goulburn Broken Catchment Management Authority

GOULBURN BROKEN
CATCHMENT MANAGEMENT AUTHORITY

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EXECUTIVE SUMMARY

This plan outlines the water regimes required to protect and enhance the water dependent environmental values for Wallenjoe Swamp. This information will inform the management of the wetlands and the development of seasonal watering proposal for wetlands in the Goulburn Broken Catchment for consideration by the VEWH.

Wallenjoe Swamp is a 359ha deep freshwater marsh located 7 km east of Corop Township in northern Victoria. The wetland provides important breeding habitat for Brolgas and contains the *Environment Protection Biodiversity Conservation Act* (1999) listed stiff groundsel (*Senecio behavianus*) within the Goulburn Broken Catchment and Victoria. The wetland is the third in a chain of four wetlands, is managed by Parks Victoria and is valued for its rarity, species diversity and waterbird habitat.

In the plan the following four ecological objectives have been established for the wetland:

- Improve the diversity of native wetland flora species to be consistent with Red Gum EVC benchmarks;
- reduce the cover and diversity of exotic flora species;
- provide opportunities for waterbird breeding especially Brolgas; and
- provide opportunities for native frogs breeding.

To achieve these ecological objectives minimum, optimum and maximum watering regimes are recommended. These are summarised in the table below. The ecological objectives and watering regimes were developed by a Scientific Technical Committee.

Watering Regime for Wallenjoe Swamp

Minimum – *Provide two flooding events in ten years, filling the wetland to variable depths to maintain Red Gum EVC with minimum water requirements to allow survival of existing vegetation.*

Optimum – *Provide five to seven flooding events in ten years, filling the wetland to variable depths to provide Red Gum EVC with appropriate watering requirements, allow the regeneration and recruitment of species within the wetland body and encourage breeding opportunities for aquatic fauna.*

Maximum – *Provide an annual flooding event over a ten year period, filling the wetland to variable depths to encourage growth of Red Gum EVC or breeding opportunities for aquatic biota.*

The plan also details potential risks associated with the delivery of environmental water to the wetland, opportunities to improve the environmental water delivery efficiency to the wetland, and key environmental water management knowledge gaps including the flood regime requirements of aquatic dependent ecological vegetation classes and their associated flora species such as Stiff groundsel.

The preferred means for delivering environmental water to Wallenjoe Swamp is to pass water down the Wanalta Creek via the Western Waranga Main Channel at Groves Weir, through One Tree Swamp and Two Tree Swamp. This raises three issues:

- Delivery is not currently feasible until works at One Tree Swamp and Two Tree Swamp are completed.
- The total volume of water required as environmental water for this site is considerably more than what is needed in Wallenjoe: in addition to Wallenjoe there is the volume required to fill One Tree Swamp and Two Tree Swamp, the connection channels and allowance for transmission losses.
- Management of Wallenjoe cannot be done independently of One Tree Swamp and Two Tree Swamp.

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ACKNOWLEDGEMENTS

This report could not have been developed without the assistance and patience of many individuals. Acknowledgement goes to the team at Australian Ecosystems for their consistent data collection within the Goulburn Broken Catchment wetlands and reports developed.

Members of the Scientific Technical Group which comprised Keith Ward, Timothy Barlow, Simon Casanelia and Jo Wood (Goulburn Broken Catchment Management Authority), Sam Green (Goulburn-Murray Water), Damien Cook (Australian Ecosystems) and Doug Frood (Pathways Bushland and Environment Consultant) for their input and development into the watering plans.

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ABBREVIATIONS

BE	Bulk Entitlement
CEWH	Commonwealth Environmental Water Holder
DPI	Department of Primary Industries
DSE	Department of Sustainability and Environment
EPA	Environment Protection Authority
EVC	Ecological Vegetation Class
EWaMP	Environmental Water Management Plan
EWR	Environmental Water Reserve
GB CMA	Goulburn Broken Catchment Management Authority
GL	Gigalitre (one billion litres)
G-MW	Goulburn-Murray Water
IVT	Inter-valley transfer
IWC	Index of wetland condition
kl	Kilolitre (one thousand litres)
km	Kilometre
MDBA	Murray-Darling Basin Authority
ML	Megalitre (one million litres)
NVIRP	Northern Victoria Irrigation Renewal Project
VEWH	Victorian Environmental Water Holder

1. INTRODUCTION

1.1 BACKGROUND

Environmental water management in Victoria is entering a new phase as ongoing water recovery sees significant volumes of water being returned to the environment. The increasing environmental water availability is providing new opportunities to protect, restore and reinstate high value ecosystems throughout northern Victoria. The spatial coverage of environmental watering has expanded considerably in recent years and this trend will continue into the future.

Environmental watering in Victoria has historically been supported by management plans, which document key information such as the watering requirements of a site, predicted ecological responses and water delivery arrangements. State and Commonwealth environmental watering programs now have the potential to extend beyond those sites that have been watered in the past. Therefore, new plans are required to provide a transparent and informed approach to environmental water delivery across new environmental watering sites.

1.2 PURPOSE

The Victorian Catchment Management Authorities (CMAs), Department of Sustainability and Environment (DSE) and the Victorian Environmental Water Holder (VEWH) are working together to develop new Environmental Water Management Plans for both current and future environmental watering sites throughout northern Victoria. The primary purpose of the plans is to provide a consistent set of documents that support Seasonal Watering Proposals to be submitted by CMAs to the Victorian Environmental Water Holder annually (section 6.3 – Implementation: Seasonally Adaptive Approach). The supporting information will include:

- lead management agencies and their management responsibilities;
- the water dependant environmental, social and economic values of the site;
- the site's environmental condition and threats;
- hydrological and ecological objectives;
- opportunities for improved water delivery, efficiency or capacity through structural works or other measures; and
- scientific knowledge gaps and recommendations for future work.

This document is the Environmental Water Management Plan for Wallenjoe Swamp in the Goulburn Broken Catchment Management region. This watering plan is not a holistic management plan for the site as it is limited to issues related to the management of water dependent values and environmental water.

1.3 REGION

The Goulburn Broken Catchment comprises the catchments of the Goulburn and Broken River. The catchment covers a total of 2,391,544 hectares or 10.5 per cent of Victoria's total land area (Figure 1) and approximately two per cent of the Murray Darling Basin's total land area (DNRE, 2002). Despite its small contribution to the total land area of the Murray Darling Basin, it generates 11 per cent of the basin's water resources. Within the Goulburn Broken Catchment approximately 2,000 natural wetlands have been recorded including a number of wetlands formally recognised for their conservation significance. These include the internationally significant Barmah Forest Ramsar site, ten wetlands of national significance listed in *A Directory of Important Wetlands in Australia* (EA, 2001) and 111 wetlands of bioregional significance identified for the *National Land and Water Resource Audit* (CoA, 2002). In addition, a large number of wetlands support state and nationally threatened biota communities and birds listed on international agreements and conventions.

Wallenjoe Swamp is a 359 hectare deep freshwater marsh within a 500 hectare Natural Features Reserve within the Goulburn Broken Catchment (Figure 1). The swamp is situated in the Wanalta wetland system, a 1,588.3 hectare wetland complex comprising the hydrologically connected One Tree Swamp (631 hectares), Two Tree Swamp (82 hectares), Wallenjoe Swamp (359 hectares) and Mansfield Swamp (516.3 hectares) (Figures 2 and 3). The wetlands are managed by Parks Victoria and are listed under *A Directory of Important Wetlands in Australia* (EA, 2001) as part of the Wallenjoe Wetlands listing (ref.VIC060; Figure 2). Wallenjoe Swamp is classified as a Natural Features Reserve – Wildlife Area under the VEAC investigation of 2008 (VEAC, 2008).

Wallenjoe Swamp is part of an extensive basin (Corop Lakes Drainage Area) formed by geological subsidence which occurred with the uplifting of the Mt Camel range to the south-west of the area (Felton, 1993) .

The Drainage area comprises three-sub catchments including the Cornella Creek system, Wanalta Creek and tributaries, and Woolwash Depression (DPI, 2007). The Wanalta Creek system has a catchment area of 28,400 hectares and terminates at One Tree Swamp, which flows into a larger wetland complex of Two Tree, Wallenjoe and Mansfield Swamps and forms part of the larger Timmering Depression (SKM, 2005).

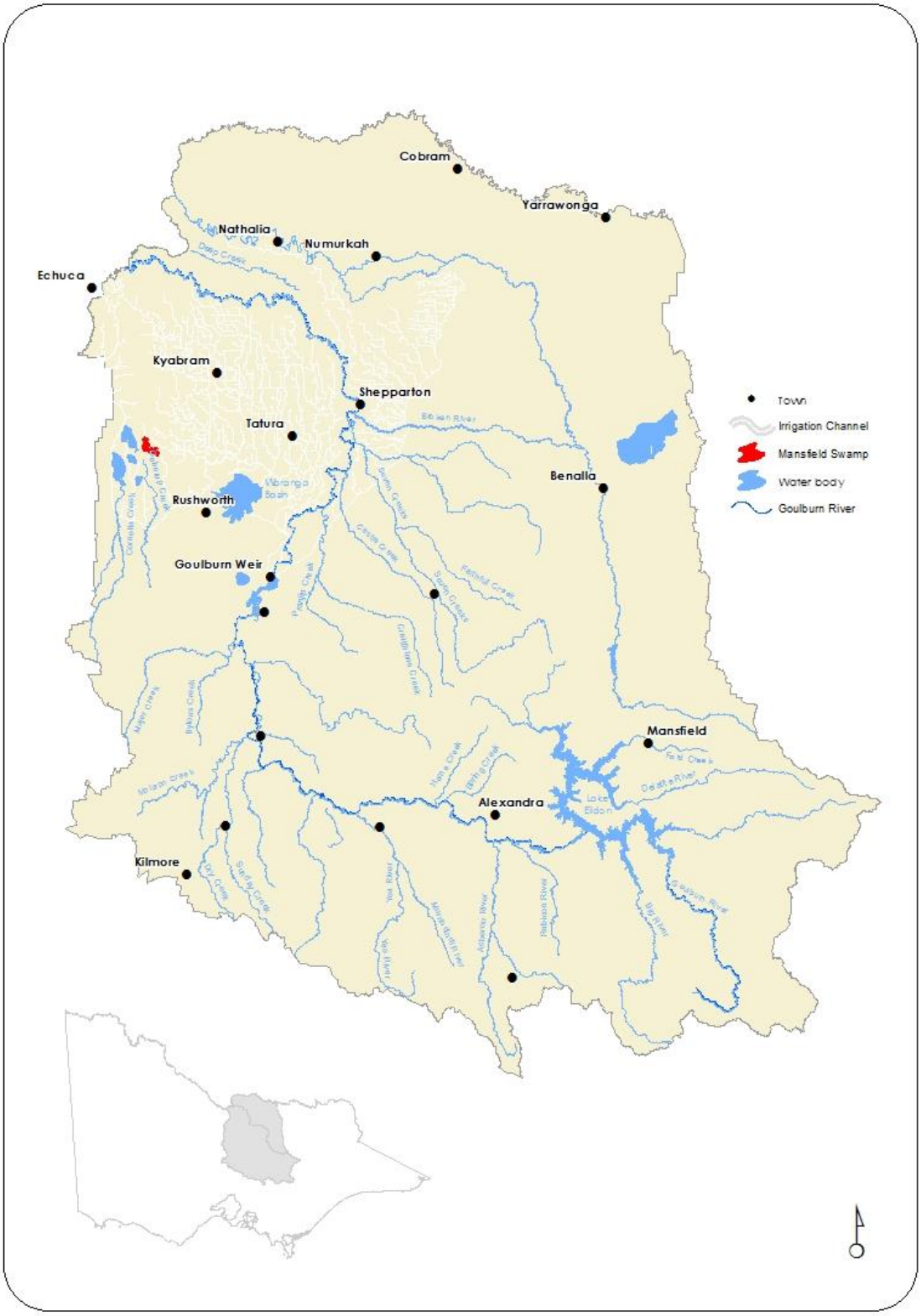

Figure 1: Wallenjoe Swamp within the Goulburn Broken Catchment

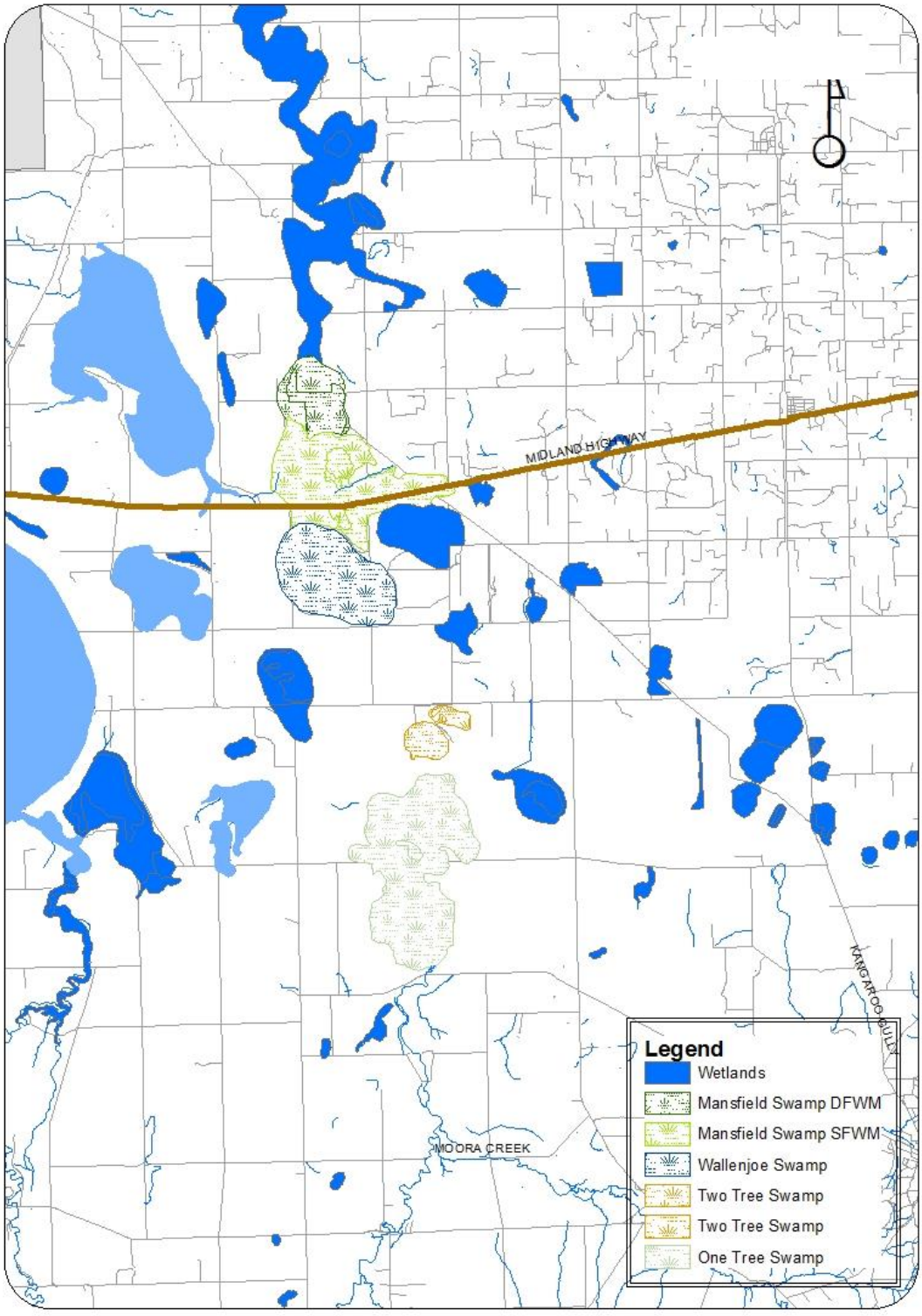

Figure 2: Wallenjoe Swamp within the Wanalta Wetlands complex and larger Corop Lakes area.

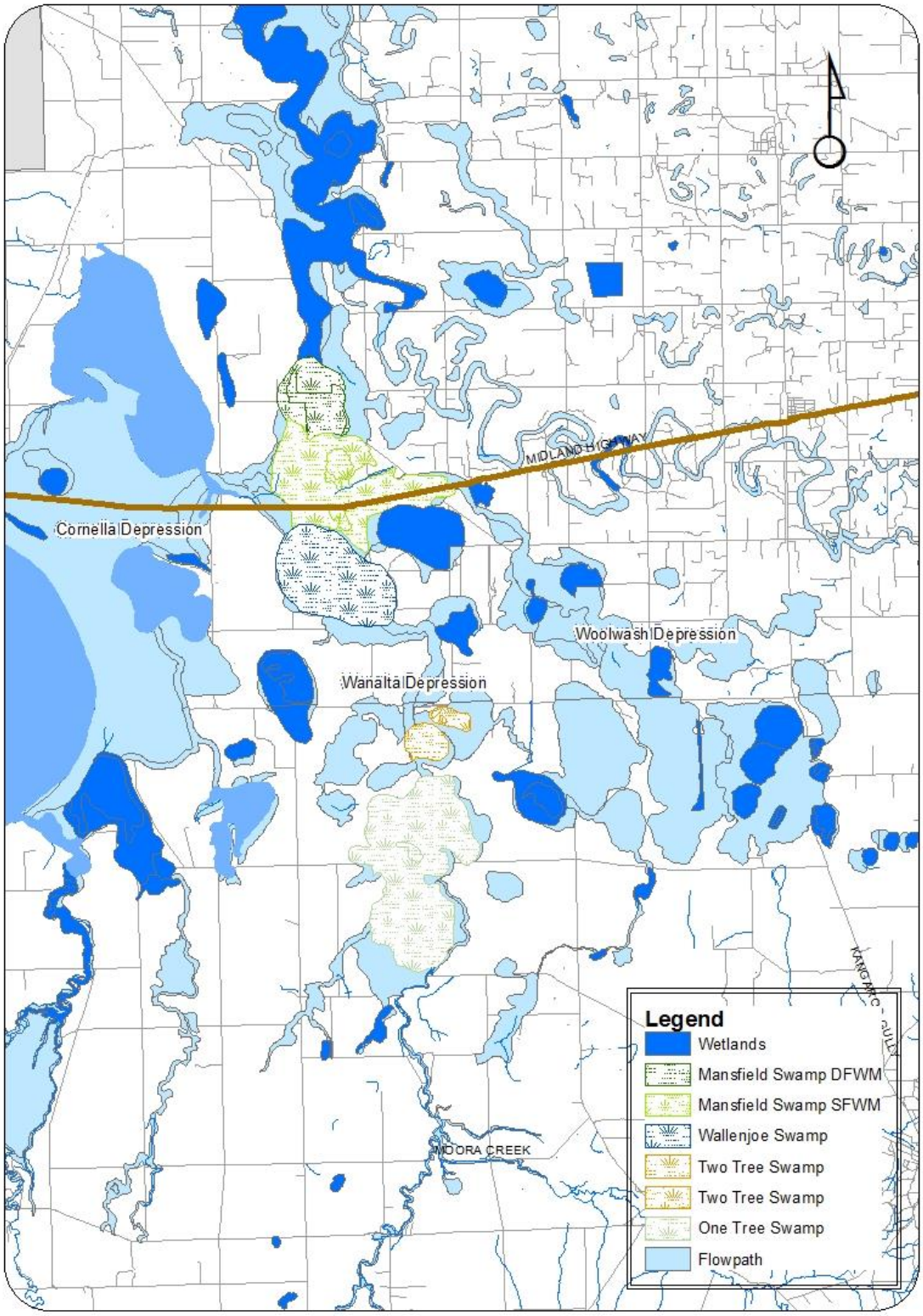

Figure 3: Wallenjoe Swamp along the flow path of the Wanalta Depression

1.4 CONSULTATION

This plan was prepared by the Goulburn Broken Catchment Management Authority with input from a Scientific Technical Committee. The Scientific Technical Committee developed ecological and hydrological goals for Wallenjoe Swamp at a workshop based on the local history of the swamp, knowledge of past and present watering regimes, the water requirements to support existing ecological values and the current condition of the swamp (Appendix 1). Members of the Scientific Technical Committee included Sam Green (Goulburn-Murray Water), Damien Cook (Australian Ecosystems), Doug Frood (Pathways Bushland and Environment), Keith Ward, Timothy Barlow, Jo Wood and Simon Casanelia (Goulburn Broken CMA). Draft plans of this report were submitted to members of the Goulburn Broken Wetland Management Group.

1.5 INFORMATION SOURCES

Information used in the development of this Plan was compiled from various sources including:

- Goulburn Broken Regional River Health Strategy (GBCMA, 2005a);
- Corop Lakes Drainage Area Strategy: Wallenjoe Swamp (Felton, 1993);
- Wanalta Creek Wetlands – Identification of water regime for One Tree, Two Tree and Wallenjoe Swamp (SKM, 2005).
- Scoping Infrastructure Works for Priority Wetlands in the Shepparton Irrigation Region. Wallenjoe Swamp (Paynter, 2011).
- Monitoring ecological response to flooding. A study of One Tree, Two Tree, Wallenjoe and Mansfield Swamps in the Goulburn Broken Catchment (Cook and Jolly, 2011).

This information was supplemented by discussions with people with an intimate knowledge of the swamp area, its environmental values, and the management and operation of Wallenjoe Swamp.

In addition, a number of state-wide data sets and digital mapping layers were used including:

- Flora Information System of Victoria (DSE, 2005a);
- Atlas of Victorian Wildlife (DSE, 2007a);
- Bioregional Conservation Status of Ecological Vegetation Classes;
- Wetland environments and extent up to 1994; and
- Moira Shire Aerial photography (2007 layer).

1.6 LIMITATIONS

The information sources used in the development of this report have a number of limitations. The data in the Flora Information System and the Atlas of Victorian Wildlife comes from a combination of incidental records and systematic surveys. The data varies in accuracy and reliability due to the distribution and intensity of survey efforts. In addition, the lack of knowledge about the distribution and characteristics of invertebrates and non-vascular plant species means the data is weighted towards the less cryptic elements of flora and fauna, i.e. vascular flora and vertebrates. The water regime for Wallenjoe Swamp discussed in this Plan was developed using local knowledge, technical experts, field observations and scientific literature on the water requirements of relevant aquatic flora and fauna where available.

This report also draws on material collated from management plans, research documents and published literature. These sources vary in their age and hence the degree to which they reflect the current situation. However, the Plan intends to be a live document and will be amended as new information becomes available.

2. SITE OVERVIEW

2.1 CATCHMENT HISTORY

Wallenjoe Swamp is part of the larger Corop Lakes drainage area situated in the Victorian Riverina Bioregion (Figure 2). The area is characterised by flat to gently undulating landscape on Recent unconsolidated sediments with evidence of former stream channels and wide floodplain areas associated with major river systems and prior streams. Alluvium deposits from the Cainozoic period gave rise to the red brown earths and texture contrast soils which dominate Riverine Plain (DSE, 2011). The Corop Lakes area is characterised by the large meandering Timmering Depression and the Cornella, Woolwash and Wanalta Creeks. Wallenjoe Swamp the third swamp in the chain of Wanalta Wetlands which are classified as nationally significant in A Directory of Important Wetlands – VIC 060 (EA, 2001). The Wanalta Creek catchment is approximately 284Km^2 comprising Wanalta Creek, Nine Mile and Five Mile Creeks (Corrick and Cowling, 1978).

Prior to European settlement Wallenjoe Swamp was a seasonal open stand Red Gum Swamp filling on an annual basis in winter-spring from rainfall and run-off in the surrounding catchment and drying annually in summer-autumn (Felton, 1993). Wallenjoe Swamp would have naturally received water from the Wanalta depression and catchment run-off (Figure 3).

Post-European settlement saw 192.6 hectares of Wallenjoe Swamp become a reserved forest area. A meeting of the Echuca and Waranga United Waterworks Trust held at Corop in 1884 saw the application for the inclusion of Wallenjoe Swamp into the Trusts territory (Anon, 1884). The Swamp was utilised as a hunting area for Ducks and Painted Snipe (Chisholm, 1933). Wallenjoe Swamp was described as an open stand of very mature Red Gums receiving natural drainage water from One Tree and Two Tree Swamp. In 1962 a contract to mill 100,000 su.ft of River Red Gum logs from the swamp was awarded to a G. Sparkes. However, only 7,333 su.ft of Red Gum logs was removed from the Swamp as each log had at least a 50% defect allowance and logging at the Swamp ceased after this contract (Fleming, 1966). In 1966, a letter was written to the Forests Commission in Melbourne to turn Wallenjoe Swamp into a Wildlife Reserve.

Between 1976-77 land surrounding the 192.6 hectare forest reserve was purchased and sheep grazing was withdrawn for the Wildlife Reserve proclamation (Anon, 1990). In 1981 the Land Conservation Council declared Wallenjoe Swamp a Wildlife Reserve.

Over 60 per cent of the Goulburn Broken Catchment has been cleared for agricultural purposes (Miles et al., 2010). Wallenjoe Swamp lies within the Rochester Irrigation district where cropping and livestock production occurs. Drainage, land forming and river regulation have also significantly reduced the number and area of wetland habitats within the district. Therefore, the remnant vegetation and wetland within the Rochester catchment form an important corridor in the catchment and are a stronghold for native flora and fauna.

2.2 LAND STATUS AND MANAGEMENT

Wallenjoe Swamp is managed by Parks Victoria as a Natural Features Reserve – Wildlife Area (section 2.3 – Wetland Characteristics, Figure 3). A range of management agencies are also responsible for ensuring that management of the study area complies with a broad range of legislative requirements. Lead management agencies and their key responsibilities are summarised in Table 1. The broader community including adjacent landholders, Yorta Yorta Peoples (section 3.4.1 - Cultural heritage values), Landcare, Trust for Nature and recreational users also have an interest and role in the management of the planning area. The successful management of the study area therefore relies on effective cooperation and partnership between the government agencies and the broader community.

Table 1: Lead government agencies and their key study area responsibilities

Agency	Responsibility
Aboriginal Affairs Victoria	Promote knowledge and understanding within the wider community of the study area's Aboriginal people and their history. Administer legislation protecting Aboriginal heritage sites within the study area (*State Aboriginal Heritage Act 2006* and Part IIA of the Commonwealth *Aboriginal Torres Strait Islander Heritage Protection Act 1984*).
Department of Primary Industries	Provide technical and extension support for the sustainable management of fisheries, agriculture, minerals and petroleum. Management of hunting on public land.
Department of Sustainability and Environment	Provide financial, policy and strategic support for the management of public and private land. Management of flora and fauna, State Forest and public Land Water Frontage.
Environmental Protection Authority	Protect, restore and enhance air, land and water quality and control of unwanted noise.
Goulburn Broken Catchment Management Authority	Implementation of the Goulburn Broken Regional Catchment Strategy. Works on waterways, regional drainage and floodplain management, and co-ordinating Commonwealth and State natural resource management investment. Determining the environmental water requirements of swamps and streams, developing and submitting annual water proposals to DSE for consideration, and managing the delivery of environmental water in accordance with DSE's watering plan.
Goulburn-Murray Water	Manages water related services including storage, delivery and drainage systems across Northern Victoria.
Murray-Darling Basin Authority	The Murray-Darling Basin Authority's principal aim is to manage the Basin's water resources in the national interest.
Parks Victoria	Management of Wallenjoe Swamp Wildlife Area.
Victorian Environmental Water Holder	Management of environmental water entitlements on behalf of the Minister for Environment as of July 2011.

2.3 WETLAND CHARACTERISTICS

Wetlands in Victoria are currently classified using a system developed by Corrick and Norman (1980, Appendix 2) which includes information on water depth, permanency and salinity (Corrick and Norman, 1980). Wetlands through Victoria were mapped and classified between 1975 and 1994 and developed into spatial layers (DSE, 2007b). Wallenjoe Swamp is classified as a deep freshwater marsh in the Department of Sustainability and Environment wetlands 1994 layer. It is classified as a Red Gum Swamp and has a mean depth of 0.95m and has a calculated capacity of 3410.5ML[1]. The wetland is located within the Victorian Riverina Bioregion within the Wanalta Creek Catchment (Table 2 and Figures 2 &3). Wallenjoe Swamp was previously classified as a State Game Reserve but in 2010 was classified as a Wildlife Area by the Victorian Environmental Advisory Council (VEAC, 2008).

Approximately 85 per cent of Wallenjoe Swamp is public land (Figure 4) surrounded by irrigated agriculture. Environmental water has not been delivered to the swamp due to lack of infrastructure (section 8 – Environmental Water Infrastructure). Wanalta Creek is the primary source of water for Wallenjoe Swamp. This water passes through One Tree and Two Tree Swamps before entering Wallenjoe Swamp.

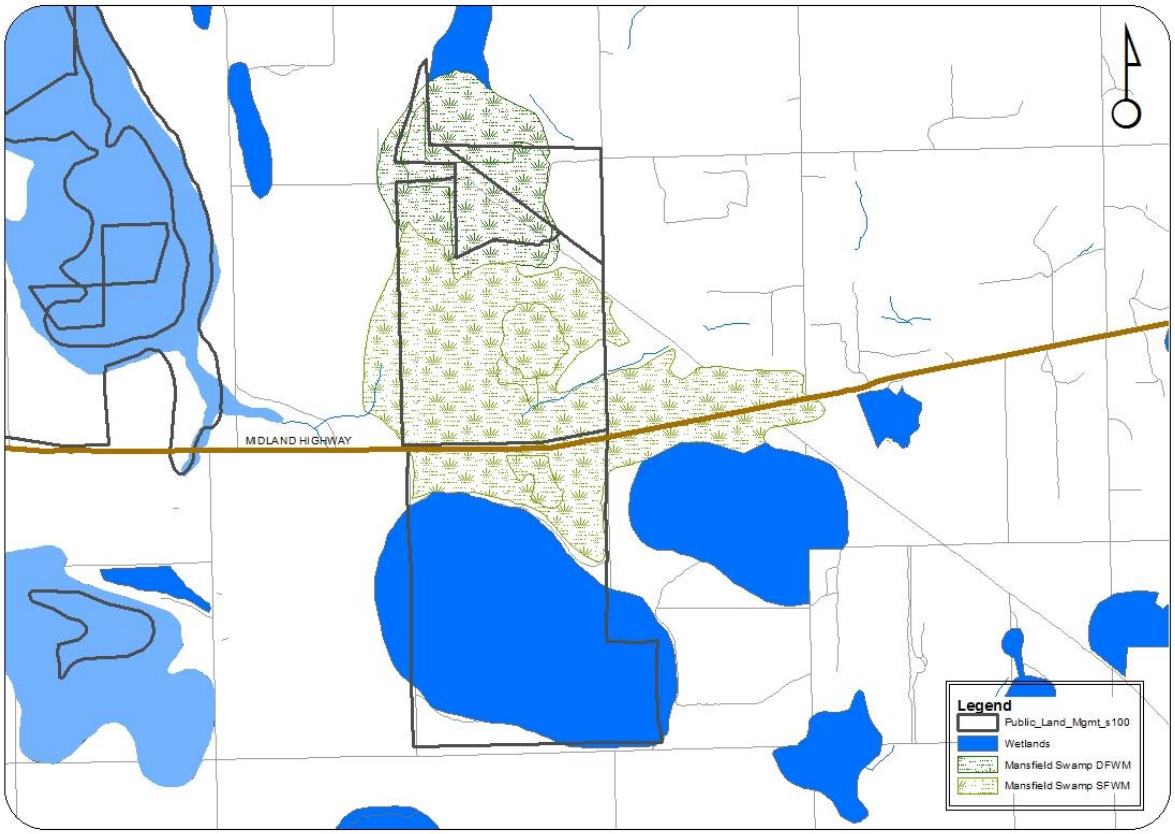

Figure 4: Wallenjoe Swamp public land boundary

[1] Environmental water allocation volumes will vary corresponding with ecological and hydrological targets that need to be met at time of delivery.

Table 2: Summary of site characteristics

Characteristics	Description
Name	Wallenjoe Swamp
Mapping Id	782598612
Area (ha)	359
Bioregion	Victorian Riverina
Conservation Status	National^
Land Status	Public
Land Manager	Parks Victoria
Surrounding Land Use	Irrigated Agriculture
Water Supply	Wanalta Depression
1788 Wetland Category	Deep Freshwater Marsh
1994 Wetland Category	Deep Marsh
Wetland Capacity (ML)	3,410.5#
Mean wetland depth at Capacity (m)	0.95m*

2.4 ENVIRONMENTAL WATER SOURCES

The Environmental Water Reserve is the legally recognised amount of water set aside to meet environmental needs. The reserve includes minimum river flows, unregulated flows and specific environmental entitlements. Environmental entitlements are held in storage and if available and required can be delivered to wetlands or streams to protect their environmental values and health. Environmental entitlements are held by the Victorian Environmental Water Holder.

Environmental water for Wallenjoe Swamp can be sourced from the Victorian River Murray Flora and Fauna Bulk Entitlement. This bulk entitlement has a source volume of 27,600ML and is managed by the Victorian Environmental Water Holder.

Future water reserves that may also be used in Wallenjoe Swamp include water savings from the Goulburn-Murray Water Connections Project (previously the Northern Victoria Irrigation Renewal Project (NVIRP)) and environmental water held by the Commonwealth Environmental Water Holder (CEWH) (Appendix 3).

2.5 LEGISLATIVE AND POLICY FRAMEWORK

There is a range of international treaties, conventions and initiatives, as well as National and State Legislation, policies and strategies that direct management of the study area. Those with particular relevance to the study area and the management of its environmental and cultural values are listed below. For the functions and major elements of each refer to Appendix 4.

International treaties, conventions and initiatives:

- Japan Australia Migratory Birds Agreement (JAMBA) 1974.
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 1979.
- China Australia Migratory Birds Agreement (CAMBA) 1986.
- Republic of Korea Australia Migratory Birds Agreement (ROKAMBA) 2002.

Commonwealth legislation and policy:

- *Australian Heritage Commission Act* 1975 (Register of the National Estate).
- *Aboriginal and Torres Strait Islander Heritage Protection Act* 1984 (Part IIA).
- *Native Title Act* 1993.
- Wetlands Policy of the Commonwealth Government of Australia 1997.
- *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act).
- *Water Act* 2007.
- A Framework for Determining Commonwealth Environmental Watering Actions 2009.

Victorian legislation:

- *Crown Land (Reserves) Act* 1978.
- *Flora and Fauna Guarantee Act* 1988.
- *Water Act* 1989.
- *Catchment and Land Protection Act* 1994.
- State Environment Protection Policy (Waters of Victoria) 2003.
- *Aboriginal Heritage Act* 2006.

Victorian policy, codes of practice, charters and strategies:

- Goulburn Broken Catchment Regional Catchment Strategy (GBCMA, 2003).
- Our Water Our Future (DSE, 2004).
- Goulburn Broken Regional River Health Strategy (GBCMA, 2005b).
- Northern Region Sustainable Water Strategy (DSE, 2009b).
- Biodiversity Strategy for the Goulburn Broken Catchment, Victoria 2010-2015 (Miles et al., 2010).

2.6 RELATED PLANS AND ACTIVITIES

A number of key management documents have been written that directly or indirectly assist with management of Wallenjoe Swamp. These include:

- Corop Lakes Drainage Area. Salinity/Drainage Management Strategy. Individual Wetland Strategy: Wallenjoe Swamp (Felton, 1993).
- Environmental Management Requirements for the Corop Lakes Drainage Area: Timmering and Woolwash Depression (DCE, 1993).
- Stiff Groundsel (*Senecio beharianus*) Recovery Plan 1999-2001 (Alexander, 1999).
- Wanalta Depression Drainage Course Declaration (SKM, 2001).
- Wanalta Creek Wetlands – Identification of water regime for One Tree, Two Tree and Wallenjoe Swamp (SKM, 2005).
- Conservation Plan for the Timmering Landscape Zone: Biodiversity in the Shepparton Irrigation Region (Heard et al., 2007).
- National Recovery Plan for the Stiff Groundsel *Senecio behrianus* (Nevill and Camilleri, 2010)
- Scoping Infrastructure Works for Priority Wetlands in the Shepparton Irrigation Region. Wallenjoe Swamp (Paynter, 2011).

3. WATER DEPENDENT VALUES

3.1 FAUNA

3.1.1 FAUNA LISTINGS AND SIGNIFICANCE

Wallenjoe Swamp provides habitat for a variety of water dependent and terrestrial species. To date 84 native species have been recorded at the Swamp (Appendix 5). These include 76 birds, 5 frogs, 2 reptiles and 1 marsupial. Of these 49 are wetland dependent species one is listed under the *Convention on the Conservation of Migratory Species* (*Bonn*), three are listed under the *Flora and Fauna Guarantee Act* (1988), ten are considered vulnerable or near threatened on the *DSE Advisory list of threatened vertebrate fauna in Victoria* (2007) (Table 3 for wetland species and Appendix 5 for all species). Two species are listed under the Japan Australia Migratory Bird Agreement (JAMBA), two are listed under the China Australia Migratory Bird Agreement (CAMBA) and one is listed under the Republic of Korea Australia Migratory Agreement (ROKAMBA). At an international level, the Wanalta wetlands including Wallenjoe Swamp also plays an important role in providing habitat for international migratory species such as Latham's Snipe (*Gallinago hardwickii*).

Many waterbirds such as ducks, herons, spoonbills and moorhens, utilise Wallenjoe Swamp as a breeding and feeding ground. Historical records show that in the 1960s Wallenjoe Swamp was a breeding ground for Australasian Shovelers (*Anas rhynchotis*), Yellow-billed Spoon-bills (*Platalea flavipes*), Nankeen Night Herons (*Nycticorax caledonicus*) and Australian White Ibis (*Threskiornis molucca*) and were sighted in nests 60 feet off the ground (Bright, 1966). Monitoring of Wallenjoe Swamp in 2012 found Dusky Moorhens (*Gallinula tenebrosa*), Pink-eared Ducks (*Malacorhynchus membranaceus*) and Australian Shelduck (*Tadorna tadornoides*) were breeding at the swamp. Plumed Whistling Duck (*Dendrocygna eytoni*) was observed in Wallenjoe Swamp in January 2011 (Cook and Jolly, 2011) (Figure 5).

Brolga (*Grus rubicunda*) have been recorded nesting at Wallenjoe Swamp (Weber, 2012) and will be the focal species for this watering plan (section 3.1.2-Significant Fauna).

Five amphibians were recorded at Wallenjoe Swamp is 2011, with evidence of a *Limnodynastes* species having bred. Aquatic invertebrates and fish populations have not been monitored at Wallenjoe Swamp and should be monitored in the future to determine a more complete picture of the Wallenjoe Swamp food web and the importance of the wetland in the landscape (refer to section 9 – Knowledge gaps and recommendations).

Table 3: Conservation status of fauna species recorded at Wallenjoe Swamp

Common Name	Scientific Name	Type	International agreements	FFG	DSE Status
Australasian Shoveler	*Anas rhynchotus*	B			Vul
Azure Kingfisher	*Alcedo azurea*	B			NT
Brolga	*Grus rubicundas*	B		L	Vul
Eastern Great Egret	*Ardea modesta*	B	J,C	L	Vul
Hardhead	*Aythya australis*	B			Vul
Latham's Snipe	*Gallinago hardwickii*	B	J, C, R, B		NT
Musk Duck	*Biziura lobata*	B			Vul
Nankeen Night Heron	*Nycticorax caledonicus*	B			NT
Royal Spoonbill	*Platalea regia*	B			Vul
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	B	C	L	Vul

Legend
Type: (Bird (B)
International: CAMBA (C), JAMBA (J), ROKAMBA (R), Bonn (B)
FFG Status: Listed as threatened (L)
DSE Status: Vulnerable (Vul), Near Threatened (NT)

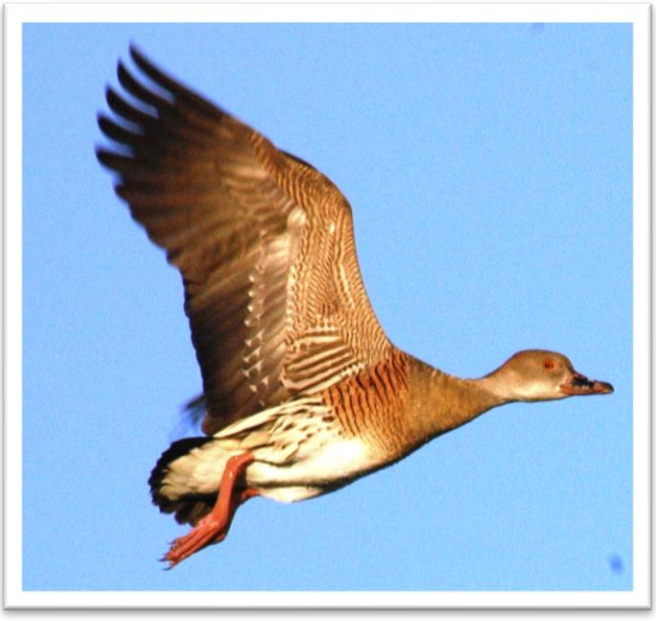

Figure 5: Plumed Whistling Duck observed at Wallenjoe Swamp, January 2011

Photo D. Cook, Australian Ecosystems 2011

3.1.2 SIGNIFICANT FAUNA

Wallenjoe Swamp provides critical breeding habitat for Brolgas. The protection of the Southern Cane-grass (*Eragrostis infecunda*) in the swamp is required to ensure breeding habitat for the Brolgas is maintained. Brolgas breed in response to flooding (Rogers and Ralph, 2011). Brolga numbers in Northern Victoria have diminished rapidly over the past few decades and it is imperative that these wetlands are protected to allow Brolgas breeding to occur. Brolgas flock together between December and May usually in areas with deep freshwater marshes. Greens Lake north of Gaynor Swamp is usually a flocking area for Brolgas. This flocking behaviour may be the beginning of initial pair bonding between Brolga (Arnol et al., 1984). Between May and August Brolgas scope areas for nesting sites and breeding pairs return to traditional nest swamps waiting for them to fill (Arnol et al., 1984). Nest construction begins around July and August when wetlands fill from winter rains. Egg laying and incubation occur between August and December with nests being built in water less than 30cm deep (Arnol et al., 1984), and eggs being incubated for 31 days (Rogers and Ralph, 2011). Young are reared between October and December (Figure 6) and one to two days after hatching the chicks leave the nest and are totally dependent on their parents for food, warmth and protection for two to three months (Arnol et al., 1984).

Figure 6: Juvenile Brolga sighted at One Tree Swamp, January 2011.

Photo: D.Cook, Australian Ecosystems 2011

3.2 FLORA - VEGETATION COMMUNITIES

A hierarchical system of classification of vegetation classes has been developed in Victoria over the past decade in order to classify vegetation into units that are both ecologically meaningful and useful for vegetation managers. The classification that has been adopted in Victoria is Ecological Vegetation Classes (EVCs), which are defined by a combination of floristics, lifeform, position in the landscape and an inferred fidelity to particular environments. Each EVC includes a collection of floristic communities that occur across a biogeographic range and although differing in species, have similar habitat and ecological processes operating. Approximately 300 EVCs have been described for Victoria.

Red Gum Swamp (EVC #292) covers 100% of Wallenjoe Swamp and is classified as vulnerable in the Victorian Riverina Bioregion (Table 4). Understory species characteristic of Red Gum Swamp EVC recorded at Wallenjoe Swamp include graminoids such as *Carex tereticaulis* (Poong'ort) and *Eleocharis acuta* (Common Spike-sedge) and herbs such as *Marsilea drummondii* (Common Nardoo). Southern Cane-grass grows within Wallenjoe Swamp and is an important nesting material for Brolgas (Cook and Jolly, 2010).

Table 4: Conservation status of water-dependent Ecological Vegetation classes recorded at Wallenjoe Swamp

EVC C number	EVC Name	Bioregional Conservation Status
292	Red Gum Swamp	Vu

Vu = Vulnerable. Meaning the EVC is moving towards extinction with 70% or more of these areas having been cleared since European settlement.

3.2.1 FLORA – SPECIES LISTING AND SIGNIFICANCE

A total of 62 native flora species have been recorded at Wallenjoe Swamp including 40 water dependent species (Appendix 7 for all flora species). Of these species, three are considered rare, vulnerable or endangered in Victoria under the *Advisory list of Rare or Threatened Plants in Victoria* (DSE, 2005a), one is listed under the *Flora and Fauna Guarantee Act* (1988) and the *Environmental Protection Biodiversity Conservation Act* (1999) (Table 5).

Table 5: Listed water-dependent flora species recorded at Wallenjoe Swamp

Common Name	Scientific Name	EPBC Status	FFG Status	DSE Status
Annual Bitter-cress	*Cardamine paucijuga s.l*			v
Stiff Groundsel	*Senecio behrianus*	E	L	en
Slender Water-ribbons	*Triglochin dubia*			r

Legend: EPBC Status: Endangered (E), Vulnerable (V)**;** FFG Status: Listed as threatened (L)**:** DSE Status: Endangered (en), Vulnerable (v), Rare (r)

3.2.2 FLORA - SIGNIFICANCE

Stiff groundsel was presumed to be extinct until it was found in the Corop area in 1991 (Nevill and Camilleri, 2010). Its decline can be attributed to the clearance of habitat and/or a change in flooding regime at sites (DSE, 2005b). It is found in freshwater marsh areas that retains seasonal flooding and are usually dominated by Cumbungi (*Typha sp*), Lignum and Common Nardoo (Alexander, 1999) with a flooding depth of approximately 30cm (Nevill and Camilleri, 2010). Sparse flowering occurs from January to May and stems can grow up to 1 metre in length in wet areas (Alexander, 1999). Populations spread by woody rhizome as there is no evidence of regeneration by seed. It is a short, woolly perennial forb usually 15 to 100cm high with grey-green leaves and yellow flower heads (Figure 7). Due to the small number of populations of Stiff groundsel, the known habitat requirements are limited to generalisations and are a significant knowledge gap. The current population of Stiff groundsel found at Wallenjoe Swamp was introduced via planting in 2003-05. This was actioned within the National Recovery Plan 1999-2001 (Alexander, 1999).

Figure 7: Stiff Groundsel (*Senecio beharianus*).

Photo: D. Cook, Australian Ecosystems 2011

Southern Cane-grass is a significant species for Brolga breeding and is considered as a focal flora species for this plan.

Southern Cane-grass grows rapidly in response to rainfall or flooding (Figure 8). It flowers between September and May in response to rainfall (Roberts and Marston, 2011). It tolerates a flooding duration of 1-6 months at an approximate depth between 10-50cm and a flooding frequency of 2-3 years (Roberts and Marston, 2011).

Figure 8: Southern Cane-grass (*Eragrostis infecunda*).

Photo: D. Cook, Australian Ecosystems 2011

3.3 WETLAND DEPLETION AND RARITY

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

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

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

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

Comparison between the wetland layers has demonstrated the impact of European settlement and development on Victorian wetlands. This has been severe, with approximately one-third of the state's wetlands being lost since European settlement; many of those remaining are threatened by continuing degradation from salinity, drainage and agricultural practices (EA, 2001). Across the state, the greatest losses of original wetland area have been in the freshwater meadow (43%), shallow freshwater marsh (60%) and deep freshwater marsh (70%) categories (DNRE, 1997).

Wallenjoe Swamp is classified as a Deep Freshwater Marsh in the 1994 wetland layer. Deep Freshwater marshes within the Goulburn Broken Catchment tend to be smaller and less permanent than some other wetland types and therefore more susceptible to changes in conditions as a result of threats impacting upon them including drainage and water regulation (GBCMA, 2006, Lyon et al., 2002) and have declined by 70 percent.

3.3.1 ECOSYSTEM FUNCTIONS

Wetlands are considered ecologically important due to their role in maintaining biological diversity, promoting biochemical transformation and storage and decomposition of organic materials (DSE, 2007b).

These wetlands perform important functions including:

- enhancing water quality through filtering sediments and re-using nutrients;
- absorbing and releasing floodwaters;
- providing feeding, breeding and drought refuge sites for an array of flora and fauna, especially waterbirds and fish.

However, the capacity of floodplain wetlands to perform the ecological functions outlined above will depend on their condition (section 5 – Threats and Condition).

3.4 SOCIAL VALUES

3.4.1 CULTURAL HERITAGE

Wallenjoe Swamp has been identified as a culturally sensitive area (Figure 9) and the surrounding catchment has a long history of Indigenous occupation and is an important part of their cultural and spiritual heritage. Culturally sensitive areas are classified under the Aboriginal Heritage Act 2006 (Vic) as waterways or land within 200m of waterway.

Wallenjoe Swamp would have been a place of concentrated resources due to the abundance of bird life and terrestrial animals attracted by the wetland, as well as the wetland plants that could be harvested. The larger Corop catchment is also contains a known Aboriginal quarry on the Camel Ranges where greenstone was obtained for use in the manufacture of stone axes. Due to the location of Wallenjoe Swamp in close proximity to several Traditional Owner groups it is likely that the area was utilised as a shared resource when food sources were limited in the broader region' (Sutherland, 2011).

There are a total of 13 registered Aboriginal Archaeological sites identified by Aboriginal Affairs Victoria within a 5 km radius of the Wallenjoe Swamp Wildlife Reserve.

The Yorta Yorta Cooperative Management Agreement was signed in 2004. The agreement establishes a formal role for the Yorta Yorta Peoples in the management of land and water in their traditional country. The Yorta Yorta Nations in their draft Greater Regional Natural Resource Management Plan set out a number of objectives to protect the regions native ecosystems and biodiversity including:

- to restore, maintain and protect all native ecosystems; and
- ensure the long term viability of populations and species considered rare and endangered, threatened or of special concern.

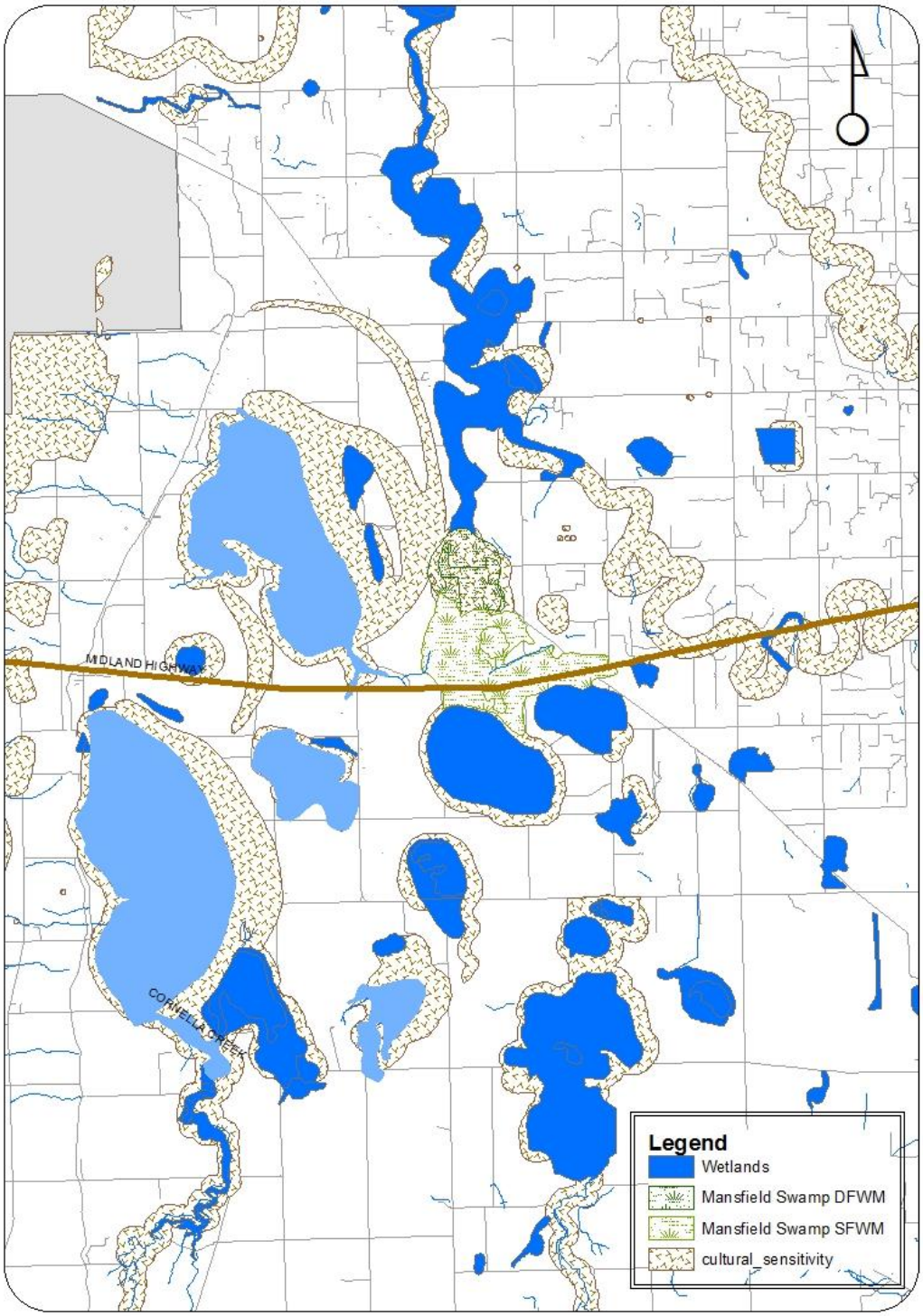

Figure 9: Culturally sensitive areas within and around Wallenjoe Swamp.

3.4.2 RECREATION

Activities enjoyed by visitors to the swamp include bird watching, picnicking, bike riding and walking. None of these activities are directly dependent on wetland flooding. However, wetland flooding can enhance the enjoyment of visitor's activities by providing more diverse habitat and fauna experiences.

3.5 ECONOMIC

Wetlands provide both direct and indirect economic values to Goulburn Broken Catchment (Cork et al., 2001) . The direct economic values that Wallenjoe Swamp provides to the Goulburn Broken Catchment include consumptive uses such as hunting and non-consumptive uses such as tourism and recreation. Indirect economic values that Wallenjoe Swamp provides to the Goulburn Broken Catchment include water filtration, flood protection, water storage, groundwater recharge, nutrient discharge, carbon storage and habitat for threatened flora and fauna species.

4. HYDROLOGY AND SYSTEM OPERATIONS

Wetland hydrology is the most important determinant in the establishment and maintenance of wetland types and processes. It affects the chemical and physical aspects of the wetland which in turn affects the type of flora and fauna that the wetland supports (DSE, 2007b). A wetland's hydrology is determined by surface and groundwater inflows and outflows in addition to precipitation and evapotranspiration (DSE, 2007b). Duration, frequency and seasonality (timing) are the main components of a wetland's hydrological regime.

4.1 WATER MANAGEMENT AND DELIVERY

4.1.1 PRE-REGULATION

Under natural conditions, Wallenjoe Swamp was a seasonal wetland dominated by River Red Gums and hosted a variety of seasonal wetland flora and fauna species. Flows to the swamp were mainly seasonal floodwaters from the Wanalta Depression and local catchment run-off. Before the construction of the channel, flows from the Wanalta Creek system would have flowed along the chain of wetlands of One Tree, Two Tree and Wallenjoe Swamp before ending up in Mansfield Swamp.

4.1.2 POST-REGULATION

Settlement in the Corop Catchment occurred around the 1840s. Land was cleared for grazing and cropping. The natural wetting and drying cycles of wetlands within this region have been significantly altered since regulation of the Wanalta Creek in 1909 when the Waranga Western Main Channel (WWMC) was constructed (VEAC, 2008). Flows from the Wanalta Creek enter the Waranga Western Main Channel at Groves Weir and are harvested for irrigation purposes. A regulator on Groves Weir allows flows to pass down Wanalta Creek towards the chain of Wanalta Wetlands and is only opened by the water manager during high flow events or every second winter during channel maintenance between May and August.

At present the dominant source of inflow into Wallenjoe Swamp is from the Wanalta Creek via One Tree, Two Tree Swamps (Paynter, 2010). Drought conditions and harvesting of flows from the Wanalta Creek over the past decade have seen episodic and irregular flows in the Wanalta Creek causing minimal flows entering One Tree, Two Tree, Wallenjoe and Mansfield Swamps. Flooding in 2010, 2011 and 2012 has seen Wallenjoe Swamp become wet again.

Prolonged flooding at Wallenjoe Swamp has occurred under both natural and man-made conditions. More recent records show that prolonged flooding occurred at the Swamp in 1950-51, 1973-75, and 1993-94 and again in 2010-12. Flooding of the Swamp during the 1970s saw the prolific growth of river red gum juveniles; this has now caused significant thickets within the swamp. In 1993, Wallenjoe Swamp was again under threat from prolonged flooding, outfalls from Central Goulburn Channel 14 and saline groundwater discharge (Felton, 1993). Between 1995 and 2010 the Swamp became dry due to a prolonged dry period,

with intermittent wetting occurring only. In 2010 flooding occurred and the swamp was again under threat of prolonged wetting. The wetland is currently experiencing a dry period (2014).

4.1.3 WETLAND VOLUME

Based on field measurements Wallenjoe Swamp is 359 hectares in size and has an average depth of approximately 0.95m. The volume of the swamp equates to approximately 3410.5 ML. It is estimated, however that approximately 50 per cent more of this volume would be required to compensate against loss to the soil profile in the event that environmental water was to be released to fill the wetland from a dry state.

4.1.4 ENVIRONMENTAL WATER

Environmental water has not been delivered to Wallenjoe Swamp. Potential pathways for delivering water to Mansfield Swamp includes: releases from the Western Waranga Main Channel via Wanalta Creek at Groves Weir and along the chain of One Tree, Two Tree Swamps or using non-backbone channels such as Central Goulburn Channel 11, 14 and 2/16 or backbone channel Central Goulburn 16 (section 8 – Environmental Water Delivery Infrastructure; Figure 8). All channel options require additional infrastructure to be constructed from supply points to an outfall in the Swamp (Paynter, 2011). Wallenjoe Swamp can currently only receive water from the Wanalta Wetlands during high rainfall events or flood mitigation events released from the Waranga Western Main Channel with permission from the water holder (Figure 10).

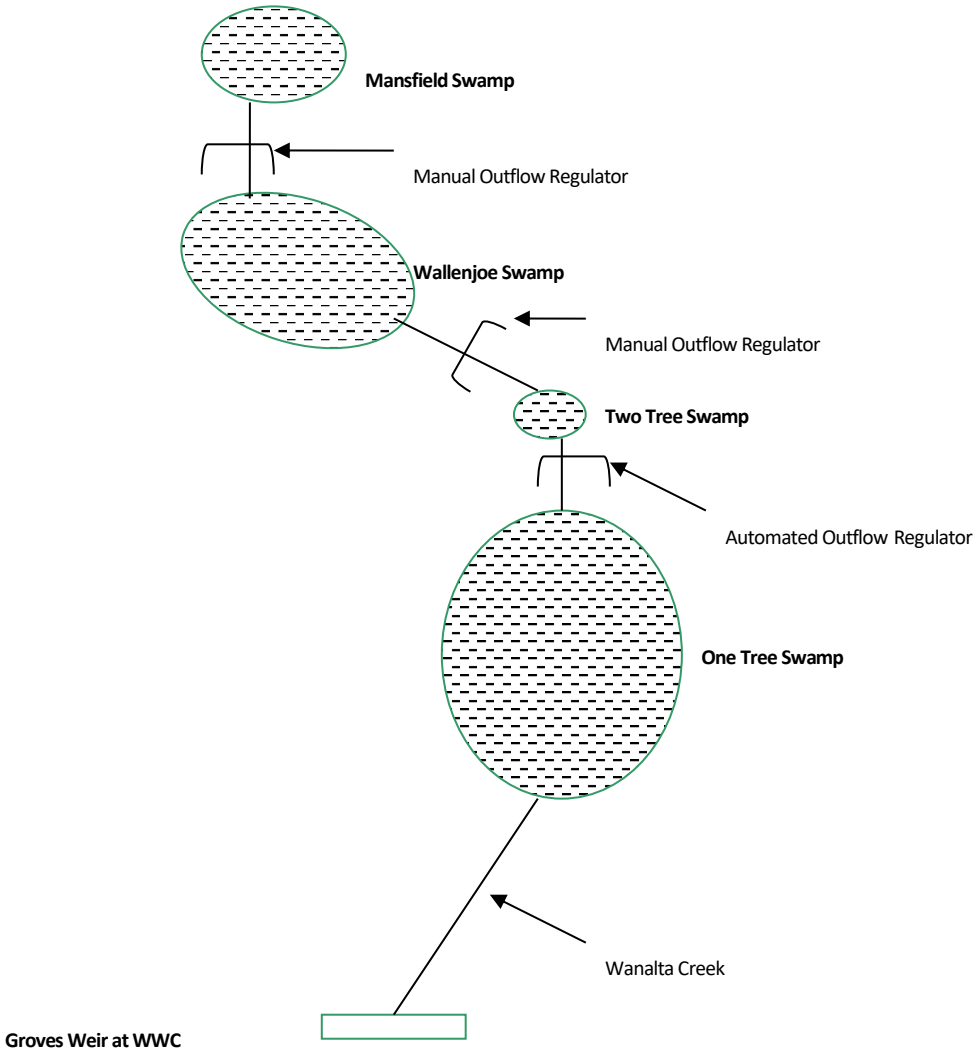

Figure 10: Schematic of Wanalta Creek and downstream wetland connections

Diagram taken from Paynter 2011 – Scoping Infrastructure works for priority wetlands in the Shepparton Irrigation Region.

5. THREATS AND CONDITION

5.1 WATER DEPENDENT THREATS

The key threats to the values of Wallenjoe Swamp are outlined below. These threats result from activities in the wetland, on adjoining land and in the surrounding catchment. To address these threats and the impacts an integrated approach is therefore required.

Altered water regime – Hydrology is the most important component of wetland ecosystems. It drives the physical and chemical properties of a wetland, and the biota it supports. As described in section 4.1.2 – Post Regulation, the natural hydrological regime of Wallenjoe Swamp has been significantly altered by the construction of the Waranga Western Main Channel and Grove Weir cutting the natural flows off the Wanalta Creek. This has impacted upon flows needed for the habitat for waterbirds to breed especially Brolgas. The constriction of natural flows down the Wanalta Creek has seen small to medium flows being passed down the creek. These flows may be diverted by licenced diverters down the Wanalta Creek, diverted to Greens lake or may be lost to evaporation before reaching Wallenjoe Swamp.

Altered physical form – Physical form means the area and bathymetry of a wetland. The area of Wallenjoe Swamp have been physically altered by past drainage and excavation activities and the construction of numerous levees and cuttings to protect higher ground from flooding (Paynter, 2010). In addition, the construction of roadways between Two Tree Swamp and Wallenjoe Swamp has reduced the broader wetland complex. At the north-west corner of Wallenjoe Swamp, construction of a drain to push flows towards Greens Lake has prevented flows pooling in Wallenjoe and also from reaching Mansfield Swamp. No impacts on the bathymetry of the wetland have been identified. Future impacts on the physical form of the wetlands are unlikely to significantly vary over the foreseeable decades occur due to the protection provided by their current land status as Natural Feature Reserves – Wildlife Area. Sediment deposition rates are unknown entering Wallenjoe Swamp from the surrounding catchment.

Poor water quality – Poor water quality including low dissolved oxygen may reduce habitat available for native aquatic biota, reducing its diversity and abundance. The water quality in Wallenjoe Swamp may be impacted by:

- Blackwater events.
- Carp (*Cyprinus carpio*) feeding in sediment which can increase turbidity.
- Run-off containing high nutrient loads entering Wallenjoe Swamp from surrounding agricultural land.
- Pollutants entering Wanalta Depression from irrigation and dryland drainage.

Degraded habitats (Soil disturbance) –Wetland soils provide the physical substrate which aquatic vegetation requires to establish, and provides habitat for benthic invertebrates and microorganisms (DSE 2009). Threatening processes that can lead to poor wetland soils within Wallenjoe Swamp include:

- Human visitation (walking off designated tracks into the wetland body)
- Driving vehicles illegally within the wetland drying both dry and wet phases; and
- Possible illegal excavation within the wetland bodies or fringes.

Exotic flora and fauna – The invasion of native vegetation by pest plants is listed as a potentially threatening process under schedule 3 of Victoria's *Flora and Fauna Guarantee Act* (1988) and is considered to be one of the major threats to the conservation of biological diversity in Victoria (PV, 2003). The growth of pest plants can be sufficiently vigorous to reduce or prevent the regeneration or establishment of native plant species, altering the composition and structure of native communities. Modifications to the composition and structure of native vegetation as a result of pest plant invasion can modify the abundance of native fauna, geomorphological process, the nutrient content of soil and disturbance regimes including fire, grazing and insect activity (PV, 2003).

A total of 14 environmental weeds have been recorded at the site comprising four wetland species (Jolly and Osler, 2011). Of these species, Spear Thistle (*Cirsium vulgare*) is listed under the *Catchment and Land Protection* Act (1994) Clustered Dock (*Rumex conglomeratus*) listed as a high risk on the *DSE advisory list of Environmental Weeds* (DSE, 2009a) and Water Plantain (*Alisma lanceolata*) listed as medium on the DSE list and pose the greatest risk to the site due to their ability to outcompete native flora species.

Pest animals threaten the ecological values of wetlands by predating native species, transmitting diseases, and competing for food and habitat and feeding on native fauna. Pest animals recorded at Wallenjoe Swamp include:

- Foxes (*Vulpes vulpes*) - Fox predation is listed as a threatening process under the *Environmental Protection Biodiversity Conservation Act* (1999) and Schedule 3 of the *Flora and Fauna Guarantee Act* (1988). Foxes are also widely recognised as a threat to young Brolga.

Invasive Native Flora – The invasion of native vegetation by other native species is an issue at Wallenjoe Swamp. River Red Gum saplings have impacted the colonisation of understory within the Red Gum Swamp EVC. The red gum swamp EVC benchmark for immature tree canopy is 5%, based on assessments at Mansfield Swamp by Parks Victoria in 2005 (which has very similar conditions to Wallenjoe Swamp), immature river red gum tree canopy was 17% (Wehner, 2012). This figure could possibly be higher for immature red gums in Wallenjoe Swamp.

5.2 CURRENT CONDITION

The condition of Wallenjoe Swamp was assessed in October 2012 using a method developed by DSE called the Index of Wetland Condition (IWC). The IWC defines wetland condition as the state of the biological, physical, and chemical components of the wetland ecosystem and their interactions (DSE, 2007b).

Wallenjoe Swamp scored 8/10 which is classed as "Good" (Table 6). The wetland catchment subindex had the lowest score of 14/20 which may be due to land use intensity class surrounding the swamp. Hydrology and Water Properties were the next lowest scores of 15 which may be due to the obstruction of natural water inlets to the swamp by roads and irrigation infrastructure and run-off of nutrients into the wetland from the surrounding agricultural landscape.

When the swamp was assessed by Australian Ecosystems in September 2010 a vegetation condition score of 2 was assigned to this EVC using Froods method, indicating that vegetation was in good condition (Cook and Jolly, 2011).

Table 6: Wallenjoe Swamp IWC subindex score, overall score and associated condition categories

IWC subindex	Score	Condition category
Wetland catchment	14	Good
Physical form	19.5	Excellent
Hydrology	15	Good
Water properties	15	Good
Soils	20	Excellent
Biota	15.97	Moderate
Overall IWC Score	**8/10**	**Good**

5.3 CONDITION TRAJECTORY

Ongoing management including the delivery of environmental water and continued monitoring of Wallenjoe Swamp is critical to protecting the ecological values at Wallenjoe Swamp. If no intervention occurs, Wallenjoe Swamp will only receive water via the Wanalta Depression, which, with an increasingly dry climate, may occur less frequently than suits the swamp vegetation and dependant aquatic fauna. Shifts in climate such as an increase in summer storm events may also impact the wetland. This may increase flooding duration over summer and possibly cause loss of species diversity and terrestrial vegetation within the wetland area.

6. MANAGEMENT OBJECTIVES AND ADAPTIVE APPROACHES

6.1 MANAGEMENT GOAL

The water management goal of Wallenjoe Swamp is derived from sources including historical documents, ecological monitoring reports, local expertise and knowledge. The goal considers the overall values the swamp supports. This includes consideration of the aquatic dependent values the swamp has historically supported and the likely aquatic dependent values it could support into the future considering climate change.

Wallenjoe Swamp water management goal

"To provide a more natural hydrological regime that supports Red Gum Swamp EVC and habitat for significant waterbird and flora species"

6.2 ECOLOGICAL AND HYDROLOGICAL OBJECTIVES

6.2.1 ECOLOGICAL OBJECTIVES

Ecological objectives are the desired ecological outcomes of the site. In line with the draft policy Victorian Strategy for Healthy Rivers, Estuaries and Wetlands (VSHREW), the ecological objectives are based on the key values of the site (section 3 – Water Dependent Values). The ecological objectives are expressed as the target condition or functionality for each key value and are expressed as one of the following trajectories for each key value:

- Protect – retain the value at an existing stage of succession.
- Improve – improve the condition of the value while allowing natural processes of regeneration, disturbance and succession to occur.
- Maintain – maintain the current condition of the value while allowing natural processes of regeneration, disturbance and succession to occur.
- Reinstate – reintroduce natural values that can no longer be found in the area.

The ecological objectives for Wallenjoe Swamp are based on values that the wetland provides for the larger Corop Catchment and on a local scale for its waterbird carrying capacity, ability to support flora and/or fauna species listed under the *Environmental Protection Biodiversity Conservation Act* (1999) and the *Flora and Fauna Guarantee Act* (1988) and their ability to support native frogs and waterbird breeding.

The ecological objectives for Wallenjoe Swamp are:

- Protect and increase the diversity of native wetland flora species consistent with Red Gum Swamp EVC benchmarks, in particular Southern Cane-grass and Stiff groundsel.
- Reduce the cover and diversity of native flora such as red gum saplings that can compete against other native flora.
- Provide opportunities for waterbird breeding especially Brolga.
- Provide opportunities for native frog breeding.

Justification for these ecological objectives is given in Table 7 and Appendix 5, 9 and 10.

Table 7: Ecological objectives for Wallenjoe Swamp

Ecological Objective	Justification (Value based)
Protect and improve the diversity of native wetland flora species to be consistent with Red Gum Swamp EVC benchmarks* in particular Southern Cane-grass and Stiff groundsel.	Increase habitat and food sources for native fauna. Increase biodiversity and protect *EPBC* listed species.
Reduce the cover and diversity of exotic and/ or highly invasive native flora species.	Exotic plant species present at Wallenjoe Swamp notably Clustered Dock and Water Plantain, are believed to be outcompeting native wetland plants. Thickets of juvenile Red Gums can also be a significant problem and outcompete other native species.
Provide opportunities for waterbird breeding especially Brolga.	The Red Gum Swamp with understory of Southern Cane-grass is a breeding ground for Brolga.
Provide opportunities for native Frog breeding^.	Wallenjoe Swamp is relatively rich in frog species as five species have been recorded (Appendix 5).

*Refer to Appendix 9. ^ Refer to appendix 10

6.2.2 HYDROLOGICAL OBJECTIVES

Consistent with the management goal and the ecological objectives above, the water regime for Wallenjoe Swamp is for flooding to occur 5 in 10 years to 7 in 10 years, in late Autumn-spring, and drying out within a year (Table 8). In the long term, reinstating a more natural hydrological regime will encourage the restoration of the original Red Gum Swamp EVC, and reduce the abundance and distribution of aquatic weeds. Monitoring will be needed in order to determine how long water should be held within the swamp. Watering the wetland every 5 in 10 to 7 in 10 years will allow submerged aquatic species to germinate, grow and reseed.

Table 8: Hydrological and ecological requirements for Wallenjoe Swamp

Ecological Objectives	Water management area	Hydrological Objectives											
		Recommended number of events in 10 years			Tolerable interval between events once wetland is dry (months)			Duration of ponding (months)			Preferred timing of inflows	Volume to fill to target supply level (ML)	Depth (mm)
		Min	Opt	Max	Min	Opt	Max	Min	Opt	Max			
Protect and improve the diversity of native wetland flora species to be consistent with Red Gum Swamp EVC benchmarks* in particular Southern Cane-grass and Stiff groundsel.	Wetland body and riparian zone	2	5-7	10	3	6	54	2	6	18[1]	Late Autumn – Spring or spring summer for more growth[2]	3410.5	Variable to 500mm
Provide opportunities for waterbird breeding especially Brolga	Wetland body	3	10	10	6	9	12	6	8	NA	Spring [2]	3410.5	Maximum of 500mm[3]
Maintain or increase the diversity and abundance of native frog species.	Wetland fringe and body	NA	NA	NA	NA	NA	12[4]	3	2-6[5]	NA	Spring-Summer	3410.5[6]	Variable to 500mm

1. Red Gums have been used as the main indicator plant for this watering regime. Red Gums should not be wet for more than two consecutive summers (Barlow, 2011).
2. (Rogers and Ralph, 2011, Young, 2003).
3. Water depth should be kept fairly constant if waterbirds are nesting/ breeding to avoid nests being abandoned (Young 2003).
4. This is estimation only as research on frog survival in dry wetlands for extended periods is limited.
5. (ARC, 2010); Appendix 9.
6. This volume is estimated from filling the wetland from dry.

6.2.3 WATERING REGIME

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

The optimal, minimum and maximum watering regimes are described below; however the duration of watering may vary between these hydrological regimes. Due to the inter-annual variability of these estimates (particularly the climatic conditions), determination of the predicted volume requirements in any given year will need to be undertaken by the environmental water manager when watering is planned.

Minimum watering regime

Provide two flooding events in ten years. Fill wetland to variable depths to provide River Red Gum EVC with minimum water requirements to allow survival of existing vegetation.

Optimum watering regime

Provide five -seven flooding events in ten years. Fill wetland to variable depths to provide River Red Gum EVC with appropriate watering requirement, allow regeneration and recruitment of species within the wetland body and encourage breeding for aquatic biota.

Maximum watering regime

Provide ten flooding events in ten years. Fill wetland to variable depths to encourage growth of specific River Red Gum EVC vegetation or encourage breeding for aquatic biota.

Filling the wetland to full supply level is not always desired. Flooding Wallenjoe Swamp to variable depths will promote increased plant diversity and drawing down the wetland slowly will allow the habitat to change, resulting in different vegetation communities establishing within the wetland body. This will assist in meeting the EVC benchmarks required to restore Wallenjoe Swamp. Wherever possible, this managed hydrological regime should be aligned with local climatic conditions. The little that is known of the water requirements for Stiff Groundsel is consistent with the optimum watering regime described above.

6.3 IMPLEMENTATION: SEASONALLY ADAPTIVE APPROACH

Each year CMAs prepare **seasonal watering proposals** for wetlands and rivers. The proposals identify the environmental water requirements of wetlands and rivers in the Goulburn Broken Catchment in the coming year. The proposals are informed by the Environmental Water Management Plans, scientific studies and reports that identify the flood or flow regimes required to meet the ecological objectives of each site or system. **Seasonal Watering Proposals** are developed using the "seasonally adaptive" approach, originally developed through the Northern Regional Sustainable Water Strategy and now incorporated in the Victorian Strategy for Healthy Rivers, Estuaries and Wetlands.

The seasonally adaptive approach identifies the priorities for environmental watering, works and complementary measures, depending on the amount of water available in a given year or prevailing climatic conditions. It is a flexible way to deal with short-term climatic variability and helps guide annual priorities and manage drought. This approach is outlined in Table 9.

The seasonally adaptive approach has been used to guide the watering regime under various climatic scenarios. In drier periods, restricted water resource availability will potentially limit the number of ecological objectives which can realistically be provided through environmental water management. However, these ecological objectives can be achieved in wetter periods as water resource availability increases.

The proposals are prepared in consultation with key stakeholders and partners and are approved by CMA boards. The proposals are submitted to the Victorian Environmental Water Holder (VEWH) for consideration. The VEWH then prepares **seasonal watering plans** based on the CMAs seasonal watering proposals. The plans describe the desired environmental water use for rivers and wetlands across Victoria in the coming year. To help facilitate the desired environmental water use outlined in these plans, the VEWH negotiates access to environmental water managed by the Commonwealth Environmental Water Holder (CEWH) and the Murray Darling Basin Authority (MDBA). The VEWH then prepares **seasonal watering statements** that authorise CMAs to undertake the agreed watering activities, including the use of CEWH and MDBA water. As more environmental water becomes available during the season the VEWH may prepare additional seasonal watering statements. Where possible, the VEWH, CEWH and the MDBA seek to coordinate the delivery and management of environmental water to maximise ecological benefits (Figure 11).

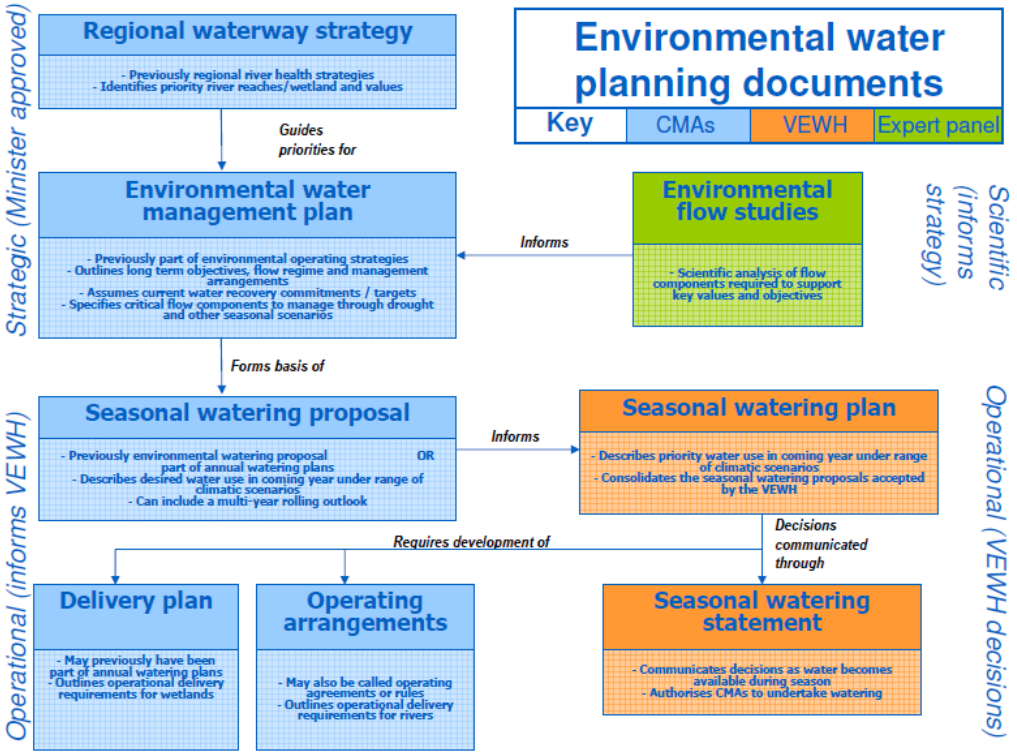

Figure 11: Flow chart for Environmental water planning

Table 9: The seasonally adaptive approach to river and wetland management

	Drought	Dry	Average	Wet to very wet
Long-term ecological objectives	Long-term objectives to move towards ecologically healthy rivers – set through regional river health strategies and sustainable water strategies and reviewed through the 15-year resource review			
Short-term ecological objectives	Priority sites have avoided irreversible losses and have capacity for recovery	Priority river reaches and wetlands have maintained their basic functions	The ecological health of priority river reaches and wetlands has been maintained or improved	The health and resilience of priority rivers and wetlands has been improved
Annual management objectives	Avoid critical loss Maintain key refuges Avoid catastrophic events	Maintain river functioning with reduced reproductive capacity Maintain key functions of high priority wetlands Manage within dry-spell tolerances	Improve ecological health and resilience	Maximise recruitment opportunities for key river and wetland species Minimise impacts of flooding on human communities Restore key floodplain linkages
Environmental water reserve	Water critical refuges Undertake emergency watering to avoid catastrophic events Provide carryover (for critical environmental needs the following year) If necessary, use the market to sell or purchase water	In priority river reaches provide summer and winter baseflows Water high priority wetlands Provide river flushes where required to break critical dry spells Provide carryover (for critical environmental needs the following year) If necessary, use the market to sell or purchase water	Provide all aspects of the flow regime Provide sufficient flows to promote breeding and recovery Provide carryover to accrue water for large watering events If necessary, use the market to sell or purchase water	Provide overbank flows Provide flows needed to promote breeding and recovery If necessary, use the market to sell or purchase water
River and wetland catchment activities	Protect refuges (including stock exclusion) Increase awareness of the importance of refuges Enhanced monitoring of high risk areas and contingency plans in place Investigate feasibility of translocations Environmental emergency management plans in place Protect high priority river reaches and wetlands through fencing; pest, plant and animal management; and water quality improvement works Implement post-bushfire river recovery plans	Protect refuges Protect high priority river reaches and wetlands through fencing, revegetation, pest plant and animal management, water quality improvement and in-stream habitat works Environmental emergency management plans in place Improve connectivity Implement post-bushfire river recovery plans	Protect and restore high priority river reaches and wetlands through fencing, revegetation, pest plant and animal management, water quality improvement and works Monitor and survey wetland condition Improve connectivity between rivers and floodplain wetlands	Protect and restore high priority river reaches and wetlands through fencing, revegetation, pest plant and animal management, water quality improvement and habitat works Monitor and survey river and wetland condition Improve connectivity between rivers and floodplain wetlands Emergency flood management plans in place Implementation of post-flood river restoration programs

7. POTENTIAL RISKS AND MITIGATION MEASURES

Potential risks associated with impacts from the application of environmental water to Wallenjoe Swamp are listed in Table 10. In addition, a detailed risk assessment process will be developed prior to delivering environmental water in any give season and will be provided in the site watering proposal. Mitigation measures will also occur before and during environmental water delivery and thereafter to assist with lessening any potential risks.

Potential risks of environmental water delivery to Wallenjoe Swamp include:

- Flood duration is too long or short. If duration is too short, waterbirds may abandon nests, frogs may not complete all stages in life-cycle and aquatic flora may not set-seed. If duration is too long, vegetation composition may be lost or become less diverse due to waterlogging.
- Flood timing is too late or early. Environmental water can only be delivered during the irrigation season when there is capacity in the Wanalta Creek, which may not coincide with the desired timing.
- Flood depth is too shallow or deep. Shallow flooding may occur if environmental water allocations cannot be achieved due to delivery constraints, or deep flooding may occur if a high rainfall event occurs after delivery.
- Flood frequency is too frequent or infrequent. This may occur if a significant rainfall event occurs after an environmental water delivery, or water cannot be delivered within a sufficient time frame.
- Poor water quality. Water in the Wanalta Creek have low dissolved oxygen, blackwater, high turbidity, increased salinity and nutrient levels when adding environmental water to Wallenjoe Swamp. Flooding wetlands that have accumulated large amounts of organic material can also lead to low dissolved oxygen.
- Pest plant and animal invasion. Aquatic pest plants and pest animals could possibly be introduced via environmental water delivery. Flooding can also stimulate the growth of pest plants and animals if it is the wrong time or duration.
- Impacts to social and economic values such as reduced public access if flooding is too high, possible flooding of adjacent agricultural areas, or the accidental degradation of surrounding cultural heritage sites.

Table 10: Potential risks associated with environmental water delivery to Wallenjoe Swamp

#	Risk	Description	Potential Impacts								Mitigation
			Environmental					Social		Economic	
			Fish *Water regime does not support breeding and feeding requirements*	**Birds** *Water regime does not support breeding and feeding requirements*	**Amphibians** *Water regime does not support breeding and feeding requirements*	**Invertebrate** *Water regime does not support breeding and feeding requirements*	**Native aquatic flora** *Watering requirement does not support establishment and growth.*	Reduced public access and use	Degradation of cultural heritage sites	Flooding of adjacent land	
1	Required watering regime not met	Flood duration too long or short		✔	✔		✔				Determine environmental water requirements based on seasonal conditions and to support potential bird breeding events Monitor flood duration to inform environmental water delivery Monitor the ecological response of the wetland to flooding Add or drawdown water where appropriate or practical
		Flood timing too late or early		✓	✓		✓	✓			Liaise with Goulburn-Murray Water to seek optimum timing of water delivery Monitor flood timing to inform environmental water delivery Monitor the ecological response of the wetland to flooding
		Flooding depth too shallow or deep		✓			✓	✓	✓	✓	Determine environmental water requirements based on seasonal conditions and to support potential bird breeding events Monitor flood depth to inform environmental water delivery Liaise with adjoining landowners prior to and during the delivery of environmental water to discuss and resolve potential or current flooding issues

		Flood frequency		✓	✓	✓	✓	✓			Prioritise water requirements of wetlands in seasonal watering proposals according to their required water regimes and inundation history Monitor the condition of the wetland Monitor the ecological response of the wetland to flooding
2	Poor water quality	Low dissolved oxygen	✓	✓			✓				Monitor dissolved oxygen levels and the ecological response of the wetland to flooding Add or drawdown water where appropriate or practical
		High turbidity	✓				✓				Monitor turbidity levels and the ecological response of the wetland to flooding Add or drawdown water where appropriate or practical
		High water temperature	✓				✓				Monitor water temperature and the ecological response of the wetland to flooding Add or drawdown water where appropriate or practical
		Increased salinity levels	✓		✓	✓	✓				Monitor salinity levels and the ecological response of the wetland to flooding Add or drawdown water where appropriate or practical
		Increased nutrient levels									Monitor nutrient and Blue Green Algae levels, and the ecological response of the wetland to flooding Place public warning signs at the wetland if BGA levels are a public health risk Add or drawdown water where appropriate or practical
		Increased organic matter	✓				✓				Implement the required water regime

3	Pest aquatic plant and animal invasion	Introduction of pest fish	✓		✓	✓	✓				Monitor the ecological response of the wetland to flooding Install a carp screen Implement an appropriate drying regime
		Growth and establishment of aquatic pest plants	✓	✓	✓	✓	✓				Monitor the abundance of native and pest aquatic plants Control pest plants in connected waterways Spray or mechanically remove pest plants Implement an appropriate drying regime

8. ENVIRONMENTAL WATER DELIVERY INFRASTRUCTURE

8.1 CONSTRAINTS

The primary proposed method to fill Wallenjoe Swamp is via the chain of Wanalta Wetlands (One Tree and Two Tree Swamp before outfalling into Wallenjoe Swamp). This method is the most practical and can occur if infrastructure upgrades and works occur along Wanalta Creek, One Tree and Two Tree Swamp (section 8.3 – Infrastructure recommendations; Figure 9). Environmental water allocations could possibly be delivered using Central Goulburn channels 11, 14, 16 and 2/16 however would be best utilised as supplementary flows only (Figure 8).

Constrains posed by the existing arrangements at the Swamp include:

- Flows natural depression –At present the dominant inflow source is the Wanalta Creek System and is dependent on inflows from Wanalta Creek and overflow passing through One Tree and Two Tree Swamp before reaching Wallenjoe Swamp.
- Flows using existing channel structures – Non-backbone channels CG 11, CG 14 and CG 2/6 and backbone channel 16 are in the vicinity of Wallenjoe Swamp. Upgrades of channel capacity would have to occur to allow delivery of an environmental water allocation. The supply points on these channels would only be able to supplement flows for an environmental water delivery as a result of capacity constraints (Paynter, 2011).

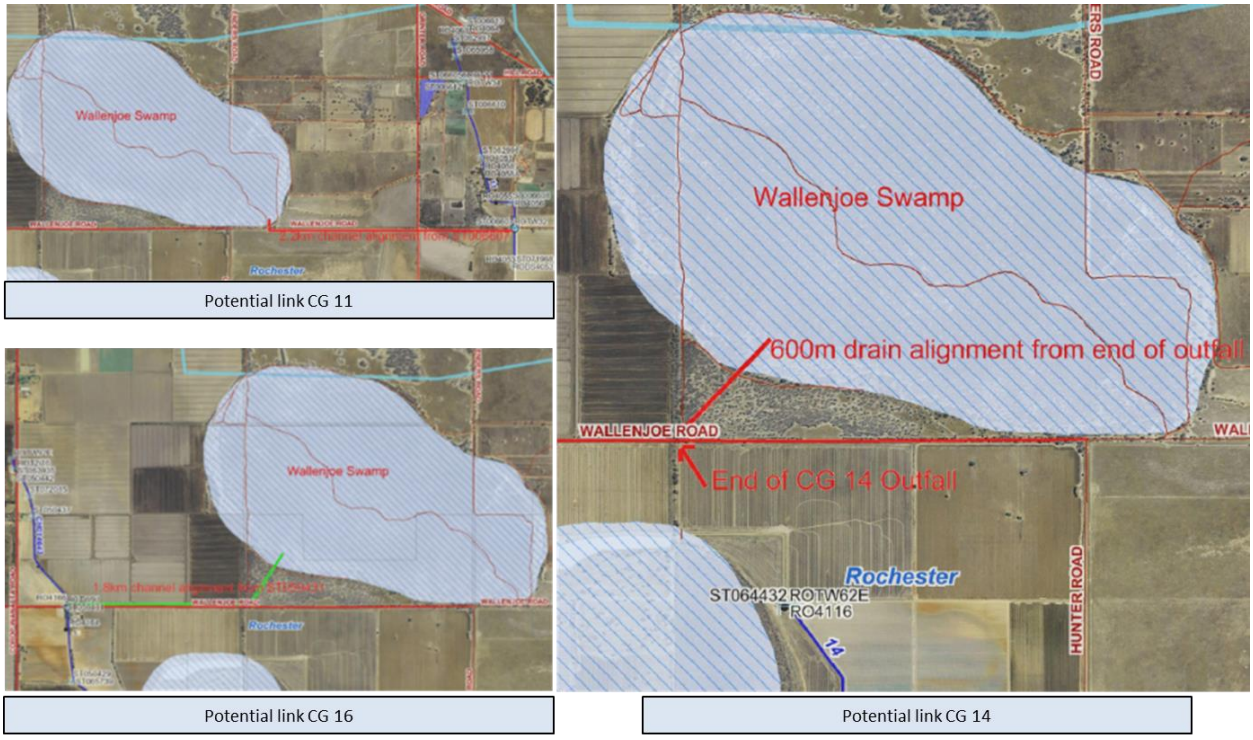

Figure 12: Potential environmental water delivery conduits using Central Goulburn Channels 11, 14 and 16 (2/16 not shown).

- Flow duration – Timing of flows and if the system can be run high enough for time allocated to fill the swamp.
- Irrigation demands – Wallenjoe Swamp does not have a delivery share, therefore environmental water can only be delivered when there is spare capacity to carry water in the irrigation channels and the Wanalta Creek.

8.2 IRRIGATION MODERNISATION

The Goulburn Murray Water- Connections Project is a $2 billion works program to upgrade ageing irrigation infrastructure across the Goulburn-Murray Irrigation District and to save water lost through leakage, evaporation and system inefficiencies. Works will include lining and automating channels, building pipelines and installing new, modern metering technology.

8.3 INFRASTRUCTURE RECOMMENDATIONS

A "*Scoping Infrastructure Works for Priority Wetlands in the Shepparton Irrigation Region – Wallenjoe Swamp*" report was developed by Goulburn-Murray Water to determine the most efficient way to deliver environmental water to the swamp using the Wanalta Creek and existing infrastructure using the rationalised system. The report recommends that the preferred method of environmental water delivery to Wallenjoe Swamp is to provide a link via Wanalta Creek and One Tree and Two Tree Swamp from the Waranga Main Channel at Groves Weir. Expenditure on the Wanalta Creek flow path is more cost effective than the channel supply options, and it is recommended that investment be concentrated on this supply option (Paynter, 2010).

Paynter (2011) describes the Infrastructure recommendations and are shown in Figure 9. This includes:

1. Modification at Groves Weir for automated flow delivery and measurement.
2. Stabilisation of the derelict weir on Wanalta Creek.
3. Improvement of hydraulic capacity of Wanalta Creek by removal of localised hydraulic obstructions.
4. Construction of One Tree Swamp 2 No. bay automated outflow regulator.
5. Construction of Two Tree Swamp 6 No. bay manual outflow regulator.

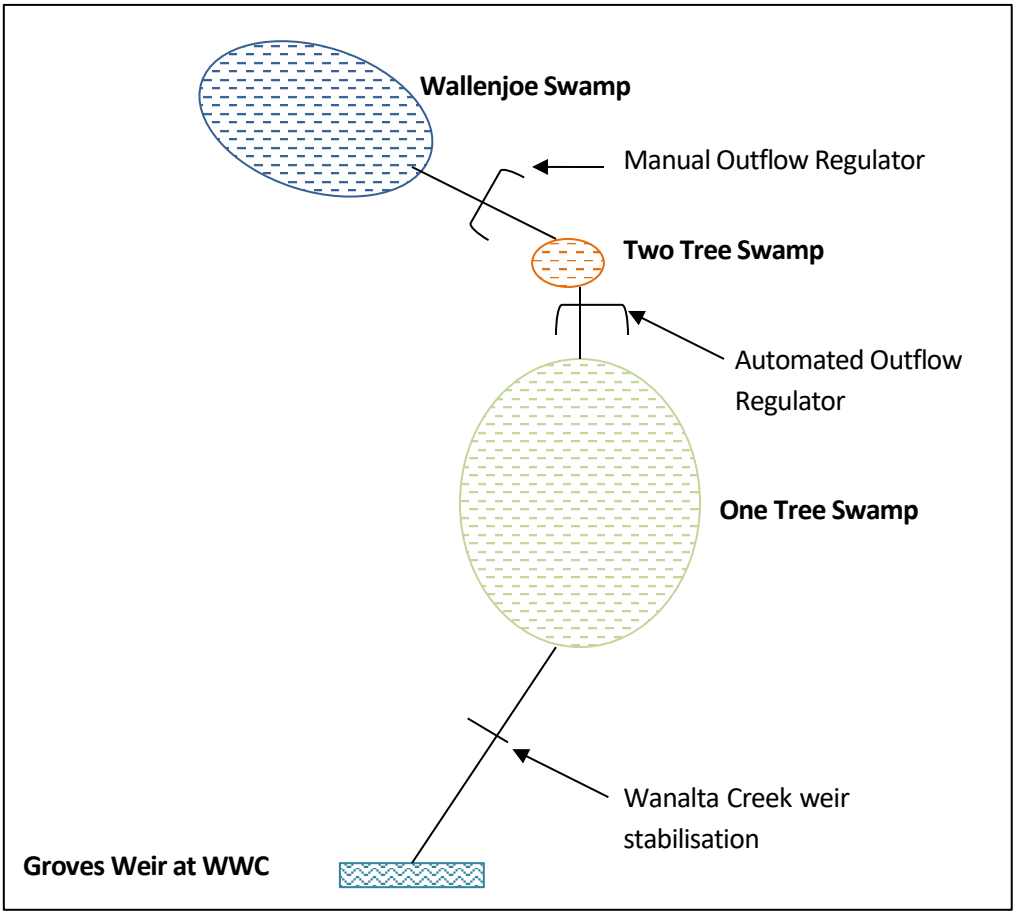

Figure 13: Hydrological connection works for the Wanalta wetlands complex.

9. KNOWLEDGE GAPS AND RECOMMENDATIONS

There are currently a number of knowledge gaps in relation to environmental water management at Wallenjoe Swamp. While most of these do not impact the ability to provide water to the wetland and generate ecological benefit, addressing these would significantly improve the accuracy of environmental water bids, and provide long-term ecological understanding of the site.

The following list describes recognised recommendations that may assist with more efficient environmental water delivery to Wallenjoe Swamp.

Recommendation	Justification
Monitor sites environmental conditions and issues that may pose threats.	Monitoring of the sites environmental conditions and issues that may pose threats. This includes monitoring species such as Spear Thistle, Clustered Dock and Water Plantain due to their ability to outcompete native flora species. Monitoring should continue on a long-term basis ensuring control of these plants. Pest animals should be monitored and prevention/eradication should occur where possible.
Simulate the natural hydrological regime to provide ecological benefits.	Deliver environmental water on average every 5-7 years in 10 if climatic conditions do not naturally fill the wetland.
Monitor water quality in Wallenjoe Swamp	During environmental water delivery, monitor water quality to ensure nutrient loads and salinity levels do not reach critical levels.
Undertake a risk management matrix	Undertake risk management matrix before delivery of environmental water to Wallenjoe Swamp
lk	

The following list describes recognised knowledge gaps and/or recommendations that may assist with more efficient environmental water delivery to Wallenjoe Swamp.

- Review the existing wetland capacity and survey the wetland bed (once site has dried).
- Monitoring of the sites environmental conditions and issues that may pose threats. This includes monitoring of exotic pest plant species on a long-term basis to ensure control and possible eradication of these species.
- Simulating the natural hydrological regime to provide ecological benefits by delivering environmental water on average five – seven years in ten if conditions prevail.
- Undertake a risk management matrix before delivering environmental water to the Wanalta Wetlands (includes all wetlands along the Wanalta chain).

- Modelling of flows within the wetland if infrastructure upgrades are proposed and continuation of monitoring of the wetland during and environmental water delivery and thereafter.
- Construction of the Two Tree Swamp outflow regulator to allow more efficient delivery of water to Wallenjoe Swamp.
- Research the ecological and hydrological requirements of Stiff groundsel. Monitoring of this species is imperative to preserve the population at Wallenjoe Swamp.

10. GLOSSARY

Alluvium

Detrital material which is transported by a river and deposited – usually temporarily – at points along the flood plain of a river. Commonly composed of sands and gravels.

Cainozoic

The division of geological time which succeeds the Mesozoic and ends at the Quaternary. Duration is approximately 63 million years from 65 million years to 2 million years.

Complex

A conceptual whole made up of complicated and related parts.

Confluence

Streams of approximately equal size which unite.

Depression

A sunken or depressed geological formation within the landscape.

Seasonal

Wetland alternates between holding water and being completely dry, in nearly all years, except possibly extremely wet and extremely dry years, and on a fairly predictable seasonal pattern; surface water persists for months (Brock et al., 2003, Roberts and Marston, 2011)

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APPENDICES

APPENDIX 1: WORKSHOP NOTES

Participants were given a booklet with wetland characteristics, maps and site information to discuss (all found in relevant sections of this plan). Ecological and hydrological requirements were determined by J. Wood and S. Casanelia before the Scientific Committee met and were discussed and changed where relevant and are now in section 6 – Management Goal.

APPENDIX 2: CORRICK AND NORMAN CLASSIFICATION OF WETLAND CATEGORIES

A system of wetland classification developed by Corrick and Norman (1980) is used to describe wetlands in Victoria. Under this system six naturally occurring wetland types are described based upon water depth, frequency of inundation, salinity and dominant vegetation.

Freshwater meadow

These include shallow (up to 0.3m) and temporary (less than four months duration) surface water, although soils are generally waterlogged throughout winter.

Shallow freshwater marsh

Wetlands that are usually dry by mid-summer and fill again with the onset of winter rains. Soils are waterlogged throughout the year and surface water up to 0.5m deep may be present for as long as eight months.

Deep freshwater marsh

Wetlands that are generally inundated to a depth of 1-2m throughout the year.

Permanent open freshwater

Wetlands that are usually more than 1m deep. They can be natural or artificial. Wetlands are described as permanent if they retain water for longer than 12 months, however they can have periods of drying.

Semi-permanent saline

These wetlands may be inundated to a depth of 2m for as long as eight months each year. Saline wetlands are those in which salinity exceeds 3,000mg/L throughout the whole year.

Permanent saline

These wetlands include coastal wetlands and part of intertidal zones. Saline wetlands are those in which salinity exceeds 3,000mg/L throughout the whole year.

APPENDIX 3: ENVIRONMENTAL WATER SOURCES

Victorian River Murray Flora and Fauna Bulk Entitlement – Deployed along the length of the Murray River in Victoria. This has been used in the past to supply water to Barmah Forest and wetlands connected to the supply networks of the Goulburn River and lower Broken Creek Systems.

Victorian Environmental Water Holder (VEWH) – The Victorian Environmental Water Holder (VEWH) was established in June 2011. VEWH is responsible for holding and managing Victorian environmental water entitlements and allocations and deciding upon their best use throughout the State. The environmental entitlements held by VEWH that could potentially be made available to this site include:

- The Victorian River Murray Flora and Fauna Bulk Entitlement; and
- Future Northern Victorian Irrigation Renewal Project (NVIRP) Environmental Entitlement.

In 1987 an annual allocation of 27,600ML of high security water was committed to flora and fauna conservation in Victorian Murray Wetlands. In 1999, this became a defined entitlement for the environment called the Victorian River Murray Flora and Fauna Bulk Entitlement.

Future NVRIP Environmental Water Entitlements - One third of water savings from Stage 1 of the NVIRP project will be used for the environment, some of which will be stored in Lake Eildon. This water will be released into stressed rivers and streams when required. The NVIRP water savings are predicted to provide up to 75GL as a statutory environmental entitlement, which will be used to help improve the health of priority stressed rivers and wetlands in northern Victoria (DSE 2008). The entitlement will have priorities which enable the water to be used at multiple locations as the water travels downstream (provided losses and water quality issues are accounted for); meaning that the water can be called out of storage at desired times to meet specific environmental needs.

The environment's share of water savings will be over and above The Living Murray and Snowy commitments and will primarily target the use of environmental water for priority Victorian wetlands and tributaries.

This will also have flow on benefits when the water enters the River Murray, which can then be reused to meet the needs of the Murray and its floodplains and wetlands, including Kerang Lakes, Barmah Forest, Gunbower Forest, Hattah Lakes, Lindsay-Wallpolla Island and various other sites along the River Murray.

Stage 2 is expected to deliver a further 200 billion litres of water savings a year, which will be shared equally between irrigators and the environment.

Commonwealth Environmental Water Holder (CEWH) – The *Water Act 2007* established the Commonwealth Environmental Water Holder to manage the water entitlements that the Commonwealth acquires. These water entitlements will be used to protect or restore environmental assets such as wetlands and streams.

69 GL of environmental water will be available for the Lower Goulburn between February and July 2011. Commonwealth environmental water is available to avoid the critical loss of threatened species. It is also available to avoid irretrievable damage or catastrophic events and to maintain key refuges to allow re-colonisation when conditions improve.

APPENDIX 4: LEGISLATIVE FRAMEWORK

Acts, Agreements and Conventions

Ramsar Convention on wetlands (Ramsar) – The Australian Government is a contracting party to the convention, which is an inter-governmental treaty whose mission is "the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world".

Bilateral Migratory Bird Agreements

Japan Australia Migratory Bird Agreement 1974 - Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment.

China Australia Migratory Bird Agreement 1986 - Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment.

These agreements require that the parties protect migratory birds by:

- Limiting the circumstances under which migratory birds are taken or traded;
- Protecting and conserving important habitats;
- Exchanging information; and
- Building cooperative relationships.

Convention of Migratory Species (Bonn Convention) 1979 - The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or Bonn Convention) aims to conserve terrestrial, marine and avian migratory species throughout their range. It is an **intergovernmental treaty**, concluded under the aegis of the United Nations Environment Programme, concerned with the conservation of wildlife and habitats on a global scale. Since the Convention's entry into force, its membership has grown steadily to include 114 (as of 1 October 2010) Parties from Africa, Central and South America, Asia, Europe and Oceania.

Republic of Korea Australia Migratory Bird Agreement 2009 – Agreement between the Government of Australia and the Government of the Republic of Korea on the protection of Migratory birds.

ACTS (NATIONAL)

***Australian Heritage Commission Act* 1975** - An Act to establish an Australian Heritage Commission.

***Aboriginal and Torres Strait Islander Heritage Protection Act* 1984** - An Act to preserve and protect places, areas and objects of particular significance to Aboriginals, and for related purposes.

***Native Title Act* 1993** – Legislation to protect any native title that has survived 200 years of colonisation.

***Environment Protection and Biodiversity Conservation Act* 1999** - The Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the Act as matters of national environmental significance.

***Water Act* 2007** - An Act to make provision for the management of the water resources of the Murray-Darling Basin, and to make provision for other matters of national interest in relation to water and water information, and for related purposes.

***Water Amendment Act* 2008** - An Act to amend the Water Act 2007, and for related purposes.

ACTS (VICTORIA)

***Crown Land (Reserves) Act* 1978** – Land reserved for a variety of public purposes are managed under this Act.

***Environmental Effects Act* 1978** – Potential environmental impacts of a proposed development are subject to assessment and approval under this Act. A structural works program and any associated environmental impacts would be subject to assessment and approval under this Act.

***Planning and Environment Act* 1987** – Controls the removal or disturbance to native vegetation within Victoria by implementation of a three-step process of avoidance, minimisation and offsetting.

***Flora and Fauna Guarantee Act* 1988** - The key piece of Victorian legislation for the conservation of threatened species and communities and for the management of potentially threatening processes.

***Water Act* 1989 (Victorian)** - The legislation that governs the way water entitlements are issued and allocated in Victoria. It defines water entitlements and establishes the mechanisms for managing Victoria's water resources.

***Catchment and Land Protection Act* 1994** - has an objective of establishing a framework for the integrated and coordinated management of catchments which will;

- maintain and enhance long-term land productivity while also conserving the environment, and
- aim to ensure that the quality of the State's land and water resources and their associated plant and animal life are maintained and enhanced.

The Act established ten Catchment and Land Protection Boards, nine of which have since expanded their roles to become Catchment Management Authorities. The *Catchment and Land Protection Act* (1994) provides for the development of Regional Catchment Strategies which, among other things, must assess the nature, causes, extent and severity of land degradation of the catchments in the region and identify areas for priority attention. Local Planning schemes must have regard for the Regional Catchment Strategies.

***Aboriginal Heritage Act* 2006** - The main purpose of this Act is to provide for the protection of Aboriginal cultural heritage in Victoria. The objectives of this Act are-

(a) to recognise, protect and conserve Aboriginal cultural heritage in Victoria in ways that are based on respect for Aboriginal knowledge and cultural and traditional practices;

(b) to recognise Aboriginal people as the primary guardians, keepers and knowledge holders of Aboriginal cultural heritage;

(c) to accord appropriate status to Aboriginal people with traditional o familial links with Aboriginal cultural heritage in protecting that heritage;

(d) to promote the management of Aboriginal cultural heritage as an integral part of land and natural resource management;

(e) to promote public awareness and understanding of Aboriginal cultural heritage in Victoria;

(f) to establish an Aboriginal cultural heritage register to record Aboriginal cultural heritage;

(g) to establish processes for the timely and efficient assessment of activities that have the potential to harm Aboriginal cultural heritage;

(h) to promote the use of agreements that provide for the management and protection of Aboriginal cultural heritage;

(i) to establish mechanisms that enable the resolution of dispute relating to the protection of Aboriginal cultural heritage;

(j) to provide appropriate sanctions and penalties to prevent harm to Aboriginal cultural heritage.

Advisory lists of rare and threatened species in Victoria (DSE) – Three advisory lists are maintained by DSE for use in a range of planning processes and in setting priorities for actions to conserve biodiversity. Unlike other threatened species lists, there are no legal requirements or consequences that flow from inclusion of a species on an advisory list. The advisory list comprises:

- Advisory list of Rare and Threatened Plants in Victoria – 2005
- Advisory list of Threatened Vertebrate Fauna in Victoria – 2007
- Advisory list of Threatened Invertebrate Fauna in Victoria - 2009

Policy and Frameworks

Wetland Policy of the Commonwealth Government of Australia 1997 - On 2 February 1997, the inaugural World Wetlands Day, the Commonwealth Government released the Wetlands Policy of the Commonwealth Government of Australia. The Wetlands Policy aims to promote the conservation, repair, and wise use of wetlands and - within the broader context of environmental management - incorporate the conservation of wetlands into the daily business of the Commonwealth Government.

Framework for Determining Commonwealth Environmental Watering Actions 2009 - The purpose of this paper is to outline a framework for determining Commonwealth environmental watering actions in the Murray-Darling Basin. The framework will be developed and implemented over the period 2009-2011, prior to the development of the Environmental Watering Plan (EWP) by the Murray Darling Basin Authority, and be adapted in accordance with the EWP once that is available.

Policy and Frameworks (Victoria)

The State Environment Protection Policy (Waters of Victoria) 2003 - Sets the framework for government agencies, businesses and the community to work together, to protect and rehabilitate Victoria's surface water environments.

Northern Region Sustainable Water Strategy 2009 - The Northern Region Sustainable Water Strategy has been released by the Victorian Government to secure the water future for urban, industrial, agricultural and environmental water users for the next 50 years.

Reports Applicable to the Environmental Watering Plan

Goulburn Broken Catchment Regional Catchment Strategy 2003 – A strategy that sets the framework for Natural Resource Management and the context for sub-strategies and action plans within the Goulburn Broken Catchment.

Our Water Our Future 2004 - Sets out 110 actions for sustainable water management aimed at every sector of the community, seeking to secure water supplies and sustain growth over the next 50 years. The 110 actions aim to:

- Repair rivers and groundwater systems – the natural source of all our fresh water – by giving them legal water rights and conducting restoration works;
- Price water to encourage people to use it more wisely;
- Permanently save water in our towns and cities, through common sense water saving and recycling measures;
- Secure water for farms through pioneering water allocation and trading systems; and
- Manage water allocation to find the right balance between economic, environmental and social values.

The Goulburn Broken Regional River Health Strategy 2005 - This Strategy fits into the broader government vision for the management of water in the State to ensure that rivers are managed in accordance with relevant Victorian Government policies. This strategy provides a framework for integration of actions which will enable rivers of high quality to be protected and others to be improved in quality for current and future generations.

The Goulburn Broken Regional River Health Strategy aims to achieve four main objectives for the rivers and streams of the Goulburn Broken Catchment:

- Enhance and protect the rivers that are of highest community values (environmental, social and economic) from any decline in condition;
- Maintaining the condition of ecologically healthy rivers;
- Achieving the "overall improvement" in the environmental condition of the remainder of rivers;
- Preventing damage from inappropriate development and activities.

Biodiversity strategy for Goulburn Broken Catchment 2009 - This Strategy follows implementation of Goulburn Broken CMAs Native Vegetation Management Strategy (developed in 2000) and from the Fringe to mainstream – a Strategic Plan for Integrating Native Biodiversity (developed in 2004). The Strategy provides a regional perspective for implementing Victoria's White Paper for Land and Biodiversity at a time of Climate Change (released December 2009).

APPENDIX 5: FAUNA SPECIES LIST

Fauna list of Wallenjoe Swamp – taken from Victorian Fauna Database 2010, D. Cook 2010-2011 counts, M. Ramsey bird observations 2012, K .Stockwell Observations 2011.

E – Listed as endangered under the *Environmental Protection Biodiversity Conservation Act (1999)*

L = listed as threatened under the *Flora and Fauna Guarantee Act (1988)*

vu = Listed as vulnerable on the DSE Advisory list of threatened vertebrate fauna (2007)

en = Listed as endangered on the DSE Advisory list of threatened vertebrate fauna (2007)

nt = Listed as near threatened on the DSE Advisory list of threatened vertebrate fauna (2007)

dd = Listed as data deficient on the DSE Advisory list of threatened vertebrate fauna (2007)

cr = Listed as critically endangered on the DSE Advisory list of threatened vertebrate fauna (2007)

w Water dependant species or Waterbirds

b Observed breeding at the Swamp

Common Name	Scientific Name	EPBC	FFG	VROTS	Origin and guild
BIRDS					
Australasian Darter	*Anhinga novaehollandiae*				w
Australasian Grebe	*Tachybaptus novaehollandiae*				w
Australasian Shoveler	*Anas rhynchotis*			vu	w b
Australian Hobby	*Falco longipennis*				
Australian Magpie	*Gymnorhina tibicen*				
Australian Pelican	*Pelecanus conspicillatus*				w
Australian Raven	*Corvus coronoides*				
Australian Shelduck	*Tadorna tadornoides*				w b
Australian White Ibis	*Threskiornis molucca*				w
Australian Wood Duck	*Chenonetta jubata*				w
Azure Kingfisher	*Alcedo azurea*				nt
Black Swan	*Cygnus atratus*				w
Black-chinned Honeyeater	*Melithreptus gularis*			nt	
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*				
Black-fronted Dotterel	*Elseyornis melanops*				w
Black-tailed Native-hen	*Gallinula ventralis*				w
Black-winged Stilt	*Himantopus himantopus*				w
Brolga	*Grus rubicunda*			vu	w
Brown Falcon	*Falco berigora*				
Brown Goshawk	*Accipiter fasciatus*				
Brown Treecreeper (south-eastern ssp.)	*Climacteris picumnus victoriae*			nt	
Chestnut Teal	*Anas castanea*				w
Collard Sparrowhawk	*Accipiter cirrocephalus*				
Crested Pigeon	*Ocyphaps lophotes*				
Crested Shrike-tit	*Falcunculus frontatus*				
Dusky Moorhen	*Gallinula tenebrosa*				w
Dusky Woodswallow	*Artamus cyanopterus*				
Eastern Great Egret	*Ardea modesta*		L	vu	w

Eastern Rosella	*Platycercus eximius*				
Eurasian Coot	*Fulica atra*				w
Flame Robin	*Petroica phoenicea*				
Galah	*Eolophus roseicapilla*				
Great Cormorant	*Phalacrocorax carbo*				w
Grey Shrike-thrush	*Colluricincla harmonica*				
Grey Teal	*Anas gracilis*				w
Hardhead	*Aythya australis*			vu	w
Hoary-headed Grebe	*Poliocephalus poliocephalus*				w
Latham's Snipe	*Gallinago hardwickii*			nt	w
Laughing Kookaburra	*Dacelo novaeguineae*				
Little Black Cormorant	*Phalacrocorax sulcirostris*				w
Little Corella	*Cacatua sanguinea*				
Little Grassbird	*Megalurus gramineus*				w
Little Lorikeet	*Glossopsitta pusilla*				
Little Pied Cormorant	*Microcarbo melanoleucos*				w
Little Raven	*Corvus mellori*				
Magpie-lark	*Grallina cyanoleuca*				
Masked Lapwing	*Vanellus miles*				w
Musk Duck	*Biziura lobata*			vu	w
Nankeen Kestral	*Falco cenchroides*				
Nankeen Night Heron	*Nycticorax caledonicus*			nt	w
Noisy Miner	*Manorina melanocephala*				
Olive-backed Oriole	*Oriolus sagittatus*				
Pacific Black Duck	*Anas superciliosa*				w b
Pink-eared Duck	*Malacorhynchus membranaceus*				w
Plumed Whistling-Duck	*Dendrocygna eytoni*				w
Purple Swamphen	*Porphyrio porphyrio*				w
Red Wattlebird	*Anthochaera carunculata*				
Red-rumped Parrot	*Psephotus haematonotus*				
Restless Flycatcher	*Myiagra inquieta*				
Royal Spoonbill	*Platalea regia*			vu	w b
Sacred Kingfisher	*Todiramphus sanctus*				
Silver Gull	*Chroicocephalus novaehollandiae*				w
Southern Boobook	*Ninox novaseelandiae*				
Straw-necked Ibis	*Threskiornis spinicollis*				w
Striated Pardalote	*Pardalotus striatus*				
Superb Fairy Wren	*Malurus cyaneus*				
Swamp Harrier	*Circus approximans*				w
Tree Martin	*Hirundo nigricans*				
Welcome Swallow	*Hirundo neoxena*				
Whistling Kite	*Haliastur sphenurus*				b
White-bellied Sea-Eagle	*Haliaeetus leucogaster*		L	vu	w
White-faced Heron	*Egretta novaehollandiae*				w
White-necked Heron	*Ardea pacifica*				w
Willie Wagtail	*Rhipidura leucophrys*				

Yellow-billed Spoonbill	*Platalea flavipes*				w
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*				
FROGS					
Barking Marsh Frog	*Limnodynastes fletcheri*				Banks of lakes or rivers
Peron's Tree Frog	*Litoria peronii*				Wet and Dry areas
Plains Froglet	*Crinia parinsignifera*				Moist depressions
Pobblebonk	*Limnodynastes dumerilii*				Most areas except Alpine and extreme dry
Spotted Marsh Frog	*Limnodynastes tasmaniensis*				Common in farm dams and wetlands
MAMMALS					
Eastern Grey Kangaroo	*Macropus giganteus*				
REPTILES					
Eastern Brown Snake	*Pseudonaja textilis*				
Tiger Snake	*Notechis scutatus*				
INTRODUCED SPECIES					
Brown Hare	*Lepus capensis*				
Common Blackbird	*Turdus merula*				
Common Starling	*Sturnus vulgaris*				
Common Myna	*Sturnus tristis*				
European Carp	*Cyprinus carpio*				w
European Greenfinch	*Carduelis chloris*				
House Sparrow	*Passer domesticus*				
Red Fox	*Vulpes vulpes*				

APPENDIX 6: ECOLOGICAL VEGETATION CLASSES

The following information is taken from the Index of Wetland Condition Assessment of Wetland Vegetation Update-March 2006. Victoria's Framework for the Native Vegetation Management (DNRE 2002) utilises the notion of Ecological Vegetation Classes (EVCs). The Framework defines an EVC as follows: "An EVC is a type of native vegetation classification that is described through a combination of floristic, life form and ecological characteristics, and through an inferred fidelity to particular environmental attributes. Each EVC includes a collection of floristic communities (ie: a lower level in the classification that is based solely on groups of the same species) that occur across a biogeographic range, and although differing in species, have similar habitat and ecological processes operating".

Below is a description of the EVC found within Wallenjoe Swamp (www.dse.gov.au).

Red Gum Swamp [EVC #292]

Woodland of swampy depressions of lowland plains, with sedgy-herbaceous understorey including aquatic species.

APPENDIX 7: FLORA SPECIES LIST

Flora list of Wallenjoe Swamp – taken from Victorian Flora Database 2010, D. Cook 2010-2011 counts.

L = Listed as threatened under the Flora and Fauna Guarantee Act (1988)

E =Listed as Endangered under the Environmental Protection Biodiversity Act (1999)

e = Endangered in Victoria in DSE Advisory list of rare and threatened plants in Victoria (2005)

k = Poorly known in Victoria in DSE Advisory list of rare and threatened plants in Victoria (2005)

v = Vulnerable in Victoria in DSE Advisory list of rare and threatened plants in Victoria (2005)

r = Rare in Victoria in DSE Advisory list of rare and threatened plants in Victoria (2005)

w = Wetland species

p = Planted

= Native to Victoria but grows outside natural range

Common Name	Scientific Name	EPBC	FFG	VROTS	Origin	Indigenous Use
Lesser Joyweed	*Alternanthera denticulata s.l.*				w	
Common Swamp Wallaby-grass	*Amphibromus nervosus*				w	
Small Vanilla-lily	*Arthropodium minus*					Tubers eaten
Common Woodruff	*Asperula conferta*					
Berry Saltbush	*Atriplex semibaccata*					
Brown-back Wallaby-grass	*Austrodanthonia duttoniana*				w	
Bristly Wallaby-grass	*Austrodanthonia setacea*					
Plump Spear-grass	*Austrostipa aristiglumis*					
Bulbine Lily	*Bulbine bulbosa*					Tubers eaten
Annual Bitter-cress	*Cardamine paucijuga s.l*			v	w	
Poong'ort / Rush Sedge	*Carex tereticaulis*				w	
Common Sneezeweed	*Centipeda cunninghamii*				w	
Clammy goosefoot	*Chenopodium pumilio*					
Pink Bindweed	*Convolvulus erubescens spp. agg.*					Tap roots made into dough
Swamp Billy-buttons	*Craspedia paludicola*				w	
Spreading Crassula	*Crassula decumbens var. decumbens*					
Purple Crassula	*Crassula peduncularis*				w	
Sieber Crassula	*Crassula sieberiana s.l.*					
Crassula	*Crassula spp.*					
Tall Flat-sedge	*Cyperus exaltatus*				w	
Star Fruit	*Damasonium minus*				w	
Pale Flax-lily	*Dianella longifolia s.l.*					Leaves used for cord and basket making.
Black-anther Flax-lily	*Dianella revoluta s.l.*					
Scarlet Sundew	*Drosera glanduligera*					
Tall Sundew	*Drosera peltata*					
Pale Sundew	*Drosera peltata subsp. peltata*				w	
Common Barnyard Grass	*Echinochloa crus-galli*					

Yellow Twin-heads	*Eclipta platyglossa*				# w	
Nodding Saltbush	*Einadia nutans subsp. nutans*					
Waterwort	*Elatine gratioloides*				w	
Common Spike-sedge	*Eleocharis acuta*				w	
Variable Spike-sedge	*Eleocharis minuta*			e		
Small Spike-sedge	*Eleocharis pusilla*				w	
Common Wheat-grass	*Elymus scaber var. scaber*					
Ruby Saltbush	*Enchylaena tomentosa var. tomentosa*					Berries and leaves eaten
Spider Grass	*Enteropogon acicularis*					
Variable Willow-herb	*Epilobium billardierianum subs. cinereum*				w	
Blue Devil	*Eryngium ovinum*					
River Red-gum	*Eucalyptus camaldulensis*				w	
Yellow Box	*Eucalyptus melliodora*					
Grey Box	*Eucalyptus microcarpa*					
Common Cudweed	*Euchiton involucratus sp*					
Annual Cudweed	*Euchiton sphaericus*					
Common Eutaxia	*Eutaxia microphylla var. microphylla*					
Spoon leaf Mud-mat	*Glossostigma cleistanthum*			v	w	
Variable Glycine	*Glycine tabacina s.l.*					Tap root chewed for licorice flavour
Tiny Cudweed	*Gnaphalium indutum*					
Silky Goodenia	*Goodenia fascicularis*					
Slender Goodenia	*Goodenia gracilis*				w	
Cut-leaf Goodenia	*Goodenia pinnatifida*					
Rough Raspwort	*Haloragis aspera*					
Bluish Raspwort	*Haloragis glauca*			k		
Common Heliotrope	*Heliotropium europaeum*					
Hypoxis	*Hypoxis spp.*					
Yellow Star	*Hypoxis vaginata*					
Grass Cushion	*Isoetopsis graminifolia*					
Broad-fruit Club-sedge	*Isolepis cernua var. platycarpa*					
Grassy Club-sedge	*Isolepis hookeriana*				w	
Narrow Plover-daisy	*Ixiolaena leptolepis*					
Hollow Rush	*Juncus amabilis*				w	
Tussock Rush	*Juncus aridicola*				w	
Toad Rush	*Juncus bufonius*				w	
Yellow Rush	*Juncus flavidus*				w	
Joint-leaf Rush	*Juncus holoschoenus*				w	
Giant Rush	*Juncus ingens*				w	
Hoary Rush	*Juncus radula*					
Plains Rush	*Juncus semisolidus*				w	
Rush	*Juncus sp*				w	
Finger Rush	*Juncus subsecundus*				w	
Billabong Rush	*Juncus usitatus*				w	
Common Blown-grass	*Lachnagrostis filiformis var.1*				w	
Stalked Plover-daisy	*Leiocarpa websteri*					

Common Duckweed	*Lemna disperma*				w	
Scaly Buttons	*Leptorhynchos squamatus*					
Austral Mud-mat	*Limosella australis*				w	
Large Mudwort	*Limosella curdieana*				w	
Native Flax	*Linum marginale*					Used for fish nets and cord. Seeds eaten.
Poison Pratia	*Lobelia concolor*				w	
Poison Lobelia	*Lobelia pratioides*				w	
Scented Mat-rush	*Lomandra effusa*					
Clove-strip	*Ludwigia peploides subsp. montevidensis*				w	
Small Loosestrife	*Lythrum hyssopifolia*				w	
Black Cotton-bush	*Maireana decalvans*					
Wingless Bluebush	*Maireana enchylaenoides*					
Dwarf Bluebush	*Maireana humillima*					
Bluebush	*Maireana spp.*					
Narrow-leaf Nardoo	*Marsilea costulifera*				w	
Common Nardoo	*Marsilea drummondii*				w	
Rough-barked Honey-myrtle	*Melaleuca parvistaminea*				p	
Creeping mint	*Mentha satureoides*					Leaves used as medicine
Yam Daisy	*Microseris scapigera spp. agg.*					Tubers eaten
Smooth Minuria	*Minuria integerrima*			r		
Tangled Lignum	*Muehlenbeckia florulenta*				w	
Mouse-tails	*Myosurus minimus var. australis*				w	
Woolly-heads	*Myriocephalus rhizocephalus*					
Upright Water-milfoil	*Myriophyllum crispatum*				w	
Clustered Water-milfoil	*Myriophyllum glomeratum*				w	
Slender Water-milfoil	*Myriophyllum gracile var. lineare*		L	e	w	
Robust Water-milfoil	*Myriophyllum papillosum*				w	
Rigid Water-milfoil	*Myriophyllum porcatum*	V	L	v	w	
Water-milfoil	*Myriophyllum spp*					
Red Water Milfoil	*Myriophyllum verucosum*				w	
Grassland Wood-sorrel	*Oxalis perennans*					
Panic	*Panicum sp*				w	
Slender Knotweed	*Persicaria decipiens*				w	
Pale Knotweed	*Persicaria lapathifolia*				w	
Creeping Knotweed	*Persicaria prostrata*				w	
Austral Pillwort	*Pilularia novaehollandiae*				w	
Curved Rice-flower	*Pimelea curviflora s.s.*					
Weeping Pittosporum	*Pittosporum angustifolium*					
Narrow Plantain	*Plantago gaudichaudii*					
Grey Tussock-grass	*Poa sieberiana var. sieberiana*					Used for string and making baskets
Red Pondweed	*Potamogeton cheesemanii*				w	
Floating Pondweed	*Potamogeton tricarinatus*				w	
Jersey Cudweed	*Pseudognaphalium luteoalbum*					
Moira Grass	*Pseudoraphis spinescens*				w	
Mulla Mulla	*Ptilotus exaltatus*					

Drumsticks	*Pycnosorus globosus*				#	
River Buttercup	*Ranunculus inundatus*				w	
Ferny Small-flower Buttercup	*Ranunculus pumilio var. pumilio*				w	
Annual Buttercup	*Ranunculus sessiliflorus*					
Paper Sunray	*Rhodanthe corymbiflora*					
Slender Dock	*Rumex brownii*				w	
Glistening Dock	*Rumex crystallinus s.l.*					
Narrow-leaf Dock	*Rumex tenax*				w	
Common Bog-sedge	*Schoenus apogon*				w	
Water Figwort	*Scrophularia auriculata*					
Cotton Fireweed	*Senecio quadridentatus*					
Variable Sida	*Sida corrugata*					
Quena	*Solanum esuriale*					
Sand-spurrey	*Spergularia brevifolia*					
Thin Duckweed	*Spirodela oligorrhiza*				w	
Spear Grass	*Stipa sp*					
Broughton Pea	*Swainsona procumbens*					
Grey Germander	*Teucrium racemosum s.l.*					
Slender Water Ribbons	*Triglochin dubia*			r	*w*	
Common Sunray	*Triptilodiscus pygmaeus*					
Trithuria	*Trithuria submersa*				w	
Fairies' Aprons	*Utricularia dichotoma s.l.*				w	
Fuzzy New Holland Daisy	*Vittadinia cuneata*					
Woolly New Holland Daisy	*Vittadinia gracilis*					
River Bluebell	*Wahlenbergia fluminalis*					
Annual Bluebell	*Wahlenbergia gracilenta s.l.*					
Rigid Panic	*Walwhalleya proluta*				w	Seeds ground to flour.
Tiny Duckweed	*Wolffia australiana*					
Broad-leaf Early Nancy	*Wurmbea latifolia subsp. vanessae*					
EXOTIC SPECIES						
Golden Wreath Wattle	*Acacia saligna*					
Creeping Knapweed	*Acroptilon repens*					
Quicksilver Grass / Small Hair-grass	*Aira cupaniana*					
Orange Fox-tail	*Alopecurus aequalis*				w	
Pimpernel	*Anagallis arvensis*					
Cape Weed	*Arctotheca calendula*					
Aster-weed	*Aster subulata*				w	
Bearded Oat	*Avena barbata*					
Wild Oat	*Avena fatua*					
Oat	*Avena sp*					
Lesser Quaking-grass	*Briza minor*					
Great Brome	*Bromus diandrus*					
Soft Brome	*Bromus hordeaceus subsp. hordeaceus*					
Thread Water Starwort	*Callitriche hamulata*				w	
Water Starwort	*Callitriche stagnalis*				w	
Thistle	*Carduus sp*					

Saffron Thistle	*Carthamus lanatus*					
Centaury	*Centaurium spp.*					
Fat Hen	*Chenopodium album*					
Square Cicendia	*Cicendia quadrangularis*					
Spear Thistle	*Cirsium vulgare*					
Fleabane	*Conyza bilbaoana*					
Ferny Cotula	*Cotula bipinnata*					
Water Crassula	*Crassula natans*				w	
Umbrella Sedge	*Cyperus eragrostis*				w	
Stinkwort	*Dittrichia graveolens*					
Barn-yard Grass	*Echinochloa crus-galli*					
Paterson's Curse	*Echium plantagineum*					
Ox-tongue	*Helminthotheca echioides*					
Barley Grass	*Hordeum sp*					
Smooth Cat's-ear	*Hypochoeris glabra*					
Cat's Ear	*Hypochoeris radiate*					
Spiny Rush	*Juncus acutus subsp. acutus*					
Capitate Rush	*Juncus capitatus*					
Sharp-leaved Fluellen	*Kickxia elatine ssp. crinata*					
Willow-leaf Lettuce	*Lactuca saligna*					
Prickly Lettuce	*Lactuca serriola*					
Hairy Hawkbit	*Leontodon taraxacoides subsp. taraxacoides*					
Perennial Rye-grass	*Lolium perenne*					
Wimmera Rye-grass	*Lolium rigidum*					
Burr Medic	*Medicago polymorpha*					
Medic	*Medicago spp.*					
Thread Iris	*Moraea setifolia*					
Brazilian Water Milfoil	*Myriophyllum aquaticum*					
Red Bartsia	*Parentucellia latifolia*					
Common Bartsia	*Parentucellia latifolia ssp. latifolia*					
Water Couch	*Paspalum distichum*				w	
Paspalum	*Paspalum spp.*					
Paradoxical Canary-grass	*Phalaris paradoxa*					
Sticky Ground-cherry	*Physalis viscosa*					
Prostate Knotweed	*Polygonum aviculare*					
Onion Grass	*Romulea rosea*					
Curled Dock	*Rumex crispus*				w	
Scorzonaera	*Scorzonera sp*					
Variegated Thistle	*Silybum marianum*					
Black Nightshade	*Solanum nigrum*					
Common Sow-thistle	*Sonchus olercea*					
Coast Sand-spurrey	*Spergularia media*					
Narrow-leaf Clover	*Trifolium angustifolium var. angustifolium*					
Hare's-foot Clover	*Trifolium arvense var. arvense*					
Hop Clover	*Trifolium campestre var. campestre*					
Cluster Clover	*Trifolium glomeratum*					

Annual-white Clover	*Trifolium michelianum var. michelianum*					
Knotted Clover	*Trifolium striatum*					
Subterraneum Clover	*Trifolium subterraneum*					
Woolly Clover	*Trifolium tomentosum*					
Wandering Speedwell	*Veronica peregrine*				w	
Squirrel-tail Fescue	*Vulpia bromoides*					
Bathurst Burr	*Xanthium spinosum*					

APPENDIX 8: INDEX OF WETLAND CONDITION METHOD

Table 11 below shows what is assessed for each of the six subindices and how they are scored.

Table 11: IWC subindices and measures.

IWC subindex	What is measured	How it is scored
Swamp catchment	1. The intensity of the land use within 250 metres of the swamp	• The more intensive the land use the lower the score
	2. The width of the native vegetation surrounding the swamp and whether it is a continuous zone or fragmented	• The wider the zone and more continuous the zone, the higher the score
Physical form	3. Whether the size of the swamp has been reduced from its estimated pre-European settlement size	• A reduction in area results in a lowering of the score
	4. The percentage of the swamp bed which has been excavated or filled	• The greater the percentage of swamp bed modified, the lower the score
Hydrology	5. Whether the swamp's water regime (i.e. the timing, frequency of filling and duration of flooding) has been changed by human activities	• The more severe the impacts on the water regime, the lower the score
Water properties	6. Whether activities and impacts such as grazing and fertilizer run-off that would lead to an input of nutrients to the swamp are present	• The more activities present, the lower the score
	7. Whether the swamp has become more saline or in the case of a naturally salty swamp, whether it has become more fresh	• An increase in salinity for a fresh swamp lowers the score or a decrease in salinity of a naturally salty swamp lowers the score
Soils	8. The percentage and severity of swamp soil disturbance from human, feral animals or stock activities	• The more soil disturbance and the more severe it is, the lower the score
Biota	9. The diversity, health and weediness of the native swamp vegetation	• The lower the diversity and poorer health of native swamp vegetation, the lower the score • The increased degree of weediness in the native swamp vegetation, the lower the score

Adapted from DSE letter 29 April 2010

Scoring method

Each subindex is given a score between 0 and 20 based on the assessment of a number of measures. Weightings are then applied to the scores as shown in Table 12. The maximum possible total score for a wetland is 38.4, which for ease of reporting, is scaled to 10 by dividing the total score by 38.4 and multiplying by 10. The score is then rounded to the nearest whole number.

Table 12: Weights of each subindex

IWC sub-index	Weight
Biota	0.73
Swamp catchment	0.26
Water properties	0.47
Hydrology	0.31
Physical form	0.08
Soils	0.07

Six wetland condition categories have been assigned to the subindex scores (Table 13) and total IWC scores (Table 14), to be consistent with the number of categories used in other condition indices such as the Victorian Index of Stream Condition. Biota score categories were determined by expert opinion and differ to those of the other subindices.

Table 13: Swamp condition categories assigned to subindex scores.

Sub-index score range (all except biota)	Biota sub-index score range	Swamp condition category
0-4	0-8	Very poor
5-8	9-13	Poor
9-12	14-16	Moderate
13-16	17-18	Good
16-20	19-20	Excellent
N/A	N/A	Insufficient data

Table 14: Swamp condition categories assigned to total IWC scores

IWC total score range	Swamp condition category
0-2	Very poor
3-4	Poor
5-6	Moderate
7-8	Good
9-10	Excellent
N/A	Insufficient data

This information has been drawn from - Version 9 of the Index of wetland Condition - Methods Manual was prepared by Phil Papas, Janet Holmes and Shanaugh Lyon of the Department of Sustainability and Environment January 2010.

APPENDIX 9: EVC BENCHMARKS FOR WALLENJOE SWAMP

EVC benchmarks have been determined for Wallenjoe Swamp by monitoring that was undertaken at the site in 2011 by Australian Ecosystems.

Benchmarks for Red Gum Swamp includes: Trees (aim to maintain 5-10% cover); Sedges (aim to have >2 species and >10% cover); Medium to large grasses (aim to have >3 species and >10% cover around verges); Aquatic herbs (aim to have >3 species and >10% cover).

APPENDIX 10: FROG BREEDING EVENTS

Table extracted from Rogers and Ralph 2011.

Frog species	Preferred hydrology of breeding site (Months)			Timing of breeding				Tadpole lifespan (Months)
	< 3	3-6	Permanent	Spring	Summer	Autumn	Winter	
Common Froglet *Crinia signifera*	*	*	*	C	CM	CM	C	2-4
Plains Froglet *Crinia parasignifera*	*	*	*	C	CM	CM	C	2-4
Pobblebonk *Limnodynastes dumerili*		*	*	CT	CM	CM	C	5-6
Barking Marsh Frog *Limnodynastes fletcheri*		*	*	C	CM	M		3-4
Spotted Marsh Frog *Limnodynastes tasmaniensis*	*	*	*	C	CM	M		3-4
Perons Tree Frog *Litoria peronii*	*	*	*	C	CM	M		3-4
Growling Grass Frog *Litoria raniformis*		*	*	C	CM	M		3-5

C = Calling, M = Mating, T = Tadpoles may be present