

Goulburn Broken Catchment Wetlands

Seasonal Watering Proposal 2013 - 2014
Goulburn Broken Catchment Management Authority



GOULBURN BROKEN
CATCHMENT MANAGEMENT AUTHORITY

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Executive Summary

This proposal outlines the priority watering actions for Black Swamp, Doctors Swamp, Kinnaird Swamp, Moodie Swamp, Reedy Swamp and the Corop wetland system for 2013-2014. Currently, these are the only natural wetlands in the Goulburn Broken Catchment that can physically and legally receive environmental water with the exception of Barmah Forest, which is not considered in this proposal. Although the Corop Wetland System can legally receive environmental water, delivery of environmental water to this system will not be considered until infrastructure works are completed in 2013-2014 to improve environmental water delivery efficiency and control.

Black Swamp, Doctors Swamp, Kinnaird Swamp, Moodie Swamp and the Corop wetland system are currently dry. The priority watering action for Doctors Swamp and the Corop wetland system is to keep these wetlands dry, consistent with their ecological and hydrological objectives. However, if Black Swamp and Kinnaird Swamp remain dry until autumn 2014, environmental water will be required to maintain the condition of their wetland vegetation communities and EPBC (1999) listed flora species.

Reedy Swamp is currently full following a short drying phase. The priority watering action for Reedy Swamp is to promote its natural drawdown and drying consistent with its ecological and hydrological objectives.

If Kinnaird, Black, Doctor and Reedy Swamps support significant waterbird breeding events in spring or summer 2013 after filling naturally (or remaining wet in the case of Reedy Swamp), then environmental water may be required to maintain water levels. Waterbirds may abandon nesting sites if surrounding water levels decrease dramatically or water depths become too shallow. The decision to deliver environmental water to these wetlands to support a bird breeding event will consider the ecological benefits, the requirements of the bird breeding event and the potential impact on the wetland vegetation communities.

If Moodie Swamp remains dry until autumn 2014 commonwealth environmental water will be required to maintain the condition of its wetland community and EPBC (1999) listed flora species.

Table 1 below outlines the potential volume of water required for wetlands in the Goulburn Broken Catchment in 2012-2013 under a range of planning scenarios.

Table 1: Priority watering actions under a range of planning scenarios in the Goulburn Broken Wetlands

SCENARIO DESCRIPTION	DRY 70% POE	AVERAGE 50% POE	WET 30% POE
Water Supply	100% HRWS allocations Perhaps 60% available as private carryover	100% HRWS allocations Perhaps 40% available as private carryover	100% HRWS allocations Perhaps 10% available as private carryover
	Operation of irrigation network is unlikely to restrict water delivery	Operation of irrigation network is unlikely to restrict water delivery	Operation of irrigation network is unlikely to restrict water delivery
Expected Wetland Inflow	No natural flooding of Black Swamp	Black Swamp may fill from natural flooding	Black Swamp may fill from natural flooding
	No natural flooding of Doctors Swamp	Doctors Swamp may fill from natural flooding	Doctors Swamp may fill from natural flooding
	No natural flooding of Kinnaird Swamp	Kinnaird Swamp may partially fill from natural flooding	Kinnaird Swamp may fill from natural flooding
	No natural flooding of Reedy Swamp	Reedy Swamp may fill from natural flooding	Reedy Swamp may fill from natural flooding
Environmental Objectives	Maintain or improve the condition of aquatic vegetation communities	Maintain or improve the condition of aquatic vegetation communities	Maintain or improve the condition of aquatic vegetation communities
	Maintain waterbird breeding habitat	Maintain waterbird breeding habitat	Maintain waterbird breeding habitat

SCENARIO DESCRIPTION	DRY 70% POE	AVERAGE 50% POE	WET 30% POE
Priority Watering Actions	Promote drawdown and drying	Promote drawdown and drying	Promote drawdown and drying
	Promote growth of EPBC (1999) listed aquatic flora species	Promote growth of EPBC (1999) listed aquatic flora species	Promote growth of EPBC (1999) listed aquatic flora species
	Maintain water levels to support bird breeding	Maintain water levels to support bird breeding	Maintain water levels to support bird breeding
Delivery Timing	Dependent on promotion of EPBC listed aquatic flora (autumn watering)	Dependent on promotion of EPBC listed aquatic flora (autumn watering)	Dependent on promotion of EPBC listed aquatic flora (autumn watering)
	Dependent on breeding events (spring/summer watering)	Dependent on breeding events (spring/summer watering)	Dependent on breeding events (spring/summer watering)
Estimated Volume of Environmental Water Required for May 2014 Watering (ML) (Priority 2)	804 ML	402 ML	402 ML
Estimated Volume of Environmental Water Required for October 2013 – January 2014 Watering (ML) (Priority 3)	2212.5 ML	1106.25 ML	1106.25 ML
Estimated Volume of Environmental Water Required August 2014 – October 2014(ML) (Priority 4)	562.5 ML	281.25 ML	281.25 ML
Estimated Volume of Environmental Water Required for 2013-2014 (Priority 5)	804 ML	3016.5 ML	1508.25 ML

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Glossary and acronyms

Catchment management authority – statutory authorities established to manage regional and catchment planning, waterways, floodplains, salinity and water quality

CEWH – Commonwealth Environmental Water Holder

CMA – Catchment Management Authority

Commonwealth Environmental Water Holder (CEWH)

– (part of the Department of Sustainability, Environment, Water, Populations and Communities) holds and manages the water entitlements purchased through the Restoring the Balance water recovery program

Environmental water entitlement – an entitlement to water to achieve environmental objectives in waterways (could be an environmental entitlement, environmental bulk entitlement, water share, section 51 license or supply agreement)

EPBC – Environmental Protection Biodiversity Conservation Act 1999

EVC – Ecological Vegetation Class

GB CMA - Goulburn Broken Catchment Management Authority

Gigalitre (GL) – one billion (1,000,000,000) litres

G-MW – Goulburn-Murray Water

High-reliability entitlement – legally recognised, secure entitlement to a defined share of water, as governed by the reserve policy (full allocations are expected in most years)

Low-reliability entitlement – legally recognised, secure entitlement to a defined share of water, as governed by the reserve policy (full allocations are expected only in some years)

Macrophytes – an aquatic plant that grows in or near water and is emergent, submergent, or floating

Megalitre (ML) – one million (1,000,000) litres

Seasonal allocation – the volume of water allocated to a water share in a given season, expressed as a percentage of total entitlement volume

Victorian Environmental Water Holder – an independent statutory body responsible for holding and managing Victorian environmental water entitlements and allocations (Victorian Water Holdings)

Water entitlement – the right to a volume of water that can (usually) be stored in reservoirs and taken and used under specific conditions

Water Holdings – environmental water entitlements held by the Victorian Environmental Water Holder

Waterway manager – agency responsible for the environmental management of waterways (includes catchment management authorities and Melbourne Water)

Waterways – can include rivers, wetlands, creeks, floodplains and estuaries

1. Background and system overview

1.1 Background

The Environmental Water Reserve (EWR) 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 can be called out of storage when needed and delivered to streams or wetlands to protect or enhance their environmental values and health. Environmental entitlements are held by the Victorian Environmental Water Holder (VEWH), the Commonwealth Environmental Water Holder (CEWH), and the Murray Darling Basin Authority (MDBA). Catchment Management Authorities (CMAs) are responsible for determining the environmental water requirements of streams and wetlands, developing and submitting seasonal watering proposals to the VEWH for consideration, and managing the delivery of environmental water in accordance with the VEWH's Seasonal Watering Plan.

The VEWH prepares seasonal watering plans based on each of the CMA's 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 the plans, the VEWH negotiates access to environmental water managed by the CEWH and the MDBA. The VEWH then prepares seasonal watering statements that authorises CMA's 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.

1.2 Purpose

The purpose of this Goulburn Broken Catchment Wetlands Seasonal Watering Proposal is to:

- identify the environmental water requirements of key wetlands across the Goulburn Broken Catchment in the coming year under a range of climatic scenarios to protect or improve their environmental values and health; and
- inform the development of environmental water priorities in the VEWH's seasonal watering plan.

The proposal is informed by scientific studies and reports that identify the hydrological regimes required to meet the ecological objectives of the wetlands. This proposal was prepared in consultation with key stakeholders and partners, and was approved by the Goulburn Broken CMA board.

1.3 System overview

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 Basins total land area (DNRE, 2002). 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 and communities, and birds listed on international agreements and conventions.

Of the natural wetlands in the catchment only ten can physically and legally receive environmental water. These are Barmah Forest, Black Swamp, Doctors Swamp, Kinnaird Swamp, Moodie Swamp, Reedy Swamp, One Tree Swamp, Two Tree Swamp, Wallenjoe Swamp and Mansfield Swamp. One Tree Swamp, Two Tree Swamp, Wallenjoe Swamp and Mansfield Swamp form a large hydrologically connected wetland system known as the Corop Wetland System. A separate seasonal watering proposal will be prepared for Barmah Forest, and therefore is not considered in the development of this proposal.

Figure 1: Priority wetlands of the Goulburn Broken Catchment



1.3.1 Black Swamp

Black Swamp is a 16.5 hectare red gum swamp managed by Parks Victoria (Appendix 1). Environmental water can be delivered by a water delivery channel connected to the swamp from the Nine Mile Creek. Black Swamp is bioregionally significant and contains a significant population of the EPBC (1999) listed River swamp Wallaby-grass (*Amphibromus fluitans*) which emerges in autumn (Figure 2). Environmental flows can only be delivered to the swamp when flows in the Nine Mile Creek exceed 100ML/day. This regularly occurs during the irrigation season (August – May). Therefore, the wetland may only require environmental water during extended dry periods or to enhance natural inundation events to ensure the success of bird breeding events or to provide optimal growth conditions for water dependent vegetation such as River Swamp Wallaby-grass.

Figure 2: EPBC Listed River Swamp Wallaby-grass (*Amphibromus fluitans*) in Black Swamp – 2008
Photo: D.Cook, Australian Ecosystems, 2008



1.3.2 Doctors Swamp

Doctors Swamp is a 200 hectare red gum swamp managed by Parks Victoria (Appendix 1; Figure 3). It is a bioregionally significant swamp and is considered one of the most intact red gum swamps in Victoria (Cook et al., 2010). Environmental water can be delivered to the swamp via an inlet on the Cattnach Canal only when the Canal is running at full capacity. Flow in the Cattnach Canal is influenced by the operation of Waranga Basin. During spring flow can be inconsistent, which limits delivery opportunities. Flow is often more consistent during summer, autumn and winter providing greater delivery opportunities. The surrounding catchment is largely unmodified, so the wetland receives a near natural flood regime. Consequently, the wetland may only require environmental water during extended dry periods or to enhance natural inundation events to ensure the success of bird breeding events or to provide optimal growth conditions for water dependent vegetation.

Figure 3: Doctors Swamp in 2010
Photo: J.Wood,Goulburn Broken CMA 2010



1.3.3 Kinnaird Swamp

Kinnaird Swamp is a 96 hectare red gum swamp managed by Goulburn-Murray Water and Moira Shire (Appendix 1). It is a significant wetland for Royal Spoonbill (*Platalea regia*) breeding and has the largest known recorded population of the EPBC (1999) listed Rigid Water Milfoil (*Myriophyllum porcatum*)(Figure 4). Water can be delivered to the swamp via the Murray Valley 5/3 (MV 5/3) channel which outfalls into the Muckatah Main drain and flows directly into Kinnaird Swamp. The delivery of environmental water depends upon irrigation demands and can only occur when there is spare channel capacity. Past environmental water allocations have seen agreements between Goulburn-Murray Water and the Goulburn Broken Catchment Management Authority to allow the MV 5/3 channel to operate after the irrigation season has closed. This has allowed efficient and effective environmental water delivery to the swamp. Due to significant changes to natural flow paths in the surrounding catchment and the regulation of the Broken Creek, the wetland may only receive flood water during wet years. Therefore, the wetland may require environmental water to provide a more natural flooding regime and enhance natural inundation events to ensure the success of bird breeding events or to provide optimal growth conditions for water dependent vegetation.

Figure 4: EPBC Listed Rigid Water Milfoil (*Myriophyllum porcatum*) at Kinnaird Swamp 2008.
Photo: D.Cook, Australian Ecosystems, 2008



1.3.4 Moodie Swamp

Moodie Swamp is a 180 hectare cane-grass wetland managed by Parks Victoria (Appendix 1). It is listed under A Directory of Important Wetlands in Australia (EA, 2001) as part of the Broken Creek listing, provides important Brolga breeding habitat and contains a large population of the EPBC (1999) listed Rigid Water Milfoil (*Myriophyllum porcatum*) (Figure 5). Water can be delivered to the swamp via a water delivery channel from the Broken Creek. Currently Moodie Swamp may only receive 117 ML of Commonwealth environmental water (Commonwealth Water Share – Broken system). There has been no survey or modelling of catchment conditions to determine changes to the natural frequency and duration of flooding events at Moodie Swamp. However, it is likely the frequency and duration of flooding at Moodie Swamp has been reduced by the regulation of the Broken River and Broken Creek (SKM, 2006). Therefore, the wetland may require environmental water to provide a more natural flooding regime and enhance natural inundation events to ensure the success of bird breeding events or to provide optimal growth conditions for water dependent vegetation. If conditions permit, temporary earth works on the Moodie Swamp delivery channel and the temporary raising of the rock weir will occur to improve delivery efficiency. Communication with associated landholders would also occur to ensure water delivery is efficient and does not affect adjoining properties.

Figure 5: EPBC Listed Rigid Water Milfoil in flower at Moodie Swamp, 2008
Photo: D.Cook, Australian Ecosystems, 2008



1.3.5 Reedy Swamp

Reedy Swamp is a 130 hectare deep freshwater marsh on the Goulburn River and is listed under A Directory of Important Wetlands in Australia (EA, 2001) as part of the lower Goulburn River Floodplain listing (Appendix 1). Reedy Swamp is part of the Lower Goulburn National Park and is managed by Parks Victoria. It contains a mosaic of Ecological Vegetation Classes (EVCs) including Tall Marsh, Floodway Pond Herbland and Rushy Riverine Swamp. Reedy Swamp is an important colonial nesting waterbird breeding site and drought refuge (Figure 6). Environmental water can be delivered to the wetland via the Central Goulburn Channel 19/12 (CG 19/12), which outfalls into Shepparton Drain 3. Shepparton Drain 3 can then be diverted into Reedy Swamp. The delivery of environmental water depends upon irrigation demands and can only occur when there is spare channel capacity. Past environmental water allocations have seen agreements between Goulburn-Murray Water the Goulburn Broken Catchment Management Authority and Parks Victoria to allow the CG 19/12 channel to remain open after the irrigation season. This has allowed efficient and effective environmental water delivery to the swamp. Goulburn River flows sufficient to naturally inundate the wetland (approximately 20,000 ML/day) still occur on a regular basis. Therefore, the wetland may only require environmental water during extended dry periods or to enhance natural inundation events to ensure the success of bird breeding events or to provide optimal growth conditions for water dependent vegetation.

Figure 6: Ibis colony at Reedy Swamp
Photo: K.Ward, Goulburn Broken CMA, 2011



1.3.6 Corop Wetland System

The Corop Wetland System is a 1,572 ha wetland complex comprising the hydrologically connected One Tree Swamp (631 hectares), Two Tree Swamp (82 hectares), Wallenjoe Swamp (359 hectares) and Mansfield Swamp (500 hectares) (Appendix 1). 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. They are valued for their size, rarity, species diversity and waterbird habitat. Of note, One Tree and Two Tree Swamps provide important breeding habitat for Brolga and One Tree Swamp is the largest Cane-grass (*Eragrostis infecunda*) wetland in the Goulburn Broken Catchment. Environmental water can be delivered to the wetland swamp from the Waranga Western Main Channel at Groves Weir. The weir can be opened to allow environmental flows into Wanalta Creek which terminates at One Tree Swamp. The natural flow paths connecting the four wetlands have been modified to improve their hydrological efficiency. As a result the

depth and duration of flooding cannot be actively managed at each wetland with the exception of Mansfield Swamp at the terminal end of the system. Therefore, any environmental water delivered to the system would fill and spill the wetlands in turn. Under Stage 2 of the G-MW Connections program (previously NVIRP), the Commonwealth Government funded the design and construction of regulating structures so the depth and duration of flooding in One Tree and Two Tree Swamps can be controlled. Goulburn-Murray Water Connections Program are expected to complete the works in 2014 with the assistance and advice of the Goulburn Broken CMA and Goulburn-Murray Water. Due to regulation of the Wanalta Creek the wetland system may only receive flood water during wet years. Therefore, the wetland system may require environmental water to provide a more natural flooding regime and enhance natural inundation events to ensure the success of bird breeding events or to provide optimal growth conditions for water dependent vegetation. However, environmental water will not be delivered to this site until planned infrastructure works are completed, which will enable efficient water delivery.

1.4 Water resources

Victorian wetlands can receive environmental water from a number of sources including entitlements held by the Victorian Environmental Water Holder, Parks Victoria, Murray Darling Basin Authority (The Living Murray) and Commonwealth Environmental Water Holder. In addition, Victorian wetlands can receive donations of water from individuals, community groups and organisations. Wetlands in the Goulburn Broken Catchment may receive environmental water from the entitlements outlined in Table 2 below.

Table 2: Environmental water available for use in Goulburn Broken Catchment wetlands

Entitlement	HR Volume (ML)	LR Volume (GL)	Management Responsibility
Victorian River Murray Flora and Fauna Bulk Entitlement 1	27,600.0	34,000.0	VEWH
Goulburn System Environmental Water Reserve Bulk Entitlement ²	22,000	0.0	VEWH
Goulburn River Environmental Entitlement 20103	1432.0	0.0	VEWH
Shepparton Modernisation Project ⁴	1,500.0	7,600.0	VEWH
One Tree Swamp Bulk Entitlement ¹	9.3	0.0	Parks Victoria
Gaynor Swamp Bulk Entitlement ¹	28.7	11.5	Parks Victoria
Stockyard Plain Bulk Entitlement ¹	112.0	0.0	DSE
Commonwealth Water Share (Broken system)	117	0.0	MDBA
Commonwealth Water Share (Goulburn system) ¹	203,500.0	11,800.0	CEWH
	256,299	53,411.5	

- 1 The water can be used to supply wetlands connected to supply networks of the Murray River, Goulburn River and lower Broken Creek.
- 2 Currently supply is by agreement with G-MW. The volume is not fixed and is based on the water saved in the previous year by the G-MW – Connections program (previously NVIRP), which is influenced by climate affected losses. The water will be turned into a fixed volume entitlement when the G-MW Connections program is finished. The water can be used to supply water to wetlands connected to supply networks of the Murray River, Goulburn River and lower Broken Creek.
- 3 Held in Lake Eildon but specified at Loddon Weir. The water can be used to supply wetlands connected to supply networks of the Murray River, Goulburn River and lower Broken Creek.
- 4 The water can be used to supply wetlands connected to supply networks of the lower Broken River and upper Broken Creek.

3. Flow objectives and recommendations

Long-term ecological and hydrological objectives have been established in Environmental Water Management Plans for each of the nine wetlands considered in this proposal. The objectives were developed by a Scientific Technical Committee comprised of local agency staff and specialist wetland consultants. These ecological and hydrological objectives are outlined in Tables 3-10.

Of particular relevance to this proposal, each wetland has an ecological objective to provide opportunities for waterbird breeding or maintain waterbird breeding habitat. In addition, they have hydrological objectives that identify optimum ponding and drying durations to improve or maintain their respective vegetation communities.

Table 3: Ecological and hydrological objectives for Black Swamp in the Goulburn Broken Catchment

Asset	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			
BLACK SWAMP														
Vegetation	Improve the diversity of native wetland flora species to be consistent with Red Gum Swamp EVC benchmarks	Wetland body and riparian zone	2	5-7	10	3	6	54	2	6	18	Late Autumn – Spring or spring summer for more growth	90	Variable to 500mm
Birds	Provide opportunities for waterbird breeding	Wetland body	3	10	10	6	9	12	6	8	NA	Spring	90	Maximum of 500mm

Activities enjoyed by visitors to Black Swamp include bird watching, picnicking, bike riding and walking. Camping is a relatively low level activity at the wetland. Recreational hunting of ducks, quails and other game species in season is permitted at the site by licenced game shooters. The direct economic values that Black Swamp provides to the Goulburn Broken Catchment include consumptive uses such as hunting and non-consumptive uses such as tourism and recreation to the area. Indirect economic values that Black Swamp provides includes water filtration, flood protection, water storage, groundwater recharge, nutrient discharge, carbon storage and habitat for threatened flora and fauna species.

Table 4: Ecological and hydrological objectives for Doctors Swamp in the Goulburn Broken Catchment

Asset	Ecological Objectives	Water management area	Hydrological objectives									Preferred timing of inflows	Volume to fill to target supply level (ML)	Depth (mm)
			Recommended number of events in 10 years			Tolerable interval between events once wetland is dry (months)			Duration of ponding (months)					
			Min	Opt	Max	Min	Opt	Max	Min	Opt	Max			
DOCTOR SWAMP														
Vegetation	Maintain diversity of native wetland flora species to be consistent with Red Gum Swamp EVC benchmarks.	Wetland body and riparian zone	2	5-7	10	3	6	54	2	6	18	Late Autumn – Spring	1284	Variable to 600mm
Birds	Provide opportunities for waterbird breeding.	Wetland body	3	10	10	6	9	12	6	8	NA	Spring	1284	Variable to 600mm

Activities enjoyed by visitors to the study area include bird watching, picnicking and walking. Camping is a relatively low-level activity at Doctors Swamp, and there is no defined camping area or facilities. Recreational hunting of ducks, quails and other game species in season is permitted at Doctors Swamp. The direct economic values that Doctors Swamp contributes to the Goulburn Broken catchment include consumptive uses such as hunting and non-consumptive such as tourism and recreation. Indirect economic values that Doctors Swamp provide to the Goulburn Broken Catchment include water filtration, flood protection, groundwater recharge, nutrient discharge, carbon storage and habitat for threatened flora and fauna species.

Table 5: Ecological and hydrological objectives for Kinnaird Swamp in the Goulburn Broken Catchment

Asset	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			
KINNAIRD SWAMP														
Vegetation	Improve the diversity of native wetland flora species to be consistent with Red Gum Swamp EVC benchmarks.	Wetland body and riparian zone	2	5-7	10	3	6	54	2	6	18	Late Autumn – Spring or spring summer for more growth	482.5	Variable to 500mm
Vegetation	Improve the diversity of native wetland flora species to be consistent with Plains Grassy Wetland EVC benchmarks.	Wetland body and riparian zone	3	5-7	10	6	6	42	3	6	9	Late Autumn – Spring	482.5	Variable to 500mm
Vegetation	Maintain populations of rigid water-milfoil and slender water-milfoil.	Floodway and Wetland body	NA	NA	NA	NA	NA	12	NA	NA	NA	Late Autumn	482.5	Variable to 500mm

Birds	Provide opportunities for waterbird breeding especially Royal Spoonbills and Australasian Shoveler	Wetland body	3	10	10	6	9	12	6	8	NA	Spring	482.5	
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Activities enjoyed by visitors to Kinnaird 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. The direct economic values that Kinnaird Swamp provides to the Goulburn Broken Catchment include non-consumptive uses such as tourism and recreation. Indirect economic values that Kinnaird Swamp provides includes water filtration, flood protection, water storage, groundwater recharge, nutrient discharge, carbon storage and habitat for threatened flora and fauna species.

Table 6: Ecological and hydrological objectives for Moodie Swamp in the Goulburn Broken Catchment

Asset	Ecological Objectives	Water management area	Hydrological objectives										Preferred timing of inflows	Volume to fill to target supply level (ML)	Depth (mm)
			Recommended number of events in 10 years			Tolerable interval between events once wetland is dry (months)			Duration of ponding (months)						
			Min	Opt	Max	Min	Opt	Max	Min	Opt	Max				
MOODIE SWAMP															
Vegetation	Maintain Cane-grass Swamp EVC.	Wetland body and riparian zone	3	5	10	6	6-9	36	3	6	9	Autumn – Spring	720	Variable to 400mm	
Birds	Provide opportunities for waterbird breeding especially Brolga.	Wetland body	5	5	10	6	9	12	2	6	NA	Spring	720	Variable to 400mm	

Activities enjoyed by visitors to Moodie swamp include bird watching, picnicking 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. Hunting in season is permitted at Moodie Swamp as it is classified as a Natural Features Reserve – Wildlife Area (ECC, 2001). The direct economic values that Moodie Swamp provides to the Goulburn Broken Catchment include non-consumptive uses such as tourism and recreation. Indirect economic values that Moodies Swamp provides includes water filtration, flood protection, water storage, groundwater recharge, nutrient discharge, carbon storage and habitat for threatened flora and fauna species.

Table 7: Ecological and hydrological objectives for Reedy Swamp in the Goulburn Broken Catchment

Asset	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			
REEDY SWAMP														
Vegetation	Improve the diversity of native wetland flora species to be consistent with mosaic of EVC benchmarks.	Wetland body and riparian zone	4	6	10	4	6-10	12-18	6	6-10	12-18	Autumn – Spring	1264	Variable to 1000mm
Birds	Maintain habitat for waterbird breeding especially Royal Spoonbills and Ibis.	Wetland body	4	6	10	4	6-10	12	6	4-9	NA	Spring	1264	Variable to 10000mm

Activities enjoyed by visitors to the study area include bird watching, photography, 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. The direct economic values that Reedy Swamp provides to the Goulburn Broken Catchment include non-consumptive uses such as tourism and recreation to the area. Indirect economic values that Reedy Swamp provides include a wide range of ecosystem services such as flood retardation, water storage, groundwater recharge, nutrient discharge and carbon storage.

Table 8: Ecological and hydrological objectives for One Tree and Two Tree Swamp in the Goulburn Broken Catchment

Asset	Ecological Objectives	Water management area	Hydrological objectives										Volume to fill to target supply level (ML)	Depth (mm)
			Recommended number of events in 10 years			Tolerable interval between events once wetland is dry (months)			Duration of ponding (months)			Preferred timing of inflows		
			Min	Opt	Max	Min	Opt	Max	Min	Opt	Max			
ONE TREE AND TWO TREE SWAMPS														
Vegetation	Maintain Cane-grass Swamp and Cane-grass wetland/ plains grassy wetland complex EVCs of One Tree and Two Tree Swamp.	Wetland body and riparian zone	3	5	10	6	6-9	36	3	6	9	Autumn – Spring	2524 ML One Tree 328 ML Two Tree	Variable to 400mm
Vegetation	Maintain Lignum Swamp EVC at Two Tree Swamp.	Wetland fringe	1	1	1	8	8	8	2	2-8	8	Spring - summer	328 ML Two Tree	Variable to 400mm
Birds	Provide opportunities for waterbird breeding especially Brolga.	Wetland body	5	5	10	6	9	12	2	6	NA	Spring	2524 ML One Tree 328 ML Two Tree	Variable to 400mm

Activities enjoyed by visitors to One Tree and Two Tree Swamps include bird watching, picnicking 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. The direct economic values that One Tree and Two Tree Swamps provide to the Goulburn Broken Catchment include non-consumptive uses such as tourism and recreation to the area. Indirect economic values these

swamps provide includes a wide range of ecosystem services such as water filtration, flood retardation, water storage, groundwater recharge, nutrient discharge and carbon storage and habitat for threatened flora and fauna species.

Table 9: Ecological and hydrological objectives for Wallenjoe Swamp in the Goulburn Broken Catchment

Asset	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			
WALLENJOE SWAMP														
Vegetation	Maintain diversity of native wetland flora species to be consistent with Red Gum Swamp EVC benchmarks.	Wetland body and riparian zone	2	5-7	10	3	6	54	2	6	18	Late Autumn – Spring	5242	Variable to 1000mm
Birds	Provide opportunities for waterbird breeding.	Wetland body	3	10	10	6	9	12	6	8	NA	Spring	5242	Variable to 1000mm

Activities enjoyed by visitors Wallenjoe Swamp include bird watching, picnicking 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. 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 include water filtration, flood protection, water storage, groundwater recharge, nutrient discharge, carbon storage and habitat for threatened flora and fauna species.

Table 10: Ecological and hydrological objectives for Doctors Swamp in the Goulburn Broken Catchment

Asset	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			
MANSFIELD SWAMP														
Vegetation	Maintain Cane-grass Swamp EVC benchmarks.	Wetland body and riparian zone	3	5	10	6	6-9	36	3	6	9	Autumn – Spring	5349	Variable to 500mm
Vegetation	Maintain Red Gum Swamp EVC benchmarks.	Wetland body and riparian zone	2	5-7	10	3	6	54	2	6	18	Late Autumn – Spring	5349	Variable to 500mm
Birds	Provide opportunities for waterbird breeding especially Brolga.	Wetland body	5	5	10	6	9	12	2	6	NA	Spring	5349	Variable to 500mm

Activities enjoyed by visitors to Mansfield Swamp include bird watching, picnicking 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. The direct economic values that Mansfield 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 Mansfield Swamp provides include water filtration, flood protection, water storage, groundwater recharge, nutrient discharge, carbon storage and habitat for threatened flora and fauna species.

4. Current situation and priority watering actions

4.1 Current situation

Above average and unseasonal rainfalls between 2010 and 2012 resulted in many wetlands across the Goulburn Broken Catchment being inundated. In most instances this was a welcome reprieve, as many wetlands across the Goulburn Broken Catchment were previously dry for ten years. However, a majority of these wetlands then experienced prolonged inundation which can temporarily or permanently alter wetland vegetation communities by favouring species adapted to extended inundation, reducing the diversity and structure of habitat. Of particular concern, River Red Gums can die as a result of waterlogging and a mature hollow bearing River Red Gum may take over 100 years to grow.

Black, Kinnaird, Moodie, One Tree, Two Tree, Mansfield and Wallenjoe Swamps are currently dry after having held water for approximately 30 months. Reedy Swamp recently filled after an unseasonal rainfall event of 160mm falling in Shepparton on 27th February 2013. The wetland had experienced a drying period of approximately two months which does not meet the required drying regime of 6-10 months. Regulating infrastructure is being used to augment the natural drawdown rate at Reedy Swamp.






The continuation of the drying phase in 2013-2014 for the majority of these wetlands is desired to protect the diversity and structure of their vegetation communities and is in line with their ecological and hydrological objectives (Section 2 Tables 3-10).

Table 11 outlines the historical and predicted hydrological condition of wetlands in the Goulburn Broken Catchment and when they received environmental water.

Table 11: Historical and predicted hydrological condition of wetlands in the Goulburn Broken Catchment

WETLAND	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014*
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014*	
Black Swamp#	Met	Met	Exceeded	Exceeded	Exceeded	Exceeded	Dry	Env. water	Dry	Env. water	Met	Exceeded	Exceeded	Dry
Doctors Swamp	Partly met	Partly met	Partly met	Partly met	Partly met	Dry	Partly met	Partly met	Met	Met	Met	Exceeded	Dry	Dry
Kinnaird Swamp#	Dry	Dry	Met	Met	Met	Dry	Dry	Env. water	Dry	Env. water	Met	Exceeded	Exceeded	Dry
Mansfield Swamp	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Met	Met	Exceeded	Exceeded	Dry
Moodie Swamp^	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Env. water	Dry	Met	Met	Exceeded	Exceeded	Dry
One Tree Swamp	Dry	Dry	Dry	Dry	Dry	Dry	Partly met	Dry	Dry	Met	Met	Exceeded	Exceeded	Dry
Reedy Swamp	Met	Met	Exceeded	Exceeded	Exceeded	Dry	Env. water	Env. water	Env. water	Env. water	Exceeded	Exceeded	Exceeded	Dry
Two Tree Swamp	Dry	Dry	Dry	Dry	Dry	Dry	Partly met	Dry	Dry	Met	Met	Exceeded	Exceeded	Dry
Wallenjoe Swamp	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Met	Met	Exceeded	Exceeded	Dry

Legend

Met water regime requirements		Exceeded maximum ponding duration	
Partly met water regime requirements		Environmental water supplied	
Dry			

Refer to appendix 2 for yearly wetting and drying history of Kinnaird Swamp.

* Predicted hydrological condition based on priority 1 and 2 watering actions.

^ Commonwealth environmental water delivery for promotion of growth of *Myriophyllum porcatum* or extension of bird breeding event only. Watering would occur only if the wetland was holding water and with the threat of drying occurring.

4.2 Priority watering actions

Wetlands within the Goulburn Broken catchment experienced prolonged inundation in excess of recommended durations during 2010-2012, and have only recently begun a dry phase in late 2012. The following priority watering actions are required for wetlands within the Goulburn Broken Catchment and are summarised in Table 12 and Figure 8:

- **Priority 1** - Maintain a dry state of Kinnaird, Black and Doctor Swamps consistent with the hydrological and ecological requirements of the wetlands (Section 2 Tables 3-7). To promote the natural drawdown and drying of Reedy Swamp, consistent with its hydrological and ecological requirements.
- **Priority 2** - If Kinnaird and Black Swamps do not naturally fill, deliver environmental water to the wetlands in May 2014 to maintain the condition of their vegetation communities and EPBC listed flora species. Rigid Water Milfoil found at Kinnaird and Moodie Swamp is likely to emerge between March and May, which coincides with seed establishment. River Swamp Wallaby-grass found at Black Swamp begins to emerge in autumn and winter for it to flower and seed in spring and summer. Filling these wetlands in autumn will require a total volume of 1704 ML (including seepages and losses). Black and Kinnaird Swamp are all classified as seasonal wetlands and will have exceeded their optimal drying period by autumn 2014 if they remain dry.
- **Priority 3** - If Kinnaird, Black and Doctor Swamps fill naturally before May 2014 and stimulate a significant waterbird breeding event, environmental water will be provided to maintain water levels between October 2013 and January 2014 to ensure waterbirds do not abandon nests.

If Reedy Swamp retains water and stimulates a significant waterbird breeding event environmental water will also be provided to maintain water levels between October 2013 and January 2014 to ensure waterbirds do not abandon nests. An attempt to comply with recommended ponding durations will occur (Section 2, Tables 3-7).

The need to maintain water levels in a wetland to support a bird breeding event is likely to occur between October and January, which coincides with key waterbird breeding cycles. The total evaporation rate in Shepparton between these months is approximately 500 mm. 2212.5 ML is required to maintain water levels in Black, Kinnaird, Doctor and Reedy Swamps between October and January in dry years (Table 12). In average and wet years when natural inflows may compensate for evaporation losses only half this volume may be required.

- **Priority 4** - Dependent on natural inflows, 562.5 ML of environmental water may be required between August 2014 and October 2014 to ensure the optimum ponding durations (six months) at Black and Kinnaird Swamps are met (Table 12).
- **Priority 5** - If wetlands fill naturally in the autumn-winter 2013 and stimulates a significant waterbird breeding event, 2212.5 ML of environmental water may be required between October 2013 and January 2014 to ensure waterbirds do not abandon their nests (as discussed in Priority 3).

If these wetlands then become significantly dry over the summer of 2013-2014 they will be monitored to determine if an autumn watering is applicable. If an autumn watering is to occur then 804 ML environmental water will be required for this event, therefore a total of 3016.5 ML will be required for the 2013-2014 period (Table 12).

Table 12: Predicted water requirements

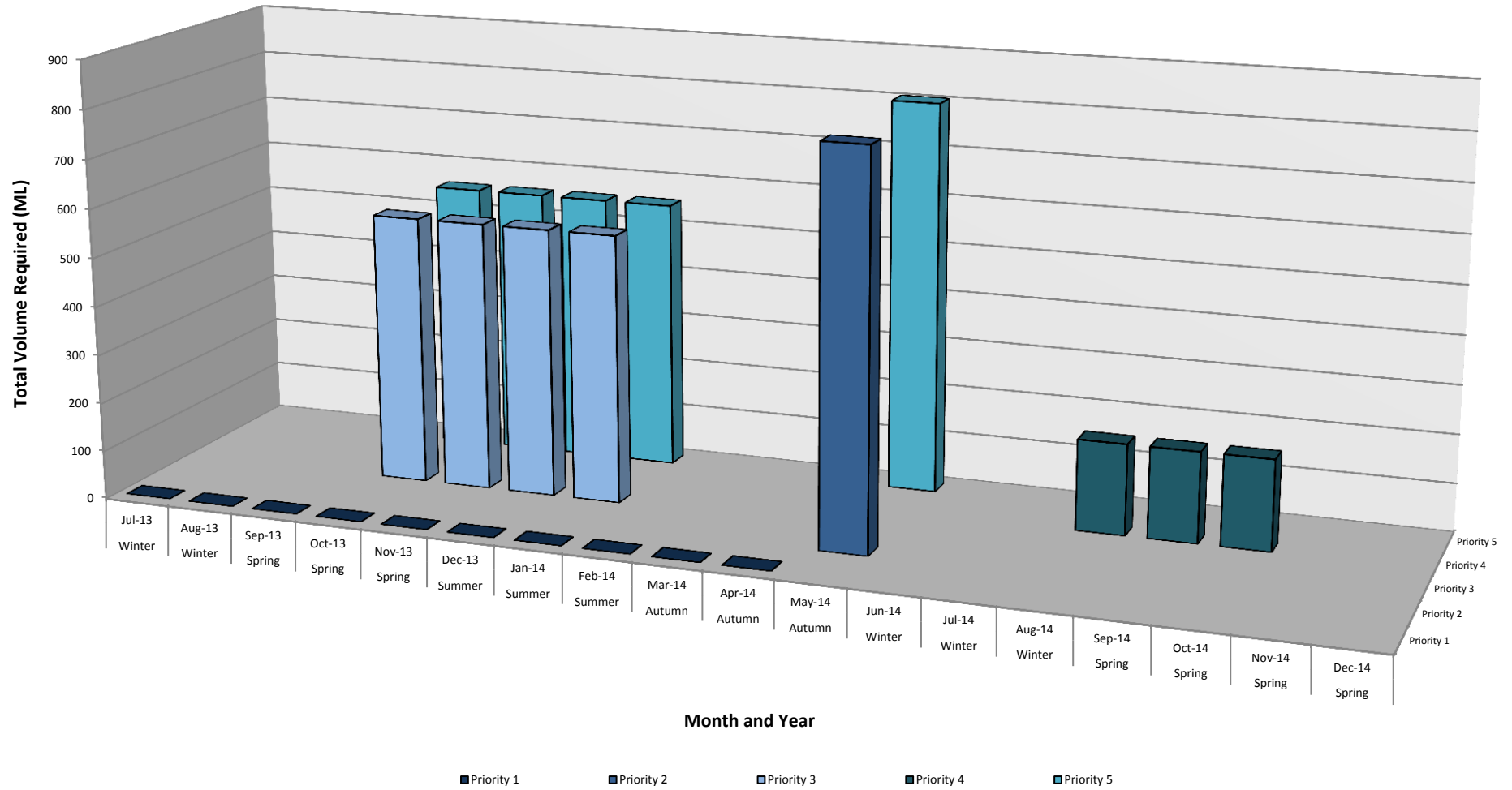
WETLAND	AREA (Ha)	VOLUME REQUIRED TO FILL (ML) MAY 2014* (Priority 2)	VOLUME REQUIRED TO COMPENSATE FOR 500 MM OF EVAPORATION (ML) OCTOBER 2013 – JANUARY 2014# (Priority 3)	VOLUME REQUIRED TO COMPENSATE FOR 500 MM OF EVAPORATION (ML) AUGUST 2014 – OCTOBER 2014# (Priority 4)	VOLUME REQUIRED TO COMPENSATE FOR 500 MM OF EVAPORATION OCTOBER 2013 – JANUARY 2014 (Priority 2) AND VOLUME REQUIRED TO FILL MAY 2014 (Priority 3) (ML) (Priority 5)
Black Swamp	16.5	132 (filling to 400mm)	82.5 (spring/summer 2013)	82.5 (spring/summer 2014)	214.5
Kinnaird Swamp^	96	672 (filling to 350mm)	480 (spring/summer 2013)	480 (spring/summer 2014)	1152
Doctors Swamp	200	NA	1000 (spring/summer 2013)		1000
Reedy Swamp	130	NA	650 (spring/summer 2013)		650
Totals	422.5	804	2212.5	562.5	3016.5

Volume required = wetland area x evaporation /100

* Wetland area (ha) x required depth (mm)/ 100x2 (assuming wetland is being filled from dry) and including seepage and losses

^ Kinnaird Swamp reserve is approximately 80 ha (refer to appendix 2) with a further 16 ha of flood easement at the northern edge of the Swamp. Calculations are based upon wetting the whole 96 ha area.

Figure 7: Graphical representation of priority watering requirements for 2013-2014.



5. Scenario planning and triggers for action

5.1 Scenario planning

The need and use of environmental water will often vary according to climatic conditions. In drier periods, restricted water resources and natural inflows may limit the ecological and hydrological objectives that can be realistically provided for a wetland through environmental water management. However, in wetter periods the desired ecological and hydrological objectives of a wetland may be largely met by natural inflows and only small volumes of environmental water may be required. Therefore, how environmental water management priorities and required volumes of environmental water may change under different climatic scenarios is considered below in Table 13 and Figure. The scenarios are based on receiving catchment inflows with a particularly Probability of Exceedence (POE) and the likely availability of environmental water, based on data from Goulburn-Murray Water. The scenarios are dry (70% POE), average (50% POE) and wet (30% POE). These scenarios were chosen as they may result in different natural inflows to the wetlands and the volume of environmental water required.

Table 13: Scenario summary for Goulburn Broken Catchment wetlands

SCENARIO DESCRIPTION	DRY 70% POE	AVERAGE 50% POE	WET 30% POE
Water Supply	100% HRWS allocations Perhaps 60% available as private carryover	100% HRWS allocations Perhaps 40% available as private carryover	100% HRWS allocations Perhaps 10% available as private carryover
	Operation of irrigation network is unlikely to restrict water delivery	Operation of irrigation network is unlikely to restrict water delivery	Operation of irrigation network is unlikely to restrict water delivery
Expected Wetland Inflow	No natural flooding of Black Swamp	Black Swamp may fill from natural flooding	Black Swamp may fill from natural flooding
	No natural flooding of Doctors Swamp	Doctors Swamp may fill from natural flooding	Doctors Swamp may fill from natural flooding
	No natural flooding of Kinnaird Swamp	Kinnaird Swamp may partially fill from natural flooding	Kinnaird Swamp may fill from natural flooding
	No natural flooding of Reedy Swamp	Reedy Swamp may fill from natural flooding	Reedy Swamp may fill from natural flooding
Environmental Entitlement Volumes Available	CEWH – 111 GL VEWH – 72 GL	CEWH – 111 GL VEWH – 72 GL	CEWH – 111 GL VEWH – 72 GL
Environmental Objectives	Maintain or improve the condition of aquatic vegetation communities	Maintain or improve the condition of aquatic vegetation communities	Maintain or improve the condition of aquatic vegetation communities
	Maintain waterbird breeding habitat	Maintain waterbird breeding habitat	Maintain waterbird breeding habitat
Priority Watering Actions	Promote drawdown and drying	Promote drawdown and drying	Promote drawdown and drying
	Promote growth of EPBC (1999) listed aquatic flora species	Promote growth of EPBC (1999) listed aquatic flora species	Promote growth of EPBC (1999) listed aquatic flora species
	Maintain water levels to support bird breeding	Maintain water levels to support bird breeding	Maintain water levels to support bird breeding
Delivery Timing	Dependent on promotion of EPBC listed aquatic flora (autumn watering)	Dependent on promotion of EPBC listed aquatic flora (autumn watering)	Dependent on promotion of EPBC listed aquatic flora (autumn watering)
	Dependent on breeding events (spring/summer watering)	Dependent on breeding events (spring/summer watering)	Dependent on breeding events (spring/summer watering)
Estimated Volume of Environmental Water Required for Priority 2	804 ML	402 ML	402 ML
Estimated Volume of Environmental Water Required for Priority 3	2212.5 ML	1106.25 ML	1106.25 ML

SCENARIO DESCRIPTION	DRY 70% POE	AVERAGE 50% POE	WET 30% POE
Estimated Volume of Environmental Water Required for Priority 4	562.5 ML	281.25 ML	281.25 ML
Estimated Volume of Environmental Water Required for Priority 5	804 ML	3016.5 ML	1508.25 ML

5.2 Triggers for action

The decision to deliver environmental water to Kinnaird, Black, Reedy and Doctors Swamps will be based on their hydrological condition, waterbird breeding activity and the potential impact environmental water delivery may have on wetland vegetation. Decisions will give consideration to the following ecological influences and will be made in consultation with Parks Victoria, G-MW, the Moira Shire and other key stakeholders:

- **Hydrological condition** - If Kinnaird and Black Swamps do not naturally fill by autumn 2014, environmental water will be delivered to these wetlands to maintain the condition of their wetland vegetation communities and EPBC listed flora species. The natural drawdown and drying of Reedy Swamp will be promoted.
- **Growth of EPBC Act (1999) listed native flora species** - The list of nationally threatened species continues to grow in Australia, with 426 animal species and 1,339 plant species listed under the EPBC Act (1999). The nationally vulnerable Rigid Water Milfoil is found at Kinnaird Swamp. The Rigid Water Milfoil population at Kinnaird Swamp is considered to be one of the largest (if not the largest) in Victoria. The species is endemic to Victoria with approximately 15 known populations. Major threats to these populations include wetland drainage and modification; weed invasion, grazing and climate change. Little is known about the biology of the plant however, field observations suggest the plant responds to autumn inundation following a dry phase (2008 observations at Kinnaird Swamp).

River Swamp Wallaby-grass is present within Black Swamp and flowers and fruits between November and May. Plant growth usually occurs during spring, however autumn watering will also ensure a response after a dry period. This was observed during environmental water delivery to Black Swamp in 2008.

- **The number and conservation status of breeding waterbirds** - Waterbird abundance has significantly declined across Victoria and much of the Murray-Darling Basin (Birds Australia 2008). Providing waterbird breeding opportunities is therefore important, particularly for threatened species. For more abundant species 100+ breeding pairs may be considered important to support. However, 1 pair of breeding Brolga may be considered important to support due to their small population.
- **The sensitivity of waterbirds to water level changes** - The sensitivity of waterbirds to water level changes is dependent upon their nesting and rearing strategies. Altricial birds (juveniles hatch in a relatively underdeveloped state and stay in the nest are tended to by adults) reed nesters (e.g. ibis and spoonbills) are most sensitive to changes in water level followed by altricial tree nesters (e.g. cormorants). Precocial birds (juveniles hatch in a relatively advanced and mobile state and are capable of leaving the nest) reed nesters (e.g. Brolga, swans and coots) are less sensitive to changes in water levels and precocial tree nesters are least sensitive (e.g. ducks).
- **Bird breeding phase** - If waterbirds are in the lag phase (nest building and feeding) drawdown and drying of the wetland could be promoted to discourage waterbirds from continuing to breed. The drawdown and drying of wetlands in later phases of bird breeding (egg laying and incubation; nesting; and fledging) poses a risk to the survival of waterbird chicks.
- **Wetland water level** - The wetland water level in conjunction with the bird breeding phase will influence the need for environmental water and the amount required. For example, if a wetland is relatively full and waterbird breeding is at the nesting phase, environmental water may not be required to ensure waterbirds fledge. The length of each breeding phase can vary between waterbird species and will be considered in the decision making process.
- **The availability of alternative waterbird breeding habitat** - The more waterbird breeding habitat available across the catchment and the Murray-Darling Basin the less critical it will be to support a bird breeding event in Black

and Kinnaird. Some waterbird species such as Brolga have preferred breeding locations and will be considered in assessing the availability of alternative waterbird breeding habitat.

- **The impact on wetland vegetation** - Wetland vegetation is critical to many wetland functions. Therefore, environmental water will not be delivered to a wetland to support waterbird breeding if it may result in long-term and significant changes to the structure and composition of the vegetation. The type and condition of wetland vegetation at Black and Kinnaird Swamps varies along with their inundation histories. These factors will influence the potential impact environmental water delivery may have on the wetland vegetation.

The above ecological influences may change at each wetland during the season and will need to be continually reviewed, along with the capacity to deliver environmental water requirements.

6. Implementation arrangements

6.1 Notice and time requirements

A notice period of one to two days minimum and preferably four days is required for environmental water orders from Goulburn system storages. If constraints in making environmental water available are foreseen by G-MW, the Environmental Water Manager will be advised accordingly. The physical delivery of environmental water to the wetlands may only take 1-3 days during the irrigation season depending on system demands. In addition, Black Swamp can only receive environmental water when flow in the Nine Mile Creek is above 100 ML/day (which regularly occurs during the irrigation season) and Doctors Swamp can only receive environmental water when the Cattanach Canal is running at full capacity. Flow in the Cattanach Canal is influenced by the operation of Waranga Basin. During spring flow can be inconsistent limiting delivery opportunities. Flow is often more consistent during summer, autumn and winter providing greater delivery opportunities.

The Goulburn Broken Catchment Management Authority will coordinate any planned delivery of environmental water with the VEWH, G-MW, Moira Shire and Parks Victoria. Further delivery arrangements will be outlined in delivery plans.

7. Risk assessment and management

The risks associated with the proposed delivery of environmental water to the five wetlands in the Goulburn Broken Catchment during spring and summer to maintain waterbird breeding habitat include: the resource manager being unable to deliver the required flow rates; improving conditions for non-native species; and the environmental water account becoming overdrawn. For all the five wetlands these have been assessed as a medium risk while remaining risks have been assessed as low (Table 14).

The likely hood of any risk event occurring before or during an environmental water delivery was predominately assessed as either Rare (1) or Unlikely (2). However, the consequences of some of these risks if they did happen were assessed as moderate (3) to serious (4).

Table 14: Risk assessment for the Goulburn Broken Wetlands

RISK CATEGORY	Risk #	Risk Type	FLOW COMPONENT		
			Spring release	Summer release	Autumn release
			Risk rating	Risk rating	Risk
Quality issues lead to non-achievement of objectives	1.0	Release volume is insufficient in meeting required flow at target point	Low	Low	Low
	1.1	Current recommendations on environmental flows at target point	Low	Low	Low
	1.2	Storage operator maintenance works affect ability to deliver water	Low	Low	Low
	1.3	Resource manager cannot deliver required flow rate (outlet/capacity constraints, insufficient storage volume)	Medium	Medium	Medium
Time	2.0	Limited CMA resource to deliver environmental release	Low	Low	Low
Cost	3.0	Cost of delivery exceeds available funding	Low	Low	Low
Human	4.0	Environmental release causes personal injury to river users	Low	Low	Low
Environmental	5.0	Releases cause water quality issues	Low	Low	Low
	5.1	Improved conditions for non-native species	Medium	Medium	Medium
Compliance	6.0	Environment water account is overdrawn	Medium	Medium	Medium
	6.1	Environmental release causes flooding on private land	Low	Low	Low
	6.2	Environmental release causes flooding to public infrastructure	Low	Low	Low

RISK CATEGORY	Risk #	Risk Type	FLOW COMPONENT		
			Spring release	Summer release	Autumn release
			Risk rating	Risk rating	Risk
	6.3	Environmental release causes flooding of Crown Land	Low	Low	Low
Reputation	7.0	Unable to provide evidence in meeting ecological objective	Low	Low	Low
	7.1	Key stakeholders not supportive of environmental water release	Low	Low	Low

Table 15 below outlines the mitigation strategies (where available) that will be employed by the Goulburn Broken Catchment Authority to address the medium risks identified above.

Table 15: Mitigation action plan

RISK #	RISK TYPE	MITIGATION STRATEGY
1.3	Resource manager cannot deliver required flow rate (outlet/ capacity constraints, insufficient storage volume)	Ongoing dialogue with G-MW regarding consumptive demand in the system, to assist in timing releases when there is available capacity to meet desired flow rates.
5.1	Improved conditions for non-native species	There is currently no strategy to mitigate this risk. However, minimising summer inundation and placing carp screens on inlet channels can reduce the risk.
6.0	Environment water account is overdrawn	Ongoing dialogue with G-MW regarding the volume of water delivered so additional water uses can be identified in advance and negotiated with the VEWH.

8. Monitoring, reporting and knowledge gaps

8.1 Monitoring

The Goulburn Broken Catchment Management Authority has formally monitored the ecological response of Black, Doctors, Kinnaird, Moodie, Reedy and One Tree, Two Tree, Wallenjoe and Mansfield Swamps to natural inundation events and environmental water deliveries since 2008.

The monitoring has recorded:

- Waterbird species present, their approximate number and breeding activity.
- Frog species present, intensity of calling activity and breeding activity.
- Vegetation communities present, their species composition and percentage cover.
- Water quality (pH, EC, temperature and turbidity).
- Water depth and extent.
- Incidental flora and fauna sightings of interest.

Compliance monitoring is also undertaken during the delivery of environmental water. This includes monitoring regulator operation and the volume of water delivered. This has been complimented by regular field observations by staff and acoustic monitoring to help determine the presence and number of waterbirds and frogs, and wetland condition. The information collected has been invaluable in informing the ongoing management of these wetlands, and State Government and VEWH reporting.

If wetlands remain dry and environmental water is required in autumn, monitoring of the vegetation response including EPBC listed species Rigid Water Milfoil and River Swamp Wallaby-grass will occur on a regular basis at Black, Kinnaird and Moodie Swamps.

In the event of wetlands naturally filling, waterbird monitoring and water depth and extent will be monitored on a regular basis in spring and summer to determine when and if environmental water is required. If environmental water is delivered to a wetland these attributes will continue to be monitored along with the volume of water delivered. Particular attention will be paid to water levels to ensure nests are not exposed by water losses and nests close to the water surface are not inundated by environmental water deliveries. Monitoring of ecological attributes such as vegetation will be dependent upon available funding and staff resources.

8.2 Reporting

Weekly reporting is planned to advise environmental entitlement holders of:

- progressive water use;
- adaptive water deployment decisions made;
- the effectiveness of the environmental water deployed in achieving the desired flood depth, extent and duration; and
- bird breeding activity .

An annual report will be prepared at the end of the 2013-2014 year to collate all the information on the use of environmental water including the environmental outcomes achieved. The report will be provided to DSE and relevant environmental entitlement holders. The information in the report will also be used to inform the future management of wetlands in the catchment.

8.3 Knowledge gaps and limitations

One of the key knowledge gaps associated with wetland environmental water management in the Goulburn Broken Catchment is the limited information on the flood regime tolerances of aquatic dependent ecological vegetation communities and their associated flora species such as Cane-grass (*Eragrostis infecunda*) and the EPBC (1999) listed Rigid Water Milfoil (*Myriophyllum porcatum*) and River Swamp Wallaby-grass (*Amphibromus fluitans*). These knowledge gaps do not prevent environmental water being delivered to the wetlands. However, more information on the flood regime tolerances of aquatic dependent ecological vegetation communities and their associated flora species would help refine wetland flood regimes and the management of environmental water.

9. Communications and stakeholder engagement

The primary stakeholders that will be engaged under the proposal are:

- the agencies involved in delivering the environmental water and include Goulburn-Murray Water, the Victorian Environmental Water Holder and the Commonwealth Environmental Water Holder.
- the relevant land managers including Parks Victoria, Goulburn-Murray Water and the Moira Shire.

Goulburn-Murray Water is the key flow delivery agency. When the final proposal for 2013-2014 is agreed, communications with Goulburn-Murray Water are aimed at making clear what the intended environmental delivery plans are and their intended purpose. Then, throughout the season, there will be regular communications (phone, email) directly with the water resource management group to understand potential delivery opportunities and constraints, and to organise environmental water deliveries.

The Victorian Environmental Water Holder will use the proposal as the basis (in whole or part), in developing the Seasonal Watering Plan. Water allocated is to be delivered in accordance with the plan and the plan is used to seek agreement from other water holders for the use of their water. Routine communication (phone, email) will report on the delivery of water under the plan, and seek to modify release plans to align with wetland needs as the year unfolds.

Commonwealth Environmental Water Holder may have allocated water to the Seasonal Watering Plan which is based on this proposal. Routine communication on the delivery of water under the plan will be via the Victorian Environmental Water Holder.

Parks Victoria is the land manager for all wetlands identified in this proposal with the exception of Kinnaird Swamp, which is managed by G-MW and the Moira Shire. Following the approval of the proposal by the Goulburn Broken Catchment Management Authority Board the CMA will liaise with the land managers on its content, seek their advice on its implementation and seek formal written approval from them to implement the proposal.

The secondary audience is those potentially affected by or interested in the delivery of environmental water to wetlands. This group includes wetland advisory groups and the Yorta Yorta Nation Aboriginal Corporation. These groups will be consulted on the implementation of the seasonal watering proposal following its approval. If time permits they may also be consulted during the development of the proposal to provide local wetland knowledge.

To assist with the environmental water management program, the Goulburn Broken CMA established the Goulburn and Broken Environmental Water Advisory Groups to provide advice on planning environmental water use (including seasonal watering proposals and water management plans) and on any environmental health trends occurring in the rivers, creeks and wetlands. The group was established in April 2012 and is comprised of members who range from differing geographic locations along the Goulburn and Broken Rivers or adjacent to wetlands. The group also includes representatives from key agency partners (such as the Department of Environment and Primary Industries, and Goulburn-Murray Water). In 2013-2014 the group will be informed and consulted on the seasonal watering proposals development.

In addition, the Goulburn Broken Catchment Management Authority will inform the broader community about the decision to provide environmental water to wetlands and what it is trying to achieve. The Goulburn Broken Catchment Management Authority will also seek to build a public understanding of how natural wetland flood regimes have changed and how we are using environmental water to improve wetland health. This will be achieved through media articles and talks directly with special interest groups.

Table 16 outlines the consultation process the Goulburn Broken Catchment Management authority has and will undertake during the development and implementation of this seasonal water proposal. All communication activities will be undertaken in accordance with the communication and media protocols of the VEWH.

Table 16: Seasonal watering proposal development and implementation consultation

STAKEHOLDER	PURPOSE	ENGAGEMENT TYPE	METHOD	TIMING
PROPOSAL DEVELOPMENT				
CMA Board	Approval of the proposal	Approve	Board Meeting Paper/Presentation	26 April 2013
PROPOSAL IMPLEMENTATION				
Yorta Yorta Nation Aboriginal Corporation	Inform the group on the proposal and seek advice on indigenous related issues	Inform/consult	Personal discussion with key staff	May 2013 – Feb 2014
Goulburn and Broken Environmental Water Advisory Groups	Inform the group on the proposal and seek advice on community and wetland management related issues	Inform/consult	Meetings	May 2013 – Feb 2014
Parks Victoria (wetland land manager)	Inform Parks Victoria on the proposal, seek their advice on its implementation and seek their approval to implement the proposal	Inform/consult/approve	Meetings and a letter seeking formal approval to implement the proposal	May 2013 – Feb 2014
Moira Shire (Kinnaird Swamp land manager)	Inform Moira Shire on the proposal, seek their advice on its implementation and seek their approval to implement the proposal	Inform/consult/approve	Meetings and a letter seeking formal approval to implement the proposal	May 2013 – Feb 2014
GB CMA wetland advisory group	Inform the group on the proposal and seek advice on community and wetland management related issues	Inform/consult	Meetings	May 2013 – Feb 2014
Local wetland advisory or interest groups	Inform the group on the proposal and seek advice on community and wetland management related issues	Inform/consult	Meetings	May 2013 – Feb 2014
VEWH	Report on deployment of water under the plan, and seek to modify release plans to align with wetland needs as the year unfolds	Inform/consult	Telephone and email	May 2013 – Feb 2014
G-MW	To understand unregulated flows, planned consumptive use releases, and to organise environmental water delivery	Inform/consult	Telephone and email	May 2013 – May 2014
G-MW (Kinnaird Swamp land manager)	Inform G-MW on the proposal, seek their advice on its implementation and seek their approval to implement the proposal	Inform/consult/approve	Meetings and a letter seeking formal approval to implement the proposal	May 2013 – Feb 2014

10. Execution and endorsement

I, the authorised representative of the agency shown below, approve the Seasonal Watering Proposal for Goulburn Broken Catchment Wetlands 2013-14.

SIGNED FOR AND ON BEHALF OF THE GOULBURN BROKEN CATCHMENT MANAGEMENT AUTHORITY

Signature of authorised representative

Name of authorised representative

Date:

11. References

COA (2002). National Land and Water Resource Audit. Australian Terrestrial Biodiversity Assessment. Canberra: Land and Water.

COOK, D., JOLLY, K. & OSLER, D. (2010). Monitoring Ecological Response to Flooding. A study of Black, Doctors, Reedy, Kinnaird Swamps in the Goulburn Broken Catchment. Report prepared for the Goulburn Broken Catchment Management Authority, Shepparton by Australian Ecosystems, Patterson Lakes.

DNRE (2002). Wetlands Technical Paper. Melbourne: Department of Natural Resources and Environment.

EA (2001). A Directory of Important Wetlands, Canberra, Environment Australia.

SKM (2006). Moodie Swamp water management recommendations. Report prepared for the Goulburn Broken Catchment Management Authority, Shepparton by Sinclair Knight and Merz, Tatura.

SKM (2007). Black Swamp Flood Regime Determination. Report prepared for the Goulburn Broken Catchment Management Authority, Shepparton by Sinclair Knight and Merz, Tatura.

Birds Australia (2008). The State of Australia's Birds 2008. Birds Australia, Carlton Victoria.

Appendix 1: Wetland Maps

Figure A1. 1: Black Swamp connection to Nine Mile Creek.

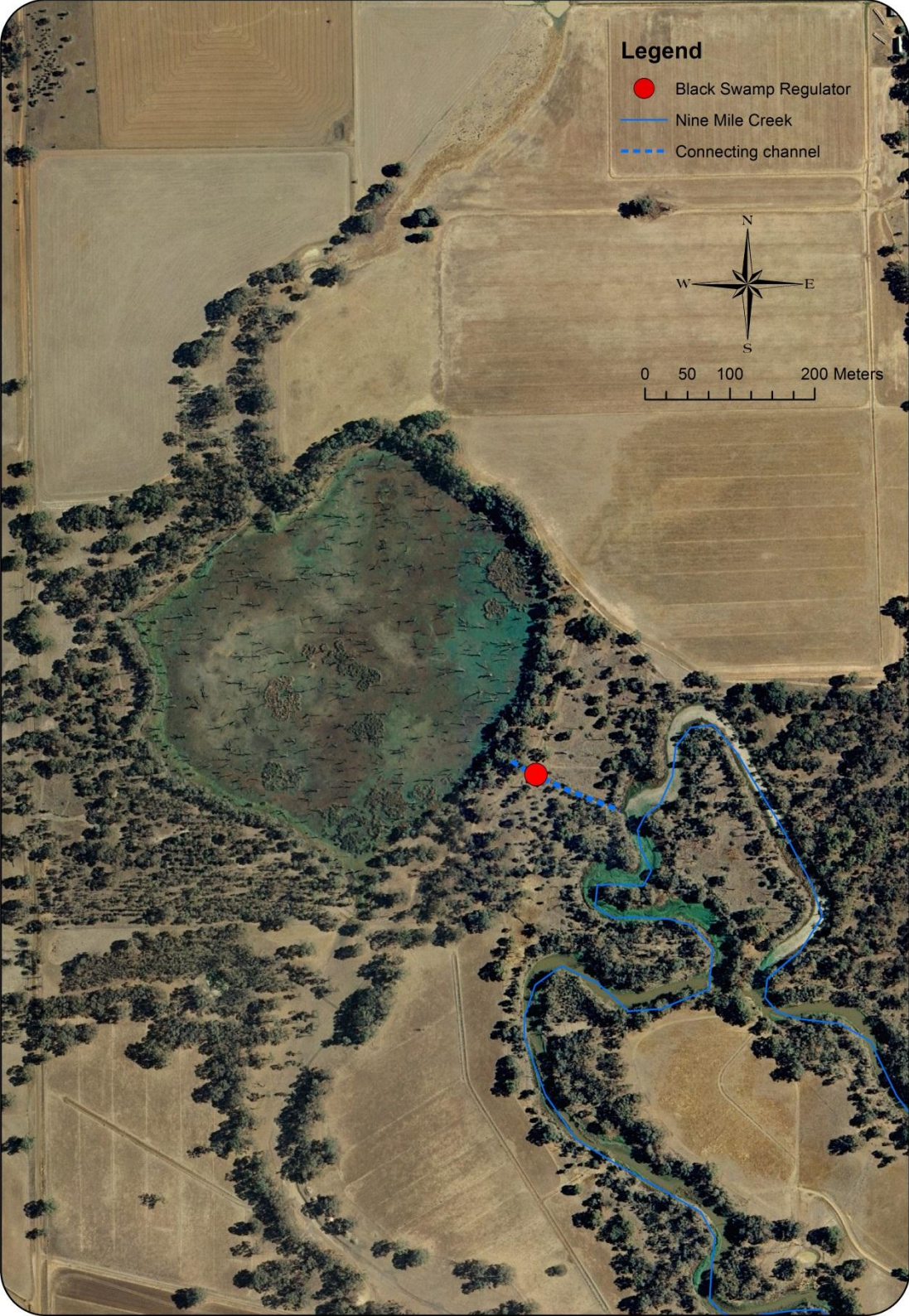


Figure A1. 2: Doctors Swamp.



Figure A1. 3: Kinnaird Swamp management.

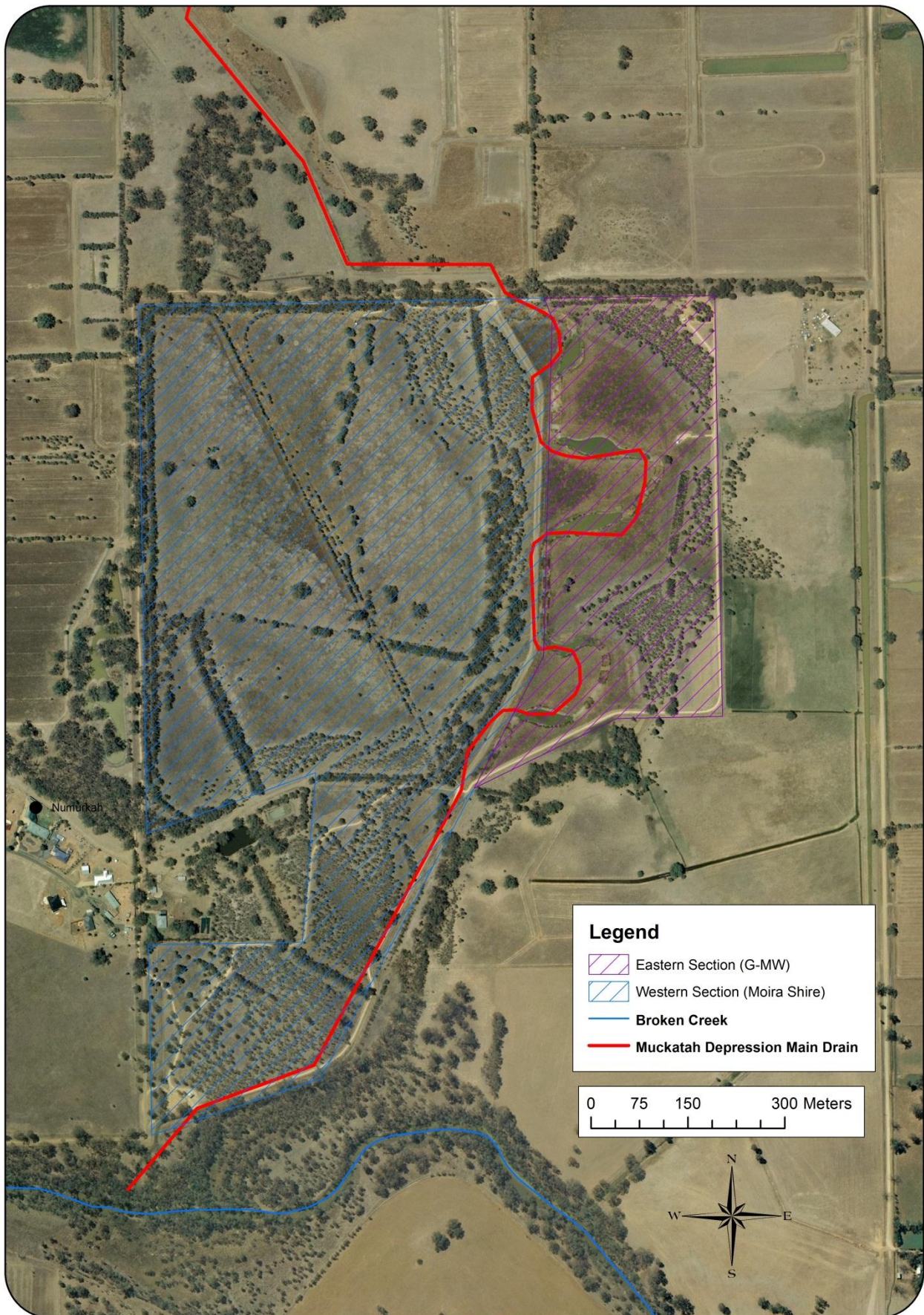
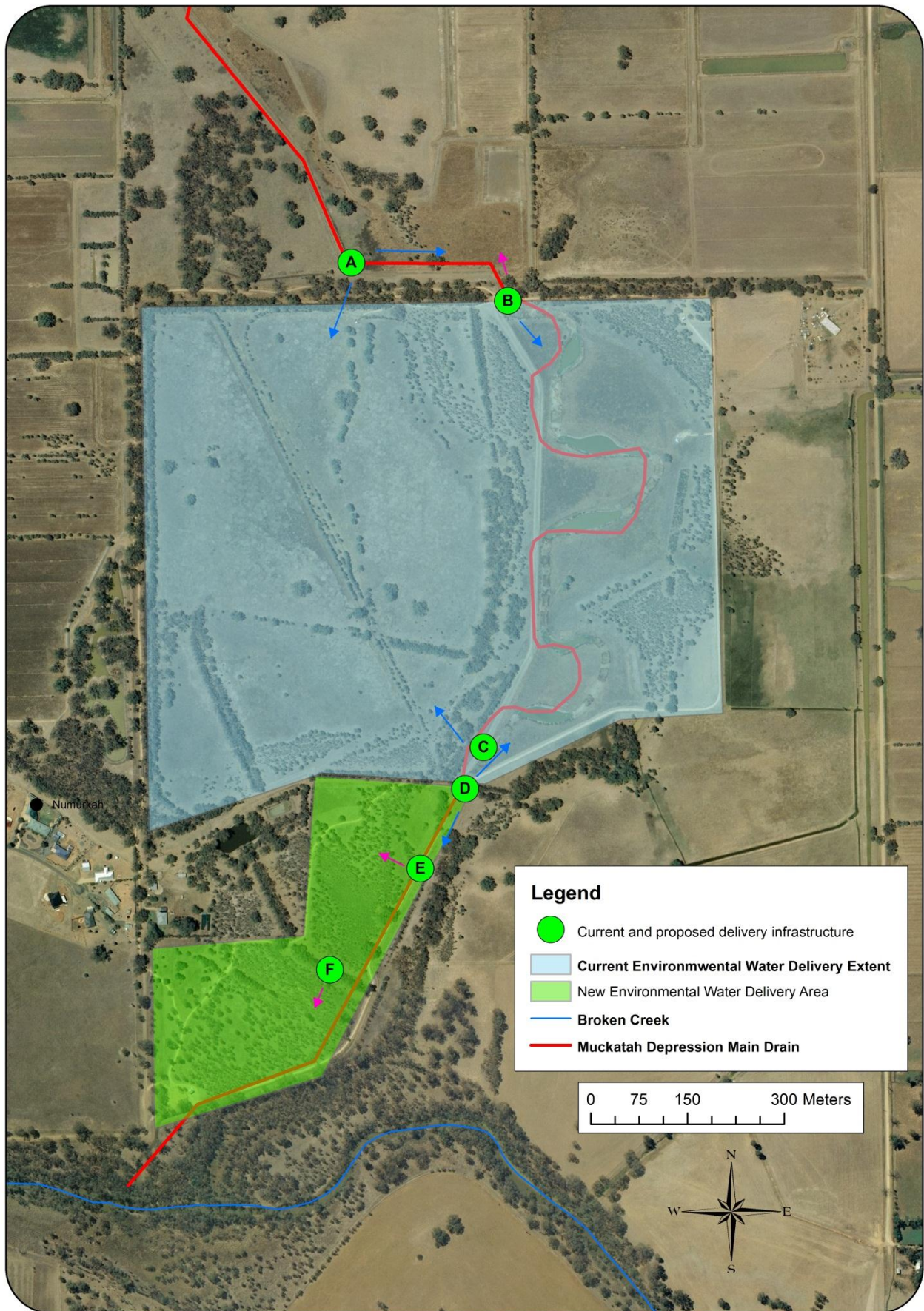


Figure A1. 4: Proposed works areas at Kinnaird Swamp (blue arrows indicate current water flow paths and pink arrows indicate new water flow paths with proposed works). Works to be completed by early 2014.



POINT A – Diversion structure

This structure was installed in 2008 for an environmental water delivery. It allows passage of water to be diverted to the western or eastern section of the swamp.

POINT B – Installation of a regulation structure

The proposed works at Point B include the removal of the boardwalk and the installation of box culverts with regulating structures. This will increase water delivery efficiency and control by allowing water to be independently delivered to the eastern and western sections of the wetland in response to ecological conditions and water availability. In addition, the proposed box culverts will provide safe operational vehicle access along the northern section of the wetland during high flow events.

POINT C – Installation of a regulated culvert

The proposed works at Point C include the installation of 600mm culvert with a control door (similar to the current structure at Point A) under the inner confining bank to allow more efficient delivery of Environmental Water from the eastern section of the wetland to the western section of the wetland. The existing 300mm inlet/outlet will remain to ensure that the wetland proper does not drain faster than the design criteria when the wetland is performing as a retardation basin following a design discharge event.

POINT D - Upgrade of the current outfall structure

The proposed works at Point D (Figure 4) include replacing the current drop board system with three lay flat doors (Padman stop system) and a retaining wall. This will provide greater control over ponding height and duration in the wetland, which is particularly important during bird breeding events.

POINT E - Installation of a pipe and the reinstatement of an access track

The proposed works at Point E include the installation of a 300mm Pipe with a door and reinstating the height of the existing access track (Figure 4). This will allow environmental water and natural low flow events to be delivered to the River Red Gum EVC in the southern section of the wetland. Currently, this section of the wetland only receives water during natural high flow events. The works will also allow low flow events to be filtered via the southern section of the wetland before entering the Broken Creek.

Point F – Breach of disused channel banks

The proposed works at Point F include the breaching of a disused channel in the southern section of Kinnaird Swamp to increase water delivery efficiency from Point E into the River Red Gum EVC.

Figure A1. 5: Moodie Swamp connection to Broken Creek by Geary's Channel



Figure A1. 6: Reedy Swamp connection to Shepparton Drain 3 and EG 19/12

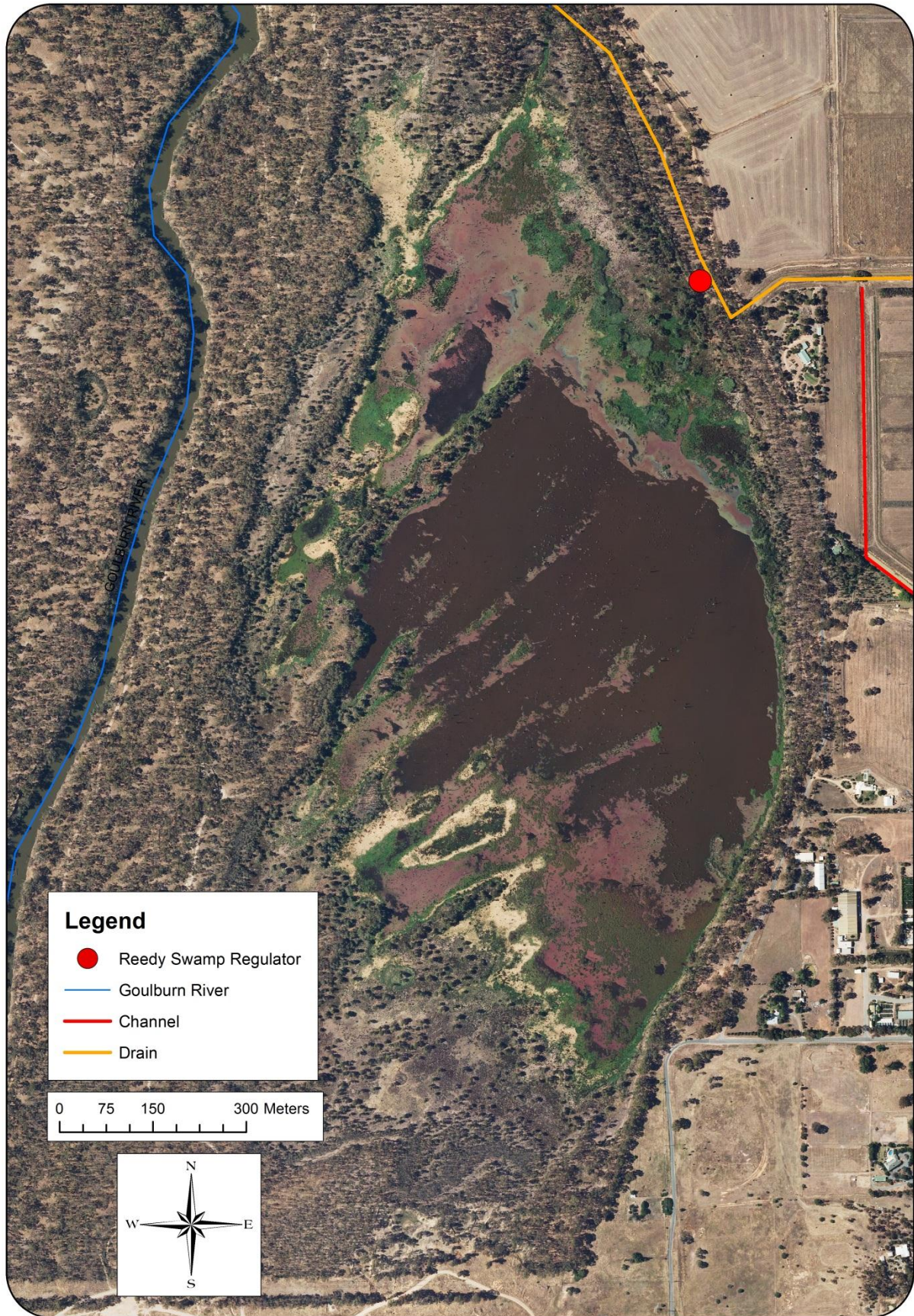
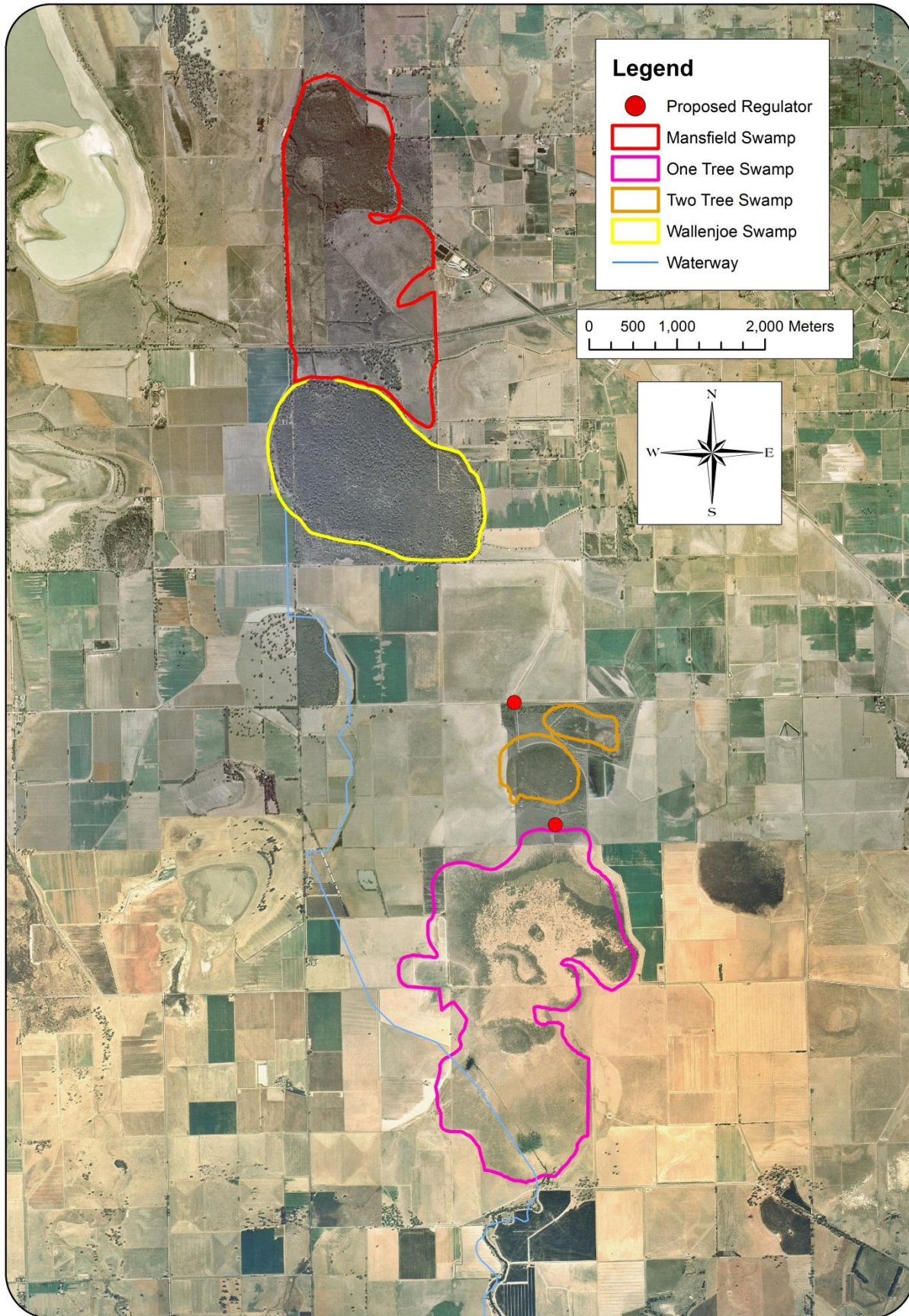


Figure A1. 7: Corop System Wetlands



Appendix 2: Summary table

System name	Goulburn Wetland System
Waterway manager	Goulburn-Murray Water
Storage operator/s	Goulburn-Murray Water
Land manager/s	Parks Victoria, Goulburn-Murray Water and Moira Shire

System summary

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 Basins total land area (DNRE, 2002). 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 and communities, and birds listed on international agreements and conventions.

Of the natural wetlands in the catchment only ten can physically and legally receive environmental water. These are Barmah Forest, Black Swamp, Doctors Swamp, Kinnaird Swamp, Moodie Swamp, Reedy Swamp, One Tree Swamp, Two Tree Swamp, Wallenjoe Swamp and Mansfield Swamp. One Tree Swamp, Two Tree Swamp, Wallenjoe Swamp and Mansfield Swamp form a large hydrologically connected wetland system known as the Corop Wetland System.

Due to the current inability to effectively manage environmental water within the Corop Wetland System, the delivery of environmental water to maintain a bird breeding event is not considered in this proposal.

Summary of planned environmental water use in 2013-14

The table below summarises planned environmental water use for the Goulburn Broken Catchment under different priorities for 2013-2014.

SCENARIO DESCRIPTION	DRY 70% POE	AVERAGE 50% POE	WET 30% POE
Water Supply	100% HRWS allocations Perhaps 60% available as private carryover	100% HRWS allocations Perhaps 40% available as private carryover	100% HRWS allocations Perhaps 10% available as private carryover
	Operation of irrigation network is unlikely to restrict water delivery	Operation of irrigation network is unlikely to restrict water delivery	Operation of irrigation network is unlikely to restrict water delivery
Expected Wetland Inflow	No natural flooding of Black Swamp	Black Swamp may fill from natural flooding	Black Swamp may fill from natural flooding
	No natural flooding of Doctors Swamp	Doctors Swamp may fill from natural flooding	Doctors Swamp may fill from natural flooding
	No natural flooding of Kinnaird Swamp	Kinnaird Swamp may partially fill from natural flooding	Kinnaird Swamp may fill from natural flooding
	No natural flooding of Reedy Swamp	Reedy Swamp may fill from natural flooding	Reedy Swamp may fill from natural flooding
Environmental Objectives	Maintain or improve the condition of aquatic vegetation communities	Maintain or improve the condition of aquatic vegetation communities	Maintain or improve the condition of aquatic vegetation communities
	Maintain waterbird breeding habitat	Maintain waterbird breeding habitat	Maintain waterbird breeding habitat
Priority Watering Actions	Promote drawdown and drying	Promote drawdown and drying	Promote drawdown and drying

	Promote growth of EPBC (1999) listed aquatic flora species	Promote growth of EPBC (1999) listed aquatic flora species	Promote growth of EPBC (1999) listed aquatic flora species
	Maintain water levels to support bird breeding	Maintain water levels to support bird breeding	Maintain water levels to support bird breeding
Delivery Timing	Dependent on promotion of EPBC listed aquatic flora (autumn watering)	Dependent on promotion of EPBC listed aquatic flora (autumn watering)	Dependent on promotion of EPBC listed aquatic flora (autumn watering)
	Dependent on breeding events (spring/summer watering)	Dependent on breeding events (spring/summer watering)	Dependent on breeding events (spring/summer watering)
Estimated Volume of Environmental Water Required for May 2014 Watering (ML) (Priority 2)	804 ML	402 ML	402 ML
Estimated Volume of Environmental Water Required for October 2013 – January 2014 Watering (ML) (Priority 3)	2212.5 ML	1106.25 ML	1106.25 ML
Estimated Volume of Environmental Water Required August 2014 – October 2014(ML) (Priority 4)	562.5 ML	281.25 ML	281.25 ML
Estimated Volume of Environmental Water Required for 2013-2014 (Priority 5)	804 ML	3016.5 ML	1508.25 ML

System overview

Key Features of the Goulburn Broken wetlands include:

Black Swamp – Red Gum swamp with a large population of the EPBC listed River-Swamp Wallaby Grass and is bioregionally significant.

Kinnaird Swamp – Red Gum, Plains Grassy Wetland swamp with largest recorded population of EPBC listed Rigid Water Milfoil in Victoria and is a significant breeding site for Royal Spoonbills.

Moodie Swamp – Cane-grass swamp with significant population of EPBC listed Rigid Water Milfoil and is listed under A Directory of Important Wetlands.

Reedy Swamp – Tall Marsh, Floodway pond hermland swamp. Important colonial nesting waterbird breeding site and drought refuge. The swamp is part of the Lower Goulburn National Park and is listed under A Directory of Important Wetlands.

Doctors Swamp – Red Gum swamp considered one of the most intact red gum swamps in Victoria and is bioregionally significant.

Current situation

Black Swamp, Doctors Swamp, Kinnaird Swamp, Moodie Swamp and the Corop wetland system are currently experiencing a dry phase. The priority watering action for these wetlands is to keep these wetlands dry, consistent with their ecological and hydrological objectives. However, environmental water may be required to maintain EVC condition and promote EPBC (1999) listed River Swamp Wallaby-grass growth in Black Swamp, and Rigid-water Milfoil at Kinnaird Swamp and Moodie Swamp during the autumn of 2014, if these wetlands remain dry until this time. If wetlands naturally fill and significant waterbird breeding events occur in the spring/summer of 2013 then environmental water may be used to maintain water levels at all wetlands.

Reedy Swamp is currently experiencing a wet phase. Waterbirds may abandon nesting sites if surrounding water levels decrease dramatically or water depths become too shallow. The decision to deliver environmental water to these wetlands to support a bird breeding event will consider the ecological benefits/ requirements of the bird breeding event and the potential impact the environmental water may have on the vegetation.

Environmental objectives

Environmental Objectives for the Goulburn Wetlands include the following:

Black Swamp – Improve the diversity of native wetland flora species to be consistent with Red Gum Swamp EVC benchmarks and provide opportunities for waterbird breeding.

Doctors Swamp – Maintain diversity of native wetland flora species to be consistent with Red Gum Swamp EVC benchmarks and provide opportunities for waterbird breeding.

Kinnairds Swamp – Improve the diversity of wetland flora species consistent with a mosaic of wetland EVCs. Maintain populations of rigid-water milfoil and slender water milfoil.

Moodie Swamp – Maintain Cane-grass Swamp EVC and population of rigid-water milfoil. Provide opportunities for waterbird breeding especially Brolga.

Reedy Swamp – Improve the diversity of native wetland flora species to be consistent with mosaic of EVC benchmarks and maintain habitat for colonial nesting waterbirds especially Ibis and Royal Spoonbills.

Priority watering actions

Priority watering actions for Goulburn Broken Wetlands are as follows:

Priority 1

Maintain a dry state of Kinnaird, Black and Doctor Swamp consistent with the hydrological and ecological requirements of the wetlands (Section 2 Tables 3-7) until autumn 2014. To promote the natural drawdown and drying of Reedy Swamp, consistent with its hydrological and ecological requirements.

Priority 2

If Kinnaird and Black Swamps do not naturally fill, deliver environmental water to the wetlands in May 2014 to maintain the condition of their vegetation communities and EPBC listed flora species. Rigid Water Milfoil found at Kinnaird and Moodie Swamp is likely to emerge between March and May, which coincides with seed establishment. River Swamp Wallaby-grass found at Black Swamp begins to emerge in autumn and winter for it to flower and seed in spring and summer. Filling these wetlands in autumn will require a total volume of 1704 ML (including seepages and losses). Black and Kinnaird Swamp are all classified as seasonal wetlands and will have exceeded their optimal drying period by autumn 2014 if they remain dry.

Priority 3

If Kinnaird, Black and Doctor Swamps fill naturally before May 2014 and stimulate a significant waterbird breeding event, environmental water will be provided to maintain water levels between October 2013 and January 2014 to ensure waterbirds do not abandon nests.

If Reedy Swamp retains water and stimulates a significant waterbird breeding event environmental water will also be provided to maintain water levels between October 2013 and January 2014 to ensure waterbirds do not abandon nests. An attempt to comply with recommended ponding durations will occur (Section 2, Tables 3-7).

The need to maintain water levels in a wetland to support a bird breeding event is likely to occur between October and January, which coincides with key waterbird breeding cycles. The total evaporation rate in Shepparton between these months is approximately 500 mm. 2212.5 ML is required to maintain water levels in Black, Kinnaird, Doctor and Reedy Swamps between October and January in dry years (Table 12). In average and wet years when natural inflows may compensate for evaporation losses only half this volume may be required.

Priority 4

Dependent on natural inflows, environmental water may be required between August 2014 and October 2014 to ensure the optimum ponding durations (six months) at Black and Kinnaird Swamps are met (Table 12).

Priority 5

If wetlands fill naturally in the autumn-winter 2013 and stimulates a significant waterbird breeding event, environmental water may be required between October 2013 and January 2014 to ensure waterbirds do not abandon their nests (as discussed in Priority 3).

If these wetlands then become significantly dry over the summer of 2013-2014 they will be monitored to determine if an autumn watering is applicable. If an autumn watering is to occur then 804 ML environmental water will be required for this event, therefore a total of 3016.5 ML will be required for the 2013-2014 period (Table 12).

Risk assessment and management

The risks associated with the proposed delivery of environmental water to the five wetlands in the Goulburn Broken Catchment during autumn to maintain EVC condition and spring and summer to maintain waterbird breeding habitat include: the resource manager being unable to deliver the required flow rates; improving conditions for non-native species; and the environmental water account becoming overdrawn. For all wetlands these have been assessed as a medium risk while remaining risks have been assessed as low.