

# Goulburn Wetlands

## Seasonal Watering Proposal

### 2023-2024



**GOULBURN BROKEN**  
CATCHMENT MANAGEMENT AUTHORITY

#### Publication details

##### Published by:

Goulburn Broken Catchment Management Authority,  
PO Box 1752, Shepparton 3632

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Please cite this document as: GB CMA (2023). Goulburn Wetlands Seasonal Watering Proposal 2023-2024. Goulburn Broken Catchment Management Authority, Shepparton.

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## Executive Summary

In this proposal the Goulburn Broken Catchment Management Authority has identified environmental water requirements for six wetlands in the Goulburn Catchment under a range of differing climate scenarios. These wetlands are Doctors Swamp, Gaynor Swamp, Horseshoe Lagoon, Kanyapella Basin, Loch Garry and Reedy Swamp. Two of these wetlands are proposed to be watered during 2023-2024, these are Doctors Swamp and Horseshoe Lagoon. A drying regime for Gaynor Swamp, Kanyapella Basin, Loch Garry and Reedy Swamp is proposed for 2023-2024.

The water regime of these wetlands has been highly modified with changes to the frequency, duration and timing of wetting and drying. Environmental water is currently being used to restore a more natural wetting regime to these sites to protect, enhance and restore the health of the wetlands.

Environmental watering objectives for Goulburn Catchment wetlands are to:

- Provide a wetting cycle that promotes healthy wetland vegetation communities.
- Provide feeding and breeding habitat for a range of waterbirds, amphibians and reptiles.
- Provide a drying period that assists with the completion of a nutrient cycle for wetlands and/or assists with the management of pest animal and plant species.

## Seasonal review 2022-2023

Environmental water deliveries were managed according to an average to wet climate scenario and water was enabled at two of the Goulburn catchment wetlands in 2022-2023. A total of 2120ML was proposed to be delivered across three wetlands, from this only 70.3ML was delivered due to wetlands filling naturally in October 2022 after a large rainfall event and still holding water at the time of writing this plan.

The key objective of the 2022-2023 Seasonal Watering Proposal was to deliver environmental water to Horseshoe Lagoon in winter 2022, Gaynor Swamp in spring 2022 and Kanyapella Basin in autumn 2023. Doctors Swamp, Loch Garry and Reedy Swamp were to be drawn down and dried.

Horseshoe Lagoon received an allocation of 70.3ML in winter 2022 as proposed and was still holding water at the time of writing this plan (March 2023). Gaynor Swamp delivery did not occur due to tampering of the regulator in winter 2022. Water was let out of the swamp and concerns raised by local landholders regarding the addition of environmental water into the swamp were discussed. These concerns were regarded by GB CMA staff and the spring top-up did not occur.

Kanyapella Basin's autumn delivery did not occur due to the site holding water after filling in October 2022.

Doctors Swamp, Loch Garry and Reedy Swamp did not draw down and dry as proposed due to naturally filling in October 2022 from large rainfall event. Currently Loch Garry and Reedy Swamp are holding water at near capacity. Doctors Swamp has drawn down due to water being let out in December 2022 due to the threat of the swamp over topping and flooding neighbouring properties.

The 2022-2023 environmental water priorities, objectives and delivery status for Goulburn wetlands are summarised in Table 1.

Table 1: Watering priorities and delivery status for wetlands 2022-2023

Priority	Wetland	Flow Component	Flow Objective	Achievement in 2022-2023
NA	Doctors Swamp	Dry	Allow swamp to draw down and dry for at least 6 months to complete nutrient cycle and to reach optimal drying period.	Dry – drawdown began in December 2022 and dried February 2023. Water let out of swamp in December 2022 to prevent flooding of neighbouring properties.
1	Gaynor Swamp	Fill	Partially fill (top-up) Gaynor Swamp in spring 2022 through early summer 2023 to prevent nest abandonment by waterbirds if waterbird breeding event occurs.	PWA not met with environmental water. Watering of the site did not proceed due to natural inflows filling the site in October 2022.
1	Horseshoe Lagoon	Partial Fill	Partially fill (top-up) Horseshoe Lagoon in winter 2022 to a variable depth of 0.5-2m for 8-10 months to maintain water level to promote recruitment and regeneration of listed EVCs and associated threatened plant species (both planted and naturally occurring).	Water for the environment was delivered in winter 2022 to top-up the lagoon.
1	Kanyapella Basin	Partial fill	Partially fill Kanyapella Basin to a maximum depth of 300mm in autumn 2023 for four months to promote and improve the diversity of EVCs and encourage threatened aquatic species populations to establish.	Autumn watering did not occur due to Basin holding water from natural fill in October 2022.
NA	Loch Garry	Dry	Allow Loch to draw down and dry for at least 6 months to complete nutrient cycle and to reach optimal drying period.	Not achieved. Loch filled in October 2022 due to large rainfall event.
NA	Reedy Swamp	Dry	Allow swamp to draw down and dry for at least 6 months to complete nutrient cycle and to reach optimal drying period.	Not achieved. Swamp filled in October 2022 due to large rainfall event.

## Priorities for 2023-2024

In consultation with Traditional Owners, the Goulburn Broken Wetland Technical Reference Group and the Goulburn Broken Environmental Water Advisory Group, the GB CMA proposes to deliver water for the environment to two Goulburn wetlands - Doctors Swamp and Horseshoe Lagoon. It is currently forecast that deliveries in 2023-2024 will occur under an average climate scenario.

Priorities for environmental watering wetlands in the Goulburn catchment for 2023-2024 are as follows:

- Partially fill Doctors Swamp in autumn 2024 to maintain vegetation growth. Watering will only occur if swamp has reached optimal drying period of six months prior to this.
- Fill Horseshoe Lagoon in Autumn 2024 to maintain water level and promote recruitment and regeneration of EVCs and threatened plant species.
- Promote drying of Gaynor Swamp, Kanyapella Basin and Loch Garry and Reedy Swamp in 2023-2024.

This proposal considers environmental water deliveries under a range of possible climate scenarios from extremely dry to wet. The potential watering actions under the different climate scenarios are outlined below (Table 2). These have been categorised into Tier 1 and Not Applicable. Tier 1 watering actions are the critically important actions that should be achievable based on estimates of supply and other available resources under each planning scenario (VEWH 2022).

Table 2: Summary of potential water actions for 2023-2024

Priority	Wetland	Potential Watering Action	Climate Scenario and ML Water			
			Ex. Dry	Dry	Average	Wet
1	Doctors Swamp	Partially fill Doctors Swamp in autumn 2024 to a maximum depth of 60cm for 6 months, to maintain growth of Red Gum (292) EVC and representative frog populations of native frog-communities. This will only occur if swamp has dried for at least six months.	600	600	600	300
NA	Gaynor Swamp	Allow swamp to draw down and dry for at least 6 months to complete nutrient cycle and manage spread of cumbungi and Typha and to reach optimal drying period.	0	0	0	0
1	Horseshoe lagoon	Fill Horseshoe Lagoon in autumn 2024 to a variable depth of 0.5-2m for 8-10 months to maintain water level to promote recruitment and regeneration of Tall Marsh (821), Floodway Pond Herbland (810) and Aquatic Herbland (653) EVCs and threatened plant species (both planted and naturally occurring). This will only occur is lagoon has dried for at least six months.	120	120	120	60
NA	Kanyapella Basin	Allow Basin to draw down and dry for at least six months to complete nutrient cycle and to reach optimal drying period.	0	0	0	0
NA	Loch Garry	Allow Loch to draw down and dry for at least six months to complete nutrient cycle and to reach optimal drying period.	0	0	0	0
NA	Reedy Swamp	Allow swamp to draw down and dry for at least six months to complete nutrient cycle and to reach optimal drying period.	0	0	0	0
<b>Total ML</b>			<b>720</b>	<b>720</b>	<b>720</b>	<b>360</b>

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## Introduction

This seasonal watering proposal outlines the Goulburn Broken CMA's priorities for the use of environmental water for delivery to wetlands in the Goulburn catchment during 2023-2024 to protect and enhance their environmental values and health.

The purpose of the seasonal watering proposal is to:

- Identify the environmental water requirements of wetlands to adaptively manage their watering regime and enable water for the environment to be delivered under a range of climatic scenarios where applicable.
- Identify the drying requirements of wetlands to assist with the completion of the nutrient cycle, control pest species and the spread of some native or exotic vegetation within wetlands.
- Provide information for the development of the VEWH seasonal watering plan as per section 192A of the *Water Act 1989* (Vic).

## System overview

The Goulburn River Basin is Victoria's largest covering 1.6 million ha or 7.1 per cent of Victoria. The Goulburn River is 570 km long, flowing from the Great Dividing Range upstream of Woods Point to the Murray River east of Echuca. Stream flow along the Goulburn River has been modified by two major features: Eildon Reservoir and the Goulburn Weir. The Goulburn River downstream of the Goulburn Weir is listed in '*A Directory of Important Wetlands in Australia*' (EA 2001).

Within the catchment, several wetlands are formally recognised for their conservation significance. Four wetlands are listed in '*A Directory of Important Wetlands in Australia*' (EA, 2001) and three are listed as Bioregionally significant (Cth 2002). These wetlands have been prioritised due to their ecological values, significance to the community and traditional owners, but also because they have the infrastructure required to receive environmental water. As the wetland environmental program progresses, other wetlands of high ecological and cultural values will be considered for watering, provided they have the necessary infrastructure in place to deliver water and land manager approvals are met.

The six wetlands that can currently receive water in the Goulburn Catchment are Doctors Swamp, Gaynor Swamp, Horseshoe Lagoon, Kanyapella Basin, Loch Garry and Reedy Swamp (Figure 1). Three swamps with proposed delivery are discussed below.

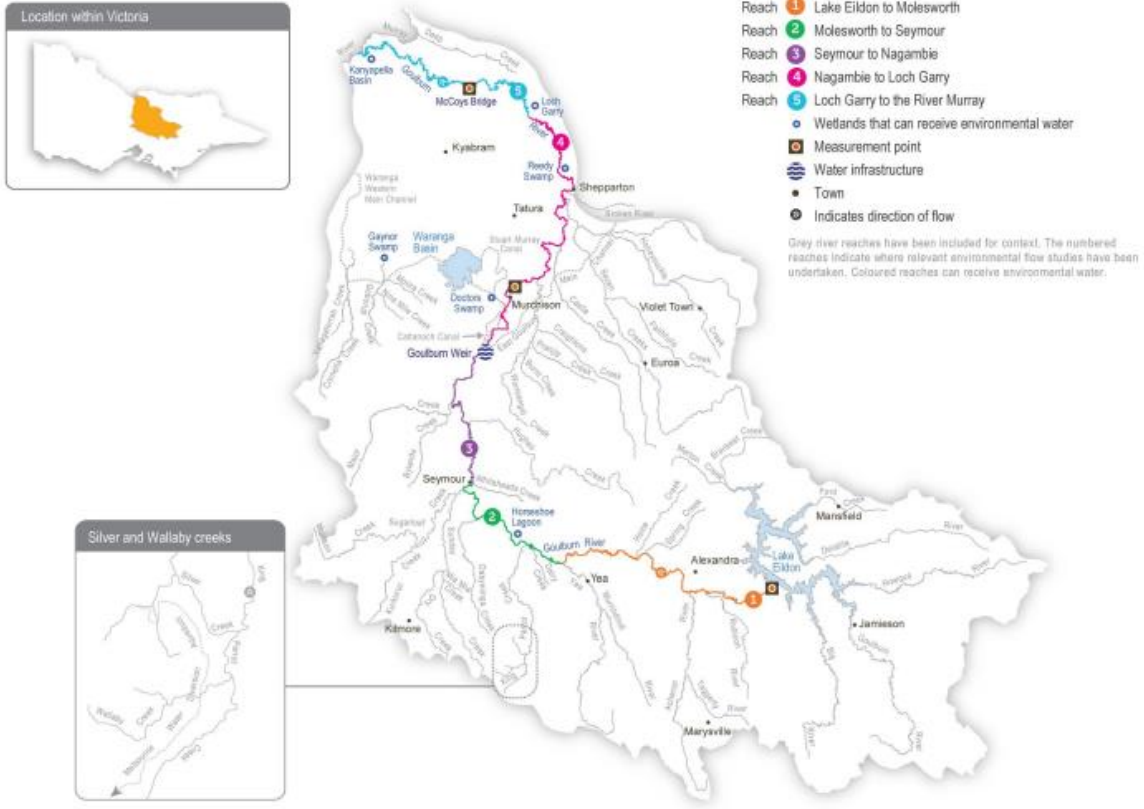


Figure 1: Goulburn Wetlands considered in this proposal

## Doctors Swamp

Doctors Swamp is a 200-hectare red gum swamp managed by Parks Victoria and is part of the Doctors Swamp Wildlife Reserve (Figure 2). It is listed as bioregionally significant in the *National Land and Water Resource Audit* (Cth 2002) and is considered one of the most intact red gum swamps in Victoria (Cook, Jolly et al. 2010).



*Figure 2: Doctors Swamp still holding water in January 2023 after filling naturally in October 2022.*

Environmental water can be delivered to the swamp via an inlet on the Cattnach Canal when it is running at 3000 ML/day or above (GBCMA, 2010). 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; however, this is dependent on water demand from the Waranga Basin. The surrounding catchment is largely unmodified, so the wetland receives a near natural flood regime. Consequently, the wetland may only require environmental water during dry periods where the optimal drying regime of six months has been exceeded or to enhance natural inundation events to ensure the success of bird breeding events or to provide optimal growth conditions for water dependent vegetation. Doctors Swamp meets several criteria outlined in *Schedule 8* of the Basin Plan – *Criteria for identifying an environmental asset*. This includes criteria 3a (i), 3a (iii) and 4c (refer to appendix 1 for criteria description).

Doctors Swamp provides habitat for 55 wetland dependent fauna species and 85 wetland dependent flora species. Eight fauna species and five flora species are listed as threatened (refer to appendix 2a and 2b).

## Horseshoe Lagoon

Horseshoe Lagoon is a former channel of the Goulburn River and is located between Kerrisdale and Trawool, approximately 15 km south-east of Seymour. The 20-hectare lagoon lies largely within the Horseshoe Lagoon Flora and Fauna Reserve, managed by Parks Victoria. A small area of the lagoon is on private property. Horseshoe lagoon received environmental water for the first time in 2019.

Horseshoe Lagoon is a site of high cultural significance to Taungurung people, particularly Taungurung women as it is central to their creation story. An Aboriginal Waterways Assessment (AWA) was undertaken at Horseshoe Lagoon in 2017. The AWA is a tool developed to assist Traditional Owners in the Murray Darling Basin to effectively participate in water planning and management. Taungurung Land & Water Council were involved in the development of the Environmental Water Management Plan for Horseshoe Lagoon (Jacobs 2019).

Horseshoe Lagoon meets several criteria outlined in *Schedule 8* of the Basin Plan – *Criteria for identifying an environmental asset*. This includes criteria 3a (i and iii), 4a and 4c (refer to appendix 1 for criteria description).



*Figure 3: Horseshoe Lagoon during environmental water event in 2021*

Horseshoe Lagoon provides habitat for a wide range of wetland and terrestrial species (Figure 3). To date 34 water dependant fauna species and 47 wetland dependant flora species have been recorded at the site. Of these 12 are listed as rare or threatened (refer to appendix 2a and 2b). There is no permanent infrastructure to deliver Environmental water to Horseshoe Lagoon. A temporary pump is brought on site and water is pumped directly from the Goulburn River.

## Engagement

This proposal was prepared by the Goulburn Broken CMA with input from Traditional Owners of Taungurung Land & Waters Council (22<sup>nd</sup> February 2023), Yorta Yorta Nation Aboriginal Corporation (18<sup>th</sup> January 2023), Goulburn Broken Wetland Technical Reference Group (GB WTRG) and the Goulburn Broken Environmental Water Advisory Group (GB EWAG).

The GB WTRG is made up of members from Rakali Consulting, Water's Edge Consulting and Senior Scientists from Department of Environment Land Water and Planning and Arthur Rylah Institute for Environmental Research. An email was sent to the committee for their advice on not watering the sites in which they were all in agreement.

The GB EWAG meets at least three times a year and additionally if required to discuss findings from wetland monitoring, wetland condition, watering objectives and watering for the coming year. The group met via Microsoft™ Teams 2nd February 2023 and members were provided with a copy of the draft proposal for comment. Comments have been incorporated into this report.

The GB EWAG (previously Goulburn Broken Wetland Management Group), established in 2012, is made up of delivery partners, Traditional Owners, industry, community groups and community members. Current membership includes Parks Victoria, Taungurung Land & Waters Council, Yorta Yorta Nation Aboriginal Corporation, Goulburn Murray Landcare Network, Goulburn-Murray Water, Moira Shire, City of Greater Shepparton, Victorian Environmental Water Holder and community members. Meetings are usually held two or three times a year to discuss the current conditions of the wetlands, the outcomes of the previous season's delivery of environmental water, and proposed watering. When possible, the group visits the wetlands to hear and see firsthand the delivery and wetland responses to environmental watering.

The Goulburn Broken CMA has agreements with Yorta Yorta Nation Aboriginal Corporation and Taungurung Land & Waters Council which outline the legal requirements the GB CMA need to abide by when undertaking natural resource management works in areas covered by these agreements.

The Land Use Activity Agreement (LUAA) forms *Schedule 9* of the Recognition and Settlement Agreement between Taungurung Land & Waters Council and the State of Victoria and is used when works activities are required on crown land. No formal notification is currently required for delivery of environmental water on Taungurung Country apart from involvement in the development of the Seasonal Watering Proposals. Consultation of proposed watering and endorsement of environmental watering at these sites is undertaken. A letter of support from Traditional Owner groups is also required.

The Aboriginal Cultural Heritage Land Management Agreement (ACHLMA) is an agreement between the GB CMA and Yorta Yorta Nation Aboriginal Corporation which is legislated by the *Aboriginal Heritage Act 2006*. This includes the following activities that are permissible under the agreement:

- Environmental Monitoring Activities at wetlands.
- Environmental water – returning natural flows at wetlands across the catchment.

Some wetlands are not included in this agreement which are in the Lower Goulburn National Park. This includes Reedy Swamp and Loch Garry.

The Goulburn Broken CMA will continue to build community understanding of how natural wetland wetting regimes have changed and how water for the environment is being used to protect and restore the wetlands. This will be achieved through reports, traditional and social media and direct contact with special interest groups and school groups.

The engagement process the Goulburn Broken CMA has undertaken during the development and implementation of this seasonal water proposal is outlined in Table 3. All communication activities will be undertaken in accordance with the communication and media protocols of the VEWH.

Table 3: Engagement undertaken in development of Seasonal Watering Proposal 2023-2024

Category	Who	IAP2 level of engagement	Engaged on 2023-2024 seasonal watering proposal	Engagement methods	Engagement Purpose
<b>Government Agencies</b>	Delivery Partners	Collaborate	Goulburn-Murray Water (River Operations Planning, Diversions) VEWH Parks Victoria Council of Greater Shepparton DEECA (Land Manger, Environmental Water)	Formal advisory group (GB EWAG) Direct engagement Review of draft proposal	Seek input into the development of the proposal. Ensure program partners understand the watering proposed and intended outcomes
<b>Traditional Owners</b>	Traditional Owners	Involve	Yorta Yorta Nation Aboriginal Corporation Taungurung Land & Water Council	Formal advisory groups (GB EWAG) Site visits	Seek input into the development of the proposal by reviewing document, providing feedback and writing a letter of endorsement. Assist with the delivery and monitoring of the watering events
<b>Recreational Users</b>	Field and Game Australia Local fishing clubs	Involve	Field and Game Trellys Fishing and Hunting	Formal advisory groups (GB EWAG) Direct engagement	Ensure understanding of the watering proposed and intended outcomes. Review SWP and provide feedback/ input.
<b>Community Groups</b>	Environment Groups	Involve	Goulburn Murray Landcare Network Goulburn Valley Environment Group Turtles Australia	Formal advisory groups (GB EWAG) Direct	Ensure understanding of the watering proposed and intended outcomes. Review SWP and provide feedback/ input.
<b>Local Landholders</b>	Landholders	Involve	Landowners that adjoin wetlands that receive environmental water and/or use the delivery channel	Direct engagement (one-on-one) or email/mail drop.	Ensure understanding of the watering proposed and intended outcomes. Seek feedback – local knowledge
<b>Technical experts</b>	Scientists and Consultants	Collaborate	Research Scientists from Arthur Rylah Institute Rakali Consulting Water's Edge Consulting	Formal advisory group (GB WTRG) Direct engagement	Seek input into the development of the proposal and ecological and hydrological objectives. Review SWP and provide feedback/ input.

## Aboriginal cultural values and use of waterways

Two Traditional Owner groups are custodians of the land within the Goulburn region. They are Taungurung Land and Waters Council (TLaWC) and Yorta Yorta Nations Aboriginal Corporation (YYNAC).

The Taungurung people occupy much of central Victoria. Their country encompasses the area between the upper reaches of the Goulburn River and its tributaries north of the Dividing Range. From the Campaspe River to Kilmore in the West, eastwards to Mount Beauty, from Benalla in the north down to the top of the Great Dividing Range (Figure 5 shaded light green). Gaynor Swamp and Horseshoe Lagoon are both located within Taungurung country. TLaWC undertook an Aboriginal Waterway Assessment (AWA) at Horseshoe Lagoon in October 2017. The purpose of the AWA is for Traditional Owners to measure and prioritise river and wetland health to enable participation in water planning and management. TLaWC used the information gathered as part of the AWA when partnering with the GB CMA in the development of the Environmental Water Management Plan for Horseshoe Lagoon in 2019. In 2021 and 2022, TLaWC, working with GB CMA managed the pumping and delivery of environmental flows to the site.

Yorta Yorta Nation Aboriginal Corporation country lands lie on both sides of the Murray River roughly from Cohuna to Albury / Wodonga. They include towns such as Echuca, Shepparton, Benalla, Corowa and Wangaratta and extend northwards to just south of Deniliquin (Figure 5 shaded dark green). Doctors Swamp, Kanyapella Basin, Loch Garry and Reedy Swamp are in Yorta Yorta country.

The GB CMA have engaged with both TLaWC and YYNAC to discuss potential watering of wetlands in 2023-2024, including on-line meetings.

### GOULBURN BROKEN CATCHMENT



Figure 4. Traditional owner land within the Goulburn Broken Catchment

Traditional Owners were asked to complete the table below (Table 4 and 5) to assist the GB CMA in ensuring environmental water can support the cultural values of wetlands in our catchment. Yorta Yorta Nation Aboriginal Corporation have also approved this seasonal watering proposal by reviewing the proposed watering actions and providing a letter of endorsement.

Table 4. Taungurung Traditional Owner values and uses of wetlands in the Goulburn Catchment

Values				
Wetland	Traditional Owner Group	Cultural NRM strategy (emerging) alignment	Outcomes	How will this be considered in 2023-2024?
Horseshoe Lagoon	Taungurung	Healing Country	Supporting the health of cultural values and landscapes - protecting intangible cultural heritage and valued species, traditional food and medicine plants.	Fill up Horseshoe Lagoon in Autumn 2024 (only if it has drawn down and dried out for at least six months) to protect and restore plant communities which include culturally important species.
			Actively fulfilling Caring for Country responsibilities - restoring a more natural water regimes to degraded significant sites, rehabilitation of habitat for native species	Continue to provide TLaWC / Biik Environmental staff with the opportunity to deliver environmental water with participation of the Taungurung water knowledge group (Baan Ganalina), as part of ongoing involvement in the assessment of biocultural values and management of the site.
		Healing Knowledge	Supporting and securing access for Taungurung contemporary cultural practices and uses, teaching places, reconnection to Country, camping sites.	Continuing involvement in the delivery of environmental water will allow the Taungurung community to maintain connections with this culturally important place through continuing to heal and care for it.

Table 5. Yorta Yorta Traditional Owner values and uses of wetlands in the Goulburn Catchment

Wetland	Traditional Owner Group	Values	How will this be considered in 2023-2024
Doctors Swamp	Yorta Yorta	Nardoo (food source), native grasses, old man weed (medicinal) and basket weaving sedges/rushes are in the area. The ephemeral wetlands support a wide array of bird life and other fauna that provide a variety of cultural values i.e., food, clothing etc.	Partially fill Doctors Swamp in autumn 2024 to maintain and promote growth of plant communities which include plant species important to Yorta Yorta people.



## Social, recreational and economic values and uses of wetlands

Water for the environment is used to protect and restore the environmental condition of rivers and wetlands. In addition, there are recreational, social, economic, and Aboriginal cultural benefits in delivering environmental water. Environmental watering of wetlands increases opportunities and visitation of wetlands for bird watching, photography, walking, camping, and hunting (previously State Game Reserves reclassified as Wildlife Reserves). Wetlands provide resources for Traditional Owners for hunting, food, medicinal and traditional activities.

A summary of potential shared benefits of the 2023-2024 proposed environmental water deliveries in the Goulburn catchment are listed in Table 6.

Table 6. Shared benefits of watering wetlands in the Goulburn Catchment in 2023-2024

Wetland	Beneficiary	Connection to wetland	Value	How have these benefits been considered?
<b>Doctors Swamp</b>	Yorta Yorta People Bird watchers Photographers Walkers Hunters	Connection to country for Yorta Yorta People.	Environmental watering provides opportunities for activities such as walking, bird watching and photography. Hunting within the area can increase local economy and recreation at Doctors Swamp.	Environmental watering will provide passive recreational activities such as bird watching and photography through increased communications around planned delivery via social media, radio, and local newspaper notifications. The GB CMA is constantly revising its communications strategy to expand networks to capture new audiences. Doctors Swamp is classified as a Wildlife Reserve meaning hunting can occur in season. Autumn watering is not targeted for hunting purposes. Hunters, however, may benefit from the water being delivered to the swamp during hunting season.
<b>Horseshoe Lagoon</b>	Taungurung women Bird watchers Photographers Walkers Campers Local landholders	Connection to country for Taungurung women.	Environmental water provides a connection to country for traditional owners, especially women from Taungurung Land and Waters Council.	Autumn watering of the site promotes growth of wetland plants that are beneficial for roosting and foraging for waterbirds. The water provides the opportunity for traditional owner women to visit the site for their cultural beliefs, traditional foods, and medicines.

## Seasonal review 2022-2023

### Climatic conditions

Climatic conditions observed from the Tatura station (Station ID 081049), Shepparton airport (Station ID 81125) and Echuca (Station ID 080015) indicate that rainfall over the 2022 year was above the mean average except for February, May and July (BoM 2023) (Figure 6). Large rainfall events in January, April, August, September and October contributed to a wet catchment and provided natural inflows that filled all of the wetlands. Water for the environment was still delivered to Horseshoe Lagoon in winter 2022 as the site required topping up.

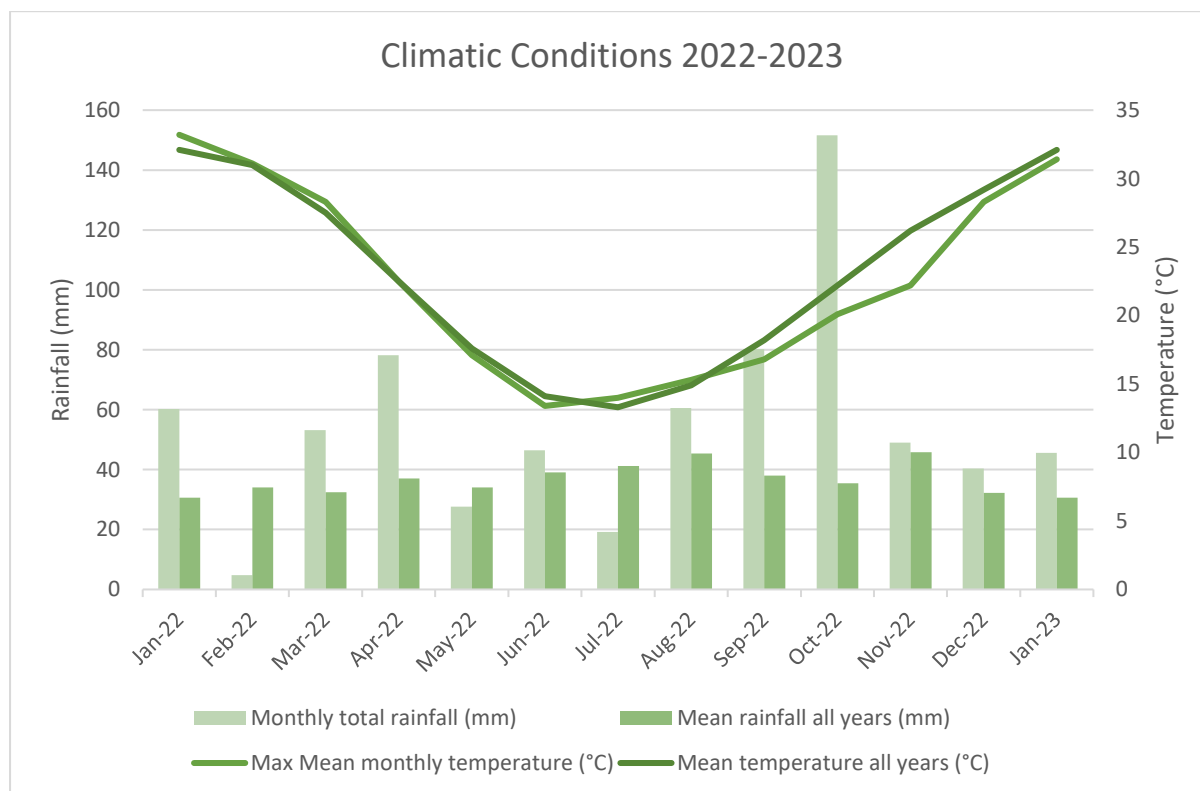


Figure 5: Climate conditions in the Goulburn region over 2022 and January 2023

All sites are still holding water at near full capacity except for Doctors Swamp and Gaynor Swamp. Doctors Swamp has drawn down due to the regulating door being opened by GMW staff in December, with guidance from GB CMA staff, to reduce the water level at the site. This was to prevent flooding of neighbouring properties as a large rainfall event in summer 2022-2023 was predicted. The swamp had reached its proposed six-to-eight-month optimal ponding period at the time of this request and was deemed no threat to flora or fauna at the site.

Gaynor Swamp regulator was vandalised during the October 14<sup>th</sup> flooding event. Two flap doors on the regulator were removed and the force of water passing through the regulator damaged the larger door on the structure (Figure 6). This let some of the water out of the swamp. The swamp has now reached equilibrium and is still holding a significant amount of water.



*Figure 6: Damage to the regulating structure at Gaynor Swamp due to vandalism in October 2022.*

The wetting and drying pattern for each wetland from 2013-2023 is shown in Table 8. Further information regarding key observations and findings from the watering actions is provided in the Key observations and findings 2022-2023 section below.

## Assessment of watering actions 2022-2023

The environmental watering objectives for the Goulburn Wetlands in 2022-2023 were to:

- Provide wetting cycles that promote healthy wetland vegetation communities; and
- Provide feeding and breeding habitat for a range of waterbirds, frogs and turtles.

The aim of the 2022-2023 seasonal watering proposal was to:

- Promote drying at Doctors Swamp to allow the completion of the nutrient cycle and allow the swamp to reach its optimal drying period of six months.
- Partially fill (top-up) Gaynor Swamp in spring 2022 through early summer 2023 to maintain optimal ponding duration of 6 months and prevent nest abandonment by waterbirds if waterbird breeding event occurs.
- Partially fill (top-up) Horseshoe Lagoon in winter 2022 to maintain water level to promote recruitment and regeneration of Tall Marsh (821), Floodway Pond Herbland (810) and Aquatic Herbland (653) EVCs and threatened plant species (both planted and naturally occurring).
- Partially fill Kanyapella Basin in autumn 2023 to a maximum depth of 300mm to promote and improve the diversity of EVCs and encourage threatened aquatic species populations to establish.
- Promote drawdown and drying of Loch Garry after a prolonged wetting (wet since September 2021). This was to allow the completion of the nutrient cycle and allow the Loch to reach its optimal drying period of at least six months.
- Promote drawdown and drying of Reedy Swamp after a prolonged wetting (wet since March 2020). This was to allow the completion of the nutrient cycle and allow the swamp to reach its optimal drying period of at least six months.

Table 7 shows regulated versus unregulated events at Goulburn System wetlands. This indicates that most sites have not reached their optimal ponding duration in the last ten years. This is difficult to assess some sites as environmental watering only began at Gaynor Swamp in 2018, Horseshoe Lagoon in 2019 and Loch Garry and Kanyapella Basin in 2020. Comparison of e-water delivery and ponding duration at these later watered sites indicates that Kanyapella Basin and Loch Garry have both met their optimal ponding duration when e-water was delivered.

Doctors Swamp has been wet six times in the last ten years. Three of these being environmental water deliveries and three being unregulated events. Of these wettings four ponded to the optimal duration of six to eight months. The presence of diverse aquatic vegetation and waterbird activities during the six wetting events indicates that Doctors Swamp is benefitting from both environmental water allocations and unregulated watering events.

Gaynor Swamp has been wet four times in the last ten years. Three environmental water deliveries and three unregulated events have occurred at the site. The autumn environmental water delivery in 2022 was topped up in spring 2022 by a large rainfall event, causing the swamp to flood. Prior to this, cane-grass was flourishing at the site, providing good nesting material for Brolga. Brolga did nest at the site in late 2022, 2023 after the flooding event, with the successful hatching of a chick. The EPBC listed Spiny Lignum has also flourished and begun to recruit due to environmental water allocations and the unregulated events.

Horseshoe Lagoon has only had two e-water deliveries that have met ponding duration as the two remaining e-water deliveries were top-ups on natural inflows. Horseshoe Lagoon vegetation in the deeper section of the lagoon has remained scarce. Aquatic plants such as the EPBC listed River Swamp Wallaby Grass have been observed in the lagoon along with Water ribbons and Upright water-milfoil, indicating that aquatic herbs are slowly responding to both environmental water and unregulated watering events.

Kanyapella Basin has been wet six times in the last ten years. Two of these wetting events have been environmental water deliveries. Monitoring of the site before environmental water was first delivered in 2020 showed some areas of the basin holding populations of the EPBC listed rigid water-milfoil. The population has remained at the site and continues to flourish. Waterbirds have also been active at the site during environmental watering. Flooding of the basin in October 2022 has increased waterbird numbers significantly and monitoring of the site has shown birds to be breeding. A regulator at the bottom of the Warrigal Creek which flows into the Goulburn River was damaged during the 2022 flooding event. This has caused water to remain in the basin as it can not currently flow out. The Basin is now moving into a prolonged wet phase which may see the loss of floristic diversity.

Loch Garry has been wet four times in the last ten years. Environmental water has been delivered to the loch twice (2020 and 2021). The 2021 delivery of environmental water remained topped-up due to rainfall events over later 2021 and early 2022. Loch Garry flooded in October 2022 with a levee being breached. It seems this will not affect future proposed waterings of the site. Due to the loch being closed to the public after the 2022 floods, monitoring of the site has not been possible.

Reedy Swamp has been wet four times in the last ten years. The swamp has endured prolonged flooding three out of the four wetting events over the last ten years. This was due to large rainfall events filling the swamp, usually after an environmental water allocation. The open wetland section of the swamp has remained open with limited recruitment of aquatic plants. Water ribbons planted at the site in 2015 have begun to thrive in the swamp and have begun to slowly recruit across the shallower edges. Red Gums planted along the margins of the swamp in 2020 have not yet flourished. Due to the swamp being closed to the public after flooding in 2022, monitoring of the site and its reaction to the flooding have not occurred.

Table 7: Watering of Goulburn Wetlands since 2013-2014 to 2022-2023

Wetland	Proposed Water in 10 years	Optimal Ponding (months)	Optimal Drying (months)	Unregulated events	Unregulated events that met ponding duration	E-water deliveries	E-water delivery that met ponding duration	Total wet events in 10 years (unregulated and e-flows)	Optimal ponding duration met in 10 years (unregulated and e-flows)#
<b>Doctors Swamp</b>	5-7	6 to 8	6	5 (2014, 2016, 2020,2021, 2022)	3 (2014, 2016, 2022)	3 (2015, 2020, 2022)	0 (two out of three e-flow deliveries have been either been added on top of natural inflows or natural inflows have occurred after e-water delivery).	6 (2014 = unreg; 2015 = e-water; 2020 = unreg and e-water combined; 2021 = unreg; 2022 = unreg and e-water combined)	4 (2014, 2016, 2020, 2022)
<b>Gaynor Swamp*</b>	5-7	6	6-9	3 (2016, 2020,2022)	2 (2016, 2022)	3 (2018, 2020, 2022)	3 (2018,2020, 2022. Note: two out of three (2020 and 2022) e-flow deliveries have been either been added on top of natural inflows or natural inflows have occurred after e-water delivery)	4 (2016 = unreg; 2018 = e-water; 2020 = e-water and unreg combined, 2022 = e-water and unreg combined)	4 (2016, 2018, 2020, 2022)
<b>Horseshoe Lagoon*</b>	8	6-8	6-18	6 (2014, 2016,2018, 2020, 2021, 2022 – note site has not dried out between 2020 and 2022)	3 (2014, 2016, 2020)	4 (2019, 2020, 2021, 2022)	2 (2019, 2020 Note: 2021,2022 not counted as they were on top of unregulated flows)	5 (2014 = unreg; 2016 = unreg; 2018 = unreg; 2019 = ewater; 2020 e-water and unreg)	4 (2014, 2016, 2019, 2020)
<b>Kanyapella Basin*</b>	10	4-8	6-9	5 (2014, 2016,2017, 2020, 2022)	2 (2014, 2022)	2 (2020, 2021)	2 (2020, 2021)	6 (2014 = unreg; 2016 = unreg; 2017 = unreg; 2020 = e-water; 2021 = e-water; 2022 = unreg)	4 (2014, 2016, 2021, 2022)
<b>Loch Garry*</b>	8	6-8	6-18	3 (2014, 2016, 2022)	2 (2014, 2016)	2 (2020, 2021)	2 (2020, 2021)	4 (2014 = unreg; 2016 = unreg; 2020 = e-water, 2021 = e=water and unreg combined)	4 (2014, 2016, 2020, 2021)
<b>Reedy Swamp</b>	6	6-10	6-10	5 (2014, 2016, 2020, 2021, 2022 – note: site remained wet from 2020)	2 (2014, 2020)	3 (2015, 2018, 2019)	3 (2015, 2018, 2019)	4 (2014 = unreg; 2015 = e-water and unreg which held until 2017; 2019 = e-water with unreg flows topping this delivery up between 2020-2022 keeping swamp wet)	4 (2014, 2015, 2018, 2019)

Note: # indicates total times site has been wet. If site has had an environmental water delivery and unreg flow event and has not dried out inbetween these two events, this is classed as one watering. \* indicates e-water has not been delivered to these sites over a ten-year period. Gaynor Swamp deliveries began 2018, Horseshoe Lagoon 2019 and Kanyapella and Loch Garry 2020.

Table 8 outlines the planned potential watering actions from 2022-2023 and an assessment of how they were achieved and current delivery status.

Table 8: Watering priorities and delivery status for Goulburn wetlands 2022-2023

Priority	Wetland	Flow Component	Flow Objective	Achievement in 2022-2023
<b>NA</b>	Doctors Swamp	Dry	Allow swamp to draw down and dry for at least 6 months to complete nutrient cycle and to reach optimal drying period.	Dry. Water let out of swamp in December 2022 to prevent flooding of neighbouring properties.
<b>1</b>	Gaynor Swamp	Fill	Partially fill (top-up) Gaynor Swamp in spring 2022 through early summer 2023 to prevent nest abandonment by waterbirds if waterbird breeding event occurs.	PWA not met with environmental water. Watering of the site did not proceed due to natural inflows filling the site in October 2022.
<b>1</b>	Horseshoe Lagoon	Partial Fill	Partially fill (top-up) Horseshoe Lagoon in winter 2022 to a variable depth of 0.5-2m for 8-10 months to maintain water level to promote recruitment and regeneration of listed EVCs and associated threatened plant species (both planted and naturally occurring).	Water for the environment was delivered in winter 2022 to top-up the lagoon.
<b>1</b>	Kanyapella Basin	Partial fill	Partially fill Kanyapella Basin to a maximum depth of 300mm in autumn 2023 for four months to promote and improve the diversity of EVCs and encourage threatened aquatic species populations to establish.	Autumn watering did not occur due to Basin holding water from natural fill in October 2022.
<b>NA</b>	Loch Garry	Dry	Allow Loch to draw down and dry for at least 6 months to complete nutrient cycle and to reach optimal drying period.	Not achieved. Loch filled in October 2022 due to large rainfall event.
<b>NA</b>	Reedy Swamp	Dry	Allow swamp to draw down and dry for at least 6 months to complete nutrient cycle and to reach optimal drying period.	Not achieved. Swamp filled in October 2022 due to large rainfall event.



## Key observations and findings in 2022-2023

### Doctors Swamp

Doctors Swamp is classified as a bioregionally significant swamp in the Goulburn Broken Catchment (Cook, 2010). An Index of Wetland Condition (IWC) assessment of Doctors Swamp in 2010 showed the swamp was in good condition. A combination of both environmental water and unregulated flows have allowed the swamp to reach its optimum wetting regime of 5-7 years in 10 years (Tables 8 and 9). Environmental water and unregulated flows into the swamp have been important in maintaining this condition. A 25mm rainfall event in January 2022 created some small inflows into Doctors Swamp. The swamp was looking dry in April 2022 and leaf skeltonisers had damaged a majority of the River red gum trees within the swamp (figure 7). 400 ML of environmental water was delivered in April 2022. The swamp held water over the autumn and winter period and the flooded in October 2022 due to a large rainfall event.



*Figure 7. Left: Leaf skeltoniser damage in April 2022 mid top: Doctors Swamp before April 22 e-water, right top: Doctors Swamp in January 2023 still holding water, mid bottom: A floating nest at Doctors Swamp, Right bottom: Running Marsh flower in Doctors Swamp.*

After the flooding event, Australasian Darters and Pied Cormorants were observed nesting. Black Swans also bred in large numbers with over 200 swans counted on an adjoining land holders paddock. These swans would move between the paddock and the swamp on a regular basis (Figure 8). A large number of ducks, herons and Eurasian Coots were also observed utilising the site. In December 2022, the GB CMA were approached by GMW requesting that water be let out of the swamp as the threat of flooding neighbouring properties if another large rainfall event occurred was a concern. GB CMA staff gave GMW permission to do this as the swamp had reached its optimal ponding regime of six to eight months and there was no threat to the ecology of the swamp.



*Figure 8: A swan and cygnets observed at Doctors Swamp in November 2022.*

## Gaynor Swamp

Gaynor Swamp has received four wetting events with a combination of both environmental water and unregulated flows over the last ten years. An Index of Wetland Condition (IWC) assessment of Gaynor Swamp in 2009 found the swamp to be in poor condition with wild oats (*Avena barbata*) being a major vegetation structure at the site. Environmental water and unregulated flows into the swamp have been important in improving this condition. Since the IWC assessment, the swamp flooded naturally in 2010, 2011, 2012 and 2022 and has since received partial natural inflows in 2016 and environmental water deliveries in 2018, 2020 and 2022. This has promoted native terrestrial and aquatic species growth within the swamp and increased floristic composition. Gaynor Swamp received 1000ML of environmental water in autumn 2022. This watering was not well received with some local community members and between the 19<sup>th</sup> and 24<sup>th</sup> of July 2022 the regulator at the site was vandalised (Figure 9). The damage to the regulator caused the loss of approximately 300ML of environmental water. Surveys of the site also discovered four abandoned Brolga nests from the loss of water. This was extremely disappointing for GB CMA staff to discover. Parks Victoria repaired the door and installed surveillance cameras at the site to deter vandals repeating this offence.



Figure 9: Vandalism of regulator at Gaynor Swamp and the effects to the swamp from this.

Left: Pipe flap door removed in July 2022, Top right: An abandoned Brolga nest, Bottom right: Original water level mark can be seen in Spiny Lignum bushes.

Discussions with ecologists after this incident indicated that if the water was returned to the swamp, Brolga may rebuild or return to the nests. GB CMA organised the delivery of this water and informed local landholders that a top-up delivery would occur at the site. This was not well received and a meeting was called to discuss options at the site. Land holders expressed their concern about the potential flooding of adjoining private property if a large rainfall event occurred. It was decided that the proposed top-up environmental watering would not go ahead. The swamp then flooded in October 2022 after a large rainfall event. Again the regulating structure was vandalised and both flaps removed. The force of water passing through the pipes, then damaged the larger regulating door on the opposite side of the structure (figure 6 above). This structure has yet to be repaired. Observations of the site have shown that Gaynor Swamp has reached equilibrium and is currently still holding water. A Brolga with a chick has also been observed.

### Horseshoe Lagoon

The optimum watering regime identified for Horseshoe Lagoon is the provision of flooding in eight in ten years with dry phases in the deepest parts of the Lagoon not exceeding six months. This wetting/drying regime will improve the diversity of native plant and animal species, including many of which are of high conservation significance such as the EPBC (1999) listed River Swamp Wallaby-grass (*Amphibromus fluitans*). Environmental Water is delivered to the lagoon by pumping from the Goulburn River.

A total of 70.3 ML of water for the environment was pumped into Horseshoe Lagoon between the 1st of August and the 15th of August 2022. For the second year Taungurung Land and Waters Council (TLaWC) - Biik Environmental managed the delivery. Prior to the delivery the deeper areas of the main lagoon remained inundated from the 2021-2022 environmental water delivery with the shallower areas and the western arm having drawn down.

The Environmental Water delivery inundated the main lagoon, western arm and surrounding fringing wetland habitats to varying depths of up to 2m. Although the volume delivered to the wetland was less than the agreed 120 ML the hydrological outcomes were still met. This was due in part to the lagoon holding some water and also the wetter than average season. Prior to the delivery the wetter season and associated rainfall did not make any significant contribution to the volume of water held in the lagoon but had primed the wetland reducing losses through the soil profile.

Following a significant rainfall event in October 2022 coupled with releases from Lake Eildon the Goulburn River experienced over bank flows, inundating the wetland and all low-lying areas to a greater extent than had been experienced for the last two decades.

As of February 2023 the main lagoon and western arm were still holding water.

Due to the flooding event in October access to the lagoon has been restricted resulting in limited field observations. As with previous years Pacific Azolla (*Azolla rubra*) and Fringed Heartwort (*Ricciocarpos natans*) covered large areas of open water of the main lagoon. It is still to be determined if the species enrichment plantings undertaken by TLaWC, The Wetland Revival Trust and Parks Victoria over the last three years have begun to recruit.



*Figure 10: Horseshoe Lagoon Day 2 of delivery. 2/08/2022*



*Figure 11: Horseshoe Lagoon (main lagoon) Immediately after delivery, 15<sup>th</sup> August 2022*



*Figure 12: Horseshoe Lagoon – western arm immediately after delivery, 15th August 2022 – water levels have remained at this level throughout the summer.*

During a training event in February 2023 conducted by Damien Cook from The Wetland Revival Trust for TLaWC at the Lagoon widespread growth of the threatened River Swamp Wallaby-grass was observed. Other wetland dependant plant species observed were Water Ribbons and Upright Water-milfoil an encouraging sign that aquatic herbs are slowly responding to the recent watering and flooding events.

An unfortunate result of the October 2022 flooding event has been the entry of carp into the lagoon. At this stage numbers and impacts are largely unknown.

The GB CMA have engaged The Wetland Rival Trust to survey vegetation, waterbird and frog populations at Horseshoe Lagoon in April/May 2023.

### Kanyapella Basin

Kanyapella Basin received its first environmental water delivery in winter 2020 of 500ML (Figure 9). This delivery ponded at the site for approximately 3 months before drying. The 2009 Index of Wetland condition assessment rated the basin in moderate condition (GB CMA, 2012). The optimum regime for this site would be for annual flooding to occur over winter and spring to pond for approximately 1-8 months duration. The site has only been naturally inundated three times in the last ten years (2011-2012 and 2016-2017 and 2022) prior to receiving water for the environment (Tables 8 and 9). A 1000ML delivery occurred in September 2021 with 500ML being delivered to the north-east corner and 500ML to the north-west corner. This watering action aimed to promote different vegetation communities to establish and to gain a better understanding of the site's hydrological response to the delivery volume. Waterbirds responded well to the watering of the north-east corner of the swamp where the vegetation is more open. Waterbirds were also observed in the north-west of the swamp but not in large numbers compared to the north-east. This may be due to the north-west corner being more vegetated and deeper than the north-east corner.

The proposed autumn watering of 2023 will not occur at Kanyapella Basin. The site flooded in October 2022 due to a large rainfall event. The Basin is still holding a significant amount of water and waterbirds are responding to this event by breeding at the site. During the floods the Warrigal Creek regulator that outfalls into the Goulburn River was damaged (Figure 13). This has caused water from the Creek to back up into the Basin and pond. The regulator is proposed to be fixed before the end of the 2023 financial year.



Figure 13: Kanyapella Basin holding a significant amount of water in March 2023. Red star indicates Warrigal Creek regulator that was damaged in the floods.

### Loch Garry

Loch Garry received an environmental water delivery of 1000ML in September 2021 (Figure 14) and has held water since. Water levels have varied since 2021, with water drawing down into the main channel in autumn 2022 before flooding in October 2022. The 2012 Index of Wetland Condition assessment rated the Loch in good condition (Jacobs, 2019b). The optimum regime for this site would be for flooding 8 in 10 years and to occur between autumn and spring, ponding for approximately 8 months. The site has been inundated four times in the last ten years including receiving water for the environment in 2020 and 2021 (Tables 8 and 9). The 2021 watering action aimed to promote different vegetation communities to establish and to gain a better understanding of the site's hydrological response to the delivery volume. The Loch was proposed to draw down and dry in 2022. This did not occur due to the site flooding in October 2022 (figure 14). Loch Garry water levels fluctuated between the environmental water delivery in 2021 and flooding in October 2022 (Figure 14). Due to the magnitude of the flooding event, the Loch is currently closed to the public. GB CMA staff have not been able to undertake surveys of the site due to this closure.



*Figure 14. Sentinel images of Loch Garry*

*Left: Loch Garry in flood, October 2022. Top right: Loch Garry in December 2022 and bottom right: Loch Garry in February 2023.*



### Reedy Swamp

Reedy Swamp filled naturally in April 2020 due to a large rainfall event and has remained holding variable water levels. In 2010, an Index of Wetland Condition assessment rated the swamp in moderate condition (GBCMA 2011). The optimum watering regime for this site would be for flooding 6 in 10 years and to occur between autumn and spring, ponding for approximately 6-10 months. The site has been inundated four times in the last ten years including receiving water for the environment in 2015, 2018 and 2019 (Tables 8 and 9). Natural rainfall events in 2012 kept the swamp wet until winter 2014 which is classed as a prolonged flooding period. Prolonged flooding at the site has also occurred in 2016-2017 and 2020-2022.

Waterbird response in 2021 was positive to the natural filling with large numbers of ducks and swans observed at the site. Terrestrial birds also benefited from the swamp holding water with a Tawny Frogmouth nesting at the site. Winter and spring rainfall kept the wetland filled until it began to drawdown in January 2022. February 2022 storms proceeded to partially fill the wetland where it stayed wet until it flooded in October 2022 (Figure 13). The promotion of an optimal drying regime (6-10 months) did not occur in 2022. This will again be attempted for the 2023-2024 watering season. Reedy Swamp has been closed to the public since the October 2022 flood event due to the issue of falling trees and public safety. This has meant GB CMA staff have not had access to the site for monitoring.



*Figure 15. Reedy Swamp in flood Oct 2022 and holding water in February 2023*



Table 10. 2022-2023 Ecological outcomes for Goulburn Wetlands

2022-2023 Ecological outcomes	
<b>Doctors Swamp</b>	Doctors Swamp was drawing down and near dry at the time of writing this plan. There was no watering proposed for Doctors Swamp in 2022-2023 and drying was proposed. Due to large rainfall event in October 2022, the swamp flooded and held water until March 2023. The regulating structure on the swamp was opened in December 2022 to let water out of the swamp to prevent flooding of adjoining private land.
<b>Gaynor Swamp</b>	Gaynor Swamp did not receive its spring 2022 top-up as proposed. The swamp filled naturally after a large rainfall event in October 2022. Waterbirds have responded well to the flooding and Brolga have been sighted rearing a chick.
<b>Horseshoe Lagoon</b>	A delivery of 70ML occurred at Horseshoe Lagoon to top up the wetland after rainfall in April began to fill the site. Swans nested at the site. In Spring Azolla filled the main body of the lagoon. Populations of River Swamp Wallaby Grass have expanded. Three species of Fresh water Turtles were observed.
<b>Kanyapella Basin</b>	Kanyapella Basin received environmental water volume of 1000ML. Environmental water was split into two deliveries with 500ML being delivered for the first time to the north-east edge of the Basin. The other 500ML was delivered to the north-west edge of the swamp (which also received an environmental water allocation in 2020). Vegetation communities responded well to the watering with the promotion of new growth of aquatic plants at both sites. Water birds also responded to the watering with numerous ducks observed in the deeper water in the north-east corner of the Basin.
<b>Loch Garry</b>	Loch Garry received 1000ML environmental water allocation (500ML was delivered in 2020). This promoted the growth of aquatic vegetation which in-turn supported waterbird and turtles at the site.
<b>Reedy Swamp</b>	Drying of the swamp was proposed for 2022-2023. This did not occur due to large rainfall events throughout 2021-2022 which kept the swamp holding water in 2023.

## Shared benefits 2022-2023

A review of the shared benefits of the Goulburn wetlands in 2022-2023 is listed in Table 11 below. As there was only a small amount of environmental water delivered in 2022-2023 shared benefits also includes the natural flooding of these sites.

Table 11: Shared benefits 2022-2023

Beneficiary	Review of benefits
Traditional Owners	Watering of wetlands and participation of Traditional Owners in delivering Environmental Water to sites allows these communities to meet cultural obligations and maintain connections with Country through continually healing and caring for it.
Recreational users/ local groups	The natural filling of most wetlands in the Goulburn Catchment has allowed recreational users such as bushwalkers and bird watchers to utilise these areas and connect with nature.

## Environmental Objectives

Long-term ecological and hydrological objectives have been established in Environmental Water Management Plans for the wetlands considered in this proposal. The ecological objectives for the Goulburn wetlands are outlined below in Tables 12-17. The objectives vary by wetland, with Doctors Swamp and Horseshoe Lagoon all having objectives relating to either maintaining/improving populations of turtle species and frogs and species diversity of native wetland flora for 2023-2024. Gaynor Swamp, Kanyapella Basin, Loch Garry and Reedy Swamp have the objective of drying for the 2023-2024 season.

Table 12. Potential watering actions and environmental objectives for Doctors Swamp

Potential Watering action	Partially fill Doctors Swamp in autumn 2024 to a maximum depth of 60cm for 6 months only if the swamp has been dry for six months prior to this.
Expected Watering Effects	Inundate 70% of the swamp including deeper and some fringing margins to maintain the condition of the River Red Gum Swamp and Plains Grassy Wetland EVCs. Inundate 70% of the swamp to maintain refuge habitat and appropriate breeding conditions for representative populations of frogs, such as the EPBC listed Sloane's Froglet ( <i>Crinia sloanei</i> ).
Environmental Objectives	Maintain or improve Red Gum Swamp EVC 292 at Doctors Swamp by 2025 with 5-10% cover of River Red Gum, >2 species of medium to large sedges with >10% cover around verges, >3 species of medium to large grasses with >10% cover in the zone where dominant around verges, and >8 species of aquatic herbs with >10% cover. <ul style="list-style-type: none"> <li>Sedge species include: <i>Eleocharis macbarronii</i> and <i>Carex tereticaulis</i></li> <li>Medium to large grasses include: <i>Amphibromus</i> spp. and <i>Walwhalleyaproluta</i></li> <li>Aquatic herb species include: <i>Marsilea mutica</i>, <i>Myriophyllum</i>sp. <i>Marsilea costulifera</i> <i>Potamogeton cheesemanii</i>, <i>Damasonium minus</i>, <i>Triglochin</i> sp</li> </ul> <p>Maintain Plains Grassy Wetland EVC 125 at Doctors Swamp by 2030 with cover of woody species no more than 10% projective foliage cover. Understorey dominated by native wetland forbes and or native wetland graminoids characteristic of the EVC. Species present should include <i>Potamogeton</i>, <i>Runnunculus</i>, <i>Amphibromus</i>, and <i>Lachnagrostis</i> species.</p> <p>Maintain representative populations of native water-dependent communities of frogs at Doctors Swamp in 80% of years, including Sloanes Frolget (<i>Crinia sloanei</i>), Barking marsh frog (<i>Limnodynastes fletcheri</i>), Common froglet (<i>Crinia signifera</i>), Perons tree frog (<i>Litoria peronii</i>), Plains froglet (<i>Crinia parainsignifera</i>), Pobblebonk (<i>Limnodynastes dumerili</i>), and Spotted marsh frog (<i>Limnodynastes tasmaniensis</i>).</p>
Rationale for proposed application in 2023-2024	Doctors swamp dried in February 2023. If the site remains dry and exceeds its optimal drying period of 6 months a partial fill in autumn 2024 is necessary to achieve the objectives for the asset. A complete fill is not possible at the site due to potential flooding of neighbouring properties and council road.

Table 13: Promotion of drying at Gaynor Swamp

<b>Potential Watering action</b>	Promote drying at site
<b>Expected Watering Effects</b>	None
<b>Environmental Objectives</b>	Allow swamp to draw down and dry for at least 6 months to complete nutrient cycle and manage spread of cumbungi and Typha and to reach optimal drying period.
<b>Rationale for proposed application in 2023-2024</b>	Water was delivered to the swamp in autumn 2022 to promote the growth of aquatic vegetation in-turn providing nesting and feeding material for waterbirds, especially Brolga. A proposed environmental water spring top-up in 2022 did not occur at the site due to a large flooding event. Since then, the swamp has held water and is now moving into a prolonged wetting phase (greater than six months ponding).

Table 14. Potential water actions and environmental objectives for Horseshoe Lagoon

<b>Potential Watering action</b>	Fill Horseshoe Lagoon in autumn 2024 to a variable depth of 0.5-2m for 8-10 months only if the site has drawn down and been dry for at least six months.
<b>Expected Watering Effects</b>	Inundate wetland to promote and improve growth of EVCs in both deeper (<2m) and fringing (=0.5m) parts of the wetland.  Inundate wetland to margins to maintain soil moisture and suppress growth of weeds to promote growth of natural and re-introduced threatened species such as River Swamp Wallaby-grass ( <i>Amphibromus fluitans</i> ), Green-top Sedge ( <i>Carex chlorantha</i> ), Veiled Fringe-sedge ( <i>Fimbristylis velata</i> ) and Hypsela ( <i>Hypsela tridens</i> ).  Fill wetland to stimulate ecosystem functions to support food resources and create breeding conditions to support turtle populations including the Eastern long necked ( <i>Chelodina longicollis</i> ), Murray River ( <i>Emydura macquarii</i> ) and Broad-shelled ( <i>Chelodina expansa</i> ).
<b>Environmental Objectives</b>	Protect diversity, recruitment, and regeneration of target EVCs from the 2012 - 2019 benchmark by 2025.  Maintain water level to promote recruitment and regeneration of Tall Marsh (821), Floodway Pond Herbland (810) and Aquatic Herbland (653) EVCs and threatened plant species (both planted and naturally occurring).  Protect threatened plant species, including River Swamp Wallaby-grass ( <i>Amphibromus fluitans</i> ), Green-top Sedge ( <i>Carex chlorantha</i> ), Veiled Fringe-sedge ( <i>Fimbristylis velata</i> ), Hypsela and ( <i>Hypsela tridens</i> ) at Horseshoe Lagoon by 2030. Establish benchmark of condition these species by 2024.  Protect Eastern long necked ( <i>Chelodina longicollis</i> ), Murray River ( <i>Emydura macquarii</i> ) and Broad-shelled ( <i>Chelodina expansa</i> ) at Horseshoe Lagoon by providing the feeding and breeding habitat needed to support life cycle processes, assessed by the presence of these species in 50% years to 2025.
<b>Rationale for proposed application in 2023-2024</b>	Horseshoe Lagoon filled naturally between April/ May 2021. The Lagoon was still holding water in March 2022, with deeper parts of the lagoon acting as refuge pools. The lagoon received an environmental water allocation of 70ML in July 2022 and then flooded in October 2022 due to a large rainfall event. European Carp entered the Lagoon via the flooding of the Goulburn River. This has caused concern with Traditional Owners and NRM managers of the site due to damage the Carp are causing at the site.  Plantings of aquatic species were undertaken in November 2020, January 2021 and 2022 to promote and reinstate threatened species within the lagoon.  Topping up or filling the lagoon (if it dries out) in autumn 2024 will be necessary to promote growth of EVCs and encourage establishment of planted species.

Table 15. Promotion of drying at Loch Garry

<b>Potential Watering action</b>	Promote drying for 2023-2024
<b>Expected Watering Effects</b>	None
<b>Environmental Objectives</b>	Promote drying of Loch after prolonged wetting in 2021-2023.
<b>Rationale for proposed application in 2023-2024</b>	Loch Garry received its first environmental water allocation of 1000ML in Spring 2021 (it received 500ML in Autumn 2020). Large rainfall events and natural inflows have assisted with keeping the site wet into February 2022. The site then flooded in October 2022 after a large rainfall event and was still holding water at the time of writing this plan.  The long-term inundation of the Loch has led to the depletion of the littoral zone seedbank and a variable water level is required to promote establishment of littoral vegetation and that without direct seeding this may take some time to achieve and will be dependent on upstream propagules arriving in natural and managed watering events.  Promotion of a drying regime for at least 6 months will allow the completion of the nutrient cycle and allow the Loch to reach its optimal drying period.

Table 16. Promotion of dry at Kanyapella Basin

<b>Potential Watering action</b>	Promote drying for 2023-2024
<b>Expected Watering Effects</b>	None
<b>Environmental Objectives</b>	Promote drying of Basin after prolonged wetting in 2021-2023.
<b>Rationale for proposed application in 2023-2024</b>	<p>Kanyapella Basin flooded in October 2022 after a large rainfall event. A regulating structure on the Warrigal Creek was damaged in the floods and is prevent water leaving the Basin and moving into the Goulburn River. This has allowed the Basin to pond water which has been beneficial for aquatic vegetation and waterbirds.</p> <p>The Basin is now moving into a prolonged wetting phase and will require drawing down and drying for at six to nine months to promote an optimal drying regime and allow the Basin to complete its nutrient cycle.</p>

Table 17: Promotion of drying at Reedy Swamp

<b>Potential Watering action</b>	Promote drying of the site
<b>Expected Watering Effects</b>	None
<b>Environmental Objectives</b>	Promote drying of the site to prevent prolonged inundation and allow swamp to reach optimal drying period.
<b>Rationale for proposed application in 2023-2024</b>	<p>Reedy Swamp filled naturally in April 2020 due to a large rainfall event. Winter and spring rainfall in 2021 kept the swamp holding water. Rainfall events in January, February and flooding in October 2022 then filled the swamp.</p> <p>To promote an optimal drying regime (6-10 months) water should not be delivered to the site until spring 2024 (dependent when site dries completely).</p>

## Scenario planning

The demand and utilisation of environmental water will vary according to climatic conditions. In drier periods reduced natural inflows and restricted water resources may mean that environmental water is not available. However, in wetter periods the ecological and hydrological objectives of a wetland may be largely met by natural inflows and only small volumes of environmental water may be required. Currently, good inflows in 2022-2023 and allocations reaching 100% early in the season there are reserves in the Goulburn system that will provide for an opening allocation under all inflow conditions (Table 18 – February 2023). There is also a large volume of environmental water carryover that will aid in delivering early season watering priorities.

Table 18: Goulburn system outlook seasonal determination of high reliability shares

Inflow Conditions	3 July 2023	15 August 2023	16 October 2023	15 February 2024
Wet	100%	100%	100%	100%
Average	92%	100%	100%	100%
Dry	86%	95%	100%	100%
Extreme Dry	82%	82%	82%	88%

Scenarios are based on receiving catchment inflows with a Probability of Exceedance (PoE) and the likely availability of environmental water, based on data from Goulburn-Murray Water. The scenarios are extreme dry/drought (99% PoE), dry (90% PoE), average (50% PoE) and wet (10% PoE). These scenarios depict representative seasonal conditions with different natural inflows to the wetlands and the volume of environmental water required. Table 19 rationalises the volumes required for delivery at proposed watering sites for 2023-2024.

Table 19: Scenario planning for Goulburn Wetlands to be watered in 2023-2024.

Wetland	Scenario 1 Extreme Dry 99% PoE No natural inflow to wetlands	Scenario 2 Dry 90% PoE Little to no natural inflow to wetlands, rainfall	Scenario 4 Average 50% PoE Average natural inflow to wetland	Scenario 5 Wet 10% PoE Above average inflow to wetland
<b>Doctors Swamp</b>	600ML – provide drought refuge and maintain wetland to avoid critical loss	600ML – provide refuge and maintain wetland to avoid critical loss	600ML – maintain water levels or fill swamp if primed due to natural inflows. Provide conditions for bird breeding, frogs and maintain EVCs.	300ML – maintain water levels if swamp holding water and water birds are breeding. Provide optimal conditions for bird breeding, frog populations and maintain EVCs.
<b>Horseshoe Lagoon</b>	120ML - provide drought refuge and maintain wetland to avoid critical loss	120ML – provide refuge and maintain wetland to avoid critical loss	120ML - maintain water levels or fill swamp if primed due to natural inflows. Provide conditions for bird breeding and turtle nesting and improve or maintain EVCs.	60ML - maintain water levels if swamp holding water. Provide optimal conditions for bird breeding and turtle nesting events and improve or maintain EVCs.

Note: Watering at both Doctors Swamp and Horseshoe Lagoon will only occur if they have dried for at least six months.

#### Potential watering actions 2023-2024

The environmental water management priorities currently being considered for inclusion in 2023-2024 Seasonal Watering Proposal are listed below (Table 20). These have been categorised into Tier 1 and Not Applicable. Tier 1 watering actions which are the critically important actions that should be achievable based on estimates of supply and other available resources under each planning scenario.

In 2023-2024, in all climatic scenarios from extremely dry to wet it is proposed to deliver water for the environment to Doctors Swamp and Horseshoe Lagoon. The natural hydrological regime of Horseshoe Lagoon has been altered due to catchment changes and river regulation and require water for the environment to deliver water in all climatic conditions. Environmental Water deliveries are not proposed for Gaynor Swamp, Kanyapella Basin, Loch Garry or Reedy Swamp under any climate scenarios as they enter a drying phase.

Table 20: Potential Watering Actions 2023-2024

Priority	Wetland	Potential Watering Action	Climate Scenario and ML Water			
			Ex. Dry	Dry	Average	Wet
1	Doctors Swamp	Partially fill Doctors Swamp in autumn 2024 to a maximum depth of 60cm for 6 months, to maintain growth of Red Gum (292) EVC and representative frog populations of native frog-communities. This will only occur if swamp has dried for at least six months.	600	600	600	300
NA	Gaynor Swamp	Allow swamp to draw down and dry for at least 6 months to complete nutrient cycle and manage spread of cumbungi and Typha and to reach optimal drying period.	0	0	0	0
1	Horseshoe lagoon	Fill Horseshoe Lagoon in autumn 2024 to a variable depth of 0.5-2m for 8-10 months to maintain water level to promote recruitment and regeneration of Tall Marsh (821), Floodway Pond Herbland (810) and Aquatic Herbland (653) EVCs and threatened plant species (both planted and naturally occurring). This will only occur is lagoon has dried for at least six months.	120	120	120	60
NA	Kanyapella Basin	Allow Basin to draw down and dry for at least six months to complete nutrient cycle and to reach optimal drying period.	0	0	0	0
NA	Loch Garry	Allow Loch to draw down and dry for at least 6 months to complete nutrient cycle and to reach optimal drying period.	0	0	0	0
NA	Reedy Swamp	Allow swamp to draw down and dry for at least 6 months to complete nutrient cycle and to reach optimal drying period.	0	0	0	0
<b>Total ML</b>			<b>720</b>	<b>720</b>	<b>720</b>	<b>360</b>



## Delivery constraints

Delivery constraints are physical, operational or administrative factors that can impact the delivery of environmental water to the wetlands. A notice period of one to two days minimum, preferably four days, is required for environmental water orders from Goulburn system storages. If constraints in making environmental water available are foreseen by Goulburn-Murray Water, the Environmental Water Manager will be advised accordingly. The physical delivery of environmental water to the wetlands may only take 1-15 days during the irrigation season depending on system demands.

Doctors Swamp can only receive environmental water when the Cattanach Canal is running at near full capacity (3000ML or above). The operation of Waranga Basin influences flow in the Cattanach Canal. During spring, flow can be inconsistent at times, limiting delivery opportunities. Reasonable notification to Goulburn-Murray Water of a potential delivery to the site will assist with this issue. Flow in the channel is also often more consistent during summer, autumn and winter, as a result of irrigation season, providing greater delivery opportunities.

Horseshoe Lagoon can receive environmental water by pumping directly from the Goulburn River. A contractor is engaged to supply, install, operate, and remove a temporary pump. A service point (SP) number has been allocated by Goulburn-Murray Water for this site to facilitate future watering.

The Goulburn Broken Catchment Management Authority will coordinate any planned delivery of environmental water in 2023-2024 with the VEWH, Goulburn-Murray Water, Parks Victoria, and adjoining landholders. Further delivery arrangements will be outlined in delivery plans.

The delivery constraints for wetlands in the Goulburn Catchment are summarised below in Table 21.

Table 21: Possible delivery constraints to wetlands in the Goulburn system in 2023-2024

Priority site	Delivery Constraint	Impact/Consequence	Mitigating Action	Temporary/Systemic Constraint
<b>Doctors Swamp</b>	Delivery channel (Cattanach Canal) to wetland is influenced by the operation of Waranga Basin. Flows in the channel need to be at near fully capacity to deliver to the wetland and can be inconsistent during the year.	Impact on delivery timing and duration if water not available. Impact on the promotion and maintain of vegetation may occur if water can not be delivered. Frog populations may suffer if a prolonged dry event occurs due to Doctors Swamp not being able to receive water.	GB CMA to discuss appropriate timing of watering with GMW to meet both irrigation demand and environmental water delivery requirements.	Systemic
<b>Horseshoe Lagoon</b>	Water needs to be pumped into the wetland from the adjoining Goulburn River via a portable pump. This requires adequate river flows, approvals, budget and labour.	Impact on delivery if river flows not high enough. If approvals not met, delivery cannot occur which may be detrimental to flora and fauna at the site. Budget costs and pressure on labour can be high. May not have the funding to hire a pump or may get burn out from staff/ TOs in managing pump. Impact on TO's as a cultural site, water in the lagoon may be an important part of connection to country and healing. This may not be able to take place if water is not available.	GB CMA to ensure budget, approvals and labour in place well before planned delivery.	Temporary/Systemic

## Confounding Factors

Confounding factors are other environmental factors that have the potential to limit or impact desired environmental watering outcomes. Regulation of the Goulburn River and land use changes have altered the landscape reducing and changing vegetation and therefore habitat for many species. Species diversity and richness has been severely impacted which may result in some of the watering outcomes not able to be realised. Many wetlands are small and often disconnected from the main river channel and each other resulting in a disconnected landscape limiting the movement of plants and animals. Invasive animals and plants such as foxes, carp and blackberry can have serious impacts on native flora and fauna. Table 21 below identifies confounding factors for the Goulburn wetlands to be watered in 2023-2024 and the proposed and planned mitigating actions.

Table 22: Confounding factors

Wetland	Confounding factor	Mitigating Action
Doctors Swamp	Introduction of carp to the wetland during delivery – impacts on aquatic vegetation and water quality.	GB CMA to install temporary carp screen prior to delivery. Investigate the potential installation of permanent carp screen at regulator.
Horseshoe Lagoon	<p>Foxes are a threat to turtle population by raiding nests and killing adults. Foxes also predate birds and frogs.</p> <p>Deer are impacting the vegetation and water quality at Horseshoe Lagoon.</p> <p>The invasive blackberry (WoNS) is present in large clumps. If left untreated it can take over native vegetation and it also harbours foxes</p> <p>Aquatic plant species absent, propagules not available for natural regeneration, therefore vegetation objectives may not be met.</p> <p>Lack of instream woody habitat limiting macroinvertebrates – food web.</p>	<p>Parks Victoria and the surrounding landholders are undertaking a coordinated fox control program. Baiting has occurred on the surrounding properties and soft jaw traps set within the lagoon. Parks Victoria organised a fox drive in April 2021. GB CMA and Parks Victoria have used turtle detector dogs to find turtle nest so they can be protected from them being raided.</p> <p>Work with Parks Victoria, TLaWC and surrounding landholders to come up with a plan to reduce impacts of the deer. Parks Victoria are organising a hunter too remove the deer in 2022.</p> <p>GB CMA engaged TLaWC in early 2022 to undertake 4 days of blackberry control. Continue to encourage Parks Victoria and adjoining landholders to undertake annual weed management.</p> <p>Parks Victoria and TLaWC have commenced planting aquatic species that are absent or in low numbers.</p> <p>GB CMA to consider reintroduction of woody habitat.</p>

## Increasing Knowledge

WetMAP - Victoria's Wetland Monitoring and Assessment Program for environmental water is a state-wide monitoring program designed to assess the ecological response of vegetation, waterbirds, and fish to the delivery of environmental water in Victorian wetlands. The WetMAP program objectives are:

- Build on current knowledge and conceptual models to improve the understanding of the relationships between environmental flows and ecological response/ outcomes.
- Determine whether the current ecological objectives for environmental watering are being met.
- Inform environmental flow management for CMAs – inform the development of objectives and planning for environmental water delivery.
- Communicate the ecological outcomes of environmental water delivery in Victorian wetlands to the Minister, water industry stakeholders and broader community.
- Contribute to Victoria' Murray Darling Basin Plan reporting requirements.

WetMAP monitoring began at Doctors Swamp, Gaynor Swamp and Reedy Swamp in late 2017. Monitoring began at Horseshoe Lagoon, Kanyapella Basin and Loch Garry in 2020 (<https://www.ari.vic.gov.au/research/wetlands-and-floodplains/assessing-wetland-response-to-water-for-the-environment>). This monitoring will complement the monitoring being undertaken by the GB CMA staff.

Compliance monitoring is undertaken during the delivery of environmental water. This involves monitoring regulator operation and volumes of water delivered. GB CMA, Parks Victoria and Traditional Owners undertake field observations when possible. In the case of Horseshoe Lagoon Parks Victoria regularly install trail cameras to record turtles and other wildlife as well as feral animals. Acoustic recorders are deployed at all wetlands either during or shortly after the delivery to determine the presence and number of birds and frogs. The information collected has been highly valuable in informing the ongoing management of these wetlands, and for State Government and VEWH reporting.

During any environmental water delivery in 2023-2024 monitoring of the vegetation response including EPBC (1999) listed species Rigid water-milfoil (*Myriophyllum porcatum*) and River Swamp Wallaby-grass (*Amphibromus fluitans*) will occur on a regular basis at Horseshoe Lagoon. Monitoring of vegetation response and frog populations will occur at Doctors Swamp with an increased focus on the EPBC listed Sloanes Froglet.

In the event of wetlands naturally filling, waterbird monitoring, water depth and extent will be monitored on a regular basis 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. 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.

## Knowledge Gaps and Limitations

One of the key knowledge gaps associated with wetland environmental water management is the limited information on the flood regime tolerances of aquatic dependent ecological vegetation communities and their associated flora species.

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.

The integration of traditional ecological knowledge for the purposes of informing wetland watering has not yet been carried out in a comprehensive way across the Goulburn catchment. Working closely with Traditional Owners, and facilitating Traditional Owner led assessments of biocultural values to identify cultural priorities for watering, including the tailoring of e-water deliveries to better align with cultural values such as the growth of medicinal plants, watering of sites at particular times for cultural activities, maintaining connection to Country, and healing of Country is extremely important.

## Reporting

The first level of reporting is on the use of environmental entitlements. Weekly reporting advises environmental entitlement holders of progressive water use and on any adaptive water deployment decisions made.

The second level of reporting is on environmental outcomes achieved. Information on the use of environmental water, environmental outcomes recorded, and any knowledge gained will be reported to GB CMA partners and the board monthly and summarized in the 2024-2025 Goulburn System Wetlands Seasonal Watering Proposal. WETMAP also produces annual reports on the results of the program.

## Risk Management

The risks associated with the proposed delivery of environmental water to the wetlands in the Goulburn Broken Catchment are outlined in Table 23 below, along with their mitigation actions and the organisation responsible for their implementation. These will be reviewed and updated prior to the delivery of environmental water in site specific environmental water delivery plans.

Table 23: Risk assessment of proposed water delivery to Goulburn System Wetlands

Pre-Mitigation Risk								Residual Risk				
Risk ID	Risk category	Relevant to Wetlands	Requires inclusion and tailoring in delivery plan	Risk description	Likelihood	Consequence	Risk Rating	Mitigation actions	Lead organisation for action	Likelihood	Consequence	Risk Rating
NOGB2020-01	Environment	Yes	Yes - depends on the volume of the delivery (affects consequence rating). Treatment may be similar, however.	Specified flow rates are insufficient to achieve the intended extent of wetland inundation or magnitude and duration of river flows, resulting in a failure to achieve planned environmental outcomes.	Possible	Major	Medium	<ul style="list-style-type: none"> <li>• Include contingency allowance in estimated watering requirements, based on previous event data, and consider a contingency in the duration of the event to achieve desired wetland inundation.</li> <li>• Monitor event (especially for deliveries to new sites or for previously untested events) and adjust flows as necessary, or terminate event if it becomes clear that insufficient water is available.</li> <li>• Identify and address constraints that may limit the flow rates for environmental deliveries.</li> </ul>	CMA CMA CMA/GMW	Possible	Minor	Low
NOGB2020-02	Reputational	Yes	Yes - depends on the volume of the delivery (affects consequence rating).	Specified flow rates are insufficient to achieve the intended extent of wetland inundation or magnitude and duration of river flows, resulting in a failure to achieve planned environmental outcomes and loss of community support.	Possible	Major	Medium	<ul style="list-style-type: none"> <li>• Communications on the environmental benefits of watering actions.</li> <li>• Monitor event (especially for deliveries to new sites or for previously untested events) and adjust flows as necessary or terminate event if it becomes clear that insufficient water is available.</li> <li>• Communicate the need for complimentary measures to optimise the benefits of environmental watering actions.</li> </ul>	CMA	Unlikely	Minor	Low
NOGB2020-03	Environment	Yes	No- generic risk that is mitigated prior to delivery plan process	Overestimates of environmental water demand prevents planning for supplying demands at other locations <i>Notes: Planning watering actions also includes decisions around the carryover and trade of water as alternatives to current year water use decisions.</i>	Possible	Minor	Low	<ul style="list-style-type: none"> <li>• CMAs review demand estimates and targets met by unregulated flows throughout the delivery cycle and regularly advise VEWH of any changes so unused water can be reallocated.</li> <li>• CMAs review demand estimates at the conclusion of the watering year, prior to the development of the following seasonal watering proposal, so estimates of future requirements are more accurate.</li> <li>• River operators provide regular updates on flows, including through OAG meetings</li> <li>• Manage Water Holdings to maximise supply opportunities for all sites</li> </ul>	CMA CMA MDBA/GMW VEWH	Unlikely	Minor	Low

NOG82020-04	Environment	Yes	Yes – consequence level likely to vary depending on volume and needs to be actively managed during delivery	Inaccurate accounting and measurement or operational error results in target flows either not being achieved or being exceeded, leading to a failure to achieve planned environmental outcomes  Occurring in Upper Broken Ck below Casey's weir offtake due to weed growth, which is also limiting flow capacity (likelihood for Broken is "possible")	Unlikely	Moderate	Low	<ul style="list-style-type: none"> <li>Review accounting and measurement processes to be used to ensure that techniques are agreed, and monitoring/measurement sites are operational.</li> <li>Apply agreed arrangements as documented in the Murray and Goulburn Systems Operating Arrangement documents</li> <li>GMW to undertake additional gaugings</li> <li>Weed control in Bkn Ck programmed for autumn (weather conditions permitting)</li> </ul>	GMW (MDBA in some waterways such as Barmah) GMW/VEWH  GMW GMW/CMA	Unlikely	Minor	Low
NOG82020-05	Business Costs	Yes	Yes – consequence level likely to vary depending on volume and needs to be actively managed during delivery	Volumes of environmental water delivered or released exceed volumes approved for use in the event, leading to potential overdrawn of accounts or preventing other planned actions being undertaken. <i>Notes: Planning watering actions also includes decisions around the carryover and trade of water as alternatives to current year water use decisions.</i>	Unlikely	Major	Low	<ul style="list-style-type: none"> <li>Ensure that deliveries are reported progressively throughout the event and are monitored against ordered volume.</li> <li>Ensure ordering and delivery procedures are kept up-to-date and adhered to.</li> <li>Ensure metering and reporting processes for temporary pump operations are suitable and effective</li> </ul>	CMA & GMW GMW/CMA/VEWH CMA	Unlikely	Minor	Low
NOG82020-06	Environment	Yes	Yes – depends on the volume of the delivery (affects consequences rating). Treatment may be similar however.	Environmental water account is overdrawn, leading to water not being available as per approved watering statement to complete planned actions and environmental benefits not being achieved. <i>Notes: Planning watering actions also includes decisions around the carryover and trade of water as alternatives to current year water use decisions.</i>	Unlikely	Major	Low	<ul style="list-style-type: none"> <li>Monitor ABA balances and undertake regular communications with CMA and RWC as part of portfolio management activities.</li> <li>Ensure that deliveries are reported progressively throughout the event and are monitored against ordered volume.</li> </ul>	VEWH CMA & GMW	Unlikely	Minor	Low
NOG82020-07	Environment	Yes (where delivered via infrastructure)	No, managed prior to delivery plan development	Planned maintenance of water delivery infrastructure results in planned/specified flows not being achieved, leading to a failure to achieve planned environmental outcomes.	Likely	Minor	Low	<ul style="list-style-type: none"> <li>Undertake early planning and communications between the CMA and storage operator to minimise likelihood of constraints, enable scheduling of maintenance outside of high demand periods or identify alternative environmental water delivery windows to avoid scheduled maintenance activities.</li> <li>Consider adding time contingencies to planned maintenance schedules to ensure works are completed prior to commencement of watering actions.</li> </ul>	CMA and GMW  CMA	Unlikely	Minor	Low
NOG82020-08	Environment	Yes	Yes, requires consideration, if possible, for the site during delivery plan process (i.e.: where site is known to have poorly maintained infrastructure)	Failure of poorly maintained environmental delivery infrastructure results in planned/specified flows not being achieved, reducing the ability to achieve planned environmental outcomes. (Including failure or damage due to vandalism)	Likely	Moderate	Medium	<ul style="list-style-type: none"> <li>Asset ownership is clarified, and the asset owners perform regular maintenance, and pre-event asset inspections, on delivery infrastructure. <i>*Note that insufficient resources are likely to limit the asset owner's ability to regularly inspect and maintain infrastructure. Increased resources for these activities may further reduce the likelihood and risk ratings.</i></li> </ul>	Asset Owner  Asset Owner Asset Owner CMA Asset Owner PV			

				Requires site specific risk assessment - relevant to wetlands, not rivers and streams, apart from perhaps Warrigal Creek (not targeted with e-water). Risk only relevant to wetlands sites - residual risk rating to be assessed at Delivery Plan/Event Plan phase				<ul style="list-style-type: none"> <li>Report vandalism to police.</li> <li>Review asset design to minimise opportunities for interference or damage.</li> <li>For privately owned assets, arrange approvals to use/operate assets and undertake pre-delivery inspections</li> <li>Communicate failures to the CMA</li> <li>Initiate documentation of asset ownership and management arrangements in national parks.</li> </ul> <p>Consider monitoring options to detect vandalism, interference, or failure of assets at individual sites with elevated risks.</p>				
NOG82020-09	Environment	Yes – where delivered via infrastructure	Yes, requires consideration, if possible, for the site during delivery plan process (i.e.: where site is known to have poorly maintained infrastructure)	<p>Poor condition of delivery infrastructure results in the asset owner being unable to operate the structure due to OH&amp;S risks, leading to failure to deliver environmental flows and to achieve environmental objectives.</p> <p>Note: This issue may affect multiple sites</p> <p><i>GMW to confirm OH&amp;S status and likelihood rating</i></p>	Likely	Moderate	Medium	<ul style="list-style-type: none"> <li>Asset owner to undertake regular maintenance and pre-event asset inspections on delivery infrastructure.</li> <li><i>*Note that insufficient resources are likely to limit the asset owner's ability to regularly inspect and maintain infrastructure. Increased resources for these activities may further reduce the likelihood and risk ratings.</i></li> <li>Communicate failures to the CMA</li> <li>Develop design for new regulating structure and seek funding to implement necessary upgrades in conjunction with asset owner.</li> <li><i>Note: PV proposing to issue operating licences for BMF regulators</i></li> </ul>	Asset Owner  Asset Owner CMA (MDBA in Barmah Forest)	Unlikely	Minor	Low
NOG82020-10	Environment	Yes	Yes	<p>High operational and consumptive water demands lead to reduced access for environmental deliveries, with the result that target flows/volumes cannot be achieved, impacting on environmental outcomes</p> <p>Note: Goulburn R is a particular risk - see new separate Goulburn risk added</p>	Likely	Minor	Low	<ul style="list-style-type: none"> <li>Event planning will seek to avoid peak demand periods, and events will be monitored and adjusted as necessary.</li> <li>System operators to provide longer term forecasts for future consumptive demands as an input to planning watering proposals</li> <li>Develop longer term agreements on river capacity access for environmental deliveries.</li> <li>Investigate opportunities to undertake deliveries outside the irrigation season with consideration of appropriate delivery costs</li> </ul>	CMA and GMW  GMW/MDBA  VEWH CMA and VEWH	Possible	Minor	Low
NOG82020-12	Legal	Yes	Yes, where relevant	<p>Environmental releases, either on their own or potentially in combination with unexpected tributary inflows, cause unauthorised inundation of private land, resulting in impacts on landowner activities and assets.</p> <p>Note that 2022 floods have caused erosion or damage to the riverbanks which may result in Environmental releases (at previously acceptable flow rates) causing unauthorised inundation of private land, resulting in impacts on landowner activities and assets.</p>	Possible	Major	Medium	<ul style="list-style-type: none"> <li>Ensure currency of any landholder agreements for inundation of private land.</li> <li>Release plans designed to avoid exceeding operational thresholds or unauthorised flooding.</li> <li>Monitor events and adjust releases to avoid overbank flows. This may include limiting deliveries to daylight hours only, where feasible and consistent with watering requirements.</li> <li>Monitor forecast rainfall and tributary inflows and adjust releases to avoid overbank flows.</li> <li>Monitor deliveries to new locations to build an understanding of flow patterns and inundation thresholds and adjust releases accordingly.</li> <li>Investigate post flood to determine commence to flow of major erosion in the Mid Goulburn (and other systems as required).</li> </ul>	CMA CMA GMW/MDBA  GMW/MDBA CMA  CMA/Storage operator	Unlikely	Moderate	Low



								<ul style="list-style-type: none"> <li>Seek advice from storage operator of any known changes in bank levels and commence to flow levels.</li> </ul>				
NOGB2020-13	Reputational	Yes	Yes	Public land and/or access routes into public land areas may be inundated by delivery of environmental water, leading to potential impacts on recreational opportunities for park users (e.g. access to boat ramps, fishing spots, firewood collection etc.). Applies to Lower Goulburn	Almost certain	Moderate	High	<ul style="list-style-type: none"> <li>Watering proposals to identify potential impacts, communication of planned events, access closures, alternative recreational opportunities and alternative access routes</li> </ul>	CMA Land Manager	Almost certain	Minor	Medium
NOGB2020-15	Business Costs	Yes	Yes	Public land visitor vehicles cause damage to tracks, or to other assets in the surrounding landscape, due to off-road activity (by users going off track to avoid floodwaters) during and after environmental watering. Risks only relevant to wetland sites – residual risk rating to be assessed at delivery plan phase.	Likely	Moderate	Medium	<p>Land Managers:</p> <ul style="list-style-type: none"> <li>implement management activities to prevent access to flooded roadways (e.g. close roads, communicate planned events, install signage)</li> <li>repair damage during and after environmental watering events</li> <li>maintain key higher ground tracks to enable alternative access routes during environmental watering.</li> </ul> <p><i>*Note that insufficient resources may limit the land manager's ability to implement management activities and hence ability to effectively mitigate the described risk.</i></p>	Land Manager			
NOGB2020-17	Service Delivery	Yes	Yes	Access routes into public land areas may be inundated by delivery of environmental water, leading to potential impacts on land management and maintenance activities (e.g. fire mgmt. works) Risks only relevant to wetland sites – residual risk rating to be assessed at delivery plan phase.	Almost certain	Moderate	High	<ul style="list-style-type: none"> <li>Early planning and communications of proposed actions with land manager to minimise likelihood of impacts, and scheduling of maintenance works outside of planned delivery periods.</li> </ul>	CMA			
NOGB2020-19	Reputational	Yes	No- generic risk with treatment at program level	Environmental water deliveries result in low DO levels, with adverse environmental impacts.	Unlikely	Major	Low	<ul style="list-style-type: none"> <li>Communicate benefits of environmental water management to the broader community and engage with recreational user peak bodies and management agencies.</li> <li>Communicate the benefits of environmental water management and inform the local community of environmental water management activities and the underlying rationale, including black water mitigations.</li> <li>Inform communities of black water vs hypoxic black water issues, to build understanding and support</li> </ul>	VEWH CMA - VEWB/CEWO	Unlikely	Moderate	Low

NOGB2020-20	Environment	Yes	Possible inclusion in delivery plan. Site level consideration and mitigation.	Environmental water deliveries may generate or mobilise BGA blooms, with adverse water quality and/or health impacts (including to people, livestock and pets), resulting in cessation of releases and environmental impacts	Possible	Major	Medium	<ul style="list-style-type: none"> <li>Consider likelihood of initiating BGA blooms in event planning and amend as required to manage risk.</li> <li>Land managers or water corporation implement a risk-based monitoring program during environmental watering events, and where issues are identified, activate BGA response processes.</li> </ul> <p><i>*Notes: Parks Victoria are currently writing a BGA risk management plan for Northern Victoria Region that considers the potential risk of environmental water events. This plan will outline proactive and reactive monitoring and management responsibilities that Parks Victoria commits to as a Local Waterway Manager for BGA. Adequate BGA resourcing is being considered as part of this plan.</i></p> <ul style="list-style-type: none"> <li>Regional monitoring and advice on BGA status.</li> </ul>	CMA / GMW Land Manager GMW  GMW	Unlikely	Minor	Low
NOGB2020-21	Reputational	Yes	Yes if known issues at site and specific actions required	Environmental water management activities may conflict with or not complement water based recreational objectives, leading to loss of community support for activities.	Almost certain	Moderate	High	<ul style="list-style-type: none"> <li>Communicate benefits of environmental water management to the broader community and engage with recreational user peak bodies.</li> <li>Engage with local recreational user groups to inform them of environmental water management activities and the underlying rationale.</li> <li>Adjust events or actions to reduce/avoid impact where practical without reducing environmental outcomes.</li> <li>Communicate alternate recreational opportunities.</li> <li>Enhance community understanding of water system operations and entitlement frameworks (water literacy).</li> </ul>	VEWH  CMA CMA Land Manager VEWH	Possible	Minor	Low
NOGB2020-22	Business Costs	Yes	Possible inclusion in delivery plan. Site level consideration and mitigation.	Insufficient resources available (including staff, funding for maintenance of roads, regulators etc.) across partner organisations to deliver all planned environmental watering actions, leading to cancellation or interruptions of deliveries. Risk only relevant to wetlands sites - residual risk rating to be assessed at Delivery Plan phase (e.g. Gaynor Swamp + NE sites - rely on others to monitor pumps). Not as much of an issue for rivers/creeks post-COVID.	Possible	Major	Medium	<ul style="list-style-type: none"> <li>Partners notify the CMA and VEWH of resource constraints in advance of deliveries and VEWH convene OAG meetings to consider implications and potential solutions.</li> <li>Continue to actively prioritise actions to match available resources and ensure key actions are delivered.</li> <li>Reallocate tasks and available funds to ensure highest priority watering actions are delivered.</li> </ul>	VEWH  CMA CMA			
NOGB2020-23	Environment	Yes	Possible – mitigated through other processes at existing sites, however, could be included at a new site where watering is being undertaken as a trial to collect this information.	Insufficient information and knowledge available to inform environmental water deliveries	Unlikely	Moderate	Low	<ul style="list-style-type: none"> <li>Identify important knowledge gaps and secure funding to improve scientific understanding.</li> <li>Consider deferring deliveries until sufficient information is available to mitigate unacceptable risks.</li> <li>Implement adaptive management processes and undertake trials to collect data.</li> <li>Seek necessary resources to undertake approvals and assessments.</li> </ul>	CMA	Unlikely	Minor	Low

NOGB2020-24	Legal	Yes	No	Failure to recognise cultural heritage issues at a site targeted for watering may result in necessary permits and approvals not being obtained, leading to prosecution and fines.	Possible	Moderate	Medium	<ul style="list-style-type: none"> <li>Undertake desktop reviews and site assessments with archaeologists, traditional owners and land managers, to identify approval needs and contingency measures.</li> <li>Obtain any necessary formal approvals/permits and implement required actions.</li> </ul>	CMA			
NOGB2020-25	Cultural heritage	Yes	Possible	Environmental watering causes harm to identified cultural heritage  <i>Note: difficult to assess consequence under cultural heritage category - needs further testing with TOs. Hard for non-TOs to try and assess, so doesn't really fit within a traditional risk assessment process</i>	Unlikely	Moderate	Low	<ul style="list-style-type: none"> <li>Work with Traditional Owners to ensure that the potential impact of environmental water deliveries on cultural heritage is understood and agreed, minimised or avoided.</li> <li>Consider opportunities for additional resourcing for TO groups to engage in risk assessments</li> </ul>	CMA DEECA/VEWH	Unlikely	Moderate	Low
NOGB2020-26	Reputational	Yes	No	Inability to demonstrate outcomes achieved through environmental watering activities may lead to a loss of public/political support for activities	Possible	Major	Medium	<ul style="list-style-type: none"> <li>Rationalise and refocus current monitoring programs (e.g. Wetmap) to better identifying outcomes.</li> <li>Seek additional funds to address gaps in monitoring programs and knowledge.</li> <li>Communicate the benefits of environmental watering and monitoring results (Note: It may not be possible/affordable to address all monitoring gaps, so this risk may still be rated as medium after mitigation actions.)</li> </ul>	DEECA VEWH CMA	Possible	Minor	Low
NOGB2020-27	Environment	Yes	Yes	Environmental deliveries improve conditions for non-native species (e.g. carp, invasive species, feral horses) and over-abundant native species (e.g. kangaroos, Red Gum encroachment) leading to adverse environmental impacts.	Likely	Moderate	Medium	<ul style="list-style-type: none"> <li>Study/understand life history of species and develop high level management strategies.</li> <li>Develop and implement site specific management strategies aimed at eradication/control of existing populations (e.g. carp management strategy, willow removal program, water-lily spraying program, feral animal programs).</li> <li>Implement pest reduction efforts prior to delivery of water, to ensure increases in populations remain within "tolerable" levels (Note: This risk is still rated as <b>medium</b> after mitigation actions.)</li> </ul>	DEECA CMA/Land Manager	Likely	Moderate	Medium
NOGB2020-28	Environment	Yes	Yes – risk to be assessed for delivery	Environmental watering actions trigger non-targeted environmental responses (e.g., bird breeding) causing unintended consequences (or lost opportunities) for other environmental values.	Likely	Moderate	Medium	<ul style="list-style-type: none"> <li>Undertake monitoring and communicate these issues as they arise and apply adaptive management and review of delivery plans.</li> <li>Consider including contingency allowance in delivery plan water volumes to complete breeding events.</li> </ul>	CMA	Possible	Minor	Low
NOGB2020-29	Environment	Yes	No	Ineffective planning and/or uncoordinated water ordering results in administrative obstacles that prevent watering opportunities.	Unlikely	Moderate	Low	<ul style="list-style-type: none"> <li>Enable the full range of watering actions possible in seasonal watering proposals and the seasonal watering plan (as per SWP guidelines)</li> <li>Review and update the Murray system environmental watering ordering template</li> </ul>	CMA/VEWH VEWH/MDBA	Unlikely	Moderate	Medium
NOGB2020-33	Reputational	Yes	No	Community concern over environmental releases under dry seasonal conditions may lead to a loss of support for	Unlikely	Moderate	Low	<ul style="list-style-type: none"> <li>Communicate benefits of environmental watering to the community, especially in relation to strategic watering in dry periods.</li> <li>Enhance community understanding of water system operations and</li> </ul>	CMA VEWH	Unlikely	Minor	Low

				environmental watering actions.				entitlement frameworks (water literacy).				
<b>NOGB2020-34</b>	Reputational	Yes	No	Under dry conditions, community expectations of the extent of environmental watering that can be achieved are not met, leading to a loss of support for environmental watering actions. Note - e-water deliveries may be constrained in 22-23 due to high consumptive avail.	Possible	Moderate	Medium	<ul style="list-style-type: none"> <li>Communications to inform the community on the limits of environmental water holdings and the extent of actions possible under dry conditions.</li> </ul> <i>Note that public concern in this regard may be heightened as a result of the Menindee 2019 fish death events.</i>	CMA	Unlikely	Minor	Low
<b>NOGB2020-35</b>	Environment	Yes	No	Limited environmental deliveries may reduce opportunities to test ecological responses to environmental flows, impacting on effectiveness of research projects.	Unlikely	Minor	Low	<ul style="list-style-type: none"> <li>Review monitoring program and adjust if possible. Reprioritise future flow targets.</li> </ul>	CMA	Unlikely	Minor	Low
<b>NOGO2022-42</b>	Reputational	Yes	Yes	Watering wetlands in wetter conditions leads to community concern over incr. flood risk resulting in loss of support for environmental watering program. Note: especially for Loch Garry flood protection district	Possible	Moderate	Medium	<ul style="list-style-type: none"> <li>communicate results of modelling to d/s landholders demonstrating low impacts</li> <li>notification of planned delivery events to landholders</li> <li>staged trial flows with increasing flows over several years to enable monitoring and assessment of outcomes</li> </ul>	CMA			

## Approval

I, Chris Cumming, the authorised representative of the Goulburn Broken Catchment Management Authority, approve the Seasonal Watering Proposal for the Goulburn Wetlands 2023-2024.

Signed for and on behalf of Goulburn Broken Catchment Management Authority

A handwritten signature in black ink, appearing to read 'CC', with a small dot at the end.

Signature of authorised representative

Name of authorised representative

Chris Cumming (CEO)

Date: 6 April 2023

## References

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

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## Appendices

### Appendix 1 - Schedule 8 – Criteria for identifying an environmental asset.

Taken from the Basin Plan <https://www.legislation.gov.au/Details/F2012L02240>

Item	Criteria
<b>Criterion 1: The water-dependent ecosystem is formally recognised in international agreements or, with environmental watering, is capable of supporting species listed in those agreements</b>	
1	<p>Assessment indicator: A water-dependent ecosystem is an environmental asset that requires environmental watering if it is:</p> <p>(a) a declared Ramsar wetland; or</p> <p>(b) with environmental watering, capable of supporting a species listed in or under the JAMBA, CAMBA, ROKAMBA or the Bonn Convention.</p>
<b>Criterion 2: The water-dependent ecosystem is natural or near-natural, rare or unique</b>	
2	<p>Assessment indicator: A water-dependent ecosystem is an environmental asset that requires environmental watering if it:</p> <p>(a) represents a natural or near-natural example of a particular type of water-dependent ecosystem as evidenced by a relative lack of post-1788 human induced hydrologic disturbance or adverse impacts on ecological character; or</p> <p>(b) represents the only example of a particular type of water-dependent ecosystem in the Murray-Darling Basin; or</p> <p>(c) represents a rare example of a particular type of water-dependent ecosystem in the Murray-Darling Basin.</p>
<b>Criterion 3: The water-dependent ecosystem provides vital habitat</b>	
3	<p>Assessment indicator: A water-dependent ecosystem is an environmental asset that requires environmental watering if it:</p> <p>(a) provides vital habitat, including:</p> <p style="padding-left: 40px;">(i) a refugium for native water-dependent biota during dry spells and drought; or</p> <p style="padding-left: 40px;">(ii) pathways for the dispersal, migration and movements of native water-dependent biota; or</p> <p style="padding-left: 40px;">(iii) important feeding, breeding and nursery sites for native water-dependent biota; or</p> <p>(b) is essential for maintaining, and preventing declines of, native water-dependent biota.</p>
<b>Criterion 4: Water-dependent ecosystems that support Commonwealth, State or Territory listed threatened species or communities</b>	
4	<p>Assessment indicator: A water-dependent ecosystem is an environmental asset that requires environmental watering if it:</p> <p>(a) supports a listed threatened ecological community or listed threatened species; or</p> <p style="padding-left: 40px;">Note: See the definitions of <b>listed threatened ecological community</b> and <b>listed threatened species</b> in section 1.07.</p> <p>(b) supports water-dependent ecosystems treated as threatened or endangered (however described) under State or Territory law; or</p> <p>(c) supports one or more native water-dependent species treated as threatened or endangered (however described) under State or Territory law.</p>
<b>Criterion 5: The water-dependent ecosystem supports, or with environmental watering is capable of supporting, significant biodiversity</b>	
5	<p>Assessment indicator: A water-dependent ecosystem is an environmental asset that requires environmental watering if it supports, or with environmental watering is capable of supporting, significant biological diversity. This includes a water-dependent ecosystem that:</p> <p>(a) supports, or with environmental watering is capable of supporting, significant numbers of individuals of native water-dependent species; or</p> <p>(b) supports, or with environmental watering is capable of supporting, significant levels of native biodiversity at the genus or family taxonomic level, or at the ecological community level.</p>

## Appendix 2a – Threatened fauna species recorded at Goulburn Wetlands

Common Name	Scientific Name	Doctors Swamp	Gaynor Swamp	Horseshoe Lagoon	Kanyapella Basin	Loch Garry	Reedy Swamp	EPBC	FFG
Australasian Bittern	<i>Botaurus poiciloptilus</i>	Y	Y					Endangered	Critically Endangered
Australasian Shoveler	<i>Anas rhynchotis</i>		Y	Y	Y	Y	Y		Vulnerable
Australian Little Bittern	<i>Ixobrychus dubius</i>		Y				Y		Endangered
Australian Painted Snipe	<i>Rostratula australis</i>		Y		Y			Endangered	Critically Endangered
Blue-billed Duck	<i>Oxyura australis</i>	Y	Y				Y		Vulnerable
Broad-shelled turtle	<i>Macrochelodina expansa</i>			Y					Endangered
Brolga	<i>Antigone rubicunda</i>	Y	Y		Y		Y		Endangered
Caspian Tern	<i>Hydroprogne caspia</i>		Y				Y		Vulnerable
Eastern Great Egret	<i>Ardea modesta</i>	Y	Y	Y	Y	Y	Y		Vulnerable
Freckled Duck	<i>Stictonetta naevosa</i>		Y				Y		Endangered
Hardhead	<i>Aythya australis</i>		Y	Y	Y	Y	Y		Vulnerable
Lewins Rail	<i>Rallus pectoralis pectoralis</i>		Y				Y		Vulnerable
Little Egret	<i>Egretta garzetta nigripes</i>		Y		Y				Endangered
Magpie Goose	<i>Anseranas semipalmata</i>	Y							Vulnerable
Murray River Turtle	<i>Emydura macquarii</i>			Y	Y		Y		Critically Endangered
Musk Duck	<i>Bizura lobata</i>	Y	Y		Y	Y	Y		Vulnerable
Sloane's Froglet	<i>Crinia sloanei</i>	Y						Endangered	Endangered
White-bellied Sea Eagle	<i>Haliaeetus leucogaster</i>		Y		Y	Y	Y		Endangered

## Appendix 2b – Threatened flora recorded at Goulburn wetlands

Common Name	Scientific Name	Doctors Swamp	Gaynor Swamp	Horseshoe Lagoon	Kanyapella Basin	Loch Garry	Reedy Swamp	EPBC	FFG
River Swamp Wallaby-grass	<i>Amphibromus fluitans</i>			Y	Y	Y		Vulnerable	
Winged Water-starwort	<i>Callitriche umbonata</i>		Y		Y				Endangered
Western Bitter-cress	<i>Cardamine lineariloba</i>		Y						Endangered
Riverine Bitter-cress	<i>Cardamine mairensis</i>	Y			Y				Endangered
Small Scurf Pea	<i>Cullen parvum</i>						Y		Endangered
Spiny Lignum	<i>Duma horrida</i> subsp. <i>horrida</i>		Y						Critically Endangered
Long Eryngium	<i>Eryngium paludosum</i>	Y			Y				Endangered
Veiled Fringe-sedge	<i>Fimbristylis velata</i>			Y					Endangered
Dwarf Brooklime	<i>Gratiola pumilo</i>				Y				Endangered
Sand Rush	<i>Juncus psammophilus</i>						Y		Endangered
Salt Paperbark	<i>Melaleuca halmaturorum</i> subsp. <i>halmaturorum</i>		Y						Endangered
Rigid Water-milfoil	<i>Myriophyllum porcatum</i>				Y			Vulnerable	Critically Endangered
Open Marshwort	<i>Nymphoides geminate</i>	Y							Endangered
Swamp Buttercup	<i>Ranunculus undosus</i>				Y				Endangered
Floodplain Fireweed	<i>Senecio campylocarpus</i>				Y	Y	Y		Endangered
Branching Groundsel	<i>Senecio cunninghamii</i> var. <i>cunninghamii</i>		Y						Endangered
Slender Darling-pea	<i>Swainsona murrayana</i>				Y			Vulnerable	Endangered
Red Swainson-pea	<i>Swainsona plagiotropis</i>				Y			Vulnerable	Endangered