

Lower Broken Creek Seasonal Watering Proposal 2024-2025



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Document Control

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1 CONTEXT

This Seasonal Watering Proposal (SWP) outlines the Goulburn Broken Catchment Management Authority's (GB CMA) priorities for the use of environmental water in the lower Broken and Nine Mile Creeks in 2024-25, as required under section 192A of the *Water Act 1989*. It aims to:

- identify the environmental water requirements of the lower Broken and Nine Mile Creeks in the coming year under a range of climatic scenarios to protect or improve the environmental values and health of these waterways; and
- inform the development of environmental water priorities in the VEWH's Seasonal Watering Plan for 2024-25.

The SWP is informed by scientific studies and reports that identify the flow regime required to meet the ecological objectives of the creeks. It was prepared in consultation with key stakeholders and partners and was approved by the CEO of the GB CMA.

The format of this Seasonal Watering Proposal is different to previous years. The Victorian Environmental Water Holder (VEWH) has amended the Seasonal Watering Proposal guidelines in 2024-25 and reduced the length of the document whilst still retaining the key information including:

- what environmental watering actions may be delivered during 2024-25;
- the rationale for delivering these environmental watering actions;
- a summary of the engagement undertaken; and
- risk management.

2 SYSTEM OVERVIEW

Waterway Manager – Goulburn Broken Catchment Management Authority

Storage Manager – Goulburn-Murray Water

Environmental water holders – Victorian Environmental Water Holder and Commonwealth Environmental Water Holder

Land Manager – Parks Victoria (for Nature Reserves)

Lower Broken and Nine Mile creeks have been regulated for over a century. Before regulation, the creeks would have had most of their flow in winter/spring and contracted to isolated pools or dried out during summer/autumn. The adjacent floodplain would have also flooded regularly. The creeks now have numerous weirs that maintain a relatively constant water level from mid-August until mid-May to support irrigated agriculture and little flow during the non-irrigation season. These modifications have changed the way native species use the creek and favour invasive species such as arrowhead. Previously, native fish would have moved into the creek when it was flowing and returned to the Murray River as it dried. Both creeks now provide year-round habitat for native fish, and fish passage structures allow fish to move between weir pools. Water for the environment is used to support these permanent fish habitats by providing flows to trigger fish movement and support fish passage, encourage the growth of native plants, promote in-stream productivity, control water quality and flush the water fern azolla as necessary.

Regulated water is delivered to lower Broken Creek from the Goulburn and Murray systems via the irrigation channel network. Lower Broken Creek is operated separately from upper Broken Creek and Broken River, which are both supplied from Lake Nillahcootie on upper Broken River.

Water for the environment can be provided to lower Broken Creek from the Goulburn system through the East Goulburn Main Channel and from the Murray system through the Yarrawonga Main Channel. Water is released into lower Broken Creek from several irrigation regulators along the length of lower Broken Creek. The main priority for environmental flows in the lower Broken Creek system is to maintain minimum flows throughout the year to maintain suitable habitat for native fish. Particular attention is given to reaches 1 and 2 during the non-irrigation season when flow can stop. The next priority is to deliver freshes in winter/spring to trigger fish movement and spawning, maintain water quality and manage azolla accumulations in reaches 3 and 4. Rices Weir is the measurement point for environmental flows in lower Broken Creek.

A map showing lower Broken Creek and Nine Mile Creek is located in the Appendix section of the SWP.

Some of the environmental flow targets for lower Broken Creek are partly or wholly met by operational water releases — inter-valley transfers (IVTs) from the Goulburn to the Murray or Barmah Choke bypass flows that are delivered to meet downstream demands. These operational deliveries mainly occur during peak irrigation demand periods between spring and autumn. Water for the environment may be used to supplement these operational releases and to deliver recommended flow components that are not met by operational releases.

3 TRADITIONAL OWNER CULTURAL VALUES AND USES

The Lower Broken Creek system is within Yorta Yorta Country, and their cultural connection is evident throughout the landscape.

Each year, the Goulburn Broken CMA meets with the representatives of the Yorta Yorta Nation Aboriginal Corporation to discuss water for the environment in lower Broken Creek. A meeting was held in March 2024 to discuss 2024 environmental watering priorities.

The planned environmental flows for 2024-25 in the lower Broken Creek are supported by the Yorta Yorta Nation Aboriginal Corporation. Flows will support in-stream vegetation and native fish, along with other aquatic plants and animals. Goulburn Broken CMA will continue to work with Yorta Yorta people to identify how the management of water for the environment can better support cultural values.

In 2021, the Yorta Yorta Nation Aboriginal Corporation provided the following statement about the cultural values of the Broken River system including lower Broken Creek:

“The Broken River (and Broken Creek) holds many cultural values. Common reed contained within the slack water provides important material for tools while also providing refuge for culturally important fish species (large and small-bodied). The creek also has significant stands of old growth river red gum containing important habitat and exhibiting scars made from carving out canoes and coolamons.”

The Yorta Yorta Nation Aboriginal Corporation has raised concerns about flow regulation in all their waterways, which is affecting their Country and cultural knowledge.

The Yorta Yorta Nation Aboriginal Corporation continues to pursue the Yorta Yorta People's inherent rights to water for Country. Rights to water will improve their spiritual, cultural, environmental, social and economic needs, in line with the Yorta Yorta Whole of Country Plan 2021-2030.

4 SOCIAL RECREATIONAL AND ECONOMIC VALUES AND USES

In planning the potential watering actions in Table 3, Goulburn Broken CMA considered how environmental flows could support values and uses, including:

- water-based recreation (such as canoeing, fishing, game hunting and kayaking)
- riverside recreation and amenity (such as aesthetic and amenity values that are particularly important for the community's mental health and wellbeing during dry periods and for passive recreation)
- community events and tourism
- socio-economic benefits (such as consumptive water users, Goulburn-Murray Water irrigators and diverters and Goulburn Valley Water customers).

The creeks making up the lower Broken Creek system have a narrow riparian zone with residential and farming properties adjoining or overlooking them. The creek system runs through the Katamatite, Wunghnu, Numurkah and Nathalia townships. Consequently, the communities have a direct connection with their creek, which provides high aesthetic and amenity value, that is particularly important to community. The creeks are also important recreational areas in terms of fishing, canoeing, kayaking and passive recreation.

"The Broken and Nine Mile Creeks are important in regards to being one of the most accessible waterways in Victoria for fishing, family picnics and camping" (Nathalia community member, 22 February 2023).

The expected shared benefits from delivery of water for the environment in the lower Broken Creek and Nine Mile Creek in 2024-25 include the presence of winter flows which supports amenity as well as maintains adequate depth for recreational pursuits such as canoeing and fishing.







The lower Broken Creek system is the source of consumptive water (irrigation and S&D) for over 70 diverters, as well as urban water for the township of Nathalia. The creek can be prone to poor water quality experiencing high turbidity, elevated colour and/or low dissolved oxygen events. Delivery of baseflows and freshes during the warmer months can contribute to improved water quality for consumptive users.

5 ENVIRONMENTAL VALUES AND OBJECTIVES

Lower Broken and Nine Mile Creeks support a diverse and abundant native fish community, including Murray cod, golden perch, silver perch, unspotted hardyhead and Murray-Darling rainbowfish. Sections of the lower Broken and Nine Mile creeks have been reserved as state park and natural feature reserves. The associated floodplain and wetland habitats support box-

dominated grassy woodland communities and numerous species of state and national conservation significance, including river swamp wallaby grass and the Australasian bittern.

Table 1 : Environmental objectives in Lower Broken Creek

	F1 - Protect and increase native fish populations, including threatened Murray cod, golden perch, silver perch and small bodied species
	PR1 - Protect platypus and rakali populations, particularly outside the irrigation season
	T1 - Protect turtle populations, particularly outside the irrigation season
	V1 - Avoid the excessive build-up of <i>azolla</i> V2 - Increase the cover and condition of native in-stream and littoral vegetation communities
	MI1 - Increase the diversity and abundance of waterbug populations
	WQ1 - Maintain oxygen levels suitable for aquatic animals

6 ENGAGEMENT

Key community and stakeholder groups have been engaged during the development of this proposal through two mechanisms – the Broken Environmental Water Advisory Group (EWAG) and direct engagement e.g. through meetings, email updates and one-on-one informal discussions.

The Broken EWAG was established by the GB CMA in April 2012 to provide advice on planning environmental water use and on any environmental health trends occurring in the rivers, creeks and wetlands across the Broken Basin. The group meets 3-4 times per year with the most recent meeting in March 2024. The group includes community members, Taungurung Land and Waters Council, Parks Victoria, the Goulburn Valley Environment Group and key agency partners (the VEWH, the CEWH and GMW). Yorta Yorta Nation Aboriginal Corporation have also been invited to join the group. However, to date limited resources has restricted their involvement.

Direct engagement has also occurred with Traditional Owners (Yorta Yorta Nations Aboriginal Corporation and Taungurung Land and Waters Council) and program partners (GMW, the VEWH, the CEWH) through other forms of meetings (i.e. Operational Advisory Groups etc) and separate emails and discussions with GB CMA staff.

Engagement during the planning process for the 2024-25 proposal indicated that community and stakeholder groups remain supportive of the proposed watering actions for the lower Broken and Nine Mile Creeks.

In addition to the above, communications about the environmental flow program and the specific environmental flows and objectives proposed in the Broken Basin for 2024-25 will occur through a variety of communication materials and products (e.g. media releases, talks and newsletter articles for special interest groups). The communications will help build the general public’s awareness and understanding of environmental water in the region, particularly the resulting environmental and

shared benefits. Further details are available in the Goulburn Broken Environmental Water Communication Action Plan, which is reviewed and refined throughout the year.

Table 1: Summary of stakeholder engagement that informed this Seasonal Watering Proposal

Stakeholder(s)	Engagement method	Engagement purpose
Government agencies <ul style="list-style-type: none"> • GMW • VEWH • CEWH • Parks Victoria 	<ul style="list-style-type: none"> • Broken EWAG meeting 19 March 2024 • Direct engagement • Review of draft proposal 	<ul style="list-style-type: none"> • Seek input to development of the proposal. Understand any delivery constraints or issues and plan for environmental water delivery in 2024-25. • Gather observations on waterway health and trends.
Traditional Owners <ul style="list-style-type: none"> • Yorta Yorta Nation Aboriginal Corporation • Taungurung Land and Waters Council 	<ul style="list-style-type: none"> • Broken EWAG meeting 19 March 2024 (couldn't attend but received meeting notes) • Direct engagement • Review of draft proposal 	<ul style="list-style-type: none"> • Seek feedback on environmental water priorities for 2024-25. • Identify cultural objectives for the waterways and incorporate them into environmental water planning. • Gather observations on waterway health and trends.
Recreational Users <ul style="list-style-type: none"> • EWAG members 	<ul style="list-style-type: none"> • Broken EWAG meeting 19 March 2024 	<ul style="list-style-type: none"> • Seek feedback on environmental water priorities for 2024-25. • Gather observations on waterway health and trends. • Confirm recreational and social uses of the waterways.
Environment Groups <ul style="list-style-type: none"> • Goulburn Valley Environment Group 	<ul style="list-style-type: none"> • Broken EWAG meeting 19 March 2024 (couldn't attend but received meeting notes) 	<ul style="list-style-type: none"> • Seek feedback on environmental water priorities for 2024-25. • Gather observations on waterway health and trends. • Confirm recreational and social uses of the waterways.
Landholders <ul style="list-style-type: none"> • EWAG members 	<ul style="list-style-type: none"> • Broken EWAG meeting 19 March 2024 	<ul style="list-style-type: none"> • Seek feedback on environmental water priorities for 2024-25. • Gather observations on waterway health and trends. • Confirm recreational and social uses of the waterways.

7 SCOPE OF ENVIRONMENTAL WATERING

An environmental FLOWS study for the lower Broken Creek system was recently completed in 2019 (Jacobs 2019) informing objectives and flow recommendations (watering actions) for the management of the lower Broken and Nine Mile creeks key ecological values.

Given the system is highly regulated, the focus of this seasonal watering proposal is on maintaining minimum base or low flows and increasing flow variability in all reaches. The relevant objectives, flow recommendations (watering actions) and ecological values are presented in Table 3.
















The objective of increasing flow variability throughout all reaches is supported by the most recent ecological impact assessment of the system (Gower *et al*, 2024). The expert panel assessed impacts on bank condition, bank vegetation and native fish and summarised that 'future management of the lower Broken Creek should aim to increase water level variability and importance to identify potential opportunities to alter the predominately static flow at some or all sites'. This recommendation is considered in the potential watering actions (Table 3) where ranges of flows (eg. 20-40ML/d) are proposed to support flow variability within the system.

Additionally, the operational ability to deliver environmental water to the system via a number of delivery points should support meeting objectives within each reach. Although Table 3 below indicates that compliance is measured at Reach 4 (Rices Weir), meeting ecological objectives within each of the reaches is considered in 2024-25 potential watering actions (spring/summer/autumn low flows). Water will be delivered via various outfalls along the creek(s) which will support environmental objectives for each reach. Flows will be monitored across various reaches.

The importance of Environmental Water delivery in lower Broken Creek within each of the reaches includes:

- Reach 1 supports beds of aquatic vegetation and a range of aquatic species including platypus (historically), silver perch, Murray cod, golden perch and river blackfish. Delivery of environmental water into reach 1 supports the ability to maintain water quality, and/or recover from water quality events.
- Reach 2 (predominately Nine Mile creek) supports beds of aquatic vegetation and a range of aquatic species including platypus (historically), Murray cod and Murray-Darling rainbowfish. There has been a substantial investment in restoring instream woody habitat to this reach, complimenting delivery of environmental water. Delivery of environmental water into reach 2 supports the ability to maintain water quality, and/or recover from water quality events as well as increase the success of other recovery efforts such as native fish stockings.
- Reaches 3 & 4 supports a relatively diverse native fish community including Murray cod and golden perch. This reach is shallow over large areas and highly regulated through a series of eight weirs. Consequently, reaches 3 and 4 are prone to Azolla accumulations and low dissolved oxygen, particularly during hot conditions. Poor water quality has contributed to several past fish death events. Environmental water is critical for maintaining water quality, keeping fish ladders operational and promoting a robust native fish community. Delivery of environmental water into reaches 3 and 4 will be critical to the ability to maintain water quality, and/or recover from water quality events as well as increase the success of other recovery efforts such as native fish stocking.

Table 2: Potential Watering Actions in 2024-25

Potential environmental watering action	Expected watering effects	Environmental objectives	
Lower Broken and Nine Mile Creeks - Reach 4 (compliance point)			
Winter low flow - (20-40 ML/day during May to August)¹	<ul style="list-style-type: none"> Provide native fish with passage through fish ladders Provide suitable foraging habitat for platypus and rakali (water rats), and support the conditioning of females in preparation for the breeding season Provide habitat for turtles, including protection from exposure during their winter dormancy Provide flowing-water habitat and avoid winter drying of weir pools for fish, vegetation, waterbugs, platypus and turtles Maintain water over submerged aquatic plants so they are protected from drying and frost Reduce the stagnation of weir pools to maintain water quality 	 F1  PR1  T1	 MI1  V2  WQ1
Spring/summer/autumn low flow (70-250 ML/day in reaches 1 and 2 and 200-450 ML/day in reaches 3 and 4 during August to May)	<ul style="list-style-type: none"> Provide habitat for aquatic biota including native fish, platypus, rakali (water rats), turtles and waterbugs Support the movement and recruitment of fish Maintain native instream and littoral vegetation communities through water level variability Maintain oxygen levels in summer <p>Additional benefits when delivered from December to February (at 250-450 ML/day):</p> <ul style="list-style-type: none"> mobilise azolla and increase oxygen levels during high-risk periods 	 F1  PR1  T1	 WQ1  MI1  V2
Winter/spring fresh(es) (one to three freshes of 300-450 ML/day for one to two weeks during July to November)	<ul style="list-style-type: none"> Flush and mobilise azolla if it has accumulated to maintain water quality Trigger the movement and spawning of fish Encourage the germination and growth of littoral and in-stream vegetation Reduce the stagnation of weir pools to maintain water quality 	 F1  V1/V2  WQ1	

¹ This flow may be difficult to achieve when channel maintenance work is being completed. If maintenance work is required, waterway managers will work with the storage manager to minimise impacts where possible. Possible mitigation actions include closing fishways to maintain water in weir pools and scheduling works to minimise the duration of impacts on flow.

8 SCENARIO PLANNING

8.1 Climate Outlook for 2024-2025

Water delivery to the lower Broken creek relies on regulated supplies from the Murray and Goulburn systems. At the end of February 2024 storages levels were Lake Hume 78%, Lake Dartmouth 96%, and Lake Eildon is 96% reflecting recent wet years (RMNV, 2024).

The February 2024 system outlook for seasonal determinations indicate that 'Average' inflow conditions should allow the Murray and Goulburn systems to reach seasonal determinations of 100% (HRWS) by mid-August 2024.

The February 2024 allocation outlooks issued by the Northern Victoria Resource Manager are outlined in more detail in Tables 4a & b below.

Overall, it is expected that there will be sufficient water resources to meet the proposed priority environmental watering actions for 2024-25 for the lower Broken creek.

Table 4a: Murray system outlook for seasonal determination of high reliability water

Climate Scenario	1 July 2024	15 August 2024	17 October 2024	15 February 2025
Wet	99%	100%	100%	100%
Average	83%	97%	100%	100%
Dry	67%	71%	91%	100%
Extreme Dry	61%	61%	61%	62%

Source: [Current Outlook - Northern Victoria Resource Manager \(nvrnm.net.au\)](https://nvrnm.net.au)

Table 4b: Goulburn system outlook for seasonal determination of high reliability water

Climate Scenario	1 July 2024	15 August 2024	17 October 2024	15 February 2025
Wet	100%	100%	100%	100%
Average	80%	100%	100%	100%
Dry	68%	83%	100%	100%
Extreme Dry	64%	69%	75%	80%

Source: [Current Outlook - Northern Victoria Resource Manager \(nvrnm.net.au\)](https://nvrnm.net.au)

8.2 Scenario Planning

Scenario planning involves taking account of variations in water availability across climate scenarios (ranging from drought to wet) and differing ecological goals to identify the most appropriate potential watering actions for each scenario.

The lower Broken Creek system differs to many other environmental water locations in that the environmental flow needs are relatively fixed from year to year i.e. are largely independent of annual climatic conditions which makes standard scenario planning process less applicable.

Most of the water in the lower Broken Creek system is typically sourced from the Murray and Goulburn Rivers through regulating structures. Catchment runoff may contribute short flow peaks post rainfall periods but does not significantly contribute to environment flow needs apart from very wet years. However, even in wet years the potential watering actions may not change. E.g. winter baseflows, timing of freshes to achieve ecological benefits, or flows to improve water quality. Potential watering actions therefore remain consistent across each scenario, although the timing and purpose may change from year-to-year depending on the conditions.

Additionally, the volume of water expected to be available to lower Broken Creek in 2024-25 exceeds that required to meet environmental flow requirements under all scenarios, resulting in identifying the same potential watering actions for each climate scenario. Depending on the climatic conditions and broader system demands, flows are delivered through a combination of different water sources including environmental water, Inter-Valley Trade (IVT), Murray bypass and unregulated inflows.

With the likelihood of high reliability allocations, it is expected that priority watering actions will be achieved for the lower Broken Creek system during 2024-25. Potential watering actions for all planning scenarios include maintaining the baseflow above 20 ML per day outside the irrigation season to support the ecological values of the creek, including macroinvertebrates, fish, platypus, rakali and aquatic vegetation communities. Similarly, the requested range of baseflows across the spring, summer and autumn (irrigation season) allows flexibility to target flows depending on resource availability and system demands, as well as creek conditions. These flows also support important ecological benefits including providing habitat for aquatic biota including native fish, platypus, rakali, turtles and aquatic invertebrates. The flows also support the movement and recruitment of fish, maintain native instream and littoral vegetation communities as well as maintaining water quality, particularly dissolved oxygen levels in summer.

The request of delivering multiple freshes in 2024-25 will be of particular importance to trigger the movement and spawning of native fish within the system which have likely been impacted by flooding and low-oxygen blackwater events in recent years. The native fish recovery restocking program (eg. Freshwater catfish in reach 4) in the creek will also benefit from the delivery of the freshes.

The Goulburn Broken CMA will monitor water quality throughout the year, and it may request to increase the flow to the upper end of the recommended range in Table 3 if *Azolla* and/or dissolved oxygen concentrations are trending towards levels of concern. The total volume of water for the environment that will be needed to achieve planned watering actions in 2024-25 will vary depending on operational deliveries (including IVTs) and the sizes and durations of any unregulated flow events. A carryover target of 5,000 ML applies in all planning scenarios to ensure a minimum low flow and/or a small fresh can be delivered early in 2025-26.

Table 5 below outlines potential environmental watering and expected water use in a range of planning scenarios. Overall, the watering actions proposed for the lower Broken Creek are the same for all planning scenarios, as the system is highly regulated and there is expected sufficient water available to meet the tier 1 priorities.

Table 5: Scenario Planning in 2024-25

Planning scenario	Drought	Dry	Average	Wet
Expected conditions	<ul style="list-style-type: none"> No unregulated flow 	<ul style="list-style-type: none"> Some unregulated flow in winter No unregulated flow throughout the irrigation season (mid-August to May) No diversion of unregulated Murray River flow is available 	<ul style="list-style-type: none"> Unregulated flow in winter/spring Unregulated flow is unlikely from October to May Diversion of unregulated Murray River flow is available from mid- August to October 	<ul style="list-style-type: none"> Unregulated flow is likely in winter/ spring Unregulated flow is possible from November to May Diversion of unregulated Murray River flow available from mid-August to November
Potential environmental watering – tier 1 (high priorities) ¹	<ul style="list-style-type: none"> Winter low flow (~4,000 ML) Spring/summer/autumn low flow (~65,500 ML) Winter/spring freshes (~10,500 ML) 			
Possible volume of water for the environment required to achieve objectives	<ul style="list-style-type: none"> 80,000 ML 			
Priority carryover requirements for 2025-26	<ul style="list-style-type: none"> 5,000ML 			

¹ Tier 1 potential environmental watering for lower Broken Creek is not classified as tier 1a or 1b because the water available for use is shared across various systems and it is not possible to reliably determine the supply specifically available for lower Broken Creek.

9 RISK MANAGEMENT

Each year the environmental water holders facilitate a risk workshop and develop a table of risks associated with environmental water delivery in northern Victoria. Risks associated with the proposed water delivery in the lower Broken Creek and Nine Mile Creek are shown in the table 6 below. Risks identified for other systems not relevant to this proposal have been removed. Mitigation strategies that will be employed by the GB CMA and supporting stakeholders to address the inherently high and medium risks are identified.

In summary, of the risks identified (all systems), approximately 50% were categorised as environmental and 25% as reputational risks. The majority of the risks were inherently rated as low-medium, and only three high risks identified prior to mitigation actions. All identified risks were assessed as having low residual risk for 2024-25 following the application of the identified mitigation actions.

Overall, proposed watering actions for 2024-25 for the lower Broken creek have not generated risks without effective mitigation actions or controls, of which monitoring, and communication are the key controls.

Table 6: Summary of relevant Risk Assessment 2024-25

System	Risk category	Risk description	Inherent Risk Rating	Mitigation actions	Residual Risk Rating
Murray, Goulburn, Broken & Ovens	Environment	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. Applicable for mid-Goulburn flow trials in 2023-24 (new actions), also applicable to post-flood environment. Much lower risk for Ovens.	Medium	<ul style="list-style-type: none"> • 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. • 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. • Identify and address constraints that may limit the flow rates for environmental deliveries. 	Low

Murray, Goulburn, Broken & Ovens	Reputational	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.	Medium	<ul style="list-style-type: none"> • Communications on the environmental benefits of watering actions. • 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. • Communicate the need for complimentary measures to optimise the benefits of environmental watering actions. 	Low
Murray, Goulburn, Broken & Ovens	Environment	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>	Low	<ul style="list-style-type: none"> • 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. • 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. • River operators provide regular updates on flows, including through OAG meetings • Manage Water Holdings to maximise supply opportunities for all sites 	Low
Murray, Goulburn, Broken & Ovens	Environment	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")	Low	<ul style="list-style-type: none"> • Review accounting and measurement processes to be used to ensure that techniques are agreed, and monitoring/measurement sites are operational. <p>- Apply agreed arrangements as documented in the Murray and Goulburn Systems Operating Arrangement documents - GMW to undertake additional gaugings - Weed control in Broken Ck programmed for autumn (weather conditions permitting)</p>	Low
Murray, Goulburn, Broken & Ovens	Business Costs	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</i>	Low	<ul style="list-style-type: none"> • Ensure that deliveries are reported progressively throughout the event and are monitored against ordered volume. • Ensure ordering and delivery procedures are kept up-to-date and adhered to. • Ensure metering and reporting processes for temporary pump operations are suitable and effective 	Low

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		<i>includes decisions around the carryover and trade of water as alternatives to current year water use decisions.</i>		- residual risk assessment based on consideration of likely 24-25 water availability and value	
Murray, Goulburn, Broken & Ovens	Environment	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>	Low	<ul style="list-style-type: none"> • Monitor ABA balances and undertake regular communications with CMA and RWC as part of portfolio management activities. • Ensure that deliveries are reported progressively throughout the event and are monitored against ordered volume. 	Low
Murray, Goulburn, Broken & Ovens	Environment	Planned maintenance of water delivery infrastructure results in planned/specified flows not being achieved, leading to a failure to achieve planned environmental outcomes.	Low	<ul style="list-style-type: none"> • 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. • Consider adding time contingencies to planned maintenance schedules to ensure works are completed prior to commencement of watering actions. 	Low
Murray, Goulburn, Broken & Ovens	Environment	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)	Medium	<ul style="list-style-type: none"> • 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> • Report vandalism to police. • Review asset design to minimise opportunities for interference or damage. • For privately owned assets, arrange approvals to use/operate assets and undertake pre-delivery inspections • Communicate failures to the CMA 	

				<ul style="list-style-type: none"> • Initiate documentation of asset ownership and management arrangements in national parks. - Consider monitoring options to detect vandalism, interference or failure of assets at individual sites with elevated risk 	
Murray, Goulburn, Broken & Ovens	Environment	<p>Poor condition of delivery infrastructure results in the asset owner being unable to operate the structure due to OH&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>Pre-mitigation risk updated from 'likely' to 'unlikely' for 2023</i></p>	Low	<ul style="list-style-type: none"> • Asset owner to undertake 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> • Communicate failures to the CMA • Develop design for new regulating structure and seek funding to implement necessary upgrades in conjunction with asset owner. <i>Note: PV proposing to issue operating licences for BMF regulators</i> 	Low
Murray, Goulburn, Broken & Ovens	Environment	<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>	Low	<ul style="list-style-type: none"> • Event planning will seek to avoid peak demand periods, and events will be monitored and adjusted as necessary. • System operators to provide longer term forecasts for future consumptive demands as an input to planning watering proposals • Develop longer term agreements on river capacity access for environmental deliveries. • Investigate opportunities to undertake deliveries outside the irrigation season with consideration of appropriate delivery costs 	Low
Murray, Goulburn, Broken & Ovens	Legal	<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><i>Note that 2022 floods have caused erosion</i></p>	Medium	<ul style="list-style-type: none"> • Ensure currency of any landholder agreements for inundation of private land. • Release plans designed to avoid exceeding operational thresholds or unauthorised flooding. • 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. • Monitor forecast rainfall and tributary inflows and adjust 	Low

		<i>or damage to the river banks 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.</i>		<p>releases to avoid overbank flows.</p> <ul style="list-style-type: none"> • Monitor deliveries to new locations to build an understanding of flow patterns and inundation thresholds and adjust releases accordingly. - Investigations post flood to determine commence to flow of major erosion in the Mid Goulburn (and other systems as required) - Seek advice from storage operator of any known changes in bank levels and commence to flow levels 	
Murray, Goulburn, Broken & Ovens	Reputational	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.).	High	<ul style="list-style-type: none"> • Watering proposals to identify potential impacts. communication of planned events, access closures, alternative recreational opportunities and alternative access routes - Plan event timings to limit flow changes during peak visitation periods 	Low
Murray, Goulburn, Broken & Ovens	Environment	<p>Environmental water deliveries result in low dissolved oxygen (DO) levels, with adverse environmental impacts.</p> <p><i>Note: Advice is that annual leaf litter accumulation is sufficient to cause risk, even if previously inundated</i></p> <p><i>- Rainfall rejection or high consumptive deliveries may drive risk issues here, rather than e-water</i></p>	Low	<ul style="list-style-type: none"> • Where possible implement a full annual suite of flow components in river systems, including those designed to control build of organic matter (such as winter flushes). Plan deliveries with consideration of high temperature periods where appropriate. • Develop monitoring and response plans and reserve contingency volumes in delivery plans for dilution flows if DO concentrations drop to levels of concern. • Monitor leaf litter loads and avoid exceeding any flow thresholds likely create hypoxic black water events - where possible, and considering temperature drivers - Assess new/proposed actions for DO impact potential and adjust watering plans as needed. 	Low
Murray, Goulburn, Broken & Ovens	Reputational	Environmental water deliveries result in low DO levels, with adverse environmental impacts.	Low	<ul style="list-style-type: none"> • Communicate benefits of environmental water management to the broader community and engage with recreational user peak bodies and management agencies. • 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. 	Low

				- Inform communities of black water vs hypoxic black water issues, to build understanding and support	
Murray, Goulburn, Broken & Ovens	Environment	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.	Medium	<ul style="list-style-type: none"> • Consider likelihood of initiating BGA blooms in event planning and amend as required to manage risk, including investigation alternate delivery paths - e.g. lower outlets/offtakes, or non-delivery (e.g. as per 2022 for lower Broken creek) • Land managers or water corporation implement a risk-based monitoring program during environmental watering events, and where issues are identified, activate BGA response processes. <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 considering as part of this plan.</i></p> <ul style="list-style-type: none"> • Regional monitoring and advice on BGA status. 	Low
Murray, Goulburn, Broken & Ovens	Reputational	Environmental water management activities may conflict with or not complement water based recreational objectives, leading to loss of community support for activities. Highest risk at Goulburn River (for river/creek sites) - rated accordingly.	High	<ul style="list-style-type: none"> • Communicate benefits of environmental water management to the broader community and engage with recreational user peak bodies. • Engage with local recreational user groups to inform them of environmental water management activities and the underlying rationale. • Adjust events or actions to reduce/avoid impact where practical without reducing environmental outcomes. • Communicate alternate recreational opportunities. • Enhance community understanding of water system operations and entitlement frameworks (water literacy). <p>- Implement earlier planning of events to provide more time for partners to consider and flag any potential issues for include in event plans</p>	Low

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Murray, Goulburn, Broken & Ovens	Business Costs	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.	Medium	<ul style="list-style-type: none"> • Partners notify the CMA and VEWH of resource constraints in advance of deliveries and VEWH convene OAG meetings to consider implications and potential solutions. • Continue to actively prioritise actions to match available resources and ensure key actions are delivered. • Reallocate tasks and available funds to ensure highest priority watering actions are delivered. 	
Murray, Goulburn, Broken & Ovens	Environment	Insufficient information and knowledge available to inform environmental water deliveries	Low	<ul style="list-style-type: none"> • Identify important knowledge gaps and secure funding to improve scientific understanding. • Consider deferring deliveries until sufficient information is available to mitigate unacceptable risks. • Implement adaptive management processes and undertake trials to collect data. <p><i>- residual risk based on consideration of proposed 24-25 watering actions</i></p>	Low
Murray, Goulburn, Broken & Ovens	Legal	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.	Medium	<ul style="list-style-type: none"> • Undertake desktop reviews and site assessments with archaeologists, traditional owners and land managers, to identify approval needs and contingency measures. • Obtain any necessary formal approvals/permits and implement required actions. - Seek necessary resources to undertake approvals and assessments 	Low
Murray, Goulburn, Broken & Ovens	Cultural heritage	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</i>	Low	<ul style="list-style-type: none"> • Work with Traditional Owners to ensure that the potential impact of environmental water deliveries on cultural heritage is understood and agreed, minimised or avoided. - Consider opportunities for additional resourcing for TO groups to engage in risk assessments - Consider pre-watering site assessments or surveys with TOs 	Low


		<i>and assess, so doesn't really fit within a traditional risk assessment process</i>			
Murray, Goulburn, Broken & Ovens	Reputational	Inability to demonstrate outcomes achieved through environmental watering activities may lead to a loss of public/political support for activities	Medium	<ul style="list-style-type: none"> • Rationalise and refocus current monitoring programs (e.g. Wetmap) to better identifying outcomes. • Seek additional funds to address gaps in monitoring programs and knowledge. • Communicate the benefits of environmental watering and monitoring results <p>(Note: It may not be possible/affordable to address all monitoring gaps, so this risk may still be rated as medium after mitigation actions.)</p> <p><i>Residual risk for 24-25 reflects recent high flows experience - some community nervousness, general acceptance of ewater benefits</i></p>	Low
Murray, Goulburn, Broken & Ovens	Environment	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. Particular issue in Goulburn River (risks of carp migration into system has impacted flows proceeding - likely to happen regardless), but applicable to all river systems.	Medium	<ul style="list-style-type: none"> • Study/understand life history of species and develop high level management strategies. • 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). - Implement pest reduction efforts prior to delivery of water, to ensure increases in populations remain within "tolerable" levels, e.g. consider adjusting timing and magnitude of flows, and check in with fish ecologists <p><i>(Note: Residual risk based on 2024-25 conditions - as a result of widespread natural flooding, incremental impact of e-water on pest species breeding is reduced)</i></p>	Low
Murray, Goulburn, Broken & Ovens	Environment	Environmental watering actions trigger non-targeted environmental responses (e.g. bird breeding) causing unintended consequences (or lost opportunities) for other environmental values. Can't think of likely examples for rivers/creeks: Risk only relevant to wetlands sites - residual risk	Medium	<ul style="list-style-type: none"> • Undertake monitoring and communicate these issues as they arise and apply adaptive management and review of delivery plans. • Consider including contingency allowance in delivery plan water volumes to complete breeding events. 	Low

		rating to be assessed at Delivery Plan phase. For 24-25, wetlands that are high from natural inflows may need top up flows to support bird breeding if initiated, resulting in changes to e-water plans			
Murray, Goulburn, Broken & Ovens	Environment	Ineffective planning and/or uncoordinated water ordering results in administrative obstacles that prevent watering opportunities.	Low	<ul style="list-style-type: none"> • Enable the full range of watering actions possible in seasonal watering proposals and the seasonal watering plan (as per SWP guidelines) - Review and update the Murray system environmental watering ordering template 	Low
Murray, Goulburn, Broken & Ovens	Business Costs	River operators release water for flood mitigation which causes downstream flooding and debits those releases to environmental water accounts <i>*Note that debits of releases to environmental accounts is specific to Lake Hume and pre-releases from other storages could not be debited to environmental accounts</i>	Low	<ul style="list-style-type: none"> • Resolve appropriate water accounting treatment as part of the development of the Enhanced Environmental Water Deliveries SDL Adjustment Measures project (aka Hydrocues project) • Refer to MDBA Environmental Water Management Group for development of suitable accounting arrangements. - residual risk assessment based on consideration of likely 24-25 water availability and value 	Low
Murray, Goulburn, Broken & Ovens	Reputational	River operators release water for flood mitigation which causes downstream flooding and public perceive the releases are for environmental purposes.	Low	<ul style="list-style-type: none"> • River operators to clearly communicate to customers and the broader community when large releases are for operational purposes 	Low
Murray, Goulburn, Broken & Ovens	Reputational	Sections of the community perceives (incorrectly) that high river flows are due to environmental releases in dry conditions, leading to a loss of support for watering activities.	Medium	<ul style="list-style-type: none"> • Communications to inform the community on the drivers/reasons for high flows in river systems, especially under dry scenarios - residual risk based on 24-25 conditions 	Low
Murray, Goulburn, Broken & Ovens	Reputational	Community concern over environmental releases under dry seasonal conditions may lead to a loss of support for environmental watering actions.	Low	<ul style="list-style-type: none"> • Communicate benefits of environmental watering to the community, especially in relation to strategic watering in dry periods. • Enhance community understanding of water system operations and entitlement frameworks (water literacy). 	Low

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Murray, Goulburn, Broken & Ovens	Reputational	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 24-25 due to high consumptive avail.	Medium	<ul style="list-style-type: none"> • Communications to inform the community on the limits of environmental water holdings and the extent of actions possible under dry conditions. <p><i>Note that public concern in this regard may be heightened as a result of the Menindee 2019 fish death events.</i></p> <p>- residual risk based on 24-25 conditions</p>	Low
Murray, Goulburn, Broken & Ovens	Environment	Limited environmental deliveries may reduce opportunities to test ecological responses to environmental flows, impacting on effectiveness of research projects.	Low	<ul style="list-style-type: none"> • Review monitoring program and adjust if possible. Reprioritise future flow targets. 	Low
Murray, Goulburn, Broken & Ovens	Safety	Environmental releases create rapid or unexpected changes in flow conditions, resulting in injury to river users	Low	<ul style="list-style-type: none"> • Include consideration of ramp-ups and ramp-down phases in release plans to reduce rapid water level changes. • Appropriate notification actions to alert general river users, especially for high use sites and high use periods. • Provide information on proposed changes to PV for inclusion in Change of Conditions Section of their website • Implement communications plan about environmental water releases <p>- Undertake notifications to water users with assets potentially at risk due to changing river levels</p>	Low

10 APPROVAL, ENDORSEMENT AND CONSENT

WATERWAY MANAGER APPROVAL OF THE SEASONAL WATERING PROPOSAL	
<p>I, the authorised representative of the agency shown below, approve the Seasonal Watering Proposal for the Lower Broken Creek in 2024-25.</p> <p>SIGNED FOR AND ON BEHALF OF GOULBURN BROKEN CATCHMENT MANAGEMENT AUTHORITY</p> <p>Signature of authorised representative: </p> <p>Name of authorised representative: Chris Cumming</p> <p>Position of authorised representative: CEO</p> <p>Date: 19/04/2024</p>	

ENDORSEMENT OF THE SEASONAL WATERING PROPOSAL				
I, the authorised representative of the agency shown below, approve the Seasonal Watering Proposal for the Lower Broken Creek in 2024-25.				
Role	Endorsing partner	Representative Role	Status Date	Notes/Comments
Water Corporation	Goulburn-Murray Water	Andrew Shields River Operations Manager	<input checked="" type="checkbox"/> Endorsed. Date: 08/04/2024	NA
Land Manager	Parks Victoria	Kane Weeks Regional Director – Northern Victoria	<input checked="" type="checkbox"/> Endorsed. Date: 17/04/2024	NA
Traditional Owner	Yorta Yorta Nation Aboriginal Corporation	Jay Whittaker Whole of Country Manager	<input checked="" type="checkbox"/> Endorsed. Date: 16/04/2024	NA

CONSENT TO USE OF CONTENT						
Role	Endorsing partner	Delegate Role	Content	For use in the		Notes
				Seasonal Watering Proposal	Seasonal Watering Plan	
Traditional Owner	Yorta Yorta Nation Aboriginal Corporation	First name Surname Title	Chapter 3	<input checked="" type="checkbox"/> Consent provided. Date:16/04/2024	<input checked="" type="checkbox"/> Consent provided. Date: 16/04/2024	NA

11 REFERENCES

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2. Jacobs (2019). Lower Broken Creek FLOWS study. Issues and Flows Recommendations Paper, report to the Goulburn Broken CMA. March 2019.
3. Jones, M. J., O'Connor, J. P. and Moloney, P. (2017). Lower Broken Creek Fish Population Survey, Arthur Rylah Institute for Environmental Research, unpublished client report, 47p.
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5. Peter Cottingham & Associates and SKM (2011). Environmental Water Delivery: Lower Broken Creek, prepared for Commonwealth Environmental Water, Department of Sustainability, Environment, Water, Population and Communities, Canberra.
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12 APPENDICES

Map of lower Broken Creek and Nine Mile Creek showing delineated reaches

