



Australian Government

Commonwealth Environmental Water Office

Commonwealth Environmental Water

Portfolio Management Plan

Murrumbidgee River

2017–18



Front cover image credit: Baby Murray River turtles at Two Bridges Swamp. Photo by Joanne Ocock, NSW Office of Environment and Heritage.

Back cover image credit: Grey falcons at Balranald. Photo by Peter Morton.

The Commonwealth Environmental Water Office respectfully acknowledges the traditional owners, their Elders past and present, their Nations of the Murray-Darling Basin, and their cultural, social, environmental, spiritual and economic connection to their lands and waters.

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Commonwealth environmental water portfolio management planning

Commonwealth Environmental Water Holder

The Commonwealth Environmental Water Holder is a statutory position established under the *Water Act 2007* and is responsible for managing the Commonwealth's environmental water holdings. This water must be managed to protect and restore the rivers, wetlands and floodplains (and the native animals and plants they support) of the Murray-Darling Basin. Mr David Papps is the current Commonwealth Environmental Water Holder. He is supported by staff of the Commonwealth Environmental Water Office. The Office employs six local engagement officers who live and work in regional centres across the Murray-Darling Basin.

Commonwealth environmental water

Commonwealth environmental water holdings are water entitlements that have been acquired by the Australian Government through investments in water-saving infrastructure and purchases on the water market. The holdings are a mix of entitlement types held across 19 catchments. The rules governing the entitlements vary across states and across catchments. Commonwealth environmental water entitlements are subject to the same fees, allocations, carryover and other rules as equivalent entitlements held by other water users.

There are broadly three options for managing Commonwealth environmental water:

- delivering water to a river or wetland to meet an identified environmental demand
- carrying water over for use in the next water year (referred to as 'carryover')
- trading water, that is, selling water and using the proceeds to buy water in another catchment or in a future year, or investing in complementary 'environmental activities'.

Purpose of the document

This document sets out the plans for managing the Commonwealth environmental water portfolio in the Murrumbidgee catchment for 2017–18. Efficient and effective management of Commonwealth environmental water requires the utilisation of all portfolio management options. By taking a multi-year approach to planning, portfolio management tools such as use, carryover and trade can be managed for maximising environmental outcomes.

The portfolio management plans support transparent, coordinated and adaptive management of Commonwealth environmental water, consistent with the Basin-wide environmental watering strategy and having regard to the Basin annual environmental watering priorities.

To learn more about the planning approach see *Portfolio Management Planning: Approach to planning for the use, carryover and trade of Commonwealth environmental water, 2017–18* (available at: <http://www.environment.gov.au/water/cewo/publications> under 'Planning approach').

Delivery partners

Commonwealth environmental water is managed in conjunction with and delivered by a range of partners. This portfolio management plan has been developed in consultation with our delivery partners, including New South Wales Office of Environment and Heritage, Department of Primary Industries – Water, and Water NSW.

Your input

The management of Commonwealth environmental water relies on considerable advice and assistance from local organisations, state governments and others. Individuals and groups within the Murray-Darling Basin community are encouraged to submit suggestions for the management of Commonwealth environmental water. Please contact the Office via: ewater@environment.gov.au.

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1. Environmental watering in the Murrumbidgee catchment

1.1. The Murrumbidgee catchment

The Murrumbidgee catchment covers 84 000 square kilometres of southern New South Wales. It is bordered by the Great Dividing Range to the east, the Lachlan Catchment to the north and the Murray Catchment to the south (Green et al 2011). The river originates in the alpine area of Kosciuszko National Park and flows through the Monaro High Plains and the low-lying plains of the western Riverina, joining the River Murray south of Balranald.

Supporting a complex range of natural ecosystems, the Murrumbidgee catchment contains many significant in-channel and wetland habitats including the mid-Murrumbidgee and Lowbidgee wetlands, which provide important habitat for a range of aquatic and terrestrial species including frogs, fish and waterbirds.

The primary users of water in the region are the two major irrigation districts in the catchment—Murrumbidgee and Coleambally Irrigation Areas. Irrigation also occurs around Hay and Balranald in the west and in eastern parts of the catchment, including around Wagga Wagga.

Regulated water is provided by two major headwater storages, Burrinjuck Dam on the Murrumbidgee River and Blowering Dam on the Tumut River. Collectively these storages have a capacity of 2654 GL.

Most of the flow in the Murrumbidgee River comes from the upper portion of the catchment, and is delivered by the main tributary rivers: Cotter, Yass, Molonglo, Queanbeyan, Bredbo, Numeralla, Goodradigbee and Tumut (Kingsford & Thomas 2001). Several tributaries located immediately downstream of the dams contribute significant inflows, including Adelong, Adjungbilly, Gilmore, Hillas, Tarcutta, Kyeamba, Jugiong, Muttama, Billabong and Houlaghans Creeks, and Goobarragandra River (Sinclair Knight Merz 2011). The middle and lower portions of the catchment do not contribute significant inflows.

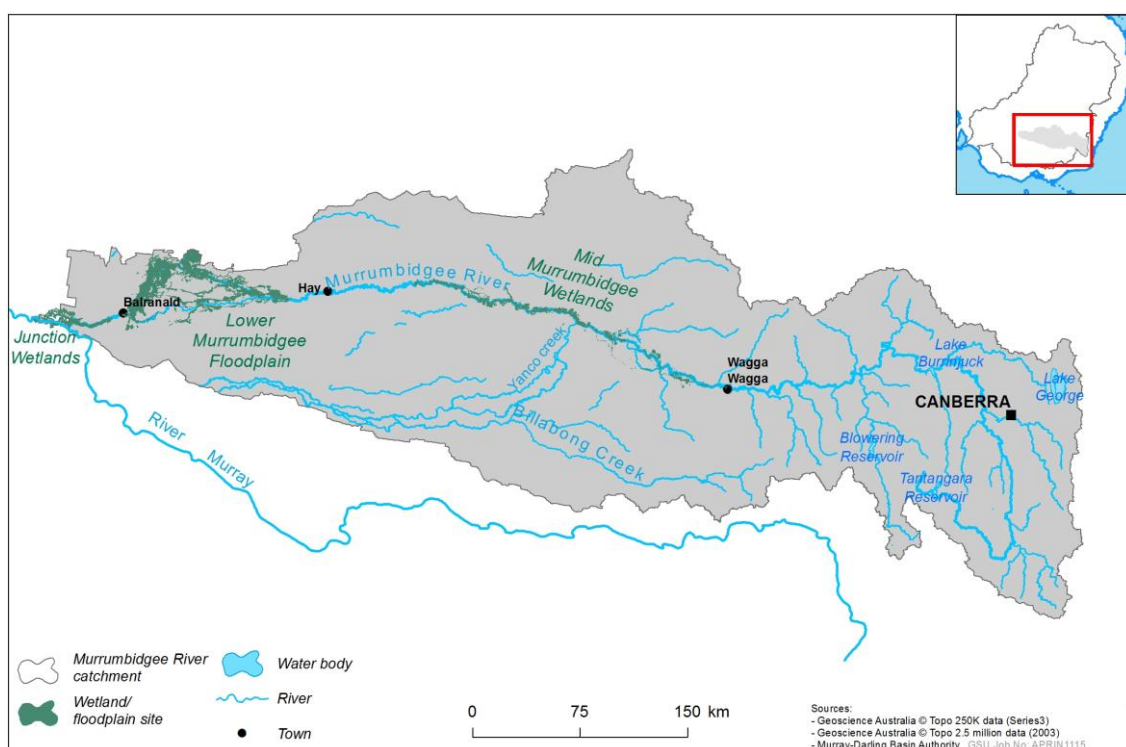


Figure 1: Map of the Murrumbidgee catchment (courtesy of the Murray-Darling Basin Authority).

1.2. Environmental objectives in the Murrumbidgee catchment

The long-term environmental objectives for the Murray-Darling Basin are described in the Basin Plan's environmental watering plan and the Basin-wide environmental watering strategy, which includes 'quantified environmental expected outcomes' at both Basin-scale and for each catchment. The expected outcomes relevant for the Murrumbidgee catchment are described in [Attachment A](#).

Basin state governments are also developing long-term watering plans for each catchment. These plans will identify the priority environmental assets and ecosystem functions in the catchment, the objectives and targets for these assets and functions, and their watering requirements. Once developed, these plans will provide the key information on the long-term environmental water demands in the catchment. Prior to the development of long-term watering plans, the Office will continue to draw on existing documentation on environmental water demands developed by state governments, local natural resource management agencies and the Murray-Darling Basin Authority.

Based on these strategies and plans, and in response to best available knowledge drawing on the results of environmental watering monitoring program, the objectives for environmental watering in the Murrumbidgee catchment are summarised in Table 1 below. The objectives for water-dependent ecosystems will continue to be revised as part of the Commonwealth Environmental Water Office's commitment to adaptive management.

Table 1: Summary of objectives being targeted by environmental watering in the Murrumbidgee catchment

BASIN-WIDE OUTCOMES (Outcomes in red link to the Basin-wide Environmental Watering Strategy)	OBJECTIVES FOR MURRUMBIDGEE ASSETS				
	IN-CHANNEL ASSETS	OFF-CHANNEL ASSETS			
	Murrumbidgee River channel	Yanco Creek system	Mid-Murrumbidgee Wetlands	Lowbidgee Floodplain Wetlands	Junction Wetlands
VEGETATION	Maintain and improve riparian and in-channel vegetation condition	Maintain and improve condition of wetland vegetation	Avoid further damage and to assist ecological capacity to recover	Maintain, improve and in some cases promote the recovery of wetland and floodplain vegetation diversity and condition	Avoid further damage and to assist ecological capacity to recover
WATERBIRDS		Provide habitat, including foraging habitat, to support survival and maintain the condition of waterbirds			
		Provide opportunities for waterbird breeding and support naturally triggered colonial bird breeding events that are in danger of failing due to drying.			
FISH	Provide flows, including restoring natural flow events that are affected by river regulation and/or extraction, to support habitat and food sources and promote increased movement, recruitment and survival of native fish.	Provide flows to support habitat and cues for increased movement, recruitment and survival of native fish (particularly for floodplain specialists).			
INVERTEBRATES	Provide habitat to support increased microinvertebrate and invertebrate survival, diversity, abundance and condition.				
OTHER VERTEBRATES	Provide habitat to support survival and maintain and improve the condition of frogs and turtles.				

BASIN-WIDE OUTCOMES (Outcomes in red link to the Basin-wide Environmental Watering Strategy)	OBJECTIVES FOR MURRUMBIDGEE ASSETS				
	IN-CHANNEL ASSETS	OFF-CHANNEL ASSETS			
	Murrumbidgee River channel	Yanco Creek system	Mid-Murrumbidgee Wetlands	Lowbidgee Floodplain Wetlands	Junction Wetlands
CONNECTIVITY	Support longitudinal connectivity along the Murrumbidgee River, including end of system flows. Support lateral connectivity (within constraints) to wetlands and floodplains	Support lateral connectivity (within constraints) between the river channel and wetlands and floodplains			
PROCESSES	Support primary productivity, nutrient and carbon cycling, biotic dispersal and movement				
WATER QUALITY	Provide refuge habitat from adverse water quality events (e.g. hypoxic blackwater)	Support water quality in off-channel assets in terms of Dissolved Oxygen (DO) and salinity Support transport of salt and nutrients off the floodplain into the river channel and downstream.			
RESILIENCE		Provide drought refuge habitat			

Information sourced from: Charles Sturt University (2014); CEWO (2015); MDBA (2012a, b, c, 2014); DPI (2014); Roberts and Marston (2011) and Sinclair Knight Merz (2011).

1.3. Environmental flow requirements

Not all environmental demands can and will be met through the use of held environmental water. Some demands are met by regulated water deliveries for consumptive purposes and inter-valley transfers, while others are met by large unregulated/natural flow events or are beyond what can be delivered within operational constraints.

Figure 2 shows the broad environmental demands that are in scope for Commonwealth environmental water. Importantly, these are broad, indicative demands and individual watering events may contribute to particular opportunities, such as using infrastructure to deliver water to individual wetlands that would otherwise not be possible due to constraints. Also, there may be opportunities for Basin State governments to remove or modify constraints, which will improve the efficiency and/or effectiveness of environmental watering. Further information on delivery constraints are described in [Attachment B](#).

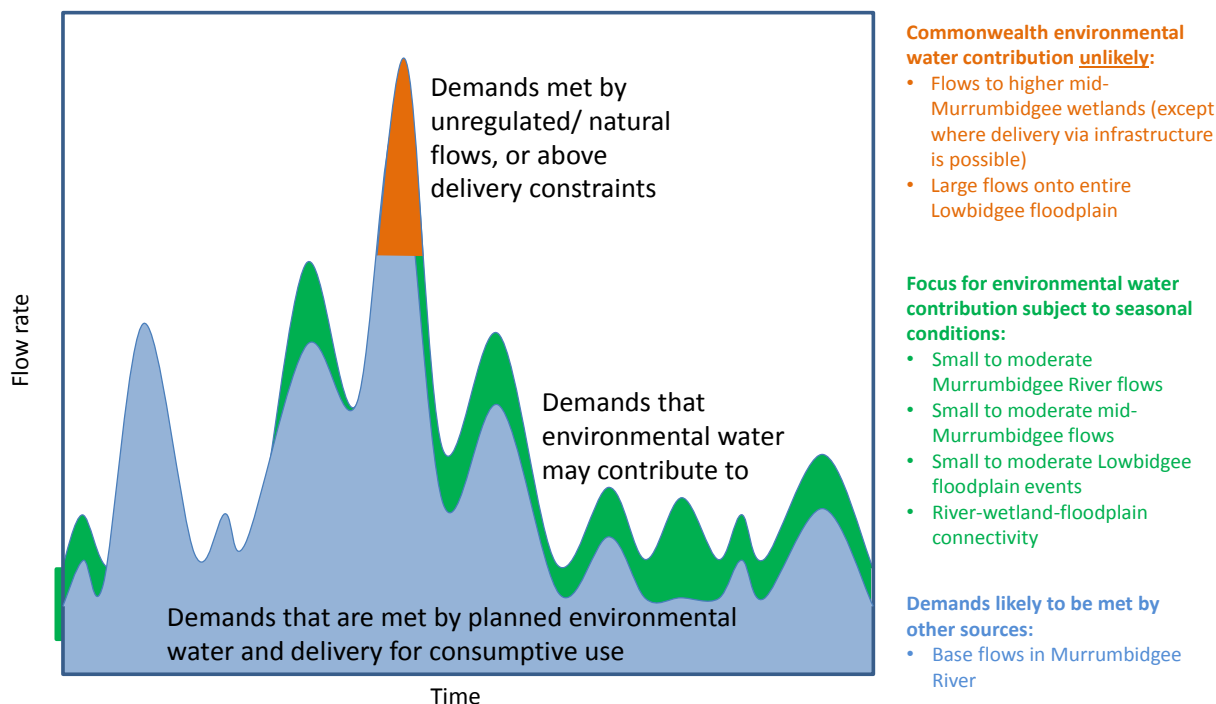


Figure 2: Scope of demands that environmental water may contribute to in the Murrumbidgee catchment

Based on the above objectives sought and delivery constraints, specific watering requirements (flow magnitude, duration, timing and frequency) have been identified as being in scope for Commonwealth environmental water. These water requirements are described in Table 3. As with the objectives, the environmental water requirements will continue to be reviewed and revised in response to new knowledge.

1.4. Monitoring and adaptive management

Operational monitoring is undertaken for all Commonwealth environmental watering actions and involves collecting on-ground data with regard to environmental water delivery such as volumes delivered, impact on the river system's hydrograph, area of inundation and river levels. It can also include observations of environmental outcomes.

Intervention monitoring is also being undertaken at sites in the mid-Murrumbidgee Wetlands, Lowbidgee Floodplain and Murrumbidgee River. It aims to understand the environmental response from Commonwealth environmental watering with respect to the targeted objectives.

Information on the monitoring activities is available at <http://www.environment.gov.au/water/cewo/catchment/murrumbidgee/monitoring>. Monitoring information is also provided by state governments.

Key findings and recommendations from the first two years (2014–16) of Long-term monitoring in the Murrumbidgee catchment (Wassens et al 2015, 2016) include:

- The delivery of environmental flows to wetland assets can, in transit, have a positive influence on in-channel outcomes. Monitoring has detected the spawning of eight species of native fish in the Murrumbidgee River including golden perch, silver perch (EPBC Act critically endangered) and Murray cod (EPBC Act vulnerable), and capture of young of year Murray cod and golden perch.
- Commonwealth environmental water has improved habitat and breeding success for a range of waterbird species (little pied cormorants, little black cormorants, great cormorant, Australasian darters, Eastern great egrets (EPBC Act migratory), royal spoonbills, straw-necked and Australian white ibis (EPBC Act marine) and nankeen night herons) across the catchment. Flows that provide seasonal foraging habitat for migratory shorebirds (unvegetated muddy shorelines and open shallow lagoons and lakes) in spring (August–November) should be targeted.

- Adult, tadpole and juvenile southern bell frogs (EPBC Act vulnerable) have been detected across the Lowbidgee and mid-Murrumbidgee wetlands. This includes the first record of southern bell frogs breeding in the mid-Murrumbidgee wetlands in 40 years and the first recording in Yanga National Park in many years. It is recommended environmental water continue to support critical habitat refuge.
- Repeat seasonal watering of degraded wetland sites may be required. Yarradda Lagoon, in the mid-Murrumbidgee zone, has experienced a steady increase in species diversity and percentage cover with repeated environmental watering. Future watering actions should occur in late winter-spring, which is the ideal time to support aquatic plant communities.
- Following colonial water bird breeding events in the Lowbidgee floodplain and neighbouring wetlands (i.e. Lower Lachlan and mid-Murray), Commonwealth environmental water should be prioritised for delivery to key foraging areas in the months and water year following breeding to promote survival of first year birds.

The outcomes from these monitoring activities are used to inform portfolio management planning and adaptive management decision-making as outlined in Section 2.

2. Portfolio management in 2017–18

In planning for the management of Commonwealth environmental water, the Commonwealth Environmental Water Office aims to maximise the outcomes achieved from the available water. This includes consideration of the urgency of demands (based on targeted objectives and watering requirements, watering history and asset condition) and the available supply under different resource scenarios. Plans for water delivery, trade and carryover are then made in a multi-year context, with an assessment also undertaken of need for water in future years.

This planning process is outlined in full in Table 3 below and summarised in the sections below.

2.1. Antecedent and current catchment conditions and the demand for environmental water in 2017–18

In 2016 the Murrumbidgee catchment experienced high winter rainfall resulting in widespread natural flooding along the Murrumbidgee system in winter, spring and summer.

The natural flooding resulted in widespread wetland/floodplain inundation with associated positive vegetation and waterbird response. Commonwealth environmental water (together with NSW environmental water) successfully provided flows to support largescale waterbird breeding events (including straw-necked ibis, Australian white ibis, eastern great egret, royal spoonbill, pelicans and numerous cormorant rookeries). Floodplain inundation also resulted in a hypoxic blackwater event, as overbank flows returned high carbon loads back to the river in the lower Murrumbidgee. Commonwealth, NSW and TLM environmental water provided refuge habitat for native fish and other aquatic fauna and reduced the severity and duration of the hypoxic blackwater event in the Lower Murrumbidgee River.

Environmental water demands for environmental assets in the Murrumbidgee catchment in 2017–18 are represented in Table 3 and summarised below:

Mid-Murrumbidgee wetlands: High demand. The mid-Murrumbidgee River Wetlands are key environmental asset within the Basin. The condition of the mid-Murrumbidgee wetlands is generally poor due to a lack of inundation. Natural flooding in September-October 2016 inundated many wetland assets, some for the first time in over four years.

Environmental water is required this year to reconnect low level wetlands with the main channel to continue the recent improvements in wetland vegetation condition; provide habitat for waterbirds, fish, turtles and frogs; and allow for movement and dispersal of aquatic animals.

Monitoring of ecological response at Yarradda Lagoon demonstrates the capacity for these assets to recover following repeat years of seasonal inundation.

Despite widespread natural flooding in 2016–17 the mid-Murrumbidgee wetlands and Lowbidgee floodplain water requirements are currently out of phase. In future, following successful inundation and improvements in condition of the mid-Murrumbidgee wetlands, and constraints being management, it is anticipated environmental demand for these assets will be more closely aligned allowing a more whole of system watering strategy.

Yanco Creek system: Moderate demand. In-channel environmental water deliveries will contribute to recovery after the hypoxic blackwater event of 2016–17. Wetland vegetation is generally in good condition, with inundation required this year or next to maintain this condition.

Lowbidgee floodplain wetlands: Generally in moderate condition; environmental demand in 2017-18 at a system scale is driven by natural cues. Natural flooding inundated large areas of the Lowbidgee Floodplain in spring-summer 2016 with positive outcomes for vegetation, waterbirds, wetland fish, frogs and turtles. Environmental water use in recent years has improved the condition and resilience of water dependent vegetation in many wetlands across the Lowbidgee allowing them to respond to natural flood events.

Under a drier inflow scenario, the will focus will be to maintain core refuge sites (a key recommendation from LTIM reporting (Wassens et al 2016)). Under moderate and wetter conditions, the aim is to continue to maintain and build resilience to wetland sites in the Redbank (including Yanga National Park), Nimmie-Caira, Fiddlers-Uara and Western Lakes management areas.

Murrumbidgee River Channel, distributaries and anabranches: Moderate demand overall; the condition of the native fish population in the lower Murrumbidgee River is poor. A large scale hypoxic blackwater event in spring and summer 2016 resulted in some fish deaths in the lower reaches of the Murrumbidgee system. Environmental water deliveries may focus on native fish condition and recruitment through improvements to fish passage and connectivity, aquatic habitat and riverine productivity.

Under very low or very high inflow scenarios Commonwealth environmental water may contribute to aquatic habitat refuge.

Junction Wetlands: High demand. Despite early environmental watering, followed by widespread natural flooding in 2016–17 the condition of the Junction Wetlands remains very poor due to a lack of repeated inundation. Any opportunity for inundation will help consolidate responses from watering in 2016–17.

Murray-Darling Basin-wide environmental watering strategy and 2017–18 annual priorities

In contributing to these demands, the Commonwealth Environmental Water Office will also be aiming to contribute to the expected outcomes in the Basin-wide environmental watering strategy (see [Attachment A](#)) and the following 2017–18 Basin annual environmental watering priorities relevant to the Murrumbidgee River Region.

- Support Basin-scale population recovery of native fish by reinstating flows that promote key ecological processes across local, regional and system scales for the southern connected Basin.
- Support viable populations of threatened native fish and maximise opportunities for range expansion and the establishment of new populations.
- Improve the abundance and diversity of the Basin's waterbird population.
- Enable recruitment of trees and support growth of understorey species within river red gum, black box and coolibah communities on floodplains that received overbank flooding during 2016 by inundating the floodplains again.

The Commonwealth Environmental Water Holder will not inundate private land without prior approval from land holders while contributing to the Basin annual environmental watering priorities.

2.2. Water availability in 2017–18

Forecasts of Commonwealth water allocations

The volume of Commonwealth environmental water likely to be carried over in the Murrumbidgee catchment for use in 2017–18 is estimated to be 83.6 GL. Total carryover in the southern-connected Basin is estimated to be 264.2 GL.

Allocations against Commonwealth water entitlements in the Murrumbidgee catchment are determined by the NSW government and will vary depending on inflows. The following forecasts in Table 2 are based on the best available information including State forecasts and historical inflow scenarios.

Table 2: Forecasts of Commonwealth water allocations (including carryover) in 2017-18 in the Murrumbidgee River Valley as at 31 May 2017

Entitlement type	Forecasts of Commonwealth water allocations (including carryover) in 2017-18 (GL) ²					
	Very dry ←					Very wet →
	95 percentile	90 percentile	75 percentile	50 percentile	25 percentile	10 percentile
Murrumbidgee (general/high security and conveyance)	146	192	263	302	303	303
Murrumbidgee (supplementary) ³	Nil	Up to 5	Up to 10	10 – 20	Up to 21.9	~ 21.9
Lowbidgee (supplementary) ³	Nil	Up to 50	50 – 100	> 100	Up to 393	~ 393
Total – Southern-Connected Basin^{1,4}	861	1273	1376	1614	1577	1526

Notes:

1. The southern-connected Basin includes the Murrumbidgee, Murray, Lower Darling, Goulburn, Campaspe (excluding Coliban) and Loddon entitlements.
2. Forecasts for regulated catchments are given to the nearest whole gigalitre except where the entitlement held by the Commonwealth is below 1 GL.
3. Forecasts for Supplementary Access are indicative estimates only.
4. Total forecast water available in the southern-connected Basin assumes that in Victoria 100 per cent of water held in spillable accounts becomes available under a median or dry scenario and 50 per cent or less becomes available under wetter scenarios. These figures do not include supplementary, unregulated or ground water accruals in the southern-connected Basin.

Information on allocations to Commonwealth environmental water holdings can be found at <http://www.environment.gov.au/water/cewo/about/water-holdings> and is updated monthly.

Water resource availability scenarios

Commonwealth environmental water is not managed in isolation. When considering the available resource to meet environmental demands, it is necessary to also factor in the resources managed by other entities and available to contribute to environmental objectives. Relevant resources include held environmental water managed by state government agencies, planned environmental water including account based and unregulated flows, conveyance water and consumptive water. Further detail on sources of environmental water in the Murrumbidgee catchment is provided in Attachment C.

By combining the forecasts of water held by the Commonwealth with streamflow forecasts, as well as taking into account operational considerations, water resource availability scenarios can be developed ranging from very low to very high. Based on available information, moderate to very high resource availability scenarios are in scope for 2017-18.

2.3. Overall purpose of managing environmental water based on supply and demand

Environmental water needs (demand) and water availability (supply) both influence the overall purpose of Commonwealth environmental water management. Under different combinations, the management purpose can range from 'avoiding damage' to the environment to 'improving' ecological health. This in turn informs the mix of portfolio management options that are suitable for maximising outcomes.

Figure 3 shows how current demands and forecasted supply are considered together.

The overall 'purpose' for managing the Commonwealth's water portfolio in the Murrumbidgee catchment for 2017–18 is to protect the mid-Murrumbidgee wetlands and ensuring their ecological capacity for recovery, while maintaining the ecological health and resilience of other important sites in the catchment. Under wetter conditions, improve will be in scope.

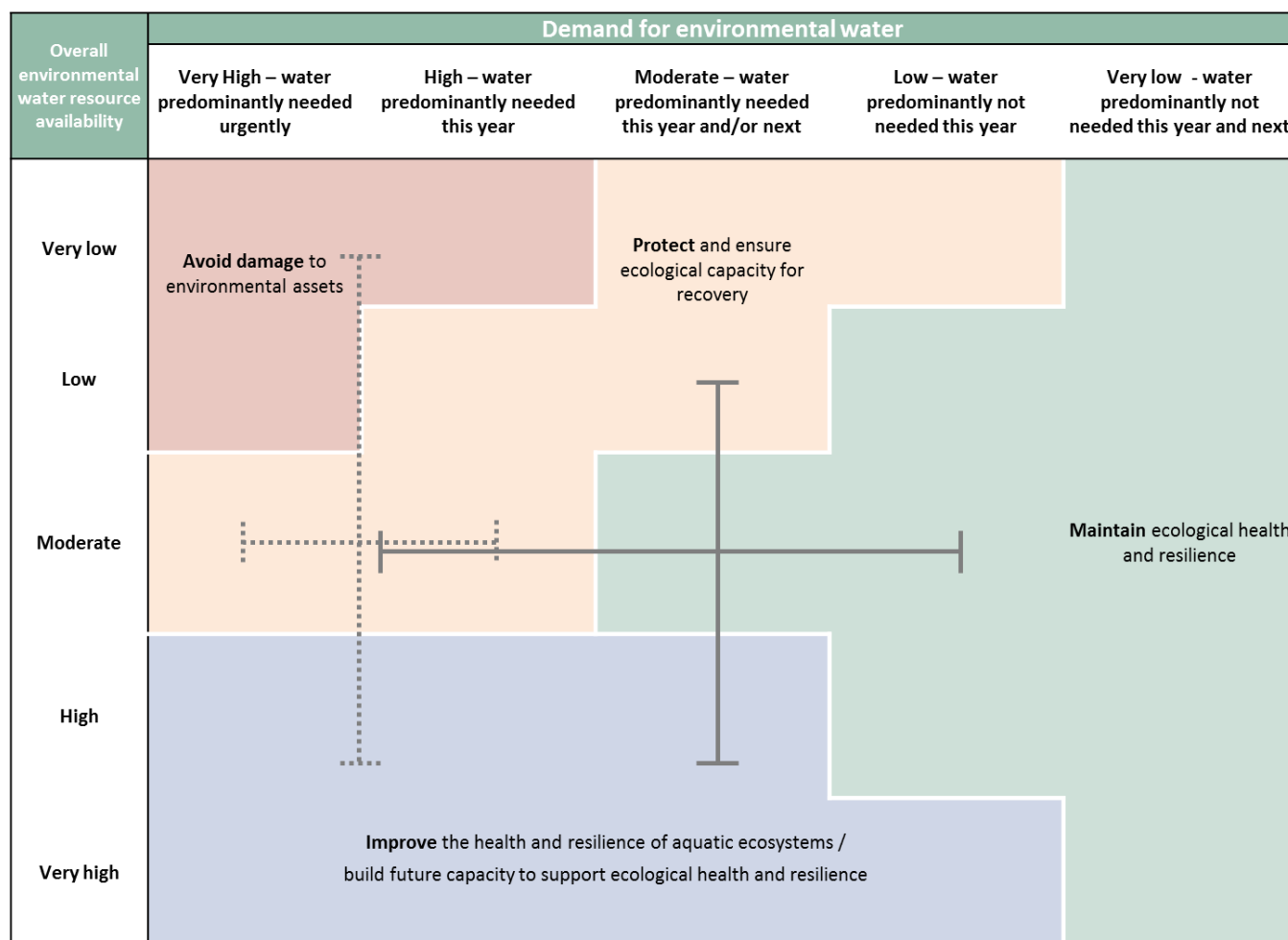


Figure 3: Determining a broad purpose for portfolio management in the Murrumbidgee catchment for 2017–18. Note: dotted lines represent the mid-Murrumbidgee wetlands while unbroken grey lines represent potential range in demand and resource availability for other assets in the catchment for the 2017-18 water year.

Further detail on how the overall purpose for portfolio management changes under different supply and demand scenarios is provided in *Portfolio Management Planning: Approach to planning for the use, carryover and trade of Commonwealth environmental water, 2017–18* (available at: <http://www.environment.gov.au/water/cewo/publications>).

2.4. Water Delivery in 2017–18

Consistent with the demands and purpose described above, the Office is considering supplying environmental water to the following watering actions for 2017–18. In planning watering actions, the Office has prioritised actions that follow natural cues and inflow scenarios to mimic natural inundation of key environmental assets, if these occur. Where key environmental assets are in poor ecological condition, the Office has prioritised actions to these assets if the inflow scenario does not meet the demand – subject to resource availability and other constraints. Refer to Table 3 for supporting information regarding the basis for determining these watering intentions.

A key priority for Commonwealth environmental water is a low level mid-Murrumbidgee wetlands reconnection event. The aim is to contribute to river flows and inundation of fringing wetlands to prevent further damage and loss of wetland vegetation communities, as well as maintain habitat and provide movement opportunities for waterbirds and native aquatic species (including fish, turtles, frogs and invertebrates). The action is subject to water availability, dam release capacities and assessment of potential third party impacts (refer Action 1 in [Attachment B](#) for operational considerations and limitations). The watering action would also contribute to downstream demands, including Yanco Creek, the Lowbidgee Floodplain including the junction wetlands and potentially the lower Murray. Subject to NSW government consideration and support, Commonwealth environmental water used in the Murrumbidgee River may be credited as return flows for further environmental use downstream in the River Murray. Investigations into the feasibility of Murrumbidgee return flows are underway. In the absence of such arrangements, the contribution the Murrumbidgee can make to the outcomes downstream in the Murray is limited except under very wet scenarios (where Lake Victoria is at capacity and the flow at the South Australian border is unregulated). The Office is currently working with NSW agencies to trial return flow arrangements for the mid-Murrumbidgee reconnection event.

If the proposed reconnection action does not occur, Commonwealth environmental water may be pumped to individual high priority wetland assets in the mid-Murrumbidgee. See Action 2 in [Attachment B](#) for standard operational arrangements. It is important to note that it is not operationally feasible to pump to all wetland sites in the mid-Murrumbidgee as these are vast in number.

Commonwealth environmental water will also target environmental assets in the Murrumbidgee River, Yanco Creek and across the Lowbidgee Floodplain including the Junction wetlands to maintain the condition and diversity of wetland vegetation communities, and provide habitat and recruitment opportunities for waterbirds, native fish, turtles and frogs. Timing and scale of these actions will be based on environmental demand and natural cues. Target species include, but are not limited to the southern bell frog (EPBC Act vulnerable), Murray cod (EPBC Act vulnerable), Australasian bittern (EPBC Act critically endangered) and eastern great egret (EPBC Act migratory).

Appropriate follow-up watering to floodplain assets will help to further improve the condition and resilience of assets that have been stressed as a result lack of inundation. Building greater resilience in the system will help assets to maintain condition and function in dry years, and to respond well in wetter years. Providing environmental water in the next year will also help to support the successful recruitment of vegetation, waterbirds, fish and frogs following an increase in growth and reproduction in 2016-17, which will help to improve abundance and diversity in the coming years. Under low water inflow scenarios, Commonwealth environmental water use in the Lowbidgee will target critical refuge habitats (including Waugarah Lagoon, Telephone Creek, Avalon Dam, Nimmie and Talpee Creeks). Critical habitat watering will consider extending flows to connect to permanent refuge lakes to prevent stranding larvae and juvenile native fish on the floodplain. Larger scale wetland and floodplain inundation including river-floodplain connection will be targeted under moderate and wet scenarios and through potential Lowbidgee supplementary access. The scale of watering will be informed by natural cues, subject to water availability. Target sites will include wetland and floodplain assets in North Redbank system, South Redbank (including Yanga National Park), Nimmie-Caira (Eulimbah, Telephone and Suicide floodways and Nap Nap Swamp) and potentially Fiddlers Creek and Western Lakes. See Action 4 in [Attachment B](#) for standard operational arrangements. In addition Commonwealth environmental water will opportunistically target the Junction Wetlands where feasible (Action 9 in Attachment B).

Watering actions that contribute to maintaining waterbird habitat within the Murrumbidgee catchment, and potentially link to waterbird habitat in other parts of the Basin (e.g. across the Macquarie, Lachlan, and Mid-Murray catchments (see [Waterbird breeding & movements](#) (CSIRO, 2016)), may also be targeted under moderate - wetter scenarios.

River-floodplain connectivity in the lower Murrumbidgee may be supported by in-channel flows targeting native fish movement and recruitment and in-channel productivity.

Stakeholder Feedback

Stakeholder feedback from the lower Murrumbidgee has again recommended that the mid-Murrumbidgee connection watering action be a priority for 2017–18. However, stakeholder feedback from some mid-Murrumbidgee areas remain opposed to a mid-Murrumbidgee connection action. The Office will continue working with stakeholders to resolve concerns.

2.5. Trading water in 2017–18

The Water Act 2007 provides for the trade of Commonwealth environmental water allocations and entitlements and specifies the conditions under which sales may occur. To improve environmental outcomes must be the primary reason for trade of Commonwealth Environmental water. The Commonwealth Environmental Water Holder has no plans to trade entitlements in 2017–18.

As part of the portfolio management process, the Commonwealth Environmental Water Office regularly assesses environmental demand and supply throughout the year, considering factors such as environmental condition and demand, current and forecast climate conditions and water availability, carryover capacity and market conditions.

Where the need arises to adjust the availability of allocations in any valley in the southern-connected Basin for environmental use, the transfer of allocations from another southern connected catchment would be explored as the preferred and more efficient option to allocation purchase or sale. The transfer would be undertaken consistent with the rules identified in state water resource plans that apply to all water users. Possible third party impacts from portfolio transfers are considered when trade limits apply.

In 2017-18, possible administrative transfers between environmental water accounts to enable environmental water delivery include:

- large (>100 GL) **within** the Murrumbidgee, due to the large size of environmental watering activities;
- small (~30 GL) **within** the Murrumbidgee;
- small (~30 GL) **into or out of** the Murrumbidgee trade zone 13, if required and allowable given trade limits.

In the southern Basin, water allocation outlook statements are forecasting high allocations early in the season, and opportunities to sell allocation may arise in 2017-18. The issue of whether to sell will be considered once there is greater certainty regarding environmental use during the peak winter-spring demand period, most likely from October 2017 onwards. Should a decision be made to sell allocation, further information will be made available at: <http://www.environment.gov.au/water/cewo/trade/current-trading-actions>.

For more information on the rules and procedures governing the trade of Commonwealth environmental water, refer to the *Commonwealth environmental water Trading Framework* at: <http://www.environment.gov.au/water/cewo/publications/water-trading-framework-dec2014>.

2.6. Carrying over water for use in 2018–19

The volume of water carried over for use in 2018–19 will depend upon resource availability and demand throughout the year. A minimum carryover target of 50 GL is being reserved to meet early season water requirements and as a risk management strategy should low inflows result in low allocations. As documented in Table 3 below, potential demands in 2018–19 include:

- winter-spring watering of the mid-Murrumbidgee wetlands
- Lowbidgee Floodplain and Junction Wetlands watering actions
- restoring ecologically significant flow components impacted by river regulation to support native fish.

This volume is also reserved as a contingency volume for use in 2018–19 should there be insufficient allocations available and there is a critical need for environmental water (e.g. hypoxic blackwater or waterbird breeding event).

Carryover volumes will be adjusted throughout the year as the season unfolds in response to both current and future demands and the water available to meet these demands. These decisions will be based upon best information available at the time.

Given the connected nature of southern Murray-Darling Basin catchments and the varying carryover, account and use limits, carryover is considered at a broader scale than just the Murrumbidgee catchment.

More information on how the Commonwealth makes decisions on carryover is at:
<http://www.environment.gov.au/water/cewo/portfolio-mgt/carryover>

2.7. Identifying Investment Opportunities

Changes to the *Water Act 2007* in 2016 have increased the flexibility for the Commonwealth Environmental Water Holder (CEWH) to use the proceeds of water allocation sales to invest in environmental activities. Under these amendments environmental activities must improve environmental outcomes and be undertaken for the purpose of protecting and restoring environmental assets in the Basin.

The CEWH will publically release a Discussion Paper seeking feedback on what type of activities stakeholders would like the CEWH to consider when developing a framework for future investment in environmental activities.

It should be noted that proceeds of past water sales must be managed based on the legislation in place at that time, and are not available to be used for these activities.

Table 3a: Environmental demands, priority for watering in 2017–18 and outlook for coming years in the Murrumbidgee catchment – VERY LOW to LOW WATER RESOURCE AVAILABILITY/**VERY DRY-DRY INFLOW SCENARIO in 2017–18**

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system) ¹		Watering history			2017-18			Implications for future demands		
			(from all sources of water)			Predominant urgency of environmental demand for water	Purpose under very low to low resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2018–19 if watering occurred as planned in 2017–18	2019-20 Range of likely demand	Met in 2018-19
	Flow/volume	Required frequency (maximum dry interval)	2014–15 (drying)	2015-16 (drying)	2016-17 (wet)						Not met in 2018-19
Mid-Murrumbidgee Wetlands ²	Pumping to individual high priority wetland assets targeting wetland vegetation and maintenance of aquatic refuge habitat	8 in every 10 years - annual (2 years)				HIGH to maintain established aquatic habitat. However overbank connection is preferred	Avoid Damage - Protect	A high potential for water use Up to 15 GL	HIGH	MODERATE - HIGH Particularly for established aquatic habitat refuges	
										HIGH	
	Tombullen storage releases to augment flows over 12 GL/day at Darlington Point	7–8 in every 10 years (2 years)				HIGH. The condition of the mid-Murrumbidgee wetlands is generally poor due to a lack of inundation.	Avoid Damage - Protect	A high potential for water use Up to 10 GL per event	HIGH	MODERATE	
										HIGH	
	Minimum of 15 GL/day @ Darlington Point for 3–5 days plus a gradual recession targeting low-lying wetland vegetation and aquatic habitat	7–8 in every 10 years (2 years)				HIGH. The condition of the mid-Murrumbidgee wetlands is generally poor due to a lack of inundation.	Avoid Damage - Protect	Up to 130 GL planned for winter 2017. Follow-up watering in autumn 2018 subject to available allocations and unlikely under this inflow scenario.	HIGH	HIGH Follow up watering may be warranted due to very poor condition of sites	
										HIGH	
Yanco Creek System	Up to 30 GL, targeting up to 1400 ML/day @ Yanco Creek off-take targeting low-lying wetland vegetation and aquatic habitat and native fish	3 in every 10 years (3 years)				LOW Watering, following natural cues, required to maintain the good condition of wetland-floodplain vegetation	Maintain	Possible supplementary use.	MODERATE, subject to natural cues	LOW-MODERATE	
										MODERATE	
Lowbidgee Core refuge and permanent aquatic habitat sites	Up to 70 GL targeting critical refuge habitat requirements	Annual				HIGH Annual watering required for critical habitat requirements	Protect-Maintain	High Potential only for critical/permanent habitats up to 70 GL	HIGH	HIGH	
										HIGH	

¹ Volumes may be limited by current channel constraints.

¹ Roberts and Marston (2011), Hardwick and Maguire (2012), Alluvium (2013)

² Note: Differences in filling height (i.e. flows required to fill a wetland) vary among the lagoons that make up the mid-Murrumbidgee wetlands, and so their condition and watering requirement vary accordingly.

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system) ³		Watering history			2017-18			Implications for future demands		
			(from all sources of water)			Predominant urgency of environmental demand for water	Purpose under very low to low resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2018–19 if watering occurred as planned in 2017–18	2019-20 Range of likely demand	Met in 2018-19
	2014–15	2015-16	2016-17	Not met in 2018-19							
	Flow/volume	Required frequency (maximum dry interval)	(drying)		(drying)						(wet)
Lowbidgee North Redbank	Up to 60 GL targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds	River red gum forest and spike rush wetlands 1-3 years (3 years)				LOW Watering, following low inflow scenario natural cues, to maintain the good condition of wetland-floodplain vegetation	Maintain	Potential for low level wetland inundation Up to 30 GL	MODERATE, subject to natural cues	MODERATE	
										HIGH	
Lowbidgee Yanga National Park	Up to 60 GL targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds	River red gum forest and spike rush wetlands 1-3 years (3 years)				LOW Watering, following low inflow scenario natural cues, to maintain the good condition of wetland-floodplain vegetation	Maintain	Potential for low level wetland inundation Up to 30 GL	MODERATE, subject to natural cues	MODERATE	
										HIGH	
Lowbidgee Nimmie-Caira	Up to 20 GL targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds	Refuge habitat annual Lignum dominated wetlands 1 to 5 years, with duration of up to 7 months				LOW Watering, following low inflow scenario natural cues, to maintain the good condition of wetland-floodplain vegetation	Maintain	Potential for low level wetland inundation Up to 20 GL	MODERATE, subject to natural cues	MODERATE	
										HIGH	
Lowbidgee Fiddler-Uara	Up to 20 GL targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds	Black box and lignum wetlands every 3 to 7 years				LOW Watering, following low inflow scenario natural cues, to maintain the good condition of wetland-floodplain vegetation	Maintain	Low Potential.	MODERATE, subject to natural cues	LOW	
										MODERATE	
Lowbidgee Western Lakes	Up to 10 GL to maintain open water habitats and floodplain vegetation	Wetland habitats and open water black box and lignum wetlands every 3 to 7 years				LOW Watering, following low inflow scenario natural cues, to maintain the good condition of wetland-floodplain vegetation	Maintain	Low Potential	MODERATE, subject to natural cues	LOW	
										MODERATE	

³ Volumes may be limited by current channel constraints.

³ Roberts and Marston (2011), Hardwick and Maguire (2012), Alluvium (2013)

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system) ⁴		Watering history (from all sources of water)			2017-18			Implications for future demands		
			2014-15	2015-16	2016-17	Predominant urgency of environmental demand for water	Purpose under very low to low resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2018-19 if watering occurred as planned in 2017-18	2019-20 Range of likely demand	Met in 2018-19
	Flow/volume	Required frequency (maximum dry interval)	(drying)	(drying)	(wet)						Not met in 2018-19
Murrumbidgee River channel, distributaries and anabranches	Winter-spring in-channel flows (base flows and freshes) in the Murrumbidgee River targeting critical flow components for native fish spawning, movement and recruitment and in-stream vegetation	7 in every 10 years				LOW Watering, following natural cues, required to continue recovery of native fish populations.	Protect	Low Potential, subject to natural cues	MODERATE, subject to natural cues	LOW	
										MODERATE	
	Moderate in-channel pulse targeting native fish movement and recruitment, productivity and in-stream vegetation (flows >3500 ML/day at Balranald)	7 in every 10 years				HIGH Native fish populations in the lower Murrumbidgee River are in poor condition. Water required for improved fish passage and connectivity, aquatic habitat and riverine productivity	Not Applicable	Option unlikely to be achievable under this resource availability.	MODERATE	MODERATE	
										HIGH	
	Distributary and anabranch freshes to restore flow components most impacted by river regulation and support native fish	7 in every 10 years to annual				LOW Watering, following natural cues, required to continue recovery of native fish populations.	Protect	Moderate potential subject to natural cues up to 10 GL	MODERATE, subject to natural cues	MODERATE	
										MODERATE	
	Contribute to managing water quality issues within in-stream and wetland environments across the Murrumbidgee Catchment	Contingency in response to poor water quality				HIGH Provide refuge habitat for aquatic animals, including potential hypoxic conditions as a result of blue-green algae blooms.	Avoid Damage - Protect	Contingency in response to poor water quality/aquatic habitat availability.	HIGH (Contingency)	HIGH (Contingency)	
										HIGH (Contingency)	

⁴ Volumes may be limited by current channel constraints.

⁴ Roberts and Marston (2011), Hardwick and Maguire (2012), Alluvium (2013)

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system) ⁵		Watering history (from all sources of water)			2017-18			Implications for future demands		
			2014-15	2015-16	2016-17	Predominant urgency of environmental demand for water	Purpose under very low to low resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2018-19 if watering occurred as planned in 2017-18	2019-20 Range of likely demand	Met in 2018-19
	Flow/volume	Required frequency (maximum dry interval)	(drying)	(drying)	(wet)						Not met in 2018-19
Junction Wetlands	Flows greater than 5 GL/day @ d/s Balranald Weir and >10 GL/day @ Murrumbidgee confluence on the Murray targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds	5 in every 10 years				HIGH Limited flows since 2012 have severely compromised the recovery of degraded wetland vegetation and the recruitment of frog and turtles	Not Applicable	Option unlikely to be achievable under this resource availability.	HIGH	HIGH	
										HIGH	
	Flows greater than 7 GL/day @ d/s Balranald Weir targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds	5 in every 10 years				HIGH Limited flows since 2012 have severely compromised the recovery of degraded wetland vegetation and the recruitment of frog and turtles	Not Applicable	Option unlikely to be achievable under this resource availability.	HIGH	HIGH	
										HIGH	
	Pumping to individual high priority wetland assets targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds	7-8 in every 10 years (2 years)				HIGH Limited flows since 2012 have severely compromised the recovery of degraded wetland vegetation and the recruitment of frog and turtles	Avoid Damage - Protect	A high potential for water use Up to 10 GL	HIGH	HIGH	
										HIGH Follow up watering warranted due to very poor condition of sites	

Key - events in previous years

	means demand was met by Commonwealth environmental water or any other source
	means demand was partially met by Commonwealth environmental water or any other source (may be used to indicate infrastructure assisted delivery)
	means water not provided (or not required)

Note that not all demands require water every year; drying phases are important for floodplains and temporary wetlands or streams

Key - potential watering in 2017-18

	means a high priority for Commonwealth environmental watering (full or partial contribution, and subject to seasonal and operational considerations)
	means a secondary priority for Commonwealth environmental watering, likely to be met via other means (other water holders, or natural flows)
	means a low priority for Commonwealth environmental watering

Key - urgency of environmental demands

	means critical demand i.e. urgent need for water in that particular year to manage risk of irretrievable loss or damage
	means high demand for water i.e. needed in that particular year
	means moderate demand for water i.e. water needed that particular year and/or next
	means low demand for water i.e. water generally not needed that particular year
	means very low demand for water i.e. water generally not needed that particular year or the following year

Note that demand is considered at a generalised scale; there may be specific requirements that are more or less urgent within the flow regime

Carryover potential	Low to moderate proportion of allocations expected to be carried into 2018-19 targeting a minimum of 50 GL. Moderate proportion of allocations may be carried over to 2019-20, but will depend on resource availability demands. Level of carryover will depend on environmental demands and resource availability.
Trade potential	Under very low to low resource availability scenarios, small to moderate transfers into or out of the Murrumbidgee may be required for priority environmental use across the southern connected basin. There may be a need to adjust the availability of allocations through trade. The issue of whether to sell allocation will be considered once there is greater certainty regarding environmental water use during the winter-spring period, most likely from October 2017 onwards.

⁵ Volumes may be limited by current channel constraints.

⁵ Roberts and Marston (2011), Hardwick and Maguire (2012), Alluvium (2013)

Table 3b: Environmental demands, priority for watering in 2017–18 and outlook for coming years in the Murrumbidgee catchment –MODERATE WATER RESOURCE AVAILABILITY/MEDIAN INFLOW SCENARIO in 2017–18

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system) ⁶		Watering history (from all sources of water)			2017-18			Implications for future demands		
			2014–15	2015-16	2016-17	Predominant urgency of environmental demand for water	Purpose under medium resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2018–19 if watering occurred as planned in 2017–18	2019-20 Range of likely demand	Met in 2018-19
	Flow/volume	Required frequency (maximum dry interval)	(drying)	(drying)	(wet)						Not met in 2018-19
Mid-Murrumbidgee Wetlands ⁷	Pumping to individual high priority wetland assets targeting wetland vegetation and maintenance of aquatic refuge habitat	8 in every 10 years - annual (2 years)				HIGH However overbank connection is preferred	Avoid Damage - Protect	A high potential for water use should the preferred reconnection not be possible Up to 50 GL	HIGH	MODERATE - HIGH Particularly for established aquatic habitat refuges	
										HIGH	
	Tombullen storage releases to augment flows over 12 GL/day at Darlington Point	7–8 in every 10 years (2 years)				HIGH. The condition of the mid-Murrumbidgee wetlands is generally poor due to a lack of inundation.	Avoid Damage - Protect	A high potential for water use Up to 10 GL per event	HIGH	MODERATE	
										HIGH	
	Minimum of 15.5 GL/day @ Darlington Point for 3–5 days plus a gradual recession targeting low-lying wetland vegetation and aquatic habitat	7–8 in every 10 years (2 years)				HIGH. The condition of the mid-Murrumbidgee wetlands is generally poor due to a lack of inundation.	Avoid Damage - Protect	Up to 130 GL planned for winter 2017. A high potential for follow-up watering in autumn 2018 subject to available allocations. Up to 150 GL	HIGH	HIGH Follow up watering may be warranted due to very poor condition of sites	
										HIGH	
Yanco Creek System	Up to 30 GL, targeting up to 1400 ML/day @ Yanco Creek off-take targeting low-lying wetland vegetation and aquatic habitat and native fish	3 in every 10 years (3 years)				LOW- MODERATE Watering, in response to natural cues, required to maintain condition of wetland vegetation	Maintain	A moderate potential for up to 30 GL including potential supplementary take	MODERATE, subject to natural cues	LOW-MODERATE	
										MODERATE	
Lowbidgee Core refuge and permanent aquatic habitat sites	Up to 70 GL targeting critical refuge habitat requirements	Annual				HIGH Annual watering required for critical habitat requirements	Protect-Maintain	High Potential only for critical/permanent habitats up to 70 GL	HIGH	HIGH	
										HIGH	

⁶ Volumes may be limited by current channel constraints.

⁶ Roberts and Marston (2011), Hardwick and Maguire (2012), Alluvium (2013)

⁷ Note: Differences in filling height (i.e. flows required to fill a wetland) vary among the lagoons that make up the mid-Murrumbidgee wetlands, and so their condition and watering requirement vary accordingly.

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system) ⁸		Watering history			2017-18			Implications for future demands		
			(from all sources of water)			Predominant urgency of environmental demand for water	Purpose under medium resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2018-19 if watering occurred as planned in 2017-18	2019-20 Range of likely demand	Met in 2018-19
	Flow/volume	Required frequency (maximum dry interval)	2014-15 (drying)	2015-16 (drying)	2016-17 (wet)						Not met in 2018-19
Lowbidgee North Redbank	Up to 60 GL targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds	River red gum forest and spike rush wetlands 1-3 years (3 years)				MODERATE Watering, following natural cues, to maintain the good condition of wetland-floodplain vegetation particularly to keep known rookery sites in 'event ready' condition	Maintain	A high potential for water use following natural cues Up to 60 GL	MODERATE, subject to natural cues	MODERATE	
										HIGH	
Lowbidgee Yanga National Park	Up to 60 GL targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds	River red gum forest and spike rush wetlands 1-3 years (3 years)				MODERATE Watering, following natural cues, to maintain the good condition of wetland-floodplain vegetation particularly to keep known rookery sites in 'event ready' condition	Maintain	A high potential for water use following natural cues Up to 40 GL	MODERATE, subject to natural cues	MODERATE	
										HIGH	
Lowbidgee Nimmie-Caira	Up to 20 GL targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds	Refuge habitat annual Lignum dominated wetlands 1 to 5 years, with duration of up to 7 months				MODERATE Watering, following natural cues, to maintain the good condition of wetland-floodplain vegetation, particularly to keep known rookery sites in 'event ready' condition	Maintain	A high potential for water use following natural cues Up to 20 GL	MODERATE, subject to natural cues	MODERATE	
										HIGH	
Lowbidgee Fiddler-Uara	Up to 20 GL targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds	Black box and lignum wetlands every 3 to 7 years				LOW Watering, following natural cues, to maintain the good condition of wetland-floodplain vegetation	Maintain	Low Potential	LOW, subject to natural cues	LOW	
										MODERATE	
Lowbidgee Western Lakes	Up to 10 GL to maintain open water habitats and floodplain vegetation	Wetland habitats and open water black box and lignum wetlands every 3 to 7 years				LOW Watering, following natural cues, to maintain the good condition of wetland-floodplain vegetation	Maintain	Low Potential	LOW, subject to natural cues	LOW	
										MODERATE	

⁸ Volumes may be limited by current channel constraints.

⁸ Roberts and Marston (2011), Hardwick and Maguire (2012), Alluvium (2013)

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system) ⁹		Watering history (from all sources of water)			2017-18			Implications for future demands		
			2014-15	2015-16	2016-17	Predominant urgency of environmental demand for water	Purpose under medium resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2018-19 if watering occurred as planned in 2017-18	2019-20 Range of likely demand	Met in 2018-19
	Flow/volume	Required frequency (maximum dry interval)	(drying)	(drying)	(wet)						Not met in 2018-19
Murrumbidgee River channel, distributaries and anabranches	Winter-spring in-channel flows (base flows and freshes) in the Murrumbidgee River targeting critical flow components for native fish spawning, movement and recruitment and in-stream vegetation	7 in every 10 years				MODERATE Watering, following natural cues, required to continue recovery of native fish populations.	Protect	Low Potential, likely to be achieved by other environmental watering actions and other sources of water	MODERATE, subject to natural cues	LOW	
	Moderate in-channel pulse targeting native fish movement and recruitment, productivity and in-stream vegetation (flows >3500 ML/day at Balranald)	7 in every 10 years				HIGH Native fish populations in the lower Murrumbidgee River are in poor condition. Water required for improved fish passage and connectivity, aquatic habitat and riverine productivity	Protect	A high potential for up to 60 GL targeting fish passage and channel productivity	MODERATE, subject to natural cues	MODERATE	
	Distributary and anabranch freshes to restore flow components most impacted by river regulation and support native fish	7 in every 10 years to annual				MODERATE Watering, following natural cues, required to continue recovery of native fish populations.	Protect	Moderate potential subject to natural cues up to 10 GL	MODERATE, subject to natural cues	MODERATE	
	Contribute to managing water quality issues within in-stream and wetland environments across the Murrumbidgee Catchment	Contingency in response to poor water quality				MODERATE Flood events can return high carbon loads back to the river and trigger hypoxic blackwater events	Avoid Damage - Protect	Contingency in response to poor water quality unlikely to be required under this inflow scenario	HIGH (Contingency)	HIGH (Contingency)	
										HIGH (Contingency)	

⁹ Volumes may be limited by current channel constraints.

⁹ Roberts and Marston (2011), Hardwick and Maguire (2012), Alluvium (2013)

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system) ¹⁰		Watering history			2017-18			Implications for future demands		
			(from all sources of water)			Predominant urgency of environmental demand for water	Purpose under medium resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2018–19 if watering occurred as planned in 2017–18	2019-20 Range of likely demand	Met in 2018-19
	Flow/volume	Required frequency (maximum dry interval)	2014–15	2015-16	2016-17						Not met in 2018-19
			(drying)	(drying)	(wet)						
Junction Wetlands	Flows > 5 GL/day @ d/s Balranald Weir and >10 GL/day @ Murrumbidgee confluence on the Murray targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds	5 in every 10 years				HIGH Limited flows since 2012 have severely compromised the recovery of degraded wetland vegetation and the recruitment of frog and turtles	Avoid Damage - Protect	A potential for watering potentially through no take of Lowbidgee supplementary allocations	HIGH	HIGH	
			HIGH								
	Flows greater than 7 GL/day @ d/s Balranald Weir targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds	5 in every 10 years				HIGH Limited flows since 2012 have severely compromised the recovery of degraded wetland vegetation and the recruitment of frog and turtles	Avoid Damage - Protect	A potential for watering potentially through no take of Lowbidgee supplementary allocations	HIGH	HIGH	
			HIGH								
	Pumping to individual high priority wetland assets targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds	7–8 in every 10 years (2 years)				HIGH Limited flows since 2012 have severely compromised the recovery of degraded wetland vegetation and the recruitment of frog and turtles	Avoid Damage - Protect	A high potential for water use Up to 10GL	HIGH	HIGH	
			HIGH								
<div>Key - events in previous years</div> <div><div></div> means demand was met by Commonwealth environmental water or any other source</div> <div><div></div> means demand was partially met by Commonwealth environmental water or any other source (may be used to indicate infrastructure assisted delivery)</div> <div><div></div> means water not provided (or not required)</div> <div>Note that not all demands require water every year; drying phases are important for floodplains and temporary wetlands or streams</div> <div>Key - potential watering in 2017-18</div> <div><div></div> means a high priority for Commonwealth environmental watering (full or partial contribution, and subject to seasonal and operational considerations)</div> <div><div></div> means a secondary priority for Commonwealth environmental watering, likely to be met via other means (other water holders, or natural flows)</div> <div><div></div> means a low priority for Commonwealth environmental watering</div> <div>Key - urgency of environmental demands</div> <div><div></div> means critical demand i.e. urgent need for water in that particular year to manage risk of irretrievable loss or damage</div> <div><div></div> means high demand for water i.e. needed in that particular year</div> <div><div></div> means moderate demand for water i.e. water needed that particular year and/or next</div> <div><div></div> means low demand for water i.e. water generally not needed that particular year</div> <div><div></div> means very low demand for water i.e. water generally not needed that particular year or the following year</div> <div>Note that demand is considered at a generalised scale; there may be specific requirements that are more or less urgent within the flow regime</div>							Carryover potential	Low to moderate proportion of allocations expected to be carried into 2018-19 targeting a minimum of 50 GL.	Moderate proportion of allocations may be carried over to 2019-20, but will depend on resource availability demands.	Level of carryover will depend on environmental demands and resource availability.	
							Trade potential	Under a moderate resource availability scenarios, small to moderate transfers into or out of the Murrumbidgee may be required for priority environmental use across the southern connected basin.			

¹⁰ Volumes may be limited by current channel constraints.

¹⁰ Roberts and Marston (2011), Hardwick and Maguire (2012), Alluvium (2013)

Table 3c: Environmental demands, priority for watering in 2017–18 and outlook for coming years in the Murrumbidgee catchment – HIGH to VERY HIGH WATER RESOURCE AVAILABILITY/**WET-VERY WET INFLOW SCENARIO in 2017–18**

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system) ¹¹		Watering history			2017-18			Implications for future demands		
			(from all sources of water)			Predominant urgency of environmental demand for water	Purpose under high to very high resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2018–19 if watering occurred as planned in 2017–18	2019-20 Range of likely demand	Met in 2018-19
	Flow/volume	Required frequency (maximum dry interval)	2014–15 (drying)	2015-16 (drying)	2016-17 (wet)						Not met in 2018-19
Mid-Murrumbidgee Wetlands ¹²	Pumping to individual high priority wetland assets targeting wetland vegetation and maintenance of aquatic refuge habitat	8 in every 10 years - annual (2 years)				HIGH However overbank connection is preferred	Not Applicable	Option unlikely to be required under this resource availability. Demand likely to be achieved by natural high flows	HIGH	MODERATE - HIGH Particularly for established aquatic habitat refuges	
										HIGH	
	Tombullen storage releases to augment flows over 12 GL/day at Darlington Point	7–8 in every 10 years (2 years)				HIGH. The condition of the mid-Murrumbidgee wetlands is generally poor due to a lack of inundation.	Avoid Damage - Protect	A high potential for water use Up to 10 GL per event	HIGH	MODERATE	
										HIGH	
	Minimum of 15.5 GL/day @ Darlington Point for 3–5 days plus a gradual recession targeting low-lying wetland vegetation and aquatic habitat	7–8 in every 10 years (2 years)				HIGH. The condition of the mid-Murrumbidgee wetlands is generally poor due to a lack of inundation.	Avoid Damage - Protect	Up to 130 GL planned for winter 2017. Follow-up watering in autumn 2018 unlikely to be required under this resource availability.	HIGH	HIGH Follow up watering may be warranted due to very poor condition of sites	
										HIGH	
Yanco Creek System	Up to 40 GL, targeting up to 1400 ML/day @ Yanco Creek off-take targeting low-lying wetland vegetation and aquatic habitat and native fish	3 in every 10 years (3 years)				HIGH Watering, following natural cues, to maintain-improve the good condition of wetland vegetation	Improve	A moderate potential for up to 40 GL including potential supplementary take	MODERATE, subject to natural cues	LOW-MODERATE	
										MODERATE	
Lowbidgee Core refuge and permanent aquatic habitat sites	Up to 70 GL targeting critical refuge habitat requirements	Annual				HIGH Annual watering required for critical habitat requirements	Not Applicable	Option unlikely to be required under this resource availability. Demand likely to be achieved by natural high flows.	HIGH	HIGH	
										HIGH	

¹¹ Volumes may be limited by current channel constraints.

¹¹ Roberts and Marston (2011), Hardwick and Maguire (2012), Alluvium (2013)

¹² Note: Differences in filling height (i.e. flows required to fill a wetland) vary among the lagoons that make up the mid-Murrumbidgee wetlands, and so their condition and watering requirement vary accordingly.

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system) ¹³		Watering history (from all sources of water)			2017-18			Implications for future demands		
			2014-15	2015-16	2016-17	Predominant urgency of environmental demand for water	Purpose under high to very high resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2018-19 if watering occurred as planned in 2017-18	2019-20 Range of likely demand	Met in 2018-19
	Flow/volume	Required frequency (maximum dry interval)	(drying)	(drying)	(wet)						Not met in 2018-19
Lowbidgee North Redbank	Up to 60 GL targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds, including supporting significant waterbird breeding events to completion	River red gum forest and spike rush wetlands 1-3 years (3 years)				HIGH Watering, following natural cues, to maintain-improve the good condition of wetland-floodplain vegetation, including supporting waterbird breeding events	Improve	A high potential for water use Up to 60 GL and Lowbidgee Supplementary access ¹⁴	MODERATE, subject to natural cues	MODERATE	
										HIGH	
Lowbidgee Yanga National Park	Up to 60 GL targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds, including supporting significant waterbird breeding events to completion	River red gum forest and spike rush wetlands 1-3 years (3 years)				HIGH Watering, following natural cues, to maintain-improve the good condition of wetland-floodplain vegetation, including supporting waterbird breeding events	Improve	A high potential for water use Up to 60 GL and Lowbidgee Supplementary access ⁷	MODERATE, subject to natural cues	MODERATE	
										HIGH	
Lowbidgee Nimmie-Caira	Up to 20 GL targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds, including supporting significant waterbird breeding events to completion	Refuge habitat annual Lignum dominated wetlands 1 to 5 years, with duration of up to 7 months				HIGH Watering, following natural cues, to maintain-improve the good condition of wetland-floodplain vegetation, including supporting waterbird breeding events	Improve	A high potential for water use Up to 20 GL and Lowbidgee Supplementary access ⁷	MODERATE, subject to natural cues	MODERATE	
										HIGH	
Lowbidgee Fiddler-Uara	Up to 20 GL targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds	Black box and lignum wetlands every 3 to 7 years				HIGH Watering required to maintain-improve the condition of wetland-floodplain vegetation.	Improve	A high potential for watering in 2017-18 including Lowbidgee Supplementary access ⁷	MODERATE, subject to natural cues	LOW	
										MODERATE	
Lowbidgee Western Lakes	Up to 10 GL to maintain open water habitats and floodplain vegetation	Wetland habitats and open water black box and lignum wetlands every 3 to 7 years				HIGH Watering required to maintain-improve the condition of wetland vegetation.	Improve	A high potential for watering in 2017-18 including Lowbidgee Supplementary access ⁷	MODERATE, subject to natural cues	LOW	
										MODERATE	

¹³ Volumes may be limited by current channel constraints.

¹³ Roberts and Marston (2011), Hardwick and Maguire (2012), Alluvium (2013)

¹⁴ Lowbidgee supplementary access will not occur where natural flooding is likely to achieve environmental outcomes.

The environmental water demands of the Junction Wetlands will also be considered in any potential Lowbidgee supplementary access.

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system) ¹⁵		Watering history (from all sources of water)			2017-18			Implications for future demands		
						Predominant urgency of environmental demand for water	Purpose under high to very high resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2018–19 if watering occurred as planned in 2017–18	2019-20 Range of likely demand	Met in 2018-19
	Flow/volume	Required frequency (maximum dry interval)	2014–15 (drying)	2015-16 (drying)	2016-17 (wet)						Not met in 2018-19
Murrumbidgee River channel, distributaries and anabranches	Winter-spring in-channel flows (base flows and freshes) in the Murrumbidgee River targeting critical flow components for native fish spawning, movement and recruitment and in-stream vegetation	7 in every 10 years				HIGH Watering, following natural cues, required to continue recovery of native fish populations.	Not Applicable	Option unlikely to be required under this resource availability. Demand likely to be achieved by natural high flows.	LOW, subject to natural cues	LOW	
	Moderate in-channel pulse targeting native fish movement and recruitment, productivity and in-stream vegetation (flows >3500 ML/day at Balranald)	7 in every 10 years				HIGH Native fish populations in the lower Murrumbidgee River are in poor condition. Water required for improved fish passage and connectivity, aquatic habitat and riverine productivity	Not Applicable	Option unlikely to be required under this resource availability. Demand likely to be achieved by natural high flows.	MODERATE, subject to natural cues	MODERATE	
	Distributary and anabranch freshes to restore flow components most impacted by river regulation and support native fish	7 in every 10 years to annual				HIGH Watering, following natural cues, required to continue recovery of native fish populations.	Not Applicable	Option unlikely to be required under this resource availability. Demand likely to be achieved by natural high flows.	MODERATE, subject to natural cues	MODERATE	
	Contribute to managing water quality issues within in-stream and wetland environments across the Murrumbidgee Catchment	Contingency in response to poor water quality				HIGH Flood events can return high carbon loads back to the river and trigger hypoxic blackwater events	Avoid Damage - Protect	Contingency in response to poor water quality	HIGH	HIGH	
										HIGH	
Junction Wetlands	Flows greater than 5 GL/day @ d/s Balranald Weir and >10 GL/day @ Murrumbidgee confluence on the Murray targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds	5 in every 10 years				HIGH Limited flows since 2012 have severely compromised the recovery of degraded wetland vegetation and the recruitment of frog and turtles	Avoid Damage - Protect	A high potential for watering potentially through no take of Lowbidgee supplementary allocations	HIGH	HIGH	
										HIGH	
	Flows greater than 7 GL/day @ d/s Balranald Weir targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds	5 in every 10 years				HIGH Limited flows since 2012 have severely compromised the recovery of degraded wetland vegetation and the recruitment of frog and turtles	Avoid Damage - Protect	A high potential for watering potentially through no take of Lowbidgee supplementary allocations	HIGH	HIGH	
										HIGH	
	Pumping to individual high priority wetland assets targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds	7–8 in every 10 years (2 years)				HIGH Limited flows since 2012 have severely compromised the recovery of degraded wetland vegetation and the recruitment of frog and turtles	Not Applicable	Option unlikely to be required under this resource availability.	HIGH	HIGH	
										HIGH	

¹⁵ Volumes may be limited by current channel constraints.

¹⁵ Roberts and Marston (2011), Hardwick and Maguire (2012), Alluvium (2013)

Key - events in previous years

means demand was met by Commonwealth environmental water or any other source

means demand was partially met by Commonwealth environmental water or any other source (may be used to indicate infrastructure assisted delivery)

means water not provided (or not required)

Note that not all demands require water every year; drying phases are important for floodplains and temporary wetlands or streams

Key - potential watering in 2017-18

means a high priority for Commonwealth environmental watering (full or partial contribution, and subject to seasonal and operational considerations)

means a secondary priority for Commonwealth environmental watering, likely to be met via other means (other water holders, or natural flows)

means a low priority for Commonwealth environmental watering

Key - urgency of environmental demands

means critical demand i.e. urgent need for water in that particular year to manage risk of irretrievable loss or damage

means high demand for water i.e. needed in that particular year

means moderate demand for water i.e. water needed that particular year and/or next

means low demand for water i.e. water generally not needed that particular year

means very low demand for water i.e. water generally not needed that particular year or the following year

Note that demand is considered at a generalised scale; there may be specific requirements that are more or less urgent within the flow regime

Carryover potential	Low to moderate proportion of allocations expected to be carried into 2018-19 targeting a minimum of 50 GL.	Moderate proportion of allocations may be carried over to 2019-20, but will depend on resource availability demands.	Level of carryover will depend on environmental demands and resource availability.
Trade potential	Under high and very high resource availability scenario, there may be an opportunity to trade allocation (subject to an assessment that a reasonable level of supply or demand exists within the water market). The issue of whether to sell allocation will be considered once there is greater certainty regarding environmental water use during the winter-spring period, most likely from October 2017 onwards		

3. Next steps

3.1. From planning to decision making

It is important to distinguish between planning and operational decision making. As shown in Figure 4, planning allows the Office to manage the environmental water portfolio in a holistic manner and is an exercise in developing a broad approach or intention, based on the key drivers (demand and supply).

Decision making throughout each year builds on the intention by considering in more detail the specific prevailing factors and additional factors such as costs, risks, and constraints to water delivery and market conditions.

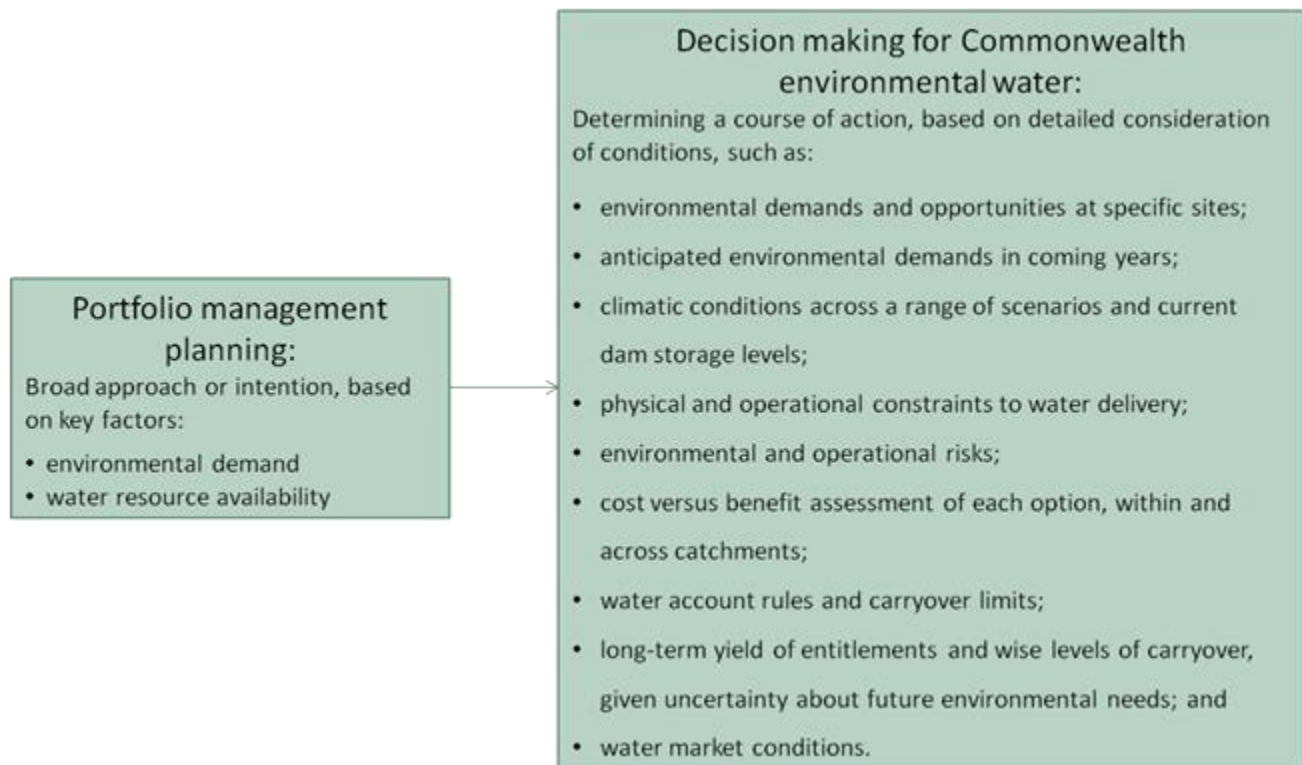


Figure 4: Planning and decision making for Commonwealth environmental water use

3.2. Further information

For further information on how the Office plans for water use, carryover and trade, please visit our web site: <http://www.environment.gov.au/water/cewo>

or the sites below:

- Water use: www.environment.gov.au/topics/water/commonwealth-environmental-water-office/assessment-framework
- Carryover: <http://www.environment.gov.au/topics/water/commonwealth-environmental-water-office/portfolio-management/carryover>
- Trade: *Discussion Paper – Trade of Commonwealth Environmental Water and Commonwealth Environmental Water Trading Framework*: <http://www.environment.gov.au/water/cewo/trade/trading-framework>

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Attachment A – Expected outcomes from the Basin-wide environmental watering strategy

Expected outcomes from the Basin-wide environmental watering strategy (MDBA 2014) that are relevant to the Murrumbidgee catchment are described below.

RIVER FLOWS AND CONNECTIVITY

- Baseflows are at least 60 per cent of the natural level
- Contributing to a 30 per cent overall increase in flows in the River Murray
- A 30–60 per cent increase in the frequency of freshes, bankfull and lowland floodplain flows

VEGETATION

- Maintain the current extent of water-dependent vegetation near river channels and on low-lying areas of the floodplain.
- Improve condition of black box, river red gum and lignum shrublands
- Improved recruitment of trees within black box and river red gum communities
- Increased periods of growth for non-woody vegetation communities that closely fringe or occur within the river and creek channels

Vegetation extent¹⁶

Area of river red gum (ha)	Area of black box (ha)	Shrublands	Non-woody water dependent vegetation
68 300	38 900	Lignum in the Lower Murrumbidgee	Closely fringing or occurring within the Murrumbidgee River, Billabong and Yanco creeks

Black box condition

Vegetation condition score		Percent of vegetation assessed (within the managed floodplain)
0–6	>6–10	
54 per cent	46 per cent	73 per cent

River red gum condition

Vegetation condition score					Percent of vegetation assessed (within the managed floodplain)
0–2	>2–4	>4–6	>6–8	>8–10	
3 per cent	8 per cent	22 per cent	40 per cent	27 per cent	93 per cent

WATERBIRDS

- Maintain current species diversity
- Increase Basin-wide abundance of waterbirds by 20–25 per cent by 2024
- A 30–40 per cent increase in nests and broods (Basin-wide) for other waterbirds
- Up to 50 per cent more breeding events (Basin-wide) for colonial nesting waterbird species

¹⁶ Area (ha) (+/- 10%) is based on Cunningham et al (2013), cited in MDBA (2014)

Important Basin environmental assets for waterbirds in the Murrumbidgee

Environmental asset	Total abundance and diversity	Drought refuge	Colonial waterbird breeding	Shorebird abundance	In scope for Commonwealth watering
Fivebough Swamp	*			*	No
Lowbidgee floodplain	*	*	*	*	Yes

FISH

- No loss of native species
- Improved population structure of key species through regular recruitment, including
 - Short-lived species with distribution and abundance at pre-2007 levels and breeding success every 1–2 years
 - Moderate to long-lived with a spread of age classes and annual recruitment in at least 80 per cent of years
- Increased movements of key species
- Expanded distribution of key species and populations

Key species for the Murrumbidgee include:

Species	Specific outcomes	In-scope for Commonwealth water in the Murrumbidgee?
Flathead galaxias (<i>Galaxias rostratus</i>)	Improve core range in additional locations, including the Murrumbidgee	Not until a population is established
Freshwater catfish (<i>Tandanus tandanus</i>)	Expand the core range of current populations in Colombo-Billabong Creek	Yes
Golden perch (<i>Macquaria ambigua</i>)	A 10–15 per cent increase of mature fish (of legal take size) in key populations	Yes
Macquarie perch (<i>Macquaria australasica</i>)	Expand current populations (candidate sites include Cotter River, Murrumbidgee above Cooma, Adjungbilly Creek).	No
Murray cod (<i>Maccullochella peelii</i>)	A 10–15 per cent increase of mature fish (of legal take size) in key populations	Yes
Olive perchlet (<i>Ambassis agassizii</i>)	Olive perchlet are considered extinct in the southern Basin. Reintroduction using northern populations is the main option for recovery. Candidate sites may result from improved flow that reinstates suitable habitat in the mid-Murrumbidgee wetlands.	Restoration of flow to mid-Murrumbidgee wetlands could support the future reintroduction of the species.
River blackfish (<i>Gadopsis marmoratus</i>)	Expand the range of current population in the Murrumbidgee River.	Yes

Species	Specific outcomes	In-scope for Commonwealth water in the Murrumbidgee?
Silver perch (<i>Bidyanus bidyanus</i>)	Improve core range in Billabong–Yanco system and ACT reaches of the Murrumbidgee.	Yes, but only in the Billabong–Yanco system (ACT out of scope)
Southern purple-spotted gudgeon (<i>Mogurnda adspersa</i>)	Establish 3–4 additional populations (candidate sites include the Murrumbidgee in Adjungbilly and Adelong Creeks).	No
Southern pygmy perch (<i>Nannoperca australis</i>)	Establish additional populations in the lower Murrumbidgee wetlands	Only if additional populations are established
Trout cod (<i>Maccullochella macquariensis</i>)	For the connected population of the Murrumbidgee–Murray–Edwards, continue downstream expansion.	Yes
Yarra pygmy perch (<i>Nannoperca obscura</i>)	Establish additional populations (no specific locations identified)	Only if additional populations are established

Important Basin environmental assets for native fish in the Murrumbidgee

Environmental asset	Key movement corridors	High Biodiversity	Site of other Significance	Key site of hydrodynamic diversity	Threatened species	Dry period / drought refuge	In-scope for Commonwealth e-water
Lowbidgee Floodplain			*				Y
Murrumbidgee main channel (including upland reaches)	*		*		*		Y (d/s of storages)
Upland Murrumbidgee main channel	*		*		*		N
Cotter River			*		*		N
Billabong–Yanco–Colombo Creeks		*	*	*	*	*	Y

Attachment B – Library of watering actions

Operational considerations in the Murrumbidgee catchment

The delivery of environmental water in the Murrumbidgee River Valley is currently constrained by the release capacities from storages and channel capacities. The Water Sharing Plan for the Murrumbidgee River Regulated Water Source includes river channel capacity constraints on maximum flows (NSW Legislation 2003; DPI 2015). This includes:

- Flows in the Murrumbidgee River at Gundagai are limited to less than 29,500 ML/day to prevent inundation of Tenandra Bridge on the Mundarlo Road near Gundagai.
- Flows in Tumut River are limited to less than 9000 ML/day at Oddy's Bridge and 9300 ML/day at Tumut to minimise bank erosion.
- Yanco Weir diversion is currently limited by the Water Sharing Plan to 1400 ML/day to Yanco Creek. Flows over ~2000 ML/day may cause floodplain inundation.
- Release capacities of storages may constrain the magnitude of augmentation.
- Environmental watering actions may inundate areas of low-lying private property and impact on riparian landholders by restricting access to land and/or stock or by causing damage to crops, stock, or private infrastructure.
- Channel capacity may limit environmental water delivery

In 2016, Water NSW publicly stated and actively managed environmental flows to a maximum of 20,000 ML/day at Wagga Wagga in response to landholder complaints of potential third party impacts. Historically, releases for irrigation water supply have been made at flow rates of up to 23,000 ML/day.

The Murray-Darling Basin Authority (2015) published the Murrumbidgee reach report: Constraints Management Strategy which provides further information about constraints in the Murrumbidgee catchment.

Potential watering actions under different inflow scenarios

Under certain levels of water resource availability and inflow scenarios, watering actions may not be pursued for a variety of reasons, including that environmental demand may be met by unregulated flows and that constraints and/or risks may limit the ability to deliver environmental water. Table 4 identifies the range of potential watering actions in the Murrumbidgee catchment and the inflow scenarios that relate to these actions.

Table 4: Summary of potential watering actions for the Murrumbidgee catchment

Broad Asset	Indicative demand ¹⁷	Applicable inflow scenario				
		Very Low	Low	Moderate	High	Very High
Mid-Murrumbidgee wetlands	Minimum (15.5 GL/d @ Darlington Point for up to 6 days plus a gradual recession	Option a priority but unlikely under this inflow scenario.	Reconnection action: Contribute to river flows (fresh) and inundation of fringing wetlands to continue recovery of wetland vegetation communities, and provide habitat to support survival and maintain the condition of waterbirds and native aquatic biota (including fish, turtles, frogs and invertebrates).			Objectives are likely to be achieved from unregulated flow under this scenario.
	Tombullen storage releases to augment flows over 12 GL/day at Darlington Point					
	Pumping to individual high priority wetland assets	Infrastructure assisted: Contribute to habitat to support survival and maintain the condition of waterbirds and native aquatic biota (including fish, turtles, frogs and invertebrates).			Option unlikely to be required under this scenario.	
Yanco Creek system	Yanco Wetlands (up to 30 GL action @ Yanco off-take)	Yanco Creek System: Contribute to flows reconnecting and refilling the anabranch creeks and lagoons located in the mid-Yanco Creek system.				Option unlikely to be required under this scenario.
Lowbidgee - Core refuge and permanent aquatic habitat	Up to 70 GL	Critical Habitat provision: support critical fauna and flora habitat requirements and recruitment opportunities.			Option unlikely to be required under this scenario	
Lowbidgee - North Redbank	Up to 60 GL	Wetland inundation: Contribute to river flows (fresh) using regulators to inundate target wetlands in the Lowbidgee to maintain and improve wetland vegetation diversity and condition, provide habitat to support survival and maintain the condition of native fish, waterbirds, and other aquatic vertebrates (e.g. frogs), hydrological connectivity between the floodplain and river, and contribute to processes such as nutrient and carbon cycling through return flows.			Bird breeding event contingency: Maintain wetland water levels and acceptable levels of water quality to support the completion of a naturally-triggered breeding event, including landscape scale watering with lower Lachlan.	
Lowbidgee - Yanga National Park	Up to 60 GL					
Lowbidgee - Nimmie-Caira	Up to 20 GL (key wetland and rookery sites)					

¹⁷ Volume limited by current channel constraints. Volumes will be scaled according to inflow scenario and resource availability.

Broad Asset	Indicative demand ¹⁷	Applicable inflow scenario				
		Very Low	Low	Moderate	High	Very High
Lowbidgee - Fiddler-Uara	Up to 20 GL	Wetting-Drying cycle: A decision may be made to not provide water to sites that require a drying phase or where target watering frequency has been achieved in recent years.			Lowbidgee Supplementary: Utilise a portion of river flows to contribute to outcomes as per <i>Wetland Inundation</i> objectives for regulated allocations.	
Lowbidgee - Western Lakes	5 - 10GL (Open water habitats and vegetation)					
Murrumbidgee River Channel, distributaries and anabranches	Winter-spring in-channel flows	Restoring natural flow variability: Contribute to river flows (base flows and freshes) in the Murrumbidgee River channel.			Option unlikely to be required under this scenario.	
	Moderate in-channel pulse (>3500 ML/day at Balranald)	Option a priority but unlikely under this inflow scenario	Native fish flow: Contribute to river flows (base flows and freshes) to provide suitable in-stream conditions for native fish breeding, recruitment, movement and dispersal.		Option unlikely to be required under this scenario.	
	Distributary and anabranch freshes	Restoring natural flow variability: Contribute to river flows (base flows and freshes) in the Murrumbidgee distributaries: Yanco-Colombo-Billabong Creek system, Old Man Creek system and/or other creeks.			Option unlikely to be required under this scenario.	
	Water quality contingency	Provide localised refuge habitat for fish and aquatic biota to prevent, or during, an adverse water quality/water level event.	Option unlikely to be required under this scenario.		Provide localised refuge habitat for fish and aquatic biota to prevent, or during, an adverse water quality event.	
Junction Wetlands	Target flows >5 GL/day @ d/s Balranald Weir and >10 GL/day @ Murrumbidgee confluence on the Murray Flows greater than 7 GL/day @ d/s Balranald Weir	Option a priority but reduced likelihood of natural trigger events under this scenario.		Reconnecting event: Contribute to river flows (fresh) and inundation of fringing wetlands to continue recovery of wetland vegetation communities, and provide habitat to support survival and maintain the condition of waterbirds and native aquatic biota (including fish, turtles, frogs and invertebrates).		

Broad Asset	Indicative demand ¹⁷	Applicable inflow scenario				
		Very Low	Low	Moderate	High	Very High
	Pumping to individual wetland assets for refuge sties	<i>Infrastructure assisted:</i> Contribute to habitat to support survival and maintain the condition of waterbirds and native aquatic biota (including fish, turtles, frogs and invertebrates).			Option unlikely to be required under this scenario.	

Potential watering actions – standard operating arrangements

Table 4 identifies the range of potential watering actions in the Murrumbidgee catchment in the Murray-Darling Basin that give effect to the long-term demands and flow regime identified as being in scope for the contribution of Commonwealth environmental water in any given year. The standard considerations associated with these actions are set out below.

1. Mid-Murrumbidgee Reconnection

Watering Action: Contribute to river flows (freshes) and inundation of fringing wetlands to avoid further damage and protect wetland vegetation communities, and provide habitat to support survival and maintain the condition of waterbirds and native aquatic biota (including fish, turtles, frogs and invertebrates).

Standard operational considerations:

The proposed event will involve the release of environmental water from upper storages in conjunction with rainfall-derived tributary flows. Infrastructure assisted delivery to individual wetlands will also be considered.

Typical extent:

- Inundation of low-level wetlands.
- This option will target a peak flow rate for three to five days and a recession that mimics a more natural recession rate (nominally a 10 to 15 per cent decrease in flow per day).
- Environmental flows likely to be delivered between late autumn and early spring (May to September) to avoid irrigation season.
- While the volume of environmental water required will depend on the volume of baseflows, the proposed upper flow limits for this option are:
 - 28,000 ML/day (4.73 metres gauge height) at Gundagai.
 - 27,500 ML/day (4.9 metres gauge height) at Wagga Wagga¹⁸.
- This option is likely to contribute flows required to inundate the mid-Yanco Creek system wetlands (Action 3), could provide some of the required flows for, and provide additional benefits to, the proposed in-channel actions (Actions 5 and 6) and watering of the Junction Wetlands.

Approvals:

- Agreement from landholders whose properties might be inundated by environmental flows is preferred.
- Action may result in the 1400 ML/day Yanco Creek off-take constraint specified in the Water Sharing Plan being exceeded. Approval to exceed the 1400 ML/day constraint at the Yanco Creek off-take is required from the NSW Minister for Primary Industries.

¹⁸ Note: as per Tables 3a, b and c, the proposed maximum flow limit for 2017-18 planning is 20,000 ML/day at Wagga Wagga.

2. Mid-Murrumbidgee wetland – infrastructure assisted delivery

Watering action: Contribute to wetland inundation, using existing water delivery infrastructure, to refill high priority low lying wetlands to provide habitat to support survival and maintain the condition of waterbirds and native aquatic biota (including fish, turtles, frogs and invertebrates).

Standard operational considerations:

- Delivery to mid-Murrumbidgee wetlands through pumping is not as ecologically effective as filling the wetlands with a reconnecting river flow. The purpose of this option is to continue/maintain recent improvements in wetland vegetation condition at these sites and provide habitat to maintain condition of waterbirds, native fish, other aquatic vertebrates (turtles, frogs) and invertebrates.

Typical extent:

- It is not operationally feasible to pump to all sites; system scale objectives cannot be achieved with infrastructure assisted watering alone. The wetlands in the mid-Murrumbidgee that can be delivered to via existing infrastructure and without higher reconnecting flows include:
 - Yarradda Lagoon in the mid-Murrumbidgee
 - Gras Innes and Oak Creek via Bundidgerry Creek
 - Yanco Agricultural (McCaughey's) Lagoon, Turkey Flat and Gooragool Lagoon via Murrumbidgee Irrigation infrastructure
 - Coonancoocabil Lagoon (off Murrumbidgee Irrigation infrastructure or via Gogeldrie Weir pool)
 - A number of wetlands within the Yanco Creek system
 - Other privately owned wetlands and waterways to restore ecological function to these areas.

Approvals:

- In some cases, access to channels will need to be negotiated with landholders or irrigation corporations and agreement for inundation of privately owned wetlands will need to be sought.

3. Mid-Yanco Creek Anabranches and Wetlands

Watering Action: The option would aim to maintain riparian and wetland vegetation condition (including river red gums) by reconnecting and refilling the anabranch creeks, flood-runners, lagoons and wetlands in the Yanco Creek System.

Standard operational considerations:

- The proposed event will involve the release of environmental water from upper storages, possibly in conjunction with rainfall-derived tributary flows.
- Alternatively delivery via both Yanco Creek Offtake and Coleambally Catchment Drain may achieve some objectives and limit inconvenience to upper Yanco Creek landholders.
- A third option is to divert a high unregulated flow, possibly through supplementary access, down the Yanco Creek system.

Typical extent:

- The action will target sites in the mid-Yanco Creek (between Morundah and Yanco Bridge on Kidman Way). Target sites include the 'Silver Pines' wetland complex.
- Flows above 1400 ML/day and/or additional volumes delivered through Coleambally Catchment Drain may be required to achieve desired outcomes.

Approvals:

- Agreement from landholders whose properties might be inundated by environmental flows is preferred.
- Target flows will result in the 1400 ML/day Yanco Creek off-take constraint specified in the Water Sharing Plan being exceeded. Approval to exceed the 1400 ML/day constraint at the Yanco Creek off-take is required from the NSW Minister for Primary Industries.

4. Lowbidgee Wetlands

Watering Action: Using regulators, inundate target wetlands across the Lowbidgee to maintain, improve and in some cases promote the recovery of wetland vegetation diversity and condition (lignum, black box and river red gums and associated understory communities such as reeds, sedges and rushes), and provide habitat to support survival and maintain condition of native fish, waterbirds, other aquatic vertebrates (frogs) and invertebrates.

Standard operational considerations:

- The Lowbidgee contains suitable habitats for nationally important breeding colonies of threatened and internationally significant migratory waterbird species (MCMA 2009).
- Seasonal inundation of wetlands is important for the reproduction and survival of several frog species, including the EPBC Act vulnerable southern bell frog, in the Lowbidgee. Ensuring key southern bell frog sites receive flows over spring-summer and water levels are maintained over summer months is crucial for maintaining viable populations in the Lowbidgee system.
- Consideration will be given to the condition of individual sites as well as prevailing conditions to reinstate an appropriate wetting–drying cycle.
- Consideration will be given to using escapes to allow water to return to the river channel to improve hydrological connectivity and provide for transport of biota, nutrients, sediment and carbon and improve the health of the river system, and benefit fish and other organisms.
- Subject to occurrence and announcements, supplementary allocations may be used to protect a portion of river flows to inundate target wetlands in the Lowbidgee to maintain and improve wetland vegetation diversity and condition, hydrological connectivity between the floodplain and river, and contribute to processes such as nutrient and carbon cycling.

Typical extent:

- Possible target sites include: Core refuge and permanent aquatic habitat, North Redbank system, South Redbank (Yanga National Park), Nimmie-Caira and Fiddlers-Uara Creek systems and the Western Lakes. The scale of watering actions is dependent on environmental demand and water availability.

No additional approvals required.

5. Native fish flows

Watering Action: Contribute to base flows, freshes and the recession of natural bankfull and overbank flows to create favourable conditions for fish passage, reproduction and survival.

Standard operational considerations:

- This may involve contributing in-stream flows to improve movement opportunities (including off-channel recruitment), maximise available breeding habitat, create flow conditions favourable for reproduction, or contribute to the survival of native fish.

Typical extent:

- Target flow rates will be dependent on the prevailing flow conditions, target outcome and operational considerations.
- Environmental water will be delivered from storages and may target reaches along the length of the Murrumbidgee River and main distributaries.
- Subject to announcements, supplementary allocations may be used to protect a portion of river flows.
- Environmental deliveries for this option will likely be delivered in late winter (movement and condition), spring and early summer (spawning and recruitment).

No additional approvals required.

6. Restoring natural flow variability

Watering Action: Contribute to river flows restore natural flow events that are affected by river regulation and/or extraction.

Standard operational considerations:

- This option will contribute to objectives of the native fish flows (Action 5).

Typical extent:

- Environmental water may be delivered to the Murrumbidgee River channel, Yanco-Colombo-Billabong Creek system, Old Man Creek system, and/or other creek systems.
- Target flow rates will be dependent on the prevailing flow conditions, target outcome and operational considerations.
- Subject to announcements, supplementary allocations may be used to protect a portion of river flows.
- Environmental releases would be kept in channel and are not intended to inundate floodplain or wetland habitat.

No additional approvals required.

7. Contingency to support significant bird breeding events

Watering action: Maintain wetland water levels to support the completion of a significant waterbird breeding events.

Standard operational considerations:

- These contingency actions will only occur in response to developing issues/events.
- The bird breeding contingency is not to trigger a breeding event but for use when a breeding event is already underway and considered in danger of failure due to receding water levels.

Typical extent:

- Target flow rates will be dependent on the prevailing conditions, the nature of the water quality/falling water level issue and operational considerations.
- This option is contingent on conditions throughout the year, but is more likely to be required during warmer months.

No additional approvals required.

8. Contingency to support critical habitat requirements

Watering action: Contribute to managing water quality issues within in-stream and wetland environments across the Murrumbidgee catchment.

Standard operational considerations:

- Contingency actions will only occur in response to developing issues/events.

Typical extent:

- Target flow rates will be dependent on the prevailing conditions, the nature of the water quality/falling water level issue and operational considerations.
- This option is contingent on conditions throughout the year, but is more likely to be required during warmer months.

No additional approvals required.

9. Junction Wetlands

Watering Action: Contribute to river flows (freshes) and inundation of fringing wetlands to avoid further damage and protect wetland vegetation communities, and provide habitat to support survival and maintain the condition of waterbirds and native aquatic biota (including fish, turtles, frogs and invertebrates).

Standard operational considerations:

- Requires higher flows in the Murrumbidgee (flows >5000 ML/day @ d/s Balranald Weir) and the Murray (>10,000 ML/day @ Murrumbidgee confluence) to ensure inundation is achieved.
- Flows greater than 7000 ML/day d/s Balranald Weir, independent of flow rates in River Murray, can connect and fill low level creek systems (Waldaira, Peacock and Mainie Creeks) in the Junction Wetlands.

- The proposed action may be achieved by a decision to 'not take' Lowbidgee supplementary allocations during announced access periods to protect peak flows to achieve Junction Wetlands watering (rather than diverting supplementary flows into Nimmie-Caira, for example).
- The proposed action may also involve the release of environmental water from upper storages in conjunction with rainfall-derived tributary flows. Should river-floodplain inundation not be possible, infrastructure assisted delivery to individual wetlands will be considered.

Typical extent:

- Inundation of low-level wetlands and creek systems (for example Peacock and Mainie Creeks).

Approvals:

- Agreement from landholders whose properties might be inundated by environmental flows is preferred and would be required for infrastructure assisted watering of individual sites.

Attachment C – Long-term water availability

Commonwealth environmental water holdings

The Commonwealth holds the following entitlements in the Murrumbidgee catchment:

- Murrumbidgee high security
- Murrumbidgee general security
- Murrumbidgee Irrigation (Conveyance)
- Coleambally Irrigation (Conveyance)
- Murrumbidgee supplementary

The full list of Commonwealth environmental water holdings can be found at www.environment.gov.au/topics/water/commonwealth-environmental-water-office/about-commonwealth-environmental-water/how-much and is updated monthly.

Other sources of environmental water

Other potential sources of held environmental water that may be used to complement Commonwealth environmental water delivery in the Murrumbidgee catchment include:

- Environment Entitlement - The Living Murray Programme (Murray-Darling Basin Authority)
- Environmental Water Allowance (New South Wales Office of Environment and Heritage)
- NSW licensed entitlement (New South Wales Office of Environment and Heritage)
- Yanga Lowbidgee entitlement (NSW Parks and Wildlife Service)

Planned environmental water

In addition to water entitlements held by environmental water holders, environmental demands may also be met via natural or unregulated flows and water provided for the environment under rules in state water plans (referred to as 'planned environmental water').

The Water Sharing Plan for the Murrumbidgee Regulated River Water Source (2003) establishes releases of planned environmental water (under Part 3, Clause 15) under operating rules for Burrinjuck and Blowering dams.

- Transparent releases:
 - Transparent releases from Blowering Dam to the Tumut River are equal to 560 ML/day plus any water use expected to occur between the dam and the confluence with the Murrumbidgee River. When inflows fall below 560 ML/day, release volumes are equal to inflows in addition to expected use.
 - Transparent releases from Burrinjuck Dam are the lesser of either the volume of inflows to the dam over the previous 24 hours or 615 ML.
- Translucent releases:
 - Translucent releases are made from Burrinjuck Dam on each day between 22 April and 21 October. Daily release volumes are calculated based on catchment conditions and storage volumes in Lake Burrinjuck.
- Minimum daily end of system flow targets (including Murrumbidgee River at Balranald).



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