



Australian Government

Commonwealth Environmental Water Office

Commonwealth Environmental Water Portfolio Management Plan

Murrumbidgee River Valley

2019–20

Acknowledgement of the traditional owners of the Murray-Darling Basin

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. Ms Jody Swirepik is the current Commonwealth Environmental Water Holder. She is supported by staff of the Commonwealth Environmental Water Office, which includes 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 it 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 River Valley for 2019–20. 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, 2019–20* (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 Department of Planning, Industry and Environment, WaterNSW, Gayini Nimmie-Caira Core Team, NSW Department of Primary Industries – Fisheries, scientists from Charles Sturt University engaged in monitoring the outcomes of Commonwealth environmental water use and the Murrumbidgee Environmental Water Allowance Reference Group (Murrumbidgee EWARG).

Your input

The management of Commonwealth environmental water relies on considerable advice and assistance from 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 Commonwealth Environmental Water Office via: ewater@environment.gov.au.

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1. Environmental watering in 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.

The rivers and wetlands of the Murrumbidgee catchment hold significant spiritual and cultural importance for Aboriginal people. The Wiradjuri are the largest Aboriginal nation in the Murrumbidgee catchment, with their nation extending from the River Murray to beyond Dubbo in the north, and west to Balranald. At the western end of the catchment are the traditional land of the Barapa Barapa, Muthi Muthi, Nari Nari, Nyeri Nyeri, Wadi Wadi, Wamba Wamba, Weki Weki, and Wolgalu nations. The mountains at the eastern end of the Murrumbidgee catchment are the country of the Ngunawal and Ngarigo nations. (MDBA 2019)

Supporting a complex range of natural ecosystems, the Murrumbidgee catchment contains many significant in-channel and wetland habitats including the mid-Murrumbidgee and Lowbidgee floodplain wetlands, which provide important habitat for a range of aquatic and terrestrial species including frogs, fish and waterbirds. In the mid-Murrumbidgee, two wetlands, Fivebough and Tuckerbil, are listed under the international Ramsar Convention. Both of these wetlands support a high abundance and diversity of waterbirds, including threatened and migratory shorebird species and also provide significant breeding habitat for waterbirds including egrets and brolgas (White 2011).

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. Blowering Dam and Tantangara Reservoir catchments are also affected by the operation of the Snowy Mountains Hydro Electricity scheme.

Most of the flow in the Murrumbidgee River comes from the upper portion of the catchment (gaining stream), 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 (losing stream).

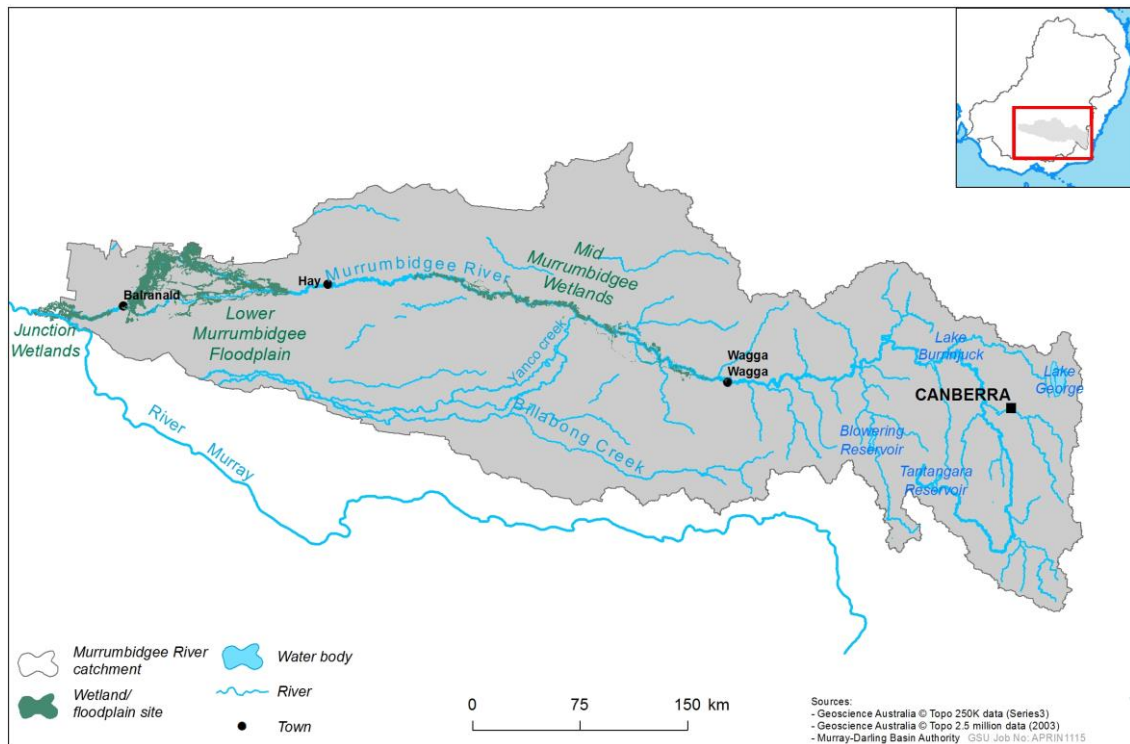


Figure 1: Map of the Murrumbidgee catchment including major towns and headwater storage (courtesy of the Murray-Darling Basin Authority).

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 a Basin-scale and for each catchment. The expected outcomes relevant for the Murrumbidgee catchment are summarised in Table 1 and described in detail in [Attachment A](#).

Basin state governments are also finalising 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 finalised, these plans will describe the key information on the long-term environmental water demands in the catchment. Prior to the finalisation of long-term watering plans, the Commonwealth Environmental Water 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.

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 in some cases protect 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. | | | | |
| CONNECTIVITY | Support longitudinal connectivity along the Murrumbidgee River, including end of system Murray 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: MDBA (2012a, b, c; 2014); DPI (2014); Roberts and Marston (2011); Sinclair Knight Merz (2011); and Wassens et al (2014)

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 flows events or are beyond what can be delivered within operational constraints ([Attachment B](#)). 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. 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 operational delivery including constraints is described in [Attachment B](#).

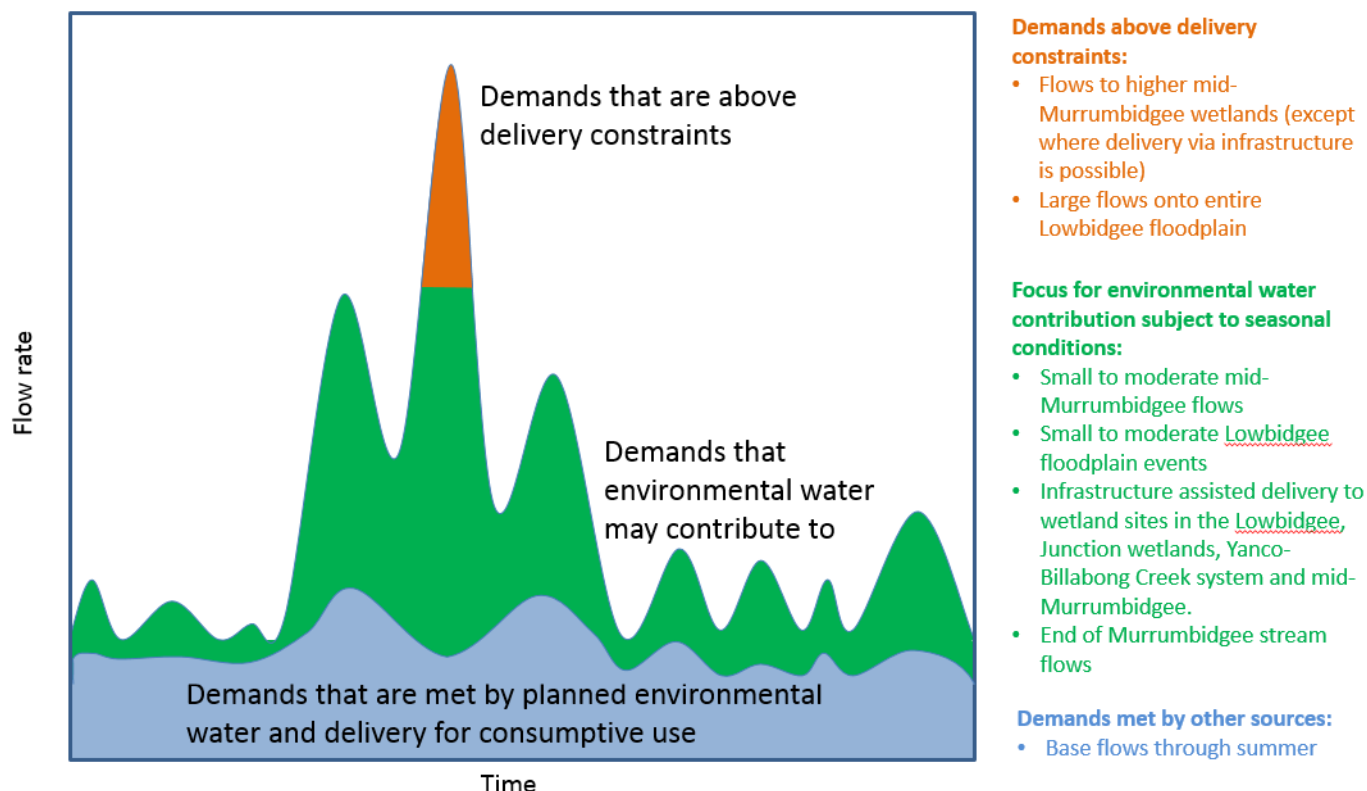


Figure 2: Scope of demands that environmental water may contribute to in the Murrumbidgee catchment

Low flows are often met by other sources of water, such as consumptive water deliveries. Conversely, very high flows are the result of unregulated or natural flows caused by rainfall. Commonwealth environmental water cannot contribute to these high flows, as doing so may create unacceptable third party impacts. The focus for Commonwealth environmental watering is therefore on mid-range flows, such as small to moderate flows in the river to assets such as the mid-Murrumbidgee Wetlands and Lowbidgee Floodplain (Figure 2).

Based on the objectives outlined in Table 1 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 below. Environmental water objectives and Environmental water requirements will continue to be reviewed and revised in response to new knowledge and outcomes from monitoring.

2. Portfolio management in 2019–20

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. Lessons from previous years

Monitoring observations and lessons learned in previous years are a critical component for the effective and efficient use of Commonwealth environmental water. The Commonwealth Environmental Water Office works with the Murray–Darling Basin Authority, state agencies, research organisations, regional organisations, local groups and landholders to collect and collate relevant information to inform short-term and long-term environmental water decisions. This continual review of information and outcomes is helping to build knowledge about the best way to get positive environmental outcomes on a larger scale, based on what works and what doesn't work. Key findings and recommendations from the 2018-19 watering year (Kopf et al 2019 unpublished) and first four years (2014-18) of Long-term monitoring in the Murrumbidgee catchment (Wassens et al 2019a, 2019b, 2018, 2016a, 2016b) include:

- Spawning of riverine fish in the Murrumbidgee River is closely linked to water temperature. To date, there has been little evidence to suggest that managing for discrete flow peaks within the monitored reaches of the mid-Murrumbidgee influenced native fish spawning. This might be in part due to the already higher water flows occurring in the mid-Murrumbidgee, with irrigation deliveries creating conditions suitable for spawning throughout the breeding season.
- Monitoring has found correlation between increasing carp densities in mid-Murrumbidgee wetlands over time with declines in the abundance of frogs and tadpoles. Management actions that include the removal of adult carp prior to pumping, either through physical removal and/or short-term drying out of the wetland, are likely to have positive benefits for frogs and vegetation.
- The maintenance of native fish communities through floodplain wetlands is largely provided by persistent waterbodies and/or regular connection to the river channel. Monitoring has indicated that invasive fish densities are likely to have remained stable in many permanent creek systems in the Lowbidgee floodplain (e.g. Telephone Creek and Wagouragh Lagoon). Notwithstanding the point above, retaining water in these types of wetlands is important for promoting increased survival of native turtle, fish and frog populations.
- Breeding in many frog species, including the southern bell frog (EPBC Act vulnerable), is triggered by rising water levels in wetlands during October and November. Watering actions undertaken from late summer through to winter are important for providing refuge habitat but are unlikely to provide suitable conditions for breeding the following spring.
- Environmental water has supported the establishment of aquatic vegetation communities in the mid-Murrumbidgee and Lowbidgee floodplains over the 2014-18 period, in-particular the re-establishment of spiny mud grass, common spike rush and two fringing species: lesser joyweed, and the culturally significant old man weed at two of the monitored mid-Murrumbidgee wetlands. By contrast, wetlands that did not receive environmental water were dominated by terrestrial species and had higher cover of introduced species such as spear thistle, as well as greater cover of river red gum seedlings and saplings.
- The overall condition of wetland fish communities across the Murrumbidgee is poor and populations are dominated by highly abundant opportunistic generalist species, while more sensitive floodplain specialists are typically absent. Diversity of wetland fish in Murrumbidgee wetlands could be increased through either 1) recolonisation by species that are locally extinct or 2) increased use of wetlands by species that do not typically occupy wetlands under the existing regime. The former

could potentially be achieved during very large overbank flows when connectivity is increased and the latter may be achieved for wetlands that are more frequently connected to the river. Both of these mechanisms would require maintenance of permanent wetland refuge.

- Where possible, Commonwealth environmental water should be prioritised to provide annual seasonally-inundated habitat (spring-summer) for waterbirds in the Lowbidgee floodplain and mid-Murrumbidgee wetlands. Most waterbirds commence breeding in spring, however the stimuli for breeding is usually a combination of season, rainfall and flooding. The provision of environmental water is likely to be extremely important in creating feeding habitat to support survival of young waterbirds. Inundating floodplain habitat to create foraging habitat would benefit waterbird populations in the Murray-Darling Basin by promoting the survival of juvenile and adult waterbirds.
- Broad-scale wetland reconnections and periods of low flow are necessary to promote resources for river food webs. Future planning of watering actions that allow for wetland reconnections either via managed return flows or by generating peaks in river height may assist with the mobilisation of carbon and nutrients from the floodplain to the river.
- Monitoring in the Yanga floodplain system during an environmental water delivery action has indicated that recruitment of native fish species, such as golden perch, can occur from within the floodplain system independent of a connection to the Murrumbidgee River. Environmental flows from the river have also been shown to provide a source of fish larvae and juvenile fish in the floodplain system.
- Monitoring of weir pool stratification (the establishment of a thermocline, with warmer, oxygenated water above and cooler, low dissolved oxygen below) and hypoxic water management in the Lower Murrumbidgee River in 2019 showed that high temperatures and low flow conditions have the potential to adversely affect water quality. Mixing of the hypoxic bottom water with oxygenated surface water can result in low dissolved oxygen concentrations throughout the water column thereby potentially causing fish kills. Water quality can be improved and fish kills mitigated against by:
 - steadily increasing in-channel flows and gradually releasing hypoxic water from weirs, and
 - exporting hypoxic water from weirs onto the floodplain using existing regulators.

The outcomes from these monitoring activities are used to inform portfolio management planning and adaptive management decision-making.

2.2. Antecedent and current catchment conditions and the demand for environmental water in 2019–20

In 2018-19 the Murrumbidgee catchment experienced average to very much below average rainfall resulting in limited natural inundation along the Murrumbidgee system and low water allocations. Temperatures ranged across the catchment from very much above average to highest on record (Bureau of Meteorology 2019). These conditions, along with low flows, led to adverse water quality conditions in the lower Murrumbidgee River during summer 2019. In response to these conditions, flows of Commonwealth, NSW and The Living Murray environmental water were delivered to the lower Murrumbidgee River, successfully improving water quality and avoiding more severe fish kills.

Commonwealth and NSW environmental water was also provided to support a large young-of-year golden perch population in Yanga Lake. The delivery of environmental water en route to Yanga Lake also contributed to native vegetation diversity and condition, and provided refuge habitat for waterbirds, native fish and other aquatic fauna in Yanga National Park and Gayini Nimmie-Caira. This action also supported breeding of a range of waterbird species including the Australasian bittern (EPBC Act and NSW BC Act endangered) and Eastern great egret (EPBC Act migratory JAMBA).

Other Commonwealth environmental watering actions focused on and successfully delivered flows to maintain critical refuge habitats as well as maintain and improve vegetation condition at sites throughout the Murrumbidgee catchment, including in the Gayini Nimmie-Caira, North Redbank and Toogimbie Indigenous Protected Area, and selected mid-Murrumbidgee and Junction wetlands via pumping.

The NSW Department of Primary Industries – Water reported in their mid May 2019 allocation statement, that the Murrumbidgee Valley has experienced 'near extreme dry' (96th percentile) inflows in 2018-19, which are the lowest inflows since the Millennium drought ended in 2010. The Bureau of Meteorology outlook for June to August, issued on 30 May 2019, shows below average winter rainfall is likely for the catchment with warmer than average temperatures.

A number of assets have been identified as having a high or critical demand for environmental water in 2019-20. However, the capacity to contribute to some of these environmental needs is contingent on significant improvements to anticipated water availability in the catchment for 2019-20 (refer to section 2.3). With the potential for hot and dry conditions to persist into 2019-20 and consequently limited environmental water availability, the Commonwealth environmental water office will focus on the provision of refuge habitat for native fish and other aquatic fauna.

Environmental water demands for environmental assets in the Murrumbidgee catchment in 2019-20, formed in consultation with delivery partners, are represented in Table 3 and summarised below:

Mid-Murrumbidgee wetlands: High to critical demand. The mid-Murrumbidgee River Wetlands are a key environmental asset within the Basin. The condition of the mid-Murrumbidgee wetlands is generally poor due to a lack of repeated inundation. Ideally, inundation of low-level wetlands through reconnection with the Murrumbidgee River is required annually to continue improving the condition of vegetation. Natural flooding in September-October 2016 inundated many wetland assets, some for the first time in over four years and was followed up by a managed low-level inundation action in July-August 2017.

Subject to available allocations, environmental water is required in 2019-20 to again 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.

Since 2013, a small number of individual wetlands in the mid-Murrumbidgee have received environmental water on an annual basis for a number of years via the use of infrastructure (pumping). Monitoring of ecological responses at two of these wetlands, Yarradda and Gooragool lagoons, has demonstrated the capacity for these assets to recover following repeat years of seasonal inundation.

Despite widespread natural flooding in 2016–17 and the low-level mid-Murrumbidgee inundation in 2017-18, the mid-Murrumbidgee wetlands and Lowbidgee floodplain water requirements remain out of phase with prevailing climatic conditions (i.e. the poor ecological condition of the mid-Murrumbidgee

means environmental demand remains High under all inflow scenarios, whereas the relatively better ecological condition of the Lowbidgee means environmental demand can follow inflow scenarios). In the future, following further successful inundation and improvements in condition of the mid-Murrumbidgee wetlands, it is anticipated environmental demand for these assets will be more closely aligned allowing a more whole of system watering strategy that is consistent with prevailing climatic conditions and inflow scenarios.

Under a limited resource availability scenario, environmental watering will focus on maintaining key refuge wetland sites (such as Yarradda and Gooragool Lagoons) and recent improvements to wetland vegetation condition through the use of infrastructure (pumping).

Yanco Creek wetland floodplain system: High demand overall. Wetland vegetation is generally in good condition overall, with inundation required this year to maintain this condition. Delivery for vegetation outcomes will also consider integration with in-channel native fish actions.

Wanganella Swamp has a critical demand for water due to the risk of losing aquatic vegetation species. Commonwealth environmental water will be pumped to this site under a very low water inflow scenario.

Lowbidgee floodplain wetlands: Generally in moderate to good condition; environmental demand in 2019-20 at a system scale is driven by prevailing climatic conditions (ie the scale of watering targeted across the Lowbidgee floodplain will reflect the conditions of the catchment, so as conditions become wetter, the area inundated is also expected to increase, subject to available allocations and competing demands). Environmental water use in 2018-19 focussed on supporting young-of-year golden perch population in Yanga Lake and maintaining refuge habitat 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 focus will be to maintain core refuge sites (a key recommendation from LTIM reporting (Wassens et al 2016 a, b)) and trigger southern bell frog breeding at key sites in Gayini Nimmie-Caira where populations have declined over the past four years (S Wassens (Charles Sturt University) pers. comm., 15 May 2019). 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), Gayini 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 remains poor.

Environmental water delivered in-channel will focus on native fish condition and recruitment through improvements to fish passage and connectivity, aquatic habitat and riverine productivity. This may be achieved through the opening of Lowbidgee weirs and promoting return flows from the floodplain.

Under very low or very high inflow scenarios Commonwealth environmental water will be prioritised to provide aquatic habitat refuge in response to poor water quality and low dissolved oxygen conditions.

Junction Wetlands: High demand. Despite early environmental watering followed by widespread natural flooding in 2016-17; the ecological condition of the Junction Wetlands generally remains very poor due to a lack of repeated natural inundation. The two wetland sites that have received infrastructure assisted environmental water annually are recovering. Any opportunity for inundation will help consolidate responses from environmental watering undertaken since 2015-16 and unregulated flows in 2016-17.

Under a drier inflow scenario Commonwealth environmental water will focus on pumping of individual wetland sites (including Waldaira Lagoon and Mainie Swamp) to provide refuge habitat and maintain recent improvements to vegetation.

Murray–Darling Basin-wide environmental watering strategy and 2019–20 annual priorities

The Murray–Darling Basin Authority publish the Basin annual environmental watering priorities each year and have published multi-year priorities since 2017-18. There are no specific 2019–20 Basin annual environmental

watering priorities relevant to the Murrumbidgee catchment, however the rolling annual priorities are applicable.

Rolling, multi-year priorities

The rolling, multi-year priorities for river flows and connectivity are to:

- Support lateral and longitudinal connectivity along the river systems.

The rolling, multi-year priorities for native vegetation are to:

- Maintain the extent, improve the condition and promote recruitment of forests and woodlands.
- Maintain the extent and improve the condition of lignum shrublands.

The rolling, multi-year priorities for waterbirds are to:

- Improve the abundance and maintain the diversity of the Basin's waterbird population.

The rolling, multi-year priorities for native fish are to:

- Support Basin-scale population recovery of native fish by reinstating flows that promote key ecological processes across local, regional and system scales in the southern connected Basin.
- Support viable populations of threatened native fish, maximise opportunities for range expansion and establish new populations.

2.3. Water availability in 2019–20

Forecasts of Commonwealth water allocations

The volume of Commonwealth environmental water likely to be carried over in Murrumbidgee catchment for use in 2019–20 is estimated to be approximately 36.9 GL. Total carryover in the southern-connected Basin is estimated to be 410-420 GL.

Allocations against Commonwealth water entitlements in the Murrumbidgee catchment are determined by state governments 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 2019–20 in the Murrumbidgee catchment as at 31 May 2019.

| Entitlement type | Forecasts of Commonwealth water allocations (including carryover) in 2019–20 (GL) ² | | | | | |
|---|--|---------------|---------------|---------------|---------------|---------------|
| | Very dry ←————→ Very wet | | | | | |
| | 95 percentile | 90 percentile | 75 percentile | 50 percentile | 25 percentile | 10 percentile |
| Murrumbidgee (general/high security and conveyance) | 55 | 72 | 154 | 231 | 322 | 336 |
| Murrumbidgee (supplementary) ³ | Up to 22 | Up to 22 | Up to 22 | Up to 22 | Up to 22 | Up to 22 |
| Lowbidgee (supplementary) ³ | Up to 393 | Up to 393 | Up to 393 | Up to 393 | Up to 393 | Up to 393 |
| Total – Southern-Connected Basin^{1,4} | 681 | 999 | 1258 | 1630 | 1763 | 2001 |

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/portfolio-mgt/holdings-catchment> 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, natural and unregulated flows, conveyance water and consumptive water. Further detail on sources of environmental water in 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 very low to low resource availability scenarios are in scope for 2019–20. Moderate to very high resource scenarios are only possible if conditions become wetter. As of 15 May 2019, an additional 100,000 ML of inflows into Murrumbidgee dams is required to meet all 1 July 2019 high priority commitments, including full opening allocations to conveyance entitlements. If this shortfall remains through June 2019 it is anticipated that full opening high security and full deliverability of carryover will be met on 1 July 2019, however opening conveyance allocations may be low and would be increased as a priority in 2019–20 (NSW Department of Industry 2019).

2.4. 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 2019–20 is to avoid damage through the provision of critical refuge habitat at key sites and protect or maintain the condition of environmental assets. Under wetter conditions, improvement to ecological condition of important habitats will be in scope. The purpose for the mid-Murrumbidgee wetlands is to protect and avoid damage and remains a priority under all resource scenarios subject to available allocations.

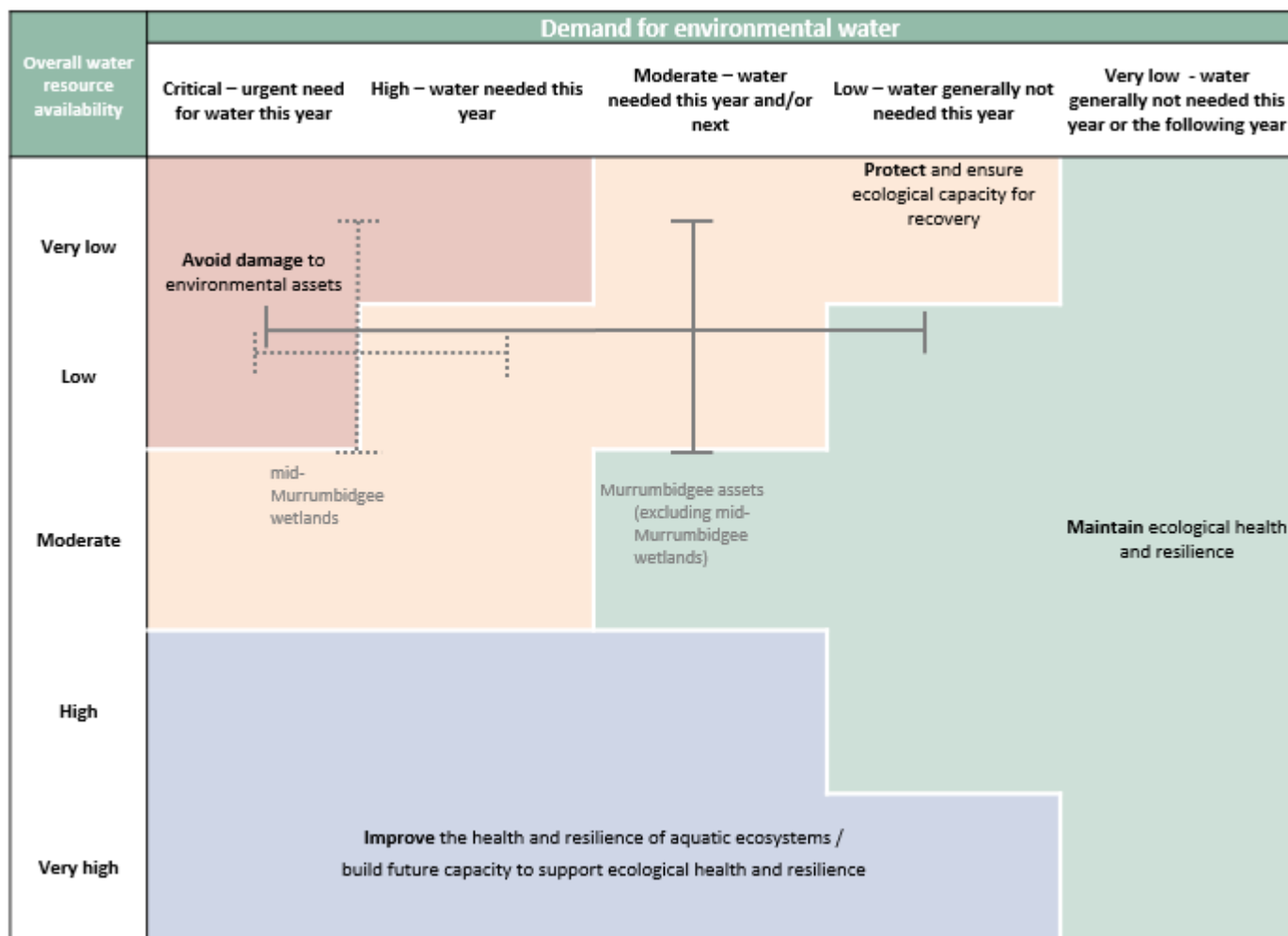


Figure 3: Determining a broad purpose for portfolio management in the Murrumbidgee catchment for 2019–20. Note: dotted lines represent the mid-Murrumbidgee wetlands while unbroken grey lines represent potential range in demand and water resource availability for other assets in the catchment for the 2019-20 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, 2019–20* (available at: <http://www.environment.gov.au/water/cewo/publications>).

2.5. Water Delivery in 2019–20

As in previous years, the use of Commonwealth environmental water will be adaptively managed throughout 2019-20 in response to changing water resource availability and environmental conditions and demands.

Consistent with the demands and purpose described above, the Commonwealth Environmental Water Office is considering supplying environmental water to the following watering actions for 2019–20 (see also Table 3 for supporting information regarding the basis for determining these watering intentions).

Under a very low to low water resource availability, which is anticipated to be in scope for 2019-20, Commonwealth environmental water will target critical refuge habitats in the mid-Murrumbidgee and Lowbidgee. This includes delivery of water to Ramsar listed Fivebough and Tuckerbil Wetlands in the mid-Murrumbidgee to maintain habitat condition to support threatened waterbird species and waterbirds listed under international migratory agreements. As monitoring has indicated, maintaining refuge sites during dry

conditions will be critical in enabling survival of waterbirds, native fish, frogs and turtles (Wassens et al. 2019). Environmental water will also be delivered between October to November to trigger southern bell frog breeding at key sites in Gayini Nimmie-Caira (Lowbidgee), such as Eulimbah, where populations have declined over the past four years (S Wassens (Charles Sturt University) pers. comm., 15 May 2019).

To maintain recent improvements in vegetation condition and/or prevent loss of aquatic vegetation, as well as provide habitat to support survival of waterbirds, native frogs and other aquatic fauna, Commonwealth environmental water will target Wanganella Swamp in the Yanco Creek system and sites in the Junction Wetlands. Should improvements to water resource availability occur other priority wetland sites in the mid-Murrumbidgee and Lowbidgee will be targeted for environmental water to maintain and improve wetland vegetation and provide habitat to support survival of waterbirds, native fish and other aquatic animals.

If low inflows and dry conditions result in a decline in water quality in-stream or wetland environments across the Murrumbidgee catchment, environmental water will target refuge habitat for aquatic animals, including native fish, subject to available allocations.

Larger scale wetland and floodplain inundation including river-floodplain connection will be targeted should moderate and wet scenarios arise during 2019-20. This would include potential for Lowbidgee supplementary access. The scale of watering will be informed by prevailing climatic conditions and subject to water availability. Target sites will include wetland and floodplain assets in North Redbank system, South Redbank (including Yanga National Park), Gayini Nimmie-Caira (Eulimbah, Telephone and Suicide floodways and Nap Nap Swamp), Western Lakes and potentially the Yanco Creek system. See Action 4 in [Attachment B](#) for standard operational arrangements.

River-floodplain connectivity in the lower Murrumbidgee may be supported by in-channel flows targeting native fish movement and recruitment and in-channel productivity. This will be considered under moderate and wet scenarios.

Considering the relative high mobility of waterbirds, watering actions that contribute to maintaining waterbird habitat or support waterbird breeding within the Murrumbidgee catchment may also benefit waterbird populations more broadly (e.g. across the Macquarie, Lachlan, and Mid-Murray catchments (see CSIRO, 2019)). Under moderate - wetter scenarios, actions targetting cross-catchment landscape-scale objectives will be considered.

A key priority for Commonwealth environmental water remains a low-level mid-Murrumbidgee wetlands reconnection action. Based on the forecast low water resource availability for 2019-20 there is insufficient environmental water holdings for this action to proceed in winter 2019. Should conditions become wetter and environmental water availability improve throughout 2019-20, a low-level reconnection may be possible in autumn-winter 2020. The aim is to contribute to river flows and inundation of fringing wetlands to continue improvement and promote recovery 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. The refinement of arrangements to provide for return flows of environmental water from the Murrumbidgee to the Murray (a "pre-requisite policy measure" required to be in place on 1 July 2019 under the Basin Plan) will enable Commonwealth environmental water used in the Murrumbidgee River to be credited as return flows for further environmental use downstream in the River Murray.

Stakeholder Feedback

Proposed watering actions have been developed in consultation in with key delivery partners, including the NSW Department of Planning, Industry and Environment, other NSW agencies (including NSW Department of Primary Industries - Fisheries, Gayini Nimmie-Caira Core Team, Murrumbidgee EWARG) and Charles Sturt University, who are contracted to provide the Monitoring Evaluation and Research program (previously the Long Term-Intervention Monitoring Project) in the Murrumbidgee.

2.6. Trading water in 2019–20

The Water Act 2007, requires the Commonwealth Environmental Water Holder to trade for the purpose of protecting and restoring the environment. In addition to the obligations of the Water Act 2007, the CEWH and CEWO staff are required to comply with a wide range of existing legislative requirements. This includes: financial management arrangements for Commonwealth agencies; freedom of information; and policies relating to information management, auditing, employee conduct and accountability.

Large parts of the Basin are currently experiencing pressures from water scarcity, with declining storage levels, low allocations and rainfall deficiencies evident in most catchments. It is likely that insufficient water resources will constrain proposed actions. 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 2019-20, possible administrative transfers between environmental water accounts to enable environmental water delivery include:

- small (~30 GL) within the Murrumbidgee, due to the small size of allocations available for environmental watering activities;
- small (~30 GL) into the Murrumbidgee trade zone 13, if required and allowable given trade limits.

No specific commercial trade of water in the Murrumbidgee has been identified for 2019-20. Trade opportunities will be reviewed in the valley throughout the water year and as conditions change. Planning on water trade considers: supply and demand within the catchment and across the Basin. As part of the planning process, the Commonwealth Environmental Water Office undertakes a Basin-wide analysis to identify opportunities to use allocation trade to better match differing demands across catchments. Consideration is given to the water available to meet both current and future environmental needs. Additionally these decisions are influenced by current climatic conditions, as well as implications of trade for commercial outcomes in communities.

Further information will be provided to the market ahead of any trade of Commonwealth environmental water at: <http://www.environment.gov.au/water/cewo/trade>

For more information on the rules and procedures governing the trade of Commonwealth environmental water, see the *Commonwealth environmental water Trading Framework* available at: <http://www.environment.gov.au/water/cewo/publications/water-trading-framework-nov2016>

2.7. Carrying over water for use in 2020–21

The volume of water carried over for use in 2020–21 will depend upon resource availability and demand throughout the year. As the 2019–20 water year progresses, a carryover target will be determined for the Murrumbidgee Catchment, sufficient to meet early season requirements. As documented in Table 3 below, potential demands in 2020–2021 include:

- low-level mid-Murrumbidgee wetlands reconnection
- Lowbidgee Floodplain and Junction Wetlands watering actions, including returning flows from the floodplain to the river.
- Yanco-Billabong watering actions
- supporting native fish through restoring ecologically significant flow components impacted by river regulation, including through the provision of lateral (floodplain) and longitudinal (in-channel) connections.

This volume is also reserved as a contingency volume for use in 2019–20 should there be insufficient allocations available and there is a critical need for environmental water (e.g. 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 here:

<http://www.environment.gov.au/water/cewo/portfolio-mgt/carryover>

2.8. Identifying Investment Opportunities

Under the *Water Act 2007*, the Commonwealth Environmental Water Holder (CEWH) has the flexibility to use the proceeds from the sale of water allocations to fund environmental activities in the Basin.

'Environmental activities' must be consistent with the CEWH's obligation to exercise their function to protect and restore environmental assets. Environmental activities must also improve the capacity of the CEWH to meet the objectives of the Basin Plan environmental watering plan, and be directly linked to current or future delivery of water for the environment.

The option of investing the proceeds in environmental activities will be considered alongside other available water management options, such as purchasing water at another time or place. The CEWH is finalising an Investment Framework and an Annual Investment Plan to inform future investment in environmental activities.

Table 3: Environmental demands, priority for watering in 2019–20 and outlook for coming year in the Murrumbidgee catchment.

| Environmental assets | Indicative demand (for <u>all sources of water</u> in the system) ¹ | | Watering history | 2019-20 | | Implications for future demands |
|--|---|---|---|--|---|---|
| | Flow/Volume | Required frequency (maximum dry interval) | (from all sources of water) The Murrumbidgee catchment benefited from a major rain (unregulated) event in spring (Sep) 2016 which resulted in good natural flow events during Sep-Oct 2016 | Environmental demands for water | Potential Commonwealth environmental water contribution? | Likely environmental demand in 2020–21 if watering occurred as planned in 2019–20 |
| Mid-Murrumbidgee Wetlands ² | Infrastructure assisted delivery to individual high priority wetland assets targeting provision of refuge habitat and maintenance of wetland vegetation (minimum of 4 GL required under a very low inflow scenario to support critical refuge requirements) | 8 in every 10 years – annual (2 years) | Demand met or partially met over the last 5 years | HIGH to CRITICAL To provide refuge habitat for aquatic animals and maintain established aquatic habitat. However overbank connection is preferred | High Potential for water use under Very Low to Moderate inflow scenarios Up to 16 GL (volume contributed will be dependent on resource availability/antecedent conditions, with a minimum of 4 GL required under a Very Low inflow scenario) | HIGH TO CRITICAL |
| | Tombullen storage releases to augment flows over 13 GL/day at Darlington Point | 7–8 in every 10 years (2 years) | Demand met or partially met over the last 3 years | HIGH The condition of the mid-Murrumbidgee wetlands is generally poor due to a lack of inundation. | High Potential for water use under Moderate to High inflow scenarios subject to natural flow event triggers Up to 10 GL per event | HIGH |
| | Minimum of 15.5 GL/day @ Darlington Point for up to 6 days plus a gradual recession targeting low-lying wetland vegetation and aquatic habitat up to 230 GL | 7–8 in every 10 years (2 years) | Demand met 2 out of the last 5 years, last met 2017-18. | HIGH The condition of the mid-Murrumbidgee wetlands is generally poor due to a lack of inundation. | Up to 150 GL under Moderate to High inflow scenarios planned for autumn/winter 2020 subject to available allocations | HIGH |
| Mid-Murrumbidgee Ramsar sites (Fivebough and Tuckerbil wetlands) | Fivebough 500ML to inundate 60% of wetland. | Fivebough: Shallow water 9 in every 10 years. | Fivebough: Required frequency met over the last 5 years. | HIGH Required to maintain ecological character under Ramsar | High Potential for water use minimum of 550 ML under a Very Low inflow scenario | HIGH |
| | Tuckerbil 500 ML to fill | Fill Tuckerbil 4 of every 10 years | Tuckerbil: Required frequency met over last 4 years. | | Moderate to High Potential for water use. Up to 2 GL under Low inflow scenario | |
| Yanco Creek System | Up to 20 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) | Demand met or partially met in 3 of the last 5 years, however watering required to maintain condition of wetland-floodplain vegetation | MODERATE Watering, required to maintain the good condition of wetland-floodplain vegetation | Low to Moderate Potential for water use Up to 20 GL under Moderate to High inflow scenarios. Supplementary use prioritised if available. | MODERATE, subject to natural cues |

¹ Volumes may be limited by current channel constraints. Roberts and Marston (2011), Hardwick and Maguire (2012), Alluvium (2013)

² Note: Difference 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 requirements vary accordingly

| Environmental assets | Indicative demand (for <u>all sources of water</u> in the system) ¹ | | Watering history | 2019-20 | | Implications for future demands |
|--|---|---|---|---|---|---|
| | Flow/Volume | Required frequency (maximum dry interval) | (from all sources of water) The Murrumbidgee catchment benefited from a major rain (unregulated) event in spring (Sep) 2016 which resulted in good natural flow events during Sep-Oct 2016 | Environmental demands for water | Potential Commonwealth environmental water contribution? | Likely environmental demand in 2020-21 if watering occurred as planned in 2019-20 |
| Yanco Creek System – Wanganella Swamp | Pumping of 1.5 GL to prevent loss of aquatic vegetation species | 7-8 in every 10 years (2 years) | Demand met 1 out of the last 5 years | CRITICAL to prevent loss of aquatic vegetation species (cumbungi rhizomes) | High Potential for water use Up to 1.5 GL under Very Low to Moderate inflow scenarios. | HIGH |
| Yanco Creek System – Wanganella Swamp and Forest Creek | Up to 5 GL targeting wetland and black box vegetation communities | 3 in every 10 years (3 years) | Demand met or partially met in 3 of the last 5 years | MODERATE Watering following natural cues to maintain condition of wetland-floodplain vegetation | Moderate Potential if natural flow event triggers an opportunity under Moderate to High inflow scenario. Supplementary use prioritised if available. | LOW, subject to natural cues |
| Lowbidgee - Core refuge and permanent aquatic habitat sites (includes pumping to Toogimbie Indigenous Protected Area) | Up to 40 GL targeting critical refuge habitat requirements (minimum of 8.5 GL is required under a Very Low inflow scenario to meet these needs) | Annual | Demand met over the last 5 years | HIGH to CRITICAL Annual watering required for critical habitat requirements | High Potential for critical/permanent habitats. Volume contributed will be dependent on resource availability/antecedent conditions, with a minimum of 8.5 GL required under a Very Low inflow scenario increasing to 40 GL under Moderate inflow scenarios | HIGH to CRITICAL |
| Lowbidgee – Rookery sites | Up to 30 GL in the event of naturally triggered colonial waterbird breeding | As required in response to naturally triggered colonial bird breeding event | As required | HIGH to CRITICAL to support successful completion of waterbird breeding events | Low Potential, unless colonial waterbird breeding is naturally triggered under Moderate to Very High inflow scenario | HIGH to CRITICAL |
| Lowbidgee - North Redbank³ | Up to 40 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) | Met or partially met over the last 5 years | MODERATE Watering following natural cues, to maintain the good condition of wetland-floodplain vegetation | Moderate Potential for wetland inundation Up to 20 GL under Moderate to High inflow scenarios | LOW, subject to natural cues |
| Lowbidgee - Yanga National Park³ | Up to 30 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) | Met or partially met over the last 5 years | LOW Watering following natural cues to maintain the good condition of wetland-floodplain vegetation | Low Potential for wetland inundation Up to 20 GL under Moderate to High inflow scenarios | MODERATE, subject to natural cues |

³ Cumulative volume - includes volume allocated for this asset under Lowbidgee Core refuge and permanent aquatic habitat

| Environmental assets | Indicative demand (for <u>all sources of water</u> in the system) ¹ | | Watering history | 2019-20 | | Implications for future demands |
|---|--|---|---|---|--|---|
| | Flow/Volume | Required frequency (maximum dry interval) | (from all sources of water) The Murrumbidgee catchment benefited from a major rain (unregulated) event in spring (Sep) 2016 which resulted in good natural flow events during Sep-Oct 2016 | Environmental demands for water | Potential Commonwealth environmental water contribution? | Likely environmental demand in 2020–21 if watering occurred as planned in 2019–20 |
| Lowbidgee - Gayini Nimmie-Caira³ | Up to 40 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 | Met or partially met over the last 5 years | HIGH Watering following natural cues to maintain the good condition of wetland-floodplain vegetation | High Potential for wetland inundation Up to 30 GL under Moderate to High inflow scenarios | MODERATE, subject to natural cues |
| Lowbidgee - Fiddlers-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 | Met 2 out of the last 5 years | LOW Watering following natural cues to maintain the good condition of wetland-floodplain vegetation | Low Potential for wetland inundation Up to 10 GL under High inflow scenarios | LOW, subject to natural cues |
| Lowbidgee - Western Lakes | Up to 30 GL to maintain open water habitats and floodplain vegetation | Wetland habitats and open water, black box and lignum wetlands every 3 to 7 years | Met or partially met over the last 5 years | MODERATE Watering following natural cues, to maintain open water bodies and good condition of wetland-floodplain vegetation | Moderate Potential Up to 20 GL under Moderate to High inflow scenario | MODERATE, subject to natural cues |
| Lowbidgee full system watering | Up to 180 GL ⁴ for Basin-wide waterbird habitat and future population recovery. Improve overall condition of the floodplain. Prioritise use of up to 393 GL of Lowbidgee supplementary allocations if made available. | Opportunistic based on natural occurring rain and flow events | Met or partially met over the last 5 years | HIGH Improve the complexity and health of priority waterbird habitat to maintain species richness and aid future population recovery | Low Potential Up to 90 GL under High inflow scenario. Up to 393 GL of Lowbidgee supplementary allocations will be prioritised if made available under High to Very High inflow scenarios. | HIGH |
| Murrumbidgee River channel, distributaries and anabranches | Contribute up to 10 GL from Tombullen storage to higher river flows (freshes) in spring-summer to support native fish spawning, recruitment, movement and dispersal. | 7 in every 10 years | Met 2 out of the last 5 years | MODERATE Watering following natural cues, required to continue recovery of native fish populations. | Moderate Potential Up to 5 GL if natural flow event triggers an opportunity under Moderate to High inflow scenario. | LOW |

⁴ Cumulative volume – includes volumes of all Lowbidgee wetland actions listed above.

| Environmental assets | Indicative demand (for <u>all sources of water</u> in the system) ¹ | | Watering history | 2019-20 | | Implications for future demands |
|----------------------|--|---|---|---|--|---|
| | Flow/Volume | Required frequency (maximum dry interval) | (from all sources of water) The Murrumbidgee catchment benefited from a major rain (unregulated) event in spring (Sep) 2016 which resulted in good natural flow events during Sep-Oct 2016 | Environmental demands for water | Potential Commonwealth environmental water contribution? | Likely environmental demand in 2020–21 if watering occurred as planned in 2019–20 |
| | Moderate in-channel pulse targeting native fish movement and recruitment, productivity and in-stream vegetation (flows >3500 ML/day at Balranald) up to 50 GL | 7 in every 10 years | Met 2 out of the last 5 years | MODERATE 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 | Moderate Potential Up to 40 GL under Moderate to High inflow scenarios | MODERATE |
| | Distributary and anabranch freshes to restore flow components most impacted by river regulation and support native fish up to 15 GL | 7 in every 10 years to annual | Demand met 2 out of the last 5 years | MODERATE Watering following natural cues to maintain the good condition of wetland-floodplain vegetation | Moderate Potential subject to natural cues up to 10 GL | MODERATE, subject to natural cues |
| | Contribute to managing water quality issues within in-stream and wetland environments across the Murrumbidgee Catchment | Contingency in response to poor water quality | As required | CRITICAL Provide refuge habitat for aquatic animals due to poor water quality, including potential hypoxic conditions. | Contingency in response to poor water quality/aquatic habitat availability. This may include up to 15 GL contingency under very low to low inflows, in the absence of IVT (Lower Murrumbidgee weir pool stratification, high risk fish kills). | CRITICAL (Contingency) |
| Junction Wetlands | Flows greater than 5 GL/day @ d/s Balranald Weir and >10 GL/day on the Murray@ Murrumbidgee confluence targeting wetland vegetation and habitat for native fish, frogs, turtles and waterbirds | 5 in every 10 years | Demand met in 3 of the last 5 years | HIGH The condition of the Junction Wetland is generally poor due to a lack of inundation | Low Potential under low inflows. Requires Lowbidgee Supplementary allocations under Moderate to High inflow scenarios subject to return flow (PPM) accounting and spill risk downstream. | 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 | Demand met in 3 of the last 5 years | HIGH The condition of the Junction Wetland is generally poor due to a lack of inundation | Low Potential under low inflows. Likely to be achieved by other environmental watering actions and also through Lowbidgee Supplementary allocations under Moderate to High inflow scenarios | HIGH |
| | Pumping to individual high priority wetland assets targeting wetland vegetation and refuge habitat for native fish, frogs, turtles and waterbirds | 7–8 in every 10 years (2 years) | Demand met in 4 of the last 5 years | HIGH TO CRITICAL To support continued recovery of wetland vegetation and provide refuge habitat | HIGH Potential for water use up to 3 GL under Very Low to Moderate inflow scenarios (volume contributed will be dependent on resource availability/antecedent conditions, with a minimum of 1.5 GL required under a Very Low inflow scenario) | HIGH |

| Environmental assets | Indicative demand (for <u>all sources of water</u> in the system) ¹ | | Watering history | 2019-20 | | Implications for future demands |
|----------------------|--|---|---|---------------------------------|--|---|
| | Flow/Volume | Required frequency (maximum dry interval) | (from all sources of water) The Murrumbidgee catchment benefited from a major rain (unregulated) event in spring (Sep) 2016 which resulted in good natural flow events during Sep-Oct 2016 | Environmental demands for water | Potential Commonwealth environmental water contribution? | Likely environmental demand in 2020–21 if watering occurred as planned in 2019–20 |
| | | | | Carryover potential | The volume of Commonwealth environmental water likely to be carried over in Murrumbidgee catchment for use in 2019–20 is estimated to be low subject to Commonwealth environmental water holdings at 30 June 2020, water resource availability and environmental watering actions undertaken in 2019-20. | Available allocations to be carried into 2020–21 will be identified in Murrumbidgee environmental water holdings at https://www.environment.gov.au/water/cewo/about/water-holdings . |
| | | | | Trade potential | Small transfers into the Murrumbidgee may be required for priority environmental use. No specific commercial trade of water has been identified for 2019-20. Trade opportunities will be reviewed throughout the water year and as conditions change. | Potential to trade will depend on environmental demands, resource availability and market conditions. |

Key - potential watering in 2019–20

| | |
|--|---|
| | High priority for Commonwealth environmental watering (likely to receive water even under low water resource availability) |
| | Secondary priority for Commonwealth environmental watering (watering to occur only if natural trigger is met, or under moderate – high water resource availability); or water demand likely to be met via other means |
| | Low priority for Commonwealth environmental watering (under high – very high water resource availability) |
| | Unable to provide Commonwealth water due to constraints |

Key - environmental demands

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

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 Commonwealth Environmental Water 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.

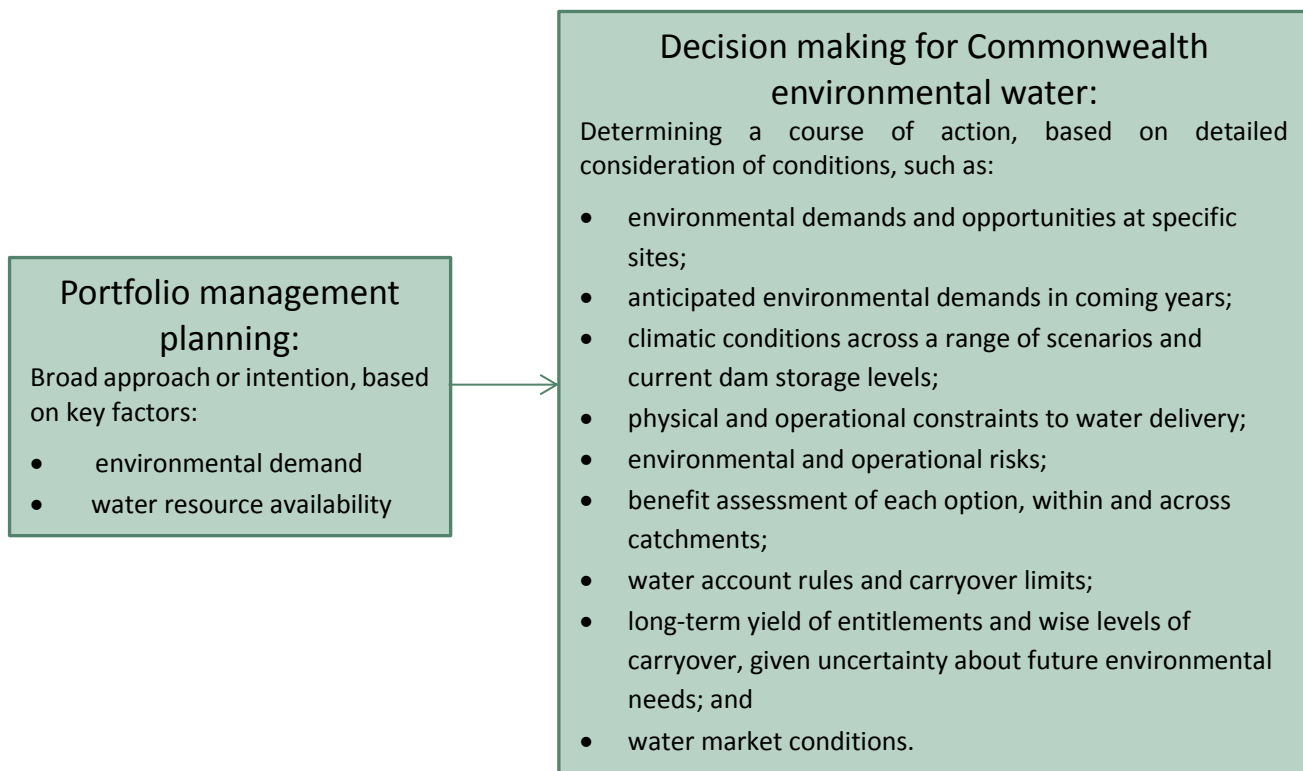


Figure 4: Planning and decision making for Commonwealth environmental water use

3.2. Monitoring

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 systems hydrograph, area of inundation and river levels. It can also include observations of environmental outcomes.

The Monitoring, Evaluation and Research (MER) Program (previously the Long Term Intervention Monitoring Project 2014-2019) has sites in the mid-Murrumbidgee Wetlands, Lowbidgee Floodplain and Murrumbidgee River as focus areas. It aims to understand the environmental response from Commonwealth environmental watering with respect to the targeted objectives by carrying out monitoring of site condition over many years.

Information on the monitoring activities is available at <https://www.environment.gov.au/water/cewo/catchment/murrumbidgee/monitoring>.

Monitoring information is also provided by state governments and The Living Murray program.

3.3. Further information

For further information on how the Commonwealth Environmental Water 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: <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 extent⁵

| 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

Important Basin environmental assets for waterbirds in the Murrumbidgee

⁵ Area (ha) (+/- 10%) is based on Cunningham et al (2013), cited in MDBA (2014)

| Environmental asset | Total abundance and diversity | Drought refuge | Colonial waterbird breeding | Shorebird abundance | In scope for Commonwealth watering |
|----------------------|-------------------------------|----------------|-----------------------------|---------------------|------------------------------------|
| Fivebough Swamp | * | | | * | Yes |
| 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 – Operational details for watering

Operational considerations in the Murrumbidgee catchment

The delivery of environmental water in the Murrumbidgee catchment 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 2016). 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, noting that the Water Sharing Plan specifies a flow limit of 32,000 ML/day at 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. This limit reflects loss rates within Yanco Creek, not a flooding threshold, and may be relaxed subject to NSW Minister (or delegate) approval.
- 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 2017, Water NSW managed environmental flows to a maximum of 23,000 ML/day at Wagga Wagga for the winter mid-Murrumbidgee wetland reconnection action with significant coordination and notification of potentially affected landowners by NSW Department of Planning, Industry and Environment. No landholder complaints or third party impacts were reported or observed. 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 levels of water resource availability

Under certain levels of water resource availability, 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 Murrumbidgee catchment and the levels of water resource availability that relate to these actions.

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

| Broad Asset | Indicative demand ¹ | 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 Tombullen storage releases to augment flows over 13 GL/day at Darlington Point | Option a priority but unlikely under these inflow scenarios. | | <i>Reconnection action:</i> 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 these scenarios. |
| | Infrastructure assisted delivery to individual sites for refuge habitat and wetland vegetation up to 16 GL | <i>Critical Habitat provision:</i> support critical fauna and flora habitat requirements and recruitment opportunities | 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 these scenarios. | |
| | Infrastructure assisted delivery to Ramsar sites (Fivebough and Tuckerbil wetlands) up to 2 GL | <i>Critical Habitat provision:</i> support critical habitat requirements for waterbirds. | Maintain Ramsar ecological character and contribute to habitat to support survival, maintain condition and breeding of waterbirds and native aquatic biota (including fish, turtles, frogs and invertebrates). | | Option unlikely to be required under these scenarios. | |
| Yanco Creek system | Yanco Wetlands (up to 20 GL action @ Yanco off-take). Prioritise use of SAL if available | Option a priority but unlikely under these inflow scenarios. | | <i>Yanco Creek System:</i> Contribute to flows reconnecting and refilling the anabranch creeks and lagoons located in the mid-Yanco Creek system. Prioritise SAL if available. | | Option unlikely to be required under this scenario. |

¹ Volume limited by current channel constraints. Volumes will be scaled according to inflow scenario and resource availability.

| Broad Asset | Indicative demand ¹ | Applicable inflow scenario | | | | |
|--|--|---|--|----------|---|---|
| | | Very Low | Low | Moderate | High | Very High |
| | Infrastructure assisted delivery to Wanganella Swamp up to 1.5 GL | <i>Critical Habitat provision:</i> Prevent loss of aquatic wetland vegetation species and provide habitat to support survival and maintain condition of waterbirds and native aquatic biota | | | Option unlikely to be required under these scenarios. | |
| | Wanganella Swamp and Forest Creek system up to 5 GL² | Option unlikely under this inflow scenario. | Contribute to flows to reconnect and refill Wanganella Swamp and Forest Creek to maintain vegetation condition. Prioritise use of supplementary water if available. | | | Option unlikely to be required under these scenarios. |
| Lowbidgee - Core refuge and permanent aquatic habitat sites | Up to 40 GL | <i>Critical Habitat provision:</i> support critical fauna and flora habitat requirements and provide breeding opportunities. Includes infrastructure assisted delivery to Toogimbie IPA. | | | Option unlikely to be required under these scenarios. | |
| Lowbidgee - North Redbank | Up to 40 GL³ wetland and 5 GL rookery | Option a priority but unlikely under this inflow scenario. | <i>Wetland inundation:</i> 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. <i>Wetting-Drying cycle:</i> 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. | | | <i>Bird breeding event contingency:</i> 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. <i>Lowbidgee Supplementary:</i> Utilise a portion of river flows to contribute to outcomes as per <i>Wetland Inundation</i> objectives for regulated allocations. |
| Lowbidgee - Yanga National Park | Up to 30 GL³ wetland and 10 GL rookery | | | | | |
| Lowbidgee - Gayini Nimmie-Caira | Up to 40 GL³ wetland and 15 GL rookery (key wetland and rookery sites) | | | | | |
| Lowbidgee - Fiddlers-Uara | Up to 20 GL | | | | | |

² Cumulative volume - includes volume Wanganella Swamp infrastructure delivery action

³ Cumulative volume - includes volume allocated for this asset under Lowbidgee Core refuge and permanent aquatic habitat.

| Broad Asset | Indicative demand ¹ | Applicable inflow scenario | | | | |
|--|---|---|-----|---|---|---|
| | | Very Low | Low | Moderate | High | Very High |
| Lowbidgee - Western Lakes | Up to 30 GL (Open water habitats and vegetation) | Option unlikely to be required under these scenarios. | | Top-up to partially fill Paika Lake to provide habitat to support and maintain condition of waterbirds, native fish and other aquatic species and to maintain condition of floodplain vegetation communities | Maintain condition of floodplain vegetation communities and provide habitat to support and maintain condition of waterbirds, native fish and other aquatic species. | |
| Lowbidgee Full System Floodplain Watering | Up to 180 GL (cumulative volume encompassing above Lowbidgee wetland actions). Up to 393 GL of Lowbidgee supplementary allocations will be prioritised for use if made available. | Option unlikely to be required under these scenarios. | | | Improve or maintain the character, condition and resilience of floodplain vegetation communities. Basin-wide waterbird habitat & future population recovery | |
| Murrumbidgee River Channel, distributaries and anabranches | Late spring-early summer in-channel flows up to 10 GL | Option a priority but reduced likelihood of natural trigger events under these scenarios. | | Restoring natural flow variability: Contribute to higher river flows (freshes) in the Murrumbidgee River channel from Tombullen storage to support native fish spawning, recruitment, movement and dispersal, including larval drift. Opportunistic connection to Lowbidgee lakes is predicted. | | Option unlikely to be required under this scenario. |
| | Moderate in-channel pulse (>3500 ML/day at Balranald) up to 50 GL | Option a priority but unlikely under these inflow scenarios. | | 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 up to 15 GL | Option a priority but unlikely under these inflow scenarios | | 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. |

| Broad Asset | Indicative demand ¹ | Applicable inflow scenario | | | | |
|-------------------|---|--|---|--|--|-----------|
| | | Very Low | Low | Moderate | High | Very High |
| | 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 these scenarios. | | 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 | Option a priority but reduced likelihood of natural trigger events under these scenarios. | | <i>Reconnecting event:</i> 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). | | |
| | Flows greater than 7 GL/day @ d/s Balranald Weir | | | | | |
| | Delivery to individual wetland assets to provide refuge habitat and support wetland vegetation recovery up to 3 GL | <i>Critical Habitat provision:</i> support critical fauna and flora habitat requirements and recruitment opportunities | Support recovery of wetland vegetation and provision of 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 these scenarios. | |

Potential watering actions – standard operating arrangements

Table 4 identifies the range of potential watering actions in 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 action will involve the release of environmental water from upper storages when there are no significant rainfall-derived tributary flows. For this action to proceed, sufficient/significant environmental water allocations are required. 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 maximum flow rate is 23,000 ML/day at Wagga Wagga. The Office will continue to pursue opportunities to increase the flow rates to upper limits under the Water Sharing Plan of 28,000 ML/day (4.67 metres gauge height) at Gundagai (noting the limit specified in the Water Sharing Plan is 32,000 ML/day at Gundagai) and 27,500 ML/day (4.68 metres gauge height) at Wagga Wagga.
- 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 required.
- 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 relevant NSW Minister (or Delegate).

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 and Gooragool Lagoons in the mid-Murrumbidgee
 - Gras Innes and Oak Creek via Bundidgerri Creek
 - Fivebough and Tuckerbil wetlands, Yanco Agricultural (McCaughey's) Lagoon, Nericon, Campbells, 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.

- Where higher flows to reconnect wetlands are unlikely, infrastructure assisted delivery to individual wetlands, such as Wanganella Swamp, will be considered.

Typical extent:

- The action will target sites in the mid-Yanco Creek (between Morundah and Yanco Bridge on Kidman Way). Target sites may include the 'Silver Pines' wetland complex and Wanganella Swamp.
- Flows above 1400 ML/day and/or additional volumes delivered through Coleambally Catchment Drain may be required to achieve desired outcomes.
- Agreement from landholders whose properties might be inundated by environmental flows is preferred and are required for infrastructure assisted watering of individual sites.

Approvals:

- Agreement from landholders whose properties might be inundated by environmental flows will be sought.
- 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, and in some cases pumping, 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), Gayini Nimmie-Caira and Fiddlers-Uara Creek systems and

the Western Lakes. The scale of watering actions is dependent on environmental demand and water availability. Pumping environmental water to Toogimbie Indigenous Protected Area (IPA) wetlands will also be targeted.

Approvals:

- Agreement from landholders whose properties might be inundated by environmental flows will be sought and is required for infrastructure delivery.

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 flow rates and lake water levels, connection to Tala and Yanga Lakes may be targeted
- 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 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.

Approvals:

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

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.

Approvals:

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

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). Infrastructure assisted delivery of environmental water to individual wetland sites will be pursued, when higher flows are unlikely to occur.

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 Gayini 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 Gayini 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 Program (Murray-Darling Basin Authority)
- Environmental Water Allowance (New South Wales Department of Planning, Industry and Environment)
- NSW licensed entitlement (New South Wales Department of Planning, Industry and Environment)
- Yanga Lowbidgee entitlement (NSW Parks and Wildlife Service)
- Subject to Inter-Valley Trade rules and account balances, Commonwealth environmental water allocations from other Southern Connected Basin catchments may be transferred to the Murrumbidgee and vice-versa depending on availability and relative priority for use and carryover.

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 (2016) contains provisions under Part 4 for the commitment, identification, establishment and maintenance of planned environmental water. Part 6 Division 1 of the Water Sharing Plan establishes environmental flow rules for Burrinjuck and Blowering dams, and minimum end of system flow targets.

- Transparent releases:
 - Transparent releases from Blowering Dam to the Tumut River are a minimum of 560 ML/day plus any water use expected to occur between the dam and the confluence with the Murrumbidgee River, when inflows are greater than 560 ML/day. When inflows fall below 560 ML/day, release volumes are equal to or greater than 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 when inflows are greater than 615 ML/day. Daily release volumes are calculated based on catchment conditions and storage volumes in Lake Burrinjuck.
- Minimum daily end of system flow targets to be maintained throughout the year in the Murrumbidgee River at Balranald and in Billabong Creek at Darlot (including Murrumbidgee River at Balranald).

