Australian Government

Commonwealth Environmental Water Office

Integrated planning for the use, carryover and trade of Commonwealth environmental water

Murrumbidgee River Valley

2015–16

Front cover image credit: Murrundi Wetlands, Murrumbidgee catchment 2014
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Back cover image credit: Southern bell frog (vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*)
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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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This report should be attributed as 'Integrated planning for the use, carryover and trade of Commonwealth environmental water: Murrumbidgee River Valley 2015–16, Commonwealth of Australia 2015'.

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Table of contents

Commonwealth environmental water portfolio management planning

Purpose of the document

This document consists of two parts. Part I sets out the Commonwealth Environmental Water Office's (the Office) portfolio management planning for the 2015–16 water year and for the following two years. While focussed on the Murrumbidgee Catchment, the identified use, carryover and trading intentions have been considered together with those for other catchments in a Murray-Darling Basin-wide analysis.

Part II of this document establishes the context for how the Office integrates its management of the Commonwealth environmental water portfolio in the Murrumbidgee Catchment and across the Murray-Darling Basin more broadly. It sets out the environmental demands that Commonwealth environmental water may contribute to in the Murrumbidgee Catchment, as well as the long-term supply profile for Commonwealth environmental water. Part II also explains how these two factors are considered together to inform an overall purpose for portfolio management, as well as the most appropriate mix of portfolio management options to maximise the benefits that can be achieved across multiple years.

Purpose of portfolio management planning

Efficient and effective management of the Commonwealth environmental water holdings requires the utilisation of all portfolio management options (use, carryover and trade). To support improved outcomes from water use over time, carryover provides the opportunity to optimise water use across water years and to improve water availability early in a water year, while trade provides further capacity to optimise use over the long-term as well as across catchments.

Through multi-year integrated planning, portfolio management tools such as use, carryover and trade can be strategically managed for maximising environmental outcomes. Integrated portfolio management planning will also support the Office in:

- meeting Basin Plan obligations and contributing to the long-term objectives of the environmental watering plan, the expected outcomes in the Basin-wide environmental watering strategy and Basin annual environmental watering priorities
- managing the Commonwealth environmental water portfolio in response to the demands identified by Basin States in long-term environmental watering plans, once available
- applying adaptive management (including the setting of objectives, evaluating outcomes and informing future decision making)
- providing increased transparency in relation to the Commonwealth Environmental Water Holder's portfolio management (use, trade and carryover) behaviour
- coordinating water use with delivery partners, including developing long-term delivery arrangements.

Scope of integrated portfolio management planning

The following portfolio management options have been determined to be in scope for integrated planning by the Office:

- use
- carryover
- trade of allocations, including:
    - transfer of allocations between connected catchments
    - sale of allocations
    - purchase of allocations.

The Office's portfolio management planning seeks to consider long-term demands (i.e. flow regimes) and supply, covering at least the preceding three years and out to three years.

Part I: Portfolio management planning for 2015–16 in the Murrumbidgee Catchment

1. Purpose and portfolio management for 2015–16

1.1. Overall purpose

Demand for environmental water

Following the breaking of the millennium drought, natural flow events and environmental watering actions resulted in improvements in the condition of many of the wetlands in the lower Murrumbidgee Catchment. However, in some cases particularly in the mid-Murrumbidgee wetlands, limited flows have compromised the recovery of vegetation and the recruitment of fauna such as frogs and turtles. Environmental water demands for environmental assets in the Murrumbidgee Catchment in 2015–16 are represented in Table 2 and summarised below:

***Mid-Murrumbidgee wetlands*:** High demand, environmental water is required this year. By the end of the millennium drought, many areas had not been inundated for over five years (up to 14 year in some cases), with vegetation in critical and declining condition. While flows in 2010–12 have commenced recovery, monitoring results have indicated further watering actions are required to protect these assets from further decline and to assist with their ecological capacity to recover. Identified as a Basin Annual Environmental Watering Priority for 2015–16 - *Improve the condition of wetland vegetation communities in the mid-Murrumbidgee wetlands through a winter or spring fresh.*

***Yanco Creek system*:** Moderate–High demand. Wetland vegetation is generally in good condition, with wetting required this year to maintain this condition.

***Lowbidgee Wetlands*:** Low-Moderate demand. Many of the wetland areas are in moderate condition and improving following natural events, environmental watering and appropriate wetting-drying cycles. Monitoring results have shown a positive vegetation response, along with waterbird and frog breeding, from past environmental watering. Following consecutive seasonal inundation some areas now require a drying period in 2015–16. Maintaining refuge (e.g. for fish, turtles and frogs) sites will be a focus should the Lowbidgee more broadly enter a drying phase.

***Murrumbidgee River Channel and distributaries*:** Moderate demand. Native fish populations are continuing to recover. Previous environmental watering actions have contributed to increased native fish numbers, supported the productivity and biodiversity of fish and microcrustaceans, and supported functions such as nutrient and carbon cycling.

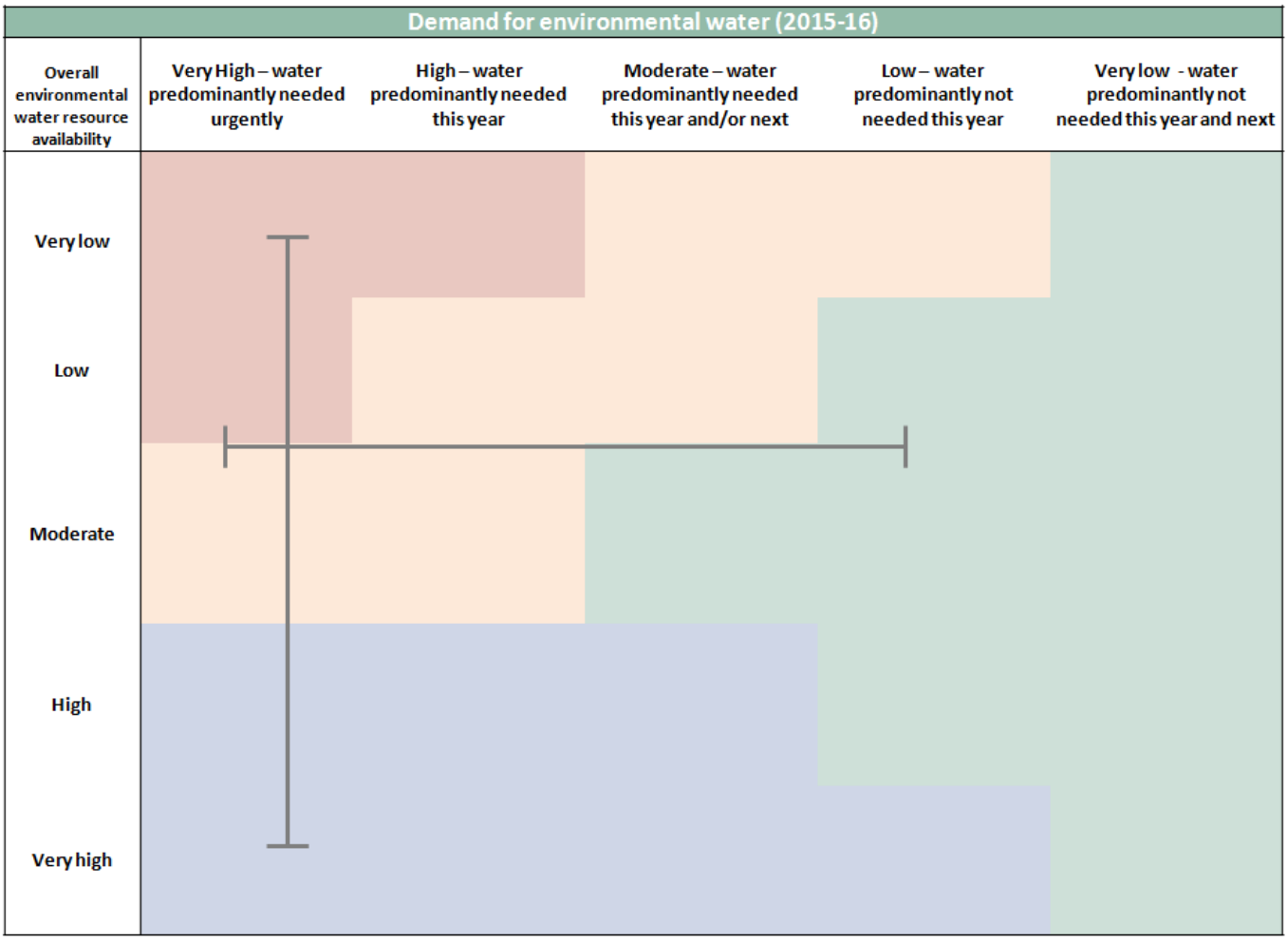
Supply

Water resource availability (supply) in the context of meeting environmental demands is made up of allocations against entitlements held for the environment by the Commonwealth Environmental Water Holder, New South Wales Office of Environment and Heritage and Victorian Environmental Water Holder, as well as natural and unregulated flows, and planned environmental water provisions. Further detail is provided in Part II, Section 4.

Considering carryover of Commonwealth environmental allocations from 2014–15 to 2015–16 and the range of potential opening allocations for 2015–16, along with the full range of potential streamflows, all resource availability scenarios are in scope for 2015–16. However, the condition of the Murray–Darling Basin is likely to be dry for the 2015–16 water year (MDBA 2015). Dry conditions suggest **low to moderate resource availability** is most likely, while high resource availability is only possible if conditions become wet.

Purpose

Figure 1 shows how these two factors are considered together. The overall 'purpose' for managing the Commonwealth's water portfolio in the Murrumbidgee for 2015–16 is to avoid further decline in the mid-Murrumbidgee wetlands and to assist with their ecological capacity to recover, while protecting and maintaining the ecological health and resilience of other important sites in the catchment.



Avoid damage: Avoid damage to environmental assets

Protect: Ensure ecological capacity for recovery

Maintain: Maintain ecological health and resilience

Improve: Improve the health and resilience of aquatic ecosystems / Build future capacity to support ecological health and resilience

Figure 1: Determining a broad purpose for portfolio management in the Murrumbidgee Catchment for 2015–16

Note: grey lines represent potential range in demand and resource availability

1.2. Water Use

Consistent with the demands and purpose described above, the Office is considering supplying environmental water to the following watering actions for 2015–16. Table 1 summarises which of these actions are relevant to which resource availability scenarios in 2015–16, with further detail and rationale established in Table 2a,b and c, including implications for future years based on assumed use behaviour for 2015–16. Table 1 also identifies the 2015–16 Basin annual environmental watering priorities (published by the Murray-Darling Basin Authority) that the various watering actions may contribute to meeting.

Table 1: Potential Commonwealth watering actions and applicable resource availability scenarios for the Murrumbidgee Catchment in 2015–16

Watering action	2015–16 Basin annual environmental watering priority(s)[1]	Resource availability scenarios action is likely to be pursued under		
		Low – very low	Moderate	High – very high
Mid-Murrumbidgee reconnection	• Basin-wide flow variability and longitudinal connectivity • Basin-wide in-stream and riparian vegetation • Mid-Murrumbidgee Wetlands • Basin-wide waterbird habitat and future population recovery • Basin-wide native fish habitat and movement • Silver perch	Unlikely	Yes	Yes
Mid-Murrumbidgee wetland – infrastructure assisted delivery	• Basin-wide in-stream and riparian vegetation • Mid-Murrumbidgee Wetlands • Basin-wide waterbird habitat and future population recovery	Yes	Yes	No
Mid-Yanco Creek Anabranches and Wetlands	• Basin-wide flow variability and longitudinal connectivity • Basin-wide in-stream and riparian vegetation • Basin-wide waterbird habitat and future population recovery • Basin-wide native fish habitat and movement	Yes	Yes	No
Lowbidgee Wetlands (critical habitat requirements (drought refuge, southern bell frog etc))	• Basin-wide in-stream and riparian vegetation • Basin-wide waterbird habitat and future population recovery • Basin-wide native fish habitat and movement	Yes	Yes	Yes

[1] For full details on the Basin annual environmental watering priorities refer to the MDBA website at http://www.mdba.gov.au/what-we-do/environmental-water/environmental-watering-priorities

Restoring natural flow variability	• Basin-wide flow variability and longitudinal connectivity • Basin-wide native fish habitat and movement • Silver perch	No	Yes	Yes (Supplementary)
Native fish flows	• Basin-wide flow variability and longitudinal connectivity • Basin-wide native fish habitat and movement • Silver perch	Yes	Yes	No
Contingency to support significant colonial waterbird breeding events	• Basin-wide waterbird habitat and future population recovery	No	No	Yes
Contingency to support critical habitat requirements	• Basin-wide native fish habitat and movement	Yes	Yes	Yes

Mid-Murrumbidgee Wetlands

Mid-Murrumbidgee Reconnection

Summary: Contribute to river flows (fresh) and inundation of fringing wetlands to continue recovery of wetland vegetation communities, and provide a mosaic of habitat to support survival and maintain the condition of waterbirds and native aquatic biota (including fish, turtles, frogs and invertebrates).

Timing: Targeting winter-spring.

Note: mid-Murrumbidgee wetland and Lowbidgee floodplain water requirements are currently out of phase. In future, following 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.

Operational considerations and feasibility:

- Low headwater storage levels will limit dam release capacities and impact ability to achieve desired flow rates without significant tributary inflows.
- No additional variations from the standard operational considerations (see action 1 in Part II, Section 3.6).

Mid-Murrumbidgee wetland – infrastructure assisted delivery:

Summary: Contribute to wetland inundation, using existing water delivery infrastructure, to refill 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).

Timing: year round

Operational considerations and feasibility:

- Delivery to mid-Murrumbidgee wetlands through pumping is not as ecologically effective as filling the wetlands with a reconnecting river flow. The lack of existing infrastructure means this option is limited to a few discrete sites.
- No variations from the standard operational considerations (see action 2 in Part II, Section 3.6).

Yanco Creek System

Mid-Yanco Creek Anabranches and Wetlands

Summary: This 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.

Timing: year round

Operational considerations and feasibility:

- This action may be pursued with or without a mid-Murrumbidgee reconnection action.
- No variations from the standard operational considerations (see action 3 in Part II, Section 3.6).

Lowbidgee

Lowbidgee Wetlands

Summary: Using regulators, inundate target wetlands across the Lowbidgee to maintain, improve and in some cases promote the recovery of wetland vegetation diversity and condition (lignum, black box and river red gums and associated understory communities such as reeds, sedges and rushes), and provide habitat to support survival and maintain condition of native fish, waterbirds and other aquatic vertebrates (frogs). For parts of the system that have been well watered over previous years, a decision may be made to not provide water to sites that require a drying phase.

Timing: year round

Operational considerations and feasibility:

- Seasonal inundation of wetlands is important for the reproduction and survival of several frog species, including the endangered southern bell frog, in the Lowbidgee.
- 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.
- Many sites received environmental water on a number of occasions over the past three years and may not require water in 2015–16. Consideration will be given to the condition of individual sites as well as prevailing conditions. Any follow-up environmental watering of sites would aim to consolidate benefits from watering in previous years.
- No variations from the standard operational considerations (see action 4 in Part II, Section 3.6).

In-channel flows

Native fish flows:

Summary: Contribute to base flows, freshes and the recession of natural bankfull and overbank flows to protect native fish from adverse hydrology during critical life stages and create favourable conditions for fish reproduction and survival.

Timing: late winter (movement and condition), spring and early summer (spawning and recruitment)

Operational considerations and feasibility:

- Environmental water will be delivered from storages, including Tombullen, and may target reaches along the length of the Murrumbidgee River and main distributaries. Subject to announcements, supplementary allocations may be used to protect a portion of river flows.
- No variations from the standard operational considerations (see action 5 in Part II, Section 3.6).

Restoring natural flow variability:

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

Timing: year round

Operational considerations and feasibility:

- This option will contribute to objectives of the native fish flows.
- Environmental water will be delivered from storages and may target reaches along the length of the Murrumbidgee River and main distributaries. Subject to announcements, supplementary allocations may be used to protect a portion of river flows.
- No variations from the standard operational considerations (see action 6 in Part II, Section 3.6).

Contingency to support significant colonial waterbird breeding events

Summary: Maintain wetland water levels to support the completion of significant waterbird breeding events.

Timing: This option is contingent on conditions throughout the year, but is more likely to be required under wetter scenarios.

Operational considerations and feasibility:

- 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.
- No variations from the standard operational considerations (see action 7 in Part II, Section 3.6).

Contingency to support critical habitat requirements

Summary: Contribute to managing water quality issues and refuge sites within in-stream and wetland environments across the Murrumbidgee Catchment.

Timing: This option is contingent on conditions throughout the year, but is more likely to be required during warmer months.

Operational considerations and feasibility:

- Target flow rates will be dependent on the prevailing conditions, the nature of the water quality/falling water level issue and operational considerations.
- No variations from the standard operational considerations (see action 8 in Part II, Section 3.6).

Stakeholder feedback:

Stakeholder feedback has recommended that a mid-Murrumbidgee reconnection action be pursued as a priority for 2015–16 to promote the recovery of vegetation communities in the mid-Murrumbidgee wetlands after extended drought of 2001–10. It was noted that Commonwealth environmental water was not delivered to the mid-Murrumbidgee wetlands in 2013–15 other than small isolated actions (e.g. Yarradda Lagoon), resulting in a substantial decline in aquatic vegetation communities compared to 2011–13. Stakeholder feedback also noted issues related to third party impacts, constraints and road infrastructure. Feedback will be sought on an ongoing basis as planning transitions to implementation phase (see Section 1.6).

1.3. Carryover

A moderate proportion of allocations available in 2014–15 were carried over to 2015–16. Given the relatively high environmental demands in the Murrumbidgee for 2015–16, if water resource availability remains low, a low proportion of Commonwealth's available allocations for 2015–16 are expected to be carried over to support environmental demands in 2016–17 (see Table 2). The level of available allocations to be carried over to 2016–17 will depend upon resource availability and demand.

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

1.4. Trade

At this time there is no plan to buy or sell allocations in the southern connected basin in 2015–16. Currently, there is only limited market opportunity for allocation purchase to be pursued. The moderate to high demands for environmental water that may extend to 2016–17 mean that the sale of allocations will be considered based on ongoing assessments of environmental demands within the southern connected basin and across the Murray-Darling Basin over the next two years (Table 2). The types of scenarios where the need to adjust the availability of Commonwealth allocations is most likely to arise in coming years include:

- If environmental demands have been met and it is determined that there is sufficient forecast allocation to meet future demands across the southern connected Basin, the market will be assessed to determine if there are opportunities to sell surplus water and secure proceeds to improve the Commonwealth Environmental Water Holder's capacity to meet current or future environmental demands across the Murray-Darling Basin

- If a Basin-scale analysis identifies urgent environmental demands within a particular catchment and allocation purchase provides an opportunity to meet those demands using proceeds from the sale of water in a catchment with less urgent demands

- If conditions were to become wet while environmental demands remain high, market conditions might provide a favourable opportunity to purchase allocations to assist in meeting demands and augmenting natural flows

Refer to the Commonwealth environmental water Trading Framework, which includes operating rules, procedures, and protocols, for further information.

1.5. A note on transfer

Where the need arises to adjust the availability of allocations in the Murrumbidgee Catchment, it should be noted that the transfer of allocations from other southern connected catchments would generally be considered as the preferred and more efficient option to allocation purchase or sale, consistent with the rules identified in state water resource plans that apply to all water users.

1.6. Your input

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

Table 2a: Environmental demands, potential watering in 2015–16 and outlook for coming years in the Murrumbidgee - **VERY LOW TO LOW WATER RESOURCE AVAILABILITY IN 2015–16**

Environmental assets	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)			2015–16			Implications for future demands		
						Predominant urgency of environmental demand for water	Purpose under low to very low resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2016–17 if watering occurred as planned in 2015–16	2017–18 Range of likely demand	Met in 2016–17 Not met in 2016–17
	Flow/volume	Required frequency (maximum dry interval)	2012–13 (mod)	2013–14 (drying)	2014–15 (drying)						
Mid-Murrumbidgee Wetlands[2]	Minimum (~15.5 GL/day @ Darlington Point for 3–5 days plus a gradual recession	7–8 in every 10 years (2 years))				HIGH	**Avoid Damage - Protect**	A high potential for watering in 2015–16 Up to 100GL			
	Target (~27.5 GL/day @ Wagga Wagga for 3–5 days plus a gradual recession)	5–6 in every 10 years (4 years)				HIGH	**Avoid Damage - Protect**	Option unlikely to be achievable under this resource availability.			
Yanco Creek System	~ 40 GL action @ Yanco Creek off-take	3 in every 10 years (3 years)				HIGH	**Protect**	A high potential for watering in 2015–16 Up to 20 GL			
Lowbidgee Floodplain (North Redbank system, South Redbank (Yanga), Nimmie-Caira and Fiddlers-Uara Creek systems and Western Lakes)	Small - (up to 200 GL inflow @ Maude)	9 in every 10 years (3 years)				MODERATE	**Protect-Maintain**	High Potential only for critical habitat requirements targeted (e.g. southern bell frog). Otherwise drying phase for much of Lowbidgee Up to 25GL			
	Moderate - (~400 GL inflow @ Maude)	5 in every 10 years (3 years)				MODERATE	**Protect**	Low Potential. Opportunistic watering subject to supplementary announcement			
	Large - (~800 GL inflow @ Maude)	3 in every 10 years (8 years)				MODERATE	**Protect**	Low Potential. Opportunistic watering subject to supplementary announcement			
Murrumbidgee channel	Winter-spring fresh (~5 GL/day @ Darlington Point - Balranald for 20 days)	7 in every 10 years				MODERATE	**Protect**	A high potential for watering in 2015–16 Up to 50 GL			
	Summer fresh (~1 GL/day @ Darlington Point - Balranald for 20 days)	7 in every 10 years				MODERATE	**Protect**	Low Potential.			

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

Junction Wetlands	>5 GL/day @ d/s Balranald Weir and >10 GL/day @ Barmah on the Murray	5 in every 10 years				VERY HIGH	**Avoid Damage - Protect**	Option unlikely to be achievable under this resource availability.		
							Carryover potential	Low - Moderate proportion of available allocations carried into 2016–17	A low to moderate proportion of available allocations may be carried over to 2016–17	–
							Trade potential	High urgency to augment available allocations for mid-Murrumbidgee wetlands action through the transfer of Commonwealth environmental water into the Murrumbidgee. However limited potential for allocation purchase. Moderate to high demands means allocation sale unlikely.	High urgency to augment available allocations for mid-Murrumbidgee wetlands action through the transfer of Commonwealth environmental water into the Murrumbidgee. However limited potential for allocation purchase. Mod-high demands means allocation sale unlikely.	Potential to trade will depend on environmental demands and resource availability.

Key - events in previous years

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

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

means water did not contribute to meeting demands.

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

Key - potential watering in 2015-16

means a high potential for Commonwealth environmental watering (subject to seasonal and operational considerations)

means a moderate potential for Commonwealth environmental watering, or a partial contribution may be made

means a low potential for Commonwealth environmental watering

Key - urgency of environmental demands

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

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

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

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

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

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

Information for Table 2a, b and c sourced from: Alluvium (2013); Wassens (2015); SKM (2011); MDBA (2012a, 2012b, 2012c, 2012d, 2014c); Roberts and Marston (2011).

Table 2b: Environmental demands, potential watering in 2015–16 and outlook for coming years in the Murrumbidgee - **MODERATE WATER RESOURCE AVAILABILITY IN 2015–16**

Environmental assets	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)			2015–16			Implications for future demands		
						Predominant urgency of environmental demand for water	Purpose under moderate resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2016–17 if watering occurred as planned in 2015–16	2017–18 Range of likely demand	Met in 2016–17 Not met in 2016–17
	Flow/volume	Required frequency (maximum dry interval)	2012–13 (mod)	2013–14 (drying)	2014–15 (drying)						
Mid-Murrumbidgee Wetlands[3]	Minimum (~15.5 GL/day @ Darlington Point for 3–5 days plus a gradual recession	7–8 in every 10 years (2 years))				HIGH	**Avoid Damage - Protect**	High potential for watering in 2014–15 but demand expected to be met by following action Up to 100GL			
	Target (~27.5 GL/day @ Wagga Wagga for 3–5 days plus a gradual recession)	5–6 in every 10 years (4 years)				HIGH	**Avoid Damage - Protect**	A high potential for watering in 2014–15 Up to 150GL			
Yanco Creek System	~ 40 GL action @ Yanco Creek off-take	3 in every 10 years (3 years)				HIGH	**Protect**	A high potential for watering in 2014–15 Up to 20 GL			
Lowbidgee Floodplain (North Redbank system, South Redbank (Yanga), Nimmie-Caira and Fiddlers-Uara Creek systems and Western Lakes)	Small - (up to 200 GL inflow @ Maude)	9 in every 10 years (3 years)				MODERATE	**Protect-Maintain**	High Potential only for critical habitat requirements targeted (e.g. southern bell frog). Otherwise drying phase for much of Lowbidgee Up to 25GL			
	Moderate - (~400 GL inflow @ Maude)	5 in every 10 years (3 years)				MODERATE	**Protect-Maintain**	Low Potential. Opportunistic watering subject to supplementary announcement			
	Large - (~800 GL inflow @ Maude)	3 in every 10 years (8 years)				MODERATE	**Protect-Maintain**	Low Potential. Opportunistic watering subject to supplementary announcement			
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	Summer fresh (~1 GL/day @ Darlington Point - Balranald for 20 days)	7 in every 10 years				MODERATE	**Protect-Maintain**	Demand expected to be met by other sources			

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

Junction Wetlands	>5 GL/day @ d/s Balranald Weir and >10 GL/day @ Barmah on the Murray	5 in every 10 years				VERY HIGH	**Avoid Damage - Protect**	Option unlikely to be achievable under this resource availability.		
							Carryover potential	Moderate proportion of available allocations carried into 2015–16	A low to moderate proportion of available allocations may be carried over to 2016–17	–
							Trade potential	High urgency to augment available allocations for mid-Murrumbidgee wetlands action through the transfer of CEW into the Murrumbidgee. However limited potential for allocation purchase. Mod-High demands means allocation sale unlikely.	High urgency to augment available allocations for mid-Murrumbidgee wetlands action through the transfer of CEW into the Murrumbidgee. However limited potential for allocation purchase. Mod-high demands means allocation sale unlikely.	Potential to trade will depend on environmental demands and resource availability.

Key - events in previous years

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

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

means water did not contribute to meeting demands.

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

Key - potential watering in 2015-16

means a high potential for Commonwealth environmental watering (subject to seasonal and operational considerations)

means a moderate potential for Commonwealth environmental watering, or a partial contribution may be made

means a low potential for Commonwealth environmental watering

Key - urgency of environmental demands

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

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

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

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

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

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

Information for Table 2a, b and c sourced from: Alluvium (2013); Wassens (2015); SKM (2011); MDBA (2012a, 2012b, 2012c, 2012d, 2014c); Roberts and Marston (2011).

Table 2c: Environmental demands, potential watering in 2015–16 and outlook for coming years in the Murrumbidgee - **HIGH TO VERY HIGH WATER RESOURCE AVAILABILITY IN 2015–16**

Environmental assets	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)			2015–16			Implications for future demands		
						Predominant urgency of environmental demand for water	Purpose under high to very high resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2016–17 if watering occurred as planned in 2015–16	2017–18 Range of likely demand	Met in 2016–17 Not met in 2016–17
	Flow/volume	Required frequency (maximum dry interval)	2012–13 (mod)	2013–14 (drying)	2014–15 (drying)						
Mid-Murrumbidgee Wetlands[4]	Minimum (~15.5 GL/day @ Darlington Point for 3–5 days plus a gradual recession	7–8 in every 10 years (2 years))				HIGH	**Protect**	Demand expected to be met by other sources			
	Target (~27.5 GL/day @ Wagga Wagga for 3–5 days plus a gradual recession)	5–6 in every 10 years (4 years)				HIGH	**Protect**	A high potential for watering in 2014–15 Up to 150GL			
Yanco Creek System	~ 40 GL action @ Yanco Creek off-take	3 in every 10 years (3 years)				HIGH	**Protect-Improve**	A high potential for watering in 2014–15 Up to 20GL			
Lowbidgee Floodplain (North Redbank system, South Redbank (Yanga), Nimmie-Caira and Fiddlers-Uara Creek systems and Western Lakes)	Small - (up to 200 GL inflow @ Maude)	9 in every 10 years (3 years)				MODERATE	**Maintain - Improve**	Demand expected to be met by other sources			
	Moderate - (~400 GL inflow @ Maude)	5 in every 10 years (3 years)				MODERATE	**Maintain - Improve**	Opportunistic watering subject to supplementary announcement			
	Large - (~800 GL inflow @ Maude)	3 in every 10 years (8 years)				MODERATE	**Improve**	Opportunistic watering subject to supplementary announcement			
Murrumbidgee channel	Winter-spring fresh (~5 GL/day @ Darlington Point - Balranald for 20 days)	7 in every 10 years				MODERATE	**Protect-Maintain**	A high potential for watering in 2014–15 Up to 50GL			
	Summer fresh (~1 GL/day @ Darlington Point - Balranald for 20 days)	7 in every 10 years				MODERATE	**Protect-Maintain**	Demand expected to be met by other sources			

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

Junction Wetlands	>5 GL/day @ d/s Balranald Weir and >10 GL/day @ Barmah on the Murray	5 in every 10 years				VERY HIGH	**Protect-Improve**	Moderate potential for watering in 2014–15		
							Carryover potential	Moderate proportion of available allocations carried into 2015–16	A low to moderate proportion of available allocations may be carried over to 2016–17	–
							Trade potential	High urgency to augment available allocations for mid-Murrumbidgee wetlands action through the transfer of CEW into the Murrumbidgee. However limited potential for allocation purchase. Mod-High demands means allocation sale unlikely.	High urgency to augment available allocations for mid-Murrumbidgee wetlands action through the transfer of CEW into the Murrumbidgee. However limited potential for allocation purchase. Mod-high demands means allocation sale unlikely.	Potential to trade will depend on environmental demands and resource availability.

Key - events in previous years

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

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

means water did not contribute to meeting demands.

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

Key - potential watering in 2015-16

means a high potential for Commonwealth environmental watering (subject to seasonal and operational considerations)

means a moderate potential for Commonwealth environmental watering, or a partial contribution may be made

means a low potential for Commonwealth environmental watering

Key - urgency of environmental demands

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

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

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

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

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

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

Information for Table 2a, b and c sourced from: Alluvium (2013); Wassens (2015); SKM (2011); MDBA (2012a, 2012b, 2012c, 2012d, 2014c); Roberts and Marston (2011).

Part II: Commonwealth environmental water portfolio management planning

2. Background

2.1. Commonwealth environmental water

The Commonwealth Environmental Water Holder is an independent statutory position established by the *Water Act 2007* (the Water Act) to manage the Commonwealth environmental water holdings. The Commonwealth Environmental Water Holder leads and is supported by the Commonwealth Environmental Water Office (the Office), a division of the Australian Government Department of the Environment.

Under the Water Act, Commonwealth environmental water must be managed to protect or restore environmental assets, so as to give effect to relevant international agreements. The Water Act also requires that the Commonwealth Environmental Water Holder perform its functions and exercise its powers consistently with and in a manner that gives effect to the Basin Plan and that Commonwealth environmental water is managed in accordance with the Basin Plan's environmental watering plan.

2.2. 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 Murray River south of Balranald.

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

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

Regulated water is provided by two major headwater storages, Burrinjuck Dam on the Murrumbidgee River and Blowering Dam on the Tumut River. Collectively these storages have a capacity of 2 654 GL.

Most of the flow in the Murrumbidgee River comes from the upper portion of the catchment, and is delivered by the main tributary rivers: Cotter, Yass, Molonglo, Queanbeyan, Bredbo, Numerall, 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 (SKM 2011). The middle and lower portions of the catchment do not contribute significant inflows.

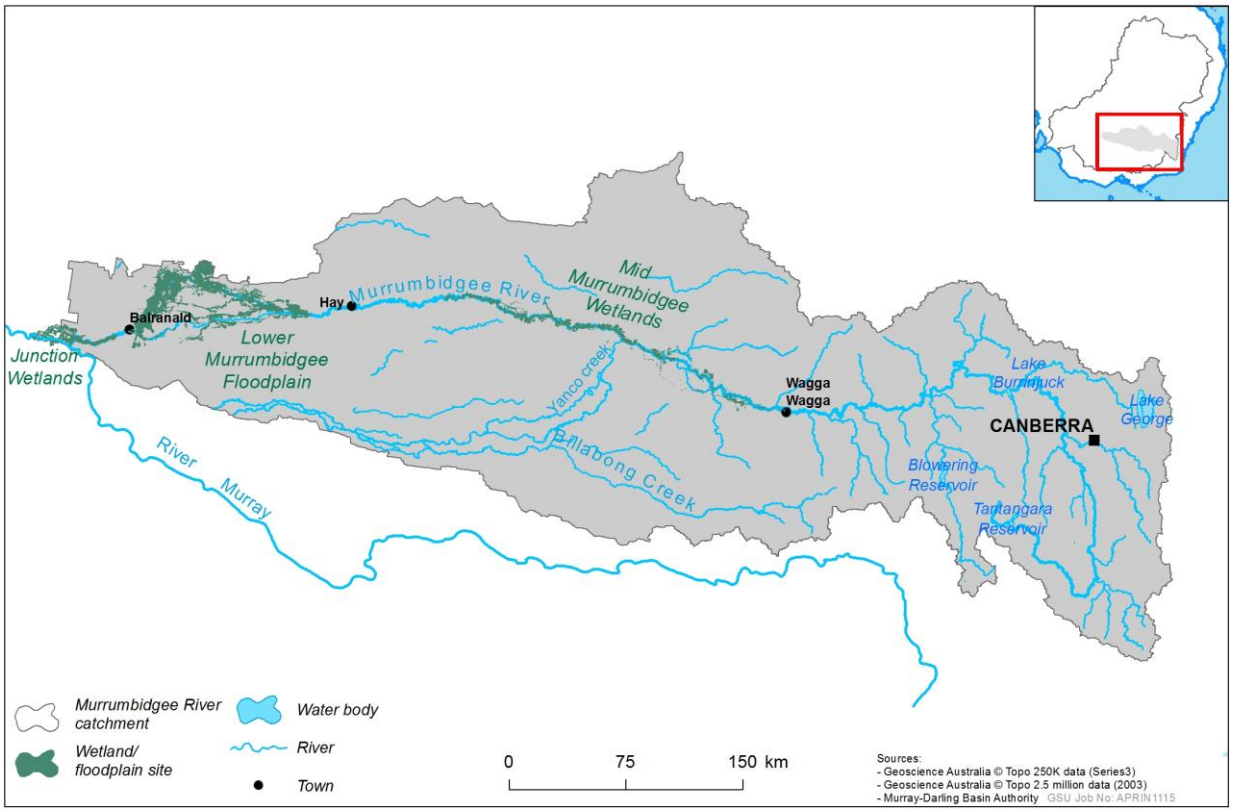

Figure 2: Map of the Murrumbidgee Catchment (courtesy of the Murray-Darling Basin Authority).

3. Long-term environmental water demands in the Murrumbidgee Catchment

3.1. Basin-wide environmental watering strategy

The Murray-Darling Basin Authority has published the first Basin-wide environmental watering strategy (the Strategy, MDBA 2014a). Building on the Basin Plan's environmental objectives, the Strategy sets out the Authority's best assessment of the expected environmental outcomes over the next decade as a result of implementing the Basin Plan and associated water reforms. The Strategy focuses on four components: river flows and connectivity; vegetation; waterbirds; and native fish. The expected outcomes for each component are summarised below, with more specific quantified outcomes provided in Attachment A.

River flows and connectivity: Improve connections along rivers and between rivers and their floodplains.

Vegetation: Maintain extent and improve the condition.

Waterbirds: Maintain current species diversity, improve breeding success and numbers.

Native Fish: Maintain current species diversity, extend distributions, improve breeding success and numbers.

3.2. Long-term watering plans

State governments are developing long-term watering plans for each catchment in the Basin. These plans will identify:

- the priority environmental assets and ecosystem functions in the catchment
- the objectives and targets for these assets and functions
- their watering requirements.

In developing these plans, state governments will be consulting with environmental water holders and local communities.

Once developed, these plans will provide the key information on the long-term environmental water demands in the catchment and the Office's planning for the Murrumbidgee Catchment will be reviewed so that this information can be incorporated.

Prior to the development of long-term watering plans, the Office will continue to draw on existing documentation on environmental water demands developed by state governments, local natural resource management agencies and the Murray-Darling Basin Authority.

Key documentation includes:

- The Murrumbidgee Monitoring and Evaluation Plan, developed under the Commonwealth Environmental Water Office's Long-Term Intervention Monitoring Project (CSU 2014)
- The assessment of environmental water requirements for the proposed Basin Plan (MDBA 2012a–c)
- Environmental Water Delivery: Murrumbidgee Valley, developed for the Commonwealth Environmental Water Office by SKM (2011)
- Murrumbidgee reach report: Constraints Management Strategy, developed by Murray-Darling Basin Authority (2014b)

- Murray-Darling Basin Authority (2015). *Environmental Watering Priority - Improve the condition of wetland vegetation communities in the mid-Murrumbidgee wetlands through a winter or spring fresh.*

- A range of scientific literature, monitoring outcomes (e.g. Wassens et al 2012 and 2013 and 2014 etc, Alluvium 2013 and Roberts and Marston 2011) and on-ground knowledge (from NSW Office of Environment and Heritage, NSW Department of Primary Industries – Fisheries, NSW Parks and Wildlife and Water NSW officers).

The following section represents the Office's summary of the long-term environmental water demands, based on these documents. The objectives and expected outcomes for water-dependent ecosystems will continue to be revised and refined in response to best available knowledge, including drawing on the results of environmental watering monitoring programmes.

3.3. Expected outcomes in the Murrumbidgee Catchment

The expected outcomes from environmental watering in the Murrumbidgee Catchment, and how these contribute to Basin-wide outcomes, are described below in Table 3. These outcomes will be refined and/or revised once the long-term watering plan for the catchment has been developed.

Table 3: Summary of long-term expected outcomes from environmental watering in the Murrumbidgee

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

Information sourced from: Charles Sturt University (2014); CEWO (2014); MDBA (2014a); MDBA (2012a); MDBA (2012b); MDBA (2012c); NSW Department of Primary Industry (2014); Roberts and Marston (2011) and Sinclair Knight Merz (2011).

3.4. Flows in scope for Commonwealth environmental watering

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. Figure 3 shows the broad environmental demands that are in scope for the Office to focus on contributing to in the Murrumbidgee. Importantly, these are broad, indicative demands and individual watering events may contribute to particular opportunities, such as using infrastructure to deliver water to individual wetlands that would otherwise not be possible due to constraints. Also, there may be opportunities for Basin State governments to remove or modify constraints, which will improve the efficiency and/or effectiveness of environmental watering.

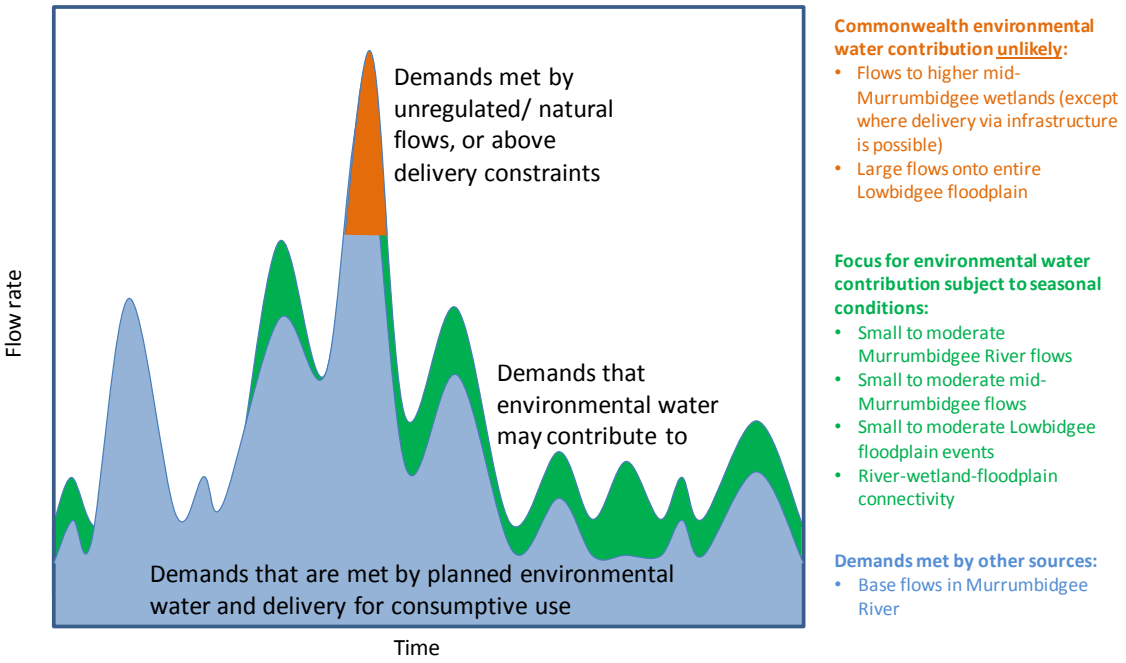

Figure 3: Scope of demands that environmental water may contribute to in the Murrumbidgee.

The delivery of environmental water in the Murrumbidgee River Valley is currently constrained by the release capacities from storages, channel capacities, and system constraints. The Water Sharing Plan for the Murrumbidgee River Regulated Water Source includes river channel capacity constraints on maximum flows (NSW Legislation 2003; NSW Office of Water 2013).

The Murray-Darling Basin Authority (2014b) has recently published the Murrumbidgee reach report: Constraints Management Strategy which provides further information about constraints in the Murrumbidgee Catchment. The Commonwealth Environmental Water Office will develop watering options within existing water delivery and channel capacity constraints unless the agreement of all affected parties has been obtained for an alternative delivery approach.

Operational considerations such as delivery methods, opportunities, constraints and risks will differ depending on the inflow scenario and are summarised in Table 4. In Table 4, operational considerations are assessed against inflow scenarios.

Table 4: Current opportunities and constraints on environmental watering for the Murrumbidgee.

Inflow scenario	Very low	Low	Moderate	High	Very high
Opportunities					
Manage the recession of naturally occurring high flows to provide for a more natural flow pattern.					
Use environmental water in conjunction with, or to maximise the environmental benefit of, naturally occurring river flows.					
Pumping and water diversion via regulating structures to key sites may be considered depending on an assessment of the action and the level of river flows.					
Constraints					
Delivery options are limited due to high unregulated flows resulting in reduced channel capacity, limiting the operation of river infrastructure and inhibiting additional releases from storages.					
Flows in the Murrumbidgee River at Gundagai are limited to less than 29 500 ML/day to prevent inundation of Tenandra Bridge on the Mundarlo Road near Gundagai.					
Flows in Tumut River are limited to less than 9 000 ML/day at Oddy's Bridge and 9 300 ML/day at Tumut to minimise bank erosion.					
Yanco Weir diversion is currently limited by the Water Sharing Plan to 1 400 ML/day to Yanco Creek. Flows over ~2 000 ML/day may cause floodplain inundation.					
Release capacities of storages may constrain the magnitude of augmentation.					
Risks*					
The provision of Commonwealth environmental water must consider potential inundation impacts to property and infrastructure.					
Environmental flows inundate floodplain and wetland habitat that is rich in organic matter, creating adverse water quality conditions.					

Inflow scenario	Very low	Low	Moderate	High	Very high
Environmental flows promote spawning and recruitment by exotic invasive species.					
Significant natural rainfall occurs on an environmental watering action resulting in unintended third party impacts.					
Return flows are re-regulated for irrigation purposes, limiting environmental benefits of upstream environmental flow releases for the lower Murrumbidgee floodplain and lower Murray River.					

Constraints as they relate to specific watering actions are described in the standard operating considerations listed in Section 3.6 below.

Based on the above outcomes sought and delivery constraints, Table 5 identifies flows that are in scope for Commonwealth environmental watering. Some specific watering requirements (flow magnitude, duration, timing and frequency) have also been listed, drawn from existing resources. The watering requirements for the Murrumbidgee will be developed in full by the state government as part of their long-term watering plan and will be reflected in future planning documents by the Commonwealth Environmental Water Office.

Table 5: Long-term indicative elements of a flow regime in scope for Commonwealth environmental watering in the Murrumbidgee.

Environmental assets	Indicative long-term demand	
	Flow/volume	**Required frequency (maximum dry interval)**
Mid-Murrumbidgee Wetlands	Minimum (~15.5 GL/day @ Darlington Point)	7–8 in every 10 years (2 years)
	Target (~27.5 GL/day @ Wagga Wagga for up to 5 days plus a gradual recession)	5–6 in every 10 years (4 years)
Yanco Creek System	~ 40 GL action @ Yanco Creek off-take	3 in every 10 years (3 years)
Lowbidgee Floodplain (North Redbank system, South Redbank (Yanga), Nimmie-Caira and Fiddlers-Uara Creek systems and Western Lakes)	Small event (~200 GL inflow @ Maude)	9 in every 10 years (3 years)
	Moderate event (~400 GL inflow @ Maude)	5 in every 10 years (3 years)
	Large event (~800 GL inflow @ Maude)	3 in every 10 years (8 years)

Murrumbidgee channel	Winter-spring fresh (~5 GL/day @ Darlington Point - Balranald for 20 days)	7 in every 10 years
	Summer fresh (~1 GL/day @ Darlington Point - Balranald for 20 days)	7 in every 10 years
Junction Wetlands	>5 GLL/day @ d/s Balranald Weir and >10 GL/day @ Barmah on the Murray	5 in every 10 years

Information for Table 2a,b and c sourced from: Alluvium (2013); Wassens (2015); SKM (2011); MDBA (2012a, 2012b, 2012c, 2012d, 2014c); Roberts and Marston (2011).

3.5. 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 availability to deliver environmental water.

Table 6: Summary of potential watering actions for the Murrumbidgee

Asset	Indicative flow/volume requirement	Applicable level(s) of resource availability				
		Very Low	**Low**	**Moderate**	**High**	**Very High**
Mid-Murrumbidgee wetlands	**Minimum (~15.5 GL/d @ Darlington Point for up to 5 days plus a gradual recession** **Target (~27.5 GL/d @ Wagga Wagga for up to 5 days plus a gradual recession)**	Option a priority but reduced likelihood of natural trigger events under this resource availability.		*Reconnection action:* Contribute to river flows (fresh) and inundation of fringing wetlands to continue recovery of wetland vegetation communities, and provide habitat to support survival and maintain the condition of waterbirds and native aquatic biota (including fish, turtles, frogs and invertebrates).		Option a priority but required volumes likely reduced under this resource availability.
		Infrastructure assisted: Contribute to wetland inundation, using existing water delivery infrastructure, to refill low lying wetlands in the mid-Murrumbidgee Floodplain to provide habitat to support survival and maintain the condition of waterbirds and native aquatic biota (including fish, turtles, frogs and invertebrates).				Option unlikely to be required under this resource availability.
Yanco Creek system	**Yanco Wetlands (~ 40 GL action @ Yanco Creek off-take)**	*Yanco Creek System*: Contribute to flows reconnecting and refilling the anabranch creeks and lagoons located in the mid-Yanco Creek system.				Option unlikely to be required under this resource availability.
Lowbidgee Wetlands	**Small event (~200 GL inflow @ Maude)** **Medium event (~400 GL inflow)** **Large event (~800 GL inflow)**	*Critical Habitat provision*: providing flows to fill wetlands to support critical fauna and flora habitat requirements and recruitment opportunities (e.g. southern bell frog and fishing bat).			Option unlikely to be required under this resource availability.	
		Wetland inundation: Contribute to river flows (fresh) using regulators to inundate target wetlands in the Lowbidgee to maintain and improve wetland vegetation diversity and condition, provide habitat to support survival and maintain the condition of native fish, waterbirds, and other aquatic vertebrates (e.g. frogs), hydrological connectivity between the floodplain and river, and contribute to processes such as nutrient and carbon cycling through return flows.				Option unlikely to be required under this resource availability.
		Wetting-Drying cycle: For parts of the system that have been well watered over previous years, a decision may be made to not provide water to sites that require a drying phase.				Option unlikely to be required under this resource availability.
		Option unlikely to be required under this resource availability.			*Breeding event contingency:* Maintain wetland water levels and acceptable	

				levels of water quality to support the completion of a naturally-triggered breeding event
		Option unlikely to be required under this resource availability.		*Lowbidgee Supplementary*: Protect a portion of river flows 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.
Murrumbidgee River Channel	**Murrumbidgee channel fresh:** **spring (~5 GL/d @ Balranald for 20 days)** **summer (~1 GL/d @ Balranald for 20 days)**	*Restoring natural flow variability:* Contribute to river flows (base flows and freshes) in the Murrumbidgee River channel, Yanco-Colombo-Billabong Creek system, Old Man Creek system and/or other creeks.		Option unlikely to be required under this resource availability.
		Native fish flow: Contribute to river flows (base flows and freshes) to provide suitable in-stream conditions for native fish breeding and recruitment.		Option unlikely to be required under this resource availability.
		Water quality contingency: Provide localised refuge habitat for fish and aquatic biota to prevent, or during, an adverse water quality/water level event.	Option unlikely to be required under this resource availability.	*Water quality contingency*: Provide localised refuge habitat for fish and aquatic biota to prevent, or during, an adverse water quality event.
Junction Wetlands	**>5,000 ML/day @ d/s Balranald Weir and >10,000 ML/day @ Barmah on the Murray**	Option unlikely to be targeted under this resource availability.		*Reconnecting event:* Contribute to river flows (fresh) and inundation of fringing wetlands to continue recovery of wetland vegetation communities, and provide habitat to support survival and maintain the condition of waterbirds and native aquatic biota (including fish, turtles, frogs and invertebrates).

Note: Under certain resource availabilities, options 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 the deliver environmental water

3.6. Potential watering actions – standard operational considerations

Table 6: Summary of potential watering actions for the Murrumbidgee

<table>
<tr><th rowspan="2">Asset</th><th rowspan="2">Indicative flow/volume requirement</th><th colspan="5">Applicable level(s) of resource availability</th></tr>
<tr><th>Very Low</th><th>Low</th><th>Moderate</th><th>High</th><th>Very High</th></tr>
<tr><td rowspan="2">Mid-Murrumbidgee wetlands</td><td rowspan="2">Minimum (~15.5 GL/d @ Darlington Point for up to 5 days plus a gradual recession

Target (~27.5 GL/d @ Wagga Wagga for up to 5 days plus a gradual recession)</td><td colspan="2">Option a priority but reduced likelihood of natural trigger events under this resource availability.</td><td colspan="2">Reconnection action: Contribute to river flows (fresh) and inundation of fringing wetlands to continue recovery of wetland vegetation communities, and provide habitat to support survival and maintain the condition of waterbirds and native aquatic biota (including fish, turtles, frogs and invertebrates).</td><td>Option a priority but required volumes likely reduced under this resource availability.</td></tr>
<tr><td colspan="4">Infrastructure assisted: Contribute to wetland inundation, using existing water delivery infrastructure, to refill low lying wetlands in the mid-Murrumbidgee Floodplain to provide habitat to support survival and maintain the condition of waterbirds and native aquatic biota (including fish, turtles, frogs and invertebrates).</td><td>Option unlikely to be required under this resource availability.</td></tr>
<tr><td>Yanco Creek system</td><td>Yanco Wetlands (~ 40 GL action @ Yanco Creek off-take)</td><td colspan="4">Yanco Creek System: Contribute to flows reconnecting and refilling the anabranch creeks and lagoons located in the mid-Yanco Creek system.</td><td>Option unlikely to be required under this resource availability.</td></tr>
<tr><td rowspan="3">Lowbidgee Wetlands</td><td rowspan="3">Small event (~200 GL inflow @ Maude)

Medium event (~400 GL inflow)

Large event (~800 GL inflow)</td><td colspan="3">Critical Habitat provision: providing flows to fill wetlands to support critical fauna and flora habitat requirements and recruitment opportunities (e.g. southern bell frog and fishing bat).</td><td colspan="2">Option unlikely to be required under this resource availability.</td></tr>
<tr><td colspan="4">Wetland inundation: Contribute to river flows (fresh) using regulators to inundate target wetlands in the Lowbidgee to maintain and improve wetland vegetation diversity and condition, provide habitat to support survival and maintain the condition of native fish, waterbirds, and other aquatic vertebrates (e.g. frogs), hydrological connectivity between the floodplain and river, and contribute to processes such as nutrient and carbon cycling through return flows.</td><td>Option unlikely to be required under this resource availability.</td></tr>
<tr><td colspan="4">Wetting-Drying cycle: For parts of the system that have been well watered over previous years, a decision may be made to not provide water to</td><td>Option unlikely to be required</td></tr>
</table>

		sites that require a drying phase.		under this resource availability.
		Option unlikely to be required under this resource availability.		*Breeding event contingency:* Maintain wetland water levels and acceptable levels of water quality to support the completion of a naturally-triggered breeding event
		Option unlikely to be required under this resource availability.		*Lowbidgee Supplementary*: Protect a portion of river flows 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.
Murrumbidgee River Channel	**Murrumbidgee channel fresh:** **spring (~5 GL/d @ Balranald for 20 days)**	*Restoring natural flow variability:* Contribute to river flows (base flows and freshes) in the Murrumbidgee River channel, Yanco-Colombo-Billabong Creek system, Old Man Creek system and/or other creeks.		Option unlikely to be required under this resource availability.
	summer (~1 GL/d @ Balranald for 20 days)	*Native fish flow:* Contribute to river flows (base flows and freshes) to provide suitable in-stream conditions for native fish breeding and recruitment.		Option unlikely to be required under this resource availability.
		Water quality contingency: Provide localised refuge habitat for fish and aquatic biota to prevent, or during, an adverse water quality/water level event.	Option unlikely to be required under this resource availability.	*Water quality contingency*: Provide localised refuge habitat for fish and aquatic biota to prevent, or during, an adverse water quality event.

Junction Wetlands	**>5,000 ML/day @ d/s Balranald Weir and >10,000 ML/day @ Barmah on the Murray**	Option unlikely to be targeted under this resource availability.	*Reconnecting event:* Contribute to river flows (fresh) and inundation of fringing wetlands to continue recovery of wetland vegetation communities, and provide habitat to support survival and maintain the condition of waterbirds and native aquatic biota (including fish, turtles, frogs and invertebrates).

Note: Under certain resource availabilities, options 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 the deliver environmental water above identifies the range of potential watering actions in Murrumbidgee that give effect to the long-term demands and flow regime identified as being in scope for the Office to contribute environmental water to in any given year. The standard considerations associated with these actions are set out below.

1. Mid-Murrumbidgee Reconnecting event

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

Standard operational considerations

The proposed event will involve the release of environmental water from upper storages in conjunction with rainfall- derived tributary flows. Should no suitable event occur, a smaller standalone option, targeting the lowest level wetlands only, or infrastructure assisted delivery to individual wetlands will 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 winter and late spring to avoid peak irrigation season (November to April).
- While the volume of environmental water required will depend on the volume of baseflows, the proposed flow limits for this option are:
    - 28 000 ML/day (4.73 metres gauge height) at Gundagai.
    - 27 500 ML/day (4.9 metres gauge height) at Wagga.

- This option is likely to contribute flows required to inundate the mid-Yanco Creek system wetlands (Option 3), could provide some of the required flows for, and provide additional benefits to, the proposed in-channel actions (Options 5 and 6) and watering of the Junction Wetlands.

Approvals

- Agreement from landholders whose properties might be inundated by environmental flows would be required.

- Target flows will result in the 1 400 ML/day Yanco Creek off-take constraint specified in the Water Sharing Plan being exceeded. Approval to exceed the 1 400 ML/day constraint at the Yanco Creek off-take would be required from the NSW Minister for Primary Industries.

2. Mid-Murrumbidgee wetland – infrastructure assisted delivery

Watering action: Contribute to wetland inundation, using existing water delivery infrastructure, to refill 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

- The wetlands in the mid-Murrumbidgee that can be delivered to via existing infrastructure and without higher reconnecting flows include:

    - Yarradda Lagoon in the mid-Murrumbidgee

    - Gras Innes and Oak Creek off Bundidgerry Creek

    - Yanco Agricultural (McCaughey's) Lagoon, Turkey Flat and Gooragool Lagoon off Murrumbidgee Irrigation infrastructure

    - Coonancoocabil Lagoon (off Murrumbidgee Irrigation infrastructure or off Gogeldrie Weir pool)

    - A number of wetlands off the Yanco Creek system

    - Other privately owned wetlands and waterways to restore ecological function to these areas.

Approvals

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

3. Mid-Yanco Creek Anabranches and Wetlands

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

Standard operational considerations

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

Typical extent

- The action will target sites in the mid-Yanco Creek (between Morundah and Yanco Bridge on Kidman Way). Target sites includes the 'Silver Pines' wetland complex.
- Flows above 1 400 ML/day and/or additional volumes delivered through Coleambally Catchment Drain may be required to achieve desired outcomes.

Approvals

- Agreement from landholders whose properties might be inundated by environmental flows would be required.
- Target flows will result in the 1 400 ML/day Yanco Creek off-take constraint specified in the Water Sharing Plan being exceeded. Approval to exceed the 1 400 ML/day constraint at the Yanco Creek off-take would be required from the NSW Minister for Primary Industries.

4. Lowbidgee Wetlands

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

Standard operational considerations

- The Lowbidgee contains suitable habitats for nationally important breeding colonies of vulnerable 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 endangered southern bell frog, in the Lowbidgee. Ensuring key 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: North Redbank system, South Redbank (Yanga), Nimmie-Caira and Fiddlers-Uara Creek systems and Western Lakes.

No additional approvals required.

5. Native fish flows

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

Standard operational considerations

- This may involve contributing in-stream flows to maximise available breeding habitat, create flow conditions favourable for reproduction, or contribute to the survival of native fish.

Typical extent:

- Target flow rates will be dependent on the prevailing flow conditions, target outcome and operational considerations.

- Environmental water will be delivered from storages and may target reaches along the length of the Murrumbidgee River and main distributaries.

- Subject to announcements, supplementary allocations may be used to protect a portion of river flows.

- Environmental deliveries for this option will likely be delivered in late winter (movement and condition), spring and early summer (spawning and recruitment).

No additional approvals required.

6. Restoring natural flow variability

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

Standard operational considerations

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

Typical extent

- Environmental water may be delivered to the Murrumbidgee River channel, Yanco-Colombo-Billabong Creek system, Old Man Creek system, and/or other creek systems.

- Target flow rates will be dependent on the prevailing flow conditions, target outcome and operational considerations.

- Subject to announcements, supplementary allocations may be used to protect a portion of river flows.

- Environmental releases would be kept in channel and are not intended to inundate floodplain or wetland habitat.

No additional approvals required.

7. Contingency to support significant bird breeding events

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

Standard operational considerations

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

- The bird breeding contingency is not to trigger a breeding event but for use when a breeding event is already underway and considered in danger of failure due to receding water levels.

Typical extent

- Target flow rates will be dependent on the prevailing conditions, the nature of the water quality/falling water level issue and operational considerations.

- This option is contingent on conditions throughout the year, but is more likely to be required during warmer months.

No additional approvals required.

8. Contingency to support critical habitat requirements

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

Standard operational considerations

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

Typical extent

- Target flow rates will be dependent on the prevailing conditions, the nature of the water quality/falling water level issue and operational considerations.

- This option is contingent on conditions throughout the year, but is more likely to be required during warmer months.

No additional approvals required.

4. Long-term water availability

4.1. Commonwealth environmental water holdings

The Commonwealth holds the following entitlements in the Murrumbidgee Regulated River Water Source:

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

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

4.2. 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 include:

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

4.3. 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 or protected 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 (NSW Legislation, 2003) establishes releases of planned environmental water (under Part 3) including transparent and translucent releases.

5.Next steps

5.1. From planning to decision making

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

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

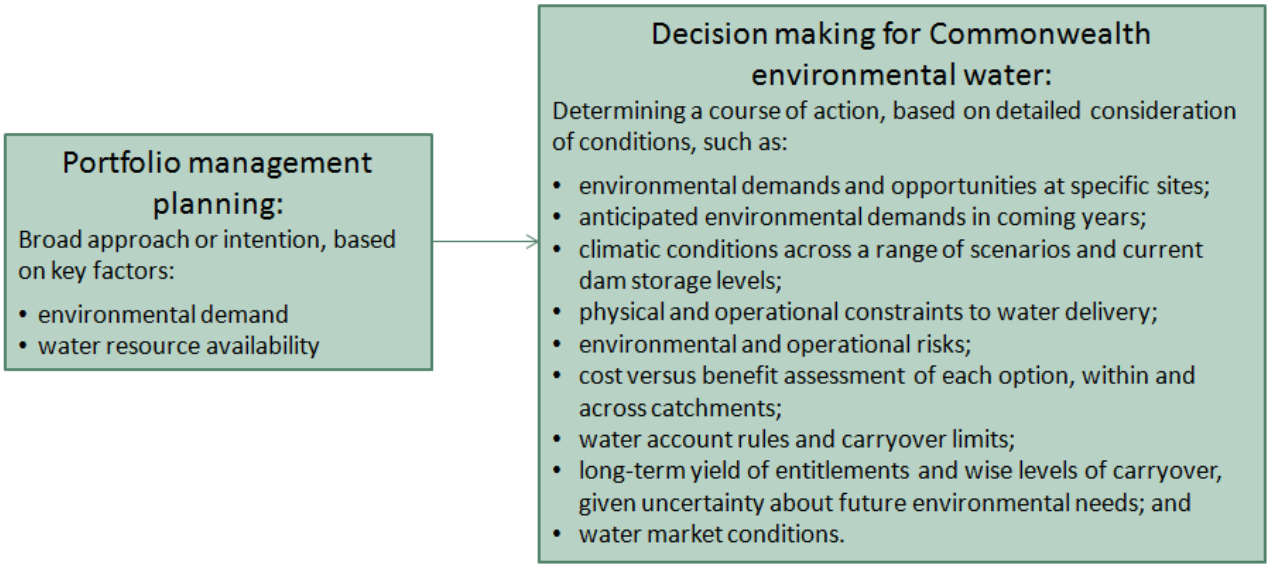

Figure 4: Planning and decision making for Commonwealth environmental water use

5.2. Further information

For further information on how the Office plans for water use, carryover and trade, please visit our web site www.environment.gov.au/topics/water/commonwealth-environmental-water-office

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

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

Expected outcomes from the Basin-wide Environmental Watering Strategy (MDBA 2014a) that are relevant to the Murrumbidgee 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 extent

Area of river red gum (ha)*	Area of black box (ha)*	Area of coolibah (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

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

FISH

No loss of native species

Improved population structure of key species through regular recruitment, including

- Short-lived species with distribution and abundance at pre-2007 levels and breeding success every 1–2 years
- Moderate to long-lived with a spread of age classes and annual recruitment in at least 80 per cent of years

Increased movements of key species

Expanded distribution of key species and populations

Key species for the Murrumbidgee include:

Species	Specific outcomes	In-scope for C'th water in the Murrumbidgee?
Flathead galaxias (*Galaxias rostratus*)	Improve core range in additional locations, including the Murrumbidgee	Not until a population is established
Freshwater catfish (*Tandanus tandanus*)	Expand the core range of current populations in Columbo-Billabong Creek	Yes
Golden Perch (*Macquaria ambigua*)	A 10–15 per cent increase of mature fish (of legal take size) in key populations	Yes
Macquarie perch (*Macquaria australasica*)	Expand current populations (candidate sites include Cotter River, Murrumbidgee above Cooma, Adjungbilly Creek).	No
Murray cod (*Maccullochella peelii*)	A 10–15 per cent increase of mature fish (of legal take size) in key populations	Yes
Olive perchlet (*Ambassis agassizii*)	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.

Species	Specific outcomes	In-scope for C'th water in the Murrumbidgee?
River blackfish (*Gadopsis marmoratus*)	Expand the range of current population in the Murrumbidgee River.	Yes
Silver perch (*Bidyanus bidyanus*)	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 (*Mogurnda adspersa*)	Establish 3–4 additional populations (candidate sites include the Murrumbidgee in Adjungbilly and Adelong Creeks).	No
Southern pygmy perch (*Nannoperca australis*)	Establish additional populations in the lower Murrumbidgee wetlands	Only if additional populations are established
Trout cod (*Maccullochella macquariensis*)	For the connected population of the Murrumbidgee–Murray–Edwards, continue downstream expansion.	Yes
Yarra pygmy perch (*Nannoperca obscura*)	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 C'th 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–Columbo Creeks		*	*	*	*	*	Y

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