



Australian Government

Commonwealth Environmental Water Office

**Commonwealth Environmental Water**

Portfolio Management Plan

# Mid–Murray Region

2018–19



**Front cover image credit:**

Edward River in the Edward Wakool, Photo by Commonwealth Environmental Water Office.

**Back cover image credit:**

River Bluebell at Barmah, Photo by Commonwealth Environmental Water Office.

**Acknowledgement of the traditional owners of the Murray-Darling Basin**

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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. Ms Swirepik is supported by staff of the Commonwealth Environmental Water Office. The Office employs six local engagement officers who live and work in regional centres across the Murray–Darling Basin.

## Commonwealth environmental water

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

There are broadly three options for managing Commonwealth environmental water:

- delivering water to a river or wetland to meet an identified environmental demand
- leaving water in storage and 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 Mid-Murray Region for 2018–19. 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, 2018–19* (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 NSW Office of Environment and Heritage, Victorian Environmental Water Holder, Victorian Catchment Management Authorities, NSW Department of Primary Industries, the Murray–Darling Basin Authority, scientists engaged in monitoring the outcomes of Commonwealth environmental water use, the Murray–Lower Darling Environmental Water Advisory Group, the Edward-Wakool Environmental Water Reference Group and various community groups and individuals.

## 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](mailto:ewater@environment.gov.au).

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# 1. Environmental watering in Mid-Murray Region

## 1.1. The Mid-Murray Region catchment

The Mid-Murray planning area extends from Hume Dam to Euston (Figure 1). The region contains a number of wetlands of national and international importance including the Ramsar listed Barmah-Millewa, Gunbower and New South Wales Central Murray forests. River Murray flows in this region are strongly influenced by the Goulburn, Ovens, Kiewa, Loddon and Campaspe Rivers.

The delivery of Commonwealth environmental water to the Mid-Murray Region differs depending on which part of the region water is being delivered to. Where possible, environmental water will be managed to benefit multiple sites en route, thereby maximising the efficient and effective use of environmental water. The day to day delivery of environmental water along the main stem of the River Murray is managed by the Murray–Darling Basin Authority’s River Murray Operations, in close cooperation with state government agencies and state water authorities.

For the New South Wales portion of the Mid-Murray Region, Commonwealth environmental water use is coordinated with other environmental water deliveries by the NSW Office of Environment and Heritage. Water delivery is managed by WaterNSW and/or Murray–Darling Basin Authority River Murray Operations. In some instances Murray Irrigation Limited and landholder infrastructure may also deliver environmental water, subject to separate agreements.

For the Victorian portion of the Mid-Murray Region, Commonwealth environmental water use is coordinated with other environmental water deliveries by the Victorian Environmental Water Holder. Water delivery is managed by the state water authority, Goulburn-Murray Water, and regional waterway managers including the North-Central Catchment Management Authority, Goulburn-Broken Catchment Management Authority, North-East Catchment Management Authority and the Mallee Catchment Management Authority.

Environmental water is managed by a number of water holders in the Murray, including the Commonwealth Environmental Water Holder, The Living Murray, the Victorian Environmental Water Holder and NSW Office of Environment and Heritage. Environmental water portfolios are coordinated to maximise the effectiveness of water delivery for achieving environmental outcomes. For example, the Southern Connected Basin Environmental Watering Committee was established by the Murray–Darling Basin Ministerial Council in October 2014 to coordinate the efficient and effective delivery of all environmental water in the southern-connected Basin.



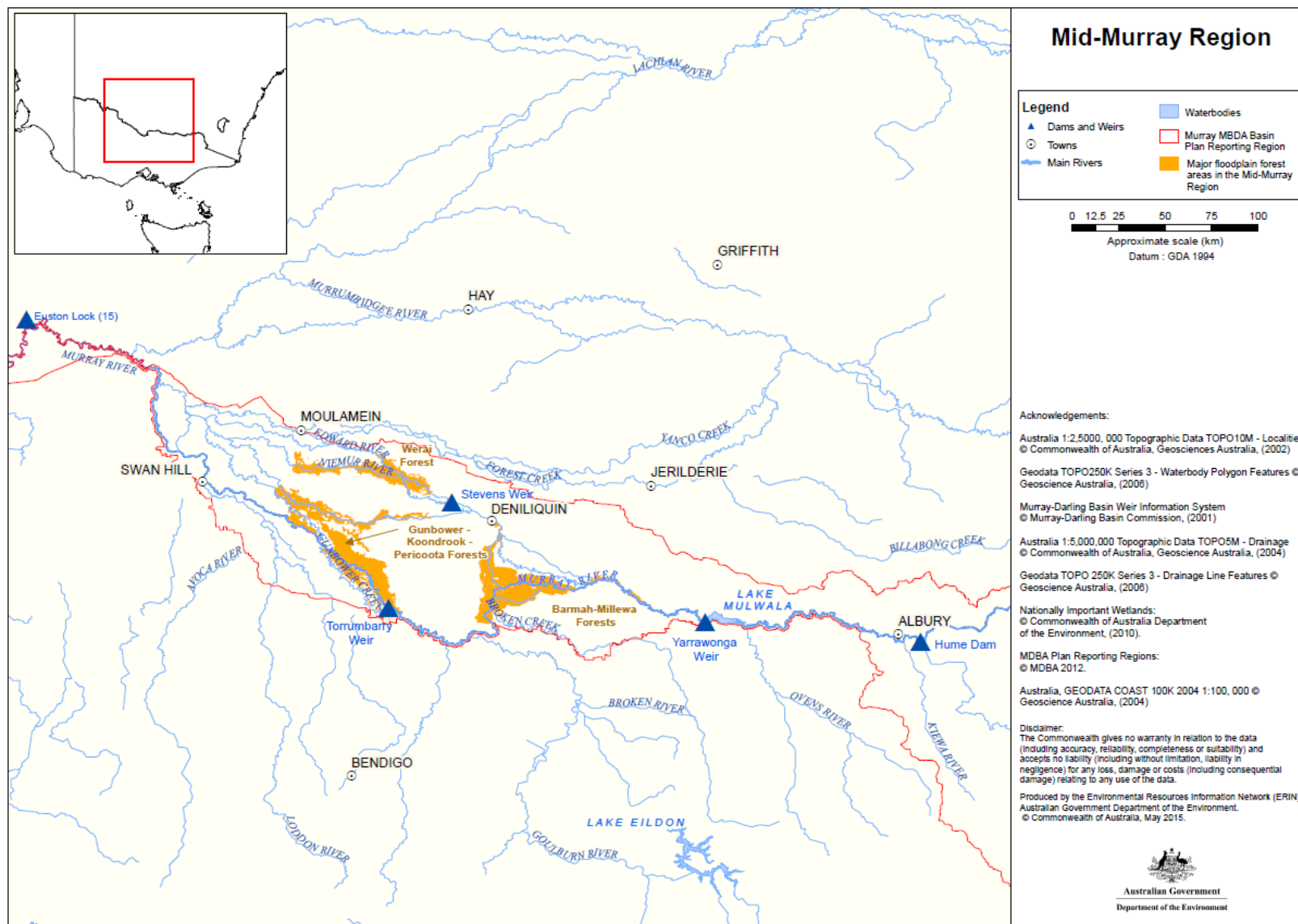


Figure 1: Map of the Mid-Murray Region.

## 1.2. Environmental objectives in the Mid-Murray Region 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. In addition, the Basin annual environmental watering priorities (MDBA, 2017c) represent annual steps to guide environmental watering to meet the long-term outcomes in the Basin-wide environmental watering strategy. The expected outcomes relevant for the Mid-Murray Region are described in Attachment A.

The Victorian state government has also developed a long-term watering plan for the Victorian Murray region (DELWP 2015). The plan identifies the priority environmental assets and ecosystem functions in the catchment, the objectives and targets for these assets and functions, and their watering requirements (and is available here: [https://www.water.vic.gov.au/\\_data/assets/pdf\\_file/0023/53168/Victorian-Murray-LTWP\\_17-11-2015-FINAL.pdf](https://www.water.vic.gov.au/_data/assets/pdf_file/0023/53168/Victorian-Murray-LTWP_17-11-2015-FINAL.pdf)). Once developed, the New South Wales Murray plan will also provide key information on the long-term environmental water demands in the catchment.

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

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



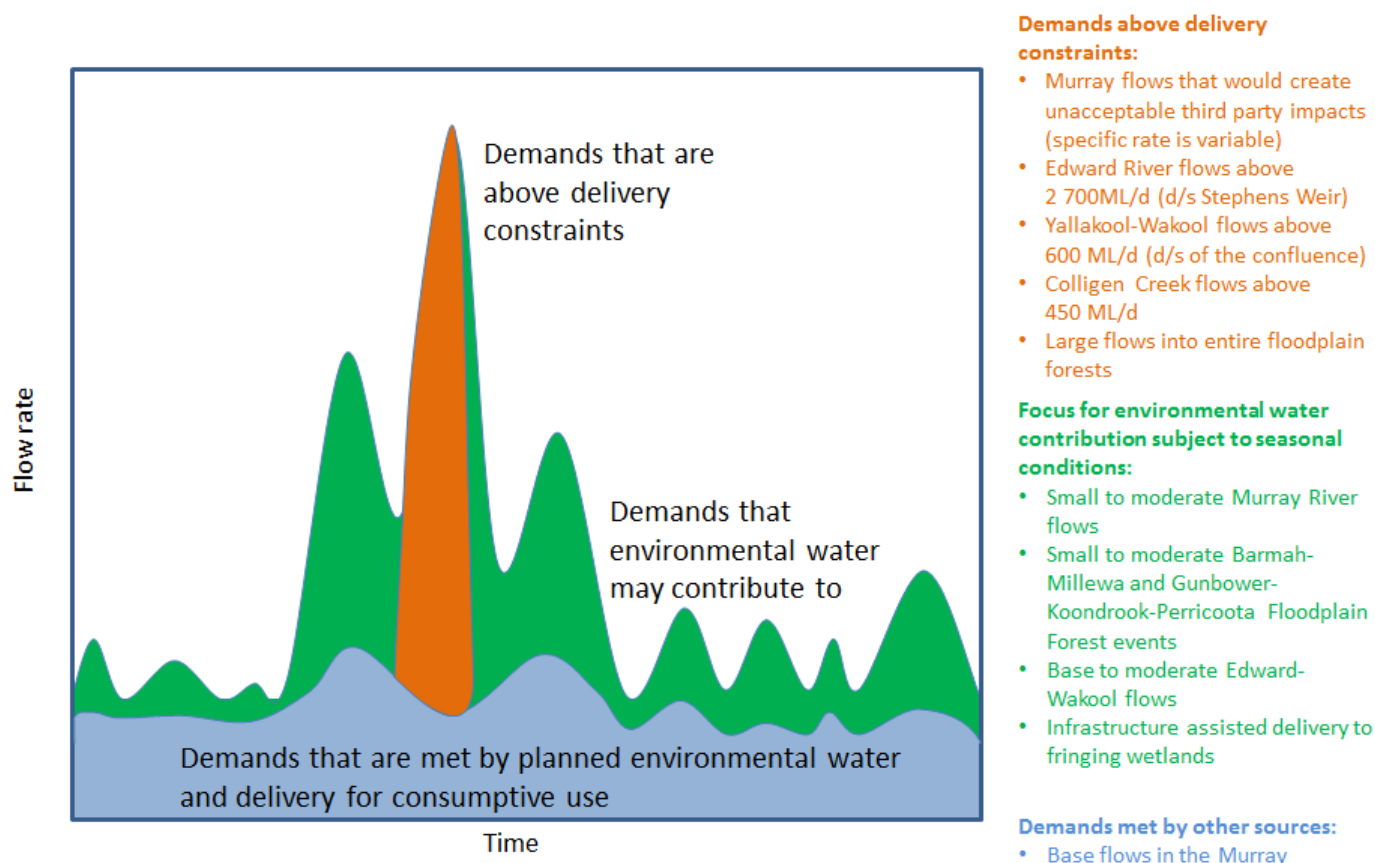
**Table 1:** Summary of objectives being targeted by environmental watering in the Mid-Murray Region

BASIN-WIDE OUTCOMES (Matters in red link to the Basin-wide environmental watering strategy, MDBA 2014)	OBJECTIVES FOR MID-MURRAY ASSETS						
	IN-CHANNEL ASSETS			OFF-CHANNEL ASSETS			
	River Murray (Hume Dam to Euston)	Edward-Wakool River System	Gunbower Creek	Barmah-Millewa Forest	Gunbower-Koondrook-Perricoota Forest	Edward-Wakool Forests (e.g. Werai, Neimur)	Off-channel wetlands and ephemeral creeks
VEGETATION	Maintain riparian and in-channel vegetation condition. Increase periods of growth for non-woody vegetation communities that closely fringe or occur within river corridors.			Maintain the current extent of floodplain vegetation near river channels and on low-lying areas of the floodplain. Improve condition of black box, river red gum and lignum shrublands. Improve recruitment of black box and river red gum communities. Increased periods of growth for non-woody vegetation communities that closely fringe or occur within the creek channels, and those that form extensive stands within wetlands and low-lying floodplains including Moira grasslands in Barmah-Millewa Forest.			Maintain and improve condition of wetland vegetation.
WATERBIRDS	Provide habitat and food sources to support waterbird survival and recruitment, and maintain condition and current species diversity.						
				Support naturally triggered colonial bird breeding events.			
FISH	Provide flows to support habitat (including longitudinal connectivity and bench inundation) and food sources and promote increased movement/dispersal, recruitment and survival/condition of native fish.			Provide flows to support habitat and cues for increased movement, recruitment and survival/condition of native fish (particularly for floodplain specialists).			
INVERTEBRATES	Provide habitat to support increased microinvertebrate and macroinvertebrate survival, diversity, abundance and condition.						
OTHER VERTEBRATES	Provide habitat to support survival, maintain condition and provide recruitment opportunities for frogs and turtles.						
CONNECTIVITY	Maintain lateral connectivity by contributing to an increase in the frequency of freshes, bankfull and lowland floodplain flows.						
	Maintain baseflows and increase overall flows in the River Murray. Maintain longitudinal connectivity along the River Murray to fulfil important environmental functions such as nutrient and sediment transport, organism dispersal and water quality.			Maintain connectivity through creeks and anabranches, thereby enhancing connectivity and functioning through the length of the River Murray.			
PROCESSES	Increase primary productivity, nutrient and carbon cycling, biotic dispersal and movement. Increase transport of organic matter, salt and nutrients downstream.						
WATER QUALITY	Maintain water quality and provide refuge habitat from adverse water quality events. Increase mobilisation and export of salt from the River Murray system.						
RESILIENCE	Provide drought refuge habitat and maintenance/condition of native biota.						

Information sourced from: MDBA (2014); Department of the Environment (2014); Department of the Environment (2011a-d); MDBA (2012a-f); DELWP (2015).

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



**Figure 2:** Scope of demands that environmental water may contribute to in the Mid-Murray Region.

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

### 1.4. Monitoring and adaptive management

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

In addition, some components of the Mid-Murray Region are included as icon sites in The Living Murray program. The Living Murray program aims to improve the ecological condition of significant forests, wetlands and lakes along the River Murray as part of helping to deliver the Basin Plan objectives and outcomes.

Key findings from operational and site monitoring for the Barmah-Millewa Forest include:

- Murray cod, trout cod and golden perch were recorded in their highest abundances in 2017 compared to the last ten years of monitoring. The majority of native species have continued the trend of increasing abundances over the past five sample years. Unfortunately, large numbers of exotic carp remain throughout the wetlands and creeks of Barmah-Millewa Forest.
- The broad distribution and recent increase in small-bodied native fish at flowing habitats indicates that connectivity between habitats has improved and facilitated the dispersal of these species throughout the waterways of the Barmah-Millewa Forest. A return to natural flow conditions within and through the forest, likely enhanced improved habitat and food for these species.
- An effective sampling protocol for assessing Murray crayfish condition has been established for the Barmah-Millewa Forest and provides a reliable means to determine future impacts (Raymond et.al, 2017).
- Surveys in 2016–17 indicate that (Ward 2017):
  - the understorey vegetation at monitored sites of Barmah-Millewa Forest displayed a return towards more normal expected conditions following the extremes of Millennium Drought in 2005–2009, extremes of prolonged and deep flooding in 2010–2012, and then a series of seasonal low-level flooding in winter-spring alternating with dry summer-autumn periods in 2013–2015.
  - a greater diversity and cover abundance of mostly native wetland species largely returned in the lower, more flood-prone regions of the floodplain that were otherwise lacking plant cover during the drought and during the first year of major flooding.
- Moira grass has suffered long-term declines in extent largely due to drought and disturbance by foraging and grazing by introduced animals.
  - In 2016, significant and prolonged natural winter flooding to depths of more than two meters occurred providing what is believed to be optimal conditions for the development and flowering of Moira Grass, although results at the time indicated that the abundance of Moira Grass seeds within the seed bank did not increase (Nielson et.al. 2017).
  - Subsequently however, Moira Grass had a positive response to environmental water delivered in Barmah-Millewa Forest in 2017–18 with strong growth and abundant flowering. Recent (April 2017) construction of complementary measures such as a 10 ha feral horse and pig exclusion fence in Barmah Forest supported the outcomes achieved through environmental watering, with clear benefits for the condition of Moira Grass and River Swamp Wallaby Grass.
- Tree health is improving, with large areas of the forest sporting fresh growth and high flowering rates amongst full canopies (Goulburn Broken CMA, 2018).
- Delivery of environmental water following natural events in 2016–17 allowed the major waterbird breeding wetlands to remain inundated to an appropriate height to protect fledglings and nests and provided foraging areas for young (Borrell and Liefing, 2017).
- Higher than average flows in 2016–17 saw a 59 per cent increase in male Australasian bittern presence in 2016, compared to 2015 (Belcher et. al., 2017).
- Mixed results have been found for water bird breeding outcomes in Barmah-Millewa Forest in 2017–18, with ibis (Australian White and Straw-necked) and spoonbills (Royal) achieving nesting success in Reed Beds Swamp of Millewa Forest (although numbers of ibis were lower than recent years) while they were unsuccessful in Boals Deadwoods in Barmah Forest due to apparent predation (MDBA 2018) and disturbance of the nesting colony by feral pigs. Cormorants (Little Pied and Little Black), Night herons and Eastern Great Egrets largely all had breeding success in various wetlands, with the Top Island egret colony the only known Great Egret nesting colony in Victoria (Goulburn Broken CMA 2018).

Monitoring in Gunbower Forest and Creek has found:

- In 2017, there was evidence to suggest that Red Gums, Black Box and Grey Box trees were recruiting and growing in Gunbower Forest, and in the case of the former two species, were likely to comprise sustainable population structures. However, it was also found that less than half of the sampled trees in Gunbower Forest supported healthy canopies. This suggests that intervention management remains warranted, and that the forests and woodlands of Gunbower Forest are likely to require more water for continued growth and population maintenance (Bennetts and Jolly, 2017).

- The Gunbower Creek Murray cod population now appears well represented by juvenile and sub-adult size classes, and not notably dissimilar to the Murray River population where juvenile and sub-adult size classes clearly dominate (Bloink C. and Robinson W. 2016).
- The Gunbower Icon site supports a relatively diverse fish community. Although caution is advised in examining the dataset for any particular year in isolation, the 2013–2016 period indicates that progress is being made towards many of the objectives and associated targets and none appear to be in decline. The recruitment success of Murray cod in recent years and likely re-establishment of a healthy population structure is a particular standout, as is the persistence of number of threatened species, albeit in low densities (e.g. trout cod in Gunbower Creek and freshwater catfish in Phyland Lagoon) (Bloink C. and Robinson W. 2016).

The Long Term Intervention Monitoring (LTIM) Project is also being undertaken in the Edward-Wakool system. It aims to understand the environmental response from Commonwealth environmental watering with respect to the targeted objectives.

Information on the monitoring activities is available at <http://www.environment.gov.au/water/cewo/catchment/mid-murray/monitoring>. Monitoring information is also provided by state governments and The Living Murray program.

Key findings and recommendations from the Edward-Wakool River System Selected Area Long Term Intervention Monitoring Project include:

- Increased flow variability during spring - summer may improve spawning opportunities for silver perch.
- The 2016 flood and related hypoxic blackwater event had a significant negative impact on Murray cod and instream water plant communities throughout the Edward-Wakool system. The effectiveness of refuge flows during hypoxic blackwater events is influenced by the extent to which environmental water contributes to the total flow in the receiving system (the larger escapes, such as the Edward and Wakool escapes, are the most effective at providing refuge habitat).
- Murray cod require stable flows of sufficient depth for spawning. Monitoring in parts of the Edward-Wakool system (e.g. Yallakool Creek) has shown that providing higher flows with the aim of inundating additional spawning habitat (such as timber/snags) did not result in increased spawning. Mapping of fish habitat in this system, especially in sites being monitored, would assist with determining what relationship, if any, may exist between flow, habitat and outcomes being targeted such as spawning and recruitment.
- Rather than being affected by flow, Murray cod recruitment may be constrained by food availability for young/juvenile fish (which is linked in turn to productivity – see point below). However, this has not been tested with very low flows (<200 ML/day) or very high (>600 ML/day) flows in this system.
- Increased flow variability is desirable, however system constraints are preventing a larger total range of flow.
- In-stream aquatic vegetation responds well to slower recession rates. This can lead to other potential benefits to aquatic habitat.
- Due to a lack of bankfull and overbank flows that cycle nutrients and carbon through the system, primary productivity is limited in the Edward-Wakool system under current system constraints. However, flows through Barmah-Millewa, Koondrook-Pericoota and Weraï during the cooler months could provide productivity benefits.

The outcomes from these monitoring activities are used to inform portfolio management planning and adaptive management decision-making as outlined in Section 2. Our understanding of the role that the Edward-Wakool region plays in achieving outcomes for native fish continues to grow, especially in relation to the broader southern-connected Basin. For example, the timing and extent of flows to encourage silver perch spawning in the Edward-Wakool system has only recently been demonstrated. This information, combined with the presence of juvenile silver perch, has confirmed the Edward-Wakool system as a potential key spawning and nursery area that could contribute to the recovery of silver perch in the Murray system.

## 2. Portfolio management in 2018–19

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

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

### 2.1. Antecedent and current catchment conditions and the demand for environmental water in 2018–19

Environmental water is important for the health of rivers, wetlands and floodplains, and the plants and animals they support. Ecological health is influenced by flows and conditions in the past—in some cases, this can date back many years, with parts of the environment still showing the effects of the millennium drought.

During the 2010 to 2012 period, natural flow events and environmental watering actions resulted in improvements in the condition of many sites in the Mid-Murray and promoted ecological recovery following the millennium drought. Drier conditions from 2013 to early 2016 saw some floodplain and wetland sites enter into a natural drying phase, while river flows also reduced in scale.

In 2016–17, the Mid-Murray experienced widescale natural inundation. This was beneficial to wetland and floodplain vegetation and waterbird populations in many areas. However, the natural floods also caused a significant hypoxic blackwater event. While environmental water was used to mitigate the impacts on native fish populations in some localities, the hypoxic blackwater still resulted in large-scale fish kills (CEWO, 2017).

Delivery of environmental water to the Mid-Murray in 2017–18 aimed to consolidate vegetation and waterbird outcomes from 2016–17 (either through natural flood or deliveries), and support the breeding and recolonisation opportunities for native fish with watering of low-lying wetlands and in-channel flows delivered throughout the year.

For 2018–19 the demands for environmental water in the Mid-Murray are represented in Table 3 and summarised below:

*River Murray Channel:* There is a moderate to high demand for environmental water to contribute to greater hydrologic variability and more natural seasonality of in-channel flows for a range of outcomes. Deliveries will support the ongoing recovery of native fish by providing habitat, food and opportunities for spawning, recruitment and movement and connecting the river with low-lying wetlands (to promote productivity, provide habitat diversity and support ephemeral ecosystems).

*Edward-Wakool system:* There is a moderate to high demand for environmental water in the Edward-Wakool system. Flows would seek to support the recovery of large bodied native fish and instream aquatic plants after the 2016 flood and hypoxic blackwater event. Where possible, this includes providing winter base flows and preventing cease-to-flow conditions in the Yallakool-Wakool and Colligen-Niemur systems, and also the maintenance of breeding habitat and unobstructed movement pathways between interconnected streams and channels.

*Barmah-Millewa Forest:* There is a high demand in Barmah-Millewa Forest for flows to support floodplain marsh, which includes Moira grass. Environmental water demands for the rest of the forest's vegetation is moderate. Elsewhere in Barmah-Millewa Forest there is a moderate to high demand for environmental water to provide and maintain greater connectivity between forest creeks and the main River Murray to support the recovery of large-bodied native fish populations such as Murray and trout cod, including the prevention of stranding in floodplain networks. Meeting all the above demands is also likely to support waterbird outcomes such as the provision of foraging habitat and food sources for a range of species. If a naturally-

triggered colonial bird breeding event occurs there will be a high demand for environmental water to support inundation of the nesting sites through to fledging stage.

*Gunbower Creek:* There is a moderate to high demand for environmental water to contribute to variable base flows and freshes to support the survival of native fish, encourage movement of large-bodied native fish and aquatic invertebrates, and support the mobilisation of carbon between Gunbower Creek and Gunbower Forest.

*Gunbower-Koondrook-Perricoota Forest:* Following significant environmental watering actions in 2014–15 and 2015–16, and natural overbank flooding in 2016–17 that supported floodplain fish spawning, bird breeding and establishment of native tree species, there is still a high demand for environmental water in Gunbower Forest. Furthermore, a large portion of Gunbower forest was kept dry over the last two summers to assist with carp management. In Koondrook-Perricoota Forest there is a high demand for environmental water to build on the outcomes from recent natural inundation however any watering undertaken is pending the resolution of potential third party impacts.

*Mid-Murray off-channel wetlands and ephemeral creeks – Hume to Euston:* There is a high demand for environmental water in permanent wetlands along this reach, with a particular focus for environmental water use in wetlands that contain Murray hardyhead or other threatened species. In the semi-permanent wetlands, there is a moderate need to maintain aquatic vegetation and waterbird habitat, and to maintain and/or improve the condition of mature river red gum trees. There is a low demand for environmental water in the ephemeral wetlands as water has recently inundated many of these assets.

### **Murray–Darling Basin Plan environmental watering priorities and the Murray–Darling Basin-wide environmental watering strategy**

The Murray–Darling Basin Authority publish the *Basin annual environmental watering* priorities each year and in 2017–18 also published multi-year priorities. Commonwealth environmental water in the Mid-Murray Region will contribute to the following multi-year environmental watering priorities and the 2018–19 Basin annual environmental watering priorities.

#### **Rolling, multi-year priorities**

- Support lateral and longitudinal connectivity;
- Maintain and improve the condition and promote recruitment of forests and woodlands;
- Improve the condition and extent of lignum shrublands;
- Improve the condition and extent of Moira grass in Barmah-Millewa Forest;
- Improve the abundance and maintain the diversity of the Basin's waterbird population;
- 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.

#### **2018–19 Annual Priorities**

- Support opportunities for lateral connectivity between the river and adjacent low-lying floodplains and wetlands to reinstate natural nutrient and carbon cycling processes
- Enable growth and maintain the condition of lignum shrublands;
- Provide flows to improve habitat and support waterbird breeding;
- 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.

In contributing to these demands, the Commonwealth Environmental Water Office will also be aiming to contribute to the expected outcomes in the Basin-wide environmental watering strategy (see Attachment A).



## 2.2. Water availability in 2018–19

## Forecasts of Commonwealth water allocations

Allocations against Commonwealth water entitlements in the Mid-Murray region 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 2018–19 in the Mid-Murray Region as at 30 April 2018.

Entitlement type	Forecasts of Commonwealth water allocations (including carryover) in 2018–19 (GL) <sup>2</sup>					
	Very dry ←————→					Very wet
	95 percentile	90 percentile	75 percentile	50 percentile	25 percentile	10 percentile
NSW Murray (High/Conveyance /General security)	73	133	245	346	427	427
NSW lower Darling (High/General security)	3	3	3	7	25	25
Murray <sup>3</sup> (Victorian High/ low reliability)	328	441	441	451	413	350
Murray (South Australian High security)	155	155	155	155	155	155
<b>Total – Murray (includes lower Darling)</b>	<b>560</b>	<b>732</b>	<b>844</b>	<b>960</b>	<b>1021</b>	<b>957</b>
<b>Total – Southern- connected Basin<sup>1</sup></b>	<b>780</b>	<b>1123</b>	<b>1356</b>	<b>1578</b>	<b>1666</b>	<b>1595</b>

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. 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.

The volume of Commonwealth environmental water likely to be carried over in the Mid-Murray Region for use in 2018–19 is estimated to be approximately 150 GL (gigalitres). Total Commonwealth carryover in the southern-connected Basin (i.e. combined carryover in the Murray, Murrumbidgee and Northern Victoria) is estimated to be 200–250 GL.

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 portfolios held by the NSW Office of Environment and Heritage, Victorian Environmental Water Holder, The Living Murray program, the River Murray Increased Flows program, planned environmental water, natural and unregulated flows, conveyance water and consumptive water. Further detail on sources of environmental water in the Mid-Murray Region is provided in [Attachment C](#).

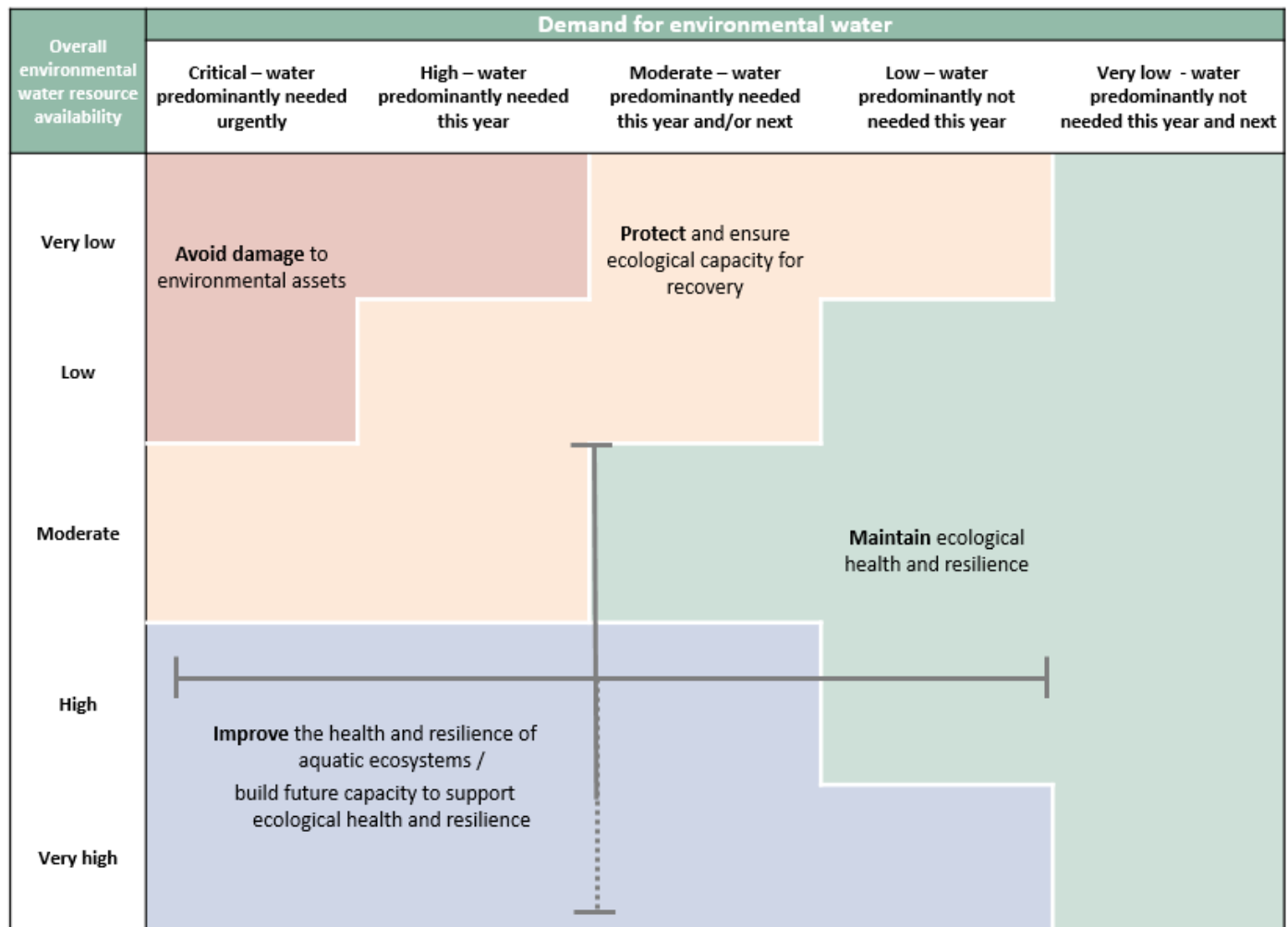
By combining the forecasts of water held by the Commonwealth with streamflow forecasts, as well as taking into account operational considerations, water resource availability scenarios can be developed ranging from very low to very high. Based on available information low to very high availability scenarios are in scope for 2018–19.

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

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

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

The overall ‘purpose’ for managing the Commonwealth’s water portfolio in the Mid-Murray Region for 2018–19 is to maintain and/or improve the ecological health and resilience of environmental assets.



**Figure 3:** Determining a broad purpose for portfolio management in the Mid-Murray Region for 2018–19. Note: grey lines represent potential range in demand and resource availability.

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, 2018–19* (available at: <http://www.environment.gov.au/water/cewo/publications>).

## 2.4. Water Delivery in 2018–19

Consistent with the demands and purpose described above, the Office is considering supplying environmental water to the following watering actions for 2018–19 (see also Table 3 for supporting information regarding the basis for determining these watering intentions).

### **River Murray Channel and Barmah-Millewa Forest 2018–19 (See Attachment B, Table 4 options 1a, 1b and 2)**

Environmental water is expected to be delivered as a River Murray ‘whole of system’ flows in 2018–19. Similar to the approach followed in 2017–18, watering will be guided by natural hydrological triggers (rainfall and inflows) in order to reinstate a portion of the once natural flow regime throughout the year. The ‘whole of system’ flows will be scalable so that the environmental watering is responsive to seasonal and operational conditions, the scale of hydrological cues and water availability. For example, environmental water may be used to prevent a rapid recession in river levels following a flow pulse, so as to support potential fish breeding that may have started in response to elevated flows.

This means that if conditions are wet, environmental water may be used for modest floodplain watering events (limited to flow rates that avoid adverse third party impacts) for outcomes such as floodplain fish breeding and recruitment, full reproductive cycles of important floodplain vegetation species, such as Moira grass, and completion of waterbird breeding events. Floodplain watering may also promote productivity and nutrient cycling processes and the export of floodplain carbon which may help mediate the acuteness of future blackwater events. If conditions are dry and inflow triggers are small, environmental watering will be focused on in-stream flow variability and periodic connectivity with low-lying anabranches and wetlands (to support fish habitat, movement and condition and riparian and wetland floodplain vegetation, and ecological productivity). While a natural cues approach will largely guide deliveries, depending upon the ecological objectives, targeted flows may be directed into Barmah-Millewa Forest to maximise outcomes within current constraints.

Following natural cues is also likely to see water being delivered most of the year. Maintaining year-round variable base flows is important for providing habitat and food for native fish, and in mixing of the water column in support of suitable water quality.

Environmental flows moving through the system also support other actions that are considered seasonally appropriate, such as weir pool raising or drawdown (to promote more natural hydrological cycles and in-stream habitat qualities) or delivery to off-channel wetland sites. River Murray ‘whole of system’ flows are also planned to be co-ordinated, where possible, with watering actions occurring in the Edward-Wakool, Goulburn, Murrumbidgee and lower Darling catchments to target system-wide environmental benefits. It is expected that flows being targeted in the Mid-Murray region will also assist in meeting watering requirements downstream in the Lower Murray.

### **Edward-Wakool System 2018–19 (Table 4 options 3a – 3c)**

*Permanent Waterways:* Environmental water will contribute to year-round variable base flows and freshes to support the recovery of in-stream habitat, particularly aquatic vegetation and areas supporting the various life stages of native fish. Watering actions will be scalable depending on catchment conditions and water availability during the year. Environmental water use may also provide a more gradual recession following periods of high flow (e.g. rain rejection flows) and improve water quality to provide refuges for aquatic plants and animals if required and where feasible to do so.

*Ephemeral waterways and wetlands:* The purpose of these annual watering events would be to maintain ephemeral instream and wetland habitat, particularly water quality, aquatic vegetation and areas supporting the various life stages of native frogs, birds and aquatic invertebrates.

*Edward-Wakool forests:* The purpose of watering events may include the protection or maintenance of floodplain vegetation health, the provision of localised habitat for aquatic native plants and animals, contributing to hydrological connectivity and nutrient/carbon cycling processes. Environmental flows, including pumping, could be considered subject to stakeholder support, operational delivery infrastructure, third party impacts and accounting being addressed.

#### **Gunbower Creek 2018–19 (Table 4 option 4)**

Environmental water will contribute to year-round variable base flows and freshes to support the survival of juvenile native fish, and encourage movement of large-bodied native fish, aquatic invertebrates and, support the mobilisation of carbon between Gunbower Creek, Gunbower Forest and the River Murray.

Consumptive water will be used to provide some of the flows, with environmental water accounting for any losses associated with the delivery of consumptive water en route in Gunbower Creek.

#### **Gunbower-Koondrook-Perricoota Forest 2018–19 (Table 4 options 5-6)**

Despite the high demand in Gunbower Forest, it is unlikely that Commonwealth environmental water will be delivered to this site in 2018–19. Any water needed to support the forest floodplain and wetlands is expected to be met by other environmental water holders. Commonwealth environmental water will support objectives in Gunbower Creek.

While there is a moderate-high demand for water in Koondrook-Perricoota Forest, Commonwealth environmental water is unlikely to be used at the site unless issues regarding potential third party impacts are resolved.

#### **Mid-Murray off-channel wetlands and ephemeral creeks 2018–19 (Table 4 option 7)**

It is anticipated that demands will be met by a number of water holders in 2018–19. Commonwealth environmental water may be provided to several wetlands, consistent with local planning processes managed by state delivery partners.

#### **Stakeholder Feedback**

The demands and watering actions have been developed based on input from and/or consultation with key partners including: NSW Office of Environment and Heritage, Victorian Environmental Water Holder, Victorian Catchment Management Authorities, NSW Department of Primary Industries – Fisheries, the Murray–Darling Basin Authority, scientists engaged in monitoring the outcomes of Commonwealth environmental water use, the Edward-Wakool Environmental Water Reference Group, the Murray-Lower Darling Environmental Water Advisory Group, and various community groups and individuals. A number of comments were received, with stakeholders supportive overall of the proposed approach. Feedback will be sought on an ongoing basis as planning transitions to implementation phase.

## **2.5. Trading water in 2018–19**

In 2018–19, administrative transfers may be required between environmental water accounts in trade zones 6, 6B, 7, 10A, 10B and 11 to enable environmental water delivery. Based upon water resource availability at the time of the watering event and scale of the event, this may include:

- small transfers (~30 GL) within trade zones for smaller environmental watering activities;
- moderate transfers (~50 GL) through the Barmah choke from trade zones 6, 10A or 10B, if required and allowable given the Barmah Choke trade limit; and
- large transfers (> 100 ggalitres) within trade zones, due to the large size of environmental watering activities.

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.

Potential for the commercial trade of Commonwealth water allocation will be reviewed throughout the water year. The Commonwealth Environmental Water Holder will inform the market of any intention to trade allocation if the conditions precedent for a sale or purchase are met.

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/current-trading-actions>.

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>.

## **2.6. Carrying over water for use in 2019–20**

The volume of water carried over for use in 2019–20 will depend upon resource availability and demand throughout the year. As the 2018–19 water year progresses, a carryover target will be determined for the southern connected basin, sufficient to meet early season requirements. As documented in Table 3 below, potential demands in 2019–20 that may require carryover include contributions to winter or early spring flows through the River Murray, Gunbower Creek, Yallakool-Wakool and/or Edward-Wakool River systems.

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 Mid-Murray Region.

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

## **2.7. Identifying Investment Opportunities**

Under the Water Act 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’ should improve the capacity of the CEWH to meet the objectives of the Basin Plan environmental watering plan.

Environmental Activities must also be consistent with:

- the CEWH’s obligation to exercise its functions to protect and restore environmental assets; and
- the requirement to use Special Account funds (including trade proceeds) to cover costs incurred in the performance of the CEWH’s functions.

The CEWH is in the process of developing an Investment Framework to guide decisions on what types of environmental activities may be considered when investing the proceeds from the sale of environmental water allocations.

**Table 3:** Environmental demands, priority for watering in 2018–19 and outlook for coming year in the Mid-Murray Region.

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system)		Watering history	2018–19		Implications for future demands
	Flow/Volume	Required frequency (maximum dry interval)	(from all sources of water)	Environmental demands for water	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2019–20 if watering occurred as planned in 2018–19
<b>River Murray from Hume Dam to Euston and Barmah-Millewa Forest<sup>1</sup></b>	2 000-5 000 ML/day at Yarrawonga Weir throughout the year for native fish habitat to improve recruitment and population structures, and water quality in main river channel and Barmah-Millewa creeks.	Annual	Continuous requirement, therefore the environmental demands has been assessed as Moderate.	High	High priority for Commonwealth environmental watering (likely to receive water even under low water resource availability)	High
	12 000 ML/day at Yarrawonga Weir for at least 7 days and up to 70 days in winter/spring targeting native fish habitat to improve recruitment and population structures (in-channel outcomes and anabranches). Would also provide carbon/productivity benefits to Edward-Wakool system during the cooler time of the year.	4 in 5 years (4 years).	Has been met in 3 of the last 5 years. Therefore the environmental demand has been assessed as Moderate.	Moderate	High priority for Commonwealth environmental watering (likely to receive water even under low water resource availability)	Moderate
	15 000 ML/day at Yarrawonga Weir for at least 7 days and up to 100-150 days in winter/spring targeting native fish habitat to improve recruitment and population structures (in-channel outcomes and giant rush wetlands). Would also provide carbon/productivity benefits to Edward-Wakool system during the cooler time of the year.	1 in 2-3 years (5-6 years).	Has been met or partially met in 2 of the last 5 years. Therefore the environmental demands has been assessed as Moderate.	Moderate	Option to be considered under a moderate to high water resource availability.	Moderate
	> 25 000 ML/day at Yarrawonga Weir (unregulated flow) for at least 7 days (river red gum forest) and followed by flows of up to 18 000 ML/day or greater for three to five months targeting Moira grassland.	2-3 in 5 years (6 years) for river red gums. Annual (2 years) for Moira grass.	For river red gum, the target has been met or partially met 2 in 5 years.  For Moira grass the target has been met 2 in 5 years.  Therefore the environmental demand has been assessed as High.	High	Reliant on large, unregulated flows. Commonwealth environmental water may extend the depth and duration of natural floods within current constraints (i.e. < 15 000 ML/day), subject to ecological need, water availability and assessment of risk and potential, adverse third party impacts.	High
<b>Yallakool - Wakool<sup>5</sup></b>  Maintenance of native fish habitat and instream aquatic vegetation Longitudinal connectivity Fish spawning, recruitment and movement Nutrient cycling Water Quality	~200 ML/day base flow for ~304 days during late winter to late Autumn (~61 GL). Note: winter base flows are a separate flow component and is included below.	Annual	Has been met 8 out of the past 9 years	Low	Likely to be met by consumptive demands except in <u>a very dry year</u> when CEW may be use to prevent system from being cut off	Low
	~800 ML/day peak for ~4 days rising from operational base flows for a period of 59 days in late winter to early spring with a gradual recession down to 430 ML/day (~51 GL in total, includes 200 ML/day base flow).	First year of trial (one off managed event).	First year of trial.	High	High priority for Commonwealth environmental watering to be assessed for environmental outcomes and extent of inundation.	High
	~430 ML/day for 41 days to maintain nesting habitat for Murray cod, and inundation for aquatic vegetation growth (~10 GL in total, includes ~200 ML/day base flow). To support Murray cod recovery post 2016 hypoxic blackwater event.	Annual	Has been met 7 out of the past 9 years	High	Priority for Commonwealth environmental water to continue ecosystem recovery	High
	~540 ML/day peak for 4 days pulse/fresh over 20 days in late spring and ~530 ML/day peak for 6 days over 48 days in late spring/early summer with gradual recessions providing variability flows (~10 GL and ~17.85 GL, includes ~200 ML/day base flow). To support silver perch and Murray cod recovery	Annual	Has been met 7 out of the past 9 years	High	Priority for Commonwealth environmental water to continue ecosystem recovery	High



	~360 ML/day peak for 3 days over 25 days pulse/fresh in late summer/early autumn with a gradual recession (~7.3 GL, includes ~200 ML/day base flow). To improve variability of flows (prevent 'flat river')	2 in 3 (4 years)	Has been met 7 out of the past 9 years	Moderate	Priority for Commonwealth environmental water to continue ecosystem recovery	Moderate
	~600 ML/day peak for 4 days over 39 days pulse/fresh in mid to late autumn with a gradual recession (~16.61 GL, includes ~200 ML/day base flow). To support silver perch recovery.	Annual	Has been met 7 out of the past 9 years and partially met 1 in 9 years.	Moderate	Priority for Commonwealth environmental water to continue ecosystem recovery - seeks to link to Autumn pulses in Southern Connected Basin	Moderate
	~170 ML/day of for 30 days (June 2019) (~5.1 GL) from early winter into 2019-2020. To support aquatic vegetation and native fish recruitment during winter	Annual	Has been met 1 (winter 2017) out of the past 9 years.	High	Priority for Commonwealth environmental water to continue ecosystem recovery. Unable to provide winter 2018 flows but will aim for winter 2019 subject to delivery infrastructure availability.	High
<b>Colligen - Niemur<sup>5</sup></b> As per Yallakool-Wakool above	The potential flow components for the Colligen-Niemur during 2018-19, and related assessment of demands & urgency of demands are similar to the flow components outlined for the Yallakool-Wakool above. The primary difference is that the flows planned for the Colligen-Niemur have been scaled to fit within its constraint for environmental flows of up to 450 ML/day.					
<b>Edward River downstream of Stevens Weir<sup>5</sup></b>	Pulse to be developed in consultation with WaterNSW and MDBA. Will need to work in with operations of Stevens Weir, delivery of operational flows & e-flows to Yallakool-Wakool and Colligen-Nimeur systems. To support silver perch recovery.	Annual	Various - flow variability during November & December (spawning period for Silver perch) may be able to meet this need.	Moderate	Priority for Commonwealth environmental water to continue ecosystem recovery - seeks to link to Autumn pulses in Southern Connected Basin	Moderate
<b>Tuppall Creek<sup>5</sup></b>	Various flow/volume requirements depending on constraints of creek system. Flow objectives are also highly site specific but may include longitudinal connectivity, improving water quality, maintaining riparian habitat, instream aquatic vegetation and native fish habitat.	Autumn & Spring each year	Has been met 8 out of the past 9 years	Moderate	Priority for Commonwealth environmental water to maintain ecosystem health - undertaken in partnership with NSW.	Moderate
<b>Merran Creek<sup>5</sup></b>		1 in 2 (2 years)	CEW was used for 1st time in 2016-17. Confirmed that operational flow can meet most needs.	Moderate	Likely to be met by operational flows. Requires Murray River to be at certain height to enable commence to flow	Moderate
<b>Jimaringle, Cochrans and Gwynnes Creeks<sup>5</sup></b>		1 in 2 (2 years)	Last use of CEW was in 2013-14. Last significant flow was the 2016 flood event.	Moderate	Use of CEW in these systems suspended pending further advice from OEH re acid sulphate soils and salinity issues.	Moderate
<b>Fringing Wetlands<sup>5</sup></b>	Various flow/volume requirements depending on wetland site. Flow objectives are also site specific but may include maintaining riparian habitat for frog, waterbird and vegetation outcomes.	Site specific	Various	Moderate	Likely to be met by OEH private wetland watering program. Use of CEW potentially available if required.	Moderate
<b>Weraí Forest<sup>5</sup></b>	Water Quality, Wetland creation/maintenance, Maintenance riparian vegetation, provision of carbon (productivity) during cooler times of the year	2-3 in 5 years (6 years) for river red gums	Has been met 3 out of the past 9 years and partially met 1 in 9 years.	Moderate	Use of CEW, including pumping, could be considered subject to stakeholder support, operational delivery infrastructure, third party impacts and accounting being addressed.	Moderate
<b>Koondrook-Perricoota Forest<sup>3</sup></b>	Annual watering proposals for this site are developed by Forestry NSW and can be contributed to by a number of water holders. Flow objectives may include maintaining habitat for aquatic vegetation, stimulate wetland vegetation response and the provision of carbon (productivity) during cooler times of the year.	2-3 in 5 years (6 years) for river red gums	Has been met 3 out of the past 9 years and partially met 1 in 9 years.	High	Commonwealth environmental water could be considered in future years, subject to stakeholder support, third party impacts and return flows being addressed.	High

<b>Edward Wakool System – Recession Flows<sup>5</sup></b>  Maintenance of instream aquatic vegetation and native fish habitat	~15 GL within constraints to provide more natural recession flows off rain rejection and unregulated events in the system.		As required - usually triggered via advice from NSW agencies re anticipated flow rates in the system.	Has been met when required (3 occasions in the past 9 years).	Moderate	Commonwealth environmental water may be used to manage flow recessions associated with natural or rain-rejection events.	Moderate
<b>Edward Wakool System - Refuge Flows<sup>5</sup></b>  Habitat flows Water quality Provision of refuges for native fish	~30-120 GL a year to manage hypoxic blackwater events and other critical habitat needs.		As required - usually triggered once dissolved oxygen levels reach 4.0 mg/l in line with Basin Plan water quality requirements.	Has been met when required (5 occasions in the past 9 years).	Critical once trigger is met	High priority for Commonwealth environmental water to abate the impact of potential fish kills if triggers are met.	Critical once trigger is met
<b>Gunbower Creek<sup>2</sup></b>	Winter low flow and summer ramp down to support juvenile fish and maintain habitat connectivity during off-irrigation season:  · Winter base flows (up to 400 ML/day at Gunbower Weir for 90 days). Net use ~8 000 ML/		Annually (1 year).	Met or partially met in the last three years. Watering required on an annual basis therefore the environmental demand has been assessed as High.	High	High priority for Commonwealth environmental watering (likely to receive water even under low water resource availability, subject to flow constraints)	High
	Spring pulse and stable summer flows for fish breeding: · Base-flow of up to 550 ML/day in spring. · High flow to 650 ML/day for 120 days in spring/summer. · Summer low flow up to 300 ML/day for 60 days in summer/autumn. Net use ~ 17,000 ML.		Fish spawning fresh 2 in 3 years.	Met or partially met in the last two years. The environmental demand has been assessed as Moderate.	Moderate	High priority for Commonwealth environmental watering (likely to receive water even under low water resource availability, subject to flow constraints)	Moderate
<b>Gunbower Forest<sup>3</sup></b>	Small-moderate actions (25 000 ML/day at Torrumbarry Weir for at least 20 days and up to 150 days in winter/spring) targeting permanent and semi-permanent wetlands, or targeted infrastructure use at the sites.	~3 000 ha via Gunbower Forest infrastructure.	6-9 in 10 years (2 years)	Significant watering action in 2014-15 and 2015-16 and natural flood event in 2016-17 inundated various parts of the Forest. Drying phase in 2017-18 with the exception of high value permanent wetlands. Environmental demand has been assessed as High.	High	It is anticipated that demands in Gunbower Forest will be met by other water holders in 2018 - 19.	Low
	Infrastructure delivery to Gunbower Forest targeting river red gum forest equivalent to around 27-35 000 ML/day at Torrumbarry Weir.	~4 000 ha via Gunbower Forest infrastructure.	1 in 3-4 years (3 years)	Met or partially met in the last four years. The environmental demand has been assessed as Moderate.	Moderate	It is anticipated that demands in Gunbower Forest will be met by other water holders in 2018 - 19.	Low

Mid-Murray Off-Channel Wetlands and ephemeral creeks Hume to Euston <sup>4</sup>	Infrastructure delivery targeting <b>permanent</b> off-channel wetlands.	Annually	Met in the last three years. Annual requirement therefore the environmental demand has been assessed as High.	High	High priority for Commonwealth environmental watering (likely to receive water even under low water resource availability)	High
	Infrastructure delivery targeting semi-permanent off-channel wetlands.	3-7 in 10 years (5 years).	Met in the last three years at some sites. Therefore the environmental demand has been assessed as Moderate.	Moderate	Option to be considered under a moderate to high water resource availability.	High
	Infrastructure delivery targeting <b>ephemeral</b> off-channel wetlands.	1 in 5 years.	Met in the last three years at most sites. Therefore the environmental demand is Low overall.	Low	Option to be considered under a moderate to high water resource availability.	Moderate
				Carryover potential	Moderate proportion of available allocations expected to be carried into 2019–20, subject to Commonwealth Environmental Water Holdings at 30 June 2019, water resource availability and environmental watering actions undertaken in 2018-19.	The volume of water in the catchment to be carried over into 2019–20 will be finalised during the 2019–20 portfolio planning process.
				Trade potential	It is expected that zero dollar portfolio transfers of Commonwealth water allocations will be undertaken between trade zones in the southern connected Basin to support environmental water delivery throughout the 2018-19 water year. Potential for the commercial trade of Commonwealth water allocation will be reviewed throughout the water year. The Commonwealth Environmental Water Holder will inform the market of any intention to trade allocation if the conditions precedent for a sale or purchase are met.	No expected urgency to augment available allocations. Potential to trade will depend on environmental demands and resource availability.

**Key - potential watering in 2018–19**

	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 - urgency of 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

1. Murray and Barmah-Millewa Forest indicators adapted from Department of the Environment (2011a), MDBA (2012d) and DPI Fisheries (2016).

2. Gunbower Creek indicators sourced from North Central CMA (2013; 2014b; 2015b; 2016b; 2017).

3. Gunbower-Koondrook-Perricoota Forest indicators adapted from MDBA (2012c), MDBA 2012 (f), Department of the Environment (2011d).

4. Mid Murray Off-Channel Wetlands and ephemeral creek indicators sourced from North Central CMA (2014a; 2015a; 2016a).

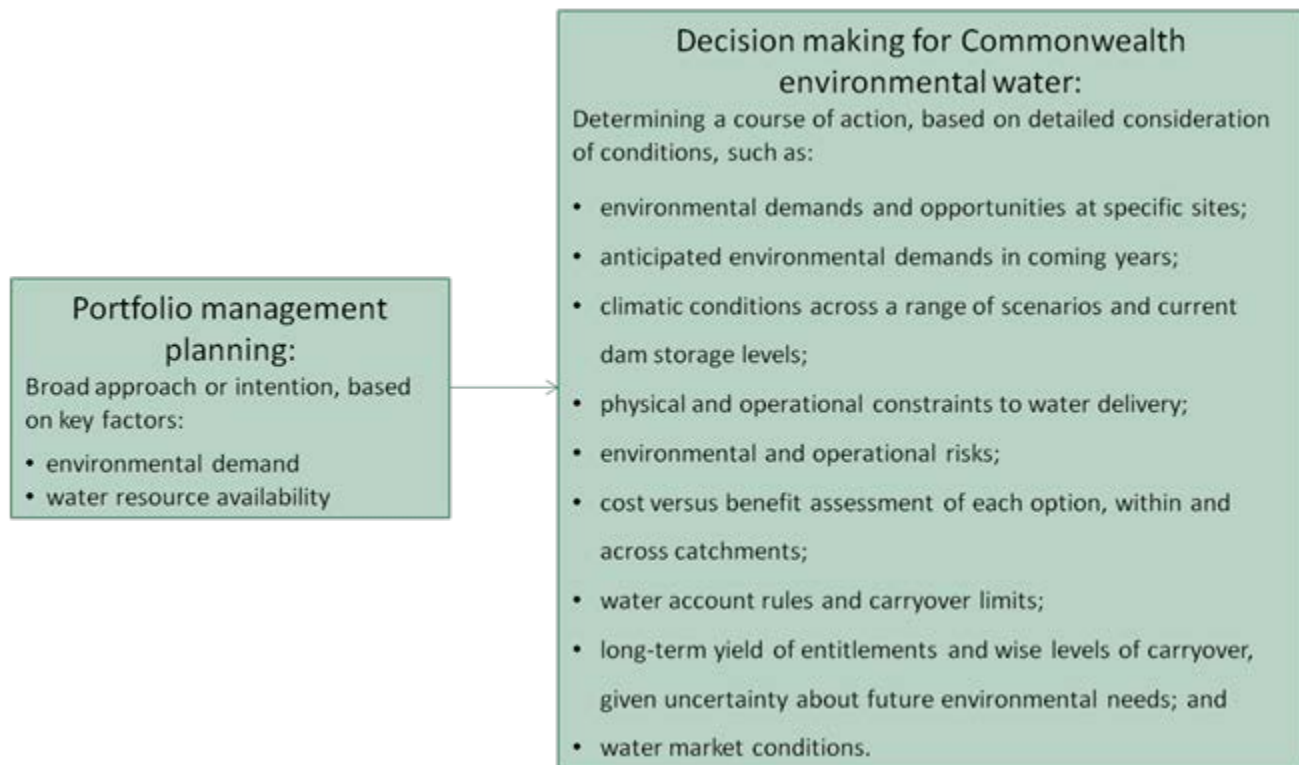
5. Edward-Wakool indicators compiled from multiple sources (Hale & SKM 2011; Watts et al 2013; Watts et al 2014; Watts et al 2015; Watts et al 2016; Watts et al 2017; Webster 2010). Previous watering actions and their outcomes have also been used for all indicators.

## 3. Next steps

### 3.1. From planning to decision making

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

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



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

### 3.2. Further information

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

or the sites below:

- Water use: [www.environment.gov.au/topics/water/commonwealth-environmental-water-office/assessment-framework](http://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 Mid-Murray Region are described below.

## RIVER FLOWS AND CONNECTIVITY

Base flows 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, and those that form extensive stands within wetlands and low-lying floodplains including Moira grasslands in Barmah–Millewa Forest.

### Vegetation extent

Region	Area of river red gum (ha)	Area of black box (ha)	Area of coolibah (ha)	Shrublands	Non-woody water dependent vegetation
Murray (assessment is for entire Murray catchment)	90 600*	41 700*	-	Lignum along the River Murray from the junction with the Wakool River to downstream of Lock 3, including Chowilla and Hattah Lakes	Closely fringing or occurring within the Murray, Edward, Kiewa, Mitta Mitta, Niemur and Wakool rivers and Tuppall Creek; Moira grasslands in the Barmah–Millewa Forest

### Black box condition

Region	Vegetation condition score		Percent of vegetation assessed (within the managed floodplain)
	0 – 6	>6 – 10	
Murray (assessment is for entire Murray catchment)	33 per cent	65 per cent	28 per cent

### River red gum condition

Region	Vegetation condition score					Percent of vegetation assessed (within the managed floodplain)
	0 – 2	>2 – 4	>4 – 6	>6 – 8	>8 – 10	
Murray (assessment is for entire Murray catchment)	2 per cent	1 per cent	10 per cent	51 per cent	35 per cent	51 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 Mid-Murray

Environmental asset	Total abundance and diversity	Drought refuge	Colonial waterbird breeding	Shorebird abundance	In scope for C'th watering
Gunbower–Koondrook–Perricoota			*		Yes
Kerang wetlands	*				Yes
Barmah–Millewa	*		*		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 Mid-Murray

Species	Specific outcomes	In-scope for C'th water in the Mid-Murray?
Flathead galaxias ( <i>Galaxias rostratus</i> )	Expand the core range in the wetlands of the River Murray.	Yes
Freshwater catfish ( <i>Tandanus tandanus</i> )	Expand the core range in Columbo-Billabong Creek and Edward-Wakool system.	Yes
Golden perch ( <i>Macquaria ambigua</i> )	A 10–15 per cent increase of mature fish (of legal take size) in key populations.	Yes
Murray cod ( <i>Maccullochella peelii peelii</i> )	A 10–15 per cent increase of mature fish (of legal take size) in key populations.	Yes
Murray hardyhead ( <i>Craterocephalus fluviatilis</i> )	Expand the range of at least two current populations. Establish 3–4 additional populations, with at least one in the Mid-Murray conservation unit.	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 River Murray.	Restoration of flow to River Murray could support the future reintroduction of the species.

Species	Specific outcomes	In-scope for C'th water in the Mid-Murray?
River blackfish ( <i>Gadopsis marmoratus</i> )	Expand the range of current populations from the Mulwala canal.	Yes
Silver perch ( <i>Bidyanus bidyanus</i> )	Expand the core range within the River Murray (Yarrawonga–Euston including the Edward-Wakool system).	Yes
Southern purple-spotted gudgeon ( <i>Mogurnda adspersa</i> )	-	Yes
Southern pygmy perch ( <i>Nannoperca australis</i> )	Expand the range of current populations at Barmah-Millewa and other Mid-Murray wetlands.	Yes
Trout cod ( <i>Maccullochella macquariensis</i> )	Expand the range of trout cod up the Murray upstream of Lake Mulwala and into the Kiewa River. For the connected population of the Murrumbidgee–Murray–Edward systems: continue downstream expansion.	Yes
Two-spined blackfish ( <i>Gadopsis bispinosus</i> )	Establish additional populations (no specific locations identified).	Yes

#### Important Basin environmental assets for native fish in the Mid-Murray

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 water
Koondrook–Perricoota	*	*	*	*	*		Yes
Gunbower	*	*	*	*	*		Yes
Barmah–Millewa	*	*	*	*	*	*	Yes
Edward–Wakool system	*	*	*	*	*	*	Yes
Werai Forest			*	*			Yes
Billabong–Yanco–Columbo Creeks		*	*	*	*	*	Yes
Lake Mulwala	*		*	*	*	*	Yes

# Attachment B – Operational details for watering

## Operational considerations in the Mid-Murray Region catchment

The delivery of environmental water in the Mid-Murray is currently constrained by the release capacities from storages, channel capacities and system constraints. Relevant constraints to be considered include:

- To avoid unseasonable inundation of Barmah-Millewa Forest during summer, delivery through the Barmah Choke is limited to approximately 10 000 ML/day downstream of Yarrawonga (MDBA, 2017).
- The delivery of Commonwealth environmental water in the Mid-Murray is affected by constraints in the tributaries of the Mid-Murray, particularly the Goulburn River. Releases on major tributaries (to avoid unacceptable third party impacts) may limit the delivery of water to Mid-Murray Region sites.
- Channel capacity may limit the delivery of Commonwealth environmental water in certain parts of the Mid-Murray Region. On the River Murray main channel there are various flow constraints to avoid the inundation of property and privately owned infrastructure. At Deniliquin, flows in the Edward River above 17 100 ML/day result in minor flood events (MDBA 2013).

Further information about constraints in the Mid-Murray Region can be found in the *Water Sharing Plan for the New South Wales Murray and Lower Darling Regulated Rivers Water Sources 2016* (NSW) (pt 10 cls 51) and *Constraints Management Strategy 2013 to 2024* (MDBA 2013).

## 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 the Mid-Murray Region and the levels of water resource availability that relate to these actions.

**Table 4:** Summary of potential watering actions for the Mid-Murray Region (See Table 3 for supporting information regarding these potential watering actions)

Broad Asset	Indicative demand	Applicable level(s) of resource availability				
		Very Low	Low	Moderate	High	Very High
<b>River Murray from Hume Dam to Euston</b>	2000 – 5000 ML/day at Yarrawonga Weir throughout year for fish habitat and water quality in main river channel and Barmah-Millewa creeks.	1a. Mid River Murray Channel Flow: Contribute to low-level in-stream flows where required to provide fish habitat and water quality outcomes, and to re-connect river with low-lying wetlands and creeks, subject to appropriate trigger. Includes the Murray River winter flow component.				
	12 000 ML/day at Yarrawonga Weir for at least 7 days and up to 70 days in winter/spring targeting in-channel outcomes and anabranches. 15 000 ML/day at Yarrawonga Weir for at least 7 days to 100-150 days in winter/spring targeting in-channel outcomes and giant rush wetlands.		1b. Mid River Murray Channel Flow: Contribute to in-stream flows to promote fish movement, condition, spawning and recruitment of flow specialists and floodplain fish species and to re-connect river with low-lying wetlands and creeks, subject to appropriate trigger.			
<b>Barmah-Millewa Forest</b>	> 25 000 ML/day at Yarrawonga Weir (unregulated flow) for at least 7 days (river red gum forest) and followed by 15 000 ML/day flows for three to five months targeting Moira grassland.		2. Barmah-Millewa Forest Flow: Contribute to an overbank flow (15 000–18 000 ML/day following large unregulated peak) to inundate up to 35 000 ha of marshland and river red gum forest; to promote fish movement, condition, spawning and recruitment of some fish species (flow and floodplain specialists); and to support completion of naturally triggered bird breeding events.			
<b>Edward-Wakool River System</b>	Permanent waterways.	3a. Maintain critical habitat flows to prevent cease to flow.	3a. To support the recovery of in-stream habitat after the 2016 flood, particularly aquatic vegetation and areas supporting the various life stages of native fish. Environmental water use is most likely to contribute to in-channel base flows and freshes. It may also be used to provide a more gradual recession to periods of high flow (e.g. rain rejection flows) and improve water quality.			3a. Provide refuge flows to maintain critical habitat flows.
	Ephemeral waterways and wetlands.		3b. To maintain ephemeral in-stream and wetland habitat, particularly water quality, aquatic vegetation and areas supporting the various life stages of native fish, frogs, birds and aquatic invertebrates.			
	Forests.			3c. To maintain vegetation health and to contribute to hydrological connectivity and nutrient/carbon cycling processes. Flows into the Werai forest system should ideally be synchronised/integrated with flows from Barmah-Millewa Forest (see also Koondrook-Perricoota forest below).		



Broad Asset	Indicative demand	Applicable level(s) of resource availability				
		Very Low	Low	Moderate	High	Very High
<b>Gunbower Creek</b>	<p>Winter baseflows of up to 400 ML/day for 90 days and summer/autumn ramp down 300 ML/day for 60 days.</p> <p>Spring pulse and stable summer flows to support fish breeding:</p> <ul style="list-style-type: none"> <li>• Base flow of up to 550 ML/day in spring.</li> <li>• Single fresh up to 650 ML/day for 120 days in spring/summer.</li> </ul>	<p>4. Gunbower Creek Channel Flow: Contribute to in-stream flows to support the survival and condition of juvenile fish and stimulate lateral movement of large-bodied native fish, aquatic invertebrates and carbon between Gunbower Creek and Gunbower Forest.</p>				

Broad Asset	Indicative demand	Applicable level(s) of resource availability				
		Very Low	Low	Moderate	High	Very High
<b>Gunbower-Koondrook-Perricoota Forest</b>	Small-moderate action (25 000 ML/day) at Torrumbarry Weir for at least 20 days and up to 150 days in winter/spring targeting permanent and semi-permanent wetlands or: <ul style="list-style-type: none"> <li>~3000 ha via Gunbower Forest infrastructure.</li> <li>~8000 ha via Koondrook-Perricoota Forest infrastructure.</li> </ul> Infrastructure delivery to Gunbower and Koondrook-Perricoota Forests targeting river red gum forest equivalent to around 27 000–35 000 ML/day at Torrumbarry Weir, or: <ul style="list-style-type: none"> <li>4000 ha via Gunbower Forest infrastructure.</li> <li>Up to 16 000 ha via Koondrook-Perricoota Forest infrastructure.</li> </ul>				5. Gunbower Forest Flow: Deliver water to inundate river red gum forest; support survival, condition and spawning of native fish (floodplain specialists) and/or supporting the completion of a bird breeding event.	
					6. Koondrook-Perricoota Forest Flow: Subject to potential third party impacts being addressed, use infrastructure to provide flows to inundate river red gum forest; support bird breeding and/or support survival, condition and spawning of native fish (floodplain specialists), and the provision of carbon (productivity) during cooler times of the year. Flows into the Koondrook-Perricoota forest system should ideally be synchronised/integrated with flows from the Murray (e.g. Barmah-Millewa Forest and/or the Goulburn River system to mimic the natural movement of flows through the mid-Murray at a systems-landscapes scale.	
<b>Mid-Murray Off-Channel Wetlands Hume to Euston</b>	Permanent Wetlands.	7. Water a range of annual, semi-annual, intermittent Mid-Murray wetlands across all scenarios, subject to seasonal cues.				
	Semi-permanent Wetlands.					
	Ephemeral Wetlands.					

Note: Under certain resource availabilities, option 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.

## Potential watering actions – standard operating arrangements

Table 4 identifies the range of potential watering actions in the Mid-Murray Region 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.

### **Watering Action 1a, 1b, 2, 5 and 6: Mid River Murray channel flow; Barmah-Millewa Forest flow; and Gunbower-Koondrook-Pericoota Forest high flow (within constraints).**

#### *Standard operational considerations:*

- In-stream environmental watering seeks to target improved seasonality of flows to promote spawning of flow specialist fish species and to re-connect rivers with low-lying wetlands. As such, an action will generally be in response to an appropriate flow triggers, such as rainfall events and flows upstream of Hume Dam and in tributaries (e.g. Ovens, Kiewa, Goulburn and Murrumbidgee rivers).
- Larger channel flows will naturally enter creeks and anabranches, low lying wetlands (e.g. Coppingers Lagoon, Duck Lagoon, Douglas Swamp, Boals-Deadwoods, St Helena Swamp, Black Swamp, Walthours Swamp, Moira Lake, Barmah Lake and Gulpa Creek Complex). In some cases infrastructure may be used to provide flow conditions for fish outcomes (e.g using Mary Ada regulator to provide flows for native fish in Toupna Creek).
- Barmah-Millewa Forest:
  - To create significant flows into Barmah-Millewa Forest, significant natural flows are required, with Commonwealth environmental water only provided to extend the duration of flows once the flow rate recedes to a level that does not create unacceptable third party impacts. Regulators may be opened or closed on either side to influence the extent and duration of flows into Barmah and Millewa forests.
  - The action would typically occur during winter or spring, consistent with natural seasonality. Unless otherwise agreed, Commonwealth environmental water will be delivered to target a maximum water level of 3.0 m at the Tocumwal Gauge (which corresponds to about 15 000 ML/day). From December to May, flows downstream of Yarrawonga Weir are managed as required to avoid unseasonal inundation of Barmah-Millewa Forest (historically around 10,000 ML/d).
  - Higher flows that enter anabranches and creeks in Millewa Forest may connect with the Edward-Wakool system and provide further benefits.
  - With other factors influencing the extent of floodplain marsh species such as Moira grass, complementary natural resource management activities will be important if Commonwealth environmental water is to be provided to extend Barmah-Millewa Forest flows, such as managing the encroachment by river red gums and grazing by vertebrate pests.
- Gunbower-Koondrook Pericoota Forest:
  - Environmental water may be contributed to channel flows to connect the River Murray with Gunbower and Koondrook-Perricoota forests.
  - A suitable flow trigger is required for environmental water to piggy-back on and resource availability may often be a limiting factor. The action would likely occur as part of a multi-site connected flow action through the Mid-Murray.

- o The use of Commonwealth environmental water in Koondrook-Perricoota Forest will depend on necessary State approvals being in place and an assessment of risks including, but not limited to, water quality issues and potential third party impacts.
- Environmental water delivery may be constrained by other demands on the system, especially during irrigation season, and capacity to release and coordinate releases from multiple storages.

*Typical extent:*

- Flow rates will be dependent on flow conditions, target outcomes and the operational considerations described above. Releases from Hume Dam will have most impact (in terms of flow variability) on flows in the upper Mid-Murray channel (from Hume to the Barmah Choke). Significantly influencing flow variability in the River Murray downstream of the Barmah Choke requires coordination of water delivery from other tributaries (e.g. the Goulburn and Murrumbidgee rivers).
- In Barmah-Millewa Forest, the extent would generally be sufficient in terms of magnitude (initial unregulated trigger of at least 20 000 – 25 000 ML/day) and duration (at least three months) to water large areas of floodplain marsh including Moira grassland and allow the open wetland vegetation to complete its flowering. Less frequently, and following a larger unregulated trigger, flows may inundate broader areas of river red gum forest. This action may also contribute to outcomes in the Edward-Wakool system (Action 3).
- For Gunbower Forest, the extent will be determined by the watering scenario agreed to by the site manager and water holders.
- For Koondrook-Perricoota Forest the extent will be subject to the advice of the forest manager (Forestry NSW), Koondrook-Perricoota Operating Committee and delivery partners.

**Watering Action 3a, 3b and 3c: Edward-Wakool River system**

*Standard operational considerations:*

- WaterNSW is responsible for managing flows in the Edward-Wakool River system, which is highly regulated. Depending on the location and purpose of the action, water may also be sourced from either Murray Irrigation and/or private landholder irrigation infrastructure. Commonwealth environmental water may be delivered in combination with natural, consumptive or other held or planned environment water.
- Forest and ephemeral waterway actions will be timed for winter/spring and late autumn to minimise the risk of hypoxic blackwater impacts. Operational considerations for Werai Forest are being reviewed to improve the potential for watering to be undertaken, particularly synchronising flows into the Werai with flows targetting Millewa Forest.
- Contingency flows may be made available, if required, to provide critical refuge habitat for aquatic species such as large bodied native fish during hypoxic events.
- Planning for actions will take into consideration the potential impacts of inundating areas that have acid sulphate soils and/or deep pools that may result in the movement of salt.
- Maintenance work will be undertaken on Stevens Weir and other delivery infrastructure in the Edward-Wakool River system during May, June and July 2018. This will prevent the delivery of flows into the Yallakool-Wakool and Colligen-Niemur systems during the winter 2018 period. The recommencement of delivering winter flows will be sought for winter 2019.

*Typical extent:* Flows will be delivered within constraints, unless otherwise agreed with potentially impacted landholders and state government agencies. During August 2018, following discussions with the landholder representatives and relevant NSW agencies, an 800 ML/d flow trial in the Yallakool-Wakool is planned, targeting productivity, native fish, and instream aquatic vegetation outcomes.

## **Watering Action 4 and 5: Gunbower Creek channel flow and Gunbower Forest flow**

### *Standard operational considerations:*

- Environmental water can be delivered to Gunbower Creek in combination with consumptive flows to the Torrumbarry Irrigation Area. Water levels in Gunbower Creek are largely driven by irrigation demand. Commonwealth environmental water will be used to account for the losses associated with the delivery of consumptive water en route through Gunbower Creek.
- High flows in Gunbower Creek can also be used to push water into Gunbower Forest using the Hipwell Road regulator. The native fish population in the highly regulated Creek can be enhanced by delivering targeted environmental flows to provide improved conditions for native fish year-round.
- When delivering water during the irrigation season, the environment shares the capacity of Gunbower Creek with irrigation flows. As such, there is potential for system capacity constraints to interrupt the supply of environmental water to Gunbower Forest.
- Unless otherwise agreed, Commonwealth environmental water will not be used to contribute to flow rates above 700 ML/day at Cohuna Weir to avoid unplanned inundation of private land.
- Due to infrastructure limitations when watering both the Gunbower Forest and Creek, winter baseflows in Gunbower Creek (as part of the large bodied fish hydrograph) may be limited to approximately 200 ML/day (50 ML/day over the Hipwell Weir fishway and 150 ML/day delivered via the 6/1 channel). This will impact upon the deliverability of the full fish hydrograph in Gunbower Creek in 2018 – 19.
- A number of planned infrastructure works are scheduled between 2017–18 to 2021–22 that will require Gunbower Creek water levels to be lowered. This has the potential to impact upon the deliverability of the full fish hydrograph and therefore presents a possible threat to the vulnerable native fish population in Gunbower Creek. Infrastructure maintenance works may be undertaken which may impact the ability to deliver the full fish hydrograph for Gunbower Creek in 2018–19.

*Typical extent:* In-channel flows through to inundation of up to 4 800 ha of river red gum forest.

## **Watering Action 6: Koondrook-Perricoota Forest via infrastructure works**

### *Standard operational considerations:*

- Commonwealth environmental water provided to Wakool River-Yallakool Creek (in the Edward-Wakool system) may assist with managing outflows from Koondrook-Perricoota Forest into the Wakool River.
- Water would be delivered to Koondrook-Perricoota Forest via the Torrumbarry Weir pool and inundation managed using a series of regulators. Outfalls to the Wakool River may need to be managed to prevent third party impacts and water quality issues.

*Typical extent:* To be determined by the watering scenario agreed to by the site manager and water holders.

*Approvals:* Commonwealth environmental water may be used in this area subject to potential third party impacts being resolved.

## **Watering Action 7: Mid-Murray off-channel wetlands – Hume to Euston**

### *Standard operational considerations:*

- The Mid-Murray wetlands are scattered along the River Murray on the New South Wales side, while almost wholly contained within the Torrumbarry Irrigation Region in Victoria. Many of the wetlands are now cut-off from natural inundation and are reliant on the managed delivery of environmental water. The delivery of environmental water to these wetlands is constrained by a number of factors such as restrictions to delivery outlets and channel capacity.
- Multiple wetlands having similar watering regimes and requiring water at the same time results in competition for resource availability, particularly in drier years. Prioritisation and ultimately trade-off decisions may be required during low resource availability periods.

- As most of the Mid-Murray wetlands in Victoria are now managed to maintain permanent or semi-permanent saline water habitats, the decision to provide environmental water may not only relate to lake levels, but also active management of salinity concentrations conducive to salt-tolerant species.

*Typical extent:* Individual wetland sites in the Mid-Murray region, from Hume Dam to Euston.

# Attachment C – Long-term water availability

## Commonwealth environmental water holdings

The Commonwealth holds the following entitlements in the Mid-Murray Region:

- NSW Murray High Security
- NSW Murray General Security
- NSW Murray Conveyance
- NSW Murray Supplementary
- Victorian Murray High Reliability
- Victorian Murray Low Reliability

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](http://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 Mid-Murray Region include:

- Environmental Entitlement: The Living Murray Program – Murray–Darling Basin Authority
- Environmental Entitlement: New South Wales – New South Wales Office of Environment and Heritage
- Bulk Entitlement – Victorian Environmental Water Holder
- River Murray Increased Flows entitlements: Jointly managed by New South Wales Office of Environment and Heritage and Victorian Environmental Water Holder

## 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’).

- Barmah-Millewa Environmental Allowance:
  - Provides an annual allocation of up to 150 GL (100 GL high security and 50 GL low security allocation). This water can be used to deliver flows to meet ecological objectives in the Barmah-Millewa Forest in accordance with specific rules.
  - A maximum of 700 GL of water can be carried over from one water year to the next. Responsibility for the Barmah-Millewa Environmental Water Allowance is shared between NSW and Victoria. More information about this water allowance is available from the *Barmah-Millewa Forest Environmental Water Management Plan* (MDBA 2012e).
- New South Wales Murray Regulated River Water Source Additional Environmental Allowance:
  - the maximum volume held is calculated as 0.15 ML multiplied by the total number of regulated river (high security) unit shares
  - releases of water from the Murray Regulated River Water Source Additional Environmental Allowance can be made for the purpose of contributing to any of the objectives (a) to (i) outlined in the Water Sharing Plan (Section 2, Clause 10).





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