Australian Government

Commonwealth Environmental Water Office

Commonwealth Environmental Water

Portfolio Management Plan

Victorian Rivers

2018–19

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Goulburn River near Murchison, Photo by M. Judd, Goulburn Broken Catchment Management Authority.

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Lower Broken Creek at Lukes Weir, Photo by D. Lovell, Goulburn Broken Catchment Management Authority.

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 Victorian rivers in the Murray-Darling Basin 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 the Victorian Environmental Water Holder, Murray-Darling Basin Authority, Goulburn Broken Catchment Management Authority, North Central Catchment Management Authority, North East Catchment Management Authority, Wimmera Catchment Management Authority, Goulburn Murray Water and Grampians Wimmera Mallee Water.

Your input

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

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1. Environmental watering in the Victorian Rivers in the Murray-Darling Basin

1.1. The Victorian Rivers in the Murray-Darling Basin

The Victorian rivers in the Murray-Darling Basin include the Goulburn-Broken, Campaspe, Loddon, Ovens (Figure 1) and Wimmera catchments. The northern Victorian rivers, particularly the Ovens and Goulburn-Broken, contribute significantly to the water resources of the River Murray, and 11.5 per cent of the Basin's stream flow originates in the Goulburn-Broken. Lake Eildon on the Goulburn River is one of the Basin's major water storages. The Wimmera River in central-west Victoria flows into Lakes Hindmarsh and Albacutya and does not connect to the River Murray. The Victorian rivers region has a highly developed agricultural sector and a population of almost half a million people (DEPI 2015).

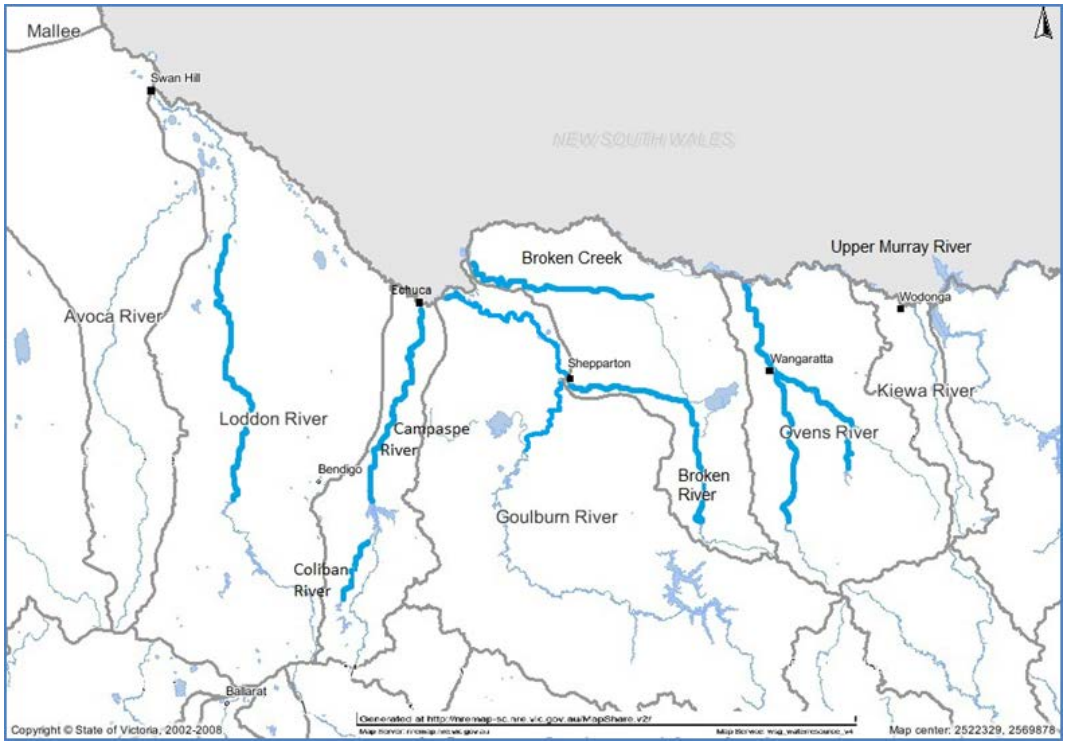

Figure 1: Map of the Victorian rivers in the Murray-Darling Basin. The Wimmera catchment is not shown here but is located in central-west Victoria.

Commonwealth environmental water is delivered to the Victorian rivers primarily as in-stream flows via managed releases from storage. Natural cues may be used to inform the use of environmental water in Victorian rivers, establishing a more natural flow regime and maximising the benefits of environmental water delivery. In lower Broken Creek, delivery is via irrigation infrastructure sourced from either the Goulburn system or the River Murray. Commonwealth environmental water use in the Victorian rivers contributes to both enhanced baseflows and freshes. This water can be credited as return flows for further environmental use downstream in the River Murray, with the exception of flows from the Loddon, Ovens and Wimmera rivers.

Goulburn Murray Water (GMW) is the principal storage and water supply manager in Victorian catchments and is responsible for the day to day delivery of water (including environmental water) throughout its river systems and irrigation supply network. Grampians Wimmera Mallee Water (GWMW) is the storage and water supply manager for the Wimmera catchment. The implementation of watering actions within the Victorian rivers is coordinated by the Victorian Environmental Water Holder (VEWH) and managed by regional waterway managers including the Goulburn-Broken Catchment Management Authority (GBCMA), North Central Catchment Management Authority (NCCMA), North East Catchment Management Authority (NECMA) and Wimmera Catchment Management Authority (WCMA).

1.2. Environmental objectives in the Victorian Rivers in the Murray-Darling Basin

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

The Victorian state government has also developed a long-term watering plan for all northern Victorian catchments. 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 (https://www.water.vic.gov.au/waterways-and-catchments/rivers-estuaries-and-waterways/environmental-water).

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 Victorian Rivers 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 Victorian rivers

BASIN-WIDE MATTERS (Matters in red link to the Basin-wide environmental watering strategy)	**OBJECTIVES FOR ENVIRONMENTAL ASSETS IN THE VICTORIAN RIVERS**	
	IN-CHANNEL ASSETS	**OFF-CHANNEL ASSETS**
	Goulburn (lower and middle reaches), Broken, Campaspe, Loddon, Ovens and Wimmera rivers; Upper and lower Broken Creek	**Goulburn River wetlands; Lower Broken wetlands; Upper Broken Creek wetlands (Moodie Swamp)**
VEGETATION	Maintain and improve riparian and in-channel vegetation cover, extent, condition and diversity. Increase periods of growth for inundation tolerant vegetation communities that closely fringe or occur within river channels.	Maintain the current extent, condition and diversity of water-dependent vegetation. Improve condition of black box, river red gum and lignum shrublands. Improve recruitment of trees within black box and river red gum communities.
WATERBIRDS	Provide habitat and food sources to support waterbird breeding, survival and recruitment, and maintain condition and current species diversity.	
		Support waterbird breeding, including brolga in Moodie Swamp
FISH	Provide flows to support habitat and food sources to promote increased movement, breeding, recruitment and survival of native fish, improve abundance and maintain species richness. Provide native fish passage through fishways.	Provide flow cues to support habitat and food sources and promote increased movement, recruitment and survival 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 and food sources to support survival, maintain condition and provide recruitment opportunities for frogs, turtles, reptiles and mammals	
CONNECTIVITY	Support longitudinal connectivity along Victorian rivers and to the River Murray for environmental functions such as nutrient and sediment transport, organism dispersal and water quality. Support lateral connectivity by increasing the frequency of freshes.	Support lateral connectivity (within constraints) to wetlands and floodplains by contributing to an increase in the frequency of lowland floodplain flows.
PROCESSES	Support primary productivity, sediment, nutrient and carbon transport and cycling; biotic dispersal/movement; and channel maintenance.	
WATER QUALITY	Maintain water quality and provide refuge habitat from adverse water quality events (e.g. low dissolved oxygen and hypoxic blackwater), including minimising accumulation of Azolla (aquatic plant) in lower Broken Creek to help maintain DO levels.	Support the transport of nutrients and carbon off the floodplain and into the river channel and downstream.
RESILIENCE	Provide drought refuge habitat.	

Information sourced from: Cottingham et al. (2003; 2007; 2010; 2014) GBCMA (2018 a-d), NCCMA (2018 a-b), NECMA 2018) WCMA (2018)

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 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 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.

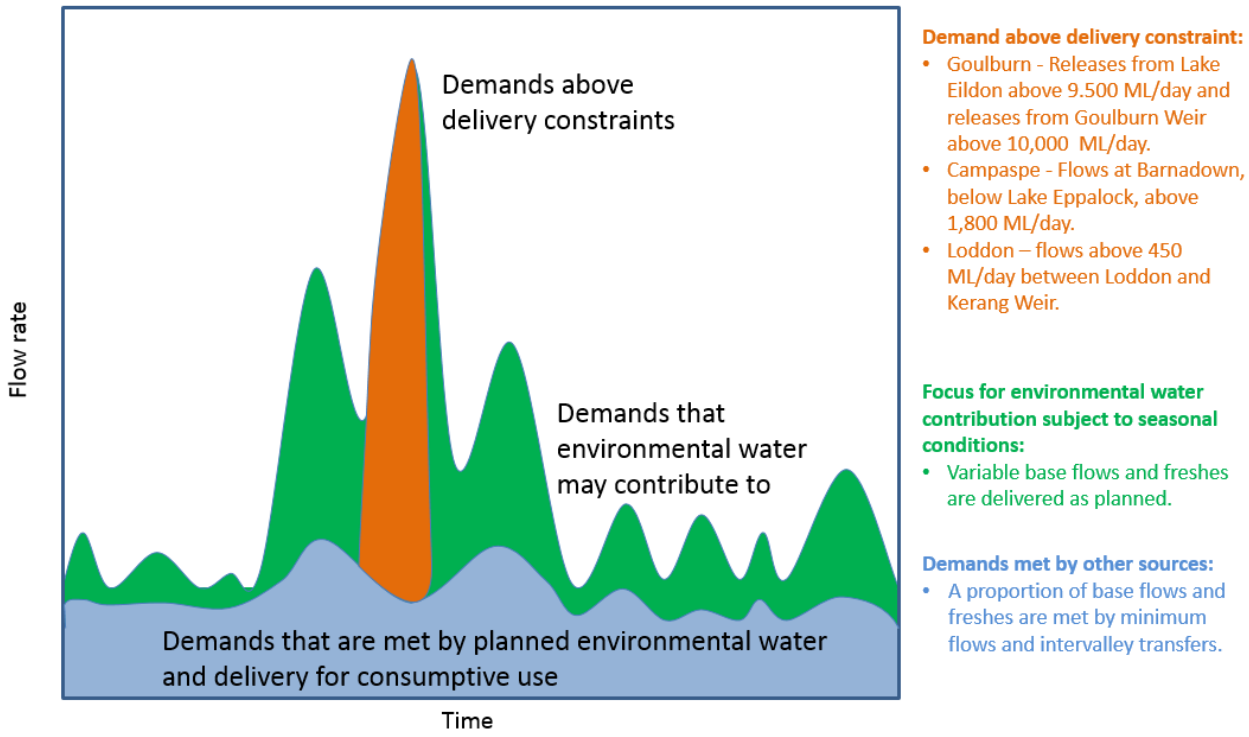

Figure 2: Scope of demands that environmental water may contribute to in the Victorian rivers of the Murray-Darling Basin

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.

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

Information on the monitoring activities in the Goulburn is available at http://www.environment.gov.au/water/cewo/catchment/northern-victorian-rivers/monitoring

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

Key findings from the 2016–17 Goulburn LTIM Project (as per link above) relevant to this plan include:

Macroinvertebrates

- After the winter/spring floods, macroinvertebrate richness, abundance and large crustacean biomass increased in both Goulburn and Broken Rivers.
- Increased macroinvertebrate diversity, abundance and biomass in edge habitats was observed following the natural spring flood. Notably, this response was larger than the effect observed for smaller managed spring flow events in previous years.

Bank Condition

- Current environmental flows do not contribute to greater erosion than would occur under regulated flows.
- Bank erosion and deposition are highly variable spatially, both along the bank and with elevation, and over time, with a single point on the bank often changing from erosion to deposition with subsequent flow events.

Vegetation

- Given the very wet, antecedent conditions, the decision to not deliver the spring fresh following the natural flood was beneficial for new vegetation.
- The March 2017 summer/autumn fresh appeared to provide some positive effects for mature native grasses.
- Mud drapes that encourage vegetation establishment most commonly develop during slower rates of flow recession.

Fish

- Long-distance movements (>20 km) of golden perch coincided with elevated flows.
- Attraction flows (the extended autumn fresh in March 2017) saw the movement of some tagged sub-adult silver perch into the lower Goulburn River. Higher numbers of silver perch were found in 2017, and this is likely due to immigration from the Murray River.
- The majority of golden perch eggs (and carp larvae) coincided with the falling limb of the hydrograph. While golden perch are known to be flow-dependent spawners, the observation of spawning well after the peak of flows highlights the importance of higher water temperature for spawning.
- The elevated spring flows that improved the recruitment of semi-aquatic bank vegetation may explain the higher abundance of Murray River rainbow fish, listed as threatened in Victoria (as well as carp spawning and recruitment).
- However, recent modelling indicates that within-channel flows (i.e. the component of the hydrograph that Commonwealth environmental water currently adds to) have relatively little effect on carp population dynamics (size of the population and the factors involved in its maintenance, decline, or expansion), compared to widespread flood events.

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

2. Portfolio management in 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

Asset condition across the Victorian rivers in the Murray-Darling Basin reflect 15 years of harsh climate conditions. Over this period there was prolonged drought conditions between 1997 and 2010, significant flooding in 2010 and 2011, wet conditions in 2012–13 and a subsequent series of three moderate/dry years, until 2016–17. Environmental watering in recent years and the wet conditions experienced during 2016–17 have contributed to some improvement in river health and supported ongoing recovery across the catchments. The sites to be targeted with environmental water in the Victorian rivers are predominantly in-channel. This means that despite the high flows experienced in 2016–17 and environmental watering in 2017–18, many of the sites continue to require water every year and therefore have high demand, as summarised below and outlined in Table 3.

Goulburn River: High demand

Key demands in the Goulburn River include baseflows and freshes to support native fish and waterbugs, and to maintain existing bank and aquatic vegetation. Opportunities to support native fish spawning and recruitment will be in scope with moderate to high water resource availability.

Lower Broken Creek: High demand

The presence of numerous small weirs in the system and annual issues with low dissolved oxygen levels and Azolla growth threaten native fish survival. Year-round demands for environmental water include maintaining dissolved oxygen above 5 mg/L, minimising Azolla presence and keeping the fishways open to facilitate native fish passage.

Upper Broken Creek: High demand

If poor water quality occurs this poses a threat to the stable fish communities in the river. Key demands for environmental water include maintaining water quality to support native fish and waterbug survival as well as benefit riparian vegetation.

Goulburn-Broken catchment wetlands – Moodie Swamp: Moderate demand

During 2016, natural flows inundated Moodie Swamp and in 2017–18 environmental water topped-up the swamp. If the wetland is dry in autumn there may be a need for water to maintain waterbird and frog habitat and the health of the ridged water milfoil and cane grass.

Broken River: Moderate to high demand

If very low flows are experienced, environmental water delivery will be for maintaining habitats to support native fish, aquatic plants and waterbugs, and to provide native fish passage.

Campaspe River High demand

Ongoing recovery and protection of instream habitats are a key demand to support native fish, waterbugs and platypus, and for instream and bank vegetation.

Loddon River High demand

Key demands in dry-moderate scenarios will be to maintain water volume and quality in refuge pools for fish, platypus and water rat movement and to maintain healthy ecosystem processes.

Ovens River: High demand

In an average to dry scenario the environmental need is for preventing no flow events and contribute to maintaining native fish movement by connectivity between pools and riffles and with the River Murray.

Wimmera River: High demand

Carryover from 2016–17 will be available for use in 2018–19 to provide in-stream flows to support native fish, riparian vegetation, water bugs and water quality.

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 Victorian rivers in the Murray-Darling Basin 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 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
- 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 Victorian rivers 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 Victorian rivers as at 30 April 2018.

Entitlement type	Forecasts of Commonwealth water allocations (including carryover) in 2018–19 (GL)[1,2]					
	Very dry ← → Very wet					
	95 percentile	90 percentile	75 percentile	50 percentile	25 percentile	10 percentile
Goulburn (High/Low Reliability)	138	267	312	319	317	309
Upper Broken Creek and Broken River	0.0	0.3	0.5	0.5	0.5	0.5
Campaspe (High/Low Reliability)	2	3	5	7	7	7
Loddon (High/Low Reliability)	1	3	3	3	4	4
Ovens (High Reliability)	0.1	0.1	0.1	0.1	0.1	0.1
Wimmera & Glenelg	7	7	7	7	21	28
Total – Vic Rivers	**148**	**280**	**328**	**337**	**335**	**328**
Total – Southern-Connected Basin[3]	**780**	**1123**	**1356**	**1578**	**1666**	**1595**

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 Victorian rivers for use in 2018–19 is estimated to be approximately 39 GL. Total carryover in the southern-connected Basin 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 held environmental water, planned environmental water, natural and unregulated flows, conveyance water and consumptive water. Further detail on sources of environmental water in the Victorian rivers in the Murray-Darling Basin 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 high resource availability scenarios are in scope for the Goulburn-Broken system in 2018–19.

In the remaining Victorian tributaries a flexible range of variable baseflows and freshes that Commonwealth environmental water may contribute to is available, allowing for a number of delivery options across all resource availability scenarios (Table 3c).

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. **Error! Reference source not found.** shows how current demands and forecasted supply are considered together.

The overall 'purpose' for managing the Commonwealth's water in the Victorian rivers in the Murray-Darling Basin for 2018–19 is to protect and improve the aquatic and riparian vegetation and native fish and other biota via habitat provision. If overall resource availability increases, deliveries will seek to re-establish and improve the resilience of native in-channel and bank vegetation through elevated baseflows and freshes.

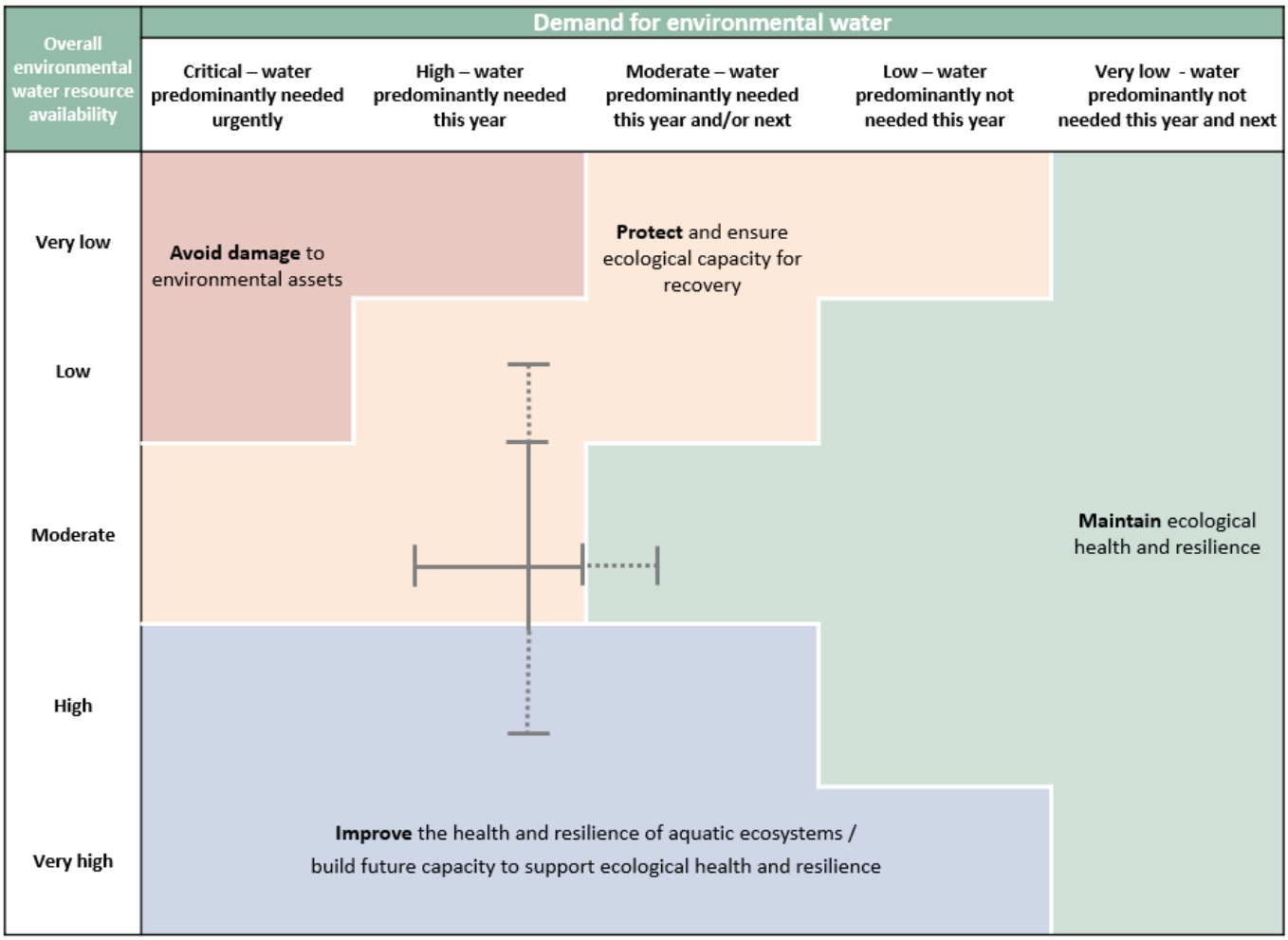

Figure 3: Determining a broad purpose for portfolio management in the Goulburn-Broken system for 2018–19. Note: grey lines represent potential range in demand and resource availability.

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 Commonwealth Environmental Water 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). Volumes and flows for each action are agreed between the delivery partners and reflect those in the Victorian Catchment Management Authority Seasonal Watering Proposals and Victorian Environmental Water Holder Seasonal Watering Plan. Specific information on operational arrangements is provided in Attachment B.

Goulburn River (See Attachment B, Table 4 options 1a. – 1i.)

Commonwealth, Victorian and The Living Murray environmental water will be coordinated with natural flows and intervalley transfers of water to meet environmental demands. All actions will be delivered in-channel and may include year-round variable baseflows, an early spring fresh, a spring/summer fish spawning fresh, a summer/autumn fresh and a winter fresh. There is also potential for environmental water to contribute to a combined fish attractant flow with the River Murray and to coordinate releases with other southern-connected basin watering actions to meet broader environmental need. Where possible, downstream demands in summer and autumn will be managed to minimise impact on lower Goulburn river bank vegetation and condition. Return flows are available for use downstream in the River Murray.

Lower Broken Creek (See Attachment B, Table 4 options 2a. – 2e.)

In addition to natural flows and intervalley transfer of water, Commonwealth environmental water is available to meet environmental demands. All actions will be delivered in-channel and may include year-round variable baseflows and a winter/spring flushing flow. Return flows are available for use downstream in the River Murray.

Goulburn-Broken catchment wetlands (See Attachment B, Table 4 option 3.)

Environmental water for Moodie Swamp will be provided if the maximum drying interval for waterbirds and vegetation is exceeded. These flows also benefit Upper Broken Creek reaches 1 and 2 en route.

Upper Broken Creek (See Attachment B, Table 4 option 4a and 4b.)

Commonwealth and Victorian environmental water is delivered when required to maintain year-round minimum flows and a summer/autumn fresh.

Broken River (See Attachment B, Table 4 options 5a. and 5b.)

Catchment run-off and irrigation releases are generally sufficient to meet environmental flow recommendations, however, when irrigation demand declines and runoff has yet to commence, environmental water may provide a minimum baseflow and a summer/autumn fresh.

Campaspe River (See Attachment B, Table 4 options 6a. – 6d.)

Commonwealth, Victorian and The Living Murray environmental water will be coordinated with natural flows and intervalley transfers of water to meet environmental demands. All actions will be delivered in-channel and may include year-round variable baseflows and freshes in winter/spring and summer/autumn. There is also potential for environmental water to contribute to a combined fish attractant flow with the River Murray and Goulburn River. Return flows are available for use downstream in the River Murray.

Loddon River (See Attachment B, Table 4 options 7a. – 7e.)

Commonwealth and Victorian environmental water is available to meet environmental demand throughout the year. All actions will be delivered in-stream and may include year-round variable baseflows and freshes in winter/spring, summer and autumn.

Ovens River (See Attachment B, Table 4 options 8.)

In average and wet years the flow recommendations are achieved from natural flows. In a dry to very dry scenario environmental demand is for flows to avoid a cease to flow event. Where possible environmental water delivery is planned to coincide with a bulk release water transfer.

Wimmera River (See Attachment B, Table 4 option 9.)

Any use of Commonwealth environmental water will be coordinated with other sources of environmental water and natural flows and may be used to contribute to in-channel baseflows and freshes.

Stakeholder Feedback

Early Input to the potential watering actions for 2018–19 was received via the Environmental Watering Advisory Group (EWAG) meetings organised and chaired by the North Central and Goulburn Broken Catchment Management Authorities. Membership includes local land holders, irrigators, community members, the Victorian delivery partners (including the Victorian Environmental Water Holder) and the Commonwealth Environmental Water Office. Further feedback was provided from delivery partners on drafts of the plan and included refinements to asset demands and relative urgency for delivery.

2.5. Trading water in 2018–19

In 2018-19, administrative transfers may be required between environmental water accounts in trade zones 1A, 1B, 2, 3, 4A, 4B, 4C, 5A, 9A, 9B and 21A 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 (less than 10 GL) within or between Victorian Rivers regions;
- moderate transfers (~70 gigalitres) out of Victorian Rivers regions; and
- large transfers (> 100 gigalitres) within trade zone 1A, 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-dec2014.

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 2017–18 water year progresses a carryover target will be determined for the Victorian Rivers in the Murray-Darling Basin sufficient to meet early season requirements. As documented in Table 3 below, potential demands in 2019–20 include:

- Year-round variable baseflows and freshes in the Goulburn River
- Year round variable baseflows in Lower Broken Creek
- Variable baseflows and freshes in the Campaspe and Loddon rivers
- Variable baseflows and freshes in the Wimmera river

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 Victorian rivers in the Murray-Darling Basin.

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 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 Commonwealth Environmental Water Holder'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 Commonwealth Environmental Water Holder's functions.

The Commonwealth Environmental Water Holder 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 in the northern Victorian rivers in the Murray Darling Basin.

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system		Watering History[1] (from all sources of water)	2018–19		Implications for future demands
	Flow/Volume	Required Frequency (maximum dry interval)		Environmental demand for water	Potential Commonwealth environmental water contribution	Likely urgency of demand in 2019–20 if watering occurred as planned in 2018–19
Goulburn River (Reaches 4 and 5) • Native fish, waterbugs, vegetation and physical habitat diversity • Major source of return flows for use in multiple sites downstream in the Murray River	Baseflow (all year) 500–940 ML/day at Murchison/McCoys for fish and waterbug habitat and vegetation. This includes a trial of winter variable baseflows (between the end of the winter fresh and start of the early spring fresh) of 500 ML/day up to 1500 ML/day.	Annually	This demand has been met every year since the millenium drought and is the minimum year-round flow requirement. 2018–19 will be the first time a winter variable baseflow is delivered. Learnings from the trial will inform any future deliveries.	High	High	High
	Spring fresh (Sept/Oct) Up to 10 000 ML/day at Murchison/McCoys Bridge[2] with 14 days above 6000 ML/day for lower bank vegetation establishment and maintenance of macrophytes, waterbug and fish habitat.	Annually	This flow was delivered in 2012–13, not delivered in 2013-14 and partially met during 2014–15 and 2015–16. Since then, LTIM has identified the early spring fresh as important to deliver each year. This demand was met in 2016–17 and 2017–18.	High	High	High
	Spring/summer fresh (Nov/Dec) Up to 10,000 ML/day at Murchison/McCoys for 2 days to stimulate golden perch spawning and maintain macroinvertebrate habitat.	1 in 2 years	This fresh was delivered from 2012–13 to 2014–15 and with dry conditions in 2015–16 it was not delivered. In 2016–17 fish spawning objectives were met by natural flows so the fresh was not delivered to protect low bank vegetation after prolonged periods of high natural flows. It was delivered in 2017–18.	Low	Low – GBCMA has identified this as a low priority to allow vegetation outcomes	High
	Summer/autumn fresh (Jan to March) Up to 4 600 ML/day for 10 days to stimulate the migration of juvenile native fish into the Goulburn River from the River Murray.	When conditions are conducive	A fresh specifically to attract fish upstream was first delivered in 2016–17 and again in 2017–18. It relies on suitable flow conditions in the Murray and the presence of juvenile golden/silver perch downstream.	Low	May be met by other means	High - if conditions are conducive
	Autumn fresh (March to May) 6000 ML/day at Murchison/McCoys for 2 days for maintenance of vegetation established during the spring fresh, and provide supporting conditions for waterbugs.	Annually	Achieved from 2012–13 to 2015–16. A separate autumn fresh was not delivered in 2016–17 or 2017–18 following the earlier fish attractant flow action in those years.	High – if fish attractant flow is not delivered	High if required	High
	Winter fresh (June/July) Up to 15 000 ML/day at Murchison/McCoys with 14 days above 6 600 ML/day[1] to provide vegetation and macroinvertebrate habitat.	Annually	The winter fresh was first delivered in 2014–15, then not delivered in 2015–16 due to low water availability. It was delivered in 2016–17 and 2017–18 and at time of publication of this document is planned for 2018–19.	High	May be met/partially met by other means	High
Goulburn River (Reach 1) • Native fish, water bugs, aquatic vegetation • Only receives water when it is released from Lake Eildon	Baseflow (July to Sept and April to June – non-irrigation period). 400 ML/day at Eildon for waterbugs and small-bodied fish habitat and to maintain aquatic vegetation.	Annually	This demand was met for the first time in 2017–18.	High	High	High

Environmental assets	Indicative demand (for all sources of water in the system		Watering History[1] (from all sources of water)	2018–19		Implications for future demands
	Flow/Volume	Required Frequency (maximum dry interval)		Environmental demand for water	Potential Commonwealth environmental water contribution	Likely urgency of demand in 2019–20 if watering occurred as planned in 2018–19
Lower Broken Creek (Reach 3) • Native fish • Environmental demand requires water in addition to irrigation supply • Source of return flows for use downstream in the River Murray	Baseflow (all year) 40 ML/day at Rices Weir to operate the fish ladder and provide native fish passage.	Annually	This demand is considered the minimum flow requirement and has been met during the irrigation season since 2012–13. Water delivery during the non-irrigation commenced in 2016–17 and continued in 2017–18.	High	High	High
	Spring elevated baseflow (Aug to Nov continuous). 120 ML/day at Rices Weir to minimise Azolla growth.	Annually	Since 2012–13 the full delivery of planned higher base flows and freshes has not been achieved due to periods of high irrigation demand and limited channel capacity to carry additional environmental water. DO levels have not been achieved in most years, sometimes remaining very low for extended periods. Since 2015–16, however, the duration and extent of DO fall has decreased. In 2016–17 and 2017–18 planned flows were achieved.	High	High	High
	Winter/spring flushing flow (Aug to Nov) Up to 500 ML/day at Rices Weir to manage Azolla blooms and trigger fish migration.	Annually if required		High	High	High
	Spring/summer baseflow (Sept to Dec) 250 ML/day at Rices Weir to increase native fish habitat during migration and breeding seasons.	Annually		High	High	High
	Spring to autumn high baseflow (Oct to May continuous) 150–250 ML/day at Rices Weir to minimise Azolla growth and maintain DO levels above 5 mg/L.	Annually		High	High	High
Goulburn-Broken catchment wetlands (excluding Barmah) • Delivery to Moodie Swamp for native birds and vegetation	Infrastructure delivery to semi-permanent wetlands in support of native vegetation and habitat for waterbirds and frogs.	Moodie Swamp maximum dry interval is 1 year for waterbirds and 3 years for vegetation	Environmental water has been delivered to Moodie Swamp each year between 2013–14 and 2017–18, except for the dry year in 2015–16.	Moderate	High	High
Upper Broken Creek (Reach 1) • Native fish and vegetation	Low flow Summer/autumn baseflow up to 5 ML/day when required. Winter/spring baseflow up to 10 ML/day when required.	Annually	This demand was not met in 2013–14 and has been partially met since then.	High	High	High
	Summer/autumn fresh 50 ML/day for up to 10 days to maintain water quality and support survival of native fish and macroinvertebrates	Annually	No historic information available. This flow is planned for 2018–19.	High	High	High
Broken River • Native fish and vegetation	Baseflow (all year) Minimum 15 ML/day to maintain habitat to support native fish, aquatic plants and macroinvertebrates.	Annually	Natural flows and consumptive water has been used in the past to meet/partially meet flow targets. Environmental water also benefits reach 1 and 2 (Lake Nillahcootie to Casey's Weir) en route to Moodie Swamp.	Moderate	May be met by other means	Moderate
	Summer/autumn fresh. 400–500 ML/day for 2 to 5 days to maintain aquatic vegetation, provide native fish passage and provide flow cues for native fish breeding and migration.	Annually	This target has not been met until it was partially met in 2017–18 when environmental water was delivered for the first time.	Moderate	May be met by other means	Moderate

Environmental assets	Indicative demand (for all sources of water in the system		Watering History[1] (from all sources of water)	2018–19		Implications for future demands
	Flow/Volume	Required Frequency (maximum dry interval)		Environmental demand for water	Potential Commonwealth environmental water contribution	Likely urgency of demand in 2019–20 if watering occurred as planned in 2018–19
Ovens River • Native fish	Up to the total Commonwealth environmental water entitlement of 123 ML per year (50 ML from Lake William Hovell and 73 ML from Lake Buffalo) to contribute to in-stream flows within the Ovens, Kings and Buffalo rivers, for example: • Pulsed autumn fresh in conjunction with a bulk water transfer from Lake Buffalo to scour biofilms and maintain macroinvertebrate assemblage. • Increased summer/autumn baseflows if bulk water transfer is not available to improve flow variability and ensure connectivity between pools and riffles.	Annually	In 2012–13, 2014–15, 2016–17 and 2017–18 environmental water was released to supplement in-stream baseflows in the Buffalo and Ovens River. In 2013–14 and 2015–16 environmental was delivered as part of a bulk release drawdown provided by Goulburn-Murray Water.	High	High	High
Campaspe River (reaches 2 and 4) • Native fish, vegetation and platypus • Irrigation demand is minimal in reach 4 so ewater provides most of the flows	Summer/autumn baseflow (Dec-May) 10–50 ML/day to provide permanent connectivity for water quality.	Annually	These flow components have been met every year since 2012–13. During the dry conditions in 2015–16 flow recommendations were met at the lowest end of the flow range.	High	May be met by other means	High
	Winter/spring baseflow (June-Nov) 50–200 ML/day to maintain connectivity of pool refuges for fish and waterbug habitat and to prevent water quality decline.	Annually		High	May be met by other means	High
	Winter/spring fresh (June-Nov) 2 events at 1 000–1 800 ML/day for up to 7 days to stimulate fish movement and spawning, maintain vegetation for waterbugs and platypus and flush organics to reduce the risk of blackwater events in summer.	Annually		High	High	High
	Summer/autumn fresh (Dec-May) Up to 3 freshes of 50–200 ML/day for up to 3 days to provide longitudinal connectivity, maintain habitat for waterbugs and maintain water quality.	Annually		High	May be met by other means	High
Loddon River reach 4 • Native fish, vegetation and platypus • Reach 4 flows also benefit reaches 1 to 3 en route and to reach 5 downstream)	Summer/autumn freshes (Dec-May) 50–100 ML/day for 3–4 days, 3 times/year to maintain pool habitat and reduce the likelihood of low oxygen water.	Annually	All planned flows were met in 2012–13, 2013–14, 2016–17 and 2017–18. In 2014–15 all flows were achieved except for the spring fresh which was partially met. In 2015–16 all flows were achieved except for the summer/autumn action which was partially achieved.	High	May be met by other means	High
	Winter/spring high flow (June–Nov) 450–750 ML/day for 6–10 days once a year to provide cues for native fish movement, flush organic matter from in-channel benches to aid carbon and nutrient cycles and flush fine sediment and scour biofilms to replenish food supply.	Annually		High	High	High
	Summer/autumn low flows (continuous Dec–May) 25–50 ML/day to maintain connectivity during dry periods.	Annually		High	May be met by other means	High
	Winter/spring low flow (continuous June–Nov) 50–100 ML/day to maintain pool habitats to facilitate movement of native fish and to maintain bank and fringing vegetation.	Annually			High	High
	Autumn high flow (March–May) 400 ML/day for 6–10 days, once a year, to facilitate movement and dispersal of juvenile fish and platypus.	Annually		High	May be met by other means	High

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system		Watering History (from all sources of water)	2018–19		Implications for future demands
	Flow/Volume	Required Frequency (maximum dry interval)		Environmental demand for water	Potential Commonwealth environmental water contribution	Likely urgency of demand in 2019–20 if watering occurred as planned in 2018–19
Wimmera System	Up to the total Commonwealth entitlement of 28 000 ML (LRWS) per year to contribute toward instream flows within the Wimmera River (baseflow and freshes), to support native riparian vegetation, waterbugs, connectivity and water quality.	Annual	In 2016–17 the Commonwealth received its first allocation of 14 280 ML against this entitlement, and 12 138 ML was carried over for use in 2017–18. 2017–18 was the first water year that Commonwealth environmental water was made available for delivery in the Wimmera System. Previous environmental watering has been conducted by the VEWH, and it is anticipated that Commonwealth environmental water, when available, will help supplement and build on the outcomes achieved by the VEWH.	High	High	High
				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.	Available allocations to be carried into 2018–19 will be identified in Victorian Rivers environmental water holdings at https://www.environment.gov.au/water/cewo/about/water-holdings.
				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.

1. History of annual climatic conditions in northern Victorian catchments are summarised as follows: wet in 2012–13, moderate in 2013–14, drying in 2014–15, dry in 2015–16, very wet in 2016–17 and drying in 2017–18.

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

3. Next steps

3.1. From planning to decision making

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

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

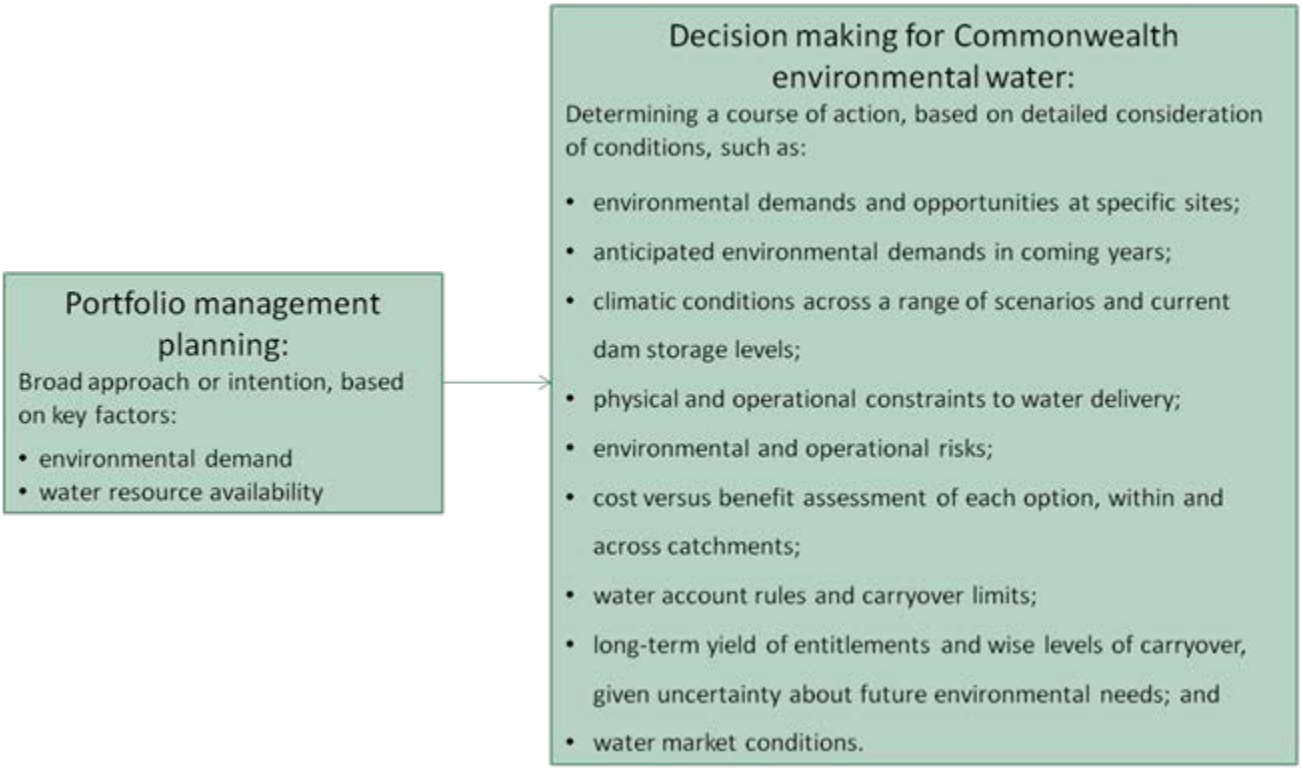

Figure 4: Planning and decision making for Commonwealth environmental water use

3.2. Further information

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

or the sites below:

- Water use: www.environment.gov.au/topics/water/commonwealth-environmental-water-office/assessment-framework
- Carryover: http://www.environment.gov.au/topics/water/commonwealth-environmental-water-office/portfolio-management/carryover
- Trade: http://www.environment.gov.au/water/cewo/trade/trading-framework

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(GBCMA) – see Goulburn Broken Catchment Management Authority

Goulburn-Broken Catchment Management Authority (2018a) Goulburn River Seasonal Watering Proposal 2018–19.

Goulburn-Broken Catchment Management Authority (2018b) Lower Broken Creek Seasonal Watering Proposal 2018–19.

Goulburn-Broken Catchment Management Authority (2018c) Broken River and Upper Broken Creek Seasonal Watering Proposal 2018–19.

Goulburn-Broken Catchment Management Authority (2018d) Goulburn Broken Wetlands Seasonal Watering Proposal 2018–19.

(MDBA) – see Murray-Darling Basin Authority

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

Goulburn-Broken

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

RIVER FLOWS AND CONNECTIVITY

Baseflows are at least 60 per cent of the natural level.

Contribute 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 current extent of forest and woodland vegetation and non woody vegetation and water-dependent vegetation near river channels and on low-lying areas of the floodplain.

Improved condition of black box and river red gum.

Improved recruitment of trees within black box and river red gum communities.

Vegetation extent

Area of river red gum (ha)	Area of black box (ha)	Area of coolibah (ha)	Shrublands	Non-woody water dependent vegetation
19 800	500			Closely fringing or occurring within the Broken Ck, Broken and Goulburn rivers

Black box condition

Vegetation condition score		Percent of vegetation assessed (within the managed floodplain)
0 – 6	>6 – 10	
28 per cent	72 per cent	77 per cent

River red gum condition

Vegetation condition score					Percent of vegetation assessed (within the managed floodplain)
0 – 2	>2 – 4	>4 – 6	>6 – 8	>8 – 10	
1 per cent	2 per cent	7 per cent	34 per cent	55 per cent	89 per cent

WATERBIRDS

Current species diversity is maintained.

A 20–25 per cent increase in Basin-wide abundance of waterbirds 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 Goulburn-Broken

Environmental asset	Total abundance and diversity	Drought refuge	Colonial waterbird breeding	Shorebird abundance	In scope for C'th watering
Corop wetlands	*	*			No
Winton wetlands		*			No
Waranga Basin		*			No

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 movement of key species.

Expanded distribution of key species and populations.

Key species for the Goulburn-Broken include:

Species	Specific outcomes	In-scope for C'th water in the Goulburn-Broken?
Flathead galaxias (*Galaxias rostratus*)	Improved core range in additional locations, including the Goulburn.	No
Golden perch (*Macquaria ambigua*)	A 10–15 per cent increase of mature fish abundance (of legal take size) in key populations.	Yes
Macquarie perch (*Macquaria australasica*)	Establishment of at least four additional riverine populations (candidate sites include mid-Goulburn River).	Yes
Murray cod (*Maccullochella peelii peelii*)	A 10–15 per cent increase of mature fish abundance (of legal take size) in key populations.	Yes
Silver perch (*Bidyanus bidyanus*)	Expanded population within the Goulburn River. Expanded population upstream of Lake Mulwala and into the Ovens River, and increased range up the lower Goulburn River Improved core range in at least two additional locations (candidate site includes Broken Ck).	Yes – lower Goulburn River. Fish may also migrate into lower Broken Creek.
Trout cod (*Maccullochella macquariensis*)	Establishment of at least two additional populations (candidate sites include the mid-Goulburn River). Note: attempts to re-establish mid-Goulburn populations have commenced.	Establishment of new populations is dependent on complimentary activities. Environmental water will however target existing populations in the lower Goulburn River to increase abundance and potentially also range
Two-spined blackfish (*Gadopsis bispinosus*)	Expand the range of at least two current populations (candidate sites include the upper Goulburn tributaries).	Yes – mid-Goulburn River.

Important Basin environmental assets for native fish in the Goulburn-Broken

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
Lower Goulburn River	*	*	*	*	*	*	*
Broken River	*	*	*		*	*	*
Broken Creek					*	*	*

Campaspe

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

RIVER FLOWS AND CONNECTIVITY

Baseflows are at least 60 per cent of the natural level.

Contribute to a 30 per cent overall increase in flows in the River Murray.

A 10-20 per cent increase in the frequency of freshes and bankfull.

VEGETATION

Maintain the current extent of forest and woodland vegetation and non-woody vegetation.

No decline in the condition of black box and river red gum.

Improved recruitment of trees within black box and river red gum communities.

Vegetation extent

Area of river red gum (ha)	Area of black box (ha)	Area of coolibah (ha)	Shrublands	Non–woody water dependent vegetation
1 900	<100			Closely fringing or occurring within the Campaspe River

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.

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 Campaspe include:

Species	Specific outcomes	In-scope for C'th e-water in the Campaspe?
Golden perch (*Macquaria ambigua*)	A 10–15 per cent increase of mature fish (of legal take size) in key populations.	Yes
Murray cod (*Maccullochella peelii peelii*)	A 10–15 per cent increase of mature fish (of legal take size) in key populations.	Yes
River blackfish (*Gadopsis marmoratus*)	Establish 1–3 additional populations (candidate sites include downstream of the Campaspe Rivers).	Yes
Silver perch (*Bidyanus bidyanus*)	Improve core range in at least two additional locations – (candidate sites include Campaspe Rivers).	Yes

Loddon River

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

RIVER FLOWS AND CONNECTIVITY

Baseflows are at least 60 per cent of the natural level.

Contribute to a 30 per cent overall increase in flows in the River Murray.

A 10–20 per cent increase in the frequency of freshes and bankfull.

VEGETATION

Maintain the current extent of forest and woodland vegetation and non-woody vegetation.

No decline in the condition of black box and river red gum.

Improved recruitment of trees within black box and river red gum communities.

Vegetation extent

Area of river red gum (ha)	Area of black box (ha)	Area of coolibah (ha)*	Shrublands	Non–woody water dependent vegetation
2 200	700			Closely fringing or occurring within the Loddon River.

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.

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 Loddon include:

Species	Specific outcomes	In-scope for C'th e-water in the Loddon?
Freshwater catfish (*Tandanus tandanus*)	Improve core range in at least three additional locations (candidate sites include the Loddon River).	Yes
Golden perch (*Macquaria ambigua*)	A 10–15 per cent increase of mature fish (of legal take size) in key populations.	Yes
Murray cod (*Maccullochella peelii peelii*)	A 10–15 per cent increase of mature fish (of legal take size) in key populations.	Yes
River blackfish (*Gadopsis marmoratus*)	Establish 1–3 additional populations (candidate sites include downstream of the Loddon).	Yes
Silver perch (*Bidyanus bidyanus*)	Improve core range in at least two additional locations – (candidate sites include the lower Loddon).	Yes

Wimmera

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

RIVER FLOWS AND CONNECTIVITY

Baseflows are at least 60 per cent of the natural level.

A 10–20 per cent increase in the frequency of freshes and bankfull.

VEGETATION

Maintain the current extent of forest and woodland vegetation and non-woody vegetation.

Improve condition of black box and river red gum.

Improved recruitment of trees within black box and river red gum communities.

Vegetation extent

Area of river red gum (ha)	Area of black box (ha)	Area of coolibah (ha)	Shrublands	Non–woody water dependent vegetation
6 500	3 100			Closely fringing or occurring within the Wimmera River.

Black box condition

Vegetation condition score		Percent of vegetation assessed (within the managed floodplain)
0 –6	>6 –10	
42 per cent	58 per cent	26 per cent

River red gum condition

Vegetation condition score					Percent of vegetation assessed (within the managed floodplain)
0 – 2	>2 – 4	>4 – 6	>6 – 8	>8 – 10	
3 per cent	5 per cent	18 per cent	60 per cent	13 per cent	20 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.

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 movement of key species.

Expanded distribution of key species and populations.

Key species for the Wimmera include:

Species	Specific outcomes	In-scope for C'th e-water in the Wimmera?
Freshwater catfish (*Tandanus tandanus*)	Expand the core range of at least two current populations (candidate sites include Wimmera River)	Yes

Attachment B – Operational details for watering

Operational considerations in the Victorian Rivers in the Murray-Darling Basin

The delivery of environmental water in the Victorian rivers in the Murray-Darling Basin is currently constrained by the release capacities from storages, channel capacities and system constraints. The potential risks to third parties are an important consideration for the delivery of environmental water. Floodplain infrastructure works may also constrain maximum flow rates at different times and locations.

Further information about constraints in the Murray-Darling Basin Victorian rivers is provided by the Murray-Darling Basin Authority and can be found *in Preliminary Overview of Constraints to Environmental Water Delivery in the Murray-Darling Basin* (MDBA 2013a) and *Constraints Management Strategy* (MDBA 2013b). Specific constraints to be considered are detailed under the potential watering actions – standard operating arrangements section later in this attachment.

Operational considerations such as constraints and risks will differ depending on the inflow scenario. Throughout the year operational and management considerations will be addressed as decisions are taken to make water available for use, and as these decisions are implemented. This will include refining the ecological objectives, assessing operational feasibility and potential risks and the ongoing monitoring of the seasonal outlook and river conditions.

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. For example, environmental demand may be met by unregulated flows or constraints and/or risks may limit the ability to deliver environmental water. Table 4 identifies the range of potential watering actions in the Victorian rivers in the Murray-Darling Basin and the levels of water resource availability that relate to these actions.

Table 4: Summary of potential watering actions for the Victorian rivers in the Murray-Darling Basin[1,2]

Broad Asset	Indicative demand	Applicable level(s) of resource availability				
		Very Low	**Low**	**Moderate**	**High**	**Very High**
Goulburn River (Reaches 4 and 5)	Year-round baseflow 500–940 ML/day at Murchison/McCoys.	1a. Contribute to minimum baseflows year-round to maintain water quality and provide suitable habitat and food resources to support native fish and waterbug condition and survival.				
		1b. Contribute to higher baseflows year-round, but especially in winter/spring to increase habitat area for instream flora and fauna and to water bank vegetation.				
	Spring fresh (Oct-Nov) of up to 10 000 ML/day at Murchison/McCoys Bridge with 14 days above 6000 ML/day.	1c. Contribute to a long-duration fresh in early spring to water bank vegetation, provide soil moisture to banks and benches and distribute seed for later germination. Establishment and maintenance of waterbugs and native fish habitat.				
	Spring/summer fresh (Nov/Dec) of up to 10 000 ML/day for 2 days at Murchison/McCoys.		1d. Contribute to short-duration fresh during November/December to stimulate golden and silver perch spawning.			
	Summer/autumn fresh (Jan to March) Up to 4600 ML/day for 10 days.		1e. Contribute to a fish attractant flow for juvenile native fish to move into the Goulburn from the Murray. Only delivered with suitable flow conditions in the Murray and the presence of juvenile native fish downstream.			
	Autumn fresh (Mar to May) of up to 6000 ML/day at Murchison/McCoys for 2 days.	1f. Contribute to a fresh to maintain existing vegetation and maintain waterbug habitat.				
	Winter fresh (June/July) of up to 15 000 ML/day at Murchison/McCoys with 14 days above 6600 ML/day.		1g. Contribute to a winter fresh to maintain bank vegetation and macroinvertebrate habitat. Also benefits downstream River Murray ecological targets, including lamprey migration.			
	Trial winter variable baseflows (between end winter fresh and start of early spring fresh) of between 500 and up to 1500 ML/day.		1h. Contribute to variable baseflows - the action will be monitored to determine ecological benefit.			
Goulburn River (Reach 1)	Baseflow (July to Sept and April to June) of 400 ML/day at Eildon.	1i. Contribute to baseflows during the non-irrigation season to maintain waterbug communities, existing aquatic vegetation, and small-bodied fish habitat.				

Broad Asset	Indicative demand	Applicable level(s) of resource availability				
		Very Low	Low	Moderate	High	Very High
Lower Broken Creek (Reach 3)	Year-round baseflow of 40 ML/day at Rices Weir.	2a. Contribute to minimum baseflows all year to support native fish movement through fishways.				
	Spring continuous baseflow (Aug to Nov) of 120 ML/day at Rices Weir.	2b. Contribute to elevated baseflows to minimise Azolla growth.				
	Winter/spring flushing flow (Aug to Nov) of 500 ML/day at Rices Weir	2c. Contribute to flushing flows to remove large Azolla blooms and trigger fish migration.				
	Spring/summer baseflow (Sept to Dec) of 250 ML/day at Rices Weir.	2d. Contribute to high baseflows to increase native fish habitat during migration and breeding seasons.				
	Spring to autumn baseflow (Oct to May continuous) of 150–250 ML/day at Rices Weir.	2e. Contribute to high baseflows between October and May to maintain DO levels above 5 mg/L and minimise Azolla growth.				
Goulburn-Broken catchment wetlands (Moodie Swamp)	Fill or top-up Moodie Swamp	3a. Contribute to flows to support wetland vegetation (especially ridged water milfoil and cane grass) and waterbird and frog habitat.				
Upper Broken Creek	Low flows (when required): summer/autumn up to 5 ML/day; winter/spring up to 10 ML/day	4a. Contribute to this low flow to provide minimum flow in the creek.				
	Summer/autumn fresh of 50 ML/day for up to 10 days.	4b. Contribute to freshes to maintain water quality and support survival of native fish and waterbugs.				
Broken River	Year-round baseflow with a minimum of 15 ML/day.	5a. Contribute to baseflows to maintain habitat to support native fish, aquatic plants and waterbugs.				
	Summer/autumn fresh of 400–500 ML/day for 2 to 5 days.	5b. Contribute to freshes to maintain aquatic vegetation, provide native fish passage and provide flow cues for native fish breeding and migration.				

Broad Asset	Indicative demand	Applicable level(s) of resource availability				
		Very Low	Low	Moderate	High	Very High
Campaspe River	Summer/autumn baseflows (Dec to May) of 10–50 ML/day.	6a. Contribute to baseflows in summer to maintain: connectivity for protecting instream and fringing vegetation; and pool habitat tor native fish populations, especially with respect to dissolved oxygen and salinity levels. Lower end of range during dry conditions and higher when possible – maintain at all times.				
	Winter/spring baseflows (June to Nov) of 50–200 ML/day.	6b. Maintain connectivity of pool refuges for fish, improved habitat for water bugs and prevent water quality decline.				
	Winter/spring fresh (June to Nov) of 2 events of 1000–1800 ML/day for up to 7 days each.	6c. Contribute to winter high flows to maintain: river red gum; native fish and macroinvertebrate populations; and emergent vegetation. Importantly this action will flush river benches of organic matter to mitigate potential water quality issues during summer. Deliver prior to platypus egg laying (August) to encourage female platypus to choose burrows higher on the river bank. Lower end of range delivered during dry conditions.				
	Summer/autumn fresh (Dec to May) of up to 3 actions of 50–200 ML/day for up to3 days.	6d. Contribute to summer/autumn freshes to: support native fish and platypus populations (through longitudinal connectivity); improve water quality; and maintain habitat for waterbugs. Volumes and duration depend on conditions.				
Loddon River	Summer/Autumn freshes (Dec–May) of up to 3 actions of 50–100 ML/day for 3–4 days at peak.	7a. Contribute to summer freshes in dry scenarios for water volume and quality in refuge pools. Higher flows during December to March may be required to minimise the risk of hypoxic blackwater events.				
	Winter/spring high flow (June–Nov) of 450–750 ML/day with a 6–10 day peak.	7b. Contribute to the winter/spring high flow to provide cues for native fish movement, flush accumulated organic matter from banks and benches, reduce organic load ahead of summer and scour biofilms to replenish food supply.				
	Summer/autumn low flows (continuous during Dec to May) of 25–50 ML/day.	7d. Contribute to summer/autumn low flows for connectivity and water quality.				
	Winter low flow (continuous during June to Nov) of 50–100 ML/day.	7d. Contribute to winter/spring low flows to maintain depth for fish, platypus and water rat movement; flush sediment and biofilm on submerged wood; maintain bank moisture and prevent terrestrialisation of bank vegetation.				
	Autumn high flow (March to May) of 400 ML/day for 6–10 days.			7e.Contribute to the autumn high flow to facilitate movement and dispersal of juvenile fish and platypus.		
Ovens River	A pulsed autumn fresh in conjunction with a bulk water transfer from Lake Buffalo or a release over several days from Nov to May.	8a. When released with a bulk water transfer, Commonwealth environmental water will contribute to maintaining: the movement of native fish; natural connectivity between pools; microinvertebrate habitat; scouring of bio-film; and macroinvertebrate assemblages. When contributing to low flows, Commonwealth environmental water will help to improve flow variability to ensure connectivity between pools and riffles. This contributes to maintaining water quality, native fish habitat, fish passage and waterbug habitat.				

Broad Asset	Indicative demand	Applicable level(s) of resource availability				
		Very Low	Low	Moderate	High	Very High
Wimmera System	Variable baseflows and freshes throughout the year in accordance with priority watering actions designed to meet recommended flow volumes for reaches 2, 3 or 4 of the Wimmera River. Larger pulses may be used to provide additional water to the terminal wetlands (Lakes Albacutya and Hindmarsh) when coupled with unregulated flows.					9a. Contribute to instream baseflows and freshes to support native fish reproduction and condition, riparian vegetation condition, macroinvertebrate habitat and food, hydrological connectivity and biotic dispersal, and maintaining appropriate water quality. When water reaches Lake Hindmarsh and Lake Albacutya this may also lead to waterbird outcomes and support Australia's objectives under the Ramsar Convention on Wetlands of International Importance and international migratory bird agreements.

1. Information sourced from: GBCMA (2018 a-d), NCCMA (2018 a-b), NECMA 2018 WCMA 2018

2. Under certain resource availabilities, options may not be pursued for a variety of reasons including that environmental demand may be met by unregulated flows and that constraints and/or risks may limit the ability to deliver environmental water.

Potential watering actions – standard operating arrangements

Table 4 identifies the range of potential watering actions in Victorian rivers 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.

A note on approvals: watering actions in Victorian rivers are implemented with local delivery partners who play a key role in engaging with the local community and third parties. As some actions may be constrained by other demands in the system, the Commonwealth Environmental Water Office routinely seeks advice from river operators on the timing, magnitude and duration of planned watering.

***Watering action 1:* Goulburn River**

Standard operational considerations

- Commonwealth environmental water delivery will not contribute to releases above 9500 ML/day from Lake Eildon to minimise the risk of potential impacts on private property in reach 1, located between Eildon Dam and Yea River.
- Releases from Goulburn Weir are limited to 10 000 ML/day by Goulburn Murray Water due to unknown impact of inundating land.
- Flows greater than 3000 ML/day below Goulburn Weir during irrigation season may impact on some access to pumps and landholders are to be notified around three week prior to these events, including for the use of water from intervalley transfers.
- The design of environmental watering actions will take into consideration other river users, including recreational fishers and irrigators, to minimise the risk and inconvenience of inundation of private land and infrastructure and distruption to recreational activities.
- Intervalley transfers undertaken by Goulburn Murray Water may impact on the volume and timing of environmental water actions.
- Drawdowns from Lake Eildon during summer/autumn may attract community concern if the lake-level recedes and affects recreational activity.
- The Bureau of Meteorology minor flood levels at each flow measurement point along the Goulburn River are:
    - 14 500 ML/day at Eildon (reach 1)
    - 21 700 ML/day at Trawool (reach 2)
    - 24 800 ML/day at Seymour (reach 3)
    - 33 100 ML/day at Murchison (reach 4)
    - 28 300 ML/day at McCoys Bridge (reach 5)

Typical extent: In-channel flows will be released from Lake Eildon, with en route benefits to reaches 1 to 3 (Eildon to Goulburn Weir). Releases from Goulburn Weir will target reaches 4 and 5 (lower Goulburn River downstream of Goulburn Weir).

***Watering action 2:* Lower Broken Creek**

Standard operational considerations

- Environmental water delivery uses infrastructure in the Shepparton and Murray Valley irrigation district. The capacity to deliver environmental water can be limited due to channel constraints when irrigation demand is high. Delivery also takes place during the non- irrigation period to keep the fish ladders open.

- Environmental water will be delivered to complement consumptive water deliveries and intervalley transfers. This approach provides third party benefits to other entitlement holders in the Murray-Darling Basin by allowing intervalley bulk water transfers to be diverted around the Barmah Choke, thereby reducing competition for channel capacity at the Choke.

Typical extent: Environmental water is delivered as in-channel flows supplied to lower Broken Creek below Katandra and Nine Mile Creek via Shepparton and Murray Valley irrigation area channel infrastructure.

***Watering action 3:* Goulburn-Broken Catchment Wetlands – Moodie Swamp**

Standard operational considerations

- Upper Broken Creek flow restriction of 10 ML/day flow also applies to ewater delivery to Moodie Swamp.

Typical extent: Wetland inundation via infrastructure.

***Watering action 4:* Upper Broken Creek**

Standard operational considerations

- Unless otherwise agreed, Commonwealth environmental water will only contribute to flows up to 10 ML/day to avoid potential third party flooding impacts.

Typical extent: In-channel flows delivered as managed releases from Lake Nillahcoote and diverted from Broken River to upper Broken Creek at Caseys Weir.

***Watering action 5:* Broken River**

Standard operational considerations

- Water volume available is much less that the volume required to delivered the desired flow components.

Typical extent: In-channel flows delivered as managed releases from Lake Nillahcoote.

***Watering action 7:* Campaspe River**

Standard operational considerations

- The maximum regulated release volume from Lake Eppalock, due to the outlet capacity of Lake Eppalock is 1850 ML/day (measured at Barnadown Weir). Planned releases are below this volume.
- Intervalley transfers and operational water delivery (e.g. the Campapse supplement) undertaken by Goulburn Murray Water may impact on the volume and timing of Commonwealth environmental water releases.
- Drawdown from Lake Eppalock during summer/autumn may attract community concern as when the lake-level recedes community perception is that it will adversely affect recreational activity.
- Flows greater than 10 000 ML/day in reach 2 (Eppalock Weir to Campaspe Weir) and greater than 8000 ML/day in reach 3 (Campaspe Weir to Campaspe Siphon) and 9000 ML/day in reach 4 (Campaspe Siphon to River Murray) will cause flooding of low lying floodplain including private property. These flows are not planned and cannot be delivered with current Eppalock outlet capacity.
- Campaspe Weir seepage remains unsolved limiting the delivery of winter high flows.
- Potential inundation of diverter pumps may limit the magnitude of winter high flow.
- Unable to deliver water during annual maintenance of the Lake Eppalock outlet tower.

Typical extent: In-channel flows released from Lake Eppalock targeting reaches 2 (Lake Eppalock to Campaspe Weir) and 4 (Campaspe Siphon to Murray River).

***Watering action 8:* Loddon River**

Standard operational considerations

- Outfall capacity of the Cairn Curran Reservoir is limited to 1600 ML/day at full supply level (the environmental flow recommendation of 3000 ML/day exceeds this capacity).
- Outfall capacity of the Laanecoorie Reservoir is limited to 1300 ML/day (the environmental flow recommendation of 7300 ML/day exceeds this capacity).
- Due to potential inundation of private land, environmental water will not contribute to flows above 450 ML/day in reach 4 (Loddon Weir to Kerang Weir) without the agreement of potentially affected landholders.
- Flow travel times and attenuation from storages present a challenge for environmental watering as peak flow rates released from storage are required to be much higher than the peak flow rate at the target location.
- Environmental flow regimes are constrained by the limited capacity of the Serpentine, Loddon and Kerang weirs to regulate low flows.
- Regulator damage at Twelve Mile Creek means there is no control over the split of water entering the Loddon River and the creek, particularly during low flows.
- Water available in the Goulburn can be delivered via the Western Waranga Channel to Loddon Weir and reach 4, depending on channel capacity during irrigation season.
- Less water is available for delivery from Cairn Curran if the supplement is not declared, meaning that it is not always possible to deliver flows to reaches 1, 2, 3a and 3b en route to Reach 4.
- Irrigation works year-round throughout the sites may prevent or interupt environmental water deliveries.

Typical extent: In-channel flows released from Cairn Curran, Tullaroop or Laanecoorie Reservoirs, particuarly targeting reach 4 (Loddon Weir to Kerang Weir).

***Watering action 8:* Ovens River**

Standard operational considerations

- Water is released each year during periods of regulated flow and prior to the storages reverting to winter storage operating levels.
- The timing for delivery of Commonwealth environmental water is dependent on inflow rates into Lake Buffalo and Lake William Hovell as entitlements can only be released when the storages are not spilling.
- To maximise environmental benefits Commonwealth environmental water release may be timed to occur with the Goulburn Murray Water 'bulk release drawdown'.
- At Lake Buffalo the maximum outflow is 850 ML/day at full supply level in years where bulk water transfer occurs. The minimum outflow of Lake Buffalo is 20 ML/day and this may imit the capacity to deliver the 73 ML of held Commonwealth entitlement over multiple days.
- Similarly in Lake William Hovell, the 50 ML of held Commonwealth entitlement can only be released over a maximum of two days, limiting the ongoing contribution it can provide for critical drought refuges under dry conditions.

Typical extent: In-channel flows in the Ovens, King and Buffalo Rivers released from Lake William Hovell and Lake Buffalo.

***Watering action 9:* Wimmera System**

Standard operational considerations

- Commonwealth environmental water is limited to Mt William Creek, reaches 3 and 4 of the Wimmera River and the terminal wetlands (Lakes Albacutya and Hindmarsh). This is due to the entitlement 'point of source' which is limited to Taylors Lake, Rockland Reservoir and Lake Lonsdale.
- The outlet capacity at Lake Lonsdale and Taylors Lake is 600 ML/day and 400 ML/day respectively. Therefore operational constraints limit the regulated delivery of large, bankfull and overbank flows in the Wimmera River.

Typical extent: Subject to water availability Commonwealth environmental water will be delivered to the Wimmera River as in-channel flows to be sourced from managed releases from the Wimmera-Glenelg headworks system. As allocations become available the Wimmera Catchment Management Authority will consult with the Commonwealth Environmental Water Office and the Victorian Environmental Water Holder regarding the planned use of this water.

Attachment C – Long-term water availability

Commonwealth environmental water holdings

The Commonwealth holds the following entitlements in the Victorian rivers in the Murray-Darling Basin:

- Goulburn (high reliability)
- Goulburn (low reliability)
- Campaspe (high reliability)
- Campaspe (low reliability)
- Loddon (high reliability)
- Loddon (low reliability)
- Broken River (high reliability)
- Broken River (low reliability)
- Ovens (high reliability)
- Wimmera System (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 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 Victorian rivers in the Murray-Darling Basin include:

- Environment Entitlement – The Living Murray Program: Murray-Darling Basin Authority
- Bulk Entitlement (River Murray – Flora and Fauna): Victorian Environmental Water Holder
- Goulburn River Environmental Entitlement: Victorian Environmental Water
- Campaspe River Environmental Entitlement: Victorian Environmental Water
- Bulk Entitlement (Loddon River Environmental Reserve): Victorian Environmental Water

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 the various bulk entitlements which specify minimum passing flows for each of the Victorian river systems (referred to in this document as 'planned environmental water'

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