

Australian Government

Commonwealth Environmental Water Office

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

Victorian Rivers

2015–16









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Acknowledgement of the traditional owners of the Murray-Darling Basin

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

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Commonwealth environmental water portfolio management planning

Purpose of the document

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

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

Purpose of portfolio management planning

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

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

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

Scope of integrated portfolio management planning

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

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

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

Part I: Portfolio management planning in Victorian rivers in the Murray-Darling Basin

1. Purpose and portfolio management for 2015–16

1.1. Overall purpose

Demand for environmental water

Since 2010, natural flows events and environmental watering actions have resulted in improvements in the condition of many Victorian rivers and associated wetlands and promoted recovery following the millennium drought. This recovery has continued under drier conditions in 2013–14 with the provision of environmental water. Environmental water demands in Victorian rivers in 2014–15 are represented in Table 2 and summarised below:

Goulburn River: Moderate–High demand. River bank and in-stream vegetation is still recovering following prolonged drought and floods in 2010-2012 and requires frequent wetting to maintain condition and promote recruitment. There is a moderate demand for environmental water to support native fish spawning and recruitment to build on the outcomes of watering in 2013-15. There is a high demand for year round baseflows that provide critical habitat for fish and other biota and to maintain water quality.

Lower Broken Creek: High demand. Environmental water is required annually for maintaining dissolved oxygen above tolerable levels for biota and for facilitating native fish passage through fishways.

Upper Broken Creek: High demand. Environmental water is required to provide an in-stream fresh to replicate original bankfull flows from the Broken River, which have not occurred in over 10 years.

Broken River: There is a moderate demand for environmental water to contribute to in-stream flows to support vegetation condition, native fish reproduction and condition, macroinvertebrates, disruption of biofilms, channel maintenance, hydrological connectivity and water quality. The priority demand is for small-moderate size freshes in spring as these demands have not been met in several years.

Goulburn-Broken catchment wetlands: The limited number of wetlands to which environmental water can be delivered are currently in a managed drying phase. In the absence of natural inflows in winter 2015 to meet the annual watering demand of these wetlands, there is a moderate to high demand for environmental water in late winter/early spring to promote the growth of EPBC listed flora species and in the case of Moodies Swamp, to encourage brolga breeding.

Campaspe River: There is a high demand for environmental water to contribute to in-stream flows in support of vegetation growth and survival, native fish reproduction and condition, hydrological connectivity, biotic dispersal and improved water quality.

Loddon River: There is a high demand for environmental water to contribute to in-stream flows in support of native riparian vegetation condition, native fish reproduction and condition, macroinvertebrates, hydrological connectivity and water quality.

Ovens River: There is a high demand for environmental water to contribute to in-stream flows in support of improved primary production through the disruption of biofilms, macroinvertebrate diversity through the provision of shallow water habitat, and native fish through the provision of flows sufficient to stimulate fish movement and allow passage between habitats.

Wimmera River: Should Commonwealth allocations become available (unlikely in 2015–16) there is a high demand for environmental water to contribute to in-stream flows to support native fish reproduction and condition, riparian vegetation condition, macroinvertebrate habitat and food, hydrological connectivity and biotic dispersal, and maintaining appropriate water quality. Larger pulses may be used to provide additional water to the terminal wetlands (Lakes Albacutya and Hindmarsh) when coupled with natural flows. This may lead to the above stated environmental benefits plus waterbird outcomes, and support Australia's objectives under the Ramsar Convention on Wetlands of International Importance and international migratory bird agreements.

<u>Supply</u>

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

Considering carryover of Commonwealth environmental allocations from 2014-15 to 2015-16 and the range of potential opening allocations for 2015-16, along with the full range of potential streamflows, **moderate to very high** resource availability scenarios are in scope for 2015-16 (with very high resource availability only possible if conditions become wet).

<u>Purpose</u>

Figure 1 shows how these two factors are considered together. The overall 'purpose' for managing the Commonwealth's water portfolio in the Victorian rivers for 2015–16 is to **protect** in-channel habitats and the condition/survival of native fish, vegetation and other biota, primarily through the provision of baseflows (subject to being able to access environmental water allocations). The overall purpose also includes seeking to **maintain** the ecological health and resilience of the river systems and key wetland sites by providing freshes and wetland inundation that maintain appropriate habitat and provide opportunities for breeding and recruitment. If water availability becomes high there may be scope to **improve** the health and resilience of aquatic ecosystems throughout the Victorian river system.



Avoid damage: Avoid damage to environmental assets

Protect:	Ensure ecological capacity for recovery
Maintain:	Maintain ecological health and resilience
Improve:	Improve the health and resilience of aquatic ecosystems / Build future capacity to support ecological health and resilience

Figure 1: Determining a broad purpose for portfolio management in Victorian rivers in the Murray-Darling Basin for 2015–16

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

1.2. Water Use

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

 Table 1: Potential Commonwealth watering actions and applicable resource availability scenarios for the

 Victorian rivers in the Murray –Darling Basin in 2015–16

Watering action	2015–16 Basin annual environmental watering priority(s) ¹	Resource availability scenarios action is likely to be pursued under			
		Moderate	High – very high		
Goulburn River	 Basin-wide flow variability and longitudinal connectivity Basin-wide in-stream and riparian vegetation Basin-wide native fish habitat and movement Silver perch 	Yes	Yes		
Lower Broken Creek	 Basin-wide native fish habitat and movement Silver perch 	Yes	Yes		
Upper Broken Creek	 Basin-wide flow variability and longitudinal connectivity Basin-wide native fish habitat and movement Basin-wide in-stream and riparian vegetation 	Yes	Yes		
Broken River	 Basin-wide flow variability and longitudinal connectivity Basin-wide native fish habitat and movement Basin-wide in-stream and riparian vegetation 	Yes	Yes		
Goulburn-Broken wetlands	 Basin-wide in-stream and riparian vegetation Basin-wide waterbird habitat and future population recovery 	Yes	Yes		
Campaspe River	 Basin-wide flow variability and longitudinal connectivity Basin-wide in-stream and riparian vegetation Basin-wide native fish habitat and movement 	Yes	Yes		
Loddon River	 Basin-wide flow variability and longitudinal connectivity Basin-wide in-stream and riparian 	Yes	Yes		

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

	vegetationBasin-wide native fish habitat and movement		
Ovens River	Basin-wide native fish habitat and movement	Yes	Yes
Wimmera System	 Basin-wide flow variability and longitudinal connectivity 	No	Yes
	Basin-wide in-stream and riparian vegetation		
	Basin-wide waterbird habitat and future population recovery		
	Basin-wide native fish habitat and movement		

Goulburn River

<u>Summary</u>: Commonwealth environmental water would be provided under this option in partnership with the Goulburn Broken Catchment Management Authority, the Victorian Environmental Water Holder and The Living Murray. The purpose would be to support vegetation condition and recruitment; native fish reproduction and condition; macroinvertebrates abundance and diversity; hydrological connectivity; biotic dispersal; transport of carbon, sediment and nutrients; and improved water quality.

Timing: Year round

Operational considerations and feasibility:

• As per the standard operational considerations for watering action 1. Goulburn River (see Part II, section 3).

Lower Broken Creek

<u>Summary</u>: Commonwealth environmental water would be provided under this option in partnership with the Goulburn Broken Catchment Management Authority and the Victorian Environmental Water Holder. The purpose would be to support native fish passage through fishways; provide improved native fish habitat during breeding and migration seasons; improve water quality, in particular maintaining dissolved oxygen levels above tolerable thresholds for biota and managing excessive Azolla growth.

Timing: mid August to mid May

Operational considerations and feasibility:

• As per the standard operational considerations for watering action 2. Lower Broken Creek (see Part II, section 3).

Upper Broken Creek and Broken River

<u>Summary</u>: Commonwealth environmental water would be provided under this option in partnership with the Goulburn Broken Catchment Management Authority and the Victorian Environmental Water Holder. The purpose would be to maintain water quality and support the condition and reproduction of in-channel vegetation, native fish and macroinverterbrates.

Timing: winter/spring and/or summer/autumn

Operational considerations and feasibility:

- Delivery of freshes of up to 200 ML/day to upper Broken Creek is subject to the outcomes of current investigations by the Goulburn Broken Catchment Management Authority into channel capacity along the creek to ensure that environmental water has no third party impacts.
- As per the standard operational considerations for watering action 3. Upper Broken Creek and 4. Broken River (see Part II, section 3).

Goulburn-Broken Catchment Wetlands

<u>Summary</u>: Commonwealth environmental water would be provided under this option in partnership with the Goulburn Broken Catchment Management Authority and the Victorian Environmental Water Holder. The purpose would be to promote the condition or wetland vegetation, provide habitat for birds, frogs and other biota, and in the case of Moodies Swamp, to encourage brolga breeding.

<u>Timing</u>: spring and/or summer/autumn

Operational considerations and feasibility:

• As per the standard operational considerations for watering action 5. Goulburn-Broken Catchment Wetlands (see Part II, section 3).

Campaspe River

<u>Summary</u>: Commonwealth environmental water would be provided under this option in partnership with the North Central Catchment Management Authority and the Victorian Environmental Water Holder. The purpose would be to support vegetation growth and survival, native fish reproduction and condition, hydrological connectivity, biotic dispersal and improved water quality.

Timing: Year round

Operational considerations and feasibility:

• As per the standard operational considerations for watering action 6. Campaspe River (see Part II, section 3).

Loddon River

<u>Summary</u>: Commonwealth environmental water would be provided under this option in partnership with the North Central Catchment Management Authority and the Victorian Environmental Water Holder. The purpose would be to support riparian vegetation condition, native fish reproduction and condition, hydrological connectivity and water quality.

Timing: Year round

Operational considerations and feasibility:

• As per the standard operational considerations for watering action 7. Loddon River (see Part II, section 3).

Ovens River

<u>Summary</u>: Commonwealth environmental water would be provided under this option in partnership with the North East Catchment Management Authority. The purpose would be to improve primary production through the disruption of biofilms, contribute toward macroinvertebrate diversity through the provision of shallow water habitat, and support native fish through the provision of flows sufficient to stimulate fish movement and allow passage between habitats.

Timing: Year round

Operational considerations and feasibility:

• As per the standard operational considerations for watering action 8. Ovens River (see Part II, section 3).

Wimmera System

<u>Summary</u>: Commonwealth environmental water would be provided under this option in partnership with the Wimmera Catchment Management Authority and the Victorian Environmental Water Holder. The purpose would be to support native fish reproduction and condition, riparian vegetation condition, hydrological connectivity and biotic dispersal.

Timing: Year round

Operational considerations and feasibility:

• As per the standard operational considerations for watering action 9. Wimmera System (see Part II, section 3).

Stakeholder feedback: Consultation on long term portfolio management planning has occurred with key delivery partners (Victorian Environmental Water Holder, the Goulburn-Broken, North Central, North East and Wimmera Catchment Management Authorities) and scientists engaged in monitoring the outcomes of Commonwealth environmental water use. Feedback will be sought on an ongoing basis as planning transitions to implementation phase (see Section 1.6).

1.3. Carryover

A moderate proportion of allocations available in 2014–15 are expected to be carried over to 2015–16 in the southern connected basin (350-360 gigalitres). Given the moderate to high environmental demands in the Victorian rivers for 2015–16, if water resource availability remains moderate, a moderate to high proportion of Commonwealth's available allocations for 2015–16 are expected to be used for the watering actions described above. A low to moderate proportion of allocations are expected to be carried over to support environmental demands in 2016–17 (see Table 2). The level of available allocations to be carried over to 2017–18 will depend upon resource availability and demand.

Given the connected nature of southern Murray-Darling Basin catchments and the varying carryover, account and use limits, carryover is considered at a broader scale than just the Victorian rivers. More information on how the Commonwealth makes decisions on carryover is here: http://www.environment.gov.au/water/cewo/portfolio-mgt/carryover

1.4. Trade

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

- If environmental demands have been met and it is determined that there is sufficient forecast allocation to meet future demands across the southern connected Basin, the market will be assessed to determine if there are opportunities to sell surplus water and secure proceeds to improve the Commonwealth Environmental Water Holder's capacity to meet current or future environmental demands across the Murray Darling Basin
- If a Basin-scale analysis identifies urgent environmental demands within a particular catchment and allocation purchase provides an opportunity to meet those demands using proceeds from the sale of water in a catchment with less urgent demands
- If conditions were to become wet while environmental demands remain high, market conditions might
 provide a favourable opportunity to purchase allocations to assist in meeting demands and
 augmenting natural flows

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

1.5. A note on transfer

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

1.6. Your input

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

Table 2a: Environmental demands, potential watering in 2015–16 and outlook for coming years in the Goulburn-Broken in the Murray-Darling Basin – MODERATE WATER RESOURCE AVAILABILITY IN 2015–16

Environmental	Indicative demo	and	Watering	history			2015-16		Implications	for future de	mands
assets	(for <u>all sources of water</u> in	n the system)	(from all s	ources of wa	ter)	Predominant urgency of	Purpose	Potential Commonwealth	Likely urgency of	2017–18	Met in 2016–17
		Required	2012-13	2013–14	2014–15	environmental demand for	under	environmental water	demand in 2016–17 if	Range of	
	Flow/volume	frequency	wet	moderate	drying	waler	resource	commonion?	planned in 2015-16	demand	Not met in 2016–
		(maximum drv interval)					availability		-		17
Goulburn River	Baseflow					High	Protect	High potential for partial			
(mid and	540–940 MI (day at	Year round						contribution to baseflow			High
lower)	McCoys Bridge ¹							requirements in conjunction			
								(minimum releases, Intervalley	High		
								Transfer and other			High
								environmental water holders)			
	Winter fresh (Jun-Aug)	1-2 events				High – annual requirement	Protect	High potential – subject to			
	Up to 15 000 ML/day at	per year				and only partially met in		unregulated flow conditions in		٨	Noderate
	Murchison & McCoys	(1 year)			McCoys	bys 2014-15. The Goulburn and Murray. Event is planned for June-July		Moderate			
	Bridge ² with 14 days				only			2015. Alternatively, delivery	Moderate		
					Offry			would begin in August 2015.			High
						High					
	Spring fresh (Sep-Nov)	1-2 events		D		High	Protect	High priority - to continue			
	Up to 15 000 ML/day at	peryedr		Partially				recovery of bank vegetation			High
	Murchison/McCoys Bridge ² with 14 days	(1 year)		(for 7-9					High		
	above 5 600 ML/day ¹			days only)							High
	Spring/summer fresh	2 in 3 vears ⁴				Moderate	Maintain	Moderate potential – to			
	(Oct-Dec)	2						support native fish breeding,		Ν	Noderate
	7000–15 000 ML/day ² at							noting that 2 successful	Moderate-High		
	Murchison & McCoys							events have been achieved			High
	Bridge ² for 2 days ³							in 2013-14 and 2014-15			nign
	Summer/autumn fresh	1-2 events				Moderate	Maintain	High potential - to continue			
		per year						recovery of bank vegeration		N	Noderate
	3 500–5 600 ML/day at Murchison & McCovs	(I year)							Moderate-High		
	Bridge for 2-4 days ³										High
Lower Broken Creek	(40 MI /day at Rices	mid August				High	Protect	High potential for partial contribution to baseflow			High
Oreek	Weir) ⁵	- mid May						requirements in conjunction	High		
								with consumptive deliveries			High
	Spring gutump baseflow	Continuous				High	Protect	High potential			
	(150–250 ML/day at	Oct-May				Tilight	Holect	- as above		Ν	Noderate
	Rices Weir) ⁵								High		
											High
	Spring-summer baseflow	Continuous				Moderate	Maintain	High potential			An eleverte
	(250 ML/day at Rices	Sep-Dec						– as above	Madarata	N	Noderate
	vven jo								Moderdie		
										N	Noderate
Upper Broken	Fresh	1 in 2 years				High	Protect	High potential, subject to			
Стеек	davs in winter/spring							assessment of 5°° party lisks		Low	
	and/or										
	summer/autumn) ⁶								Low		
										Ν	Noderate

Environmental	vironmental Indicative demand Watering history				2015-16			Implications for future demands			
assets	(for <u>all sources of water</u> in	n the system)	(from all s	ources of wa	ter)	Predominant urgency of	Purpose	Potential Commonwealth	Likely urgency of	2017-18	Met in 2016–17
		Required	2012-13	2013-14	2014-15	environmental demand for water	under moderate	environmental water	aemana in 2016–17 if	kange of likely	
	Flow/volume	frequency (maximum dry interval)	wet	moderate	drying		resource availability		planned in 2015-16	demand	Not met in 2016– 17
Broken River	Winter/spring baseflow 80-200 ML/d at d/s Back Creek Junction ⁷	Continuous (Jun-Nov)	Late winter- spring	Late winter- spring	Late winter- spring	Moderate	Maintain	Moderate potential to supplement consumptive deliveries to meet baseflow	Moderate	1	Voderate
			only	only	only			requirements in early winter			High
	Small fresh 270-500 ML/day for 2- 8 days in winter/spring	1-4 per year (1 year)	Winter only	Winter only	Winter only	Moderate	Maintain	Moderate potential to deliver a small fresh in summer/autumn in support of	Moderate	I	Moderate
	and summer/autumn ⁷						in-stream and riparian				High
	Large fresh 2600-4500 ML/day for	1 in 1 year (3 years)	in 1 year 3 years)		Moderate	Maintain	Moderate potential	Moderate	1	Moderate	
	1 day in winter/spring ⁷								Moderate		High
Goulburn- Broken catchment wetlands	Infrastructure delivery to semipermanent wetlands ⁸ (for Goulburn River wetlands	1 in 1-2 years (4.5 years*)		Water delivered to some wetlands	Drying phase for several wetlands	Moderate	Maintain	It is anticipated that demands in the Goulburn-Broken wetlands will be met by other water holders	Moderate	1	Moderate
wendings	equivalent to $>20,000$ ML/d at	t only ¹⁰				High					
	Shepparton) ⁹	*Moodies Swamp max. dry				Moderate	Maintain	Moderate potential	Moderate	1	Moderate
	demand 12 000 ML per year for infrastructure delivery	interval is 1 year	IS						Moderdie		High
 delivery Sourced from GBCMA (2015a) and Cottingham at el. (2007) Flows above 10,000 ML/day at McCoys Bridge or Myurchison would be subject to natural flow cues. Adapted from GBCMA (2015a) and Cottingham at el. (2007) The required frequency of short-duration freshes targeting breeding of native fish such as golden perch remains undocumented in the literature. The frequency estimated here is based on a number of sources including flow recommendations for spring freshes (1-2 per year), analysis of the modelled natural flow record and knowledge that flow-cues spawners may not spawn every year. Sourced from GBCMA (2015b) Sourced from GBCMA (2014; 2015c) 							Carryover potential	Low to moderate proportion of available allocations expected to be carried into 2016–17.	A moderate proportion of available allocations may be carried over to 2017–18, but will depend upon resource availability and demands	Potential c depend up availability	carryover will oon resource and demands
8. Environmental v 9. Sourced from G 10. Water delivere	water delivery via infrastructure BCMA (2015d) ed to Kinnaird Swamp and Black	is possibly for onl Swamp (Victori	y nine wetlar an environm	nds including N ental water)	loodies Swamp	on upper Broken Creek.	Trade potential	No urgency to augment available allocations, therefore limited requirement for allocation purchase	No expected urgency to augment allocation, therefore limited	Potential to depend or demands of	o trade will be n environmental and resource
Key - events in previous years means demand was met, by Commonwealth environmental water or any other source means demand was partially met, by Commonwealth environmental water or any other source means water did not contribute to meeting demands. Note that not all demands require water every year, drying phases are important for floodplains and temporary wetlands or streams							-	Moderate to high demands means allocation sale subject to ongoing assessment of demands within catchment and across the Basin.	purchase. Moderate demands within the catchment means allocation sale subject to market conditions and Basin wide analysis of demands.		

Key - potential watering in 2015-16

	means a high potential for Commonwealth environmental watering (subject to seasonal and operational considerations)
	means a moderate potential for Commonwealth environmental watering, or a partial contribution may be made
	means a low potential for Commonwealth environmental watering

Key - urgency of environmental demands



 Table 2b:
 Environmental demands, potential watering in 2015–16 and outlook for coming years in the Goulburn-Broken in the Murray-Darling Basin –
 HIGH-VERY HIGH WATER RESOURCE AVAILABILITY IN 2015–16

Environmental	vironmental Indicative demand Watering history						2015-16		Implications for future demands		
assets	(for <u>all sources of water</u> ir	n the system)	(from all sources of water)		Predominant urgency of environmental demand for	Purpose	Potential Commonwealth	Likely urgency of demand in 2014–17 if	2017–18 Banac	Met in 2016–17	
			2012–13	2013–14	2014–15	water	<u>moderate</u>	contribution?	watering occurred as	of likely -	Not mot in 001/
	Flow/volume	(maximum dry interval)	wer	moderate	arying		resource availability		planned in 2015-16	demand	Not met in 2016- 17
Goulburn River (mid and lower)	Baseflow 540–940 ML/day at McCoys Bridge ¹	Year round				High	Protect	High potential for partial contribution to baseflow requirements in conjunction with other contributors	Hiah		High
								(minimum releases, intervalley transfer and other environmental water holders)	Ŭ		High
	Winter fresh (Jun-Aug) Up to 15 000 ML/day at Murchison & McCoys Bridge? with 14 days	1-2 events per year (1 year)			McCoys	High – annual requirement and only partially met in 2014-15.	Protect	Moderate potential – subject to unregulated flow conditions in the Goulburn and Murray, Event is planned	Moderate	N	loderate
	above 6 600 ML/day ²				only			for June-July 2015. Alternatively, delivery would begin in August 2015.			High
	Spring fresh (Sep-Nov) Up to 15 000 ML/day at Murchison/McCoys	1-2 events per year (1 year)		Partially met		High	Protect	High potential – to continue recovery of bank vegetation	High		High
	Bridge ² with 14 days above 5 600 ML/day ¹			days only)							High
	Spring/summer fresh (Oct-Dec) 7000–15 000 ML/day at	2 in 3 years ⁴				Moderate	Maintain	Moderate potential – to support native fish breeding, noting that 2 successful	Moderate-High	N	loderate
	Bridge ² for 2 days ³							events have been achieved in 2013-14 and 2014-15			High
	Summer/autumn fresh (Feb-Apr) 3 500–5 600 ML/day at	1-2 events per year (1 year)				Moderate	Maintain	High potential – to continue recovery of bank vegetation	Moderate-High	N	loderate
	Murchison & McCoys Bridge for 2-4 days ³										High
Lower Broken Creek	Winter-autumn baseflow (40 ML/day at Rices Weir) ⁵	Continuous mid August – May				High	Protect	High potential for partial contribution to baseflow requirements in conjunction	High		High
	,							with consumptive deliveries and intervalley transfer	, and the second se		High
	Spring-autumn baseflow (150–250 ML/day at	Continuous Oct-May				High	Protect	Moderate-high potential, dependant on unregulated	Link	N	loderate
								meet the demand	nign		High
	Spring-summer baseflow (250 ML/day at Rices Weir) ⁵	Continuous Sep-Dec				Moderate	Maintain	Moderate-high potential, dependant on unregulated flow conditions, which may	Moderate	N	loderate
								meet the demand		N	loderate
Upper Broken Creek	Fresh (up to 200 ML/day for 1-2 days in winter/spring and/or	1 in 2 years				High	Protect	Moderate-high potential, dependant on unregulated flow conditions and subject to assessment of 3 rd party risks	Lou .		Low
	summer/autumn) ⁶							LOW	N	loderate	

Environmental	Indicative dem	and	Watering	history			2015-16		Implications for future demands		
assets	(for <u>all sources of water</u> in	n the system)	(from all s	ources of wa	ter)	Predominant urgency of	Purpose	Potential Commonwealth	Likely urgency of	2017–18 Met in 2016–17	
	Flow/volume	Required frequency (maximum dry interval)	2012-13 wet	2013–14 moderate	2014–15 drying	environmental demand for water	under <u>moderate</u> resource availability	environmental water contribution?	demand in 2016–17 if watering occurred as planned in 2015-16	Range of likely demand 17	
Broken River	Winter/spring baseflow 80-200 ML/d at d/s Back Creek Junction ⁷	Continuous (Jun-Nov)	Late winter- spring only	Late winter- spring only	Late winter- spring only	Moderate	Maintain	Moderate potential to supplement consumptive deliveries to meet baseflow requirements in early winter	Moderate	Moderate High	
	Small fresh 270-500 ML/day for 2-8 days in winter/spring and summer/autumn ⁷	1-4 per year (1 year)	Winter only	Winter only	Winter only	Moderate	Maintain	Moderate potential to deliver a small fresh in summer/autumn in support of in-stream and riparian	Moderate	Moderate	
								vegetation condition (subject to unregulated flow conditions)		High	
	Large fresh 2600-4500 ML/day for	1 in 1 year (3 years)				Moderate	Maintain	Moderate potential, subject	Modorate	Moderate	
	1 day in winter/spring ⁷			l			conditions		Moderdie	High	
Goulburn- Broken catchment wetlands	Infrastructure delivery to semipermanent wetlands ⁸ (for Goulburn River wetlands,	1 in 1-2 years (4.5 years*)		Water delivered to some wetlands	Drying phase for several wetlands	Moderate	Maintain	It is anticipated that demands in the Goulburn-Broken wetlands will be met by other water holders.	Moderate	Moderate	
	equivalent to >20 000 ML/d at Shepparton)?			only ¹⁰					Moderate	High	
	Approximate total demand 12 000 ML per max	* Moodies Swamp max. dry				Moderate	Maintain	Moderate potential	Moderate	Moderate	
	delivery	interval is 1 year								High	
Key - events in previous years means demand was met, by Commonwealth environmental water or any other source means demand was partially met, by Commonwealth environmental water or any other source (may be used to indicate infrastructure assisted delivery) means water did not contribute to meeting demands. Note that not all demands require water every year, drying phases are important for floodplains and temporary wetlands or streams							Carryover potential	Low to moderate proportion of available allocations expected to be carried into 2016–17.	A moderate proportion of available allocations may be carried over to 2017–18, but will depend upon resource availability and demands	Potential carryover will depend upon resource availability and demands	
Key - potential watering in 2015-16 means a high priority for Commonwealth environmental watering (subject to seasonal and operational considerations) means a secondary priority for Commonwealth environmental watering, or a partial contribution may be made means a low priority for Commonwealth environmental watering Key - urgency of environmental demands means critical demand i.e. urgent need for water in that particular year to manage risk of irretrievable loss or damage							Trade potential	No urgency to augment available allocations, therefore limited requirement for allocation purchase. Moderate to high demands means allocation sale subject to ongoing assessment of demands within catchment and across the Basin.	No expected urgency to augment allocation, therefore limited requirement for purchase. Moderate demands within the catchment means allocation sale subject to market conditions and Brain wide angle is of	Potential to trade will be depend on environmental demands and resource availability	
means hig means mo	th demand for water i.e. needed in the oderate demand for water i.e. water	nat particular year needed that partic	cular year and/	or next		-			demands.		

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

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

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

Table 2c: Long-Term Plan for the Victorian Rivers reflected in long-term commitments by the Commonwealth Environmental Water Holder – under all resource availability scenarios

Environmental Asset	Indicative demand		Watering (from all s	history ources of wate	er)	Potential Commonwealth environmental water contribution	Purpose and Expe	
	Flow/volume	Required	2012-13	2013–14	2014–15	- 2015-16 to 2017-18		
		Frequency	(wet)	(moderate)	(drying)	-		
Campaspe River	Up to the total Commonwealth environmental water entitlement of 6 913 ML (6 517 HRWS ¹ and 396 LRWS ²) per year ³ to contribute to in-stream flows at Barnadown Weir, for example ⁴ : • Summer/autumn low flows: 10–50 ML/day • Winter/spring high flows: 1 000–1 800 ML/day for 2-7 days • Winter/spring low flows: 50–200 ML/day • Summer/autumn freshes: 50-200 ML/day for 1-3 days					A high potential to contribute, depending on intervalley transfer requirements.	Commonwealth e survival, condition communities; incr large-bodied nati resident breeding connectivity betw 2015a).	
Loddon River	 Up to the total Commonwealth environmental water entitlement of 3 883 ML (3 356 HRWS¹ and 527 LRWS²) per year³ to contribute to in-stream flows in Reach 4 between Loddon and Kerang Weir for example⁵: Summer/autumn low flows (continuous Dec-May): 25–50 ML/day Summer/autumn freshes (Dec-May): 50-100 ML/day for 3–4 days Spring high flow (Sept-Oct): 450–750 ML/day with a 7 day peak Autumn high flow (April-May): 400 ML/day with a 6 day peak Winter/spring low flow (continuous June-Nov): 50- 100 ML/day 	Annually as per agreed hydrographs with the Victorian Environmental Water Holder and Catchment Management Authorities ⁸				A high potential to contribute to flows in Reach 4, particularly winter/spring high flows.	Depending on the environmental wa pools for macroin local movement a surfaces; and gro	
Ovens River	 Up to the total Commonwealth environmental water entitlement of 70 ML per year³ (50 ML from Lake William Hovell and 20 ML from Lake Buffalo) to contribute to in- stream flows within the Ovens, Kings and Buffalo rivers, for example⁶: Pulsed summer-autumn fresh when the bulk water transfer from Lake Buffalo is available (February – May) Variability in baseflows if bulk water transfer not available (Nov-May) 					A moderate-high potential to contribute to operational water releases by Goulburn Murray Water or to variability in baseflows, depending on the timing of the call by Goulburn Murray Water of the likelihood of a bulk water transfer.	When released wi environmental wo native fish, naturo River Murray, micr beds. When contr water will help to for fish passage b	
Wimmera System	Up to the total Commonwealth entitlement of 28 000 ML (LRWS ²) per year ³ to contribute toward in- stream flows within the Wimmera River (baseflow and freshes), subject to environmental need, delivery constraints and water availability ⁷ .	Due to the low reliability of the Commonwealth holdings, delivery is not expected to occur in most years.				If Commonwealth environmental water becomes available, consideration will be given to watering the terminal wetlands, however, this will occur very rarely as delivery to the terminal wetlands requires significant volumes of water that are only available under very wet conditions. More likely, when available, Commonwealth environmental water may be used to assist the Victorian Environmental Water Holder in meeting objectives in the greater Wimmera system via a combination of partial allocations and/or carryover from previous years.	When available. (reproduction and macroinvertebrat biotic dispersal, a Larger pulses may wetlands (Lakes H flows. This may lea waterbird outcom Ramsar Conventio agreement. Water reproduction and waterbird survival	

1. High Reliability Water Shares 2. Low Reliability Water Shares

3. Plus any additional Commonwealth environmental water, including carryover, as it becomes available.

4. Sourced from NCCMA (2015a) and advice from the Victorian Environmental Water Holder

5. Sourced from NCCMA (2015b)

6. Sourced from NECMA (2015)

7. Sourced from WCMA (2015)

8. The Victorian and Commonwealth Environmental Water Holders have agreed to 5 year watering schedules (2014-15 to 2018-19) for the Campaspe, Loddon and Ovens Rivers.

ected Outcomes

environmental water will contribute to: improved n and recruitment success of river red gum reased population size and age structure of small and ive fish (eg golden perch, Murray cod); increased g populations of platypus; and improved longitudinal veen reaches and with the River Murray (NCCMA,

e timing and volume of flows, Commonwealth ater will contribute to: maintained adequate depth in overtebrates, fish, aquatic plants and fauna; improved of fish and platypus; flushing of sediment from hard owth of fringing emergent macrophytes.

with the bulk water drawdown, Commonwealth ater will contribute to maintaining the movement of al connectivity between pools and riffles, and with the roinvertebrate habitat and scouring of bio-film from ributing to low flows, Commonwealth environmental maintain native fish habitat and connectivity sufficient between pools.

Commonwealth water will aim to support native fish d condition, riparian vegetation condition, te habitat and food, hydrological connectivity and nd maintaining appropriate water quality.

y be used to provide additional water to the terminal dindmarsh and Albacutya) when coupled with natural ad to the above stated environmental benefits plus nes and support Australia's objectives under The on on Wetlands and other international migratory bird erbird environmental outcomes may include waterbird d recruitment and an increase in local and landscape I and diversity.

Part II: Commonwealth environmental water portfolio management planning

2. Background

2.1. Commonwealth environmental water

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

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

2.2. The Victorian rivers in the Murray-Darling Basin

The Victorian rivers in the Murray-Darling Basin include the Ovens, Goulburn-Broken, Loddon, Campaspe (**Figure 2**) 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 (MDBA 2015). 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 terminal wetlands 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 2: 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. In lower Broken Creek, however, Commonwealth environmental water is delivered via irrigation infrastructure, sourced from either the Goulburn system or the Victorian Murray. Commonwealth environmental water use in the Victorian rivers contributes to both enhanced baseflows and freshes. Commonwealth environmental water used in the Victorian rivers can be credited as return flows for further environmental use downstream in the River Murray, with the exception of flows from the Loddon and the Wimmera rivers.

Goulburn-Murray Water is the principal storage and water supply manager in Victorian catchments and responsible for the day to day delivery of water (including environmental water) throughout its river systems and irrigation supply network. Grampians Wimmera Mallee Water 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 and managed by regional waterway managers including the Goulburn-Broken Catchment Management Authority, North Central Catchment Management Authority, North East Catchment Management Authority and Wimmera Catchment Management Authority.

3. Long-term environmental water demands in the Victorian rivers in the Murray-Darling Basin

3.1. Basin-wide environmental watering strategy

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

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

Vegetation: Maintain extent and improve the condition

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

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

3.2. Long-term watering plans

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

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

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

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

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

Key documentation includes:

- Seasonal Watering Proposal documents for the Goulburn River, lower Broken Creek, Broken River and Goulburn-Broken Catchment Wetlands (GBCMA 2015a-d)
- Seasonal Watering Proposal documents for the Loddon and Campaspe rivers 2015-16, (NCCMA 2015).
- Seasonal Watering Proposal document for the Ovens River 2015-16, (NECMA 2015).
- Seasonal Watering Proposal document for the Wimmera System 2015-16, (WCMA 2015).

- Environmental flow recommendation studies for the Goulburn River including Cottingham et al. (2003, 2007, 2010)
- The Goulburn Monitoring and Evaluation Plan, developed under the Office's Long-Term Intervention Monitoring Project (University of Melbourne 2014)
- The assessment of environmental water requirements for the proposed Basin Plan (MDBA 2012a-c)

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

3.3. Expected outcomes in the Victorian rivers in the Murray-Darling Basin

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

 Table 2: Summary of expected outcomes from environmental watering in the Victorian rivers in the Murray-Darling Basin

BASIN-WIDE				EXPECTE	D OUTCOMES				
OUTCOMES (Outcomes in red		IN-CHANNE	L ASSETS			OFF-C	CHANNEL ASSETS		
link to the Basin- wide Environmental Watering Strategy MDBA 2014)	Goulburn River (lower and middle sections)	Upper and lower Broken Creek	Broken River	Campaspe, Loddon, Ovens and Wimmera rivers	Goulburn River wetlands	Lower Broken wetlands	Upper Broken Creek wetlands (Moodies Swamp)	Lakes Hindmarsh and Albacutya (Wimmera catchment)	
VEGETATION	Maintain and ir Increase periods communities tha Manage encroad	mprove riparian condition and of growth for int t closely fringe c chment of terres environm	and in-channe d diversity. undation tolerc r occur within i trial vegetation ents.	el vegetation ant vegetation river channels. n on in-channel	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. Improve recruitment of trees within black box and river red gum communities.				
	Provide habitat	ondition and current s	pecies diversity.						
WATERBIRDS					Provide opportunities for waterbird breeding, especially brolga in Moodies Swamp				
FISH	Provide flows to s increased moveme fish. Provid	support habitat o ent, breeding, re- e native fish pas	and food sourc cruitment and sage through f	es to promote survival of native ishways.	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 ha	bitat to support i	ncreased micr	oinvertebrate and	macroinvertet	orate survival, dive	ersity, abundance and	d condition.	
OTHER VERTEBRATES	Provide habita	t to support surv	ival, maintain c	condition and prov	ride recruitmen	nt opportunities for	frogs, turtles, reptiles	and mammals	
CONNECTIVITY	Support longituding fulfil important e sediment trans Support lateral con the frequenc	long Victorian nctions, such a lispersal and w n contributing t Ikfull and overb	rivers in order to s nutrient and rater quality. to an increase in pank flows.	Support lateral connectivity (within constraints) to wetlands and floodplains, by contributing an increase in the frequency of lowland floodplain flows.					
	Support long	gitudinal connec	tivity to the Riv	er Murray					
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 DO and hypoxic blackwater), including minimising accumulation of Azolla (aquatic plant) in lower Broken Creek to help maintain DO levels.							odplain into the river	
RESILIENCE				Provide droug	ght refuge hab	itat.			

Information sourced from: Cottingham at el. (2003; 2007; 2010; 2014) GBCMA (2015a-d), NCCMA (2015a-b), WCMA (2015).

3.4. Flows in scope for Commonwealth environmental watering

Not all environmental demands can and will be met through the use of held environmental water. Some demands are met by regulated water deliveries for consumptive purposes and inter-valley transfers, while others are met by large unregulated/natural flows events or are beyond what can be delivered within operational constraints. Figure 3 shows the broad environmental demands that are in scope for the Office to focus on contributing to in the Victorian rivers. 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.



Commonwealth environmental water will not contribute to the following:

- Goulburn flows above 9 500 ML/day at Molesworth
- Campaspe flows above 1 850 ML/day at Barnadown Weir
- Loddon flows above 450 ML/day at Loddon Weir

Focus for environmental water contribution subject to seasonal conditions:

- Variable baseflows in the Goulburn throughout the year
- Small (autumn) to moderate (spring-summer and winter) freshes in the Goulburn
- Low baseflows and in-stream freshes in lower Broken Creek throughout the year
- Moderate freshes in upper Broken Creek and low in-stream flows for off-channel delivery to Moodies Swamp (wetland inundation)
- Variable baseflows and freshes in Victorian tributaries throughout the year

Demands met by other sources:

A proportion of baseflows and freshes in the Victorian rivers are met by minimum flows and intervalley transfers)

Figure 3: Scope of demands that environmental water may contribute to in the Victorian rivers in the Murray-Darling Basin

The delivery of environmental water in the Victorian rivers 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 (MDBA) and can be found in *Preliminary Overview of Constraints to Environmental Water Delivery in the Murray-Darling Basin* (MDBA2013a) and Constraints Management Strategy 2013 to 2014 (MDBA 2013b). Specific constraints to be considered are detailed in Section 3.6.

Operational considerations such as constraints and risks will differ depending on the inflow scenario and are summarised in Table 4. 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.

 Table 3: Current constraints on environmental watering for the Victorian rivers in the Murray-Darling Basin

Inflow scenario	Very low	Low	Moderate	High	Very high
Constraints					
Flow thresholds to avoid third-party impacts, such as inundation of private land or irrigation infrastructure, or to avoid adverse environmental impacts, or impacts to river works may constrain the delivery rate of environmental water, including targeted peak flow rates, duration and timing.					
Flow thresholds within the Murray River to avoid the inundation of river and floodplain work programs may constrain the delivery of targeted peak flow rates from the Goulburn River.					
Low allocations at the start of the water year will affect the ability to meet priority environmental flow targets during winter/spring.					
Trade restrictions for transfer of allocations between catchments may limit water availability to meet all desirable flow targets.					

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

Based on the above outcomes sought and delivery constraints, Table 5 identifies flows that are in scope for Commonwealth environmental watering. Some specific watering requirements (flow magnitude, duration, timing and frequency) have also been listed, drawn from existing resources. Meeting these watering requirement is subject to seasonal conditions, espicially fresh flows that are reliant on natural inflows that may be augmented using environmental water. The watering requirements for the Victorian rivers will be developed in full by the state government as part of their long-term watering plan and will be reflected in future planning documents by the Commonwealth Environmental Water Office.

Environmental asset	Indicative demands	Frequency (Maximum dry interval)
Goulburn River	Baseflow	Year round
(mid and lower)	540–940 ML/day @ McCoys Bridge	
	Winter fresh (Jun-Aug)	1-2 events per year
	Up to 15 000 ML/day @ Murchison & McCoys Bridge with 14 days above 6 600 ML/day	(1 year)
	Spring fresh (Sep-Nov)	1-2 events per year
	Up to 15 000 ML/day @	

Table 4: Long-term indicative elements of a flow regime in scope for Commonwealthenvironmental watering in the Victorian rivers in the Murray-Darling Basin

	Murchison/McCoys Bridge with 14 days above 5 600 ML/day	(1 year)
	Spring/summer fresh (Oct-Dec)	2 in 3 years
	Up to 15 000 ML/day @ Murchison/McCoys Bridge with 14 days above 5 600 ML/day	(max interval unknown)
	Summer/autumn fresh (Feb-Apr)	1-2 events per year
	3 500–5 600 ML/day @ Murchison & McCoys Bridge for 2-4 days	(1 year)
Lower Broken Creek	Winter-autumn baseflow (40 MI /day at Rices Weir)	Continuous (mid August – May)
	Spring-autumn baseflow	Continuous (Oct-May)
	(150–250 ML/day at Rices Weir)	
	Spring-summer baseflow	Continuous (Sep-Dec)
	(250 ML/day at Rices Weir)	
Upper Broken	Fresh	1 in 2 years
Creek	(up to 200 ML/day for 1-2 days in winter/spring and/or summer/autumn)	(max interval unknown)
Broken River	Winter/spring baseflow 80-200 ML/day at downstream Back Creek Junction	Continuous (Jun-Nov)
	Small fresh	1-4 per year
	270-500 ML/day for 2-8 days in winter/spring and summer/autumn	(1 year)
	Large fresh 2600-4500 ML/day for 1 day in winter/spring	1 in 1 year (3 years)
Goulburn-Broken catchment wetlands	Infrastructure delivery to semipermanent wetlands (for Goulburn River wetlands, equivalent to >20 000 ML/day at Shepparton) Approximate total demand 12 000 ML	1 in 1-2 years (4.5 years*) * Moodies Swamp maximum dry interval is 1
	per year for infrastructure delivery	year
Campaspe	Summer/autumn low flows	Annually
	10–50 ML/day at Barnadown Weir	
	Winter/spring high flows	
	1 000–1 800 ML/day for 2–7 days at Barnadown Weir	
	Winter/spring low flows	
	50–200 ML/day at Barnadown Weir	
	Summer/autumn freshes	•
	50–200 ML/day for 1–3 days at Barnadown Weir	
Loddon	Summer/autumn low flows (continuous Dec-May)	Annually
	25–50 ML/day at Loddon Weir	
	Summer/autumn fresh (Dec-May)	
	50–100 ML/day for 3–4 days at Loddon Weir	

	Spring high flow (Sept-Oct) 450–750 ML/day with a 7 day peak at Loddon Weir Autumn high flow (April-May) 400 ML/day with a 6 day peak at Loddon Weir Winter/spring low flow (continuous) 50- 100 ML/day at Loddon Weir	
Ovens	 Contribution options Pulsed summer-autumn fresh when the bulk water transfer from Lake Buffalo is available (February – May) Variability in baseflows if bulk water transfer not available (Nov-May) 	Annually
Wimmera	 Contribution options 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 downstream of Huddlestons Weir. Larger pulses may be used to provide additional water to the terminal wetlands (Lakes Albacutya and Hindmarsh) when coupled with natural flows 	Subject to water availability

Information sourced from: Cottingham at el. (2003; 2007; 2010), GBCMA (2015a-d), NCCMA (2015a-b), NECMA (2015), WCMA (2015)

3.5. Potential watering actions under different levels of water resource availability

Under certain levels of water resource availability, watering actions may not be pursued for a variety of reasons, including that environmental demand may be met by unregulated flows and that constraints and/or risks may limit the availability to deliver environmental water. Table 6 identifies the range of potential watering actions in the Victorian rivers and the levels of water resource availability that relate to these actions.

Table 5: Summary of potential watering actions for the Victorian rivers in the Murray-Darling Basin

		Applicable level(s) of resource availability					
Broad Asset	Indicative demand	Very Low	Low	Moderate	High	Very High	
Goulburn River	Baseflow 540-940 ML/day at McCoys Bridge	1a. Contribute t resources to sup	o minimum baseflows ye port native fish and macr	ear-round to maintain wo oinvertebrates condition o	ater quality and provide s and survival.	suitable habitat and food	
		1b. Contribute to resources to sup	o higher baseflows year- port native fish and macr	ound, but especially in w oinvertebrates condition o	vinter/spring to provide ac and survival.	ditional habitat and food	
	Winter fresh (Jun-Aug) Up to 15 000 ML/day at Murchison & McCoys Bridge with 14 days above 6 600 ML/day	1c. Contribute to winter freshes to support the condition and survival native vegetation as part of the ongoing system recovery following prolonged drought and subsequent flooding; provide channel maintenance and promote the transport of nutrients, carbon, sediment and biota.					
	Spring fresh (Sep-Nov) Up to 15 000 ML/day at Murchison/McCoys Bridge with 14 days above 5 600 ML/day	1d. Contribute to long duration freshes in spring targeting in-channel native vegetation condition and reproduction; macroinvertebrate diversity and abundance; movement and condition of native fish; biotic dispersal and the transport of nutrients, carbon and sediment.					
	Spring/summer fresh (Oct-Dec) 7000–15 000 ML/day at Murchison & McCoys Bridge for 2 days	1e. Contribute to short duration freshes between October and December to promote movement and breeding of native fish (flow cued spawners).					
	Summer/autumn fresh (Feb-Apr) 3 500–5 600 ML/day at Murchison & McCoys Bridge for 2-4 days	1f. Contribute to low magnitude, long duration freshes between February and April to support the survival and condition of in-channel native vegetation and promote the transport of nutrients, carbon, sediment and biota.					
Lower Broken Creek	Winter-autumn baseflow (40 ML/day at Rices Weir)	2a. Contribute to minimum baseflows between mid August and mid May to support native fish movement through fishways.					
	Spring-autumn baseflow (150– 250 ML/day at Rices Weir)	2b. Contribute t dissolved oxyger	o high baseflows betwe n levels above 4 mg/L.	en October and May to	manage excessive Azollo	a growth and maintaining	
	Spring-summer baseflow (250 ML/day at Rices Weir)		2c. Contribute to high provide improved habit	baseflows between Septe at and migration opportu	ember and December to nities for native fish.		
Upper Broken Creek	Fresh (up to 200 ML/day for 1-2 days in winter/spring and/or summer/autumn)	3. Contribute to moderate size freshes in response to natural flow triggers or transfers from Broken River to maintain water quality and support condition and reproduction of in-channel vegetation, native fish and macroinverterbrates.					
Broken River	Winter/spring baseflow 80-200 ML/d at downstream Back Creek Junction	4a. Contribute to baseflows between June and November to maintain water quality and provide suitable habitat and food resources to support native fish and macroinvertebrates condition and survival					

	Small fresh 270-500 ML/day for 2-8 days in winter/spring and summer/autumn	4b. Contribute to small freshes throughout the year to support the condition and reproduction of native in-channel vegetation; the condition, movement and reproduction of native fish; and provide suitable habitat for biota through maintaining water quality, scouring biofilms, inundating benches and flushing fine sediment from the riverbed			
	Large fresh 2600-4500 ML/day for 1 day in winter/spring			4c. Contribute to large freshes in winter/spring triggers, to support the condition and reproduce vegetation; the condition, movement and repro- channel maintenance	g, subject to appropriate ction of native in-channel duction of native fish; and
Goulburn- Broken Catchment Wetlands	Infrastructure delivery to semipermanent wetlands (for Goulburn River wetlands, equivalent to >20 000 ML/d at Shepparton)	5. Contribute flows via wetland regulators and/or pumping to inundate semi-permanent, temporary and ephemeral wetlands			
Campaspe River	Summer/autumn low flows 10–50 ML/day to Reach 4 between the Campaspe Siphon and the Murray River	6a. Contribute to low flows in summer/autumn to increase native fish populations and resident platypus breeding populations.			t platypus breeding
	Winter/spring high flows 1000-1800 ML/day for 2-7 days to Reaches 2 and 4 below Loddon Weir	6b. Contribute to winter/spring high flows to support river red gums, native fish and platypus populations, and connectivity between Campaspe reaches and with the Murray River. Multiple actions, possible when additional wate is available, will also reduce exotic vegetation, flush and mix pools, inundate snags and respond to blackwater event if required			
	Winter/spring low flows 50–200 ML/day at Barnadown Weir	6c. Contribute to winter/spring low flows to support native fish and platypus populations			
	Summer/autumn freshes 50–200 ML/day for 1-3 days at Barnadown Weir	6d. Contribute to summer/autumn freshes to support riparian and in-channel vegetation and native fish populations			
Loddon River	Summer/autumn low flows (continuous Dec-May) 25–50 ML/day at Loddon Weir	7a. Contribute to summer/autumn low flows to maintain sufficient depth in pools to support microinvertebrates, native fish, aquatic plants and fauna, and maintain water quality and connectivity.			
	Summer/autumn freshes (Dec-May) 50-100 ML/day for 3–4 days at Loddon Weir	7b. Contribute to summer/autumn freshes to promote local movement of native fish, flush fine sediment from hard surfaces and promote growth of fringing emergent macrophytes			
	Autumn high flow (April-May) 400 ML/day at Loddon Weir with a 6 day peak	a 6 7c. Contribute to autumn high flows to cue and facilitate upstream movement of >1 year old golden perch, silver perch and Murray cod			
	Winter/spring low flow (continuous June-Nov) 50–100 ML/day at Loddon Weir	7d. Contribute to winter/spring low flows to increase depth for fish, platypus and water rat movement, keep submerged wood and other hard surfaces clear of fine silt and sediment, support the range of vegetation types and provide habitat for platypus			
	Spring high flow (Sept-Oct) 450–750 ML/day at Loddon Weir with a 7 day peak		7e. Contribute to winter/sprin runners, flush accumulated or native fish movement and bre of riparian vegetation and sco	g high flows to provide flows through flood ganic matter from banks and benches, stimulate eeding, promoted recruitment and maintenance pur some pools	

Ovens River	Summer-autumn fresh (February – May)when the bulk water transfer from Lake Buffalo is available 70 ML over 2 days		8a. Contribute to maintaining the movement of native fish, natural connectivity between pools and riffles and with the River Murray, supporting microinvertebrate habitat and scouring of bio-film from beds 8b. Contribute to maintaining native fish habitat and connectivity sufficient for fish passage between pools.	
	Baseflows if bulk water transfer not available (Nov–May) 70 ML over 2 days			
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 natural flows			9. When available, Commonwealth environmental water may be used to assist the Victorian Environmental Water Holder in meeting objectives in the greater Wimmera system via a combination of partial allocations and/or carryover from previous years. Due to the low reliability of the Commonwealth holdings, allocation is only expected in very wet years

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

3.6. Potential watering actions – standard operational considerations

Table 6 above identifies the range of potential watering actions in the Victorian rivers that give effect to the long-term demands and flow regime identified as being in scope for the Office to contribute environmental water to in any given year. The standard considerations associated with these actions are set out below.

A note on approvals: watering actions in the Victorian rivers would be implemented with local delivery partners, who will play a key role in engaging with the local community and third parties and implementing the event. As some actions may be constrained by other demands in the system, the Office will seek advice from river operators on the timing, magnitude and duration of a proposed event.

Watering action 1: Goulburn River

Standard operational considerations

- Commonwealth environmental water delivery will not contribute to flows above 9 500 ML/day at Molesworth to minimise the risk of potential impacts on private property in reach 1, located between Eildon Dam and Molesworth.
- Unless otherwise agreed, Commonwealth environmental water will only contribute to flows up to 15 000 ML/day at McCoys Bridge. Fresh events are unlikely to target flows above 9 500 ML/day in the lower Goulburn River at McCoys Bridge, however recession management of natuiral high flow events may commence at 15 000 ML/day at McCoys Bridge.
- The design of environmental watering action 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.

Typical extent: in-channel flows in support of the aforementioned expected outcomes will be released from Lake Eildon or Goulburn Weir, particularly targeting reaches 4-5 (lower Goulburn River downstream of Goulburn Weir), with en route benefits to reaches 1-3 (Eildon to Goulburn Weir).

Watering action 2: Lower Broken Creek

Standard operational considerations

- Environmental water delivery is constrained to the period mid May to mid August, when irrigation infrastructure in the Shepparton and Murray Valley irrigation areas is in operation.
- Environmental water delivery will be delivered to complement consumptive water deliveries, including intervalley bulk water transfers, where appropriate. 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 over 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: Upper Broken Creek

Standard operational considerations

- Unless otherwise agreed, Commonwealth environmental water will only contribute to flows below channel capacity to avoid potential third party flooding impacts.
- Up to 210 ML/day can be passed into upper Broken Creek from the Broken River at Casey's Weir.

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

Watering action 4: Goulburn-Broken Catchment Wetlands

Standard operational considerations

• Delivery to Goulburn-Broken catchment wetlands, inlcuding Moodies Swamp, involves low inchannel flow rates well below channel capacity.

Typical extent: Wetland inundation via infrastructure.

Watering action 5: Campaspe River

Standard operational considerations

- The maximum regulated release volume from Lake Eppalock to avoid any potential third party flooding impacts is 1 850 ML/day (measured at Barnadown Weir). Planned releases are below this volume.
- Intervalley transfers undertaken by Goulburn Murray Water may impact on the volume and timing of Commonwealth Environmental Water releases.
- Drawdowns from Lake Eppalock during summer/autumn may attract community concern if the lake-level recedes and affects recreational activity.
- Flows greater than 10 000 ML/day in Reach 2 (Eppalock Weir to Campaspe Weir) and greater than 8 000 ML/day in Reach 3 (Campaspe Weir to Campaspe Siphon) and 9,000 ML/d in reach 4 (Campaspe Siphon to River Murray) will cause flooding of low lying floodplain including private property. These flows are not planned.
- The timing of releases and flow rates from Lake Eppalock may need to be managed by the storage operator to limit any potential effects of cold water on fish. Structures, such as Campaspe Weir and Campaspe siphon may also be acting as constraints to fish passage (Goulburn-Murray Water [GMW] 2014, pers. comm. 21 March).

Typical extent: in-channel flows in support of the aforementioned expected outcomes will be released from Lake Eppalock, particularly targeting reaches 2 (Lake Eppalock to Campaspe Weir) and 4 (Campaspe Siphon to *Murray River*).

Watering action 6: Loddon River

Standard operational considerations

- 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.
- A constant flow in the river is desirable but in the event the river did dry-out then it should be re-started with a bankfull flow.
- Rules and constraints related to water from the Goulburn system affect the delivery of the winter/spring fresh. Water not tied to the Goulburn system but stored in the Loddon storages, such as Commonwealth environmental water, can be used for this action.

Typical extent: in-channel flows in support of the aforementioned expected outcomes will be released from Cairn Curran, Tullaroop or Laanecoorie Reservoirs, particuarly targeting reach 4 (Loddon Weir to Kerang Weir).

Watering action 7: Ovens River

Standard operational considerations

- Water is to be 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. At Lake Buffalo the maximum outflow is 850 ML/day at full supply level and approximately 600 ML/day during periods of Lake drawdown. The minimum outflow of Lake Buffalo is 20 ML/day and this limits the capacity to deliver the 20 ML of total held Commonwealth entitlement over more than one day. 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.
- Inflow rates, particularly for Lake William Hovell, are to be tracked to ensure the opportunity for delivery is not inadvertently missed.
- To maximise environmental benefits Commonwealth environmental water release may be timed to occur with the Goulburn Murray Water 'bulk release drawdown'.

Typical extent: in-channel flows in the Ovens, King and Buffalo Rivers in support of the aforementioned expected outcomes will be released from Lake William Hovell and Lake Buffalo.

Watering action 8: 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. Should the allocation come on-line, the Wimmera Catchment Management Authority will consult with the Office and the Victorian Environmental Water Holder regarding the planned use of this water to provide 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 natural flows.

4. Long-term water availability

4.1. Commonwealth environmental water holdings

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

- 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 (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.

4.2. Other sources of environmental water

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

- Environment Entitlement The Living Murray Program: Murray-Darling Basin Authority
- Bulk Entitlement (River Murray Flora and Fauna): Victorian Environmental Water Holder
- Environmental Entitlement (River Murray and Goulburn System Northern Victorian Rivers Irrigation Renewal Stage 1): 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
- Bulk Entitlement (Eildon to Goulburn Weir): Goulburn-Murray Water

4.3. Planned environmental water

In addition to water entitlements held by environmental water holders, environmental demands may also be met via natural or unregulated flows and water provided 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'). The Bureau of Meteorology provides a seasonal streamflow forecasting service, which estimates the potential for low, median or high flows for the coming three months ahead.

5. Next steps

5.1. From planning to decision making

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

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



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

5.2. Further information

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

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

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 Goulburn-Broken are described below.

RIVER FLOWS AND CONNECTIVITY

Baseflows are at least 60 per cent of the natural level

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

A 30-60 per cent increase in the frequency of freshes, bankfull and lowland floodplain flows

VEGETATION

Maintained 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 Creek, Broken and Goulburn rivers

Black box condition

Vegetation co	Percent of vegetation	
0 –6	>6 –10 assessed (wi >6 –10 managed flo	
28 per cent	72 per cent	77 per cent

River red gum condition

	Percent of vegetation				
0 – 2	>2 - 4	managed floodplain)			
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 movements 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, increase up the lower Goulburn River. Improved core range in at least two additional locations (candidate site includes Broken Creek)	Yes – Iower 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: mid-Goulburn populations - attempts to re-establish have commenced	Establishment of new populations is dependent on complimentary activities. Environmental water will however target existing

Species	Specific outcomes	In-scope for C'th water in the Goulburn-Broken?
		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					*	*	*

Bibliography

Cottingham, P., Crook, D., Hillman, T., Roberts, J., and Stewardson, M. (2010) Objectives flow flow freshes in the lower Goulburn river 2010/11. Report prepared for the Goulburn-Broken Catchment Management Authority.

Cottingham, P., Brown, P., Iyon, J., Pettigrove, V., Roberts, J., Vietz, G., and Woodman, A. (2014) Mid Goulburn River FLOWS study, Final report: flow recommendations. Prepared for the Goulburn-Broken Catchment Management Authority, December 2014.

Cottingham, P., Stewardson, M., Crook, D., Hillman, T., Oliver, R., Roberts, J., and Rutherfurd, I. (2007) Evaluation of summer inter-valley water transfers from the Goulburn River, prepared for the Goulburn-Broken CMA.

Cottingham, P., Stewardson, M., Crook, D., Hillman, T., Roberts, J., and Rutherfurd, I. (2003) Environmental flow recommendations for the Goulburn River below Lake Eildon. CRC Freshwater Ecology and CRC Catchment Hydrology, Technical Report 01/2003.

Department of Environment and Primary Industries (DEPI) (2015), Victoria and the Murray-Darling Basin, <u>http://www.depi.vic.gov.au/water/rural-water-and-irrigation/murray-darling-basin</u>

GBCMA - see Goulburn-Broken Catchment Management Authority

Goulburn-Broken Catchment Management Authority (2015a) Goulburn River Seasonal Watering Proposal 2015-16.

Goulburn-Broken Catchment Management Authority (2015b) Lower Broken Creek Seasonal Watering Proposal 2015-16.

Goulburn-Broken Catchment Management Authority (2015c) Broken River Seasonal Watering Proposal 2015-16.

Goulburn-Broken Catchment Management Authority (2015d) Goulburn Broken Catchment Wetlands Seasonal Watering Proposal 2015-16.

MDBA – see Murray Darling Basin Authority

Murray-Darling Basin Authority (2012a), Assessment of environmental water requirements for the proposed Basin Plan: Lower Goulburn River (in-channel flows), <u>http://www.mdba.gov.au/what-we-do/basin-plan/development/bp-science/assessing-environmental-water-requirements</u>

Murray-Darling Basin Authority (2012b), Assessment of environmental water requirements for the proposed Basin Plan: Lower Goulburn River Floodplain <u>http://www.mdba.gov.au/what-we-do/basin-plan/development/bp-science/assessing-environmental-water-requirements</u>

Murray-Darling Basin Authority (2012c), Assessment of environmental water requirements for the proposed Basin Plan: Wimmera River Terminal Wetlands, <u>http://www.mdba.gov.au/what-we-do/basin-plan/development/bp-science/assessing-environmental-water-requirements</u>

Murray-Darling Basin Authority (MDBA) (2013a), Preliminary Overview of Constraints to Environmental Water Delivery in the Murray–Darling Basin

Murray-Darling Basin Authority (MDBA) (2013b), Constraints Management Strategy

Murray-Darling Basin Authority (2014), Basin-wide environmental watering strategy.

Murray Darling Basin Authority (2015), Goulburn-Broken, http://www.mdba.gov.au/aboutbasin/how-river-runs/goulburn-broken

NCCMA - see North Central Catchment Management Authority

North Central Catchment Management Authority (2015a). Seasonal Watering Proposal Campaspe River System Downstream of Lake Eppalock 2015–16. North Central Catchment Management Authority, Huntly, Victoria.

North Central Catchment Management Authority (2015b). Seasonal Watering Proposal for the Loddon River System 2015–16. North Central Catchment Management Authority, Huntly, Victoria.

North East Catchment Management Authority (2015). Seasonal Watering Proposal Ovens River System 2015–16. North East Catchment Management Authority, Wodonga, Victoria.

WCMA - See Wimmera Catchment Management Authority

Wimmera Catchment Management Authority (2015). Draft Seasonal Watering Proposal for the Wimmera System 2015–16. Wimmera Catchment Management Authority. Victoria.



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