



Australian Government

Commonwealth Environmental Water Office

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

Lachlan River Valley

2015–16



Front cover image credit: Western edge of Great Cumbung Swamp, August 2013
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Back cover image credit: Booligal wetlands, December 2010
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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 portfolio management planning for the 2015–16 water year and for the following two years. While focussed on the Lachlan Catchment, the identified use, carryover and trading intentions have been considered together with those for other catchments in a Murray-Darling Basin-wide analysis.

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

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

The Commonwealth Environmental Water 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 the Lachlan Catchment

1. Purpose and portfolio management for 2015–16

1.1. Overall purpose

Demand for environmental water

Since 2010, natural flow events and environmental watering actions have resulted in improvements in the condition of many of the wetlands in the Lachlan catchment and promoted recovery following the millennium drought. Drier conditions in 2013–14 and 2014–15 saw some floodplain wetlands entering into a natural drying phase. The MDBA's second Sustainable Rivers Audit (based on data collected from 2008 to 2010) concluded that the Lachlan River Valley was in very poor river ecosystem health (MDBA 2012d). While the Lachlan River valley was recognised as having good physical form and moderate macroinvertebrate communities and hydrology, the valley was rated as poor for riparian vegetation and extremely poor for native fish communities (MDBA 2012d).

Environmental water demands for environmental assets in the Lachlan catchment in 2015–16 are represented in Table 2 and summarised below:

Great Cumbung Swamp: High demand. Augment or extend tributary inflows to improve vegetation condition and maintain resilience.

Booligal Wetlands: High demand. These wetland areas are in moderate condition following natural flows and environmental watering in 2012 and 2013. However, the system will require further small to moderate flows to support ongoing recovery from drought, build resilience and restore the wetlands to a healthy and sustainable state. During drier conditions, food supply for colonial nesting waterbirds may be available. Actions to support waterbird reproduction can be considered if water levels are at risk of dropping.

Lachlan Swamps: Moderate demand. Many of the wetland areas are in moderate condition and improving following natural events, environmental watering and appropriate wetting-drying cycles. Monitoring results have shown a positive vegetation response, along with waterbird and frog breeding, from past environmental watering.

Merrowie Creek: Moderate demand. As with other parts of the catchment, the Merrowie system received much-needed water from substantial rainfalls, through winter 2012, after over a decade of drought. The Merrowie system does not require the significant flows of the Lachlan main channel, however smaller freshes will be important for aiding the continued recovery of this asset.

Lachlan River Channel: High demand. Native fish populations are considered in poor condition from the Sustainable Rivers Audit (MDBA 2012d). Protecting tributary inflows from reregulation is a high priority in most years to support fish migration, spawning and recruitment.

Willandra Creek: Low demand. This formerly ephemeral system is wetter than it was pre-development, due to increases in planned flows and water orders.

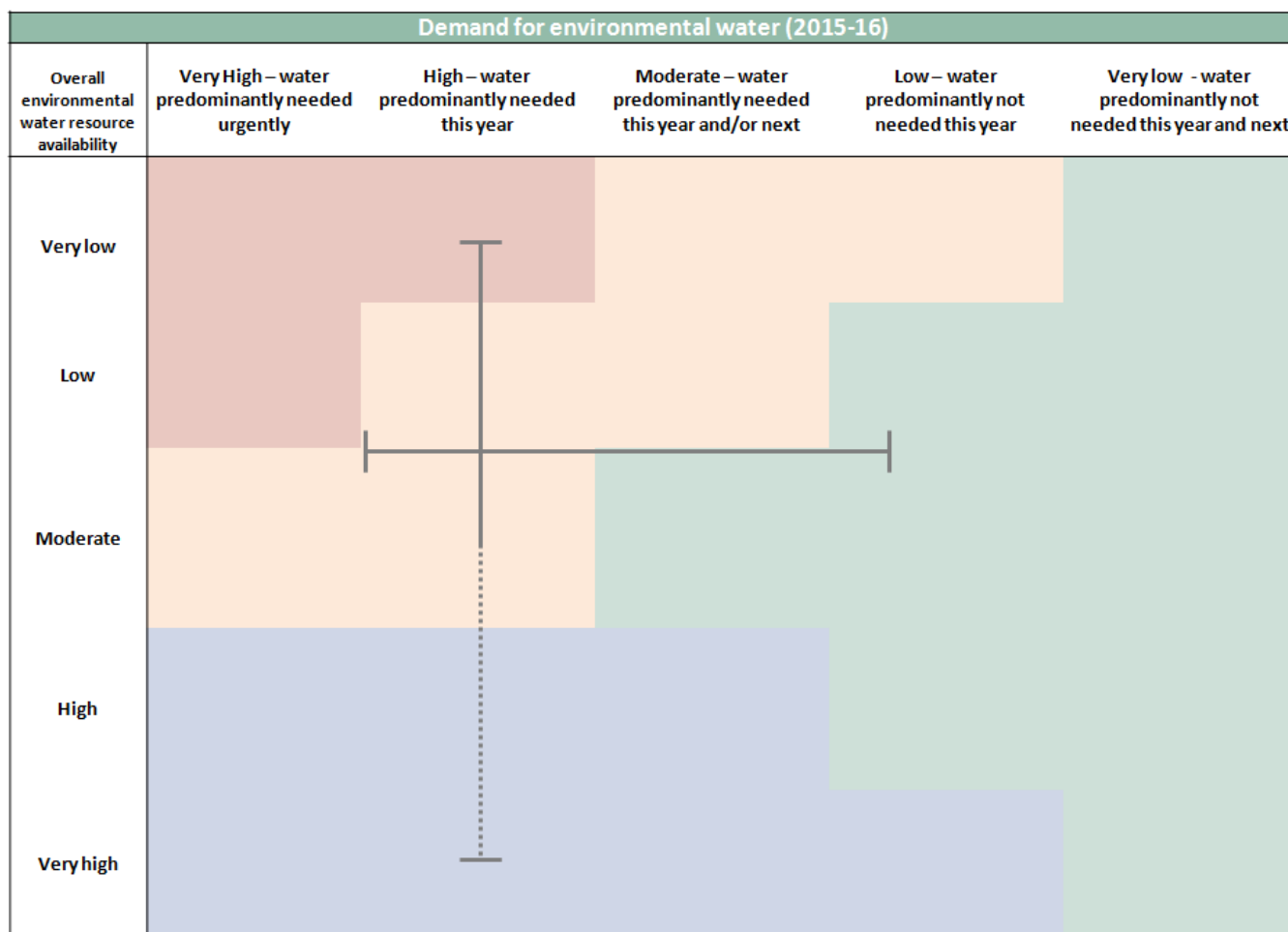
Supply

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

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

Purpose

Figure 1 shows how these two factors are considered together. The overall 'purpose' for managing the Commonwealth's water portfolio in the Lachlan for 2015–16 is to maintain the ecological health and resilience of wetland sites in the catchment, and support the recovery of native fish species.



Avoid damage: Avoid damage to environmental assets

Protect: Ensure ecological capacity for recovery

Maintain: Maintain ecological health and resilience

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

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

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

1.2. Water Use

Consistent with the demands and purpose described above, the Commonwealth Environmental Water 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 behaviour for 2015–16. Table 1 also identifies the 2015–16 Basin annual environmental watering priorities (published by the Murray-Darling Basin Authority) that the various watering actions may contribute to meeting.

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

Watering action	2015–16 Basin annual environmental watering priority(s) ¹	Resource availability scenarios action is likely to be pursued under		
		Low – very low	Moderate	High – very high
Lachlan River – providing flow to the Great Cumbung Swamp	<ul style="list-style-type: none"> • Basin-wide flow variability and longitudinal connectivity • Basin-wide in-stream and riparian vegetation • Basin-wide waterbird habitat and future population recovery • Basin-wide native fish habitat and movement 	Yes	Yes	Yes
Lachlan River - Restoring natural flow variability to support native fish	<ul style="list-style-type: none"> • Basin-wide native fish habitat and movement 	Yes	Yes	Yes
Booligal wetlands - piggybacking replenishment flows in Merrimajeel Creek	<ul style="list-style-type: none"> • Basin-wide in-stream and riparian vegetation • Basin-wide waterbird habitat and future population recovery • Basin-wide native fish habitat and movement 	Yes	Yes	Yes
Maintain inundation of key native fish or waterbird habitat	<ul style="list-style-type: none"> • Basin-wide in-stream and riparian vegetation • Basin-wide waterbird habitat and future population recovery • Basin-wide native fish habitat and movement 	Unlikely	Yes	Yes

The Commonwealth Environmental Water Office is considering supplying environmental water to the following watering actions for 2015–16.

1. Great Cumbung Swamp fresh event

Watering action: Provide hydrological connectivity to reconnect and refill low-lying wetlands. Flows along the length of the system also provide improved condition and maintenance of aquatic and riparian

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>

vegetation, and maintains aquatic habitat for native fish. Primary production, decomposition, nutrient and carbon cycling may also be enhanced.

Standard operational considerations and feasibility: Flow will be planned to remain in-channel, in order to meet targets in the terminal wetlands supplied from Wyangala dam.

Typical extent: This watering action contributes flows required to reach the Great Cumbung Swamp and wet core wetland areas.

Potential volume of Commonwealth environmental water: 10-20 GL

Timing: Late Winter/Early Spring 2015

Monitoring and evaluation: Vegetation monitoring sites have been established within the target asset.

2. Merrimajeel Creek piggyback

Watering action: Provide hydrological connectivity to reconnect and refill low-lying wetlands, and support River red gum and lignum condition and recruitment.

Standard operational considerations and feasibility: The trigger for contributing to replenishment flows involves monitoring the progression of flows to ensure any subsequent volumes can meet the target location. In-stream vegetation growth may slow the progression of flows to the target asset.

Typical extent: This watering action could contribute flows along the length of Merrimajeel Creek to fill Murrumbidgee swamp, supplied on the back of replenishment flows.

Potential volume of Commonwealth environmental water: 1-2 GL

Timing: late July 2015

Monitoring and Evaluation: Vegetation monitoring sites have been established within the target asset.

3. Native fish flow

Watering action: Protecting natural tributary inflows from regulation and allowing them to flow the length of the Lachlan River system. This action provides natural flow variability and protects the integrity of natural chemical signatures that provide cues for native fish migration and spawning.

Standard operational considerations and feasibility: Target volumes and flow rates will be dependent on the characteristics of inflow events in the upper tributaries, prevailing flow conditions and operational considerations. Action may be undertaken in conjunction with a Great Cumbung Swamp fresh event.

Typical extent: Lachlan River (channel only) below Wyangala dam to Great Cumbung Swamp, supplied from upper tributary creeks.

Potential volume of Commonwealth environmental water: Dependent on inflows, up to 15 GL

Timing: Spring-Summer 2015

Monitoring and Evaluation: Adult fish and larval surveys will be undertaken annually to provide data on fish populations.

4. Contingency for breeding events

Watering action: Maintain wetland water levels and acceptable levels of water quality to support the completion of a significant breeding event of waterbirds or other native aquatic vertebrates in a wetland.

Standard operational considerations and feasibility: This contingency is not to trigger a breeding event for waterbirds or other native animals but for use when a significant breeding event is already underway and considered in danger of failure due to receding water levels. A decision to support a breeding event will be based on the apparent size of the event, nesting site condition and feasibility of delivery within the required timeframe.

Typical extent: Potential within the Booligal Wetlands complex

Potential volume of Commonwealth environmental water: Up to 5 GL

Monitoring and Evaluation: Fixed cameras will be in place to monitor waterbird breeding events, should they occur.

Timing: Spring 2015

1.3. Carryover

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

1.4. Trade

At this time there is no plan to buy or sell allocations in the Lachlan catchment in 2015–16. Currently, there is only limited market opportunity for allocation purchase to be pursued. The moderate to high demands for environmental water that may extend to 2016–17 mean that the sale of allocations will be considered based on ongoing assessments of environmental demands within the Lachlan catchment 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 in the Lachlan catchment, the market will be assessed to determine if there are opportunities to sell surplus water and secure proceeds to improve the Commonwealth Environmental Water Holder's capacity to meet current or future environmental demands across the Murray-Darling Basin
- If a Basin-scale analysis identifies urgent environmental demands within a particular catchment and allocation purchase provides an opportunity to meet those demands using proceeds from the sale of water in a catchment with less urgent demands
- If conditions were to become wet while environmental demands remain high, market conditions might provide a favourable opportunity to purchase allocations to assist in meeting demands and augmenting natural flows

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

1.5 Your input

The management of Commonwealth environmental water relies on considerable advice and assistance from local organisations, state governments and others. Feedback will be sought on an ongoing basis as planning transitions to implementation phase. Individuals and groups within the Murray-Darling Basin community are encouraged to submit suggestions for the management of Commonwealth environmental water. Please contact the Commonwealth Environmental Water Office via: ewater@environment.gov.au.

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

Environmental assets	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)			2015-16			Implications for future demands		
	Flow/volume	Required frequency (maximum dry interval)	2012–13	2013–14	2014–15	Predominant urgency of environmental demand for water	Purpose under low to very low resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2016–17 if watering occurred as planned in 2015-16	2017–18 Range of likely demand	Met in 2016–17
			(wet)	(drying)	(drying)						Not met in 2016–17
Great Cumbung Swamp (Clear Lake, Lignum Lake, Reed beds)	Small fresh event (17-18GL @ Booligal Weir)	5 in 10 years (unknown)				High – a fresh event has not occurred since large-scale watering of 2013, other than very small (<6GL) return flows	Protect	A high potential for watering in 2015-16	Moderate	Moderate	
										High	
	Medium scale event (50-60GL @ Booligal Weir)	3 in 10 years (unknown)				Moderate – a fresh event has not occurred since large-scale watering of 2013, other than very small (<6GL) return flows	Maintain	Option unlikely to be exercised under this resource availability	Moderate	Low	
										Moderate	
	Large inundation event (~100-125GL @ Booligal Weir)	2 in 10 years (unknown)				Moderate – an event of this scale has not occurred since the 2012 flooding	Improve	Option unlikely to be exercised under this resource availability	Moderate	Very Low	
										Moderate	
Lachlan Swamp (Lake Waljeers, Ryans Lake, Lake Bullogal, Peppermint Swamp, Lake Ita and Baconian Swamp)	Small fresh event (17-18GL @ Booligal Weir)	5 in 10 years (unknown)				Moderate – a small-scale fresh event has not occurred since large-scale watering of 2013	Maintain	An appropriate use of water in 2015-16 should sufficient volume be available	Moderate	Moderate	
										High	
	Medium scale event (50-60GL @ Booligal Weir)	3 in 10 years (unknown)				Moderate – a fresh event has not occurred since large-scale watering of 2013	Maintain	Option unlikely to be exercised under this resource availability	Moderate	Low	
										Moderate	
	Large inundation event (~100-125GL @ Booligal Weir)	2 in 10 years (unknown)				Moderate – an event of this scale has not occurred since the 2012 flooding	Improve	Option unlikely to be exercised under this resource availability	Moderate	Very Low	
										Moderate	
Booligal Wetlands (incl. Muggabah and Merrimajeel Cks, Moon Moon, Upper Gum, Lower Gum, Booligal and Murrumbidgee Swamps, Lake Merrimajeel)	Small fresh event (7-8GL @ Booligal Weir)	7 in 10 years (unknown)				Mod-High – a small flow of this nature is required in most years.	Protect	An appropriate use of water should sufficient volume be available. Merrimajeel Creek is considered a high potential for watering in conjunction with replenishment flows.	Mod-High	Moderate	
										High	
	Medium scale event (50-60GL @ Booligal Weir)	3 in 10 years (unknown)				Moderate – a fresh event has not occurred since large-scale watering of 2013	Maintain	Option unlikely to be exercised under this resource availability	Moderate	Low	
										Moderate	
	Large inundation event (~100-125GL @ Booligal Weir)	2 in 10 years (unknown)				Low – an event of this scale has not occurred since the 2012 flooding	Improve	Option unlikely to be exercised under this resource availability	Moderate	Very Low	
										Moderate	
Merrowie Creek (incl. Cuba Dam, Lake Tarwong, Chillichil Swamp)	Small fresh event (7-8GL @ Gonowlia Weir)	3 in 10 years (unknown)				Low – last watered in 2011-12, ahead of drought-breaking inflows in 2012.	Maintain	An appropriate use of water in 2015-16 should sufficient volume be available	Low	Very Low	
										Low	

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system)		Watering history (from all sources of water)			2015-16			Implications for future demands		
	Flow/volume	Required frequency (maximum dry interval)	2012-13	2013-14	2014-15	Predominant urgency of environmental demand for water	Purpose under low to very low resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2016-17 if watering occurred as planned in 2015-16	2017-18 Range of likely demand	Met in 2016-17
			(wet)	(drying)	(drying)						Not met in 2016-17
Merrowie Creek (incl. Cuba Dam, Lake Tarwong, Chillichil Swamp)	Medium fresh event (13-15GL @ Gonowlia Weir)	2 in 10 years (unknown)				Low – last watered in 2011, ahead of drought-breaking natural flows in 2012.	Maintain	Option unlikely to be exercised under this resource availability	Low	Very Low	
										Low	
In-channel fish recruitment flows	Protect tributary inflows (natural trigger), between 5-15GL	Most years				Mod-High – natural inflows from tributaries should be protected where possible to provide a natural trigger for fish migration, spawning and recruitment	Protect	A high potential for watering in 2015-16, subject to a natural trigger	Mod-High	Mod-High	
										High	
Maintain inundation of key native fish or waterbird habitat following unregulated events at key times	Volumes and flow rates TBD based on specific event conditions	Whenever viable opportunities arise				Low – where opportunities and sufficient water account balance allows	Maintain	An appropriate use of water in 2015-16 should sufficient opportunities arise	Low	Low	
										Low	
Willandra Creek	Small fresh event (7-8GL @ Homestead Weir)	1-2 in 10 years				Very Low – last received water in drought-breaking natural flows in 2012	Maintain	Option unlikely to be exercised under this resource availability	Very Low	Very Low	
										Very Low	
Key - events in previous years <div><div></div> means demand was met, by Commonwealth environmental water or any other source</div> <div><div></div> means demand was partially met, by Commonwealth environmental water or any other source</div> <div><div></div> means water did not contribute to meeting demands.</div> <div>Note that not all demands require water every year, drying phases are important for floodplains and temporary wetlands or streams</div>							Carryover potential	A moderate proportion of available allocations will be carried into 2016-17.	A low to moderate proportion of available allocations may be carried over to 2017-18 but will depend upon forecast resource availability and demands.	Potential carryover will depend upon resource availability and demands	
Key - potential watering in 2015-16 <div><div></div> means a high potential for Commonwealth environmental watering (subject to seasonal and operational considerations)</div> <div><div></div> means a moderate potential for Commonwealth environmental watering, or a partial contribution may be made</div> <div><div></div> means a low potential for Commonwealth environmental watering</div>							Trade potential	If market conditions improve there may be consideration given to the purchase of allocation to assist in meeting demands. Moderate to high demands means allocation sale unlikely.	If market conditions improve there may be consideration given to the purchase of allocation to assist in meeting demands. Moderate demands means allocation sale unlikely.	Potential to trade will be depend on environmental demands and resource availability.	
Key - urgency of environmental demands <div><div></div> means critical demand i.e. urgent need for water in that particular year to manage risk of irretrievable loss or damage</div> <div><div></div> means high demand for water i.e. needed in that particular year</div>											

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

Environmental assets	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)			2015-16			Implications for future demands		
						Predominant urgency of environmental demand for water	Purpose under moderate resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2016-17 if watering occurred as planned in 2015-16	2017-18 Range of likely demand	Met in 2016-17
	Flow/volume	Required frequency (maximum dry interval)	2012-13 (wet)	2013-14 (drying)	2014-15 (drying)						Not met in 2016-17
Great Cumbung Swamp (Clear Lake, Lignum Lake, Reed beds)	Small fresh event (17-18GL @ Booligal Weir)	5 in 10 years (unknown)				High – a fresh event has not occurred since large-scale watering of 2013, other than very small (<6GL) return flows	Protect	Water separately at this scale only if medium inundation event doesn't proceed	High	Moderate	
										High	
	Medium scale event (50-60GL @ Booligal Weir)	3 in 10 years (unknown)				Moderate – a fresh event has not occurred since large-scale watering of 2013, other than very small (<6GL) return flows	Maintain	A high potential for watering in 2015-16	Low	Very Low	
										Low	
	Large inundation event (~100-125GL @ Booligal Weir)	2 in 10 years (unknown)				Moderate – an event of this scale has not occurred since the 2012 flooding	Improve	Option unlikely to be exercised under this resource availability	Moderate	Very Low	
										Moderate	
Lachlan Swamp (Lake Waljeers, Ryans Lake, Lake Bullogal, Peppermint Swamp, Lake Ita and Baconian Swamp)	Small fresh event (17-18GL @ Booligal Weir)	5 in 10 years (unknown)				Moderate – a small-scale fresh event has not occurred since large-scale watering of 2013	Maintain	Water separately at this scale only if large inundation event doesn't proceed	Moderate	Low	
										High	
	Medium scale event (50-60GL @ Booligal Weir)	3 in 10 years (unknown)				Moderate – a fresh event has not occurred since large-scale watering of 2013	Maintain	A high potential for watering in 2015-16	Low	Very Low	
										Low	
	Large inundation event (~100-125GL @ Booligal Weir)	2 in 10 years (unknown)				Moderate – an event of this scale has not occurred since the 2012 flooding	Improve	Option unlikely to be exercised under this resource availability	Moderate	Very Low	
										Moderate	
Booligal Wetlands (incl. Muggabah and Merrimajeel Cks, Moon Moon, Upper Gum, Lower Gum, Booligal and Murrumbidgee Swamps, Lake Merrimajeel, etc)	Small fresh event (7-8GL @ Booligal Weir)	7 in 10 years (unknown)				Mod-High – a small flow of this nature is required in most years.	Protect	Water separately at this scale only if large inundation event doesn't proceed	Mod-High	Moderate	
										High	
	Medium scale event (50-60GL @ Booligal Weir)	3 in 10 years (unknown)				Moderate – a fresh event has not occurred since large-scale watering of 2013	Maintain	A high potential for watering in 2015-16	Low	Very Low	
										Low	
	Large inundation event (~100-125GL @ Booligal Weir)	2 in 10 years (unknown)				Moderate – an event of this scale has not occurred since the 2012 flooding	Improve	Option unlikely to be exercised under this resource availability	Moderate	Very Low	
										Moderate	
Merrowie Creek (incl. Cuba Dam, Lake Tarwong, Chillichil Swamp, etc)	Small fresh event (7-8GL @ Gonowlia Weir)	3 in 10 years (unknown)				Low – last watered in 2011-12, ahead of drought-breaking inflows in 2012.	Maintain	A high potential for watering in 2015-16	Low	Very Low	
										Low	
	Medium fresh event (13-15GL @ Gonowlia Weir)	2 in 10 years (unknown)				Low – last watered in 2011-12, ahead of drought-breaking natural flows in 2012.	Maintain	A moderate potential for watering should sufficient volume be available	Low	Very Low	
										Low	

In-channel fish recruitment flows	Protect tributary inflows (natural trigger), between 5-15GL	Whenever viable opportunities arise				Mod-High – natural inflows from tributaries should be protected where possible to provide a natural trigger for fish migration, spawning and recruitment	Maintain	A high potential for watering in 2015-16	Mod-High	Mod-High
										High
Maintain inundation of key native fish or waterbird habitat following unregulated events at key times	Volumes and flow rates TBD based on specific event conditions	Whenever viable opportunities arise				Low – where opportunities and sufficient water account balance allows	Maintain	An appropriate use of water in 2015-16 should sufficient opportunities arise	Low	Low
										Low
Willandra Creek	Small fresh event (7-8GL @ Homestead Weir)	1-2 in 10 years				Very Low – last received water in drought-breaking natural flows in 2012	Maintain	Option unlikely to be exercised under this resource availability	Very Low	Very Low
										Very Low

Key - events in previous years

means demand was met , by Commonwealth environmental water or any other source
 means demand was partially met, by Commonwealth environmental water or any other source
 means water did not contribute to meeting demands.

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

Key - potential watering in 2015-16

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

Key - urgency of environmental demands

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

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

Carryover potential	A moderate proportion of available allocations will be carried into 2016–17.	A low to moderate proportion of available allocations may be carried over to 2017–18 but will depend upon forecast resource availability and demands.	Potential carryover will depend upon resource availability and demands
Trade potential	If market conditions improve there may be consideration given to the purchase of allocation to assist in meeting demands. High demands means allocation sale unlikely.	If market conditions improve there may be consideration given to the purchase of allocation to assist in meeting demands. Potential for low demands means allocation sale possible however, unlikely given number of moderate demands expected.	Potential to trade will be depend on environmental demands and resource availability.

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

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system)		Watering history (from all sources of water)			2015-16			Implications for future demands		
	Flow/volume	Required frequency (maximum dry interval)	2012-13	2013-14	2014-15	Predominant urgency of environmental demand for water	Purpose under high to very high resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2016-17 if watering occurred as planned in 2015-16	2017-18 Range of likely demand	Met in 2016-17
			(wet)	(drying)	(drying)						
Great Cumbung Swamp (Clear Lake, Lignum Lake, Reed beds)	Small fresh event (17-18GL @ Booligal Weir)	5 in 10 years (unknown)				High – a fresh event has not occurred since large-scale watering of 2013, other than very small (<6GL) return flows	Protect	Water separately at this scale only if large inundation event doesn't proceed	High	Moderate	
										High	
	Medium scale event (50-60GL @ Booligal Weir)	3 in 10 years (unknown)				Moderate – a fresh event has not occurred since large-scale watering of 2013, other than very small (<6GL) return flows	Improve	Water separately only if large inundation event doesn't proceed	Moderate	Low	
										Moderate	
	Large inundation event (~100-125GL @ Booligal Weir)	2 in 10 years (unknown)				Moderate – an event of this scale has not occurred since the 2012 flooding	Improve	A high potential for watering in 2015-16	Very Low	Very Low	
										Very Low	
Lachlan Swamp (Lake Waljeers, Ryans Lake, Lake Bullogal, Peppermint Swamp, Lake Ita and Baconian Swamp)	Small fresh event (17-18GL @ Booligal Weir)	5 in 10 years (unknown)				Moderate – a small-scale fresh event has not occurred since large-scale watering of 2013	Maintain	Water separately at this scale only if large inundation event doesn't proceed	Moderate	Moderate	
										High	
	Medium scale event (50-60GL @ Booligal Weir)	3 in 10 years (unknown)				Moderate – a fresh event has not occurred since large-scale watering of 2013	Improve	Water separately only if large inundation event doesn't proceed	Moderate	Low	
										Moderate	
	Large inundation event (~100-125GL @ Booligal Weir)	2 in 10 years (unknown)				Moderate – an event of this scale has not occurred since the 2012 flooding	Improve	A high potential for watering in 2015-16	Very Low	Very Low	
										Very Low	
Booligal Wetlands (incl. Muggabah and Merrimajeel Cks, Moon Moon, Upper Gum, Lower Gum, Booligal and Murrumbidgee Swamps, Lake Merrimajeel)	Small fresh event (7-8GL @ Booligal Weir)	7 in 10 years (unknown)				Mod-High – a small flow of this nature is required in most years.	Maintain	Water separately only if large inundation event doesn't proceed	Mod-High	Moderate	
										High	
	Medium scale event (50-60GL @ Booligal Weir)	3 in 10 years (unknown)				Moderate – a fresh event has not occurred since large-scale watering of 2013	Improve	Water separately only if large inundation event doesn't proceed	Moderate	Low	
										Moderate	
	Large inundation event (~100-125GL @ Booligal Weir)	2 in 10 years (unknown)				Moderate – an event of this scale has not occurred since the 2012 flooding	Improve	A high potential for watering in 2015-16	Very Low	Very Low	
										Very Low	
Merrowie Creek (incl. Cuba Dam, Lake Tarwong, Chillichil Swamp)	Small fresh event (7-8GL @ Gonowlia Weir)	3 in 10 years (unknown)				Low – last watered in 2011-12, ahead of drought-breaking inflows in 2012.	Maintain	Water separately only if large inundation event doesn't proceed	Low	Very Low	
										Low	
	Medium fresh event (13-15GL @ Gonowlia Weir)	2 in 10 years (unknown)				Low – last watered in 2011-12, ahead of drought-breaking natural flows in 2012.	Improve	A high potential for watering in 2015-16	Very Low	Very Low	
										Very Low	
In-channel fish recruitment flows	Protect tributary inflows (natural trigger), between 5-15GL	In most years				Mod-High – natural inflows from tributaries should be protected where possible to provide a natural trigger for fish migration, spawning and recruitment	Improve	A high potential for watering in 2015-16	Mod-High	Mod-High	
										High	
Maintain inundation of key native fish or waterbird habitat following unregulated events at key times	Volumes and flow rates TBD based on specific event conditions	Whenever viable opportunities arise				Low – where opportunities and sufficient water account balance allows	Improve	An appropriate use of water in 2015-16 should sufficient opportunities arise	Low	Low	
										Low	

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system)		Watering history (from all sources of water)			Predominant urgency of environmental demand for water	2015-16 Purpose under high to very high resource availability	Potential Commonwealth environmental water contribution?	Implications for future demands		
	Flow/volume	Required frequency (maximum dry interval)	2012–13	2013–14	2014–15				Likely urgency of demand in 2016–17 if watering occurred as planned in 2015-16	2017–18 Range of likely demand	Met in 2016–17
			(wet)	(drying)	(drying)						Not met in 2016–17
Willandra Creek	Small fresh event (7-8GL @ Homestead Weir)	1-2 in 10 years				Very Low – last received water in drought-breaking natural flows in 2012	Maintain	Likely to be watered in conjunction with lower Lachlan watering	Very Low	Very Low	
			Very Low								
Key - events in previous years <div><div></div> means demand was met, by Commonwealth environmental water or any other source <div></div> means demand was partially met, by Commonwealth environmental water or any other source <div></div> means water did not contribute to meeting demands.</div> <p>Note that not all demands require water every year, drying phases are important for floodplains and temporary wetlands or streams</p>							Carryover potential	A high to moderate proportion of available allocations will be carried into 2016–17.	A low to moderate proportion of available allocations may be carried over to 2017–18 but will depend upon forecast resource availability and demands.	Potential carryover will depend upon resource availability and demands	
Key - potential watering in 2015-16 <div><div></div> means a high potential for Commonwealth environmental watering (subject to seasonal and operational considerations) <div></div> means a moderate potential for Commonwealth environmental watering, or a partial contribution may be made <div></div> means a low potential for Commonwealth environmental watering</div>							Trade potential	If market conditions improve there may be consideration given to the purchase of allocation to assist in meeting demands Moderate demands means allocation sale unlikely.	If market conditions improve there may be consideration given to the purchase of allocation to assist in meeting demands. Potential for low demands means allocation sale possible.	Potential to trade will be depend on environmental demands and resource availability.	
Key - urgency of environmental demands <div><div></div> means critical demand i.e. urgent need for water in that particular year to manage risk of irretrievable loss or damage</div>											

Information for Tables 2a, 2b and 2c sourced from MDBA (2012a), MDBA (2012b), MDBA (2012c), BWR (2011) and Roberts and Marston (2011)

Part II: Commonwealth environmental water portfolio management planning

2. Background

2.1. Commonwealth environmental water

The Commonwealth Environmental Water Holder is an independent statutory position established by the *Water Act 2007* (the *Water Act*) to manage the Commonwealth environmental water holdings. The Commonwealth Environmental Water Holder leads and is supported by the Commonwealth Environmental Water Office, 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 Lachlan Catchment

Flows in the Lachlan River Valley are driven by rainfall in the upper catchment which are regulated by Wyangala Dam and three main tributary river systems; the Boorowa, Belubula and Mandagery rivers. Delivering water in the Lachlan River Valley is complex as it is a very long system with many meandering anabranches and distributary creeks that terminate in wetlands. Flow attenuation in the system is high due to the low gradient of the system and it can take 90 days for a flow event from Wyangala Dam to reach the end of the river system at Great Cumbung Swamp (BWR 2011). This creates a challenge for water managers when trying to deliver environmental water. Not all environmental water is sourced from dam releases – natural tributary inflows can be accounted for as environmental water and allowed to reach assets by bypassing regulating structures

Water supplies in the Lachlan River are regulated by Wyangala Dam (1220 GL), Lake Cargelligo (36 GL) and Lake Brewster (154 GL) (MDBA 2012b). Lake Cargelligo and Brewster are lower in the valley than Wyangala and can reduce the travel times for water delivery to the lower reaches of the Lachlan River Valley, making delivery more efficient.

Environmental water delivery within the valley occurs in two main ways. During in-channel river flows, Commonwealth environmental water is gravity-fed or regulated using infrastructure into anabranches, creeks and wetlands. During high river flows water passes overbank into floodplain and wetland sites. Where possible, environmental water will be managed to benefit multiple sites en route to maximise the efficiency and effectiveness of water delivery.

The Water Sharing Plan for the Lachlan Regulated River Water Source (2004) provides for planned environmental water and stock and domestic (replenishment flows) releases. These releases offer opportunities to 'piggy back' Commonwealth environmental water onto these river flows and increase the potential for environmental objectives to be achieved and assist with delivery efficiency.

Figure 2 shows a map of the Lower Lachlan River catchment. The map includes the towns of Hillston and Booligal, and the water storages and weirs downstream of Lake Cargelligo. The major distributaries of the Lachlan are also shown, including Willandra Creek, Moolbong creek, Middle Creek, Merrowie Creek, Merrimajeel Creek, and Muggabah creek. The map includes the location of several key environmental assets including the Great Cumbung Swamp, Lower Lachlan Swamps and Booligal wetlands.

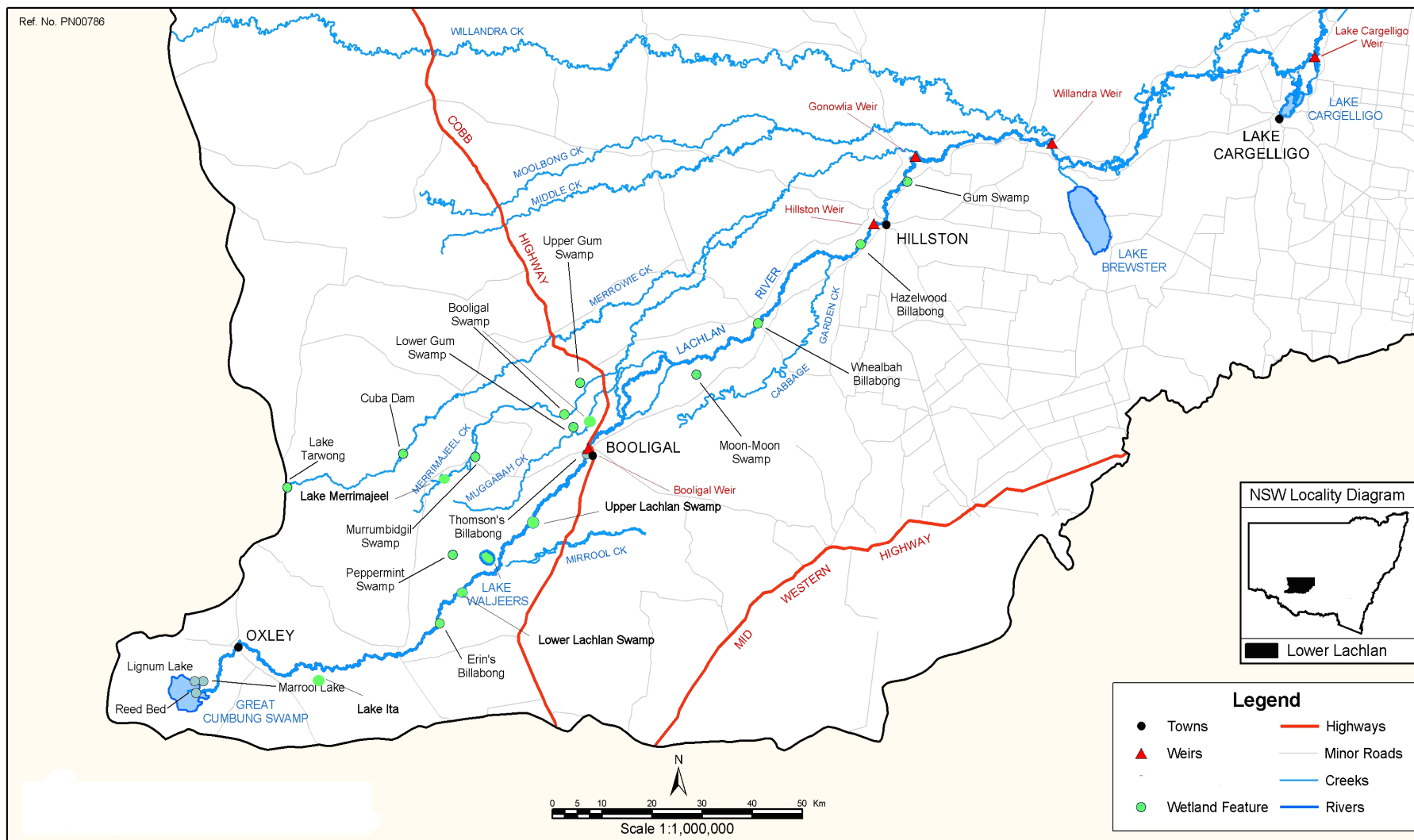


Figure 2: Map of the Lachlan Catchment BWR (2011)

3. Long-term environmental water demands in the Lachlan catchment

3.1. Basin-wide environmental watering strategy

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

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

Vegetation: Maintain extent and improve the condition

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

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

3.2. Long-term watering plans

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

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

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

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

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

Key documentation includes:

- The Lachlan Monitoring and Evaluation Plan, developed under the Commonwealth Environmental Water Office's Long-Term Intervention Monitoring Project (Commonwealth of Australia 2014)
- The assessment of environmental water requirements for the proposed Basin Plan (MDBA 2012 a-c)
- Environmental Water Delivery: Lachlan River, developed for the Commonwealth Environmental Water Office by Barma Water Resources (2011)

- Water regime for wetland and floodplain plants: a source book for the Murray–Darling Basin by Roberts and Marston (2011)

The below section represents the Commonwealth Environmental Water 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 Lachlan Catchment

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

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

BASIN-WIDE OUTCOMES (Outcomes in red link to the Basin-wide Environmental Watering Strategy)	EXPECTED OUTCOMES FOR LACHLAN ASSETS					
	IN-CHANNEL ASSETS	OFF-CHANNEL ASSETS				
	Lachlan River	Booligal wetlands	Great Cumbung Swamp	Lachlan Swamp	Merrowie Creek	Willandra Creek
VEGETATION	<ul style="list-style-type: none">Maintain riparian, floodplain and in-channel vegetation conditionImprove the recruitment of trees within blackbox and river red gum communitiesIncreased periods of growth for non-woody vegetation communities that closely fringe or occur within the river and creek channels	<ul style="list-style-type: none">Improve the condition of black box, river red gum and lignum shrublandsIncrease periods of growth for non-woody vegetation communities, including common reed (Phragmites) and cumbungi (Typha spp)Maintain condition and extent of floodplain and wetland-stream and riparian vegetation				
WATERBIRDS		<ul style="list-style-type: none">Provide habitat and food sources to support survival and maintain the condition of waterbirdsSupport naturally triggered colonial bird breeding events that are in danger of failing due to dryingMaintain or increase waterbird populations and landscape diversity of waterbirds¹				
FISH	<ul style="list-style-type: none">Protect natural flow events that support habitat and food sources and provide natural cues to promote movement, reproduction, and larval dispersal of native fish	<ul style="list-style-type: none">No loss of native speciesImproved population structure of key species through regular recruitment, including<ul style="list-style-type: none">short-lived species with distribution and abundance at pre-2007 levels and breeding success every 1-2 yearsmoderate to long-lived species with a spread of age classes and annual recruitment in at least 80 per cent of yearsProvide flow cues to support habitat and food sources and promote increased movement, recruitment and survival of native fish (particularly for floodplain specialists)				
MACROINVERTEBRATES	<ul style="list-style-type: none">Provide habitat to support survival and maintain condition of macroinvertebrates					
OTHER VERTEBRATES	<ul style="list-style-type: none">Contribute to restoration/protection of frog diversity and populations through provision of habitat to support breeding and recruitment. Provide refuge habitat for frogs, turtles and other vertebrates					
CONNECTIVITY	<ul style="list-style-type: none">Contribute to the maintenance of baseflows.Support latitudinal connectivity (within constraints) between the river channel and wetlands and floodplains, by contributing an increase in the frequency of in the frequency of freshes, bankfull and lowland floodplain flows.					
PROCESSES	Support primary productivity, nutrient and carbon cycling, biotic dispersal and movement					
WATER QUALITY	Provide refuge habitat from adverse water quality events (e.g. blackwater)	Provide drought refuge habitat				
RESILIENCE	Contribute to the maintenance or improvement of aquatic habitat to support the recruitment, growth and survival of native species					

Information sourced from: MDBA 2012 (a - c), MDBA 2014a, UC 2015 and BWR 2011

3.4. Flows in scope for Commonwealth environmental watering

Not all environmental demands can and will be met through the use of held environmental water. Some demands are met by regulated water deliveries for consumptive purposes, 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 Commonwealth Environmental Water Office to focus on contributing to in the Lachlan Catchment. Importantly, these are broad, indicative demands and individual watering events may contribute to particular opportunities, such as using infrastructure to deliver water to individual wetlands that would otherwise not be possible due to constraints. Also, there may be opportunities for Basin State governments to remove or modify constraints, which will improve the efficiency and/or effectiveness of environmental watering.

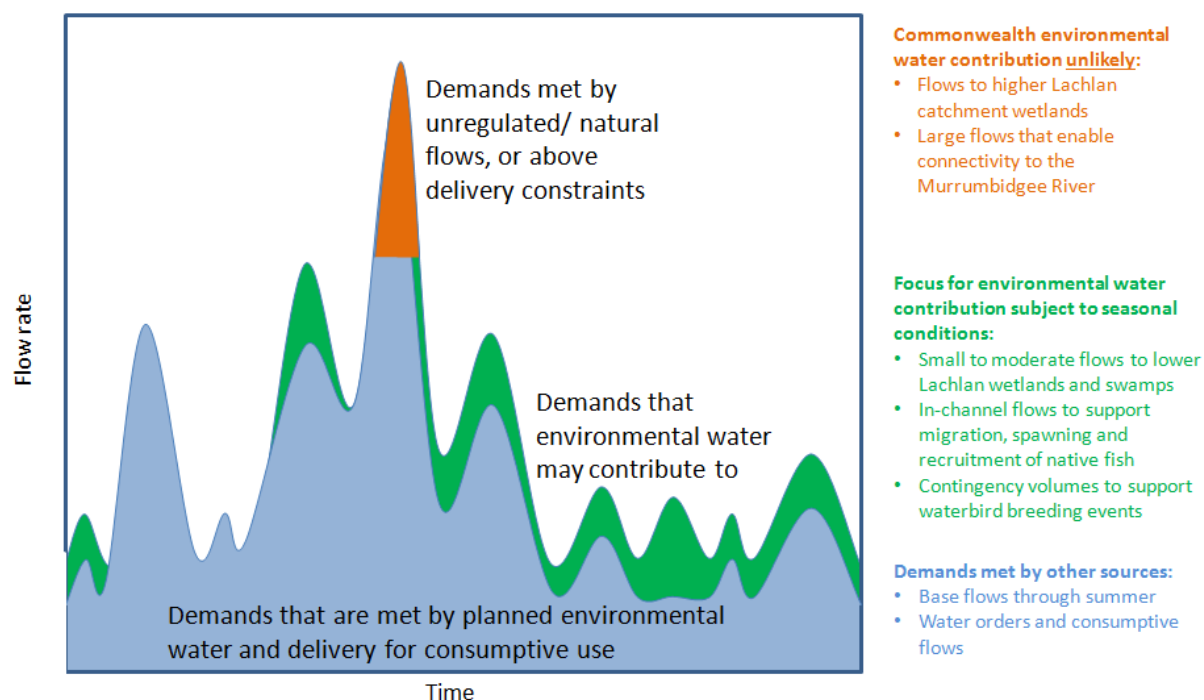


Figure 3: Scope of demands that environmental water may contribute to in the Lachlan.

The delivery of environmental water in the Lachlan River catchment is currently constrained by the release capacities from storages, channel capacities, low lying floodplain areas and effluent creek systems. Watering options will be developed in consideration of the following constraints:

Table 4: Channel capacities (BWR 2011)

Asset	Channel Capacity
Brewster weir	Release capacity – a maximum of 3 000 ML/day
Lake Ita	Commence to flow at 600 ML/day at Corrong
Lake Waljeers	Overbank flows commence at 800-1 200 ML/day at Booligal
Merrowie Creek	Commence to flow of 1 500 ML/day if no boards and Gonowlia Weir is open
Willandra Creek	Regulator is overtopped by flows of 2 400 ML/day
Risks to private infrastructure	Delivering flows exceeding approximately 2 800 ML/day at Hillston could require some private irrigation pumping infrastructure to be temporarily relocated to avoid inundation.

Operational considerations such as delivery methods, opportunities, constraints and risks will differ depending on the inflow scenario and are summarised in **Table 5**. These considerations will be assessed throughout the year as decisions to make water available for use are made and implemented. This includes refining the ecological objectives, assessing operational feasibility and potential risks, and the ongoing monitoring of the seasonal outlook and river conditions.

Under very low and low inflow scenarios, river operations may be adjusted to minimise system losses. This may provide an opportunity to use environmental water along with deliveries of consumptive water to achieve multiple outcomes. However, it is possible that river management under these conditions may compromise the feasibility or viability of some watering actions. Under these circumstances, it will be important to work closely with delivery partners to maximise the environmental benefit from the watering actions undertaken.

Favourable conditions have resulted in vegetation growth in some effluent creeks. While these creeks are assets in themselves, they are also integral to the delivery of water to key wetland assets. In-channel vegetation growth can impede water flows into these assets.

Environmental water may be made available, for some watering options, from NSW Office of Environment and Heritage (NSW OEH) as High or General security holdings, adaptive environmental water, or planned environmental water allowances. In these circumstances all sources of environmental water will be coordinated between NSW OEH and the Commonwealth Environmental Water Office to maximise the environmental benefit.

Table 5: Current opportunities and constraints on environmental watering for the Lachlan

Inflow scenario	Very low	Low	Moderate	High	Very high
Opportunities					
Manage the recession of naturally occurring high flows to provide for a more natural flow pattern.					
Use environmental water in conjunction with, or to maximise the environmental benefit of, naturally occurring tributary and/or river flows.					
Use environmental water to maintain base flows and provide freshes to support ecological improvements and refuge sites in effluent creek systems.					
Use environmental water to support bird breeding events and aquatic species propagation/breeding requirements					
Use environmental water to complement river operations (e.g. bulk transfers between storages or replenishment flows) to achieve improved environmental outcomes in the mid-Lachlan and effluent creek systems.					
Constraints					
River operations under very dry and dry conditions may limit options for use of available environmental water.					
Delivery options are limited due to high unregulated flows resulting in reduced channel capacity, limiting the operation of river infrastructure and inhibiting additional releases from storages.					
Flow thresholds for existing river infrastructure may constrain the delivery of environmental water.					
Risks*					
The provision of Commonwealth environmental water must consider potential inundation impacts to property and infrastructure.					
Potential impacts on private infrastructure requiring relocation of pumps etc					

Constraints as they relate to specific watering actions are described in the standard operating considerations listed in section 2.8 below.

Based on the above outcomes sought and delivery constraints, Table 6 identifies flows that are in scope for Commonwealth environmental watering. Some specific watering requirements (flow magnitude, duration, timing and frequency) have also been listed, drawn from existing resources. The watering requirements for the Lachlan Catchment will be developed in full by

the state government as part of their long-term watering plan and will be reflected in future planning documents by the Commonwealth Environmental Water Office.

Table 6: Long-term indicative elements of a flow regime in scope for Commonwealth environmental watering in the Lachlan

Asset/Function	Indicative long-term demand	
	Flow/volume	Required frequency (maximum dry interval)
Great Cumbung Swamp	Small fresh event (17-18GL @ Booligal Weir)	5 in 10 years (unknown)
	Medium scale event (50-60GL @ Booligal Weir)	3 in 10 years (unknown)
	Large inundation event (~100-125GL @ Booligal Weir)	2 in 10 years (unknown)
Lachlan swamps	Small fresh event (17-18GL @ Booligal Weir)	5 in 10 years (unknown)
	Medium scale event (50-60GL @ Booligal Weir)	3 in 10 years (unknown)
	Large inundation event (~100-125GL @ Booligal Weir)	2 in 10 years (unknown)
Booligal wetlands	Small fresh event (7-8GL @ Booligal Weir)	7 in 10 years (unknown)
	Medium scale event (50-60GL @ Booligal Weir)	3 in 10 years (unknown)
	Large inundation event (~100-125GL @ Booligal Weir)	2 in 10 years (unknown)
Merrowie Creek	Small fresh event (7-8GL @ Gonowlia Weir)	3 in 10 years (unknown)
	Medium fresh event (13-15GL @ Gonowlia Weir)	2 in 10 years (unknown)
Willandra Creek	Small fresh event (7-8GL @ Homestead Weir)	1-2 in 10 years (unknown)
Lachlan River (in-channel)	Protect tributary inflows (natural trigger), between 5-15GL per year	Most years
Maintain inundation of key native fish or waterbird habitat following events at key times	Volumes and flow rates to be determined based on specific event conditions	As required

Information sourced from MDBA (2012a-c) and BWR (2011)

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

Under certain levels of water resource availability, watering actions may not be pursued for a variety of reasons, including that environmental demand may be met by unregulated flows and that constraints and/or risks may limit the availability to deliver environmental water. Table 7 identifies the range of potential watering actions in the Lachlan Catchment and the levels of water resource availability that relate to these actions.

Table 7: Summary of potential watering actions for the Lachlan

Asset	Indicative flow/volume requirement	Applicable level(s) of resource availability				
		Very Low	Low	Moderate	High	Very High
Great Cumbung Swamp	<ul style="list-style-type: none">• Small fresh (17-18 GL inflow at Booligal Weir)• Medium fresh (50-60 GL inflow)• Large event (~100-125 GL inflow)	Reconnecting event: Contribute to flows to re-connect the river with low-lying wetlands				
			Reconnecting event: Contribute to flows to re-fill low-lying wetlands			
				Wetland inundation: Contribute to flows to inundate wetlands in the Lachlan Swamp and Great Cumbung Swamp systems		
Lachlan Swamps	<ul style="list-style-type: none">• Small fresh (17-18 GL inflow at Booligal Weir)• Medium fresh (50-60 GL inflow)• Large event (~100-125 GL inflow)	Reconnecting event: Contribute to flows to re-connect the river with low-lying wetlands				
			Reconnecting event: Contribute to flows to re-fill low-lying wetlands			
				Wetland inundation: Contribute to flows to inundate wetlands in the Lachlan Swamp and Great Cumbung Swamp systems		
Booligal Wetlands	<ul style="list-style-type: none">• Small fresh (7-8 GL inflow at Booligal Weir)• Medium fresh (50-60 GL inflow)• Large event (~100-125 GL inflow)	Reconnecting event: Contribute to flows re-connect the river with low-lying wetlands				
			Reconnecting event: Contribute to flows to re-fill low-lying wetlands			
				Wetland inundation: Contribute to flows to inundate wetlands in the Booligal Wetlands system		
Merrowie Creek	<ul style="list-style-type: none">• Small fresh (7-8 GL inflow at Gonowlia Weir)• Medium fresh (13-15 GL inflow)	Reconnecting event: Contribute to flows re-connect the river with low-lying wetlands				
				Reconnecting event: Contribute to flows to re-fill low-lying wetlands		
Willandra Creek	<ul style="list-style-type: none">• Small fresh (7-8 GL inflow at Homestead Weir)				Inundation event: Water through Weir spill from large event targeted at downstream wetlands	
Lachlan River channel	<ul style="list-style-type: none">• Protect tributary inflows (protect tributary inflows between 5 and 15 GL)	Natural cues for fish: Protect inflows to upstream tributaries from extraction to provide natural nutrient, chemical and temperature cues for supporting fish spawning.				
Maintain inundation of key native fish or waterbird habitat	Extend inundation. Volumes and flow rates to be determined based on conditions				Prolong inundation: Contribute water to extend inundation of key native fish or waterbird habitat following events at key times	

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 to deliver environmental water.

3.6. Potential watering actions – standard operational considerations

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

1. Great Cumbung Swamp

Watering action: Provide hydrological connectivity to reconnect and refill low-lying wetlands.

Standard operational considerations: To ensure flow predominantly in-channel in order to meet targets in the lower Lachlan, see table 4 for channel capacity of distributaries.

Typical extent: This watering action could contribute flows required to inundate the Great Cumbung Swamp supplied from Lake Brewster if available, or Wyangala dam. Water would be directed to the Great Cumbung Swamp by operation of Booligal Weir.

2. Lower Lachlan swamps

Watering action: Provide hydrological connectivity to reconnect and refill low-lying wetlands.

Standard operational considerations: The Lower Lachlan swamps can be watered separately to the Great Cumbung Swamp, but in practical terms they are generally watered in the same watering action.

Typical extent: This watering action could contribute flows required to inundate the Booligal Wetlands, Lower Lachlan Swamp and Great Cumbung Swamp supplied from Lake Brewster. Water would be directed to Booligal Wetlands by operation of Booligal Weir.

3. Booligal wetlands

Watering action: Provide hydrological connectivity to reconnect and refill low-lying wetlands

Standard operational considerations: See channel capacities (Table 4).

Typical extent: This watering action could contribute flows required to inundate the Merrowie Creek system supplied from Lake Brewster, directed by operation of Gonowlia Weir.

4. Merrowie Creek system fresh event

Watering action: Provide hydrological connectivity to reconnect and refill low-lying wetlands

Standard operational considerations: See channel capacities (Table 4).

Typical extent: This watering action could contribute flows required to inundate the Merrowie Creek system supplied from Lake Brewster, directed by operation of Gonowlia Weir.

5. Willandra Creek

Watering action: Provide hydrological connectivity to reconnect and refill low-lying wetlands

Standard operational considerations: See channel capacities (Table 4).

Typical extent: This watering action could contribute flows required to inundate Morrisons Lake

6. Lachlan River - native fish flow

Watering action: Protecting natural tributary inflows from regulation to deliver natural flow variability and allowed to flow the length of the Lachlan River system in order to protect the integrity of natural chemical signatures that provide cues for native fish migration and spawning.

Standard operational considerations: Target volumes and flow rates will be dependent on the characteristics of inflow events in the upper tributaries, prevailing flow conditions and operational considerations.

Typical extent: Lachlan River (channel only) below Wyangala to Great Cumbung Swamp, supplied from upper tributary creeks.

7. Contingency for breeding events

Watering action: Maintain wetland water levels and acceptable levels of water quality to support the completion of a significant breeding event of waterbirds or other native aquatic vertebrates in a wetland. Adequate water account balance is required in order to undertake this action.

Standard operational considerations: This contingency is not to trigger a breeding event for waterbirds or other native animals but for use when a breeding event is already underway and considered in danger of failure due to receding water levels.

Typical extent: Booligal wetlands, Merrowie Creek, Lachlan Swamp, and Great Cumbung Swamp.

4. Long-term water availability

4.1. Commonwealth environmental water holdings

The Commonwealth holds the following entitlements in the Lachlan Catchment:

- High Security
- General Security

Total annual allocations for General Security (the dominant entitlement type held by the Commonwealth in the Lachlan catchment) vary significantly across years depending on conditions. This variability is an important factor considered by the Commonwealth Environmental Water Office in portfolio management planning in the Lachlan catchment.

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 Lachlan Catchment include:

- Riverbank water (New South Wales Office of Environment and Heritage)

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 rules in state water plans (referred to as 'planned environmental water').

- Environmental Water Allowance (New South Wales Office of Environment and Heritage)
- Water Quality Allowance (New South Wales Office of Environment and Heritage)
- Translucent flows (New South Wales Office of Environment and Heritage)

5. Water use strategy

5.1. Water use scenarios based on demand and supply

On an annual basis, demands (Section 3) can be considered together with supply (Section 4) so that the Commonwealth Environmental Water Office can determine the best environmental water use overall. An example of how the Commonwealth Environmental Water Office might respond to key demand and supply scenarios, with consideration of situations where condition is not the predominant driver, is as follows:

Water use scenarios in the Lachlan catchment

1. Extended wet conditions

High Water Resource Availability - large managed wetland watering action

- Primary Purpose – Augment inundation extent in order to improve vegetation condition and habitat.
- Previous year condition not an influencing factor.
- Target location – Lower Lachlan Swamps, Great Cumbung Swamp, and associated large deflation basins. (Booligal Wetlands also likely at least in part).
- Event has not been undertaken to date.

2. Moderate Water Resource Availability - Distributary/wetland maintenance flow action

Extended dry/Moderate to average/Transitioning wet to dry conditions

- Previous year Moderate-Dry inflows.
- Primary Purpose – Maintain resilience of vegetation communities in key wetlands and distributaries.
- Target location – Lower Lachlan Swamps, Booligal Wetlands, major distributaries such as Merrowie and Willandra Creeks.
- Antecedent Condition – No unregulated inflow/flood event in current or previous year. Commence alternating strategy with the wetland complex/distributary considered most in need.
- Precedent – 2011-12 watering events.

3. Most years - regular in-channel event for tributary connectivity/instream outcomes

Extended dry/Moderate or average conditions

- Primary Purpose – Maintain and improve in-stream ecology in the mid and lower Lachlan, including native fish.
- Target location – Lachlan River downstream of Boorowa River confluence.
- Precedent – 2014 in-stream watering event.

4. As required – Waterbird breeding contingency

- Primary Purpose – Improve/maintain colonial nesting waterbird populations (recruitment).
- Target location – Booligal Wetlands, Cuba Dam (Merrowie Creek).
- Precedent – Multiple approved contingency actions (implementation only in 2010-11).

5. Consolidating vegetation recruitment

High Water Resource Availability - large managed wetland watering action

- Previous year Wet/Very Wet.
- Primary Purpose – Improve vegetation condition, and manage river red gum recruitment. Follow up watering, the year after a flood event. Consolidate vegetation responses (recruitment) with numerous other benefits. May trigger bird breeding.
- Target location – Lower Lachlan Swamps, Great Cumbung Swamp, and associated large deflation basins. (Booligal Wetlands also likely at least in part).
- Precedent – 89GL action in 2013.

6. As required - Unknown/unforeseen events.

- It is important to set aside some volume, to allow a modelled assessment of the risks/yield to the portfolio.

6. Next steps

6.1. From planning to decision making

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

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

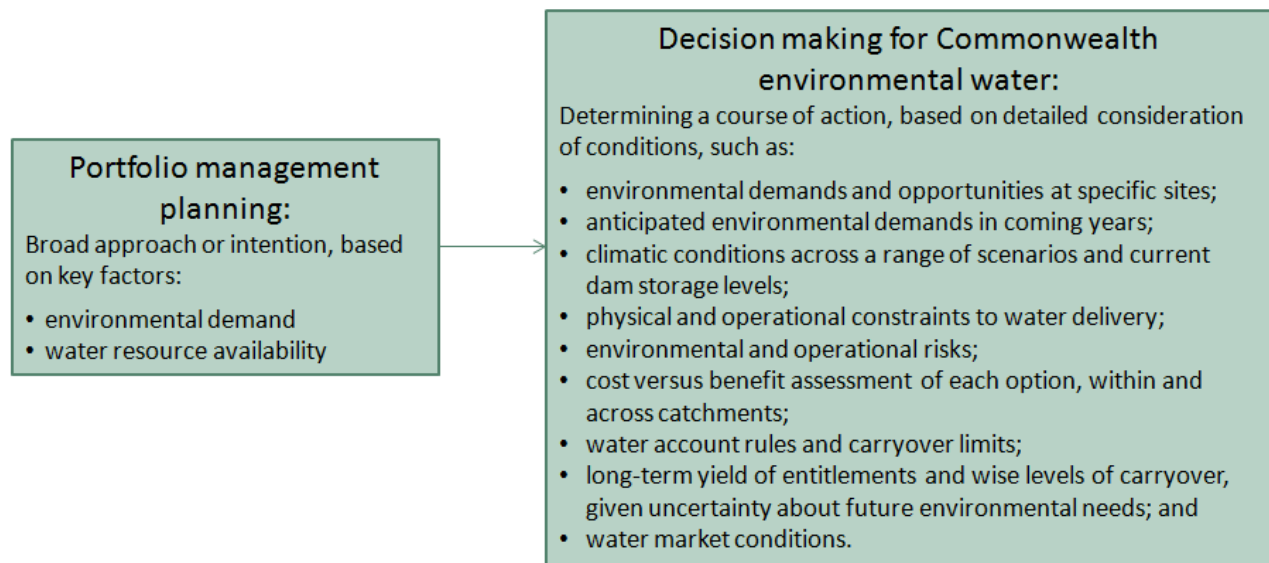


Figure 4: Planning and decision making for Commonwealth environmental water use

6.2. Further information

For further information on how the Commonwealth Environmental Water Office plans for water use, carryover and trade, please visit our web site

www.environment.gov.au/topics/water/commonwealth-environmental-water-office

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

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

Expected outcomes from the Basin-wide Environmental Watering Strategy (MDBA 2014) that are relevant to the Lachlan 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, bankfull and lowland floodplain flows

VEGETATION

Maintain the current extent of water-dependent vegetation near river channels and on low-lying areas of the floodplain.

Improve condition of black box, river red gum and lignum shrublands

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

Increased periods of growth for non-woody vegetation communities that closely fringe or occur within the river and creek channels, and for common reed and cumbungi in the Great Cumbung Swamp.

Vegetation extent

Area of river red gum (ha)	Area of black box (ha)	Area of coolibah (ha)	Shrublands	Non-woody water dependent vegetation
41,300	58,000	N/A	Lignum in the Lower Lachlan	Closely fringing or occurring within the Lachlan River and Willandra Creek; and common reed and Cumbungi in the Great Cumbung Swamp

Black box condition

Vegetation condition score		Percent of vegetation assessed (within the managed floodplain)
0–6	>6–10	
72 per cent	28 per cent	45 per cent

River red gum condition

Vegetation condition score					Percent of vegetation assessed (within the managed floodplain)
0–2	>2–4	>4–6	>6–8	>8–10	
3 per cent	8 per cent	21 per cent	41 per cent	26 per cent	93 per cent

WATERBIRDS

Maintain current species diversity

Increase Basin-wide abundance of waterbirds by 20–25 per cent by 2024

A 30–40 per cent increase in nests and broods (Basin-wide) for other waterbirds

Up to 50 per cent more breeding events (Basin-wide) for colonial nesting waterbird species

Important Basin environmental assets for waterbirds in the Lachlan

Environmental asset	Total abundance and diversity	Drought refuge	Colonial waterbird breeding	Shorebird abundance	In scope for C'th watering
Booligal wetlands	*		*		Yes
Great Cumbung Swamp	*		*		Yes
Lake Brewster	*		*		No
Lake Cowal	*		*		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 Lachlan include:

Species	Specific outcomes	In-scope for C'th watering in the Lachlan?
Flathead galaxias (<i>Galaxias rostratus</i>)	Considered extinct. Reintroduction using southern populations may be an option in the longer term, with the Lachlan a potential candidate site.	Only if re-introduced.
Freshwater catfish (<i>Tandanus tandanus</i>)	-	Yes
Golden Perch (<i>Macquaria ambigua</i>)	A 10–15 per cent increase of mature fish (of legal take size) in key populations	Yes
Macquarie perch (<i>Macquaria australasica</i>)	Range expansion of at least 2 current populations in the Lachlan is a priority. Establish 1–3 additional riverine populations within the Lachlan catchment	Yes
Murray cod (<i>Maccullochella peelii peelii</i>)	A 10–15 per cent increase of mature fish (of legal take size) in key populations	Yes
Olive perchlet (<i>Ambassis agassizii</i>)	Expand the range (or core range) of existing populations	Yes

Species	Specific outcomes	In-scope for C'th watering in the Lachlan?
	in the Lachlan River.	
River blackfish (<i>Gadopsis marmoratus</i>)	-	No
Silver perch (<i>Bidyanus bidyanus</i>)	-	No
Southern purple-spotted gudgeon (<i>Mogurnda adspersa</i>)	Establish/improve core range of populations in the Lachlan.	Only if populations are established
Southern pygmy perch (<i>Nannoperca australis</i>)	Expand the range of the Lachlan populations. Establish 1–3 additional populations in the Lachlan catchment.	Yes
Trout cod (<i>Maccullochella macquariensis</i>)	Establish additional populations in the Lachlan	Only if additional populations are established

Important Basin environmental assets for native fish in the Lachlan

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
Lachlan River – Condobolin to Booligal	*	*	*	*	*	*	Y

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