



Australian Government

Commonwealth Environmental Water Office

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

Border Rivers

2015–16



Front cover image credit: Kwiambal National Park - the junction of the New South Wales Severn River and Macintyre River

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Acknowledgement of the traditional owners of the Murray-Darling Basin

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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. Part II of this document establishes the context for how the Office integrates its management of the Commonwealth environmental water portfolio in the Border Rivers and across the Murray-Darling Basin more broadly. It sets out the environmental demands that Commonwealth environmental water may contribute to in the Border Rivers, 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 Office in:

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

Scope of integrated portfolio management planning

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

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

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

Part 1: Portfolio management planning in the Border Rivers

1. Purpose and portfolio management for 2015–16

1.1. Overall purpose

Demand for environmental water

During the millennium drought, the Border Rivers system experienced many years of restricted flows, providing limited opportunity for many fish species to spawn and recruit. In 2010–11 the Border Rivers catchment experienced very wet conditions, including flooding as a result of significant rainfall, which assisted ecological recovery following a drier than average decade. Moderate conditions occurred in 2011–12 and 2012–13 in the lower Border Rivers. During 2013–14 catchment conditions were drier with rainfall well below average rainfall and higher temperatures (DNRM 2014). In 2013–14 Commonwealth environmental water was delivered in combination with NSW planned environmental water to deliver a stimulus flow for a second successive year.

In 2014–15 conditions were generally dry in the Border Rivers. The outlook for April to June 2015 is for an increased chance of exceeding median temperatures and rainfall (BOM 2015). Conditions have improved to some extent in the Border Rivers with inflow to both Glenlyon and Pindari Dams in Autumn 2015 which will improve water availability in parts of the Border Rivers catchment. The Queensland part of the Border Rivers catchment (Goondiwindi, Southern Downs and Toowoomba local government areas) was drought declared on 1 March 2014 (DNRM 2014). Flows ceased at Mungindi in September 2014 for approximately three months. Rainfall events have enabled short periods of water harvesting during Summer and Autumn 2015.

The NSW Office of Water imposed temporary restrictions on supplementary access for the NSW Border Rivers for periods during Summer and Autumn. These restrictions were put in place to prioritise critical town water supplies along the Darling River and for Broken Hill. This has resulted in increased flows through the Border Rivers to the Barwon-Darling. These flows have contributed to alleviating some of the environmental demand in the Macintyre River in 2014–15.

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

River Channel: Moderate to high demand. There may be a need to support in-stream refuge and improve water quality in the river channel if conditions deteriorate and if these needs are not met by other flows. There is a moderate to high urgency to provide flows to improve habitat availability and longitudinal connectivity in the river channels, particularly in winter, to provide condition benefits and stimulate movement and spawning for some fish species. However, in the absence of sufficient inflows this demand is unlikely to be met therefore increasing the urgency to meet this environmental demand in 2016–17.

Anabranches: Moderate to high demand. Anabranch connection is required to support floodplain vegetation, improve wetland health and ensure exchange of nutrients and carbon with the river channel to support productivity in the system. The anabranches have had limited connection over the past few years and there is an increasing urgency to support anabranch and wetland connection.

Wetlands: Low to high demand. In particular, the wetlands between Goondiwindi and Mungindi require water to support wetland health and resilience, provide exchange of nutrients, carbon and biota and support floodplain vegetation. These areas have a higher urgency for water as they have not been sufficiently inundated for several years. The high demands, dry conditions and low water availability have made it difficult to provide environmental water to these assets.

Supply

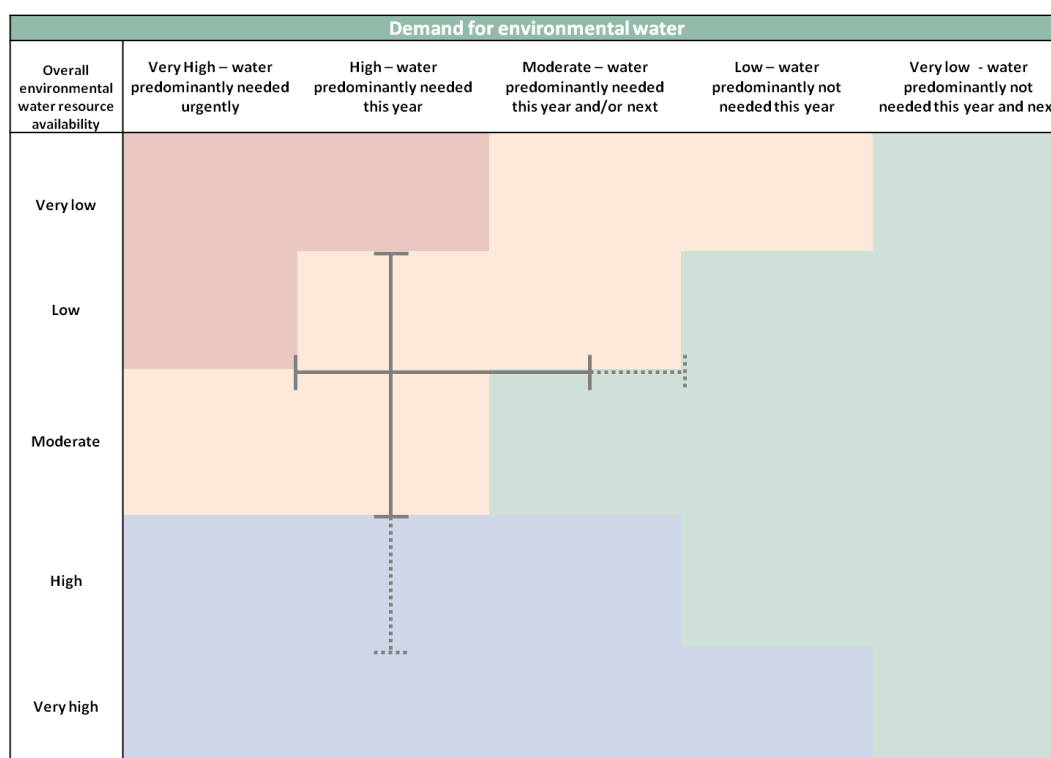
Water resource availability (supply) in the context of meeting environmental demands is made up of allocations against entitlements held for the environment by the Commonwealth Environmental Water Holder as well as natural and unregulated flows, and planned environmental water provisions. Further detail 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 (from low to very high) are in scope for 2015-16 (with high to very high resource availability only possible if conditions become wet).

Resource availability for unregulated entitlements in the Border Rivers is determined by natural or unregulated flows and planned environmental water in the system. Unregulated entitlements cannot be accessed from storages and there are no physical carryover volumes. The magnitude and pattern of individual flow events during the year is the main determinant of water availability and whether ecologically significant flow thresholds are met. Measures of mean or average stream flow do not capture the variability in flows or the hydrologic characteristics of individual flow events and hence are not a strong indicator of likely ecological outcomes. Given the highly variable nature of rainfall experienced across the Murray-Darling Basin, short-term or annual inflows cannot be forecast with precision.

Purpose

Figure 1 shows how these two factors (demand and supply) are considered together. The overall 'purpose' for managing the Commonwealth's water portfolio in the Border Rivers for 2015-16 is to **protect** in-cannel assets in the Macintyre, and where practical, contribute to wetlands and anabranches to ensure ecological capacity for recovery. This may involve infrastructure assisted delivery and/or use of market mechanisms to target environmental water to key refuge habitat within the system. If water availability becomes high, there may be scope to **improve** the health and resilience of aquatic ecosystems in the Border Rivers Valley.



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 Border Rivers 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 Border Rivers 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
River Channel	Water quality and drought contingency	<ul style="list-style-type: none"> Basin-wide native fish habitat and movement Northern Basin fish refuges Silver perch 	Possible. Likely to be met through other sources	Possible. Likely to be met through other sources	No (Likely to be met by other flows)
	Scouring and pre-conditioning flows	<ul style="list-style-type: none"> Basin-wide native fish habitat and movement Northern Basin fish refuges Silver perch 	Possible contribution if it can achieve multiple benefits	Yes	No (Likely to be met by other flows)
	Habitat availability and connectivity	<ul style="list-style-type: none"> Basin-wide flow variability and longitudinal connectivity Basin-wide native fish habitat and movement Northern Basin fish refuges Silver perch 	No (unless there are significant inflows)	Yes	Yes
Anabranches	Infrastructure assisted delivery	<ul style="list-style-type: none"> Basin-wide in-stream and riparian vegetation 	Yes	Yes	Yes
	Anabranch connectivity	<ul style="list-style-type: none"> Basin-wide native fish habitat and movement 	No	Yes	Yes
Wetlands	Wetland connection	<ul style="list-style-type: none"> Basin-wide in-stream and riparian vegetation Basin-wide native fish habitat and movement 	Possible (targeted wetlands only)	Yes	Yes
	Waterbird breeding event contingency	<ul style="list-style-type: none"> Basin-wide waterbird habitat and future population recovery 	No	No	Yes (only if required)

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>

All	Improving natural flow variability	<ul style="list-style-type: none"> • Basin-wide flow variability and longitudinal connectivity • Basin-wide native fish habitat and movement • Northern Basin fish refuges • Silver perch 	Yes	Yes	Yes
	Natural inflows	<ul style="list-style-type: none"> • Basin-wide flow variability and longitudinal connectivity • Basin-wide native fish habitat and movement • Northern Basin fish refuges • Silver perch 	Yes	Yes	Yes

Water quality and drought contingency

Summary: Contribute to flows to refresh drought refuges and mitigate degrading water quality.

Timing: Anytime depending on conditions. Most likely post bulk releases if there are limited natural inflows.

Operational considerations and feasibility:

- Consider if environmental need is not being met by other sources.
- No variations from the standard operational considerations (see action 1 in Part II, Section 3.6).

Scouring and pre-conditioning flows

Summary: Contribute to regulated and unregulated flows to scour algae and reset benthic periphyton (biofilm) processes to stimulate production through all levels of the aquatic food chain; provide migration, spawning, dispersal and recruitment cues to native fish (dependent on timing); and wet and interconnect riparian areas and, improve access to aquatic habitat.

Timing: August to December in the Severn River (NSW).

Operational considerations and feasibility:

- Dependent on whether the NSW stimulus flow will be delivered.
- Commonwealth contribution may depend on whether the water can achieve multiple benefits.
- No variations from the standard operational considerations (see action 2 in Part II, Section 3.6).

Habitat availability and connectivity

Summary: Contribute to flows to increase access to in-stream habitat (benches, large woody debris); assist carbon and nutrient cycling; support movement, spawning and recruitment opportunities of native aquatic species; and provide longitudinal connectivity to Mungindi.

Timing: Winter (July to mid-August – maintenance/conditioning flow) has highest priority. Flows could also be provided in Summer/Autumn (October-March).

Operational considerations and feasibility:

- Targeting flows to Mungindi would only be possible should adequate unregulated flows occur and there is sufficient water to contribute to those flows.

- No variations from the standard operational considerations (see action 3 in Part II, Section 3.6).

Infrastructure assisted delivery

Summary: Use infrastructure and/or private storages to contribute water to wetlands and or anabranches that may have high commence to fill thresholds or where structures or floodplain works prevent wetlands receiving water at lower volumes. This action could provide localised connectivity and persistence of waterholes and terrestrial primary production in individual anabranch systems.

Timing: To be determined.

Operational considerations and feasibility:

- Targeting wetlands or anabranches using private infrastructure would require delivery agreements to be negotiated in order to proceed.
- No variations from the standard operational considerations (see action 4 in Part II, Section 3.6).

Anabranch Connectivity

Summary: Contribute to flows to support connectivity to anabranches to help facilitate the nutrient and carbon exchange and the movement of biota between anabranches, wetlands and the river channel. These flows could also support movement, spawning, recruitment and condition of native fish and other aquatic species.

Timing: Dependent on target species. August to February could support floodplain specialist fish species (e.g. olive perchlet).

Operational considerations and feasibility:

- Targeting anabranch connection may require an increase in water availability and delivery in conjunction with adequate unregulated or other flows.
- No variations from the standard operational considerations (see action 5 in Part II, Section 3.6).

Wetland connection

Summary: Contribute to flows to support lateral and longitudinal connectivity to floodplain wetlands to boost invertebrate production; trigger breeding activity in birds, fish and amphibians and subsequent recruitment and movement of those species; initiate riparian tree regeneration and growth and create areas for aquatic plant colonisation.

Timing: Dependent on target species.

Operational considerations and feasibility:

- Under very low or very low water resource availability only specific wetlands could be targeted. The ability to target flows to achieve larger-scale wetland connection would require an increase in water availability and would rely on supplementing natural events or other flows.
- No variations from the standard operational considerations (see action 6 in Part II, Section 3.6).

Waterbird breeding event contingency

Summary: Maintain wetland water levels or appropriate flow conditions to support completion of a naturally-triggered bird breeding event.

Timing: Dependent on species. Most likely October to May.

Operational considerations and feasibility:

- Only if a naturally-triggered bird breeding event occurs and water is available and can be targeted to breeding sites. Most likely during high or very high water resource availability.

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

Improving natural flow variability

Summary: Contribute to river flow variability (e.g. baseflows, freshes) in the Severn (NSW), Macintyre and Dumaresq Rivers and/or other creeks.

Timing: year-round.

Operational considerations and feasibility:

- No variations from the standard operational considerations (see action 9 in Part II, Section 2.6).

Supporting natural river flows (unregulated)

Summary: This action would contribute unregulated water to support natural river flows to enhance flow variability and the eco-hydrological outcomes of naturally occurring unregulated flow events.

Timing: year-round.

Operational considerations and feasibility:

- No variations from the standard operational considerations (see action 9 in Part II, Section 3.6).

Stakeholder feedback:

Stakeholder feedback has recommended that actions that achieve outcomes with small amounts of water be a priority for 2015-16 in particular working with landholders on infrastructure assisted delivery for target wetlands. Stakeholders have suggested alternative planning methodologies for the use of Commonwealth environmental water in the Border Rivers. While some of these methodologies are used by the Office to help refine operational aspects of watering plans (e.g. triggers for watering), this planning process is intended to set intentions for managing the portfolio of environmental water across multiple assets by identifying the longer-term flow regime to meet environmental demands in the Border Rivers.

Feedback will be sought on an ongoing basis as planning transitions to implementation phase (see Section 1.5).

1.3. Carryover

All regulated allocations available in 2014–15 were carried over to 2015–16. If water resource availability remains low, the environmental demands in the Border Rivers are likely to be high for 2015–16, resulting in a high proportion of available allocation will be used in 2015–16 with a small amount 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 environmental demand.

More information on how the Commonwealth makes decisions on carryover is here [\[http://www.environment.gov.au/water/cewo/portfolio-mgt/carryover\]](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 Border Rivers 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 Border Rivers and across the 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 Border Rivers, 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. 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 Border Rivers catchment– **VERY LOW AND LOW WATER RESOURCE AVAILABILITY IN 2015–16**

Environmental assets	Physical and process assets	Indicative demand (for <u>all sources of water</u> in the system)		Watering history ^{11,12} (from all sources of water)			2015–16			Implications for future demands		
		Flow/volume	Required frequency (maximum dry interval)	2012–13 (moderate)	2013–14 (drying)	2014–15 (dry)	Predominant urgency of environmental demand for water	Purpose under low to very low resource availability	Potential Commonwealth water contribution?	Likely urgency of demand in 2016–17 if watering occurred as planned in 2015–16	2017–18 Range of likely demand	Met in 2016–17 Not met in 2016–17
River channel (Macintyre, Severn (NSW), Dumaresq, Barwon River to Mungindi)	Fish persistence, drought refuge habitat, water quality and connectivity	Base flow and flow variability and connectivity in Severn (NSW), Macintyre and/or Dumaresq Rivers ^{1,2}	As required in extreme dry conditions or to provide variability. (Three cease to flow events at Goondiwindi, between 15 and 30 day duration- from 2009 conditions)	Likely to have been met during wetter conditions	Irrigation releases met some of these demands for some of the time	April 2015 flows provided some longitudinal connectivity and refuge conditions	LOW to MODERATE Irrigation releases expected to provide some longitudinal connectivity and refuge in summer 2015–16.	Protect	May be met by other actions (irrigation and natural inflows). Possible use if conditions deteriorate.	MODERATE	MODERATE	
	Scouring, inundate inter-connected riparian areas. Fish movement, spawning, recruitment and condition	Flows > 2 000 ML/day ^{3,4} to change periphyton species in the Severn (NSW) River. Previous volumes 4 000–16 000 ML (August– December ⁵). Use earlier in the season helps mitigate impacts on fish.	Required frequency unknown. Stimulus flow can be released yearly if available. (Maximum unknown)	Met in the Severn (NSW). Probably met in Macintyre Brook and Dumaresq River	Met in the Severn (NSW). Probably met in Macintyre Brook	Not met in the Severn (NSW)	MODERATE May require water in 2015–16 or 2016–17.	Protect	Possible Commonwealth contribution if multiple benefits can be achieved. Dependent on NSW and Qld agreement.	LOW	LOW	
					Not met in Dumaresq River	Possibly met in Macintyre Brook and Dumaresq					HIGH	
	Access to large woody debris, support movement, spawning and recruitment of aquatic species, longitudinal connectivity, nutrient, sediment and carbon cycling.	4 000 ML/day at Mungindi for 5–11 days ⁶	(October – December) 1 in 3–4yrs ⁶ Twice in a year every 1 in 3–4yrs ⁶ (summer/autumn and winter/spring) ⁶ (Maximum unknown)	Met for summer. Also met in 2011–12	Not met	Not met	HIGH Require winter flows for fish (body condition benefits, spawning and stimulate movement).	Avoid damage	Insufficient water under a very low or low water availability scenario unless delivery is coordinated with an unregulated event and there is sufficient water available to contribute to flows	HIGH	LOW	
				Not met for winter/ spring since 2010–11.								
				Met			MODERATE to HIGH Need water in 2015–16 based on required frequency	Protect		HIGH	CRITICAL	
Anabranches (Boomi, Callandoon Creek, Dingo Creek, Whalan Creek, Booberanna, Yarlilwanna)	Nutrient and carbon cycling, enhanced primary production in local aquatic and terrestrial species. Fish movement, condition and recruitment.	1 500–4 000 ML/day (infrastructure assisted) to target particular anabranches (e.g. Booberanna or Yarlilwanna).	unknown	unknown	unknown	Landholder watered Booberanna Creek in 2014–15	MODERATE Support outcomes achieved in 2014–15	Maintain	Infrastructure assisted delivery	LOW	LOW	
		7 500 ⁷ –10 000 ⁸ ML/day at Goondiwindi for 7 days ⁷ (November to February ⁶) (Connect 4 main anabranches)	Possibly yearly ^{6,9} 1 in every 2–3 yrs for fish outcomes. (Maximum unknown)	Met in Jan and March 2013). Also met in 2011.	Not met	Unlikely (volume met but not duration).	MODERATE to HIGH Need water in 2015–16 based on required frequency	Protect	Insufficient water to meet the entire demand. Contribution could supplement unregulated flow events or large deliveries of consumptive water.	HIGH	LOW	
											CRITICAL	
Wetlands, lagoons and billabongs	Support movement, spawning and recruitment of aquatic species. Riparian	Small to medium volumes to connect upper reach wetlands: Severn (NSW): 1 200 ML/ day ⁴ Dumaresq and Macintyre Brook:	1 in every 2–3 yrs for fish outcomes. Other required frequency unknown	Likely to be met, given high flows in system	Not met Dumaresq		MODERATE for Dumaresq and Macintyre Brook. Higher urgency based on required fish frequencies and duration	Protect	Possible use depending on volumes required. More achievable in conjunction with other flows. Contribution to increase duration to meet fish requirements.	MODERATE TO HIGH for Dumaresq and Macintyre Brook	LOW	
											HIGH	

Environmental assets	Physical and process assets	Indicative demand (for all sources of water in the system)		Watering history ^{11,12} (from all sources of water)			2015–16			Implications for future demands		
							Predominant urgency of environmental demand for water	Purpose under low to very low resource availability	Potential Commonwealth water contribution?	Likely urgency of demand in 2016–17 if watering occurred as planned in 2015-16	2017–18 Range of likely demand	Met in 2016–17 Not met in 2016–17
		Flow/volume	Required frequency (maximum dry interval)	2012–13 (moderate)	2013–14 (drying)	2014–15 (dry)						
	vegetation health. Nutrient and carbon cycling.	unknown Duration of approximately 10 days for fish outcomes		Vol and duration met for Severn (NSW) from stimulus flow	Met for Severn (NSW) from stimulus flow	Volume met for Severn (NSW) from inflows	LOW for Severn (NSW)	Maintain	Will be met by Stimulus flow in the Severn, if used.	LOW for Severn (NSW)	LOW	
											MODERATE	
	Lateral and longitudinal connectivity and nutrient and carbon cycling. Support movement, spawning and recruitment of aquatic species	>20 000 ML/day at Goondiwindi for 7 days ¹⁰ (connect anabranches and wetlands between Goondiwindi and Mungindi)	1 in 2-3 years	Partially Volume met but not duration. Similar in 2010.	Not met	Not met	HIGH Need water in 2015–16 based on required frequency and duration.	Avoid damage	Insufficient water to meet the entire demand. Commonwealth unregulated water would contribute to this demand. Contribution using regulated water would rely on supplementing natural events or other flows.	HIGH	LOW	
											HIGH	
								Carryover potential	Low proportion of allocations carried into 2016–17.	Low proportion of allocations carried over into 2017–18 depending on resource availability and demands.	Level of carryover will depend on environmental demands and resource availability	
								Trade potential	Generally low to moderate need to augment supply to meet demands. If market conditions improve there may be consideration given to the purchase of allocation to assist in meeting demands. Sale of allocations unlikely considering moderate demands and low availability of water to meet them.	Moderate need to augment available allocations to meet high demands, therefore should market conditions improve there is likely to be consideration given to purchase of allocation or supplementary flow access. Sale of allocations unlikely considering a number of moderate and high demands expected.	Potential trade will depend on environmental demands and resource availability.	

¹ SKM (2009)
² NSW DWE (2009a)
³ NSW Office of Water (2011)
⁴ Davie and Mitrovic (2014)
⁵ NSW DWE (2009b)
⁶ MDBA 2012
⁷ SKM (2012).
⁸ SKM (2009)
⁹ Reid et al. (2011)
¹⁰ Reid (2006) cited in CSIRO
¹¹ NSW Real Time Water Data –<http://realtimedata.water.nsw.gov.au/water.stm?ppbm=DAILY>
¹² QLD DNRM Water monitoring portal <https://www.dnrm.qld.gov.au/water/water-monitoring-and-data/portal>

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 irretriev able 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 specfic requirements that are more or less urgent within the flow regime

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

Environmental assets	Physical and process assets	Indicative demand (for all sources of water in the system)		Watering history ^{11,12} (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 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 (moderate)	2013–14 (drying)	2014–15 (dry)						
River channel (Macintyre, Severn (NSW), Dumaresq, Barwon River to Mungindi)	Fish persistence, drought refuge habitat, water quality and connectivity	Base flow and flow variability and connectivity in Severn (NSW), Macintyre and/or Dumaresq Rivers ^{1,2}	As required in extreme dry conditions or to provide variability. (Three cease to flow events at Goondiwindi, between 15 and 30 day duration- from 2009 conditions)	Likely to have been met during wetter conditions	Irrigation releases met some of these demands for some of the time	April 2015 flows provided some longitudinal connectivity and refuge conditions	LOW to MODERATE Irrigation releases expected to provide some longitudinal connectivity and refuge in summer 2015–16.	Maintain	Likely to be met by other water sources (consumptive use, natural inflows and other actions). Possible use if conditions deteriorate.	MODERATE	MODERATE	Not met in 2016–17
	Scouring, inundate inter-connected riparian areas. Fish movement, spawning, recruitment and condition	Flows > 2 000 ML/day ^{3,4} to change periphyton species in the Severn (NSW) River. Previous volumes 4 000–16 000 ML (August– December ⁵). Use earlier in the season helps mitigate impacts on fish.	Required frequency unknown. Stimulus flow can be released yearly if available. (Maximum unknown)	Met in the Severn (NSW). Probably met in Macintyre Brook and Dumaresq River	Met in the Severn (NSW). Probably met in Macintyre Brook	Not met in the Severn (NSW)	MODERATE May require water in 2015–16 or 2016–17.	Maintain	Possible Commonwealth contribution if multiple benefits can be achieves. Dependent on NSW and Qld agreement.	LOW	LOW	Not met in 2016–17
					Not met in Macintyre Brook and Dumaresq River	Possibly met in Macintyre Brook and Dumaresq					HIGH	Not met in 2016–17
	Access to large woody debris, support movement, spawning and recruitment of aquatic species, longitudinal connectivity, nutrient, sediment and carbon cycling.	4 000 ML/day at Mungindi for 5–11 days ⁶	(October – December) 1 in 3–4yrs ⁶ Twice in a year every 1 in 3–4yrs ⁶ (summer/autumn and winter/spring) ⁶ (Maximum unknown)	Met for summer. Also met in 2011–12	Not met	Not met	HIGH Require winter flows for fish (body condition benefits, spawning and stimulate movement)	Protect	Insufficient water to meet the entire demand. Possible use. Contribution would rely on supplementing natural events or other flows	HIGH (depending on whether entire demand is met)	LOW	Not met in 2016–17
				Not met for winter/ spring since 2010–11.								
			(October – March) ⁶ 1 in 2–3 yrs ⁶ (Maximum unknown)	Met			MODERATE to HIGH Need water in 2015–16 based on required frequency	Protect		HIGH (depending on whether entire demand is met)	CRITICAL	
Anabranches (Boomi, Callandoon Creek, Dingo Creek, Whalan Creek, Booberanna, Yarlilwanna)	Nutrient and carbon cycling, enhanced primary production in local aquatic and terrestrial species. Fish movement, spawning, condition and recruitment.	1 500–4 000 ML/day (infrastructure assisted) to target particular anabranches (e.g. Booberanna or Yarlilwanna).	Unknown	unknown	unknown	Landholder watered Booberanna Creek in 2014–15	MODERATE Support outcomes achieved in 2014–15	Maintain	Infrastructure assisted delivery	LOW	LOW	Not met in 2016–17
		7 500 ⁷ –10 000 ⁸ ML/day at Goondiwindi for 7 days ⁷ (November to February ⁶) (Connect 4 main anabranches)	Possibly yearly ^{6,9} 1 in every 2–3 yrs for fish outcomes. (Maximum unknown)	Met in Jan and March 2013). Also met in 2011.	Not met	Unlikely (volume met but not duration).	MODERATE TO HIGH Need water in 2015–16 based on required frequency	Protect	Insufficient water to meet the entire demand. Contribution could supplement unregulated flow events or large deliveries of consumptive water.	HIGH (depending on whether demands met in all anabranches)	MODERATE	Not met in 2016–17
											LOW	Not met in 2016–17
											CRITICAL	Not met in 2016–17

Environmental assets	Physical and process assets	Indicative demand (for <u>all sources of water in the system</u>)		Watering history ^{11,12} (from all sources of water)			2015–16			Implications for future demands		
							Predominant urgency of environmental demand for water	Purpose under <u>moderate</u> resource availability	Potential Commonwealth environmental 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 (moderate)	2013–14 (drying)	2014–15 (dry)						
Wetlands, lagoons and billabongs	Support movement, spawning and recruitment of aquatic species. Riparian vegetation health. Nutrient and carbon cycling.	Small to medium volumes to connect upper reach wetlands: Severn (NSW): 1 200 ML/ day ⁴ Dumaresq and Macintyre Brook: unknown Duration of approximately 10 days for fish outcomes	1 in every 2–3 yrs for fish outcomes. Other required frequency unknown	Likely to be met, given high flows in system	Not met Dumaresq		MODERATE for Dumaresq and Macintyre Brook. Higher urgency based on required fish frequencies and duration	Maintain	Possible use depending on volumes required. More achievable in conjunction with other flows. Contribution to increase duration to meet fish requirements. Will be met by Stimulus flow in the Severn if used.	MODERATE TO HIGH for Dumaresq and Macintyre Brook	LOW	Not met in 2016–17
				Volume and duration met for Severn (NSW) from stimulus flow	Met for Severn (NSW) from stimulus flow	Volume met for Severn (NSW) from inflows	LOW for Severn (NSW)	Maintain			HIGH	
	Lateral and longitudinal connectivity and nutrient and carbon cycling. Support movement, spawning and recruitment of aquatic species	>20 000 ML/day at Goondiwindi for 7 days ¹⁰ (connect anabranches and wetlands between Goondiwindi and Mungindi)	1 in 2-3 years	Partially Volume met but not duration. Similar in 2010.	Not met	Not met	HIGH Need water in 2015–16 based on required frequency and duration.	Protect	Insufficient water to meet the entire demand. Commonwealth unregulated water would contribute to this demand. Contribution using regulated water would rely on supplementing natural events or other flows.	HIGH	LOW	
											HIGH	

See references at Table 2a

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 irretriev able 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	Low proportion of allocations carried into 2016–17.	Low proportion of allocations carried over into 2017–18 depending on resource availability and demands.	Level of carryover will depend on environmental demands and resource availability
Trade potential	Moderate need to augment available allocations to meet high demands, therefore should market conditions improve there is likely to be consideration given to purchase of allocation or supplementary flow access. Sale of allocations unlikely considering a number of high demands expected.	Moderate need to augment available allocations to meet high demands, therefore should market conditions improve there is likely to be consideration given to purchase of allocation or supplementary flow access. Sale of allocations unlikely considering a number of moderate and high demands expected.	Potential trade will depend on environmental demands and resource availability.

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

Environmental assets	Physical and process assets	Indicative demand (for all sources of water in the system)		Watering history ^{11,12} (from all sources of water)			2015–16			Implications for future demands		
							Predominant urgency of environmental demand for water	Purpose under high to very high resource availability	Potential Commonwealth water environmental contribution?	Likely urgency of demand in 2016–17 if watering occurred as planned in 2015–16	2017–18 Range of likely demand	Met in 2016–17 Not met in 2016–17
		Flow/volume	Required frequency (maximum dry interval)	2012–13 (moderate)	2013–14 (drying)	2014–15 (dry)						
River channel (Macintyre, Severn (NSW), Dumaresq, Barwon River to Mungindi)	Fish persistence, drought refuge habitat, water quality and connectivity	Base flow and flow variability and connectivity in Severn (NSW), Macintyre and/or Dumaresq Rivers ^{1,2}	As required in extreme dry conditions or to provide variability. (Three cease to flow events at Goondiwindi, between 15 and 30 day duration- from 2009 conditions)	Likely to have been met during wetter conditions	Irrigation releases met some of these demands for some of the time	April 2015 flows provided some longitudinal connectivity and refuge conditions	LOW to MODERATE Irrigation releases expected to provide some longitudinal connectivity and refuge in summer 2015–16.	Improve	Likely to be met by other water sources (consumptive use, natural inflows and other actions). Possible use if conditions deteriorate.	MODERATE	MODERATE	
	Scouring, inundate inter-connected riparian areas. Fish movement, spawning, recruitment and condition	Flows > 2 000 ML/day ^{3,4} to change periphyton species in the Severn (NSW) River. Previous volumes 4 000–16 000 ML (August– December ⁴). Use earlier in the season helps mitigate impacts on fish.	Required frequency unknown. Stimulus flow can be released yearly if available. (Maximum unknown)	Met in the Severn (NSW). Likely to have been met in Macintyre Brook and Dumaresq River	Met in the Severn (NSW). Likely to have been met in Macintyre Brook	Not met in the Severn (NSW)	MODERATE May require water in 2015–16 or 2016–17.	Improve	Possible Commonwealth contribution if multiple benefits can be achieved. Dependent on NSW and Qld agreement.	LOW	LOW	
					Not met in Dumaresq River	Possibly met in Macintyre Brook and Dumaresq					HIGH	
	Access to large woody debris, support movement, spawning and recruitment of aquatic species, longitudinal connectivity, nutrient, sediment and carbon cycling.	4 000 ML/day at Mungindi for 5–11 days ⁶	(October – December) 1 in 3–4yrs ⁶ Twice in a year every 1 in 3–4yrs ⁶ (summer/autumn and winter/spring) ⁶ (Maximum unknown)	Met for summer. Also met in 2011–12	Not met	Not met	HIGH Require winter flows for fish (body condition benefits, spawning and stimulate movement)	Improve	Likely to be met by other water sources (consumptive use, natural inflows and other actions). Could supplement flows if necessary to meet demand	LOW (assuming demand met by other sources)	LOW	
				Not met for winter/ spring since 2010–11.								
				Met			MODERATE to HIGH Need water in 2015–16 based on required frequency	Improve		LOW (assuming demand met by other sources)	CRITICAL	
Anabranches (Boomi, Callandoon Creek, Dingo Creek, Whalan Creek, Booberanna, Yarilwanna)	Nutrient and carbon cycling, enhanced primary production in local aquatic and terrestrial species. Fish movement, spawning, condition and recruitment.	1 500–4 000 ML/day (infrastructure assisted) to target particular anabranches (e.g. Booberanna or Yarilwanna).	Unknown	unknown	unknown	Landholder watered Booberanna Creek in 2014–15	MODERATE Support outcomes achieved in 2014–15	Improve	Infrastructure assisted delivery	LOW	LOW	
		7 500 ⁷ –10 000 ⁸ ML/day at Goondiwindi for 7 days ⁷ (November to February ⁶) (Connect 4 main anabranches)	Possibly yearly ^{6,9} 1 in every 2–3 yrs for fish outcomes. (Maximum unknown)	Met in Jan and March 2013). Also met in 2011.	Not met	Unlikely (volume met but not duration).	MODERATE TO HIGH Need water in 2015–16 based on required frequency	Improve	Insufficient water to meet the entire demand. Demand may be partially met by other sources. Contribution could supplement unregulated flow events or large deliveries of consumptive water.	MODERATE TO HIGH (depending on whether demands were met in all anabranches)	LOW	
											CRITICAL	

Wetlands, lagoons and billabongs	Support movement, spawning and recruitment of aquatic species. Riparian vegetation health. Nutrient and carbon cycling.	Small to medium volumes to connect upper reach wetlands: Severn (NSW): 1 200 ML/ day ⁴ Dumaresq and Macintyre Brook: unknown Duration of approximately 10 days for fish outcomes	1 in every 2–3 yrs for fish outcomes. Other required frequency unknown	Likely to be met, given high flows in system	Not met Dumaresq		MODERATE for Dumaresq and Macintyre Brook. Higher urgency based on required fish frequencies and duration	Improve	May be met by other water sources (consumptive use, natural inflows and other actions). Will be met by Stimulus flow in the Severn if used.	MODERATE TO HIGH for Dumaresq and Macintyre Brook	LOW
				Volume and duration met for Severn (NSW) from stimulus flow	Met for Severn (NSW) from stimulus flow	Volume met for Severn (NSW) from inflows	LOW for Severn (NSW)	Maintain			HIGH
	Lateral and longitudinal connectivity and nutrient and carbon cycling. Support movement, spawning and recruitment of aquatic species	>20 000 ML/day at Goondiwindi for 7 days ¹⁰ (connect anabranches and wetlands between Goondiwindi and Mungindi)	1 in 2-3 years	Partially Volume met but not duration. Similar in 2010.	Not met	Not met	HIGH Need water in 2015–16 based on required frequency and duration.	Improve	Insufficient water to meet the entire demand. May be met by other sources. Commonwealth unregulated water would contribute to this demand. Contribution using regulated water would rely on supplementing natural events or other flows.	MODERATE TO HIGH (depending on whether all demands were met)	LOW
											HIGH

See references at Table 2a

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	Low proportion of allocations carried into 2016–17.	Low proportion of allocations carried over into 2017–18 depending on resource availability and demands.	Level of carryover will depend on environmental demands and resource availability
Trade potential	Moderate need to augment available allocations given recent dry conditions. Wetter conditions may provide an opportunity to purchase allocations to assist in augmenting natural flows to meet higher demands.	Low expected need to augment available allocations, therefore limited requirement for allocation purchase. Sale of allocations may be considered, although there is expected to still be some moderate to high demands requiring water.	Potential trade will depend on environmental demands and resource availability.

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 Border Rivers catchment

The Border Rivers catchment originates in southern Queensland and extends into New South Wales (NSW). The principle streams of the Border Rivers region are the Macintyre River (NSW), Severn River (NSW), Dumaresq River (Qld), Macintyre Brook (Qld) and the Weir River (Qld) (Figure 2). The Macintyre River's main tributary is the NSW Severn River. The most significant unregulated tributary in the floodplain zone is the Weir River (Qld) and joins the Macintyre River upstream of Mungindi. Below the confluence of the Weir and Macintyre Rivers, the main stream becomes the Barwon River. The principal tributaries of the Dumaresq River are the Beardy River and Ottley's Creek.

Rainfall is dominant in the summer and is highly variable, which markedly affects river flow from season to season. There may be several large floods in one year, and little or no flow in another, with a wide range of variations in between.

Collectively, major public storages providing regulated supplies have a capacity of 635 GL, comprising Pindari Dam on the Severn River in NSW (312 GL), Glenlyon Dam on Pike Creek in Queensland (254 GL) and Coolmunda Dam on Macintyre Brook in Queensland (69 GL). The volume of on-farm storage is comparable to public storage, reflecting the importance of unregulated flows (diversion of river and overland flows) to irrigation supplies in the catchment. Water taken from unregulated sources is stored in large, shallow floodplain storages typically hundreds of megalitres to tens of gigalitres in capacity, including a few of several hundred gigalitres, known as 'ring tanks' or 'turkey nest' dams.

On average, the majority of water use in the Border Rivers catchment is based on opportunistic access to unregulated flows (supplementary water access in NSW and unsupplemented water allocations in Queensland). Regulated water entitlements (supplemented water allocations in Queensland, high and general security licences in NSW) comprise a smaller component of overall water use.

In the lower part of the catchment there are a number of effluent streams and anabranches that flow away from the main stem at certain river levels (DWE 2009a). These breakouts include Callandoon and Dingo creeks in Queensland, and Whalan Creek and Boomi River in NSW. The floodplains between Goondiwindi and Mungindi contain extensive anabranches that break off the Macintyre River channel and form a meandering complex of billabongs and wetlands across an extensive floodplain. Hydrological connectivity of this floodplain area relies on

overbank flows. Intermittent connection of anabranches with the rivers stimulates nutrient and carbon cycling, the fundamental ecosystem processes which drive food web dynamics at higher trophic levels (Thoms et al. 2005; McGinness and Arthur 2011; Reid et al. 2012).

When the complex floodplain of billabongs and wetlands are inundated, they have supported breeding for a range of nationally and internationally important birds such as brolgas, black-necked storks, and magpie geese (Murray-Darling Basin Authority [MDBA] 2012). The rivers and wetlands of the Border Rivers also provide habitat for a range of large and small bodied native fish species many which used to be widespread in the Murray-Darling Basin but now have a patchy distribution. Native fish species found in the Border Rivers include golden perch, Murray cod, purple spotted gudgeon and un-specked hardyhead (Davies et al. 2012; Wilson and Ellison 2010). The Border Rivers (Macintyre, Severn (NSW) and Dumaresq rivers) are part of the endangered ecological community *aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River* which is listed under the NSW Fisheries Management Act 1994 (NSW Department of Primary Industries 2007).

The Morella Watercourse/Boobera Lagoon/Pungboulal Lagoon complex is located on the floodplain between Goondiwindi and Mungindi and is listed in the *Directory of Important Wetlands in Australia* (Environment Australia 2001). It is one of the few permanent waterbodies in the Murray-Darling Basin. Boobera Lagoon is considered to be one of the most important Aboriginal sites in south-eastern Australia. The local Aboriginal people, the Gamilaraay, believe that Boobera Lagoon is the resting place of the rainbow serpent, Garriya.

Environmental water demand in the Border Rivers includes baseflow, in-channel fresh bankfull and overbank requirements. Baseflows target habitat availability, nutrient cycling, fish passage, and riparian health outcomes, and are limited to in-channel flows which can be satisfied through relatively low release rates from dams. In-channel fresh events aim to improve nutrient cycling, facilitate the migration and recruitment of native fish species, and enhance some anabranch connection. Due to high commence to flow rates, connection of the anabranch system downstream of Goondiwindi is likely only with a major unregulated flow.

Regulated releases from storages may be timed to coincide with unregulated flows in order to contribute to in-channel fresh requirements. Where possible, environmental water will be managed to benefit multiple sites en route and maximise the efficiency and effectiveness of water use.

Access to unregulated holdings is typically specified in entitlement conditions by river flow thresholds. Annual and/or multi-year volumetric limits and maximum daily take rates provide a ceiling on the volume that can be taken in any given year. The ability to utilise this volume depends on flow events that trigger access to the entitlement.

The Commonwealth's unregulated flow access entitlements cannot be actively 'delivered' and are left in-stream during unregulated flow conditions. This augments unregulated water already protected from extraction in the system and contributes to local and downstream flow benefits. In-stream use of Commonwealth environmental water contributes to improved flow variability across all flow components. Generally Commonwealth environmental water in the Border Rivers makes the greatest relative contribution in small to moderate flow events. The extent of how far benefits flow through the system depends on the circumstances for individual flow events. Benefits may extend downstream to the Barwon-Darling.

The achievement of desired environmental outcomes will be closely related to the careful coordination of the timing of environmental water releases to coincide with unregulated flows in the Border Rivers. Regulated releases (including irrigation orders, stock and domestic replenishment flows or NSW stimulus flow) also offer opportunities to 'piggy back' Commonwealth environmental water and increase its impact in achieving environmental objectives, and assist with delivery efficiency.

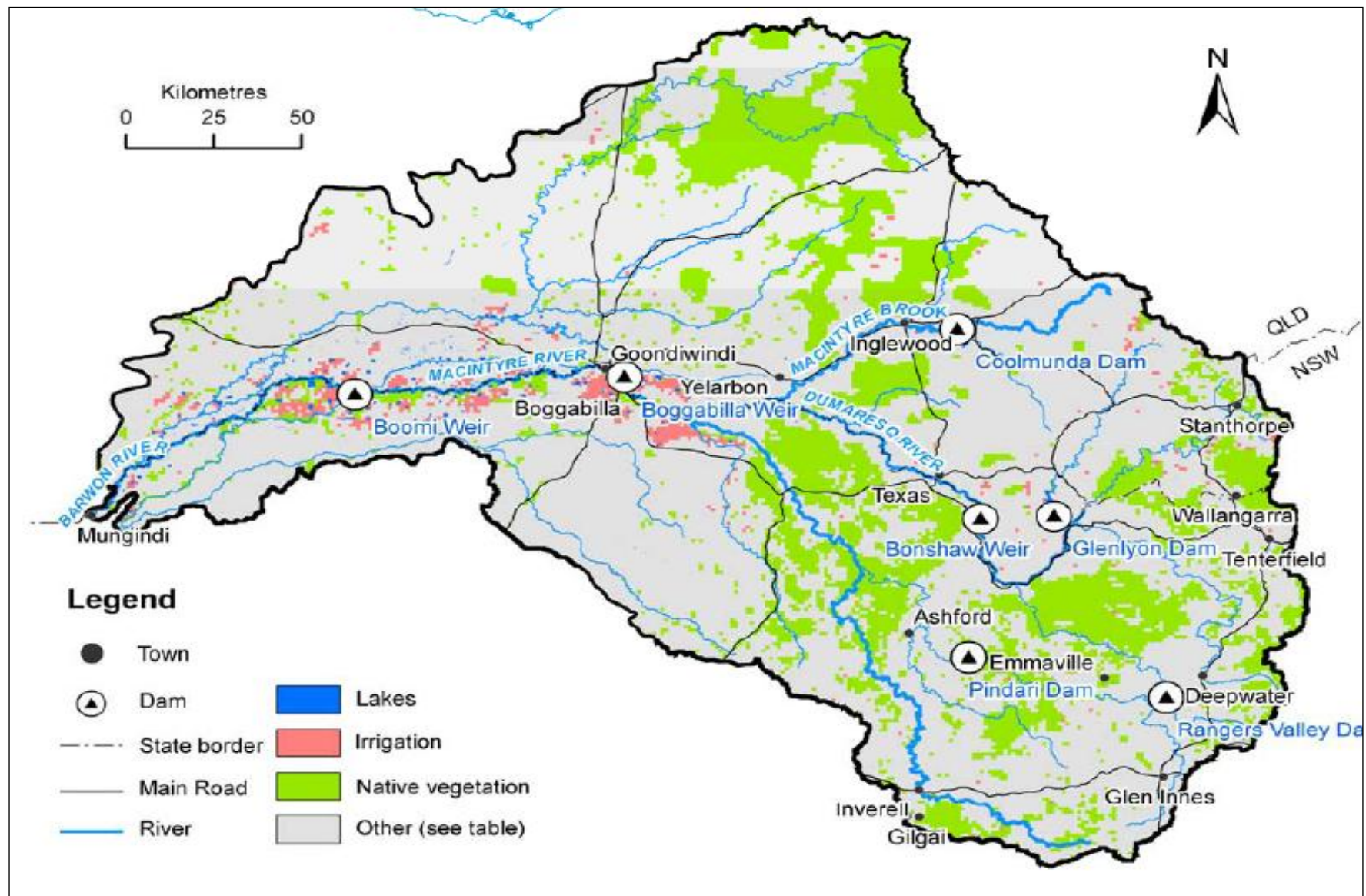


Figure 2: Map of the Border Rivers (CSIRO 2007)

3. Long-term environmental water demands in the Border Rivers 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 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 [Attachment A](#).

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

Vegetation: Maintain extent and improve the condition

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

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

3.2. Long-term watering plans

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

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

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

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

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

Key documentation includes:

- Water Sharing Plan. NSW Border Rivers regulated river water source Background document. (NSW Department of Water and Energy 2009).
- Border Rivers Resource Operations Plan (QLD Department of Environment and Resource Management (DERM) 2011).
- New-South Wales – Queensland Border Rivers Intergovernmental Agreement 2008.
- Assessment of environmental water requirements for the proposed Basin Plan: Lower Border Rivers (in-channel flows) (MDBA 2012).

- Environmental Watering Priorities for the Northern Murray Darling Basin (Sinclair Knight Merz 2009).
- Water availability in the Border Rivers (CSIRO 2007).
- Scoping Study Commonwealth Use of Private Water Storages in the Northern Murray-Darling Basin (Sinclair Knight Merz 2012).
- A range of scientific literature, monitoring outcomes and on-ground knowledge (e.g. Lintermans 2007; Thoms *et al.* (2005), Reid *et al.* 2011; Roberts and Marston 2011)

The following sections 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 Border Rivers catchment

The expected longer term outcomes from environmental watering in the Border Rivers catchment 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 3: Summary of long-term expected outcomes from environmental watering in the Border Rivers

BASIN-WIDE OUTCOMES (Outcomes in red link to the Basin-wide Environmental Watering Strategy)	EXPECTED OUTCOMES FOR BORDER RIVERS ASSETS		
	IN-CHANNEL ASSETS	OFF-CHANNEL ASSETS	
	Severn, Macintyre, Dumaresq, Weir Rivers	Wetlands, lagoons and billabongs	Anabranches and effluent creeks
VEGETATION	Maintain and improve riparian and in-channel vegetation condition, recruitment, extent, structure and composition	Maintain and improve wetland and floodplain vegetation condition, recruitment, extent, structure and composition.	
WATERBIRDS		Maintain a mosaic of foraging, roosting and breeding habitats throughout the floodplain to support waterbirds.	
		Support naturally triggered waterbird breeding events that may fail due to drying or sudden reductions in flow due to extraction.	
FISH	Provide improved habitat conditions (including lateral connection) and access for different life stages (survival/condition, migration, spawning, recruitment, refuge) though natural flow variability, supporting connectivity and provision of spawning and migration cues	Support natural flow variability and connectivity between the river channel, wetlands anabranches and floodplains	
MACROINVERTEBRATES	Provide habitat (e.g. pools and riffles) and conditions (low flows, freshes, scouring flows, snags) to maintain and improve macroinvertebrate condition.		
OTHER VERTEBRATES	Provide habitat and conditions to support survival and recruitment of native aquatic fauna (e.g. platypus, native water rat, frogs, turtles)		

CONNECTIVITY	Support longitudinal connectivity along the Border Rivers and to Barwon River	Support connectivity, particularly lateral between the river and wetlands and floodplains	Support connectivity, particularly lateral and longitudinal connectivity between the river and wetlands and floodplains
PROCESSES	Support primary production, nutrient and carbon cycling and biotic dispersal and movement		
WATER QUALITY	Maintain water quality within channels and pools	Support more natural water temperature, flow regimes and connectivity to support nutrient cycling and other water quality benefits	
RESILIENCE	Provide refuge habitat (particularly for fish and other aquatic fauna)		

Information sourced from: Davie and Mitrovic (2014), NSW DWE (2009a, b), MDBA (2012), Kingsford (1999), McGinness and Arthur (2011), Thoms *et al.* 2005, SKM (2012), CEWO (2014), Australian Wetlands (2009), SKM (2009).

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 Office to focus on contributing to in the Border 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.

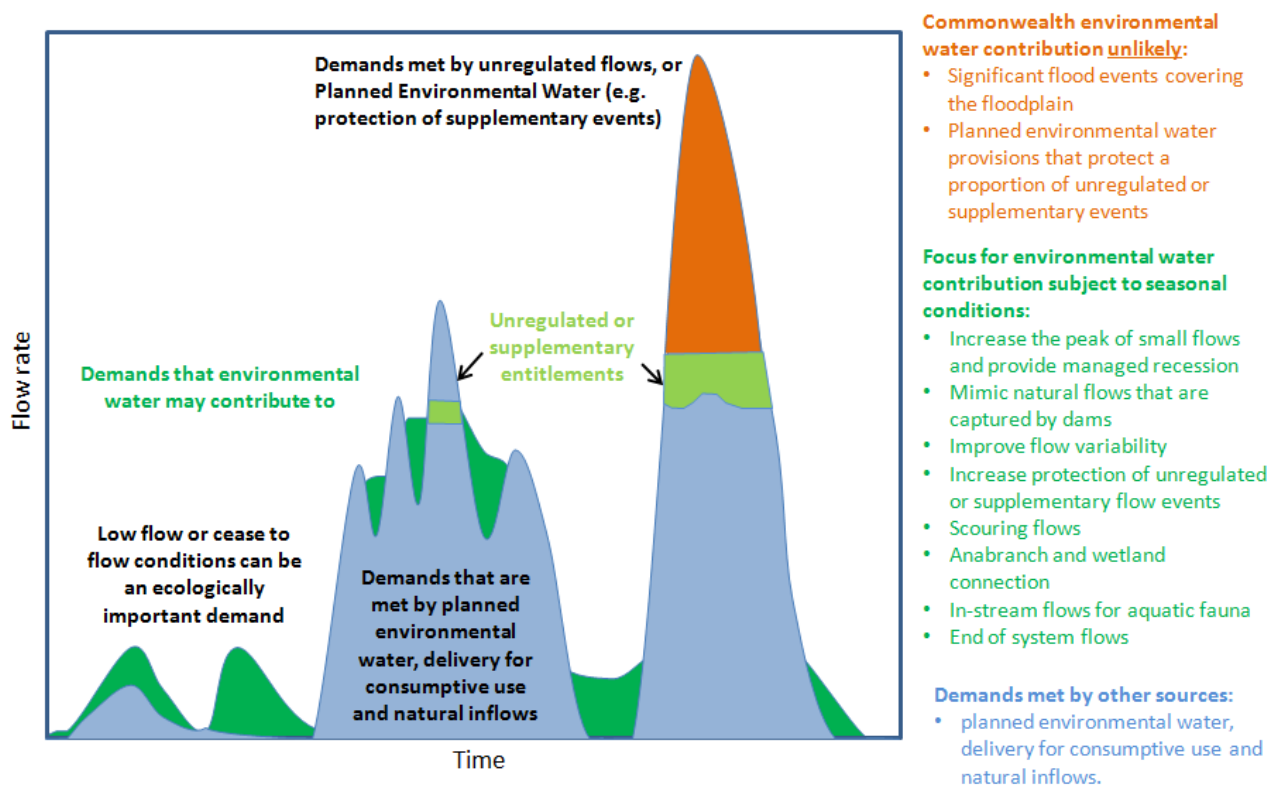


Figure 3: Scope of demands that environmental water may contribute to in the Border Rivers catchment.

Large flows are required for full lateral connectivity across the floodplain. The volumes of environmental water available are unlikely to have much impact during these conditions. Therefore contributing to large overbank flow across the floodplain is likely to be out of scope for the provision of Commonwealth environmental water (Figure 3). Contribution of the

Commonwealth's unregulated entitlements during flows of these magnitudes will form a relatively small contribution to the overall event.

The delivery of environmental water in the Border Rivers is currently constrained by the release capacities from storages, channel capacities, travel time for deliveries, access conditions for unregulated licence holders and system constraints. The MDBA has published a *Preliminary Overview of Constraints to Environmental Water Delivery in the Murray-Darling Basin* (MDBA 2013) which provides information about constraints in the Border Rivers catchment.

Watering actions will be developed in consideration of the following constraints:

- Ability to protect environmental flows from extraction through irrigation areas between Goondiwindi and Mungindi and along the Weir river
- Storage outlet capacity of 5 000 ML/day at Pindari Dam, 3 540 ML/day at Glenlyon Dam and 390 ML/day at Coolmunda Dam.
- Minor flood levels of 21 300 ML/day at Boggabilla, 12 100 ML/day at Goondiwindi and 8 800 ML/day at Mungindi.

Leaving environmental water in-stream carries the potential risk that the additional flows are extracted by downstream users in a particular event. The protection of this water (water shepherding) currently relies on existing water resource management systems including the Murray-Darling Basin Cap on diversions (specified for each valley) and existing rules governing the access of other users to unregulated flows. Additional arrangements for the Northern Unregulated Rivers are also being developed through the Commonwealth's water shepherding projects with the NSW and Queensland governments.

The risk of extraction is moderate in the Severn River (QLD, upper Border Rivers) because the access conditions of downstream users potentially do allow them to extract some of the additional in-stream flow. With existing holdings, the contribution that Commonwealth environmental water makes to unregulated flows in these areas is, however, small relative to other flows in the system. Overall the impact on flows is expected to be minor, although could be significant in some conditions – for example: relatively low flow and/or short duration flow events in which take by downstream users is limited by opportunity rather than access conditions.

Obstructions to fish passage and cold water pollution from Glenlyon Dam also constrain the ability to provide fish related environmental outcomes from both environmental and consumptive water releases in the Border Rivers (NSW Department of Primary Industries 2014; 2015).

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

Table 4: Current constraints on environmental watering for the Border Rivers

Inflow scenario	Very low	Low	Moderate	High	Very high
Constraints					
Delivery options may be limited during periods of 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.					
Release capacities of storages may constrain delivery of environmental water.					
Travel time from storages may constrain the ability to effectively augment other flows.					
Access conditions for unregulated licence holders may make it difficult to shepherd environmental flows in the Border Rivers.					
Levee banks and commence to fill thresholds may constrain ability to deliver water to specific areas.					
The size of holdings constrains ability to meet environmental demands.					

Constraints as they relate to specific watering actions are described in the standard operating considerations listed in section 3.5.

Based on the above outcomes sought and delivery constraints, Table 5 identifies flows that are in scope for Commonwealth environmental watering. Some specific watering requirements (flow magnitude, duration, timing and frequency) have also been listed, drawn from existing resources. The watering requirements for the Border 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.

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

Asset/Function	Indicative demands /events	Frequency (maximum dry)
River channel (Macintyre, Severn (NSW), Dumaresq, Barwon River to Mungindi)	Base flow and flow variability and connectivity in Severn (NSW), Macintyre and/or Dumaresq Rivers	As required in extreme dry conditions or to provide variability. (Three cease to flow events at Goondiwindi, between 15 and 30 day duration- from 2009 conditions)
	Flows > 2 000 ML/day to change periphyton species in the Severn (NSW) River (August– December).	Required frequency unknown. (Maximum unknown)
	4 000 ML/day at Mungindi for 5–11 days ⁴	(October –December) 1 in 3–4yrs Twice in a year every 1 in 3–4yrs (summer/autumn and winter/spring) (Maximum unknown)
		(October – March) 1 in 2–3 yrs (Maximum unknown)

Anabranches Boomi, Callandoon Creek, Dingo Creek, Whalan Creek, Booberanna, Yarilwanna)	1 500–4 000 ML/day (infrastructure assisted) to target particular anabranches (e.g. Booberanna or Yarilwanna).	Unknown
	7 500 ⁵ –10 000 ⁶ ML/day at Goondiwindi for 7 days (November to February) (Connect 4 main anabranches)	Possibly yearly 1 in every 2–3 yrs for fish outcomes. (Maximum unknown)
Wetlands, lagoons and billabongs	Small to medium volumes to connect upper reach wetlands: Severn (NSW): 1 200 ML/ day Dumaresq and Macintyre Brook: unknown Duration of approximately 10 days for fish outcomes	1 in every 2–3 yrs for fish outcomes. Other required frequency unknown
	>20 000 ML/day at Goondiwindi for 7 days (connect anabranches and wetlands between Goondiwindi and Mungindi)	1 in 2-3 years

Information sourced from CSIRO (2007), Davie and Mitrovic (2014), NSW DWE (2009a and b), NSW Office of Water (2011), MDBA 2012, Reid (2006) cited in CSIRO (2007), Reid et al. (2011), SKM (2009) and SKM (2012).

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 Border Rivers and the levels of water resource availability that relate to these actions.

Table 6: Summary of potential watering actions for the Border Rivers.

Broad Asset	Indicative demand	Applicable level(s) of resource availability				
		Very Low	Low	Moderate	High	Very High
River channel (Macintyre, Severn (NSW), Dumaresq, Barwon River to Mungindi)	<ul style="list-style-type: none">• Baseflows• Scouring flows above 2 000 ML/day (Aug – Dec)• 4,000 ML/day at Mungindi for 5-11 days	1. <i>Water quality and drought contingency:</i> Contribute flows to refresh drought refuges and mitigate degrading water quality.				
			2. <i>Scouring and pre-conditioning flows:</i> Contribute to flows to scour algae and reset benthic periphyton (biofilm) processes.			
				3. <i>Habitat availability and connectivity:</i> Contribute to flows to increase access to in-stream habitats, support movement, spawning and recruitment opportunities of native aquatic species and provide longitudinal connectivity to Mungindi.		
Anabranches	<ul style="list-style-type: none">• 1 500–4 000 ML/day for target areas• 7 500-10 000 ML/day at Goondiwindi for 7 days (November to February)		4. <i>Infrastructure assisted delivery:</i> Use infrastructure to deliver water to wetlands and or anabranches.			
				5. <i>Anabranch connectivity:</i> Contribute to flows to support connectivity to and between anabranches and floodplain lagoons and river channel.		
Wetlands	<ul style="list-style-type: none">• Small to medium volumes to connect upper reach and other wetlands• >20 000 ML/day at Goondiwindi for 7 days		6. <i>Wetland Connection:</i> Contribute to flows to support lateral and longitudinal connectivity, primary production, nutrient and carbon cycling, and biotic dispersal and movement.			
					7. <i>Breeding event contingency:</i> Maintain wetland water levels or other flow conditions to support completion of a naturally-triggered breeding event	
All - River, wetlands and anabranches	Baseflows and flow variability	8. <i>Improving natural flow variability:</i> Contribute to river flows (e.g. base flows, translucency flows, freshes) in the Severn, Macintyre and Dumaresq Rivers and/or other creeks.				
	Natural inflows	9. <i>Support natural river flows:</i> contribute unregulated water to support natural river flows (baseflows, freshes, bankfull and overbank components) to contribute to natural variability and system resilience				

Note: Under certain resource availabilities, options may be not 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 the Border 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.

1. River Channel – Water quality and drought contingency:

Watering action: Contribute to base flows to refresh drought refuges, ensure the persistence of pools and mitigate the risk of degrading water quality. During periods of low or no flow, this action could provide refuge habitat to maintain population resilience of native fish.

Standard operational considerations: Target flows will be dependent on the prevailing flow conditions, the nature of the water quality issue, and/or operational considerations.

Typical extent: Macintyre, Dumaresq and Severn (NSW) Rivers (channel only) from the dams to Mungindi. The extent achieved by the action would depend on resource availability, operational considerations and antecedent conditions.

Approvals: Consult with Water NSW, NSW Fisheries, OEH, QMDC and QLD DNRM before implementing this action.

2. River Channel – Scouring and pre-conditioning flows:

Watering action: Contribute to regulated and unregulated flows to scour algae and reset benthic periphyton (biofilm) processes to stimulate production through all levels of the aquatic food chain; provide migration, spawning, dispersal and recruitment cues to native fish (dependent on timing); and wet and interconnect riparian areas and, improve access to aquatic habitat.

Standard operational considerations:

- This action would supplement unregulated or regulated flows (irrigation supply, stimulus flow, stock and domestic replenishment flow). If watering in conjunction with other regulated flows, available dam release capacity may be shared amongst water orders.
- Flow rates above 2000 ML/day in the Severn (NSW) River are likely to result in a positive change in periphyton species (NSW Office of Water 2011).
- Environmental water for the Severn (NSW) River is delivered from Pindari dam in conjunction with the NSW stimulus flow, when available. The NSW stimulus flow is dependent on inflow into Pindari exceeding 1200ML/day between April and August. The stimulus flow can be released from 1 August to 1 December each year (NSW Department of Water and Energy 2009a, b). Earlier releases (e.g. late winter) may reduce cold-water pollution impacts. The NSW Stimulus flow is only protected from dam wall to confluence of Severn River and Frazers Creek (approx 22 km).
- Environmental water for the Dumaresq River is delivered from Glenlyon dam in conjunction with a suitable unregulated tributary flow event to minimise cold water pollution impacts.

Typical extent: The Severn River (NSW) below Pindari Dam, the Dumaresq River below Glenlyon Dam could also be targeted. This action could be combined with other actions to get multiple environmental benefits. Commonwealth environmental water may also provide benefits downstream in the Macintyre River.

Approvals: The timing, rate, volume and duration of the stimulus flow is determined by NSW Office of Water (NOW) and the NSW Department of Environment and Heritage. NOW is responsible for managing the release of the NSW stimulus flow from Pindari Dam in conjunction with Water NSW. For other flow options other than the Stimulus Flow, consult with Water NSW, OEH, NSW Fisheries, QMDC and QLD DNRM before implementing this action.

3. River Channel – Habitat availability and connectivity:

Watering action: Contribute to flows to increase access to in-stream habitat (benches, large woody debris); assist carbon and nutrient cycling; support movement, spawning and recruitment opportunities of native aquatic species; and provide longitudinal connectivity to Mungindi.

Standard operational considerations: This action would supplement suitable unregulated or regulated flows (e.g. irrigation supply, stimulus flow, stock and domestic replenishment flow) in order to provide longitudinal connectivity to Mungindi. Conjunctive watering helps maximise river flows and the chance of reaching the required volumes. The action could supplement flows, extend event duration, supplement unregulated flows and/or manage the recession of an event. Target flow rates will be dependent on the prevailing flow conditions, target outcome and operational considerations. The action may be limited to the duration of the inflows. Where fish outcomes are targeted, the timing and duration of the flows would be considered (e.g. late winter to help mitigate cold water pollution impacts).

Typical extent: The length of the Macintyre River to Mungindi. The action may also benefit the Dumaresq and/or Severn Rivers or Macintyre Brook depending if either dam is used to deliver environmental water. The action may also provide flows into the Barwon River.

Approvals: Consult with Water NSW, OEH, NSW Fisheries, QMDC and QLD DNRM before implementing this action.

4. Anabranches and Wetlands– infrastructure assisted delivery

Watering action: Use infrastructure and/or private storages to contribute water to wetlands and or anabranches that may have high commence to fill thresholds or where structures or floodplain works prevent wetlands receiving water at lower volumes. This action could provide localised connectivity and persistence of waterholes and terrestrial primary production in individual anabranch systems.

Standard operational considerations: This action requires further investigation but may include diverting/pumping regulated or unregulated water into channels, anabranches or other offstream environmental assets to restore ecological function to these areas. Water could also be delivered to these areas via private infrastructure. Such options have not been progressed to date due to a lack of appropriate infrastructure or delivery arrangements and/or clear demonstrated environmental need. The Office will continue to investigate the feasibility of such options and will seek feedback from interested parties.

Typical extent: Wetlands and anabranches of the Macintyre floodplain for example Callandoon, Boomi and Morella watercourses. Creek systems between the Macintyre and the Weir River may be targeted (e.g. Booberanna, Yarrilwanna).

Approvals: Access to infrastructure would need to be negotiated with landholders or irrigation corporations and agreement for inundation of privately owned wetlands would be required. Consultation with NSW NOW, OEH, QMDC, QLD DNRM and landholders required. Delivery arrangements will need to be negotiated in order to proceed.

5. Anabranch connectivity:

Watering action: Contribute to flows to support connectivity to anabranches to help facilitate the nutrient and carbon exchange and the movement of biota between anabranches, wetlands and the river channel. These flows could also support movement, spawning, recruitment and condition of native fish and other aquatic species.

Standard operational considerations: Environmental water could be used to supplement suitable unregulated or regulated flows (e.g. irrigation supply, stimulus flow, stock and domestic replenishment flow) to connect anabranches. If required, water could be used to re-connect anabranches to river channel to improve exchange of nutrients and carbon and ensure biota can return to river. Target flow rates will be dependent on the prevailing flow conditions, target

outcome and operational considerations. If fish outcomes are sought, the timing and duration of events may depend on the target species. In order to supplement unregulated events, environmental releases may need to be made from infrastructure further down in the catchment to overcome the lengthy travel times from Glenlyon and other dams. Some structures may require physical operation. The Commonwealth's unregulated water entitlements could potentially contribute to this action if access conditions are triggered.

Typical extent: Boomi River, Callandoon Creek, Dingo Creek and Whalan Creek.

Approvals: This action may require close cooperation with river operators in Queensland and New South Wales and potentially the irrigation community. Third party impacts may be a risk during larger events. Any diversions to the Boomi River should occur in collaboration with the Boomi Water Trust.

6. Wetlands – Connectivity:

Watering action: Contribute to flows to support lateral and longitudinal connectivity to floodplain wetlands to boost invertebrate production; trigger breeding activity in birds, fish and amphibians and subsequent recruitment and movement of those species; initiate riparian tree regeneration and growth and create areas for aquatic plant colonisation.

Standard operational considerations:

- Upper reach wetlands could be targeted with Commonwealth environmental water from Pindari, Glenlyon and/or Coolmunda dams.
- For lower floodplain wetlands, this action would provide water in conjunction with suitable unregulated or regulated flows (e.g. irrigation supply, stimulus flow, stock and domestic replenishment flow). In order to supplement unregulated events, environmental releases may need to be made from infrastructure further down in the catchment to overcome lengthy travel times from Glenlyon and other dams. Target flow rates will be dependent on the prevailing flow conditions, target outcome and operational considerations.
- Water could be used to maintain inundation or assist re-connection of wetlands and anabranches to the river channel to improve exchange of nutrients and carbon and ensure biota can return to river. Water may be used to provide an extended recession to provide cues for biota to move back to the river. Secondary connection of wetlands may be particularly important for dispersal of some native fish species.
- Contribution to connection events for wetlands in the lower Macintyre may be limited by water holdings and potential third party impacts. Minor flooding at Goondiwindi and Bogabilla corresponds to flows of 12,100 and 21,300 ML/day, respectively.
- The Commonwealth's unregulated water could potentially contribute to this action if access conditions are triggered.

Typical extent: upper reach wetlands on Severn (NSW), Macintyre, Dumaresq, wetlands from Yetman to Mungindi and the Morella watercourse and associated wetlands.

Approvals: This action would require close cooperation with river operators in Queensland and New South Wales and potentially the irrigation community. Third party impacts may be a risk during larger events.

7. Wetlands – Breeding event contingency:

Watering action: Maintain wetland water levels or appropriate flow conditions to support completion of a naturally-triggered breeding event.

Standard operational considerations:

- This action would only be considered if flows already in the system (unregulated, regulated, and environmental) triggered a waterbird breeding event. Consideration would be given to likelihood of success and ability to target water to the breeding site.
- This action would supplement or extend suitable unregulated or regulated flows (e.g. irrigation supply, stimulus flow, stock and domestic replenishment flow). In order to supplement unregulated events, environmental releases may need to be made from infrastructure further down in the catchment to overcome lengthy travel times from Glenlyon and other dams.
- Target flow rates will be dependent on the prevailing flow conditions, target outcome and operational considerations. This action may not be operationalised if other flows (e.g. irrigation or unregulated) are deemed sufficient to meet the required demand.

Typical extent: Wetlands and billabongs downstream of Yetman and Goondiwindi e.g. Morella Watercourse.

Approvals: This action would require close cooperation with river operators in Queensland and New South Wales and potentially the irrigation community. There may be third party impacts may be a risk during larger events.

8. River Channel – Improving natural flow variability:

Watering action: Contribute to river flow variability (e.g. baseflows, freshes) in the Severn (NSW), Macintyre and Dumaresq Rivers and/or other creeks. This could connect refuge pools, provides riffle habitats, provide more flow variability to help provide a diverse in-channel environment. This action may also support native fish and other native aquatic fauna, including some secondary connectivity for fish breeding habitat to assist dispersal.

Standard operational considerations: The watering action could include providing baseflows, small peaks, translucency flows and freshes. Water could be released from Glenlyon, Coolmunda and/or Pindari dams depending on the target reaches. Target flow rates will be dependent on the prevailing flow conditions, target outcome and operational considerations. Take thresholds would need to be considered prior to undertaking this action to ensure low flows are not automatically accessed by other users.

Typical extent: Macintyre, Dumaresq and Severn (NSW) Rivers particularly below dams and weirs. The extent achieved by the action would depend on resource availability, operational considerations and antecedent conditions.

Approvals: Consult with Water NSW, OEH, NSW Fisheries, QMDC and QLD DNRM before implementing this action.

9. River Channel, Anabranches and Wetlands - Support natural river flows

Watering action: This action would contribute unregulated water to support natural river flows to enhance flow variability and the eco-hydrological outcomes of naturally occurring unregulated flow events. Commonwealth water will increase the duration and magnitude of flow pulses within the channel network and increase the duration and possibly extent of wetlands inundated under moderate flows.

Standard operational considerations:

- This action would leave the Commonwealth's unregulated holdings in the Border Rivers in-stream to support natural river flows (baseflows, freshes, bankfull and overbank components) in accordance with the Commonwealth Environmental Water Holder decision of late 2012.

- Water will be 'taken' (accounted as in-stream flow against individual entitlements) until the annual or multi-year allocation limits are exhausted. Accounted take will commence when flow thresholds are met (Severn (QLD) River in the upper Border Rivers) or in accordance with periods of announced access (Border Rivers Main stem).
- Take will occur at the first opportunity in the water year and thereafter at all available opportunities when triggers are met. During access periods take will be at the maximum daily rate specified in entitlement conditions.

Typical extent: Severn (QLD) River, fringing floodplain wetlands and anabranches in the Dumaresq and Macintyre rivers and the Lower Macintyre River.

Approvals: Consultation with NSW OEH and NOW on specific watering actions in response to trigger events. In November 2012 the Commonwealth Environmental Water Holder approved the ongoing use, for in-stream purposes, of unregulated water entitlements (existing and future holdings) in the Queensland Murray-Darling Basin streams and NSW Barwon-Darling River including the Border Rivers.

4. Long-term water availability

4.1. Commonwealth environmental water holdings

The Commonwealth holds the following entitlements in the Border Rivers:

- Queensland Border Rivers Water Supply Scheme medium security
- Queensland Macintyre Brook Water Supply Scheme medium security
- New South Wales Border Rivers General B Security
- Queensland Border Rivers – Severn (Qld) Unsupplemented
- Queensland Border Rivers – Macintyre Unsupplemented

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

There are currently no other sources of held environmental water in the Border Rivers.

4.3. Planned environmental water

In addition to water entitlements held by the Commonwealth, 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'). Other sources of environmental water may be available to supplement Commonwealth environmental water delivery in the catchment during 2015–16 (Table 7).

The NSW Border Rivers Water Sharing Plan includes the high conservation value reach of the Severn (NSW) and Macintyre Rivers downstream of Pindari Dam. The Pindari Dam stimulus flow and translucency rules (i.e. inflows up to 50 ML/day between September and May are passed downstream; up to 200 ML/day between June and August) attempts to mitigate the impacts of the dam on the natural hydrological regime and aquatic ecosystems in the Severn River (NSW). Commonwealth environmental water would be in addition to these flows and provide increased benefits to this asset.

NSW and Queensland have water management rules in place for the Macintyre River downstream of Goondiwindi. These rules aim to provide additional flows to this area. There is an end of system low flow rule that protects tributary inflows to maintain flows at Mungindi on the Barwon above 100 ML/day (September–March). When unregulated flow events arise, announcements are made constraining the times, locations and rates for the take of water under unregulated flow access entitlements. There are complex rules for determining these announcements. For example, access to freshes below the junction of the Macintyre River and the Dumaresq River that arise from inflows above Goondiwindi, does not commence until the total flow over two consecutive days exceeds 10 000 ML. Access ceases when the total flows over two consecutive days at Goondiwindi drops below 3 650 ML. In dry to medium years it is likely that some of these events will be protected in order to meet downstream requirements for freshes in the Barwon-Darling River (although in very dry years such events are less likely to occur). Commonwealth environmental water would be in addition to these rules and provide increased benefits to this asset.

Table 7: Other potential sources of environmental water in the Border Rivers

Source	Instrument	Management Authority	Potential Allocation
Stimulus flow Pindari Dam	NSW Water Sharing Plan	NSW OEH and NOW NSW State Water (delivery)	4 000 ML/year reserved for a stimulus flow, provided trigger conditions are achieved. Can be accrued to a maximum of 8 000 ML.
Translucency flows Pindari Dam		NSW State Water	Up to 50 ML/day (September–May) Up to 200 MGL/day (June–August) Maximum of 30 000 ML/year
Improving low flows at end of system	NSW Water Sharing Plan	Qld DNRM NSW State Water/NOW	Tributary inflows protected to maintain flow at Mungindi on the Barwon above 100 ML/day (September–March)
High flow protection	NSW-Queensland Intergovernmental Agreement on the Border Rivers 2008	NSW State Water/NOW	25 per cent of unregulated flows in main trunk and Macintyre River in NSW protected from point of inflow to Mungindi
Low flow allowance Coolmunda Dam	Queensland Border Rivers Resource Operations Plan	Queensland SunWater	The first 100 ML/day of inflows released to 6 000 ML/year.

5. Next steps

5.1. From planning to decision making

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

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

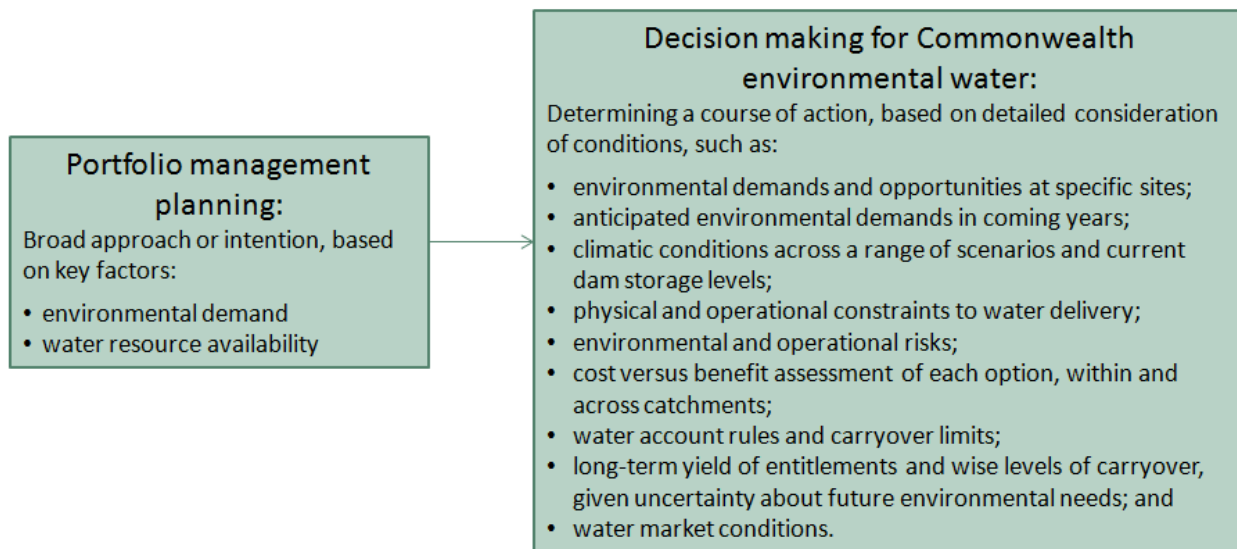


Figure 4: Planning and decision making for Commonwealth environmental water use

5.2. Further information

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

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

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

Expected outcomes from the Basin-wide Environmental Watering Strategy (MDBA 2014) that are relevant to the Border Rivers are described below.

RIVER FLOWS AND CONNECTIVITY

Baseflows are at least 60 per cent of the natural level

Contributing to a 10 per cent overall increase in flows in the Barwon-Darling

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

VEGETATION

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

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

Improved condition of lignum shrublands

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

Vegetation extent

Area of river red gum (ha)	Area of black box (ha)	Area of coolibah (ha)	Shrublands	Non-woody water dependent vegetation
10 700	3 800	35 200	Lignum in the lower Border rivers region	Closely fringing or occurring within the within the Barwon, Dumaresq, Macintyre rivers and Macintyre Brook

WATERBIRDS

Maintain current species diversity

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

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

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

FISH

No loss of native species

Improved population structure of key species through regular recruitment, including

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

Increased movements of key species

Expanded distribution of key species and populations

Key species for the Border Rivers include:

Species	Specific outcomes	In-scope for C'th e-water in the Border Rivers?
Freshwater catfish (<i>Tandanus tandanus</i>)	Expand the core range of at least 3–5 existing populations (candidate sites include Border Rivers)	Yes. Could be met by improving flow stability and extending recessions.
Golden Perch (<i>Macquaria ambigua</i>)	A 10–15 per cent increase of mature fish (of legal take size) in key populations	Yes. Could be met by providing peak events and extended recessions. Some barriers to fish passage may impact outcomes.
Murray cod (<i>Maccullochella peelii peelii</i>)	A 10–15 per cent increase of mature fish (of legal take size) in key populations	Yes. Could be met by providing peak events, flow stability and extended recessions. Some barriers to fish passage may impact outcomes.
Olive perchlet (<i>Ambassis agassizii</i>)	Expand the range (or core range) of at least 3 existing populations (candidate sites include the Border Rivers)	Yes. Could be met by supplementing natural events to establish floodplain connection.
River blackfish (<i>Gadopsis marmoratus</i>)	Range extension: Expand the range of at least two current populations (candidate sites include upland systems of the Border Rivers). Establish 1–3 additional populations.	No, remnant populations are in the upland zones.
Southern purple-spotted gudgeon (<i>Mogurnda adspersa</i>)	Expand the range (or core range) of at least 3 existing populations (priority catchments Border Rivers) Establish or improve the core range of 2–5 additional populations – (priority catchments Border Rivers)	Yes. Assist in producing or maintaining suitable habitat and providing connection.
Silver perch (<i>Bidyanus bidyanus</i>)	Range extension: Expand the core range of at least 2 existing populations	Yes. Could be met by providing peak events and extended recessions. Some barriers to fish passage may impact outcomes.

Important Basin environmental assets for native fish in the Border Rivers

Environmental asset	Key movement corridors	High Biodiversity	Site of other Significance	Key site of hydrodynamic diversity	Threatened species	Dry period / drought refuge	In-scope for C'th e-water
Macintyre River – floodplain lagoons between Goondiwindi and Boomi	Yes	Yes	Yes		Yes	Yes	Yes
Macintyre River – Mungindi to Severn in NSW	Yes	Yes		Yes	Yes	Yes	Yes
Severn River within Sundown National Park		Yes		Yes	Yes	Yes	No

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