



Australian Government

Commonwealth Environmental Water Office

Commonwealth Environmental Water Portfolio Management Plan

Northern Intersecting Streams

2019–20

Acknowledgement of the traditional owners of the Murray-Darling Basin

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

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Commonwealth environmental water portfolio management planning

Commonwealth Environmental Water Holder

The Commonwealth Environmental Water Holder is a statutory position established under the *Water Act 2007* and is responsible for managing the Commonwealth's environmental water holdings. This water must be managed to protect and restore the rivers, wetlands and floodplains (and the native animals and plants they support) of the Murray–Darling Basin. Ms Jody Swirepik is the current Commonwealth Environmental Water Holder. She is supported by staff of the Commonwealth Environmental Water Office, which employs six local engagement officers who live and work in regional centres across the Murray–Darling Basin.

Commonwealth environmental water

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

There are broadly three options for managing Commonwealth environmental water:

- delivering water to a river or wetland to meet an identified environmental demand
- leaving water in storage and carrying it over for use in the next water year (referred to as 'carryover')
- trading water, that is, selling water and using the proceeds to buy water in another catchment or in a future year, or investing in complementary 'environmental activities'.

Purpose of the document

This document sets out the plans for managing the Commonwealth environmental water portfolio in the Northern Intersecting Streams for 2019–20. Efficient and effective management of Commonwealth environmental water requires the utilisation of all portfolio management options. By taking a multi-year approach to planning, portfolio management tools such as use, carryover and trade can be managed for maximising environmental outcomes.

The portfolio management plans support transparent, coordinated and adaptive management of Commonwealth environmental water, consistent with the Basin-wide environmental watering strategy and having regard to the Basin annual environmental watering priorities.

To learn more about the planning approach see *Portfolio Management Planning: Approach to planning for the use, carryover and trade of Commonwealth environmental water, 2019–20* (available at: <http://www.environment.gov.au/water/cewo/publications> under 'Planning approach').

Delivery partners

Commonwealth environmental water is managed with advice from a range of partners. In the Northern Intersecting Streams, our partners include the Queensland Departments of Natural Resources, Mines and Energy (DNRME), Environment and Science (DES) and Agriculture and Fisheries (DAF), New South Wales Office of Environment and Heritage (NSW OEH), New South Wales Department of Primary Industries – Fisheries (DPI Fisheries), New South Wales Department of Industry – Water (DoI Water), SunWater and WaterNSW.

Your input

The management of Commonwealth environmental water relies on considerable advice and assistance from 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 Commonwealth Environmental Water Office via: ewater@environment.gov.au.

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Environmental watering in the Northern Intersecting Streams

1.1. The Northern intersecting Streams

The Northern Intersecting Streams include the Moonie, Condamine–Balonne, Nebine and Warrego river systems (Figure 1). These rivers have many common features, and for planning purposes, are grouped together. Flow in these river systems is dominated by occasional rainfall events rather than being 'controlled' by public dams and other infrastructure as occurs in 'regulated' catchments of much of the Basin to the south. The majority of water use and entitlement is in the form of diversion of river flows and water during periodic unregulated flow events that breaks out of rivers and becomes overland flows across floodplains. Large-scale irrigation in the region is supported by large capacity pumps that divert water during unregulated flow events into on-farm storages ('ring tanks') for later use. Small-scale diversion of unregulated flows direct water to cropped areas or small storages also occurs in areas where floodplains are limited or flows are too unreliable (e.g. effluent channels) to support large scale irrigation.

The Northern Intersecting Streams are characterised by highly variable rainfall and ephemeral (intermittent) river flows. Significant flow events generally result from heavy rainfall in elevated headwater areas. Runoff into rivers from lowland areas usually makes only a minor contribution as rain that falls on the flat floodplains tends to evaporate or seep into the ground rather than becoming streamflow. In some northern unregulated systems, no flow periods of several months are common and may extend to several years during prolonged dry conditions. The degree of intermittency varies between rivers. Most of the Lower Balonne system and the Moonie, Warrego, Nebine and Paroo systems are highly intermittent, experiencing no flow for 50 percent or more of the time on a long term basis.

The Northern Intersecting Streams include headwater and slopes zones but for most of their length flow through flat semi-arid rangelands. The flat landscape, low local runoff and intermittent flow conditions have led to the evolution of distinctive ecology in lowland river reaches. Aquatic and floodplain species are adapted to high flow variability and 'boom and bust' cycles. This is characterised by episodes of intense reproduction and high productivity by opportunistic plants and animals - (the 'boom') associated with periods of flooding, followed by periods of stress and reduced production - 'the bust' (Arthington and Balcombe 2011; Sheldon et al. 2010).

The lands and waters of the Northern Intersecting Streams catchments have been important to Aboriginal people for more than 25,000 years. Many Aboriginal nations retain a connection with the region and their history, culture and livelihoods are closely intertwined with its river systems.

- The Warrego catchment takes in (or closely borders) the traditional lands of the Bidjara, Gwamu/Kooma, Gunggari/Kungari, Kunja, Mandandanji, Mardigan and Murrawarri nations (MDBA 2019a).
- The downstream Barwon-Darling catchment includes the land of many Aboriginal nations including the Barkindji, Murrawarri, Ngemba and Ngiyampaa (MDBA 2019b).
- Aboriginal nations of the Condamine-Balonne region include Barunggam, Bidjara, Bigambul, Euahlayi, Gomeroi/Kamilaroi, Giabel, Githabul, Gunggari, Guwamu/Kooma, Jarowair, Kambuwal, Mandandanji, Murrawarri, and Wakka Wakka (MDBA 2019c).
- The Moonie catchment includes the traditional lands of the Bigambul, Gomeroi/Kamilaroi and Mandandanji nations (MDBA 2019d).
- The Paroo catchment includes (or borders) the traditional lands of the Bidjara, Budjiti, Gwamu/Kooma, Kunja, Mardigan and Murrawarri Nations (MDBA 2019e).

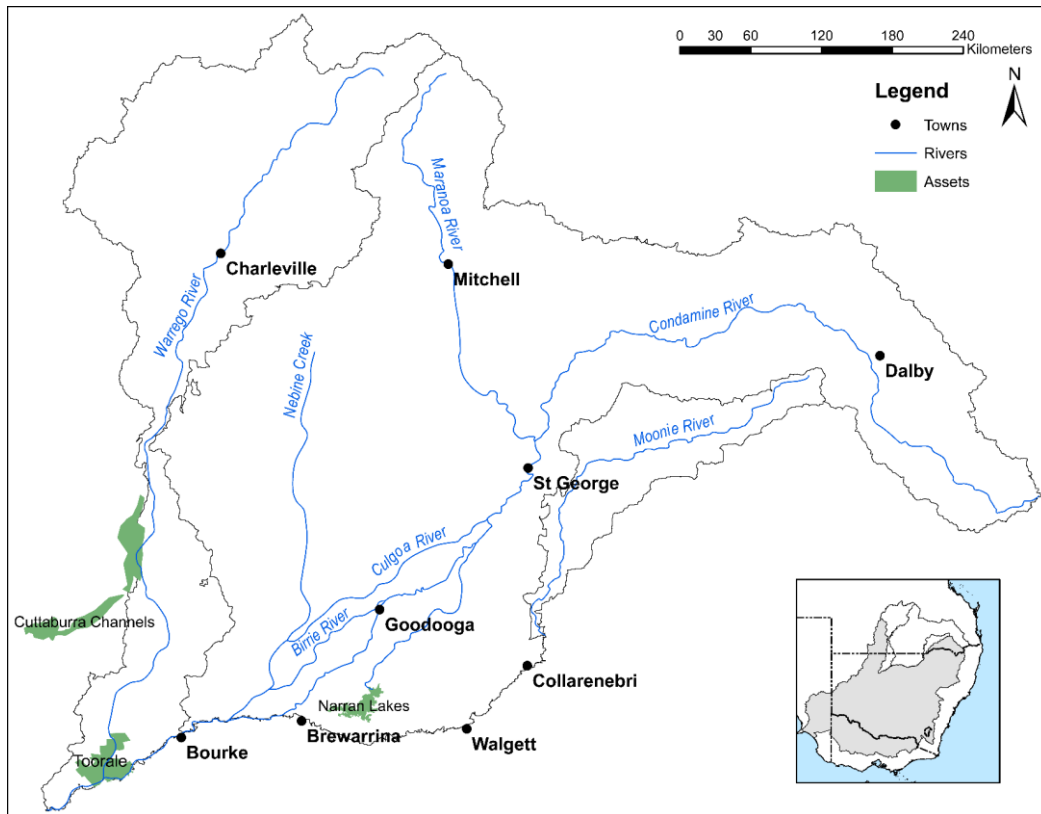


Figure 1: Map of the Northern Intersecting Streams.

Environmental assets of the Northern Intersecting Streams

There are many environmental assets in the Northern Intersecting Streams that are of international and national significance. These environmental assets include species and communities of fish, waterbirds and vegetation and important habitats such as wetlands and drought refuges.

The Condamine–Balonne and the Warrego catchments supports the largest area of wetlands of any catchment in the Murray–Darling Basin. An important example in the Condamine–Balonne is the Narran Lakes. This terminal wetland complex is of both national and international significance, comprising of the **Narran Lakes Nature Reserve** (28,323 ha) and the **Ramsar listed Narran Lakes site** (8,447 ha) within (Figure 2).

At the time of the Narran Lakes listing as a Wetland of International Importance under the Ramsar Convention, an Ecological Character Description (ECD) was outlined. This ECD describes the ecological character including components, processes and services of the wetland and is a fundamental tool for site managers by outlining threats and limit of acceptable change. Butcher et al. (2011) described the critical components and processes as:

- **Hydrology and productivity:** The Narran River system has highly variable flows driven by summer rainfall in the upper catchment. It is also a losing system because of high evaporation. A range of flood magnitudes are essential to maintain floodplain condition including productivity. Hydrological connectivity and variation in inundation is a key to maintaining floodplain productivity.
- **Vegetation:** A key characteristic of the site is the complex channelised floodplain, which is vegetated with lignum in vast expanses. Three distinct wetland basins are present within the site: Clear Lake, Back Lake and the Long Arm (Figure 2).
- **Fish:** Native fish species dominate the system with 11 species recorded from several surveys.
- **Waterbirds:** supports a significant number of migratory bird species including 14 species listed under international migratory species treaties and a further 26 species which are migratory within Australia. Significant breeding populations of colonial breeding species including great eastern egret (*Ardea modesta*), glossy ibis (*Plegadis falcinellus*), Australian white ibis (*Threskiornis molucca*) straw-necked ibis (*Threskiornis spinicollis*), and royal spoonbill (*Platalea regia*) are supported at the site.

The Narran Lakes also provides critical supporting services, such as near natural wetland system and threatened species:

- Murray cod (*Maccullochella peelii peelii*) listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) and critically endangered on the IUCN Red List (IUCN 2010).
- Australasian bittern (*Botaurus poiciloptilus*) is listed as endangered under both the EPBC Act and the IUCN Red List (IUCN 2010).
- Winged peppercress (*Lepidium monoplacoides*) is listed as endangered under the EPBC Act (Butcher et al. 2011).

A key threat to the ecological character of the Narran Lakes is increased upstream water extraction, with potential impacts identified as reduced vegetation health and loss of habitat for waterbird breeding; and reduced value as drought refuge and support of critical life stages.

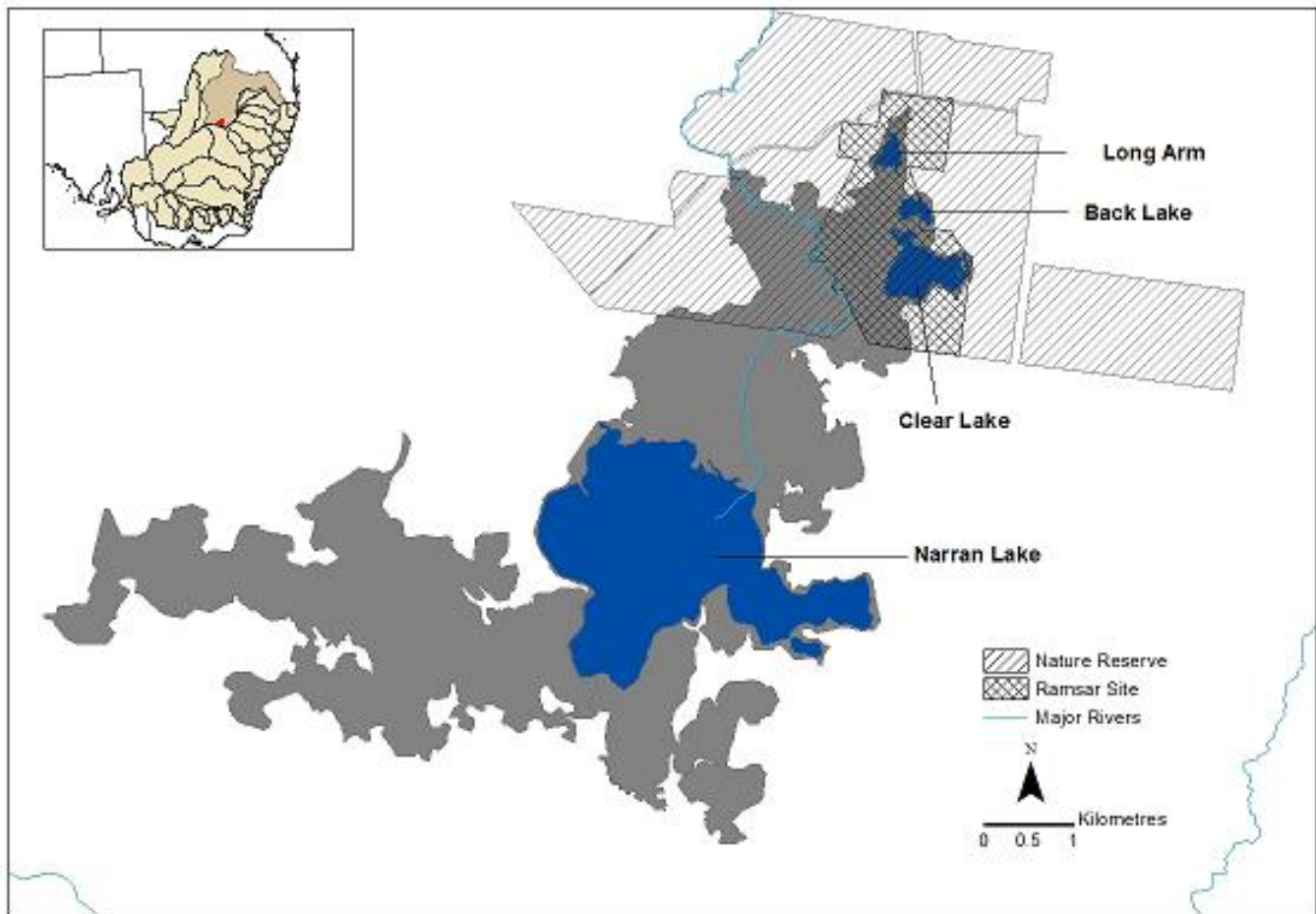


Figure 2: The Narran Lakes.

The Culgoa River floodplain comprises adjacent national parks in NSW and Queensland, which protect over 100,000 hectares of the interlinked floodplains of the Culgoa River and Nebine Creek. The Culgoa floodplain is noted for its high plant diversity and low percentage of introduced species (Dick 1993) and large relatively intact expanses of native grassland and coolibah woodland (Hunter 2005), including samples of the threatened ecological community coolibah-blackbox woodland (listed as endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act)).

The Warrego catchment contains the Cuttaburra Channels and nationally significant Yantabulla Swamp, which is a mosaic of channels, floodways and wetlands that consistently supports large numbers and a high diversity of waterbirds and when flooding provides breeding sites for ducks and colonial waterbirds.

Another ecologically important wetland is Toorale's Western Floodplain, located at the junction of the Warrego and Darling rivers. In wet conditions this area provides an important feeding and breeding site for fish, birds, frogs, turtles and yabbies. Over 100 species of birds have been seen at Toorale include eastern great egret, pink eared duck and brolgas. Toorale has a high plant diversity including a species listed as threatened in NSW, tiny teeth (*Dentella minutissima*).

These ecological populations and habitats are connected by the Barwon–Darling River, providing a critical drought refuge and movement corridor for fish and waterbirds. These are described below, and in more detail in [Attachment A](#).

Fish species in Northern Intersecting Streams listed as threatened at the state and/or Commonwealth level include Murray cod and silver perch. Additionally, these rivers support important remnant populations of olive perchlet, purple spotted gudgeon, and freshwater catfish that are less prevalent or no longer present in the southern Basin. There are a number of species that only occur in the northern Basin, including Rendahl's and Hyrtl's tandan.

Waterbird species, including international migratory species, visit habitats along Northern Intersecting Streams. These species include the great egret, glossy ibis, and rainbow bee-eater. Additionally, nationally threatened waterbirds (including Australian painted snipe and Australasian bittern) and species listed as threatened in NSW (including the brolga, freckled duck and blue-billed duck) live in habitats along the Northern Intersecting Streams. Any watering actions that contribute to maintaining waterbird habitat or support waterbird breeding within the Northern Intersecting Streams may also benefit waterbird populations more broadly across the Murray–Darling Basin and beyond, by increasing the opportunity for recruitment and recovery. Additionally, there is increasing evidence of the connection between waterbird populations observed in the Narran Lakes and other wetlands along Northern Intersecting Streams with other important nearby ecological assets such as the Macquarie Marshes and the Gwydir Wetlands. The range of many waterbird species extends further afield from the Macquarie Marshes to key ecological assets including the Booligal Wetlands, Barmah–Millewa Forest, Coorong and Lower Lakes.

Native vegetation along the Northern Intersecting Streams is also highly significant. An example is the ecological community of coolibah-black box woodland on the Culgoa River floodplain which is listed as endangered under Commonwealth and NSW legislation. Important riparian and floodplain vegetation in the dryland catchment areas include lignum, river red gum, river cooba black box, and coolibah. There is a high proportion of remnant vegetation in good condition in some areas, including the floodplains of the Warrego and Culgoa rivers.

In between boom periods river channels typically dry to a series of disconnected waterholes, which are **drought refuges** that are reconnected by the next significant flow event. Semi-permanent and permanent waterholes in the main river channels and tributary creeks and anabranch systems are critical to ensuring the survival of species between boom periods and their capacity to recolonise the system in subsequent flow periods. Much of the riverine fauna (e.g. fish, turtles, invertebrates) of the Northern Intersecting Streams is dependent upon the persistence of a network of refugial waterholes during frequent and often prolonged no flow periods.

The Barwon–Darling river channel connects all the rivers, lakes and wetlands in the northern Murray–Darling Basin, providing a critical dry period refuge and movement corridor for fish and waterbirds, as well as habitats for other aquatic species including turtles, mussels, and shrimp. Connectivity between the Barwon–Darling and the Northern Intersecting Streams is particularly important for regional communities of native fish and other aquatic species. The environmental demands in the Barwon–Darling are described in the *Commonwealth Environmental Water Portfolio Management Plan: Barwon–Darling 2019–20*.

1.2. Environmental objectives in the Intersecting Streams

The long-term environmental objectives for the Murray–Darling Basin are described in the Basin Plan's environmental watering plan and the Basin-wide environmental watering strategy, which includes 'quantified environmental expected outcomes' at both a Basin-scale and for each catchment. The expected outcomes relevant for the Northern Intersecting Streams are summarised in Table 1 and described in detail in [Attachment A](#).

The NSW state government is developing a long-term watering plan for the NSW parts of the Northern Intersecting Streams catchment. This plan will identify the priority environmental assets and ecosystem functions in the catchment, the objectives and targets for these assets and functions, and their watering requirements. Once finalised, the plan will provide the key information on the long-term environmental water demands in the catchment. Prior to the development of long-term watering plans and water resource plans, the Commonwealth Environmental Water Office will continue to draw on existing documentation on environmental water demands developed by state governments, local natural resource management agencies and the Murray–Darling Basin Authority.

The Queensland state government have also developed long-term watering plans for the Queensland Warrego, Paroo and Nebine catchments (QDNRM 2016); the Condamine-Balonne (QDNRME 2019a) and the Moonie (and Queensland Border Rivers) (QDNRME 2019b). The plans identify the priority environmental assets and ecosystem functions in these catchments, the objectives and targets for these assets and functions, and their watering requirements. The plan for the Queensland Warrego, Paroo and Nebine catchments is available here: https://www.dnrme.qld.gov.au/_data/assets/pdf_file/0015/403215/mdb-watering-plan-warrego-paroo-nebine.pdf; the Condamine Balonne plan at https://www.mdba.gov.au/sites/default/files/pubs/qld-long-term-watering-plan-condamine-balonne-2019_0.pdf; and Moonie and Queensland Border Rivers at <https://www.mdba.gov.au/sites/default/files/pubs/qld-long-term-watering-plan-border-rivers-moonie-2019.pdf>.

Both the NSW and Queensland long-term watering plans in the Northern Intersecting Streams form part of draft state catchment based water resource plans (required under the Basin Plan). Each water resource plan sets out the rules for how water is used at a local or catchment level, including new limits on how much water can be taken from the system, how much water will be made available to the environment, and how water quality standards can be met. Basin state governments are responsible for complying with water resource plans and accounting for water taken from the river system (MDBA 2019f). Water resource plans outline how each region aims to achieve community, environmental, economic and cultural outcomes and ensure that state water management rules meet the Basin Plan objectives. The plans reflect current arrangements that are working and include new arrangements that strengthen water management at a local level (MDBA 2019f).

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

Table 1: Summary of objectives for environmental watering in the Northern Intersecting Streams

BASIN-WIDE OUTCOMES (Outcomes in red link to the Basin-wide Environmental Watering Strategy)	EXPECTED OUTCOMES FOR NORTHERN INTERSECTING STREAMS ASSETS		
	IN-CHANNEL ASSETS	OFF-CHANNEL ASSETS	
		Wetlands, lagoons and billabongs	Anabranches and effluent creeks
VEGETATION	Maintain riparian and in-channel vegetation condition, growth and survival	Maintain and improve wetland vegetation condition, growth and survival in targeted sites. Maintain floodplain vegetation (with use of unregulated holdings and flows)	
WATERBIRDS		Maintain foraging, roosting and breeding habitats at targeted sites on the floodplain to support waterbirds	
FISH	Provide flows that improve habitat conditions and support different life stages (migration, spawning, recruitment, refuge)	Support natural flow variability and connectivity between the river channel, wetlands anabranches and floodplains	
INVERTEBRATES	Provide habitat (e.g. pools and riffles) and conditions (low flows, freshes, scouring flows) to maintain /improve micro and macroinvertebrate condition and diversity.		
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 in the major unregulated streams and with the Barwon-Darling	Support lateral and longitudinal (anabranches) connectivity between the river(s) 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 water quality benefits	
RESILIENCE	Provide refuge habitat for fish and other aquatic fauna		

Information sourced from: CEWO (2014), Davie and Mitrovic (2014), Kingsford (1999), McGinness and Arthur (2011), MDBA (2012a-d), NSW DWE (2009a, b), SKM (2009, 2012), Thoms et al. (2005), Australian Wetlands (2009), Eco Logical Australia (2015, 2017a, 2017b, 2018)

1.3. Environmental flow requirements

Occasional flow events are important features of the Northern Intersecting Streams. In some rivers, these flow events may only occur once or several times in a year. Seasonal flow patterns have largely been preserved in the Northern Intersecting Streams. However, diversions during unregulated flow events and flow changes associated with small public regulated water schemes (such as the Condamine–Balonne) and in-stream weirs with diversions to private infrastructure have reduced the volume, duration and frequency of flows that support in-stream and floodplain communities, and terminal wetlands in some areas. End of system flows have been reduced in all systems. Low flow regimes have also been affected in some areas, including an increase in the percentage of time with no flow and the maximum period between events that refill waterholes and re-establish hydrological connectivity throughout the system.

The Murray-Darling Basin Authority assessed the environmental flow requirements of streams across the Basin in 2012. In 2016 the Murray-Darling Basin Authority re-assessed the environmental water requirements of the Condamine–Balonne systems, based on an improved science base (MDBA 2016). There are also ongoing research activities contributing to our understanding of environmental water requirements of the Northern Intersecting Streams including the Joint-venture science program and state planning assessments as part of the long-term watering plans.

As discussed in Section 1.2, the NSW and Queensland long-term watering plans are nearing completion in 2019-20 and will be used to inform the Northern Intersecting Streams Portfolio Management Plan in 2020-21 and future years.

The Commonwealth also funded the Murray-Darling Basin Environmental Water Knowledge and Research (EWKR) project (for five years to June 2019) which provided important information, including several research projects in the Lower Balonne, to support managing environmental water in the Basin (CEWO 2019; Mynott and Balcolme 2019; Dunne 2019; Senior 2019).

Environmental watering requirements at Toorale and in the Warrego River are being refined and informed by local knowledge and Long Term Intervention Monitoring (LTIM) monitoring activities funded by the Commonwealth Environmental Water Office.

The Commonwealth Environmental Water Office has worked with water recovery teams of Commonwealth and state government to ensure that unregulated entitlements recovered in the Northern Intersecting Streams provide flows that contribute towards meeting the environmental flow requirements. Where long term outcomes are not being met by natural flows, short-term or urgent environmental demands, if feasible, can be addressed by using event based mechanisms and other management approaches, which are discussed in Section 2.

Based on the above objectives and delivery constraints, specific watering requirements (flow magnitude, duration, timing and frequency) have been identified as being in scope for Commonwealth environmental water. These water requirements are described in Table 4. As with the objectives, the environmental water requirements will continue to be reviewed and revised in response to new knowledge.

1.4. Lessons from previous years

Outcomes from monitoring and lessons learned in previous years is a critical component for the effective and efficient use of Commonwealth environmental water. These learnings are incorporated into the way environmental water is managed.

The Commonwealth Environmental Water Office works with the Murray-Darling Basin Authority, state agencies, research organisations, regional organisations, local groups and others, such as landholders to collect and collate relevant monitoring information and evaluation results that facilitates adaptive management and changing our practices where needed. This continual review of information and outcomes is helping to build knowledge about the best way to get positive outcomes on a larger scale, based on what works and what doesn't work. Experiences from recent water management in the Northern Intersecting Streams (and connection with the downstream Darling system) suggest that:

- The water needed to replenish waterholes and allow for seepage is much greater if a river has ceased-to-flow and antecedent conditions are dry, compared to when a river is still flowing.
- Within catchment water requirements need to be balanced with broader system needs when environmental water availability is low.
- Any future operational protocols and systems to better manage environmental flows should be practical. Improvements to metering and hydrometric systems are likely, which would underpin the implementation of sound operational protocols.
- There can be strong calls for water to meet broader social requirements before environmental demands become critical.

Key recent findings and recommendations from Warrego and Darling Rivers LTIM Project include:

- Flow pulses in April 2018 and April-May 2019 refilled previously dry waterholes in the lower Warrego River, allowing aquatic species such as fish, frogs and waterbirds to recolonise these sites.
- Increased flows down the Darling River zone, including the northern connectivity event improved water quality parameters such as conductivity (i.e. salinity) through dilution, which has been a consistent trend over the four years of the LTIM project.
- Juvenile native fish species were surveyed in the Warrego River following small flow pulses in 2017-18 and 2018-19. The age of golden perch monitored suggest that they spawned upstream and were transported downstream into the Selected Area. These replenishing flows to the lower Warrego River are considered important to replenish refuge habitat for the young of year native fish located in this reach.
- Vegetation on the Western Floodplain reduced in groundcover and richness in 2017-18 because of the dry conditions. However, species such as lignum appeared in better condition than the groundcover, displaying the benefits of flooding during 2016-17. Western Floodplain vegetation is expected to have responded positively to relatively small-scale inundation in April-May 2019.
- Overall, the ecology of the Selected Area appears to be resilient and well adapted to the boom and bust nature of the area.

Research projects in the Lower Balonne that form part of the EWKR project have improved our understanding of water availability and use by vegetation of the Lower Balonne floodplain (QDSITI and QDNRM 2017) and of important refugial waterholes for native fish (Mynott and Balcombe 2019).

The Commonwealth Environmental Water Office also makes use of monitoring undertaken by state partners. For example, our partners provide updates on the condition of important in-channel and riparian habitats, such as refugial waterholes in the Lower Balonne and waterbird breeding habitat in the Ramsar listed Narran Lakes. The outcomes from these monitoring activities, and any other available relevant data, are used in adaptive management to inform portfolio planning and decision-making.

Further information on the monitoring activities is available at:

<http://www.environment.gov.au/water/cewo/catchment/northern-unregulated-rivers/monitoring>

2. Portfolio management in 2019–20

The Northern Intersecting Streams has less regulating structures compared with other areas of the basin, particularly the south. This is a positive for the environment but also can limit options for discretionary use of environmental water. Water cannot be ordered from public storages at a particular time – environmental water can only be sourced as a share of an unregulated flow event, determined by entitlement conditions, or possibly in the future, released from private storages. Carryover and management of account balance cannot generally be used to influence the timing and volumes of environmental water in river systems. There is limited public infrastructure such as dams, weirs and other structures in the region to regulate environmental flows to target particular assets. There is some capacity to direct flows in at the junction of the Warrego and Darling rivers through infrastructure on the Toorale site (managed by the NSW National Parks and Wildlife Service in consultation with the Toorale Joint Management Committee). However, this is limited by the nature of the Commonwealth's entitlements in the Warrego and Darling Rivers and day to day operations of the Toorale infrastructure is managed by NSW National Parks and Wildlife Service. Upgrades and changed management of the Toorale structures and operating structures is underway through the Toorale Infrastructure Project.

Most Commonwealth unregulated entitlements are left in-stream to provide environmental benefits by restoring flows that were formerly extracted and improving flow variability. The ongoing use of existing and future unregulated entitlements in the northern Basin (excluding the Toorale Warrego River entitlements and NSW supplementary water holdings) has been approved by the Commonwealth Environmental Water Holder. These entitlements will contribute to the multi-year and 2012-20 environmental watering priorities outlined in Section 2.1.

Event based mechanisms are being designed to allow more targeted management of unregulated entitlements so as to achieve greater ecological outcomes. These mechanisms may include use of in-stream and on-farm infrastructure to store and release water, and temporary purchase, conditional purchase, and forward purchase. Management could be used to enhance overall flows, alter the timing or rate of flow or to direct flow to a different watercourse or an off-stream asset. Further discussion on events-based mechanisms can be found at Section 2.2.

2.1. Antecedent and current catchment conditions and the demand for environmental water in 2019–20

For the first half of the 2018-19, the Northern Basin experienced below average to very much below average rainfall conditions resulting in very low to no flows across all systems (BOM 2019a). At the same time, some areas were experiencing record hot temperatures during spring and summer, including very warm nights, which exacerbated no flow conditions and increased environmental demand (BOM 2019b).

Heavy rainfall from ex cyclone Trevor fell in the upper Warrego at the end of March 2019, with more falls in late April and early May. This rainfall led to significant flows in the catchment with around 400 gigalitres (GL) passing the Wyndara gauge on the Warrego River (QDNRME 2019c). Of this close to 100 GL flowed past the Turra gauge along Cuttaburra Creek and over 50 GL passed the Barringun gauge on the Warrego. Inflows into Darling River from the Warrego River were observed in late April with over 23 GL passing the gauge at Louth. Over 7 GL was estimated to have inundated the Western Floodplain with some of this water returning to the river through a breach in the Western Training embankment. Flow from the Warrego River reached Wilcannia in mid-June 2019, helping to replenish waterholes within the mid to lower reaches of the Barwon-Darling system. From an environmental perspective, these flows into the Darling (in combination with local rainfall parts of the Darling catchment) provided great benefit in wetting the system following extended dry periods, filling up pools, connecting reaches of waterway and improving water quality. However, because the system was so dry and the extent of the rainfall events was limited, large scale connectivity along the system was not achieved.

Rainfall in the Condamine-Balonne in mid-December around Chinchilla and Dalby resulted in significant flows in the middle reaches of the Condamine River with inflows to Beardmore Dam. These inflows triggered an environmental, stock and domestic (ESD) release of around 5.8 GL, which reached Dirrinabandi on the Balonne minor and around 10km downstream of the Cubbie weir on the Culgoa River. In April 2019, rainfall generated inflows into Beardmore Dam from Dogwood Creek with 3.9 GL released for ESD. Rainfall in late April led to flows in Maranoa with a further 7 GL being released for ESD (QDNRME 2019d). Releases from Beardmore connected with inflows from the Nebine River replenishing waterholes along the Culgoa and into the Barwon-Darling to Bourke (QDNRME 2019c).

Rainfall in the Moonie catchment during December 2018 led to a small flow that triggered limited access to water harvesting (QDNRME 2019e).

A range of ecological assets in the Northern Intersecting Streams are under stress. For example, the ecological information in the Condamine–Balonne indicates that despite flows in 2018–19, some ecological assets remain under stress:

- Large areas of lignum shrubland, which provide waterbird breeding and foraging habitat within the Ramsar wetland site, have not been inundated since April 2013. The last large-scale waterbird breeding event observed in the northern unregulated catchments was in March 2012, at Narran Lakes.
- Several refugial waterholes on the Narran River system, including one waterhole that was previously identified as persistent, went dry in 2017–18, increasing the population extinction risk for native aquatic

fauna, including golden perch. Despite several ESD releases in 2018-19, there has not been a flow through event along the Narran River since 2016-17.

- The Birrie and Bokhara rivers, experienced only short periods of flow in the last five years with the recent ESD flow not reaching end of system in the two middle distributaries.
- Woodland communities on the Culgoa River floodplain, including the threatened coolabah–blackbox ecological community, have not been inundated from river flows for more than six years.

There are ecological assets in the Northern Intersecting Streams that are in good condition. Waterholes and wetland habitat in the Warrego and Cuttaburra channel network has been replenished. Recent monitoring has found evidence of golden perch spawning upstream of Toorale during flow events. While ongoing monitoring of Toorale's Western Floodplain has shown how this boom and bust system comes to life after rain and environmental watering providing important habitat for native fish, waterbirds, turtles and frogs.

Annual flows at key ecological sites in the Northern Intersecting Streams between 2008 to 2018 are summarised in Table 2.

Table 2: Annual flows at key sites in the Northern Intersecting Streams 2008 to 2019 (updated 17 June 2019)

Catchment	Gauge (period of records)	Recent annual streamflow ¹										
		2008–09	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19
Moonie	Nindigully (from 1969)	Mod	Very High	Highest on record	Very High	High	Low	Very Low	Very Low	High	Mod	Very Low
Lower Balonne	St George (from 1971)	Very Low	Very High	Highest on record	Very high	High	Low	Low	Low	Mod	Low	Very Low
	Wilby Wilby (from 1964)	Very Low	High	Highest on record	Very high	High	Low	Low	Low	Mod	Very low	Very Low
Nebine Creek²	Roseleigh Crossing (from 2007)	Mod	Highest since 2007	High	High	Very Low	Low	Low	High	Mod	Low	Mod
Warrego	Wyandra Qld (from 1966)	Low	Very High	Very High	Very High	Lowest on record	Very Low	Low	Low	Mod	Low	Mod
	Ford's Bridge NSW (from 1972)	Low	Very High	Very High	Very High	Very Low	Very Low	Low	Very Low	Mod	Very low	Mod

Notes to Table 2:

1 Annual catchment streamflow was defined at key locations as follows:

Very low: up to 17.5 per cent rank	Low: 17.5 – 37.5 per cent rank	Moderate: 37.5 – 62.5 per cent rank
High: 62.5 – 82.5 per cent rank	Very high: greater than 82.5 per cent rank	

A rank of 10 per cent means that 10 per cent of the years in the observed record have lower flows than occurred in that year, with 90 per cent of years having higher flows. Data is sourced from NSW Department of Primary Industries –Water (NSW gauge sites) and Queensland Department of Natural Resources and Mines (Queensland gauge sites).

2 Indicative only. Gauged flow data is insufficient to accurately classify annual streamflow in the Nebine Creek catchment.

Murray–Darling Basin-wide environmental watering strategy and 2019–20 annual priorities

The Murray-Darling Basin Authority publish the Basin annual environmental watering priorities each year and have published multi-year priorities since 2017-18. Commonwealth environmental water in the Intersecting Streams catchment will contribute to the following multi-year environmental watering priorities and the 2019-20 Basin annual environmental watering priorities.

Rolling, multi-year priorities

The rolling, multi-year priorities for river flows and connectivity are to:

- Support lateral and longitudinal connectivity along the river systems.

The rolling, multi-year priorities for native vegetation are to:

- Maintain the extent, improve the condition and promote recruitment of forests and woodlands.
- Maintain the extent and improve the condition of lignum shrublands.

The rolling, multi-year priorities for waterbirds are to:

- Improve the abundance and maintain the diversity of the Basin's waterbird population.

The rolling, multi-year priorities for native fish are to:

- Improve flow regimes and connectivity in northern Basin rivers to support native fish populations across local, regional and system scales.
- Support viable populations of threatened native fish, maximise opportunities for range expansion and establish new populations.

2019-20 Annual Priorities

Proposed watering activities are consistent with Murray-Darling Basin Authority Basin-wide annual watering priorities for 2019-20, including:

Support flows to the Narran Lakes

- maintain habitat at Narran Lakes so waterbirds can shelter and breed
- replenish refuge waterholes for native fish

2.2. Feasibility of targeted management of entitlements by catchment¹

The Water Act 2007 provides for the trade of Commonwealth environmental water (allocations and entitlements) and specifies the conditions under which sales may occur. To improve environmental outcomes must be the primary reason for trade of Commonwealth environmental water. In most northern unregulated catchments the trade of water allocations is not an appropriate or available strategy. An alternative strategy is to enter into contracts with water licence holders as part of an event based mechanism to provide additional water to the environment. Ongoing work in 2019 in consultation with entitlement holders, local councils and state agencies is anticipated to lead to the development of the most optimal arrangement for influencing a flow event, with possible pilots in 2019-20 depending on rainfall.

¹ Previous Portfolio Management Plans for the Northern Intersecting Streams catchment referred to 'active management' of environmental flows, in the context of managing unregulated entitlements which would otherwise be left in-stream to achieve environmental benefits. For example, event-based mechanisms which allow for more targeted management of unregulated entitlements so as to achieve greater environmental outcomes. References to 'active management' have been removed in the 2019-20 Northern Intersecting Streams Portfolio Management Plan to avoid confusion, as the term 'active management' is being used with a different meaning in NSW as part of the NSW Water Reform Action Plan. 'Targeted management' is used throughout the 2019-20 Northern Intersecting Streams Portfolio Management Plan as a replacement term.

Potential for targeted management of entitlements in Northern Intersecting Streams is described in Table 3 based on the criteria on operational readiness and the environmental demands listed in Figure 2.

Overall:

- The development and implementation of new event based mechanisms in 2019-20 will focus on actions in the Lower Balonne. Further work is being undertaken by Marsden Jacob Associates on behalf of the Commonwealth Environmental Water Office to assess effectiveness, risk, feasibility, regulatory and compliance arrangements required to support the implementation of these measures.
- Management of the Commonwealth's unregulated holdings on the Warrego River at Toorale will continue in accordance with the management strategy for use of these entitlements at Boera Dam (Attachment C). Water available after license conditions are triggered will be directed either downstream to enhance low or fresh flows in the lower Warrego and Darling Rivers, and/or to areas on Toorale's Western Floodplain.
- The management strategy includes a decision tree that helps determine environmental priorities and volumes to be used. Factors considered include antecedent flows, current in-stream and wetland conditions, the size and duration of the flow and implications for the use of environmental water in future years. Where the water is delivered will depend on the relative environmental demand in these areas at the time of the flow.
- The management strategy is being updated based on adaptive management and information in the long-term watering plan for the Intersecting Streams to create greater transparency regarding decisions to direct water downstream into the Darling River or onto the Western Floodplain.
- Potential changes to the Toorale management strategy to be discussed with local stakeholders and delivery partners:
 - Directing water to the downstream Darling when:
 - extended cease-to-flow conditions are occurring (greater than 75 days of no flow at Louth; greater than 100 days of <380 ML/day flow at Louth (base flow)
 - there has been extended period since a small fresh in the Darling (greater than 1 year since small fresh (1600 ML/d for 10 days) at Louth)
 - Directing water to the Western floodplain where there has been an extended period since a small-medium watering event:
 - Greater than 2 years since a very small watering event (7 GL over 30 days)
 - Greater than 3 years since a small watering event (16 GL)
 - Greater than 6 years since a medium watering event (33 GL).
 - When the above triggers are not met (expected to be in the majority of years), the management strategy will share delivery between the Western Floodplain and the Lower Warrego and Darling Rivers.

Further information on environmental demands in the Barwon-Darling is provided in the *Commonwealth Environmental Water Portfolio Management Plan: Barwon-Darling 2019–20*.

Table 3: Potential for targeted management of entitlements in the Northern Intersecting Streams

Catchment	Environmental need			Feasibility				Possible actions <i>[italicised actions are the proposed focus of development in 2019–20]</i>	Key issues	Priority for 2019–20
	Specific environmental demands for catchment or target asset?	Long-term shortfall in meeting demand	flow management contributes to environmental requirement	Established market or willing buyers & sellers?	Flexible statutory trading options	CEWO water trading framework	Operationally feasible in 2019–20			
Moynie (Queensland)	NO	NO	NO	NO	NO	N/A	NO	<ul style="list-style-type: none"> - Water off-stream wetland to benefit waterbird habitat/breeding and wetland vegetation - Augment end of system flows into the Barwon River 	<ul style="list-style-type: none"> - Suitable wetland(s) not identified - Limited volumes held or available for purchase - Protection of in-stream flows in the Moynie & Barwon-Darling 	NO
Nebine Creek (Queensland)	NO	NO	NO	NO	NO	N/A	NO	<ul style="list-style-type: none"> - None identified 	<ul style="list-style-type: none"> - Lack of data on flows, long term hydrology, environmental values 	NO
Lower Balonne (Queensland)	YES	YES	YES	YES	YES	TBC	TBC	<ul style="list-style-type: none"> - <i>Waterhole filling flows in Lower Balonne rivers with potential connectivity to the Darling</i> - <i>Narran Lakes 25 GL inflow</i> - <i>Narran Lakes 50 GL inflow</i> - <i>Support waterbird breeding event in Narran Lakes</i> - Enhance medium to large fresh in the Narran River for fish migration 	<ul style="list-style-type: none"> - Measurement and compliance measures to ensure additional purchased flows achieve environmental outcomes - Risk of diversion of additional purchased flows and substitution for planned environmental water 	YES, pending completion of feasibility work
Warrego Queensland	NO	NO	NO	NO	NO	N/A	NO	<ul style="list-style-type: none"> - Water off-stream wetland - Augment flows to Cuttaburra Creek 	<ul style="list-style-type: none"> - Suitable wetland(s) not identified - Demand is likely to be met under existing conditions/recovery 	NO
Warrego NSW (Toorale)	YES	YES	YES	N/A	N/A	N/A	YES	<ul style="list-style-type: none"> - Enhance flows to: <i>The Lower Warrego and Darling rivers to improve low or small fresh flows and provide opportunities for native fish (movement, spawning, recruitment)</i> - Toorale Western floodplain for vegetation, waterbird habitat, breeding and recruitment of frogs, fish, birds and turtles 	<ul style="list-style-type: none"> - Measurement and accounting of managed and overall flows - Timely access to infrastructure in wet conditions and due to remote location 	YES

Note: Contributions to meet Darling environmental requirements will be informed by an assessment of water availability, antecedent conditions, and environmental demands consistent with the Commonwealth Environmental Water Office's strategy for utilisation of the unregulated entitlements on the Warrego River at Toorale.

2.3. Water availability in 2019–20

Water availability depends on the flow events that occur. Unregulated entitlements provide opportunistic access to unregulated river flows and overland flows when a flow event reaches levels specified in entitlement conditions and/or water resource plan triggers at which a period of access may be announced are met. Each entitlement will make a contribution to restoring in-stream flows reflecting its particular flow access windows, take rates and location. Daily, instantaneous, annual or multi-year limits cap overall diversions in any given year or flow event, and likewise the in-stream contributions that can be attributed to unregulated Commonwealth entitlements.

Further detail on sources of environmental water in the Northern Intersecting Streams is provided in [Attachment D](#).

The total volume of water that is available (with full activation of all unregulated entitlements in the Northern Intersecting Streams in 2019–20 exceeds 234 gigalitres. However, this upper limit would rarely, if ever be realised and high utilisation is only likely in very wet years. For example, total utilisation of Commonwealth environmental water across all northern unregulated catchments in 2015–16, a dry year, was only around 20 gigalitres.

2.4. Stakeholder Feedback

Input on environmental demands and management options for the Northern Intersecting Streams has been sought during 2018–19 and in previous years. Event based mechanisms have been discussed with Lower Balonne stakeholders and Queensland departments of Natural Resources, Mines and Energy (QDNRME) and Environment and Science (QDES) over the last few years and will continue in 2019–20. For Toorale, the Joint Management Committee (including NSW National Parks), Eco Logical and NSW DPI Fisheries have provided feedback on the management of the Western Floodplain using Commonwealth environmental water.

Feedback has included:

- There is ongoing support and interest in participation in event based mechanisms amongst Lower Balonne water users, community representatives and Queensland agencies.
- Preliminary results from research activities undertaken in the Lower Balonne waterholes has been used to support changes to low flow requirements in this system, particularly to ensure persistence of refugial waterholes in the Narran River system.
- The Darling River should be considered as a high priority for use of Commonwealth environmental water at Toorale during extended dry conditions such as those experienced in 2018-19.
- The Western Floodplain at Toorale has high ecological value and should continue to be a high priority for environmental water. The Warrego and Darling rivers also have ecological value for fish and are also a priority for environmental water.





Table 4: Environmental demands and priorities for targeted management of entitlements in the Lower Balonne for 2019–20

Environmental assets	Indicative demand (for <u>all sources of water</u> in the system)			Watering history	2019-20	
	Physical and process assets	Flow/volume	Average required frequency (maximum interval)	(from all sources of water)	Environmental demands For water	Potential for targeted management of entitlements
Lower Balonne River channels (Culgoa River, Narran River and inner distributary channels) and Barwon-Darling	Drought refuge (waterholes)	Flow reaches end of all channels within a three month period, indicated by:	Annually (no longer than 12 months between last flow)	While a filling flow has recently occurred in the Culgoa (May 2019), an end of system event did not occur in other systems. This replenishment flow is required for the lower Narran River system where the majority of key refugial waterholes in the Lower Balonne are located ² . Water is required annually to replenish refugial waterholes (contributing to persistence, connectivity and quality).	High to critical	Moderate A moderate priority for unregulated flows that trigger event management rules. Augmentation of flows through event-based mechanisms could be a higher priority in other unregulated flows, given that the demand is not likely to be met in the long term
		30 ML/day Birrie River @ Talawanta for 1 day				
		30 ML/day Bokhara River @ Bokhara for 1 day				
		30 ML/day Culgoa River @ Weilmoringle for 1 day				
		30 ML/d Narran River @ Narran Park for 1 day				
	Culgoa passing flow with connection potentially to the Bourke weir pool	300ML/d for 7 days	9 in 10 years	This flow has occurred over the past several years.	Moderate to High	High A high priority under very dry to moderate water resource availability scenarios
	Culgoa River - longitudinal connectivity	Small in channel fresh 1 000 ML/day @ Brenda for 7 days	8 in 10 years	Although small freshes have occurred 8 in 10 years, the 2017-18 fresh did not meet the duration requirements.	High	High A high priority under all water resource availability scenarios
	Narran River – fish migration	Large in-channel fresh 1 700 ML/day @ Wilby Wilby (August - May) for 14 days	4 to 6 in 10 years	The last in large in-channel fresh that partially met the demand occurred 7 years ago. A small fresh is required this year to maintain existing fish populations and provide for local dispersal and increased recruitment opportunities.	Critical	High A high priority under all water resource availability scenarios. Demand could be met in conjunction with recommended event-based mechanisms (such as seasonal assignments) to also support environmental demands of the Narran Lakes (25 GL inflow)
	Culgoa River – fish migration	Large in-channel fresh 3 500 ML/day @ Brenda (August - May) for 14 days	4 to 6 in 10 years	The last in large in-channel fresh that met the demand occurred 8 years ago, which exceeds or approaches the lifespan of short lived fish species. A large fresh is required this year to maintain healthy fish populations and provide for dispersal and recruitment.	Critical	Potentially out of scope Requires further investigation. Uncertain if sufficient additional flows could be obtained, and would likely have to target one channel not whole system
Lower Balonne River floodplain	Connectivity with the riparian zone	9 200 ML/day Culgoa River @ Brenda for 12 days	Every 2 to 3 years	The last flow of this magnitude occurred 8 years ago, exceeds critical interval (3 years) to maintain condition of river red gum, ephemeral wetlands and lignum communities. Inundation required this year to maintain ecosystem health and function.	Critical	Potentially out of scope Requires further investigation, including ecological outcomes from watering






Environmental assets	Indicative demand (for <u>all sources of water</u> in the system)			Watering history	2019-20	
	Physical and process assets	Flow/volume	Average required frequency (maximum interval)	(from all sources of water)	Environmental demands For water	Potential for targeted management of entitlements
	Connectivity with the inner floodplain	15 000 ML/day Culgoa River @ Brenda for 10 days	Every 3.5 to 4 years	The last flow of this magnitude occurred 8 years ago. Inundation required this year to maintain ecosystem health and function.	<u>Critical</u>	Out of scope Benefit of supplying additional Commonwealth environmental water would be negligible
	Connectivity with the mid floodplain	24 500 ML/day Culgoa River @ Brenda for 7 days	Every 6 to 8 years	The last flow that met the demand occurred 8 years ago. Inundation required within the next year to maintain ecosystem health and function	<u>High</u>	Out of scope Benefit of supplying additional Commonwealth environmental water would be negligible
	Connectivity with outer floodplain	38 000 ML/day Culgoa River @ Brenda for 6 days	Every 10 to 20 years	The last flow that met the demand occurred 8 years ago. Critical interval for inundation, since the 2010-11 and 2011-12 floods, will be around 2020	<u>Low</u>	Out of scope Benefit of additional Commonwealth environmental water would be negligible
Narran Lakes	Waterbird breeding habitat in northern lakes (Ramsar site**)	25 GL @ Narran Park (Narran River) over 60 days	Every 1 to 1.3 years	This demand was partially met 4 years ago. Inflows are required this year to sustain core lignum waterbird habitat and ability to support waterbird breeding.	<u>Critical</u>	High A high priority under all water resource availability scenarios
	Waterbird breeding and foraging habitat northern lakes zone**	50 GL @ Narran Park over 90 days	Every 1.3 to 1.7 years	This demand was met 7 years ago. Inflows are required this year to sustain lignum shrublands and maintain condition of riparian red gum forests.	<u>Critical</u>	
	Trigger and maintain large scale colonial waterbird breeding	154 GL @ Narran Park over 90 days	Twice in every 8 to 10 years	This demand was met 8 years ago. Last large scale waterbird breeding event was in early 2013. An event is required this year or next to provide ibis populations (with Narran site fidelity) with 2 breeding opportunities in their lifetime. An acute and chronic shortage of waterbird breeding across the Basin and the likelihood of this demand not being met in the long term, increases its urgency.	<u>Critical</u>	Potentially out of scope Commonwealth water portfolio is likely to contribute during large flow events
	Water all floodplain and wetland habitat in Narran Lakes complex, initiate waterbird breeding, provide long-term refuge**	250 GL over 180 days @ Narran Park	Every 10 to 12 years	This demand was met 7 years ago. Following the 2010-11 and 2011-12 floods, the critical interval for inundation will be from 2020 (if not received before then).	<u>Low</u>	Out of scope Benefit of additional Commonwealth environmental water would be negligible

**Vegetation types/communities that are identified as critical components of the Ramsar site include lignum shrublands, riparian forest/woodland and ephemeral herbfields. All other critical components, processes and services of the Ramsar site would be supported by meeting the indicative demand.

Key - potential watering in 2019–20

	High priority for Commonwealth environmental watering (likely to receive water even under low water resource availability)
	Secondary priority for Commonwealth environmental watering (watering to occur only if natural trigger is met, or under moderate – high water resource availability); or water demand likely to be met via other means
	Low priority for Commonwealth environmental watering (under high – very high water resource availability)
	Unable to provide Commonwealth water due to constraints

Key - environmental demands

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

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

Note: Contributions to meet Barwon-Darling environmental requirements may be considered subject to water availability, antecedent conditions, and environmental demands. Refer to *Commonwealth Environmental Water Portfolio Management Plan: Barwon-Darling 2019–20*.

3. Next steps

3.1. From planning to decision making

It is important to distinguish between planning and operational decision making. As shown in Figure 3, planning allows the Commonwealth Environmental Water Office to manage the environmental water portfolio in a holistic manner and is an exercise in developing a broad approach or intention, based on the key drivers (demand and supply).

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

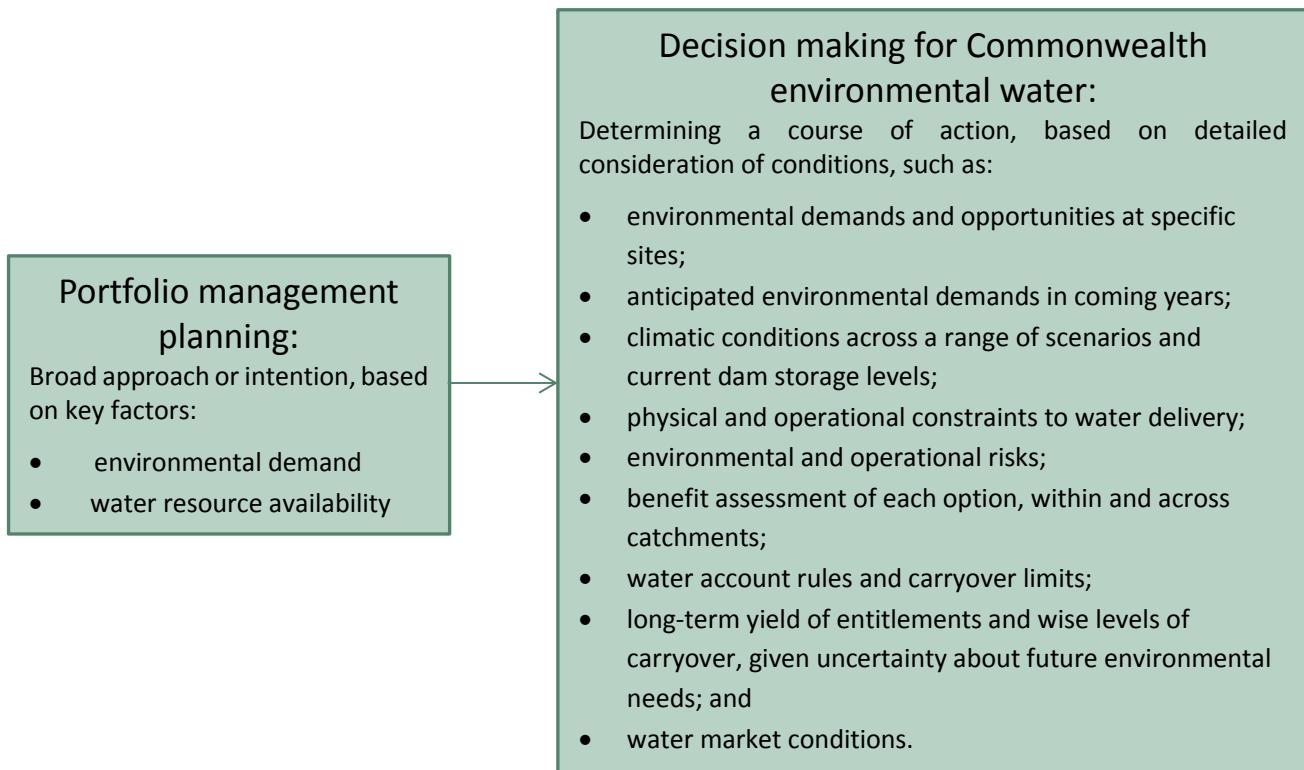


Figure 2: Planning and decision making for Commonwealth environmental water use

3.2. Monitoring

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

The LTIM Project has the junction of the Warrego and Darling rivers as a focus area. It aims to understand the environmental response from Commonwealth environmental watering with respect to the targeted objectives by carrying out monitoring of site condition over many years.

The Monitoring, Evaluation and Research (MER) Program (previously the Long Term Intervention Monitoring Project 2014–2019) has the junction of the Darling and Warrego Rivers as a focus area. It aims to understand the environmental response from Commonwealth environmental watering with respect to the targeted objectives by carrying out monitoring of site condition over many years.

Information on the monitoring activities is available at:

<https://www.environment.gov.au/water/cewo/catchment/northern-unregulated-rivers/monitoring>

Monitoring information is also provided by state governments.

3.3. Further information

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

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

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Attachment A

Lower Balonne

Wetlands cover more than 1.4 million hectares of the Condamine–Balonne–Nebine Creek catchment (Nairn and Kingsford 2012), including nationally and internationally important sites:

Balonne River Floodplain (nationally significant): several hundred hectares of billabongs and swamps within a larger floodplain area below St George in Queensland.

Narran Lakes: a large system of lakes and floodplain wetlands at the terminus of the Narran River in the Lower Balonne that supports internationally significant waterbird and migratory bird habitat. The northern part of the system is a Ramsar listed wetland. Narran Lakes is an important breeding site for many species, particularly straw-necked ibis, and also the Australian pelican, great cormorant, pied cormorant, rufous night heron, little egret, intermediate egret and the gull-billed tern (Thoms et al 2008). The lignum shrub lands in the Narran Lake Nature Reserve are some of the largest undisturbed communities of their type in NSW (NSW NPWS 2000).

Lower Balonne River floodplain: The Lower Balonne River floodplain, covering two million hectares in Queensland and New South Wales, supports the largest area of wetland of any catchment in the Murray-Darling Basin. Native grasslands and coolibah woodlands on the floodplain are some of the most extensive in Australia and are considered to be in near natural condition. The channels of the lower Balonne provide habitat for many aquatic plants and animals, including threatened species such as silver perch and Murray cod. Refugial waterholes that persist in these channels for up to 18 months in the absence of any inflow, are critical to the survival of in-stream fauna (QDSITI 2015).

Warrego

The Warrego catchment also supports a very large area of wetlands, including lignum swamps, flood channels and waterholes, black box and spike rush swamps, claypans, freshwater lakes and saline lakes (Nairn and Kingsford 2012). Several wetlands are of national importance including the following sites that are dependent on low-medium seasonal flows and large floods in the main river (Holz et al. 2008):

The Warrego River Waterholes: a string of large, permanent and intermittent waterholes and billabongs covering 500 hectares along the Warrego River channel from Charleville to south of Wyandra. The waterholes support a rich native fish fauna including Murray cod and silver perch. Flows that reconnect the waterholes have been shown to be important for redistributing previously isolated native fish assemblages and for driving recruitment of several species (Balcombe et al. 2006). Significant waterbird populations can also inhabit the waterholes after flooding.

The Warrego River Distributary System covers 12,000 hectares of open woodlands of coolibah and lignum shrubs in distributary creeks (and their associated floodplain swamps) that break from the Warrego above and below Cunnamulla. They comprise Widgeegoara, Noorama, Thurlgoonia and Tuen Creeks flowing to the south-east and Cuttaburra and Irara Creeks flowing to the south-west.

Cuttaburra Basin includes the nationally significant Yantabulla Swamp, a mosaic of channels, floodways and wetlands covering 37,000 hectares. The swamp consistently supports large numbers and a high diversity of waterbirds and when flooded provides breeding sites for ducks and colonial waterbirds (Kingsford et al. 1994; Kingsford et al. 2013). It is considered the most important breeding site in north-west NSW for the vulnerable freckled duck. The channels of Cuttaburra Creek also support large numbers of waterbirds (Kingsford et al. 1997) and a distinctive woodland vegetation comprising river red gum on the banks of the waterholes and floodplains dominated by Yapunyah gum (limited distribution in NSW), coolibah and black box, with cane grass grassland and lignum also present (King et al. 1995).

The **'Western Floodplain'** at Toorale near the junction of the Warrego and Darling rivers, is a large wetland covering over 10,000 hectares. Key vegetation species include coolibah and black box trees in the upper story, river cooba in the mid-storey and a scattered to dense shrub layer of lignum. The floodplain includes examples of coolibah-black box woodland endangered ecological community listed under

Commonwealth legislation (Gowans et al. 2012).

The Western Floodplain provides habitat for number of international migratory bird species including the rainbow bee-eater, great egret, and glossy ibis; nationally threatened waterbirds including Australian painted snipe and Australasian bittern; and waterbirds listed as threatened in NSW including the brolga, freckled duck and blue-billed duck (Alluvium 2016). Other fauna recorded in the wetland include the desert froglet and the Murray turtle (Capon 2009).

Waterholes along the Warrego River in Queensland, Cuttaburra Creek and other Warrego distributary channels and permanent waterbodies on the Warrego at Toorale provide valuable refuge habitat for fauna including waterbirds, fish, birds and aquatic macroinvertebrates during dry periods. Ten species of native fish have been recorded in waterholes in the lower Warrego in Queensland (Balcombe et al. 2006) including threatened species listed in state or Commonwealth legislation. The storages at Toorale also intermittently support significant numbers and numerous species of waterbirds (Capon 2009). Waterbird breeding activity, in the Australasian darter, black-fronted dotterel, royal spoonbill and freckled duck, has also been observed at Boera Dam and Ross Billabong (Eco Logical Australia 2015).

Moonie

Over 100 wetlands exceeding one hectare in area have been mapped in the Moonie, many of which are in the lower catchment below Nindigully (CSIRO 2008). Thallon waterholes have been observed to support between 10,000 and 20,000 waterbirds (Kingsford et al. 1997). There is past evidence of black swans, grey teal and little black cormorants breeding at the waterholes (QDNR 1999).

Threatened waterbirds including the Australian painted snipe and freckled duck and fish including purple spotted gudgeon and eel tailed catfish have been observed in the Moonie (CSIRO 2008).

The Moonie has relatively long and deep waterholes that have been shown to be critical refugia for sustaining native fish populations in the often long periods between flows in the system. Species including golden perch, bony bream, eel tailed catfish and smelt moved significant distances (up to 70 kilometres) in response to waterhole reconnecting flows, enabling recolonisation of the system and genetic mixing (QDERM 2010; Marshall et al. 2016).

Attachment B – 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 Northern Intersecting Streams are described below.

RIVER FLOWS AND CONNECTIVITY

Connectivity outcome	Condamine-Balonne	Nebine	Moonie	Warrego & Paroo
Baseflows are at least 60% of natural levels	*	*	*	*
10 percent overall increase inflows to the Barwon-Darling	*			
30 to 60% increase in the frequency of freshes, bankfull and lowland floodplain flows	*			
10 to 20% increase of freshes and bank-full events				
Maintain current levels of connectivity		*	*	*

VEGETATION

Maintain current extent of river red gum, black box, coolibah forest and woodlands; existing large communities of lignum and non-woody vegetation

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

Improved recruitment of trees within river red gum, black box and coolibah communities by 2024

Improved condition of lignum shrublands (Lower Balonne including Narran Lakes, Lower Border Rivers) by 2024

Vegetation extent

Catchment	Area of river red gum (ha)*	Area of black box (ha)*	Area of coolibah (ha)*	Shrublands	Non-woody water dependent vegetation
Warrego	7,300	80,400	121,400		Fringing/within the Warrego, Langlo, Ward & Nive rivers
Nebine	200	28,800	15,400		Fringing/within Nebine Creek
Condamine Balonne (lower Balonne)	11,500#	36,100#	62,900#	Lignum in Narran Lakes	Fringing/within the Condamine, Balonne, Birrie, Bokhara, Culgoa, Maranoa, Merivale & Narran rivers
Moonie	2,200	2,500	7,900		Fringing/within Moonie River

Area estimates (ha) are from: Cunningham SC, White M, Griffioen P, Newell G and MacNally R 2013, 'Mapping vegetation types across the Murray-Darling Basin', Murray-Darling Basin Authority, Canberra # considered to be an underestimate due to technical limitations in determining the lateral extent of floodplain inundation achieved through Basin Plan implementation

WATERBIRDS

Maintain current species diversity

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

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

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

Important Basin environmental assets for waterbirds in the Northern Intersecting Streams

Environmental asset	Total abundance and diversity	Drought refuge	Colonial waterbird breeding	Shorebird abundance	In scope for Commonwealth e-watering
Narran Lakes	*		*	*	Yes
Cuttaburra channels	*		*	*	Minor in-stream contribution
Yantabulla swamp	*				
Upper Darling River	*	*			

NATIVE 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

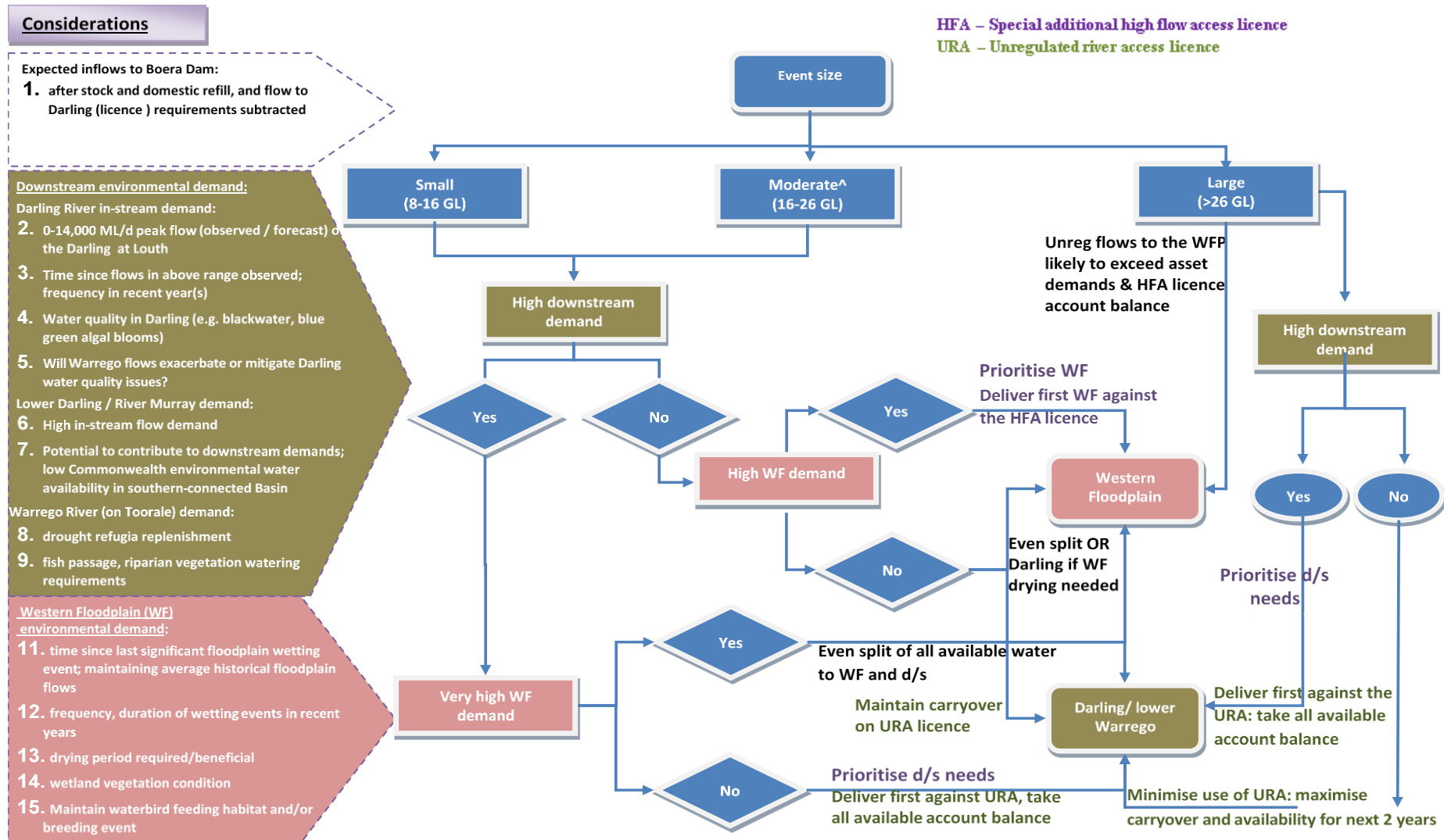
Key native fish species in the Northern Intersecting Streams:

Species	Specific outcomes	In-scope for Commonwealth water
Silver perch (<i>Bidyanus bidyanus</i>)	Expand the core range of at least 2 existing populations (Barwon–Darling is a candidate site) improve core range (candidate sites are the Warrego, Paroo and Condamine catchment (including Oakey Creek).	Limited, through improved in-stream flows in unregulated flow events
Freshwater catfish (<i>Tandanus tandanus</i>)	Expand the core range of at least 3–5 existing populations (Border Rivers, Warrego, Condamine and Paroo Rivers are amongst candidate sites)	
Olive perchlet (<i>Ambassis agassizii</i>)	Expand the range of at least 3 existing populations (the Border Rivers and middle Condamine are amongst candidate sites) Establish or improve the core range of 2–4 additional populations (Gowrie and Oakey creeks in the Condamine candidate sites)	
Southern purple-spotted gudgeon (<i>Mogurnda adspersa</i>)	Expand the range (or core range) of at least 3 existing populations (the Border Rivers/Gwydir and Condamine are amongst priority sites) Establish or improve the core range of 2–5 additional populations – (the Border Rivers/Gwydir, Barwon– Darling and Oakey Creek are amongst priority sites).	
Murray cod (<i>Maccullochella peelii</i>)	A 10–15 per cent increase of mature fish in key populations	
Golden perch (<i>Macquaria ambigua</i>)	A 10–15 per cent increase of mature fish in key populations	

Important environmental assets for native fish in the northern unregulated river catchments

Key site/ environmental asset	Key movement corridor	High biodiversity	Site of other significance	Hydrodynamic diversity	Threatened species	Dry period refuge
Warrego River (Ward River to Darling confluence)	*	*		*	*	*
Anabranes connecting Warrego and Paroo Rivers (including Gumholes, Bow, Cuttaburra Ck)	*					
Lower Moonie to Barwon River [Moonie]	*	*		*		*
Condamine headwaters and Spring Creek upstream of Killarney				*	*	*
Condamine River - Oakey Ck to Surat, including Lower Oakey Creek	*	*		*	*	*
Charley's Ck and tributaries upstream Chinchilla [Condamine]		*	*	*	*	*
Condamine River – floodplain lagoons between Condamine and Surat	*	*	*		*	*
Balonne River and Culgoa Rivers from St George to Barwon-Darling confluence	*	*			*	*

Attachment C – Management strategy for Commonwealth environmental water at Toorale*



^ In moderate events residual volumes in excess of ~16 GL Commonwealth environmental water may be available to the WF during high Darling River demand

*Subject to change as new information becomes available.

Attachment D – Long-term water availability

Commonwealth environmental water holdings

The Commonwealth holds a variety of unregulated entitlements in the Northern Intersecting Streams, with majority held in Queensland. Access conditions for entitlements can differ between management areas. For example, Commonwealth unregulated entitlements held in the Lower Balonne, both water harvesting and overland flow entitlements, are accessed through announcement. Whereas unregulated entitlements in the Moonie and Warrego, are accessed when flow conditions are met. For overland flow licences specific to the Lower Balonne in Queensland, there are set rules for the diversion of overland flow. This is the water that breaks out of rivers onto the floodplain or flows over the floodplain during floods. Diversion of overland flow ('floodplain harvesting') is to some extent provided for under most unregulated entitlements.

The full list of Commonwealth environmental water holdings can be found at www.environment.gov.au/topics/water/commonwealth-environmental-water-office/about-commonwealth-environmental-water/how-much and is updated monthly.

Other sources of environmental water

There are currently no other sources of held environmental water in the Northern Intersecting Streams.

Planned environmental water

In addition to water entitlements held by the Commonwealth, environmental demands in the Northern Intersecting Streams may be met via water provided for the environment under rules in state water plans (referred to as 'planned environmental water').

Rules limiting extraction of unregulated flows by users, such as commence/cease to take flow thresholds and instantaneous, daily, annual and multi-year use limits, form the basis of 'planned environmental water' in the Northern Intersecting Streams. They are complemented by rules in state water plans in a few areas which defer or reduce extraction during specific types of unregulated flows. Event based rules are triggered by antecedent conditions such as the time since the last flow in a target range or occurrence of a flow that is close to the magnitude required to meet specified ecological outcomes but may not do so unless extraction is limited.

Key flow event protection rules in the region are:

- Lower Balonne – water harvesting may be reduced to assist a low flow to reach the end of all the tributary channels when this has not occurred for more than a year; in the case of a flow likely to fill Narran Lakes; and the during the first medium flow (60–100,000 ML/day at St George) after a spell of 2 or 3 years. Inflows into Beardmore Dam up to 730 ML/day outside water harvesting periods are also passed downstream as environmental, stock and domestic (ESD) releases. There are several real time provisions in the resources operations plan to further manage/augment low flow events to achieve flow through if this outcome is looking unlikely.
- Warrego – deferral of water harvesting until after the peak of the flow event has passed, for dry spell (6 months) breaking flows.

While water from entitlements held by the Commonwealth will contribute to environmental demands in the Northern Intersecting Streams, particularly under low flow and conditions where event based mechanisms are triggered, environmental demands will primarily be met by unregulated flows (portion of natural events that is unallocated/not diverted under state water plans, supplemented by additional flows from episodic flow protection rules in certain conditions).