Water for the environment

Southern Connected Basin Environmental Watering Committee

Annual Report 2017–18

Acknowledgement of the Traditional Owners of the Murray–Darling Basin

SCBEWC agencies would like to acknowledge and pay respect to the Traditional Owners, and their Nations, of the Murray–Darling Basin, who have a deep cultural, social, environmental, spiritual and economic connection to their lands and waters. SCBEWC agencies understand the need for recognition of Traditional Owner knowledge and cultural values in natural resource management associated with the Basin.
Aboriginal people should be aware that this publication may contain images, names or quotations of deceased persons.

Acronyms used within this report

AHD	Australian Height Datum
CEWH	Commonwealth Environmental Water Holder
CEWO	Commonwealth Environmental Water Office
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Cwlth	Commonwealth
DAWR	Department of Agriculture and Water Resources
GBCMA	Goulburn Broken Catchment Management Authority
GL	Gigalitre (GL) = 1 billion litres
IVT	Inter-valley transfer
LLCMM	Lower Lakes, Coorong and Murray Mouth
LTIM	Long Term Intervention Monitoring
MDBA	Murray Darling Basin Authority
ML	Megalitre (ML) = 1 million litres
MLDRIN	Murray Lower Darling Indigenous Nations
NBAN	Northern Basin Aboriginal Nations
NCCMA	North Central Catchment Management Authority
NSW	New South Wales
NSW DOI Water	New South Wales Department of Industry - Water
NSW OEH	New South Wales Office of Environment and Heritage
QSA	Discharge of River Murray flow at the South Australian border
RMIF	River Murray Increased Flow
RMUF	River Murray Ungregulated Flows
SA	South Australia
SA DEW	South Australian Department of Environment and Water
SARDI	South Australian Research and Development Institute
SCB	Southern Connected Basin
SCBEWC	Southern Connected Basin Environmental Watering Committee
SDLAM	Sustainability Diversion Limit Adjustment Mechanism
TLM	The Living Murray
VEWH	Victorian Environmental Water Holder
Vic DEWLP	Victorian Department of Environment, Water, Land and Planning

Cover photo: Kayaking Hattah lakes (Source: MDBA)

Southern Connected Basin Environmental Watering Committee

2017–18 in review

Hot and dry conditions

2,128 GL* allocation of water for the environment

2,619 GL water delivered to multiple sites (use & re-use)

14 joint watering events

Delivered ~ 45 % of all flow to SA

Who we are

The Southern Connected Basin Environmental Watering Committee is the forum that supports coordination of delivery of water for the environment across multiple water holders and jurisdictions in the Southern Basin.

Why

Water for the environment improves the health of rivers, wetlands and floodplains. Healthy rivers benefit all river users and are vital to our economy as well as underpinning community health and wellbeing.

Watering highlights

over **230 GL** of water for the environment reconnected numerous wetlands in the Murrumbidgee. A Basin-scale watering priority for several years, that resulted in spectacular native fish breeding

around **112 GL** was pumped into Hattah Lakes, capitalising on previous watering, and enabling the water to reach stressed black box trees that had not been inundated since 1993

around **290 GL** of water for the environment delivered in Barmah–Millewa Forest, along with operational water, triggering growth in moira grass, a threatened species, and providing a flow pulse that connected the system from top to bottom

Our impact

The MDBA's 2017 evaluation of the Basin Plan found that over a third (37%) of all water for the environment events are now coordinated events involving multiple environmental water holders. This increasing collaboration is seeing environmental water managers combine their water to achieve larger and more effective events than would otherwise be possible.

**CEWH and TLM portfolios, incl. carry over and allocation. There was also water available to VEWH, NSW, SA and RMIF.*

2017–18
Southern Connected Basin Environmental Watering Committee

Membership
MDBA, River Operators, CEWH, DAWR, NSW OEH, NSW DOI Water, VEWH, Vic DELWP, SA DEW

Collaborates
with local communities, site & waterway managers

Plans
with local communities including Aboriginal people

Coordinates
the planning and delivery of water for the environment across the southern connected Basin

Makes shared decisions
for the allocation of the TLM portfolio, RMIF, RMUF & governance of TLM joint program

7 face to face meetings

2 teleconferences

2 joint forums with Water Liaison Working Group

2 subgroups: operations & weirpool manipulation

Key messages

Environmental water holders delivered over **2,600 GL** across the southern Basin. Coordination across jurisdictions and agencies is improving markedly, resulting in an increased scale and effectiveness of delivering water for the environment.

2017–18 was the **second largest water delivery year**, helping to consolidate the environmental benefits from the higher flows in 2016 and deliver Basin Plan outcomes.

Water for the environment was used and re-used multiple times along the river, making its use very **efficient**. The recycling of return flows down the system meant that nearly half of all the water delivered to South Australia came from water for the environment.

A number of **innovative** river operations were trialled benefiting the environment and consumptive users. For example, when Murray cod are nesting, stable water levels are important. A modified flow pattern to keep river levels stable in the Lower Darling met both operational needs and benefitted native fish. Environmental water managers under-wrote the resource costs of the changed delivery pattern to make sure no other water users were impacted. From a **community** perspective **locals** also supported reducing flows out of Menindee Lakes to maintain higher water levels for longer. It worked, **Murray cod** bred successfully in the Lower Darling.

Environmental water holders are **flexible**, planning for all conditions and adapting as conditions unfold. We delivered a lot of water early in 2017–18 to shore up the plant and animal responses to the wet 2016. However with a dry end to 2017–18, we cast our eye to the future and used carry-over into 2018–19 to support next year's watering actions should dry conditions continue.

Community bushwalk along Mullaroo Creek (Source: Mallee CMA)

Communication

Water for the environment continues to deliver many ecological highlights. Fish, birds and plants continue to show signs of a system responding positively to better management and these outcomes benefit the community.

However the latest research shows that people are generally not aware of how rivers work or where their water comes from, and don't understand the need or benefits of water for the environment.

Clearer communication is key to community understanding and acceptance

Water management can be complex, and it doesn't help that different agencies use a mix of terminologies when communicating about the use of water. This creates unnecessary confusion, inconsistencies and therefore barriers to improving community understanding.

A SCBEWC collaborative project started in 2017–18 that brings together twelve government agencies at various government levels in order to develop an overarching communications framework for water for the environment.

This includes commitment from all five environmental water holders plus seven state government and regional catchment management agencies to seek new ways to improve our individual and shared communications efforts. Working together to better communicate the importance of healthy waterways and the role that water for the environment plays.

Indian Delegates visiting the Coorong (Credit: SA DEW)

Community involvement

Basin communities are an integral part of the work we do. Local knowledge and experience combined with science supports environmental benefits and community ownership of water for the environment. To involve communities and Aboriginal people in the planning and use of water for the environment, water holders and Catchment Management Authorities use regional and local networks such as the Environmental Watering Advisory Groups in NSW and Victoria, and the Community Advisory Panel in South Australia. Site Managers all along the River Murray and its tributaries work closely with communities to incorporate local knowledge and views into the SCBEWC water for the environment planning process. Some highlight case studies include:

Live water updates

Throughout the Mid-Murrumbidgee Wetlands Watering event in August 2017, OEH staff used SMS to contact interested parties and update them in real time on what was happening. In landholder debrief and surveys following the event there was a lot of positive and practical feedback, which managers believe is because landholders were well informed throughout the event.

Southern Bell Frog (Credit: OEH)

Community knowledge in action

In October 2017, the South Australian Community Advisory Panel and Scientific Advisory Group met together to plan for providing water to the Coorong over summer 2017–18. Local information from a commercial fisherman indicated that black bream were ready to spawn but needed the right water quality conditions to breed successfully – conditions that would need the use of water for the environment through the barrages in a particular pattern to create a salt wedge of the right salinity gradient.

Together, community members, scientists, environmental water holders and state agency staff developed a watering plan to support black bream over summer. In autumn 2018, significant breeding of black bream was detected. The strongest response seen since the millennium drought.

Community Advisory Panel members at the Murray Mouth (Credit: SA DEW)

Caring for Country

Incorporating Indigenous perspectives in water use has been part of The Living Murray program for over a decade. The Indigenous Partnerships Program involves Aboriginal people in the management of key sites along the Murray, including the use of water for the environment. In May 2018, a forum brought together the Indigenous Facilitators who work as part of the Indigenous Partnerships Program and a range of Traditional Owners.

The forum facilitated cross-cultural sharing of knowledge and experiences from the upper to the lower Murray. Stories were shared of successful partnerships, including supporting connection to country, the protection of cultural heritage, two-way learning between Western and Aboriginal science and intergenerational sharing of knowledge. Feedback from the forum was very positive and there will be follow up forums in 2018–19 and beyond.

Working on Country Rangers at Chowilla speaking about their work mapping cultural sites and using this to inform the use of water for the environment at Chowilla Floodplain (Source: SA DEW)

Learning from Traditional Owners

Robinvale Elder Auntie Rose Kirby welcomed the Mallee Aboriginal Reference Group (ARG) to country during a visit to Hattah Lakes to see improvements in the landscape in the Hattah-Kulkyne National Park.

The focus of this on-country day was to demonstrate the difference between areas receiving environmental water, compared to those which aren't. Everyone was stunned by the difference. ARG members described the areas that hadn't received water as being like a 'fire and brimstone landscape'.

"We ended up on the banks of a dry lake in the far north of the national park and here, we really saw what happens to our land when it's not cared for, all the water plants are gone, replaced with salt bush and other dry land plants. The banks are lined with trees only just clinging to life. There are no birds and a light salt crust has formed on the bottom of the lake."

The group participated in a plant survey. They were happy to see that native plants are returning to areas getting water, including 'old man weed' and 'broom brush'. ARG members were able to share the importance of these plants, once used to keep their elders' camps clean.

Fish and Flows community forums

In July and October 2017 the Commonwealth Environmental Water Office hosted 'fish & flows' community forums in Renmark and Murray Bridge in South Australia. The Forums were a huge success, bringing recreational fishers and scientists together to talk about how environmental flows are helping improving fish numbers in the Murray Darling Basin. Nearly 200 people attended the Forums, with an estimated 400 joining via live streaming on twitter.

Fish scientists and agency representatives answering questions from the local community. (Source: CEWO)

Barapa Water for Country team (Source: NCCMA)

Water for Country

In August, the Barapa Water for Country team made a traditional bark canoe to celebrate the success of the Water for Country Project at Gunbower Forest.

The project is a partnership between the North Central Catchment Management Authority and Barapa Barapa Traditional Owners in Victoria. The team has used maps to prioritise cultural hot spots in and around Gunbower forest. Then, by walking in the steps of their ancestors, the hot spots are visited so their cultural values can be recorded, and watering priorities considered.

Community action at Barham Lake

In February 2017 the Commonwealth Environmental Water Office worked with local community groups to keep water levels topped up at Barham Lake. This provided enough time for local fishing clubs to come together and move eel-tailed catfish and other natives to nearby Deniliquin Lagoon.

Tony Bright, President of the Edward-Wakool Angling Association said that the program was *"a great example of local community groups working with club Barham and government agencies to achieve a great outcome for the public and environment".*

Newspaper clippings from the event (Source: The Bridge)

Strengthening Aboriginal partnerships

As set out in the Basin Plan, environmental watering will be undertaken primarily to achieve environmental outcomes. At the same time, water for the environment can contribute to some outcomes sought by the broader community including recreational uses and Aboriginal uses. However, recreational needs and Aboriginal peoples' concept of cultural water or cultural flows is broader than can be accommodated through environmental watering alone.

Examples are growing of water managers across the Basin working with Aboriginal people to deliver cultural outcomes as well as environmental outcomes, however this is usually done on a site by site basis or through formal agreements with specific Nations.

Governments are committed to working with Aboriginal people in the Basin on water matters

For example the Commonwealth Environmental Water Holder has a Partnership Agreement with the Ngarrindjeri Regional Authority for the use of water for the environment in the Coorong and Lower Lakes in South Australia.

The MDBA is working with the Murray Lower Darling Indigenous Nations and Northern Basin Aboriginal Nations on ways to integrate Aboriginal people's perspectives on environmental outcomes into long-term water planning at the Basin scale as well as water resource plans.

Students visiting Hattah Lakes for Wetlands Learning Program (Credit: Mallee CMA)

A Year in Review

Climate Conditions

Overall, conditions in the Basin in 2017 were hot and dry. The Basin experienced its driest June since 1986, its driest September on record and the driest winter in 15 years. Parts of the south-east Basin recorded the lowest rainfall on record for June.

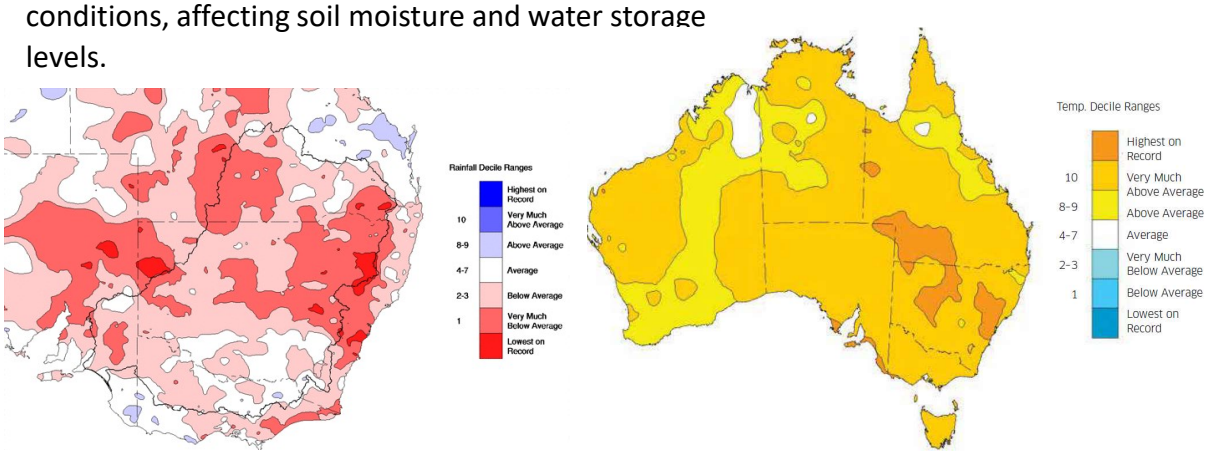
Late spring and early summer rain in parts of the southern Basin filled rainfall deficits that had emerged over the year, bringing annual rainfall totals in these parts to average. Rainfall across other parts of the southern Basin remained below average.

For the fifth consecutive year, mean annual temperatures were well above average across the Basin. Higher evaporation rates were associated with the warmer conditions, affecting soil moisture and water storage levels.

Year-to-year variability

2016–17
16,120 GL inflows
Wettest 17% of years

2017–18
4,160 GL inflows
Driest 12% of years



(Source: Bureau of Meteorology)

Water availability

2016–17 was a wet year with inflows almost twice as large as the long term average for the River Murray system (9,285 GL). As a result allocations were high, supporting the delivery of substantial volumes of water for the environment .

Year-to-year variability

2016–17
2,426 GL* available

2017–18
2,128 GL* available

2017–18 was much drier with inflows roughly half the long-term average for the River Murray system.
However the wet conditions in the previous year resulted in allocations remaining relatively high due to good levels of water in storage.

**CEWH and TLM portfolios, incl. carry over and allocation. There was also water available to VEWH, NSW, SA and RMIF.*

Basin environmental watering priorities

The Basin annual watering priorities help guide environmental water managers on where to focus water delivery from a whole-of-Basin perspective. They are the actions needed to help us achieve the Basin Plan's objectives of protecting and restoring the Basin's rivers, wetlands and floodplains.

The good rain and higher river flows in 2016 was the best opportunity seen in 25 years to help our rivers and wetlands thrive. Annual priorities in 2017–18 highlighted the need to build and consolidate the ecological outcomes from these higher flows.

We are working to achieve the Basin Plan's long-term objectives of protecting and restoring the Basin's rivers, wetlands and floodplains.

Environmental Watering Priorities for 2017-18 (Source: MDBA)

Regional watering priorities

Regional priorities help with environmental water planning and delivery at a catchment scale. Regional priorities are developed by states each year, in partnership with waterway managers and local communities. (The Commonwealth Environmental Water Holder undertakes a similar partnership approach to develop annual portfolio management plans). Regional priorities identify environmental assets and ecosystem functions needing water in each water resource plan area, taking into account the objectives of long term watering plans, climate conditions and watering actions in previous years, as well as the outlook for the coming year. Regional watering priorities are used as an input to inform the setting of Basin-scale annual priorities.

SCBEWC annual planning

Water for the environment in the Southern Connected Basin is being increasingly managed as an integrated system.

Each year environmental water managers plan for a range of conditions from dry to wet to ensure we are prepared for all weather and climate conditions. This helps us capitalise on opportunities as they arise and quickly respond to changing conditions as we work with river operators and site managers.

We take a 'one river' approach to planning

We are increasing our understanding of how the watering needs in one catchment interacts with watering needs in neighbouring catchments. We are also improving our ability to coordinate across jurisdictions to deliver water as efficiently as possible using tools such as multiple use of return flows, and synchronising timing of deliveries across tributaries to boost flows into the Murray.

The SCBEWC annual planning process occurs during February - June and considers planning for coordinated events across water holders as well as effective use of the jointly held portfolios (TLM and RMIF).

SCBEWC coordination principles aim to ensure that environmental water management and delivery is consistent with the Environmental Watering Plan (Chapter 8 of the Basin Plan).

For jointly held portfolio planning, SCBEWC considers the following to inform annual decisions: Basin and State annual environmental watering priorities; priority assets listed in long-term watering plans, watering strategies outlined in the Basin-wide environmental watering strategy; watering proposals from States, hydrological conditions, third party risks, and river operational activities.

SCBEWC coordinated water planning meeting, May 2018 (Credit: MDBA)

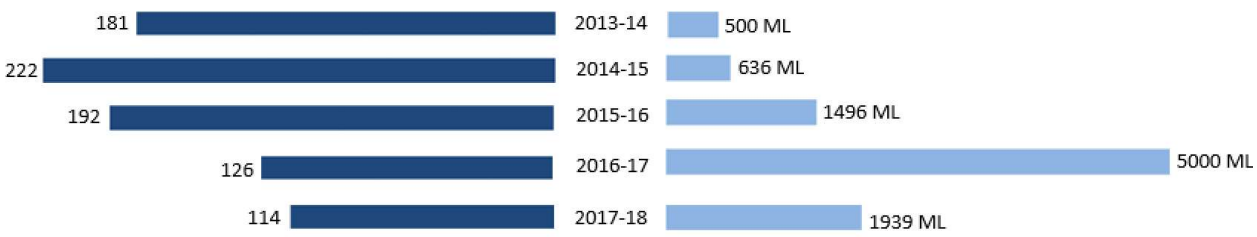
The key planning product prepared by SCBEWC in time for the start of each water year (1 July) is the operational scenarios document. The scenarios document provides a mechanism to align environmental watering needs with the MDBA River Operations Annual Operating Plan flow forecasts. Its main purpose is to identify opportunities to maximise environmental outcomes through the coordinated delivery of all environmental water along with other water in the system. The overall shaping of patterns of river flows towards a more natural pattern to protect and restore river and wetland health.

Water use

While good rain and high river flows in 2016 gave native plants and animals a chance to bounce back, many need follow-up watering to boost their health. 2017–18 saw water managers focus on helping fish to spawn, grow and move through the system, in addition to supporting waterbird feeding and breeding, and floodplain vegetation growth. However, this is not a one year exercise. Some species and sites need targeted actions over a number of years to recover and be resilient.

The availability of water for the environment changes depending on weather conditions and the volume of water in storage. This underpins the allocation of water to all entitlement holders. In drier years there can be less opportunities to deliver water due to lower availability of water to underpin actions.

Total delivered from CEWH & TLM portfolios	Total with return flows all portfolios (use & re-use)	Number of events	Median volume (ML)
1,585 GL	2,619 GL	114	1939



Number of events delivered by water holders in the Southern Basin

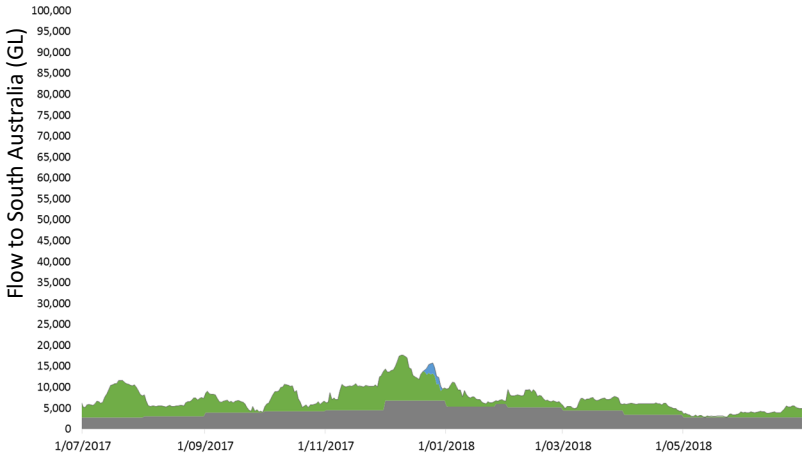
Median volume of water in each event in the Southern Basin

Pelican breeding colony in the Murrumbidgee (Credit: CEWO)

Every year is different

2017–18

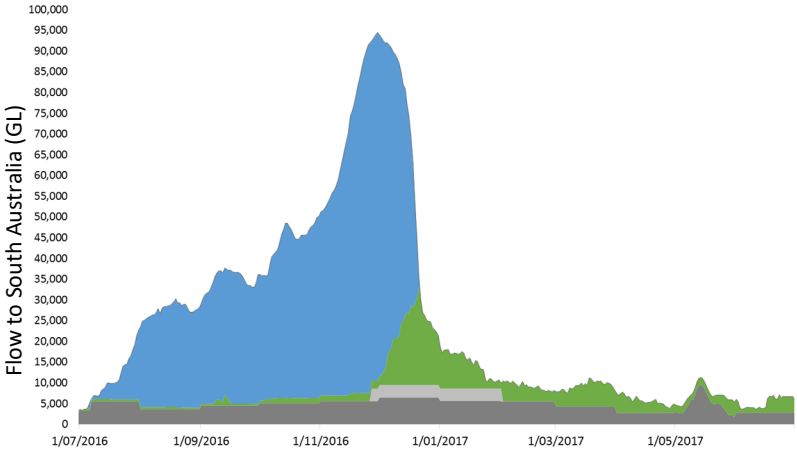
*Flows to the Lower Murray, as measured at the South Australian border (ML/day)**



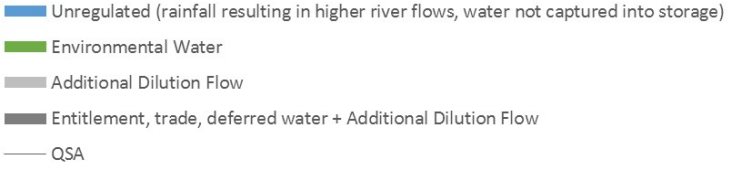
Low rainfall in 2017–18 resulted in low natural river flows. Water for the environment was used to follow on from high flows from the year before and consolidate the gains. Nearly half of the water that flowed through to reach the lower Murray was water for the environment. Our collective carryover has enabled us to take opportunities and still deliver significant volumes in the Murray each month.

2016–17

*Flows to the Lower Murray, as measured at the South Australian border (ML/day)**



Higher than average rainfall in 2016 resulted in high river flows. These natural events watered many parts of the Basin's ecosystems including the mid- Murrumbidgee wetlands, and parts of the floodplains of the Murray and Goulburn rivers.
Water for the environment added to natural flows to ensure important breeding cycles were completed for plants, fish and birds.

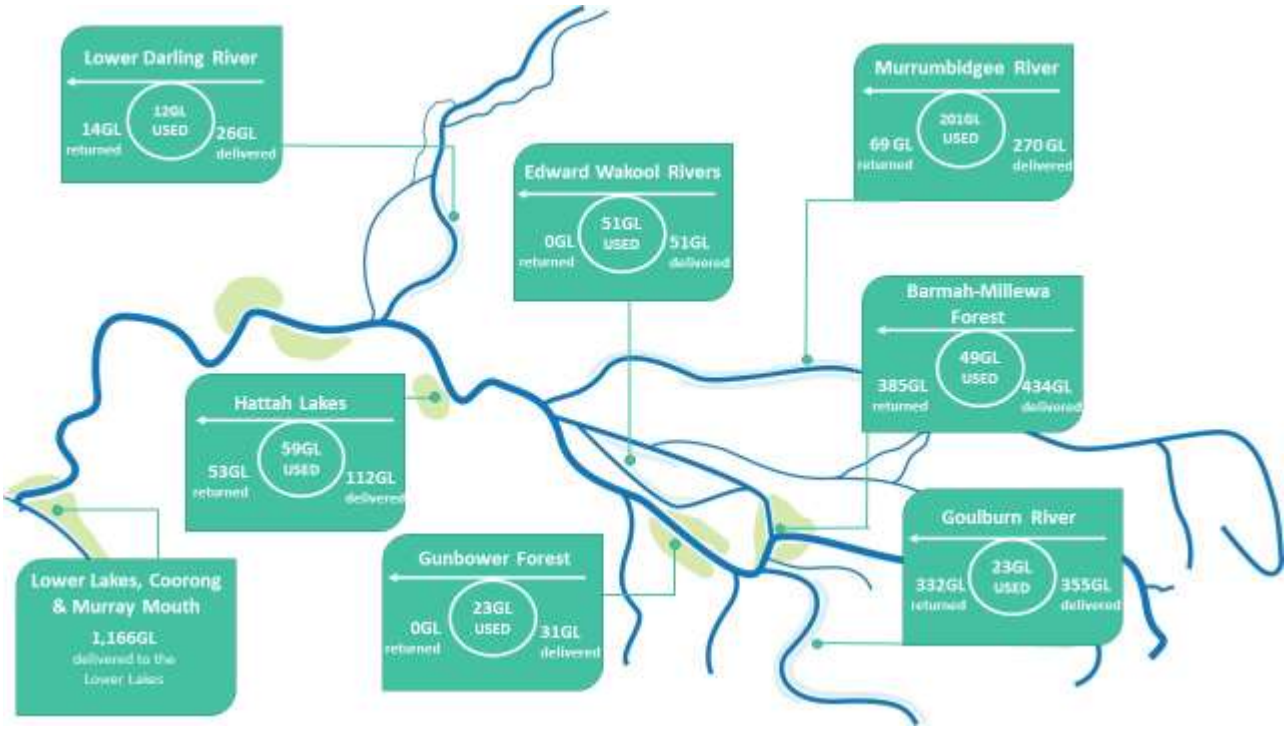


*This representation is for *accounting purposes* to track environmental use. The diagram should not be interpreted to infer that environmental water "sits on top" of other flows.

Using water efficiently – return flows

Return flows describe water that is delivered to multiple sites. Water that is used and re-used because it either remained in the river to flow downstream, or returned from floodplains and wetlands to flow back into the river.

Return flows are in effect recycling. Boosting how water is used through the river, linking watering events and sites together to get the best outcomes from all the water available.



Total annual volumes of water delivered, used and then returned from main sites within the southern Basin

Flows are coordinated

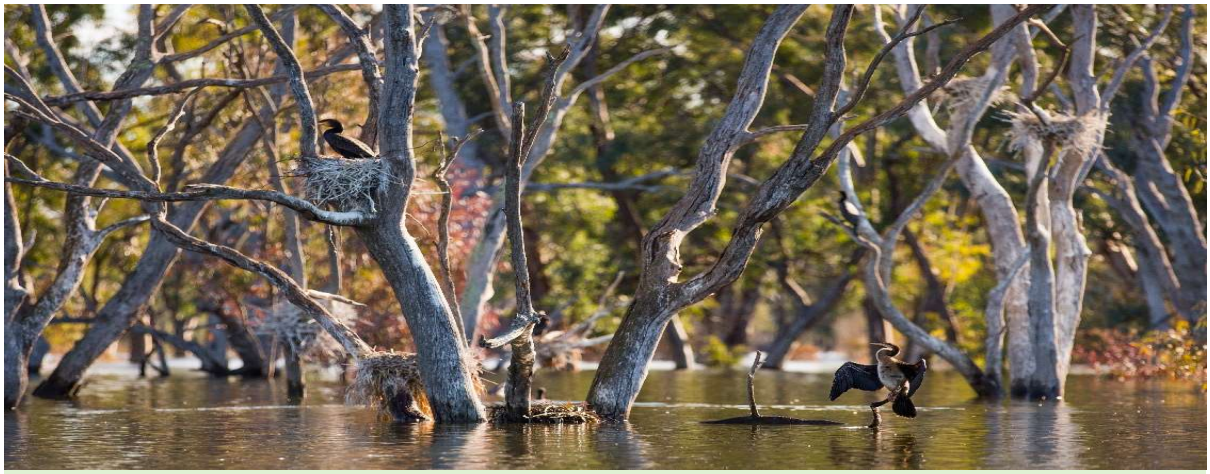
- from multiple tributaries
- from multiple environmental water holders
- building on unregulated and regulated flows
- in concert with land management
- with use of works and measures

Multiple outcomes throughout the system

- productivity and connectivity
- Fish and bird movement & breeding
- river bank & wetland plant health
- manage salinity levels
- provide flow between the Lower Lakes and Coorong (moving nutrients, sediment & salt)
- maintain an open Murray Mouth

For example, of the 355 GL of water for the environment delivered down the Goulburn River, return flows were used in watering Gunbower Creek, Hattah Lakes, and Lindsay-Mulcra-Wallpolla. There was 320 GL that eventually made it all the way through the River Murray channel, down to the Coorong, Lower Lakes and Murray Mouth, connecting river and wetlands along the way.

Coordination case study



Cormorants nesting at Hattah lakes, Victoria (Credit: Mallee CMA)

Making best use of all water in the river

An example of making the best use of all water was the delivery of over 180 GL of water for the environment in spring 2017, using water available from the Commonwealth Environmental Holder, the Victorian Environmental Water Holder, and joint-government water portfolios (TLM, and RMIF). This event was coordinated with the delivery of other parcels of water, including water being released to meet consumptive demands.

The delivery of a combination of water sources enabled more widespread watering of wetlands in the Barmah-Millewa Forest, at the right time of year in spring/early summer, to improve the growth of wetland plants such as the threatened Moira grass and trigger water bird breeding that could then be supported with targeted deliveries of environmental water over summer. Importantly this provided a follow up watering to the high natural flows that were experienced in 2016 – a management action to consolidate the strong ecological response to flooding that will help build resilience.

Water returning from this spring watering event was then used to supplement other watering activities elsewhere to link other rivers and wetlands through the system. The water that flowed out of the Barmah-Millewa Forest, plus water coming from an environmental watering event in the Goulburn River, were used to meet a large portion of the 112 GL pumped into Hattah Lakes in 2017 (a Ramsar listed wetland of international significance).

The Hattah delivery, using pumping infrastructure, capitalised on the Hattah Lakes already being partially filled and enabled the flows to reach stressed black box trees which hadn't been flooded since 1993 and were in a poor condition. The remaining water from the upstream events (and outflows from the Hattah Lakes once the lakes were drawn back down) then flowed through the remainder of the River Murray to provide connectivity all the way to the end of system at the Coorong and Murray mouth. This level of system connectivity has been identified in the Basin Wide Environmental Watering Strategy as being crucial for supporting ecological connections and processes as well as site based outcomes.

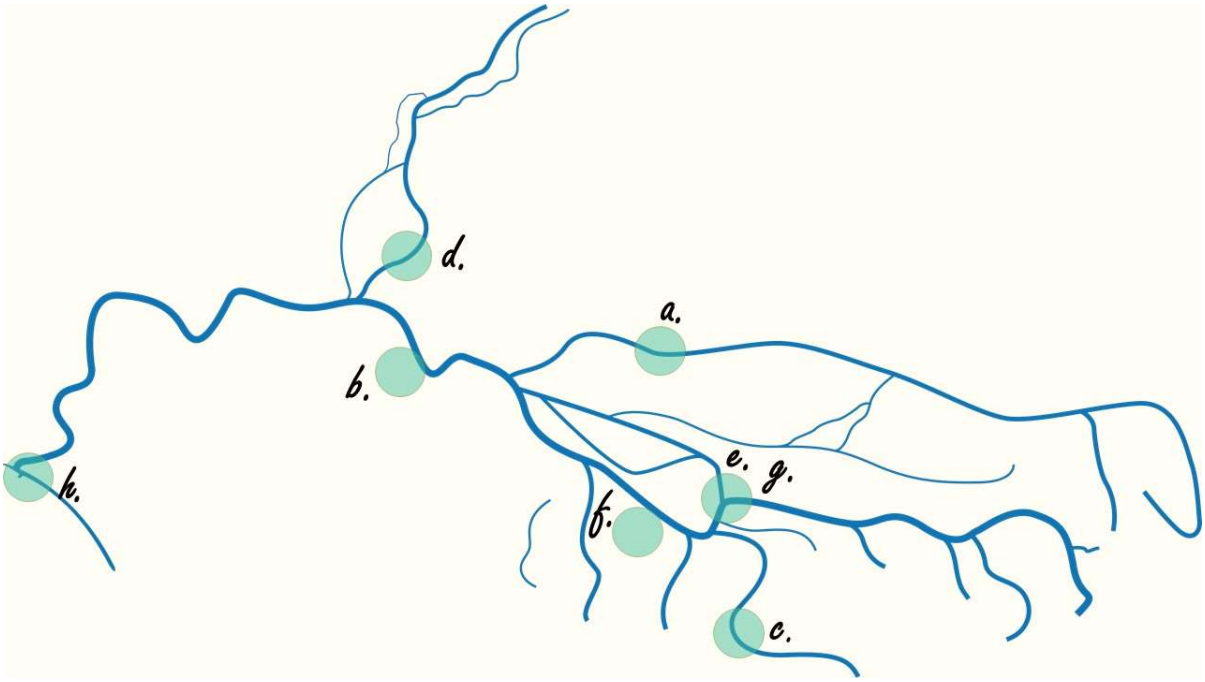
2017–18 Watering highlights

In the context of a relatively dry year, coordinated flows were delivered across the southern Basin by water managers and river operators by aligning delivery of water for the environment with operational releases and consumptive demands.

Barmah Forest, Nov 2017 (Credit: GB CMA)

Delivery of water for the environment is continuing to mature, and opportunities throughout the year allowed water managers and river operators to trial new delivery and accounting methods. Trialling and innovation are key to finding new and improved ways to shape river flows for protecting and restoring river health.

The following eight case studies from around the Southern Basin highlight some of the watering activities that were undertaken and their outcomes.



Navigation for case study watering events summarised in the following pages of this report

a. Golden Perch recruitment in the Mid-Murrumbidgee

236GL

Water for the environment was provided to reconnect numerous wetlands in the mid-Murrumbidgee, a site that had been listed as a Basin-scale priority for several years. The event achieved a flow of 22,000 ML/d at Wagga for 6 days. The inundation of approximately 3,800Ha reconnected hundreds of wetlands between the Mid-Murrumbidgee and the Murray junction.

Yarrada Lagoon, mid-Murrumbidgee (Source: OEH)

Importance of strategic monitoring and analysis

Monitoring has revealed the presence of hundreds of thousands of juvenile golden perch in Tala and Yanga Lakes (over 500,000 in Yanga Lake alone). These fish likely spawned in the river or Yanga Creek during the winter environmental flow event in 2017. The lakes provide a nursery for the fish to grow and are a food source for thousands of pelicans and other birds that feed on the fish. Delivery of water for the environment to Tala and Tanga Lakes has continued this year to support the young fish from the 2017–18 event.

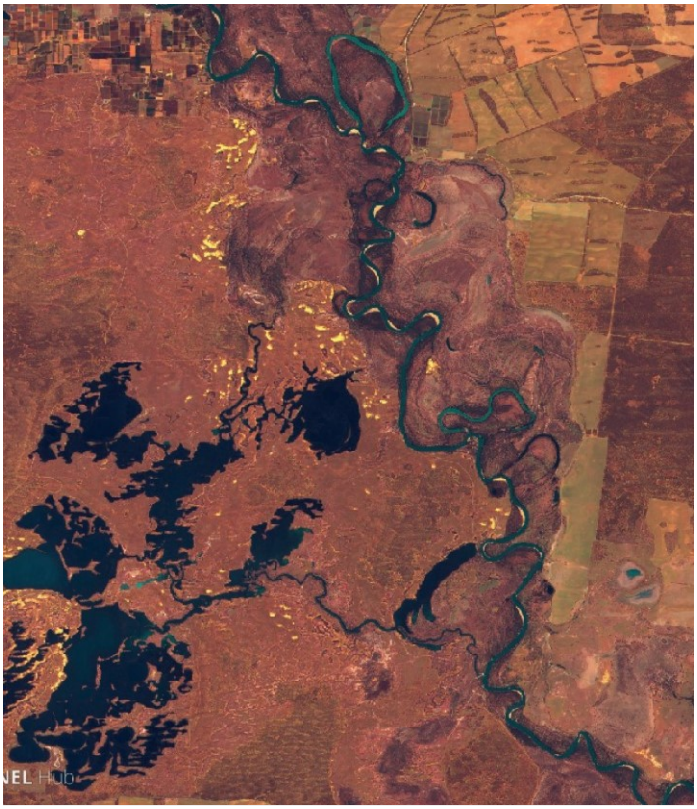
b. Black Box at Hattah

112GL

At Hattah Lakes, water for the environment was used to capitalise on the lakes' high level following the 2016 flooding. A large proportion of the water pumped in was sourced from the return flows from upstream deliveries of water for the environment.

The lakes and floodplain were inundated for 16 weeks and reached a maximum level of 44.6 m (AHD), providing perfect conditions for the recovery of black box trees that had not been flooded since the 1990s.

This was the largest delivery of water for the environment at Hattah Lakes since TLM infrastructure was completed.



Satellite imagery of Hattah Lakes, October 2017 (Source: Sentinel Hub)

c. Goulburn Winter flows and pouched lamprey migration 143GL

The Goulburn River winter pulse commenced in June 2017. The pulse delivered benefits to vegetation high on the river banks. The winter Goulburn pulse provided multiple downstream benefits in the wetlands along River Murray through to the Coorong. For example water from the Goulburn River triggered the upstream migration of more than 50 pouched lamprey from South Australia.

Goulburn River near Swing Bridge, Shepparton in August 2017 (Source Goulburn Broken CMA). SARDI carrying out lamprey monitoring (Source: SARDI)

Improved coordination benefits native fish

Several Victorian Environmental Water Holder and Goulburn-Broken Catchment Management Authority staff visited South Australia in 2017 to gain an understanding of what return flows from the Goulburn River mean for the Coorong, Lower Lakes and Murray Mouth, and to identify how they can be better linked.

As an outcome from this there were efforts at greater synchronisation of a large Goulburn winter fresh (>100 GL), which met bank vegetation outcomes in the Goulburn, then travelled down the system to facilitate large winter releases from the barrages in South Australia. This was one of the largest managed winter releases and helped populations of pouched lampreys migrate upstream to spawn.

Winter barrage releases since 2015 have helped lampreys travel from the ocean and estuary into the freshwater environment of Lake Alexandrina, and then upstream to the River Murray. In 2015 a pouched lamprey that was tagged with a microchip at the Coorong estuary was tracked all the way to Lock 11 (near Mildura) - a journey of almost 900 km.

Monitoring in winter 2017 detected more than 50 pouched lamprey moving through the barrage fishways. Scientists say that water for the environment provided suitable conditions to help cue their migration. Cross-jurisdictional planning and coordination was successful and will continue into the future.

Maintained barrage releases (Source: CEWH)

d. Building fish resilience in the Lower Darling

In the Lower Darling, water for the environment has made more habitat available for the juvenile Murray cod that spawned in 2016–17, increasing their chances of survival. After another successful spawning event in 2017–18, base flows were maintained to support habitat condition, food production and dispersal of young fish. Golden Perch and Murray Cod populations consisted of fish from a full range of sizes and outnumbered carp and other exotic species combined.

26GL

Murray cod, of sizes corresponding to the 2016 cohorts (Source: Clayton Sharpe)

Innovation and flexibility in water delivery - Good news for fish and flows in the Lower Darling

The Lower Darling supports a robust population of Murray cod. Murray cod in the Lower Darling are proving to be an important source population to help re-populate areas of the River Murray that have been affected by hypoxic blackwater water events in recent years.

In 2016–17, over 100 GL of water for the environment was delivered to the Lower Darling targeting native fish outcomes. This resulted in the strongest spawning response by Murray cod detected in the Lower Darling in the past 20 years. An innovative proposal was put forward in 2017–18 to build upon and protect the investment from last year's watering event, and to further strengthen this vital native fish population.

Murray cod fathers are dutiful fathers and diligently tend to their nests of eggs, chasing away predators and fanning their eggs to keep oxygen levels up. When cod are nesting, stable water levels are important. It is believed that rapid fluctuations in water levels can cause them to abandon their nests and their young.

A modified flow pattern was delivered to meet both operational needs and benefit native fish. From a community perspective locals were also supportive of reducing flows out of Menindee Lakes to maintain higher water levels for longer.

Operational releases were reduced to 700 ML/day and the Commonwealth Environmental Water Holder used 3,230 ML to underwrite the flow reduction to fully offset any loss of resource to Lake Victoria to make sure no other water users were impacted.

It worked, Murray cod bred successfully again.

e. Barmah-Millewa open regulators trial 11GL

For the first time, the regulators in the Barmah–Millewa Forest were opened early in winter to allow a more natural inflow of water into the creeks as the river level rose and fell during winter and spring. Large bodied fish, such as Murray cod and golden perch, were observed moving in and out of the forest and there was strong growth and flowering of moira Grass. This is something forest managers had been wanting to do for a number of years but was not possible until the water for the environment accounting arrangements were confirmed in 2017.

Low flows entering Barmah Forest at the Gulf regulators, July 2017 (Source: GBCMA)

f. Gunbower wetlands and Gunbower Creek 31GL

After natural floods in late 2016, the majority of the floodplain and wetlands in Gunbower Forest were allowed to draw down throughout 2017–18 to manage the impact of the carp. Water for the environment was used to partially fill Reedy Lagoon and Black Swamp in late spring.

Carp removal

Remnant water was pumped from Reedy Lagoon and Black Swamp and 1,170 kg of carp physically removed. A messy job indeed!

After eradicating the wetland of carp, water for the environment was delivered in late spring. The absence of carp meant that aquatic plants flourished and were able to germinate, establish and set seed. In Reedy Lagoon this resulted in a dense cover of river swamp wallaby-grass. In Black Swamp the number and distribution of aquatic plants was the highest on record and several plant species not commonly observed were recorded including river swamp wallaby-grass and wavy marshwort.

NCCMA staff removing carp from Gunbower Forest wetlands (NCCMA)

g. Barmah Millewa Forest floodplain watering 293GL

Approximately 293 GL of water for the environment was delivered to the Barmah–Millewa Forest in conjunction with operational water to achieve multiple benefits for consumptive water supply as well as environmental outcomes. In response there was increased moira grass and river swamp wallaby grass – both threatened species — and waterbirds started breeding. The water for the environment return flows provided connectivity and increased food to feed fish and other animals in the river.

More than water, the importance of complementary management actions:

Disturbance by feral pigs

One ibis colony breeding in Barmah Forest was attacked by wild pigs, underlining the importance of complementary management actions in addition to delivering water. With this information we will adapt future delivery of water for the environment accordingly. For example, trying to increase the water height to deter pigs and protect the birds .

Feral pig egg predation and disturbance at Barmah Forest (Source: CSIRO cameras)

Grazing exclusion zone

In Barmah Forest a 10 ha grazing exclusion zone was constructed in autumn 2017 to deter wild horses and other pests from grazing on threatened moira grass within the fenced zone. The photos below compare the sites along the fence boundary and show the impact that horses, pigs and other pests are having on the vegetation. This evidence is valuable for considering management of these species and how we can best target our water for the environment use. Using this information, the Goulburn Broken Catchment Management Authority has now fenced the high-quality floodplain area, and there are also broader plans around wild horse management being investigated by the Victorian government.

Grazing exclusion fence (top) and Barmah Forest Icon Site Manager within exclusion zone (Source: GBCMA & MDBA)

h. Looking after the lower Murray River and Coorong estuary

The Lower Lakes, Coorong and Murray Mouth received significant volumes of water for the environment in 2017–18. Return flows predominately from the Goulburn, Murrumbidgee, and River Murray provided continuous barrage releases over winter for fish migration between the sea and the river, flows through the warmer months for black bream breeding, and continuous flows to improve salinity levels and salt export. Black bream breeding at levels not detected since 2009 was a notable highlight, as well as the strong growth response seen for fringing lake vegetation from the draw-down over autumn. While there was widespread germination of *Ruppia tuberosa* in the Coorong, recovery was hampered by large amounts of filamentous green algae which smothered the Ruppia and broke-off flower heads before seeds could be set. Work is now underway to better understand what is happening with algal dynamics.

1,166GL

Black Bream

In the Coorong successful recruitment of black bream was detected in 2017–18. Water for the environment was delivered over spring and summer to create a salinity gradient in the Coorong estuary suitable for black bream egg and larval drift. In the April 2018 survey 102 juvenile black bream were detected, the largest number recorded since 2009. These results indicate that the freshwater flows delivered via the barrages had created the right nursery conditions for survival and growth of larval fish in the estuary.

Juvenile Black Bream (Source: SARDI)

Lowering lake levels to benefit birds

Exposed mudflats of the Lower Lakes (Source: SA DEW)

Water for the environment was delivered between March and May 2018 to support releases of freshwater to the Coorong at the same time as a controlled lowering of water levels in the Lower Lakes. This lowering event lured thousands of migratory birds to the area to feed on the abundant food in exposed mudflats, including curlew sandpipers, black-winged stilts and the rare white-rumped sandpiper. The temporary drawdown in autumn 2018 exposed the fringes of lakeshores and wetlands in the Lower Lakes, allowing native plants to germinate. As a result, more native plant species have been recorded on the shorelines of the Lower Lakes than in previous years. *"The mudflats provide a good feed for migratory birds before the long flight to their northern-hemisphere breeding grounds,"* Adrienne Rumbelow (SA DEW site manager).

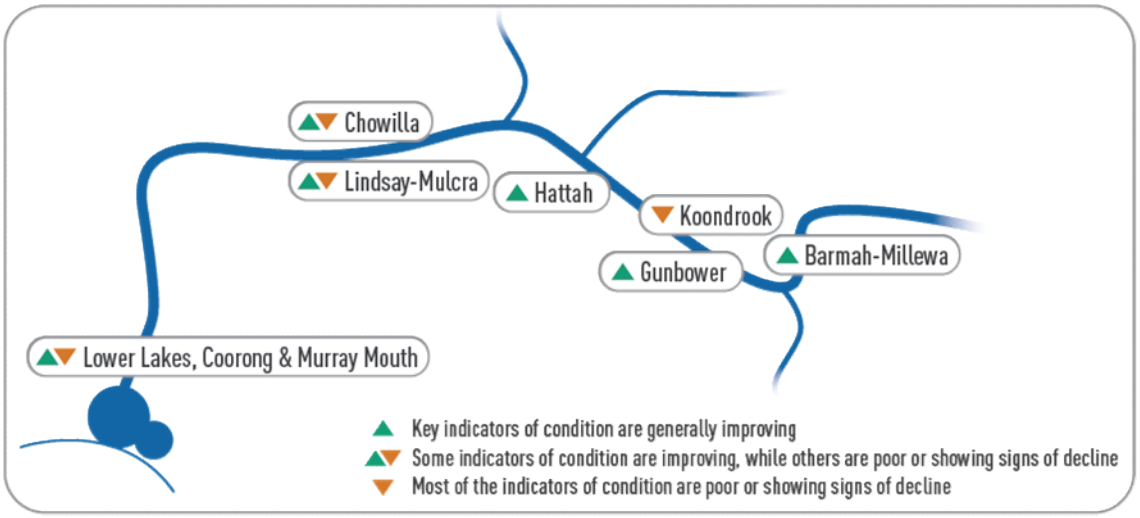
Our Impact

Our rivers have been highly modified for irrigation development, which has disrupted natural flow patterns. The millennium drought taught us that maintaining key wetlands in dry times helps sustain our plants, birds and fish, and ensures they recover more quickly and strongly when wetter conditions return.

Water for the environment is working

Monitoring outcomes

Monitoring across sites is showing that where we have been able to deliver water for the environment, and operate environmental works, the health of rivers, wetlands and floodplains are improving. The figure below shows the condition of some of the key sites that are monitored along the River Murray. Although the health of many sites is improving, for downstream sites where river regulation impacts have been greatest for longest, site conditions are mixed and some remain in poor condition.



Condition of six icon sites in the Southern Connected Basin

The figure is based on over 10 years of ecological monitoring tracking site condition as part of The Living Murray program. In 2017–18 jurisdictions delivered around 100 joint funded monitoring activities across six key sites. This included condition monitoring to assess site health, intervention monitoring to enable learning about how to improve delivering water for the environment, and risk mitigation monitoring for risks such as water quality.

Catfish monitoring at Mullaroo Creek, Lindsay Island (Credit: Mallee CMA)

Barmah Forest Site Manager Keith Ward (left) and Millewa Forest Site Manager (Ali Borrell) (Credit: MDBA)

Opportunities to improve

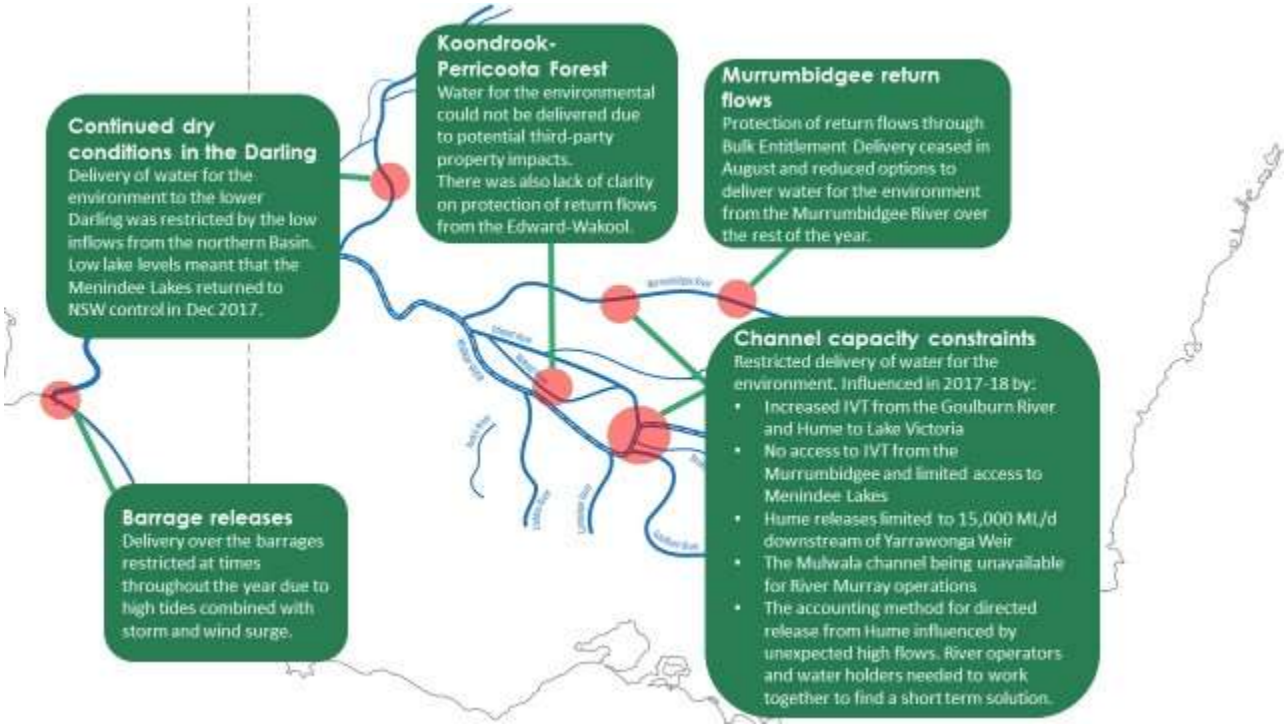
A key part of achieving the objectives and outcomes set out in the Basin Plan includes the effective management and use of all environmental water. Coordination across jurisdictions and agencies is improving markedly, resulting in an increased scale and effectiveness of delivering water for the environment. However, a number of significant challenges remain to delivering environmental water in the most effective way, and thus realising the full potential of this significant public asset.

A future with water for the environment seamlessly integrated as an everyday part of how rivers are managed

Challenges include:

- Completion of water resource plans that set out the rules for use of all water, including water for the environment,
- Improvements in compliance systems,
- Effective implementation of pre-requisite policy measures to protect environmental flows from re-regulation and extraction,
- Constraints relaxation to allow water for the environment to reach the wetlands and floodplains of some of the Basin's key environmental assets,
- Implementing Sustainable Diversion Limit adjustment projects to allow Basin Plan environmental outcomes to be achieved with less water.

As well as naturally hot and dry weather conditions in 2017–18, several operational constraints limited environmental water holders' ability to meet water for the environment needs. Examples of resource and operational challenges are pictured below:



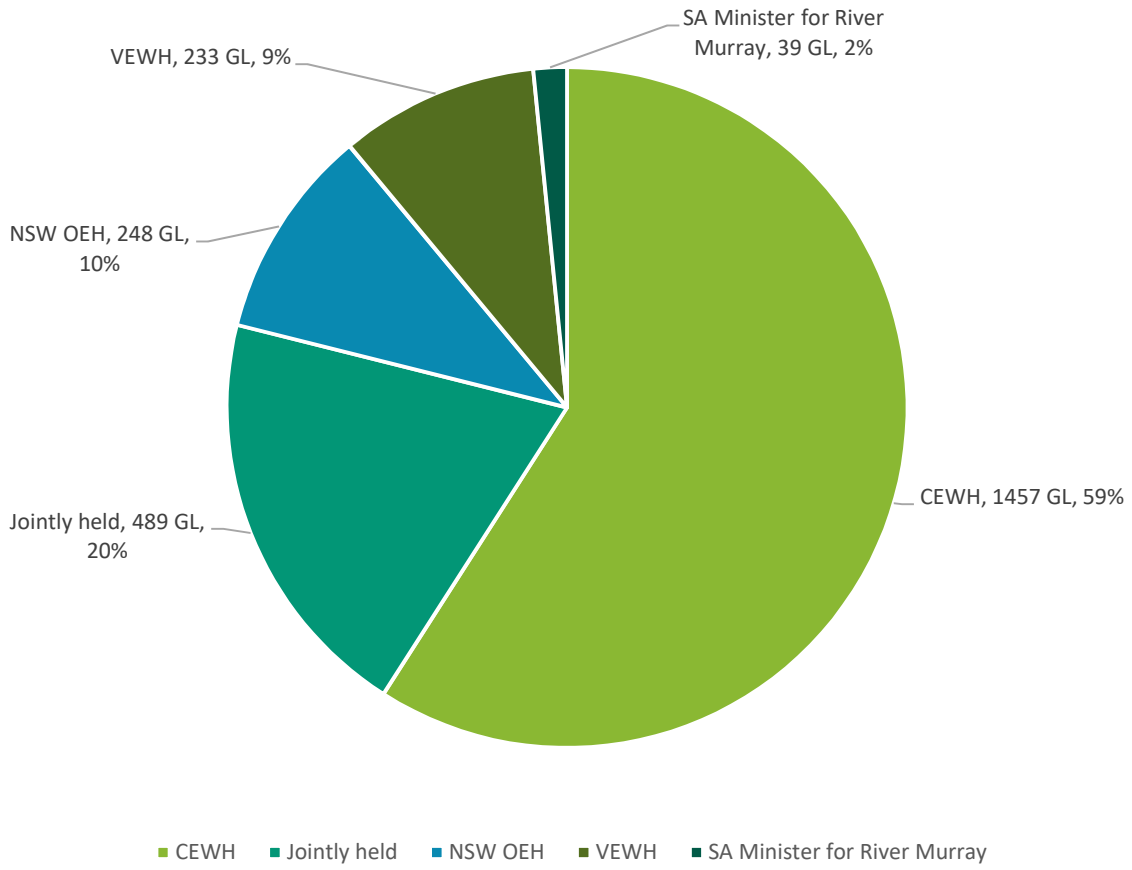
Location of key constraints that impacted the delivery of water for the environment in the SCB in 2017-18

Appendix - Who holds and manages water for the environment

The total volume of water for the environment held in the Murray-Darling Basin is 2,870 GL. Of this, 2,466 GL is available in the Southern Connected Basin.

2,466 GL in the Southern Connected Basin

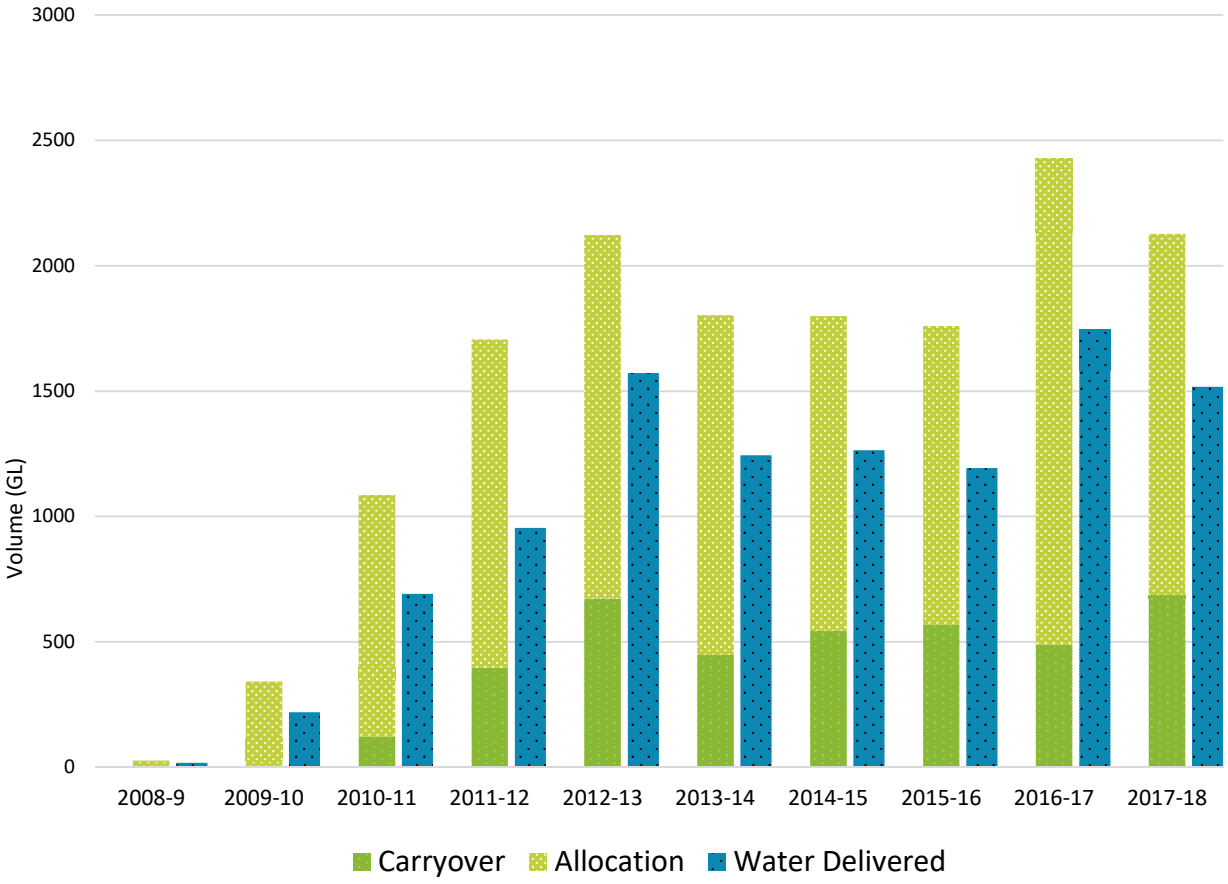
(in long-term available volume terms, not necessarily water allocations each year)



Total volume of water for the environment held by each water holder in the southern connected basin as at June 30, 2017
Note: RMIF holdings are not included.

Water holders include:
CEWH: Commonwealth Environmental Water Holder
VEWH: Victorian Environmental Water Holder
NSW: New South Wales Office of Environment and Heritage
SA: South Australian Department of Environment, Water and Natural Resources
Joint: joint government programs (The Living Murray portfolio - Cwlth, VIC, NSW, SA, and managed by MDBA; RMIF portfolio – Cwlth, VIC, NSW and managed by MDBA)

Appendix - Growth in water availability and use



Water for the environment availability and use (CEWH and Joint TLM Water combined)

- *In addition, across the last two years SCBEWC has called and delivered 167 GL of RMIF entitlements (100 GL in 2016–17 and 67 GL in 2017–18). 222 GL of environmental RMIF remains in Snowy storages, but is not callable in 2018-19 due to the Snowy storages being below the callable limit, and is also unlikely to be callable in 2019–20.*

Year	Murray system inflows (GL) *	Murray system diversions # (GL)	E-water avail^ (GL)	E-water portfolio use< (GL)	E water use with return flows> (GL)
2016-17	16,120	2,950	2,426	1,847	2,645
2017-18	4,160	3,250	2,128	1,585	2,619

**including inflows to Menindee Lakes, but excluding the Snowy Mountains Scheme, inter-valley transfers and environmental water*

 # VIC, NSW and SA diversions, not including environmental water. The high water availability in 2017–18 and the persistent hot and dry conditions drove high demand, converse to the early wet conditions and relatively low demand in 2016–17.

^ Portfolio availability (CEWH and TLM, noting other portfolios not represented include VEWH, OEH and SA DEW)

< Portfolio use (CEWH and TLM and RMIF)

> Water for the environment use including return Flows (use and re-use)

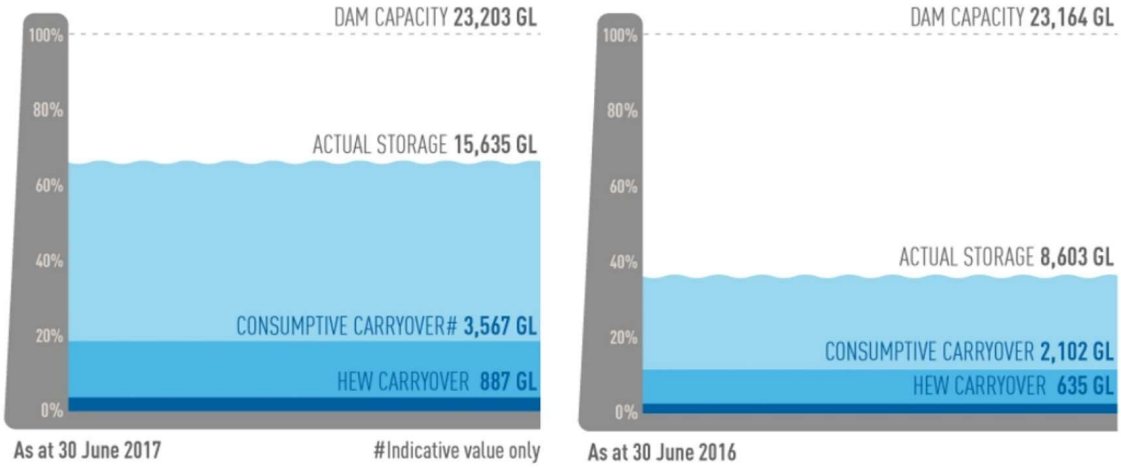
Appendix – The role of carryover

Carryover is an important management tool

Carryover provides flexibility in the timing of water delivery across years to all entitlement holders. The choices to manage water are the same for environment users with equivalent licence types to other users : use, carryover or trade.

For environmental water holders, the flexibility provided by carryover is important for being able to water wetlands or provide an in-stream flow pulse down a river early in a water year. Carryover supports early season use at a time when water allocations are often low, but at a time of year when these type of flows would have naturally occurred and are needed.

Basin-wide, carryover by environmental water holders does not take up significant storage space in dams. Consumptive carryover is typically far larger as is actual storage. (figure 8.6 reproduced in part from the MDBA Transitional Water Take Report 2016–17)



Comparison of consumptive and held environmental water (HEW) carryover as a proportion of end of year actual storage 2015–16 to 2016–17 at a basin scale.
Dam capacity (the total storage available across the basin) varies across water years due to

- *The removal of Lake Mokoan in Victoria from reporting after decommissioning, resulting in a decrease in total storage of 365 GL in 2015–16 and*
- *improvements to Chaffey Dam in NSW increasing total storage by 39 GL in 2016–17.*

Appendix – Water delivery by location

Table of 2017–18 environmental water use (GL) in the Southern Basin (based on the Basin Plan Annual Report, matter 9.3).

Site or river valley	Primary ecological purpose for the range of e-watering actions at the site or river valley	Jointly managed water (TLM & RMIF)	CEWH	VEWH	NSW OEH	South Australia	Total
Ovens River	Longitudinal connectivity	0.0	0.1	0.0	0.0	0.0	0.1
Barmah-Millewa Forest	Wetlands, including Moira grass, support waterbird populations and support native fish recovery	122.6	293.0	4.0	14.1	0.0	433.6
Lower Broken Creek	Native fish and local wetland and their waterbirds	0.0	41.9	1.5	0.0	0.0	43.4
Goulburn River (reach 1)	Fish and non-woody vegetation	0.0	0.0	4.0	0.0	0.0	4.0
Goulburn River (reach 4 & 5)	Supporting the native fish recovery and reinstating flows that promote key ecological processes	77.6	235.6	37.6	0.0	0.0	350.8
Campaspe River	Supporting the native fish recovery and reinstating flows that promote key ecological processes	5.3	6.6	17.7	0.0	0.0	29.6
Gunbower Forest and Gunbower Creek	Growth of wetland, understorey species and river red gum on floodplain and Murray cod in the creek	0.8	20.7	9.6	0.0	0.0	31.0
Koondrook Perricoota Forest and Pollack Swamp	Resilience and ecosystem resilience to support waterbird habitat	0.0	0.0	0.0	2.0	0.0	2.0
Loddon River	Supporting forests and woodlands and fish	0.0	3.1	14.7	0.0	0.0	17.7
Murrumbidgee River System	Re-connect wetlands and supporting the native fish recovery and reinstating flows that promote key ecological processes	0.0	179.2	0.0	90.7	0.0	270.0
Hattah Lakes	Enable recruitment of trees and support growth of understorey species, river red gum and black box	72.8	32.1	7.0	0.0	0.0	111.9
Lower Darling River	Improve flow regime and fish habitat to improve ecological function of the Darling River for native fish	23.1	2.7	0.0	0.0	0.0	25.8
Lindsay-Mulcra-Walpolla	Enable recruitment of trees and support growth of understorey species, river red gum and black box	0.0	0.0	9.6	0.0	0.0	9.6
Weirpool manipulations (7,8,9 and 15)	Lateral connectivity and fish habitat diversity	0.0	3.3	0.0	0.0	0.0	3.3
Murray River Region NSW	Range of actions to wetlands and river reaches to support a number of outcomes for vegetation, waterbirds, fish and productivity	0.0	48.7	0.0	11.4	0.0	60.1
Murray River Region Victoria	Range of actions to wetlands and river reaches to support a number of outcomes, including for vegetation, waterbirds and fish and productivity	0.0	0.0	11.7	0.0	0.0	11.7
Chowilla Floodplain	No watering action	0.0	0.0	0.0	0.0	0.0	0.0
Murray River Region SA	Range of actions to wetlands and river reaches to support a number of outcomes, including for vegetation, waterbirds and fish and productivity	0.0	13.2	0.0	0.0	35.6	48.8
River Murray Channel	Water delivered through the River Murray Channel accounted under water use described for other sites						
Lower Lakes, Coorong and Murray Mouth	End of basin flows for fish, waterbirds and vegetation. Improve connectivity between freshwater, estuarine and marine environments	229.7	893.7	26.4	9.355	7.1	1166.3
Total		531.8	1774.0	143.7	127.5	42.7	2619.8

Information from the Basin Plan annual reporting (matter 9.3 environmental watering events).

Appendix – Jointly held water portfolio overview

The Living Murray (324 GL was available for use)

Location	Entitlement Volume (GL)	Net Carryover Volume (GL)	Allocation (%)	Allocation (GL)
Regulated Water Entitlements				
NSW Murray Valley High Security	5.1	0.0	97%	5.0
NSW Murray Valley General Security	83.0	16.62	51%	42.3
NSW Murrumbidgee Valley General Security	85.0	0.0	45%	38.3
NSW Lower Darling High Security	0.5	0.0	100%	0.5
NSW Lower Darling General Security	47.8	0.3	100%	47.8
Victoria Murray Valley High Reliability	21.9	14.1	100%	21.9
Victoria Murray Valley Low Reliability	101.8	4.3	0%	0.0
Victoria Goulburn Valley High Reliability	45.2	19.3	100%	45.2
Victoria Goulburn Valley Low Reliability	157.0	15.0	0%	0.0
Victoria Campaspe High Reliability	0.1	0.13	100%	0.1
Victoria Campaspe Low Reliability	5.0	5.0	59%	3.0
South Australia Murray Valley	45.0	0.0	100%	45.0
SUB-TOTAL	597.5	74.8		249.0
Supplementary (unregulated licences)	397.3	0	0	0
GRAND TOTAL	994.8	74.8		249.0

River Murray Increased Flows (314 GL was available for use)

Location	Start of Year Volume (GL)	Allocation (GL)	Transfer to Hume, classified in May 2018 (GL)	Use (GL)	End of Year Volume (GL)
RMIF in Snowy	472	65			223
RMIF in Hume	0	0	314	67	247

Note RMIF has been planned for use in 2018–19 along with TLM carryover, including keeping 50 GL as a strategic drought reserve for 2019–20.

Thank you

The effective management of water for the environment relies on the contributions and efforts of many land and water organisations and communities across the southern Basin.