Reflections

Victorian Environmental Water Holder

Environmental watering in Victoria 2014–15

VICTORIAN ENVIRONMENTAL WATER HOLDER

VICTORIA State Government

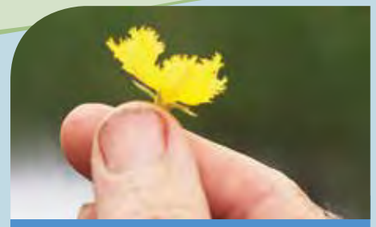
The Victorian Environmental Water Holder acknowledges the significant contribution of its program partners, particularly the waterway managers, in managing the Water Holdings to improve the environmental health of Victoria's rivers, wetlands and floodplains.

Aboriginal and Torres Straight Islander people are warned that this document may contain images or names of deceased persons.

Cover photo: Platypus, by Dave Watts.
Above: Cormorant and nest, Hattah Lakes, by Mallee CMA.

highlights of environmental watering in 2014–15

After environmental watering at Lake Yando, more than 70 different species of birds, frogs and turtles were observed.



Large scale environmental watering in Gunbower Forest saw many water-dependent plants respond positively, including two threatened species: the wavy marshwort and river swamp wallaby-grass.

After environmental watering at Moodies Swamp, a pair of brolga was sighted, feeding and displaying a coutship dance.

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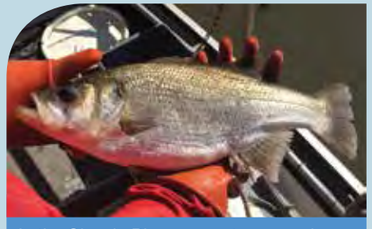
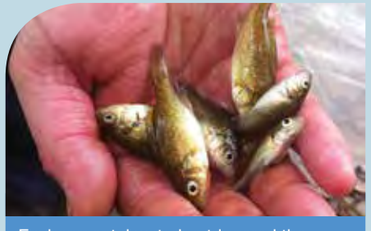
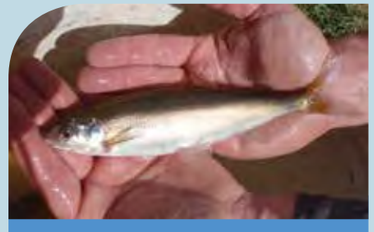


In the Glenelg River, one estuary perch swam at least 300km due to environmental watering and the removal of fish barriers.



Environmental watering triggered the spawning of Macquarie perch in the Yarra River for the second successive year.



Environmental watering was found to trigger the migration and spawning of Australian grayling in the Thomson system, with record numbers of Australian grayling eggs found in autumn 2015.

- Gippsland Region
- Central Region
- Western Region
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- The Living Murray icon sites

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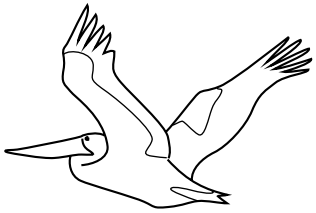


foreword

Welcome to *Reflections – environmental watering in Victoria 2014–15*. This annual booklet reflects the work of the Victorian Environmental Water Holder and its partners in supporting rivers and wetlands and the wildlife that depends on them.

In our fourth year of operation, VEWH prioritised and coordinated delivery of the largest ever number of watering actions. Together with our partners, we targeted 243 priority watering actions and delivered 645,767 ML of water across the state.

As we gather these annual stories it is becoming increasingly clear that environmental water has tangible and critical benefits for hundreds of species of plants and animals, including rare and threatened species. Our body of evidence is growing. This year's highlights include an increase in native fish abundance and diversity statewide, including spawning of Macquarie perch in the Yarra River and golden perch in the Goulburn River, as well as spawning and migration of the threatened Australian grayling in the Tarago, Latrobe, Thomson and Macalister rivers.

The delivery of environmental water to a diverse range of Victorian rivers and wetlands has supported an explosion of life. For example, frog populations in the Werribee River became 10 times more abundant after environmental water delivery. After water was delivered to Lake Yando, near Boort, more than 70 different species of birds, frogs and turtles were observed.

Meanwhile, we have also seen evidence of successful breeding of platypus populations in the Mackenzie, Campaspe and Tarago rivers.

Monitoring continues to improve the way we measure and adapt environmental water management in our rivers and wetlands. Aside from assessing water quality and observing the presence of species, Victorian waterway managers are employing cutting-edge monitoring technology such as acoustic tracking of platypus and fish and testing of water samples using environmental DNA. We are also seeing valuable use of citizen science monitoring, as communities provide qualitative feedback about environmental watering and its outcomes.

As always, I would like to recognise the ongoing time and effort of all our program partners this year, including waterway managers, storage managers, and land managers. The stories you will read in this year's *Reflections* demonstrate, yet again, the value of our collective watering efforts. Inside, you will hear from our partners in catchment management authorities and Melbourne Water as they recount the work they have undertaken – the achievements, challenges and lessons learned – in 19 Victorian river systems.

I would also like to recognise and thank the Commonwealth Environmental Water Holder and Office, the Living Murray program staff and the Victorian communities who work with us to improve the environmental condition of the State's rivers, floodplains and wetlands.

Denis Flett
Chairperson

Opposite: Hattah-Kulkyne National Park, winter 2015, by David Blom.

introduction

The VEWH is an independent statutory authority set up under the *Water Act 1989* to manage Victoria's environmental water entitlements (known as Water Holdings) to achieve environmental benefits for Victoria's rivers, wetlands and floodplains.

The role of the VEWH is to:

- make decisions about the most effective use of the environmental water entitlements, including use, carryover and trade
- commit water and authorise waterway managers to implement watering decisions
- work with storage managers and other water holders to coordinate and maximise environmental outcomes from the delivery of all water
- commission projects to demonstrate the ecological outcomes of environmental watering at key sites and to help improve environmental water management
- publicly communicate environmental watering decisions and outcomes.

Why is environmental watering important?

Rivers and wetlands are Victoria's lifeblood, so we need to protect them.

Healthy rivers and wetlands support vibrant and healthy communities. They sustain people by supplying water for towns, farms and businesses and contributing to local economies through industries such as agriculture, fishing, real estate and tourism. Healthy rivers and wetlands make cities and towns more liveable and contribute to the physical and mental wellbeing of individuals and communities. They provide places for people to play, relax and connect with nature, and sustain Indigenous communities who have a continuing connection to Country.

Why do we need environmental watering?

It creates refuges for water-dependent species during drought.

- Kate Bennetts, ecologist

It improves river health which sustains our Country and our continued connection.

- Darren Perry, Ngintait Traditional Owner

It can be very important for the breeding of fish. I have a long family history of fishing.

- Steven Threlfall, angler

It provides some open water areas in a dry landscape and makes the wildlife come back again.

- David Falla, landholder in Litchfield

Before the development of dams, weirs and channels, water readily flowed through the landscape dispersing sediment and nutrients that underpin aquatic food webs. This provided rich soil for plant growth, and food and habitat for fish species (such as Murray cod and golden perch), mammals (such as platypus), and birds (such as brolgas and royal spoonbills). Natural changes in river levels throughout the year were also cues for fish and other water animals to breed and feed.

The way water flows through the landscape has now changed. River and wetland systems also provide water to towns, industry and modern agriculture. As a result, many of Victoria's river and wetland systems have become highly modified and now operate in a way that is significantly changed from natural conditions.

introduction

Rivers and wetlands cannot sustainably provide these benefits unless their ecological health is protected and maintained. Environmental watering is a crucial tool to achieve this.

In rivers, environmental water is often delivered to mimic some of the flows that would have occurred naturally, before the construction of dams, weirs and channels. This is vital for maintaining the physical, chemical and biological health of rivers.

Environmental water managers generally focus on returning some of the small and medium-sized river flows that are critical in the life cycles of various native plants and animals. These flows can move sediment and nutrients through river systems, connect habitats and improve water quality.

The timing, duration and volume of water delivery is designed to support the native plants and animals that rely on those flows. For example, fish such as the Australian grayling rely on an increase in river flow in autumn to signal them to migrate downstream for spawning.

Many wetlands are now either disconnected from the rivers that used to naturally fill them or are permanently connected to rivers or channels. This means that some wetlands do not get enough water, and others get too much.

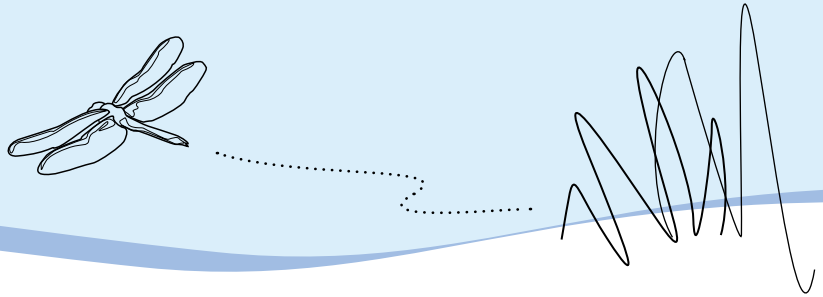
In wetlands, environmental water managers focus on mimicking the natural wetland wetting and drying cycles that so many plants and animals have evolved to depend on for their diversity and long-term resilience. For example, where wetlands and floodplains have been cut off from natural river flows, environmental water can be used to reconnect these areas, sometimes via irrigation infrastructure such as pumps, channels and regulators.

Highlights of environmental watering in 2014–15

Highlights of environmental watering in 2014–15 include:

- Environmental watering triggered the migration and spawning of Australian grayling in the Thomson system, with record numbers of Australian grayling eggs found in autumn 2015
- Environmental watering triggered the spawning of Macquarie perch in the Yarra River for the second successive year
- Frog populations in the Werribee River became ten times more abundant after environmental watering
- There was evidence of successful platypus breeding in the Campaspe, Mackenzie and Tarago rivers
- In the Glenelg River, one estuary perch swam at least 300 kilometres due to environmental watering and the removal of fish barriers
- Environmental watering provided refuge pools in Mount William Creek, Burnt Creek and MacKenzie River, supporting native fish species such as southern pygmy perch, obscure galaxias, river blackfish and flatheaded gudgeon

Left: Wavy marshwort at Reedy inlet, Gunbower Forest, by North Central CMA.



- Surveys indicated that the lower Wimmera River was in the best condition it had been for many years, thanks to several years of regular environmental watering
- Golden perch spawned in the Goulburn River in response to environmental watering in 2014–15
- After environmental watering at Moodies Swamp, a pair of brolga was sighted, feeding and displaying a courtship dance
- After water was delivered to Lake Yando, near Boort, more than 70 different species of birds, frogs and turtles were observed
- Large-scale environmental watering in Gunbower Forest saw many water-dependent plants respond positively, including two threatened species: the wavy marshwort and river swamp wallaby-grass
- Environmental watering in the Snowy River mimicked the unique flow pattern of the mountainous Snowy system. This flow pattern is important to maintain the shape of the Snowy River channel which has suffered from years of dwindling flows caused by river regulation.

Carryover and trade

Carryover and water trade are tools used by the VEWH to enable environmental water to be used when and where it is most needed. In 2014, VEWH continued to use carryover and trade to effectively and efficiently manage its growing environmental water portfolio. For example:

- In spring 2014, the VEWH transferred water from the Yarra River to the Thomson River to support Australian grayling migration
- In partnership with Melbourne Water, VEWH purchased water in the Maribyrnong system – where VEWH does not hold an entitlement – to maintain water quality over summer and autumn
- In autumn 2015, after an assessment of the VEWH's demand and supply position, the VEWH sold 12,975 ML of water in northern Victoria
- The VEWH and Melbourne Water worked in partnership to purchase and deliver around 630 ML of water in the Maribyrnong system. This was delivered to support waterbugs, fish and platypus in Jackson's Creek by maintaining water quality, connectivity and vegetation.

In some systems, carryover rules allow the VEWH to retain unused water in storage at the end of the year, which can then be used to meet environmental watering priorities in future years. At the end of 2014–15, 344,014 ML of water was carried over for use in 2015–16, subject to carryover rules and conditions (for example, evaporation and potential loss to storage spills). This water will be critical in 2015–16 to support Victorian rivers and wetlands if El Niño results in dry conditions (see section, Building resilient rivers, pages 34 – 35).

Partnerships

Working with program partners is critical to the efficient and effective delivery of the environmental watering program. Waterway managers (Victoria's catchment management authorities and Melbourne Water) and storage managers each have a key role in the local planning and implementation of watering actions. The VEWH also works closely with other water holders such as the Commonwealth Environmental Water Holder (CEWH - through the Commonwealth Environmental Water Office) and the Murray–Darling Basin Authority (through the Living Murray program) to negotiate use of their water in Victorian waterways.

Partners in the Victorian environmental watering program continue to work together to achieve benefits for Victoria's rivers, wetlands and floodplains. In 2014–15, the strength of relationships between environmental water holders, waterway managers, storage managers and land managers was demonstrated through multi-site watering events involving the Goulburn and Campaspe rivers, Gunbower Creek and the River Murray (see pages 42– 43).

protecting platypus in Victoria

Pictured: Platypus, photograph courtesy of Healesville Sanctuary.
Opposite: Dr Melody Serena, by the Australian Platypus Conservancy.

Victorian waterway managers specifically used environmental water to support platypus, employing cutting-edge technology to monitor the outcomes of this watering.

The platypus is a uniquely Australian species. Along with echidnas, platypus are part of an exceptional group of mammals which lay eggs, known as monotremes. Yet our 'duck-billed', egg-laying icon requires protection. Highly-modified rivers, with altered and reduced flows, are taking their toll on platypus populations.

The species is classified as 'near threatened' in the *2012 Action Plan for Australian Mammals* (CSIRO). It is also believed to have become extinct in at least three Victorian waterways in the last few decades: Curdies River, the Avoca River and Bass River.

In 2014–15, a number of Victorian waterway managers specifically used environmental water to support platypus, employing cutting-edge technology to monitor the outcomes of this watering.

In autumn 2015, environmental water was released to support platypus in the Campaspe River. The same releases aimed to bolster platypus downstream in the Gunbower system (where there are probably fewer than fifty individuals), with the hope of re-establishing platypus elsewhere on the Victorian side of the Murray downstream of Echuca.

Australian Platypus Conservancy biologist, Dr Melody Serena, says the lower Murray platypus population collapsed during the Millennium drought and that the autumn environmental water release provided deeper water to help protect dispersing juveniles from being killed by predators such as foxes.

"The Campaspe is a really important source of juvenile platypus," she explains.

"Platypus need to migrate to the Murray to recolonise and the only likely way that this will happen is to have conditions that support successful long-distance movements by small and inexperienced young animals."

In the west of the state, in the Wimmera system, platypus were once widespread but now the Mackenzie River supports the last known breeding population. In 2014–15, the Wimmera CMA began using ground-breaking technology to improve platypus monitoring in its streams. The CMA is screening water samples for traces of platypus DNA using an innovative technique known as environmental DNA (eDNA).

Wimmera CMA CEO, David Brennan, says the new technology will enable the CMA to detect platypus in a non-intrusive way.

"With platypus, traditional trapping methods are labour intensive and understandably platypus are not that willing to wander into a net," he says.

"This new technology means we can monitor more sections of river system where the community has reported seeing platypus and get a better idea of the extent of the species' current habitat."

protecting platypus in Victoria

The great news is that, thanks to environmental watering, platypus are repopulating mid-sections of the Mackenzie River for the first time since the Millennium drought.

"During the drought, the mid-section of the Mackenzie River dried completely and with it we lost platypus and their habitat," Wimmera CMA Environmental Water Manager Greg Fletcher says. "Now the annual summer and autumn environmental flows have made it possible for platypus to repopulate this section of the river."

Meanwhile, in an Australian first, Melbourne Water acoustically tracked platypus during an environmental flow release to the Tarago River in autumn. Low water levels prior to the environmental flow had decreased platypus habitat and had put remaining platypus at risk of predators. Environmental Water Planner, Sarah Gaskill, says the monitoring showed that platypus movement increased through the flow period which is a positive sign.

"During the environmental watering, platypus became more mobile, roving between receivers more frequently, and increasing the distances over which they foraged at night," she says.

"We are using this information to improve our understanding of platypus' preferred flow conditions across our region. This is all very promising for establishing stronger platypus populations."

Both the Wimmera and Tarago monitoring projects have been run in collaboration with Josh Griffiths from environmental research organisation **cesar**. Josh is a wildlife ecologist with extensive experience working with platypus in Victoria and Tasmania.

"Platypus are very difficult animals to monitor effectively," he says. "We need to keep innovating and using new technology as it becomes available to understand the status of platypus populations and how human activities are impacting them. With this information, we can continue to modify and improve our management actions, including environmental water management, to protect platypus into the future".

"This new technology means we can monitor more sections of river system where the community has reported seeing platypus and get a better idea of the extent of the species' current habitat."

David Brennan, Wimmera CMA CEO

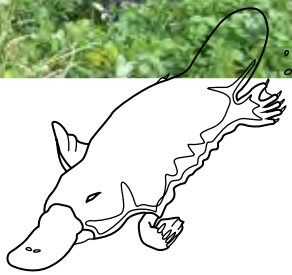
Water is critical for platypus survival

According to Australian Platypus Conservancy biologist, Dr Melody Serena, environmental flows are critical for platypus to maintain and re-establish healthy populations.

"Platypus are warm-blooded animals that need a lot of energy," she explains. "A female platypus towards the end of lactation will eat around 80 percent of her body weight in macro-invertebrates per day. Platypus like to eat aquatic insects, such as larval caddisflies and damselflies, as well as yabbies, worms and small freshwater mussels and shrimp. If a river is in drought or has very low flows, it won't attract enough insects and other food for platypus to breed and survive.

"Flow is essential for breeding. During breeding season, the mother will lay one to three eggs in burrows in the stream bank. Once hatched, the young will stay in the burrow for about three months and during that period the mother needs to go back and forth regularly from the burrow to the water to find food. If the water level drops significantly below the burrow entrance, she will have to walk back and forth across land and so becomes an easy target for predators such as foxes. And of course, if she dies, so do her young.

"The work being done by waterway managers is encouraging and the monitoring work is cutting edge," Dr Serena says. "Communities can also contribute to platypus conservation in their area by getting into the habit of reporting their platypus sightings to their local waterway manager and, if they like, to the Australian Platypus Conservancy. The more information we have about where these animals occur, the better we can target our support to ensure we have sustainable platypus populations."



Report platypus sightings

Australian Platypus Conservancy

For further information about how to report platypus to the Australian Platypus Conservancy, visit www.platypus.asn.au/reporting.html.

PlatypusSpot

PlatypusSPOT is an online tool that collects the vast wealth of community information on platypus sightings and makes this information publicly accessible. It's about raising awareness of where platypuses occur and threats to their conservation.
Visit www.platypusSPOT.org

Pictured opposite: Josh Griffiths, by **cesar**
Above: Platypus fyke nets at Labertouche Creek, by Keith Chalmers.

Above: Canoeing in Gunbower Forest near Reedy Lagoon, by Emma Coats.

shared benefits from environmental watering

By generally improving the health of the rivers, wetlands and floodplains, environmental watering can *intrinsically provide* shared benefits to communities. Examples include:

- increasing opportunities for recreational pursuits such as fishing and bushwalking
- sustaining healthy Country for Indigenous communities that have a continuing connection to rivers, wetlands and floodplains
- improving water quality which can have indirect economic benefits for irrigation.

Shared benefits can also be *actively maximised* by making decisions around the storage, delivery and use of environmental water. Examples include:

- timing the release of an environmental flow to improve conditions for kayaking over a long weekend
- timing the release of an environmental flow to increase breeding opportunities for a totem species.

Where possible, environmental water managers look for opportunities to maximise shared benefits, provided environmental outcomes are not compromised. Recent examples follow.

shared benefits

Aboriginal environmental outcomes from environmental watering

Aboriginal people have been intimately connected to Victoria's waterways for thousands of years. Recognising this, partners in the Victorian environmental watering program are working to increase the ability of the program to:

- achieve shared benefits for Aboriginal people from environmental watering (Aboriginal environmental outcomes from environmental watering), and
- incorporate traditional ecological knowledge in environmental water management.

The VEWH understands that Aboriginal aspirations for water management consist of two key areas:

- **Cultural flows** – water entitlements legally owned by Aboriginal people to improve the spiritual, cultural, environmental, social and economic conditions of those Aboriginal Nations[1]; and
- **Aboriginal environmental outcomes from environmental water** – the protection or enhancement of cultural values that have environmental value, using environmental water.

Aboriginal groups also want to see traditional ecological knowledge better incorporated in water management, including environmental water management.

> *"Traditional Owners hold extensive ecological knowledge passed down over many generations... however it is rarely used in current management practice."*
>
> *– Janine Coombs, Chairperson of the Federation of Victorian Traditional Owner Corporations and Chairperson of Barengi Gadjin Land Council*

[1] *Echuca Declaration*, Murray Lower Darling Rivers Indigenous Nations, 2007

Cultural values mapping projects

Cultural values mapping can be a crucial first step on the path to providing Aboriginal environmental outcomes from environmental water, better incorporating traditional ecological knowledge in environmental water management and assisting Traditional Owners to negotiate for their Country's water needs.

Two examples of Victorian cultural values mapping projects undertaken between 2013 and 2015 are:

The Barapa Barapa Cultural Heritage Mapping of Lower Gunbower Forest

In 2013–14, Barapa Barapa Traditional Owners and the North Central CMA mapped important cultural sites and values in Gunbower Forest. This project was funded by the Australian Government, supported by the Living Murray Indigenous Partnership Program and recently won a Victorian Landcare award. The next phase of the project, funded by the Department of Environment, Land, Water and Planning (DELWP), is to create a framework to develop cultural watering objectives which will assist in determining culturally informed watering proposals.

Above: Sharnie Hamilton holding water pepper – a culturally important plant, by North Central CMA.

from environmental watering

The Dhudhuroa and Waywurru Aboriginal Waterways Assessment of the Victorian Alps including the Ovens, King and Kiewa Rivers

In December 2014, a group of 10 Traditional Owners worked with the Murray–Darling Basin Authority to identify important sites and assess the cultural health of these sites along these rivers, from Wangaratta to Falls Creek. This project will increase the ability of Dhudhuroa and Waywurru Traditional Owners to negotiate for their Country's water needs, including for Aboriginal environmental outcomes.

Dhudhuroa Elder Gary Murray talks about the importance of water for important cultural sites:

> *"The watering of our cultural places brings, for example, a redgum to life from a seed to a tree with animals and birds. It brings Djinabis (Dhudhuroa possum skin cloaks) to keep warm, shelter for the clans from the elements, water transport canoes, weapons and carrying tools, and materials for burial rituals."*

Two other Victorian cultural values mapping projects are in their very early stages:

Wurundjeri cultural values mapping in the Yarra river system

The VEWH and Melbourne Water are working with the Wurundjeri Tribe Land and Compensation Heritage Council on a project to document the Wurundjeri cultural values in the Yarra river system to increase understanding of values that can be supported with environmental water to achieve Aboriginal environmental outcomes.

Water values and uses scoping project in the Glenelg river system

Glenelg Hopkins CMA, Gunditj Mirring Traditional Owners Aboriginal Corporation and Barengi Gadjin Land Council are undertaking a scoping project funded by the Department of Environment, Land, Water and Planning (DELWP). This project will document Traditional Owner values and uses related to water in the Glenelg system and will also consider Traditional Owner management interests and aspirations in the Glenelg river system.

All four of the projects mentioned above will assist Traditional Owner groups to negotiate for their Country's water needs and their Nations' aspirations regarding water. Most importantly for the Victorian environmental watering program, these projects will increase the ability of the program to: 1) use environmental water to provide Aboriginal environmental outcomes and 2) better incorporate traditional ecological knowledge in planning and management.

> *"Environmental watering improves river health which sustains our Country and our continued connection."*
>
> *– Darren Perry, Ngintait Traditional Owner*

Above: Dhudhuroa and Waywurru Traditional Owners in the Victorian Alps, by Murray–Darling Basin Authority.

shared benefits

Recreational benefits from environmental watering

In helping to keep rivers healthy, environmental water also provides social and recreational benefits. The *My Victorian Waterway* survey – completed in 2011 by more than 7,000 Victorians – found that communities regularly use rivers for recreation, such as bushwalking, cycling, boating, paddling and birdwatching. Rivers and wetlands also provide arenas for many important community festivals and regattas.

Environmental water delivered to rivers and wetlands has direct benefits for recreational users. For example, 28 of the top 50 Victorian recreational fishing reaches (as identified in Fisheries Victoria's *Improving Inland Recreational Fishing* Survey, 2012) are physically able to receive environmental water. In the 2014–15 water year, all of these received environmental water, helping to increase fish habitat, boost fish food sources, and increase river and wetland 'connectivity', enabling native fish to move up and downstream (and onto the floodplain) to feed and breed. In 2014–15, environmental watering has also played an important role in supporting river festivals, camping, canoeing and boating.

Aside from creating healthy recreational settings, environmental watering can provide additional recreational benefits in the way it is managed and delivered. Sometimes, for instance, water delivery timing can be 'tweaked' to ensure water is present in a river or water storage for important festivals or regattas. This can only occur if environmental targets can still be achieved.

The case studies that follow demonstrate how environmental water was managed in 2014–15 to provide shared benefits.

Above: Water skiing at the 2014 Kanamaroo Festival, by The Wimmera Mail Times.

Case study: Horsham Weir Pool

In spring 2014, good relationships and smart thinking delivered a win-win for water quality in the Wimmera River and a long-standing community event in Horsham.

A key attraction of Horsham's annual Kanamaroo Festival is a water skiing event on the Wimmera River. High water levels are needed in the Horsham Weir Pool to safely host the event and in the lead up to the 2014 festival the outlook was not looking good. Rainfall over winter had been well below average and the region was experiencing its driest spring in decades. Natural flows into waterways were in the lowest 10 percent on record, so there was no flow in the river apart from environmental water releases.

In the lead up to spring 2014, Wimmera CMA was planning to deliver a 'fresh' (an environmental flow with a short-duration peak) to improve water quality in the Wimmera River. This higher flow was needed because, as history has shown, despite ongoing low flows in the Wimmera, groundwater intrusion causes salinity to gradually rise, creating a toxic environment for fish and plants.

In a great example of cooperation, Wimmera CMA liaised with Horsham Rural City Council and agreed to retain the water in the Horsham Weir Pool and delay delivery of the water down the river until after the water skiing event.

This kept water levels high enough to accommodate water skiing, and also allowed the environmental flows to be delivered in sharper 'peaks', which makes the flows more effective at improving water quality.

With conditions looking even drier, there may not be water available to deliver the same result again this coming summer (2015–16). However, Wimmera CMA looks forward to pursuing opportunities to deliver multiple benefits where possible.

Case study: Kayakers on the Thomson river

Of two kayak 'trails' in Victoria, the Thomson River in West Gippsland hosts the only 'white water' trail. Less than a couple of hours from Melbourne, it is easily accessible and a popular destination for kayakers, valued for its unique wilderness aesthetic.

When there is water available, the West Gippsland CMA orders environmental flow releases from the Thomson Reservoir in autumn and spring. As well as providing ecological benefits, these flows also improve the conditions of the river for kayakers, providing a more connected trail and faster rapids ('white water').

Environmental water planning focuses on the ecological values of the river. However, West Gippsland CMA seeks to align releases so that environmental flow peaks occur over weekends, providing recreational benefits. On many occasions, this has occurred over the Labour Day long weekend.

West Gippsland CMA also manages a 'recreational users' contact list, which includes kayaking clubs, four-wheel drive clubs, adventure companies and angling clubs, as well as school groups and many interested individuals. A few weeks prior to an environmental water release, a notification is sent to people on the contact list detailing the timing and magnitude of the flows. Many respondents provide feedback through this channel, sharing their excitement and appreciation for being informed and also providing photos and videos to the CMA.

Right: Riding the rapids on the Thomson River, by Jake Marler.

Above: Revegetation – Upper Latrobe River near Willow Grove, by West Gippsland CMA.

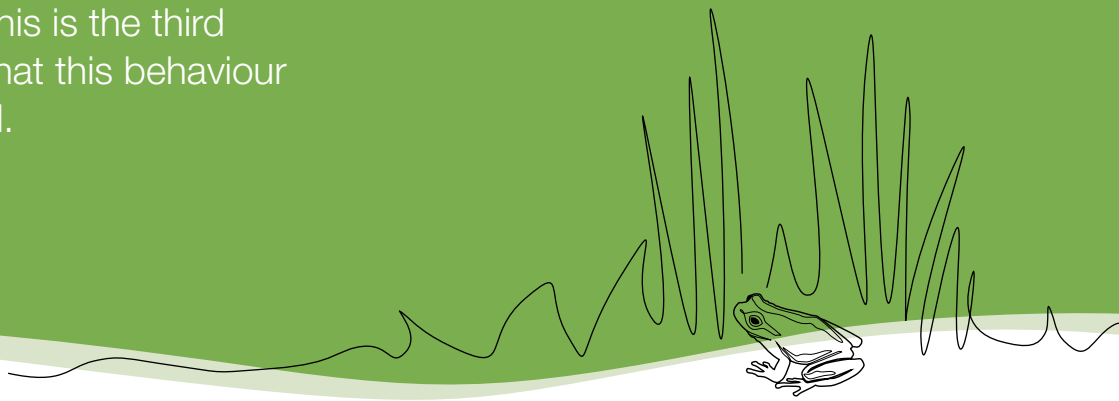
Gippsland

In 2014–15, environmental watering in west and east Gippsland continued to build on environmental successes of previous years – particularly for the vulnerable Australian grayling in the west and the iconic Snowy River in the east.

In west Gippsland, environmental watering was found to trigger the migration and spawning of Australian grayling in the Thomson system, with record numbers of Australian grayling eggs found in autumn 2015. This is the third consecutive year that this behaviour has been recorded.

As with previous years in the Snowy, environmental watering in 2014–15 aimed to mimic the unique natural flow pattern of the mountainous river system. This flow pattern is important to maintain the shape of the Snowy River channel which has suffered from years of dwindling flows caused by river regulation.

The following pages outline achievements for each system in the Gippsland Region in 2014–15.



latrobe system

While the Latrobe River benefited from the delivery of autumn freshes in 2014–15, the lower Latrobe wetlands continued an all-important drying regime.

Autumn freshes in the Latrobe River in 2014–15 aimed to prevent channel encroachment of terrestrial vegetation, wet in-stream and bank vegetation, improve channel stability and in-stream habitat, provide connectivity for fish passage and improve water quality in the estuarine reaches of the river.

David Stork, Environmental Water Officer at West Gippsland CMA said monitoring of black bream was carried out to determine their response to the autumn freshes.

“Over 50 black bream in the lower Latrobe River were tagged to monitor their movements in response to changes in flow conditions,” David said.

“This information will be used to advance management of environmental water releases in the future.”

The lower Latrobe wetlands are continuing a drying phase, including at Sale Common where drying is occurring as part of a four-year program to manage an abundance of giant rush – a native semi-aquatic plant species. Giant rush has the potential to crowd out other plant species and reduce diversity of wildlife.

“Drying has been highly successful in reducing the extent of giant rush in Sale Common, which had been taking over the wetland after a rapid wetting and drying event following the drought.”

“Drying phases are generally important for the health of the lower Latrobe wetlands as they enable the soil to oxygenate and organic matter to break down,” David said.

“They also encourage the growth and reproduction of wetland plants, and help to reduce the abundance and size of European carp.”

Waterway manager:
West Gippsland Catchment Management Authority

Storage manager:
Southern Rural Water

Site	Volume delivered in 2014/15 (ML)
Latrobe River	3,984

Left: Tagged black bream, by David Stork.

thomson system

The Australian grayling – one of Victoria's threatened fish species – continued to prosper in the Thomson River as a direct response to environmental watering in 2014–15.

Environmental watering specifically targeted Australian grayling, which is listed as 'vulnerable' under the *Commonwealth Environmental Protection and Biodiversity Conservation Act*. The Thomson River is home to one of the few remaining self-sustaining populations of this native fish.

Freshes (or pulses) were delivered in autumn to trigger migration and spawning of native migratory fish species. Freshes were again released in spring to encourage the recruitment of juvenile native fish back into the Thomson system.

Minna Tom, Environmental Water Officer with the West Gippsland CMA, said monitoring over the last decade has provided valuable insight into the spawning behavior of the Australian grayling in the Thomson system.

"This monitoring has uncovered spawning sites, showing that after a spawning event, Australian grayling eggs and larvae are found further downstream in the lower reaches of the Thomson system," Minna said.

"Most significantly, it has demonstrated the importance of well-timed and sufficiently long autumn freshes to trigger adult Australian grayling migration and subsequent spawning."

The monitoring findings have been used to refine the delivery of autumn freshes in the Thomson and Macalister rivers, and event-based monitoring over the past three years has shown successful spawning responses as a result.

"The Australian grayling also wasn't the only species to benefit from the autumn freshes with avid canoers and kayakers taking advantage of the increased flows and travelling down the river on the weekend the fresh was delivered," Minna said.

Waterway manager:
West Gippsland Catchment Management Authority

Storage manager:
Melbourne Water; Southern Rural Water

Site	Volume delivered in 2014/15 (ML)
Thomson River	13,479

Below: Grayling, by David Dawson.

macalister system

Work on a new environmental water management plan for the Macalister River began in 2014–15 as environmental flows continued to target native migratory fish species, including the iconic Australian grayling.

Environmental watering in the Macalister River in 2014–15 aimed to trigger migration and spawning of native migratory fish, boost the strength and diversity of river vegetation and connect habitat with autumn and spring environmental flows.

As in the Thomson system, Australian grayling responded well to environmental watering with monitoring confirming further spawning of this species.

Australian grayling eggs were collected in the lower Thomson system, demonstrating that the autumn freshes delivered through the Thomson and Macalister rivers are able to trigger downstream migration and spawning of this 'vulnerable' species.

Minna Tom, Environmental Water Officer with the West Gippsland CMA, said the development of the Macalister River environmental water management plan also began in 2014–15.

"This important project began with an update to the flow recommendations and early community engagement to ensure that the outcomes of the plan are understood, owned and supported by the community," Minna said.

"Water-dependent values and ecological objectives were identified and developed in partnership with a community advisory group represented by local landholders, agencies, Landcare volunteers and other interest groups."

Waterway manager:
West Gippsland Catchment Management Authority

Storage manager:
Southern Rural Water

Site	Volume delivered in 2014/15 (ML)
Macalister River	11,409

Left: Macalister River on the second day of a fresh, by West Gippsland CMA.

Snowy system

During 2014–15, 155,308 ML of water was delivered to the Snowy River, while an important project continued to investigate the relationship between environmental flows and Australian bass populations.

The Snowy River environmental flow releases aimed to support the rehabilitation of the river below Jindabyne Dam and maintain the shape of the river channel (recognising that it is not possible to restore or maintain the Snowy River to its former size with only one-fifth of its former flow volume).

Liz Brown, Environmental Water and Strategic Projects Coordinator with East Gippsland CMA, said investigations were continuing into how environmental flows can be managed to provide the maximum environmental benefit to the Victorian reaches of the Snowy River.

"The focus initially has been on investigating whether Australian bass can be supported to spawn using environmental water," Liz said.

"Australian bass are a significant species in the estuary. They are one of the major predator species and they are also a popular angling species. Little is known about their life cycles in Victorian waters with most of the limited research done to date occurring in New South Wales rivers."

The project has also improved understanding of the geomorphology of the lower Snowy River, specifically by improving understanding of the interplay between flows and constriction of the river estuary mouth.

"We now have a good hydrodynamic model of the estuary which can be used to predict conditions, including salinity, temperature and water levels, under different flows and estuary mouth conditions," Liz said.

"This will be invaluable in predicting the response of any future environmental flows on selected parameters in the estuary."

Waterway manager:
New South Wales Office of Water (New South Wales), East Gippsland Catchment Management Authority

Storage manager:
Snowy Hydro Limited

Site	Volume delivered in 2014/15 (ML)
Snowy River	155,308

Below: Australian Bass, by Daniel Stoessel (ARI).

Above: Barwon Leigh, by Corangamite CMA.

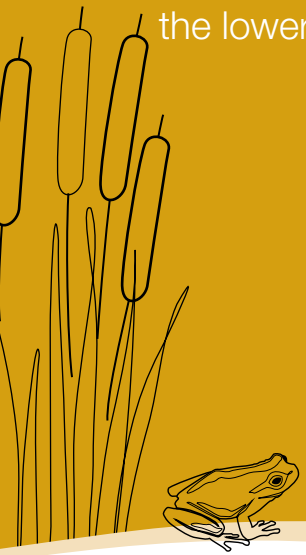
Central region

In 2014–15, many frogs, fish, birds and platypus relished the benefits of environmental watering in the Central Region of Victoria.

Success stories include Macquarie perch spawning in the Yarra River, a substantial rise in frog diversity and abundance in the Werribee River, and a rise in waterbird diversity in the lower Barwon wetlands.

In 2015, monitoring continues to demonstrate the benefits of environmental watering in these river systems. In the Moorabool River, environmental watering has helped to boost native fish numbers and diversity significantly since 2008. In the Yarra and Tarago rivers, platypus and native fish have been thriving after environmental flow releases.

The following pages outline the achievements for each system in the Central Region in 2014–15.



yarra system

In 2014-15, environmental watering triggered the spawning of Macquarie perch in the Yarra River for a second successive year.

With a large volume of environmental water available for the Yarra River in 2014–15, the focus was on providing spawning flows for Macquarie perch and Australian grayling, along with providing habitat and maintaining water quality throughout summer.

Helen Clarke, Environmental Water Resources Officer at Melbourne Water, said monitoring results from 2014–15 demonstrated a second successive year of strong recruitment for the river's Macquarie perch population.

"Macquarie perch live for a relatively long time, which has contributed to the resilience of the species," Helen said.

"Anecdotal evidence obtained from our monitoring activities also indicates an increasing number of native fish generally within the system."

Helen said Australian grayling spawning and migration monitoring from 2013–14 yielded results that are helping with the management of environmental water in the Yarra system.

"Spawning monitoring on the Yarra collected higher numbers of eggs than previous surveys, improving our understanding of the spawning flows required in the system," she said.

"Melbourne Water has also commenced a research project aiming to determine what influences Australian grayling to migrate back into freshwater systems from coastal systems. This work has shown promising results and will continue in 2015–16."

Real-time water quality monitoring of the lower sections of the river also demonstrated the water quality benefits of summer fresh releases, including improved dissolved oxygen concentrations.

Waterway and storage manager:
Melbourne Water

Site	Volume delivered in 2014/15 (ML)
Yarra River	29,251

Left: Macquarie perch, by Jarod Lyon.

tarago system

Platypus and Australian grayling thrived in the Tarago River in 2014–15 following environmental watering.

Environmental water was delivered throughout the year to maintain and improve aquatic species habitat, assist native fish spawning and migration and maintain habitat connectivity for blackfish, platypus and macroinvertebrates.

In an Australian first, Melbourne Water acoustically tracked platypus in the Tarago River during environmental watering.

Sarah Gaskill, Environmental Water Planner, explained:

“Low water levels before the environmental watering decreased platypus habitat availability, reduced connectivity along the waterway and increased predation risk. These conditions appear to inhibit platypus movements.

“During the environmental flow release in autumn, our acoustic tracking indicated that platypus increased their activity and movements in response to increased flows.”

Monitoring also showed that Australian grayling spawned following the autumn environmental flow.

“We also acoustically tracked Australian grayling to get an indication of their movement in response to the environmental flows,” Sarah said.

“Nearly all of the 25 tagged fish migrated downstream – some almost 50 kilometres – to the lower part of the Bunyip River near Koo Wee Rup.”

“One of the fish then returned all the way back upstream to where it was originally collected – a round trip of close to 100 kilometres.”

For more information about platypus tracking in the Tarago, see pages 8 – 11.

Waterway and storage manager:
Melbourne Water

Site	Volume delivered in 2014/15 (ML)
Tarago River	1,842

Below: Tarago fish ladder, by Keith Chalmers.

werribee system

Frog populations 'sky-rocketed' in a section of the Werribee River in 2014–15, in response to targeted environmental watering over the last three years.

The aims of environmental watering in the Werribee system in 2014–15 were to promote recruitment of black bream in the estuary, and facilitate movement of small-bodied fish – such as galaxias, smelt and tupong – between the fresh and estuarine reaches. Environmental watering also aimed to maintain water quality in the lower freshwater reaches and to provide habitat for macroinvertebrates and frogs in the upper reaches.

Bill Moulden, Environmental Water Planner at Melbourne Water, said frogs became a target for environmental watering in the Werribee River after feedback from the community in 2012 suggested a positive response to increased flows.

"In 2014–15, populations were at least 10 times more abundant in a reach that received environmental water compared to other sites that didn't receive environmental water," Bill said.

"This is a great example of how systems can be managed adaptively, not only for changing seasonal conditions but also in line with positive monitoring results."

Monitoring in 2014–15 showed not only greater numbers of frogs, but greater diversity of species, including southern brown tree frogs, common froglets, striped marsh frogs, pobblebonks and whistling tree frogs.

There was very strong visible evidence that environmental watering in 2014–15 also dissipated a blue-green algae bloom in one reach, and helped small-bodied fish move between the estuary and freshwater reaches – aided by a new fishway.

Waterway manager:
Melbourne Water

Storage manager:
Southern Rural Water

Site	Volume delivered in 2014/15 (ML)
Werribee River	714[1]

[1] This 714 ML includes 330 ML of allocation made available by Melbourne Water.

Left: Pobblebonk, by Keith Ward.

lower barwon wetlands

Waterbirds continued to flock to Hospital Swamps during 2014–15, with lower water levels in the wetlands providing feeding and breeding opportunities.

The aim of the environmental watering program at the lower Barwon wetlands is to maintain their ecological character, including their saltmarshes, abundant waterbirds and native plant species.

In December 2014, the inlet regulator to Hospital Swamps was shut to facilitate a natural drying regime over summer. While there were no further inflows until the regulator was opened again in April 2015, there was only a small reduction in the water level in Hospital Swamps due to mild temperatures and rainfall over summer.

Despite this, the lower level in the wetlands contributed to soil salinisation, an important process in estuarine wetlands, supporting the coastal saltmarsh ecological vegetation community and providing feeding and breeding habitat for waterbirds and the threatened orange-bellied parrot.

Waterbird surveys conducted by members of the Geelong Field Naturalists Club, on behalf of BirdLife Australia, found a myriad of species at Hospital Swamps during 2014–15.

Over 25 species were recorded at the wetland, including pink eared ducks, Australian white ibis, royal spoonbills, cormorants, grebes, swamp hens and egrets.

Waterway manager:
Corangamite Catchment Management Authority

Storage manager:
N/A

Top right: Lake Connewarre and fringing saltmarsh, and right: Coastal saltmarsh at Hospital Swamps 2015, both by Saul Vermeeren.

Moorabool system

Native fish numbers and diversity in the Moorabool system have jumped significantly thanks to environmental watering, a 2015 monitoring project shows.

The aims of the environmental watering program for the Moorabool River include providing habitat diversity for galaxia, tupong and southern pygmy perch, while maintaining diverse macroinvertebrate communities and flow-dependent vegetation communities.

In 2015, the VEWH, in partnership with the Corangamite CMA, undertook an aquatic sampling project to get an accurate picture of the species currently living in the Moorabool.

Saul Vermeeren, Environmental Water Coordinator with Corangamite CMA, said the project demonstrated the effectiveness of environmental watering.

"Excitingly, project results demonstrated a strong increase in aquatic species population and diversity resulting from environmental flows and the 2010 floods," Saul said.

"Six thousand individuals across nine native fish species were recorded in 2015, compared to 1,000 individuals across five species in 2008. The project results reflect positively on the watering program."

During the 2014–15 water year, 1,685 ML of environmental water was released to maintain water quality, fish habitat and vegetation communities in the Moorabool River during the hot and dry summer.

"Low rainfall and catchment runoff over the course of the year reduced river baseflows, which also reduced environmental water volumes in Lal Lal Reservoir," Saul said.

"Despite this, we were still able to implement three summer fresh events (pulses) and a winter fresh to flush sediment, improve water quality and provide connectivity for migratory fish species."

Waterway manager:
Corangamite Catchment Management Authority

Storage manager:
Central Highlands Water

Site	Volume delivered in 2014/15 (ML)
Moorabool River	1,685

Left: Tupong, fish surveys 2015, by Saul Vermeeren. Opposite: Moorabool River near Batesford, by Saul Vermeeren.

Above: Wimmera River at Quantong, by Chloe Wiesenfeld.

Western region

Despite dry conditions in 2014–15, environmental watering kept the Wimmera River flowing for most of the year, assisted the platypus population in the MacKenzie River and allowed one Glenelg River estuary perch to swim more than 300 kilometres.

Western Victoria, especially the Wimmera catchment, has been experiencing increasingly dry conditions since the 2010–11 floods. In this context, environmental water has been a crucial 'compensator', maintaining healthy salinity levels and providing crucial habitat for many species.

After environmental watering in 2014–15, the abundance of native fish species increased in the mid and upper Glenelg River, including pygmy perch, blackfish, estuary perch and tupong. The return of the estuary perch was a particular highlight because estuary perch had not been seen so far upstream since the construction of Rocklands Reservoir in the early 1950s.

The following pages outline the achievements for each system in the Western Region of Victoria in 2014–15.

building resilient rivers

Rainfall and inflows in western Victoria are highly variable and reflect the natural 'boom and bust' character of western Victorian river systems. For example, while the area experienced floods in late 2010 into 2011, it has been increasingly dry ever since.

In 2014–15, environmental water carried over from 2013–14 was critical in supporting western Victorian rivers and wetlands and the wildlife that depend on them.

In 2015–16, Australia is experiencing an El Niño event which is usually associated with below-average winter–spring rainfall over eastern Australia. With storage levels lowering, and uncertain weather conditions ahead, environmental water allocations in western Victoria are likely to be very low. As such, objectives for environmental watering in 2015–16 will focus on protecting water quality in the Wimmera and Glenelg systems to maintain habitat for native fish and animals.

Despite the dry outlook for the west, due to environmental watering in recent years Western region rivers are in a stronger position to bounce back when dry conditions ease. The work done by Wimmera and Glenelg Hopkins CMAs in recent years has built the resilience of the river systems.

"The Glenelg River is definitely entering this dry period in better condition than it would have without environmental watering and careful planning over recent years," says Bryce Morden of Glenelg Hopkins CMA.

"We've had a remarkable four years of improvement in the river system and we are certainly entering these dry times with stronger populations of plants and animals and a game plan of how to manage the river through drier times."

In 2014–15, both the Glenelg and Wimmera rivers were in the best condition they'd been in since before the drought. Monitoring in the Glenelg system showed that threatened native fish species and key recreational native fish species were present at more sites and in greater numbers. In the Wimmera, fish and vegetation monitoring were showing the best river conditions since monitoring began during the Millennium drought.

Both CMAs believe securing environmental water for the river systems has been pivotal in their improvement.

Above left: Jeparit Museum in April 2009 and below, in March 2015, by Wimmera CMA.


Before environmental watering


After environmental watering

"Before the Wimmera–Mallee pipeline was completed and our environmental water entitlement became more reliable, we had years in which there was no flow whatsoever in the lower Wimmera River," Greg Fletcher of Wimmera CMA explains.

"In other years, we might have had a flow in the river for a few weeks but that was it. There wasn't the water available for fish and water bugs and other creatures to complete their lifecycles – to feed and breed and reproduce to create larger, stronger populations. We have seen this happen in the MacKenzie River where platypus are recolonising locations they abandoned during the drought."

"Now, with reduced water allocations expected for 2015–16, we might not have sufficient water for all of the rivers and creeks that rely on environmental water for their condition. However, we can manage water so that fish and other animals in refuge areas have more opportunity to complete their life cycle, and this sustains populations that, in wetter years, will be able to move into other parts of the system.

"As dry conditions worsen we may experience reductions in wildlife, but with a larger population base, there is less risk of catastrophic loss."

Bryce Morden points out that river rehabilitation works in the Glenelg system have enabled environmental flows to strengthen the river and the life within it.

"Environmental flows, together with rehabilitation works, improve conditions within the river. For example, over the past decade, placement of large woody habitat and targeted removal of sand has improved fish habitat in the Glenelg River near Casterton. Environmental watering improves conditions around this habitat, cues fish migration to these areas, and increases water depth sufficiently for fish to move. We even designed and installed a fishway over a weir that works most effectively during environmental flows.

Despite these advances, Bryce notes that "we can't 'drought proof' the river ecosystem. Unfortunately some types of vegetation are less resilient to drought and ultimately the river still needs larger flow events to be sustained.

"The positive is that having some environmental water increases our ability to provide water to drought refuges and decreases our chances of long periods where the river ceases to flow. If, in good years, we can increase resilience – particularly for fish and water bugs – it is easier for the river to recover."

To learn more about environmental watering in 2015–16, see the 2015–16 *Seasonal Watering Plan* at www.vewh.vic.gov.au or visit the CMA websites at www.wcma.vic.gov.au and www.ghcma.vic.gov.au.

Above left: Wimmera River at Dimboola Weir Pool in 2008, and above right, in 2015, by Wimmera CMA.

glenelg system

Environmental flows in the Glenelg River triggered a marathon swim for one estuary perch in 2014–15, which made an upstream journey of more than 300 kilometres.

Bryce Morden, Water Resources Planner at Glenelg Hopkins CMA said environmental watering has allowed native fish to move between important habitats along the Glenelg River and its tributaries.

“One estuary perch was found to have swum at least 300 kilometres upriver due to a better connection of the freshwater part of the river to the estuary after the removal of fish barriers together with an increase in flow,” Bryce said.

“It’s great to see estuary perch returning to this part of the river following their disappearance from the area since the construction of Rocklands Reservoir in the early 1950s.”

According to monitoring undertaken by Glenelg Hopkins CMA, threatened native fish species and key recreational native fish species are occurring at more sites and in greater numbers in the Glenelg system following targeted environmental watering.

“Environmental water releases from Rocklands Reservoir and associated riparian improvements along the river has seen native fish and other aquatic animals returning. Pygmy perch, blackfish, tupong and individuals from other native fish species have all been caught in high numbers. We also saw a large array of waterbirds, water rats and platypus,” Bryce said.

“Fish surveys have also shown successful breeding occurred through winter and spring, with young fish found at most sites along the river.”

“While these improvements have been encouraging, dry conditions through the late winter and spring meant that management priorities for 2014–15 shifted to maintaining the improvements achieved in recent years and preparing for dry conditions ahead.” (See ‘Building resilient rivers’ on pages 34 – 35).

Waterway manager:
Glenelg Hopkins Catchment Management Authority

Storage manager:
Grampians Wimmera Mallee Water

Site	Volume delivered in 2014/15 (ML)
Glenelg River	15,449

Left: Glenelg River mouth, Nelson, by Stephen Ryan.

wimmera system

Surveys in early 2015 indicated that the lower Wimmera River was in its best condition for many years, thanks to several years of regular environmental water releases.

In the Wimmera system, environmental water has become more reliable since the Wimmera–Mallee pipeline was completed. Regular environmental watering has provided a lifeline to the river where below-average rainfall across the catchment means very little water has flowed naturally into the system (see 'Building resilient rivers' on pages 34 – 35).

Maintaining water quality and providing habitat for fish and platypus was the main focus of environmental watering in the Wimmera system in 2014–15.

Clare Wilson, Floodplain and Environmental Water Management Officer at Wimmera CMA, said releases of environmental water into the drying Mount William Creek, Burnt Creek and MacKenzie River provided refuge pools for native fish species such as southern pygmy perch, obscure galaxias, river blackfish and flatheaded gudgeon.

"This was the first time that environmental watering targeted the upper Mount William Creek, which our monitoring tells us, along with the lower Mount William Creek, Burnt Creek and MacKenzie River, provides important habitat for a number of native fish species," Clare said.

"Environmental watering essentially helped to keep water in these waterways until conditions cooled down and in some cases runoff from the local catchment took over."

"We know from previous monitoring work that these actions are critical in sustaining these fish communities. Monitoring also showed that the region's small platypus population, which is mostly on the MacKenzie River, is slowly growing, which is very exciting." (See 'Protecting platypus', pages 8 – 9).

The environmental water releases had the added benefit of managing salinity levels at the bottom end of the Wimmera River.

Monitoring also showed that despite major improvements in native fish populations, numbers of the introduced European Carp have remained steady since 2010–11.

Waterway manager:
Wimmera Catchment Management Authority

Storage manager:
Grampians Wimmera Mallee Water

Site	Volume delivered in 2014/15 (ML)
Wimmera River	18,159

Below: Dion and Kylie Iervasi electrofishing at Mount William Creek, by Wimmera CMA.

wimmera mallee wetlands

Twenty one of the Wimmera–Mallee wetlands received environmental water in 2014–15, including seven wetlands in the North Central region, 10 wetlands in the Wimmera region and four wetlands in the Mallee.

Fewer wetlands received environmental water in 2014–15 than in 2013–14, for a variety of reasons, largely based on previous watering history and environmental need. Across the system, many of the wetlands received water in autumn 2014 which meant that water requirements in early 2014–15 were reduced.

Environmental watering in the Wimmera–Mallee wetlands in 2014–15 aimed to provide suitable aquatic habitat to support waterbirds, provide watering points for fauna, and improve the condition of riparian native vegetation.

One of the most exciting results of 2014–15 was the sighting of a brolga at Jesse Swamp Dam in the North-Central region. This followed a successful watering of the dam and some of the surrounding wetland.

Other monitoring results throughout the wetlands included the sightings of several species of waterbirds, vegetation growth and a large boost in frog populations after each watering occurred.

An Environmental Water Advisory Group (EWAG) for the Wimmera–Mallee wetlands was formed in 2014–15. The purpose of the group is to assist in developing watering priorities and to provide knowledge and local perspectives on environmental watering and communication activities.

Waterway manager:
Wimmera, Mallee and North Central catchment management authorities

Storage manager:
Grampians Wimmera Mallee Water

Top left: Eastern long neck turtle at Falla Dam, by North Central CMA. Left: Overtopping Jesse Dam to inundate some of the surrounding wetland, by North Central CMA.

One of the most exciting results of 2014–15 was the sighting of a brolga at Jesse Swamp Dam... This followed a successful watering of the dam and some of the surrounding wetland.

Site	Volume delivered in 2014/15 (ML)
Barbers Swamp	3.5
Carapugna	8.6
Chirrup Swamp	2.4
Considines	0.4
Corack Lake	3.1
Creswick Swamp	3.3
Crow Swamp	9.3
Davis Dam	0.6
Falla Dam	2.3
Fieldings Dam	1.6
Harcoans	0.7
Jeffcott Wildlife Reserve	4.1
Jesse Swamp	3.9
John Ampt	1.0
Krong Swamp	8.5
Moreton Plains Reserve	2.5
Mutton Swamp	13.1
Pinedale	15.5
Sawpit Swamp	17.4
Tarkedia Dam	4.0
Wal Wal Swamp	6.3

Right: Looking at a scarred tree (a culturally significant site) at Davis Dam with a Barenji Gadjin representative, by North Central CMA.

Above: Gunbower Forest during the major 2014 watering event, by David Kleinert.

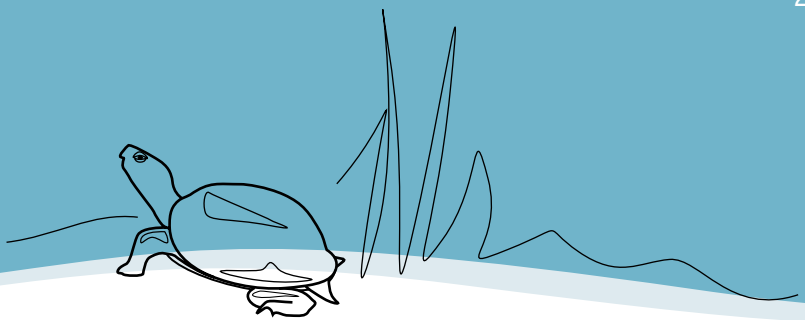
Northern region

Victoria's Northern Region saw a fantastic response to environmental watering in 2014–15 – especially from rare and threatened species.

Success stories include golden perch breeding in the Goulburn River, a boom in abundance and diversity of native vegetation in Gunbower Forest, and the sighting of more than 70 different species of birds, frogs and turtles at Lake Yando.

Environmental watering in 2014–15 provided a much-needed reprieve for many rare plants and animals. In Gunbower Forest and at Lake Yando, rare and threatened plant species flourished. In the Loddon River, bony bream (a fish now rarely sighted in the Loddon) was caught. At Moodies Swamp, the endangered Australasian bittern was recorded at the swamp for the first time.

The following pages outline the achievements for each system in the Northern Region of Victoria in 2014–15.



Making every drop count

The connected river and floodplain systems of northern Victoria provide opportunities to achieve multiple environmental benefits as water flows through the system: One water release can hit several ecosystem targets in different locations as it moves downstream.

Environmental water aiming to achieve objectives for plants and animals in tributaries upstream of the River Murray (such as the Goulburn or Campaspe Rivers) can be reused downstream in the Murray itself (known as 'return flows'). Similarly, water on its way to consumptive users (such as irrigators) can be supplemented with environmental water to maximise environmental benefits along the way. Using water in this way ensures the Victorian environmental watering program can deliver maximum environmental benefits in the most efficient way possible.

In 2014–15, waterway managers, environmental water holders and storage managers in northern Victoria worked together to deliver effective and efficient environmental outcomes in three key ways:

- reusing environmental return flows
- maximising environmental benefits from consumptive water on its way to users, and
- combining environmental and consumptive water releases to achieve greater results. (For instance, environmental water can 'piggyback' on other water deliveries to achieve larger flows required to trigger fish breeding).

Efficient water use helps reduce the volume of water needed to be recovered for the environment from consumptive water users. The diagram shows examples of where these measures were able to be used to achieve efficient and effective environmental benefits in 2014–15.

Left: Hattah Lakes, by Kerry Whitelegg.

South Australia

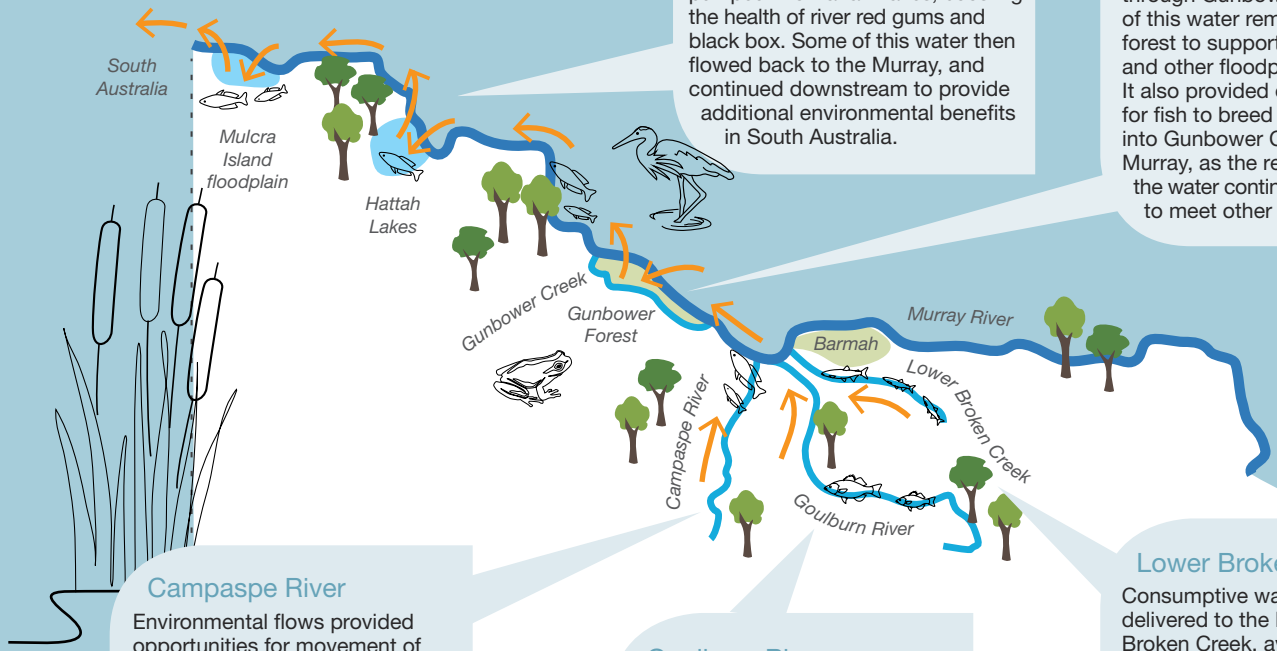
292 GL of environmental water supported River Murray wildlife in South Australia after first meeting Victorian environmental objectives. The flows – first delivered to achieve environmental benefits in Hattah Lakes, the Goulburn River, Campaspe River and Lower Broken Creek – contributed to floodplain watering at Chowilla and in the Lower Lakes, Coorong and Murray mouth.

Hattah Lakes

Environmental water delivered down the Goulburn River was pumped into Hattah Lakes, boosting the health of river red gums and black box. Some of this water then flowed back to the Murray, and continued downstream to provide additional environmental benefits in South Australia.

Gunbower Forest

Water being transferred to the Lower Murray River first flowed through Gunbower Forest. Some of this water remained in the forest to support river red gums and other floodplain vegetation. It also provided opportunities for fish to breed and move into Gunbower Creek and the Murray, as the rest of the water continued downstream to meet other needs.



Campaspe River

Environmental flows provided opportunities for movement of native fish, such as the Murray–Darling rainbow fish, in the Campaspe River. The water then continued flowing down to the Murray to meet more environmental objectives on Mulcra Island floodplain.

Goulburn River

Consumptive water on its way to the Murray was combined with environmental water, creating a larger spring flow. This resulted in golden perch spawning in the Lower Goulburn River.

Lower Broken Creek

Consumptive water was delivered to the Murray via Lower Broken Creek, avoiding Barmah-Millewa Choke (which has limited channel capacity). This delivery provided benefits for water quality and fish passage in the creek, while its delivery route helped avoid unseasonal flooding of Barmah Forest.

goulburn system

Golden perch spawned in the Goulburn River in response to environmental watering in 2014–15.

Environmental water delivery in 2014–15 focused on providing cues for golden perch spawning, along with re-establishing vegetation on the lower banks of the river which was lost during the drought and subsequent flooding.

Geoff Earl, Environmental Water Flow Coordinator with the Goulburn–Broken CMA, said perch spawning was monitored during the delivery of a spring fresh (or 'pulse') in 2014, with some promising results.

"The monitoring found the eggs were more widespread than in previous years and there were large numbers of eggs collected from Murchison to the River Murray," Geoff said.

"Monitoring also included electronic tracking that follows fish movement in response to environmental watering. Preliminary results of this tracking shows firm evidence of golden perch movement in response to the increased spring flows at the time they also spawned."

Angler reports supported these findings, with recreational fishers reporting higher fish numbers and better fishing conditions in 2014–15.

Environmental watering in the Goulburn River also assisted the recovery of vegetation on the lower banks of the river, with new plant patches establishing on the previously bare lowest metre of the river bank.

Waterway manager:
Goulburn–Broken Catchment Management Authority

Storage manager:
Goulburn–Murray Water

Source of water and volume delivered (ML)			
VEWH	CEWH	Living Murray	**Total**[1]
29,139	225,884	54,349	**309,371**

[1] Total use value identified may differ from the sum of the use per source due to rounding.

Left: Juvenile golden perch, by the Arthur Rylah Institute.

broken system

Environmental watering in the lower Broken Creek in 2014–15 continued to focus on providing flows to protect and improve native fish populations.

Meegan Judd, Environmental Water Officer with the Goulburn–Broken CMA, said environmental watering improved fish habitat and fish passage during the migration and breeding seasons. It also helped manage the threats to fish from excessive growth of azolla (an aquatic plant which can cover the water surface and decrease dissolved oxygen levels).

"Low dissolved oxygen prevents fish from breathing, with excessive azolla growth dramatically reducing the amount of suitable habitat and potentially leading to fish deaths," Meegan said.

"There were increased levels of azolla growth between September and November 2014. However, consumptive water, being delivered through the lower Broken Creek on its way to water users, flushed the azolla through the system."

"This is a great example of how consumptive water can achieve environmental benefits en route."

Meegan said large-bodied native fish continued to thrive in the Broken Creek system in 2014–15.

"While dissolved oxygen levels did fall in some periods during the year, there were no apparent impacts on native fish populations," Meegan said.

"In fact, large-bodied native fish continue to be found along lower Broken Creek, including Murray cod, golden perch and silver perch, with some fish moving along the creek through the fish ladders."

Waterway manager:
Goulburn–Broken Catchment Management Authority

Storage manager:
Goulburn–Murray Water

Site	VEWH (ML)	CEWH (ML)	Total[1] (ML)
Lower Broken Creek	1,678	32,629	**34,306**
Upper Broken Creek	387	-	**387**

[1] Total use value identified may differ from the sum of the use per source due to rounding.

Below: Broken River, by Goulburn–Broken CMA.

goulburn broken wetlands

Environmental water delivery to the Goulburn–Broken wetlands in 2014–15 focused on re-establishing vegetation and providing habitat for bird breeding after wildfire ravaged a number of the wetlands in early 2014.

Fire spread through Black Swamp, Moodies Swamp and Kinnairds wetland in February 2014, burning the wetlands and surrounding vegetation.

Moodies Swamp received 500 ML of environmental water in late 2014 to promote suitable brolga breeding habitat.

"Brolga were sighted on numerous occasions feeding and showing displays of courtship at Moodies Swamp following environmental watering," Jo said.

"In addition, the EPBC-listed[1] Australasian bittern was recorded at the swamp for the first time in September 2014. Environmental watering also supported the growth and establishment of wetland plants."

Though Black Swamp and Kinnairds wetland did not require water in the 2014–15 water year, the wetlands displayed the benefits of the April 2014 environmental watering.

Jo Wood, Environmental Water Project Officer with the Goulburn–Broken CMA, said Black Swamp and Kinnairds wetland underwent dramatic changes.

"After environmental watering in April 2014, many wetland plants emerged at Black Swamp, including common swamp wallaby-grass, common nardoo, myriophyllum, potamogeton and river swamp wallaby-grass, which is listed as a 'vulnerable' species under the *Commonwealth Environmental Protection and Biodiversity Conservation (EPBC) Act*" Jo said.

"The EPBC-listed rigid water-milfoil was recorded in parts of Kinnairds wetland, as was slender water-milfoil, which is listed as a threatened species under Victoria's *Flora and Fauna Guarantee Act*. Neither had previously been recorded there."

In spring 2015, the Goulburn–Broken CMA, with the assistance of Parks Victoria and Moira Shire Council, will be planting river red gums and wetland plants at Kinnairds wetland and Black Swamp to help recovery.

Reedy Swamp entered a drying phase in 2014–15, helping to improve the condition and diversity of the wetland's vegetation. Drying phases enable semi aquatic plants to grow, seeds to germinate and establish and oxygen to penetrate the soil.

Waterway manager:
Goulburn–Broken Catchment Management Authority

Storage manager:
Goulburn–Murray Water

Site	VEWH (ML)	CEWH (ML)	Total (ML)
Moodies Swamp	250.0	250.0	**500.0**

[1] The EPBC is the *Commonwealth Environmental Protection and Biodiversity Conservation Act*

Left: Australasian Bittern, by Damien Cook.

Campaspe system

In 2014–15, the North Central CMA released targeted environmental flows to support platypus in the Campaspe River.

The same flows aimed to bolster platypus downstream in the Gunbower system with the hope of re-establishing platypus elsewhere on the Victorian side of the Murray downstream of Echuca (see pages 8 – 11).

Environmental watering in 2014–15 also focused on enhancing river habitat and native fish breeding and movement. Winter and spring environmental flow releases were specifically aimed at improving the health of native vegetation on the river's benches and supporting in-stream vegetation lost during the 2010–11 floods.

Community observations, photopoint monitoring and long-term native fish monitoring indicate that the health of the Campaspe River is improving.

During 2014–15, seven species of native fish were recorded, including an increase in golden perch and Murray–Darling rainbowfish numbers, along with populations of Australian smelt and gudgeon. Local anglers also made good catches of Murray cod and golden perch.

An adult and juvenile Murray River turtle were also discovered on the Campaspe River for the first time in 2014–15, indicating an improvement in the condition of the river.

Meanwhile, environmental water management on the Coliban River in 2014–15 focused on maintaining connectivity in the upper reaches over summer and autumn, immediately below the Malmsbury Reservoir.

Waterway manager:
North Central Catchment Management Authority

Storage manager:
Goulburn–Murray Water, Coliban Water

Site and water source delivered (ML)	VEWH	CEWH	Living Murray	Total
Campaspe River	22.364	5,791	2,574	**30,729**
Coliban River	441	-	-	**441**

Below: Campaspe Fishway, by North Central CMA.

central murray wetlands

Environmental watering of wetlands in the Central Murray region attracted more than 60 species of waterbirds in 2014–15.

Environmental watering of these wetlands takes an integrated landscape management approach, which considers both the watering requirements of each individual wetland and the interactions that occur at a regional scale.

Watering in 2014–15 focused on supporting the endangered Murray hardyhead, promoting the health and recruitment of native plants, including river red gums and aquatic species, and providing feeding and breeding habitat for native waterbird species.

Heidi Kleinert, Project Officer with the North Central CMA, said that, as in previous years, the number and diversity of waterbirds at six wetlands in the Central Murray region improved significantly as a direct result of environmental watering.

"Waterbird monitoring funded by the Victorian Environmental Water Holder detected the presence of 18 species of waterbirds that are listed as rare or threatened," Heidi said.

"Of particular note was the presence of a high number of the threatened blue billed duck and freckled duck at Round Lake, along with sightings of the iconic brolga by members of the community at Lake Murphy and Johnson Swamp."

Monitoring also indicated an increase in the density of aquatic vegetation at Lake Elizabeth, and an improvement in the health of river red gum and lignum communities at Wirra-Lo wetland complex and McDonalds Swamp.

Waterway manager:
North Central Catchment Management Authority

Storage manager:
Goulburn–Murray Water

Site	Volume delivered in 2014/15 (ML)
Hirds Swamp	945
Johnson Swamp	1,500
Lake Elizabeth	675
Lake Murphy	2,983
McDonalds Swamp	904
Round Lake	556
Wirra-Lo wetland complex	140

Left: Australian white ibis at McDonalds Swamp, by North Central CMA.

lower murray wetlands

Thirteen wetlands, creeks and billabongs in the lower Murray region were given a significant boost with environmental water in 2014–15.

The delivery of environmental water focused on maintaining and improving vegetation condition, quality and extent throughout the wetlands, floodplains and waterways in the lower Murray region, and in some cases, rehabilitating salt-affected wetlands.

Environmental watering of the Nyah-Vinifera park was particularly successful. This important floodplain forest received 1,766 ML of environmental water, which provided much-needed flows through the park and, for the first time, through the Vinifera creek system. Swamp wallabies were seen in the forest for the first time in many years, indicating a response to improved condition. The watering also attracted a strong response from resident populations of frogs, birds and small fish, who appreciated the revived native plant habitat.

At several sites, environmental watering supported populations of the critically endangered Murray hardyhead by maintaining water quality. In March 2015, 2,500 Murray hardyhead were relocated to Brickworks Billabong. Watering of the billabong has maintained the condition of sea tassel, which is important habitat for Murray hardyhead.

Waterway manager:
Mallee Catchment Management Authority

Storage manager:
Goulburn–Murray Water

Site and volume delivered (ML)	VEWH	CEWH	Total[1]
Brickworks Billabong	100	100	**200**
Bridge Creek	567	233	**800**
Bullock Swamp[2]	181	300	**481**
Burra Creek North	317	-	**317**
Burra Creek South	220	315	**535**
Cardross Lake	288	288	**577**
Neds Corner Central	124	-	**124**
Neds Corner East	88	-	**88**
Nyah Floodplain	1,266	-	**1,266**
Psyche Lagoon	597	418	**1,015**
Sandilong creek	137	-	**137**
Vinifera Floodplain	500	-	**500**
Woorlong Wetland	34	334	**369**

[1] Total use value identified may differ from the sum of the use per source due to rounding.

[2] Includes use of 12 ML of allocation donated to the VEWH by a local landholder in the Mallee region.

Left: Nyah-Vinifera, by Mallee CMA.

loddon system

Boosted fish populations and a platypus sighting were some of the highlights of environmental watering in the Loddon system in 2014–15.

Phil Slessar, Project Officer with the North Central CMA, said fish monitoring was showing an increase in some native fish species in response to environmental flows.

"In surveys from the last two years, Murray–Darling rainbowfish have been caught in the Loddon River between Laanecoorie Reservoir and Loddon Weir, with numbers gradually increasing over that period," Phil said.

"They were caught downstream, in the reach of the river between the Loddon Weir and Kerang Weir, for the first time in 2014–15. This is one of the southern-most areas of rainbowfish distribution in the Murray–Darling Basin."

"A bony bream was also caught in the stretch of river downstream of the Macrona channel. Bony bream are rarely seen in the Loddon."

One of the highlights of the year was the sighting of a female platypus at Baringhup during a field survey in February 2015.

"Her presence during the day indicated that she had young and her behavior indicated that she was foraging for food around the snags in the river," Phil said.

Lake Yando and Lake Meran received environmental water in 2014–15.

During the watering at Lake Yando over 60 species of birds (including 36 species of waterbirds) were observed and five species of rare plants were identified.

Lake Meran, meanwhile, received a top up of 2,000 ML to support habitat and create foraging opportunities for waterbirds, and to maintain the health of the 'intermittent swampy woodland' which is depleted in the region.

Birch's Creek received a three-day flush in April 2015 to improve connectivity between pools, enhance water quality to support river blackfish and platypus populations, and water vegetation lower on the banks.

Waterway manager:
North Central Catchment Management Authority

Storage manager:
Goulburn–Murray Water

	Site	VEWH (ML)	CEWH (ML)	Total (ML)
Loddon	Loddon River	9,000	2,870	**11,870**
	Birchs Creek	100.0	-	**100.0**
Boort wetlands	Lake Meran	2,000.0	-	**2,000.0**
	Lake Yando	558	-	**558**

Left: Loddon River, by Phil Slessar.

Case study

Water creates wildlife haven at Lake Yando

Environmental watering triggered a surge in wildlife sightings at Lake Yando, a 83 hectare wetland 9 kilometres north east of Boort.

More than 550 ML of water was delivered to Lake Yando from October 2014 to January 2015, turning the dried out swamp into a picturesque wetland.

The main objectives of the watering were to give a much-needed drink to hundreds of red gum saplings on the lake's floor, encourage the growth of aquatic plants, as well as improve habitat for frogs, reptiles and birds to promote breeding.

While community members reported their own sightings of rare and threatened species, official monitoring confirmed that, post-watering, wildlife diversity had been significantly boosted.

Monitoring results post-watering

Vegetation: 154 plant species were recorded after the watering including 97 local indigenous plant species. (Only 60 indigenous species were recorded prior to the watering.)

Twelve species of rare or threatened plants were recorded including:

jerry-jerry (vulnerable)	bladder saltbush
bristly love-grass	dark roly poly
swamp buttercup	water nymph
graceful swamp wallaby-grass	winged water-starwort
pale spike-rush	sweet fenugreek
wooley knotweed	spiny lignum

Birds: 62 species of birds were recorded and all but one species were native. Seven threatened bird species were recorded including:

gray crowned babbler (endangered)	Ballion's hardhead
white-bellied sea eagle	royal spoonbill
eastern great egret	nankeen night-heron
Ballion's crake	

Butterflies: five species of butterfly were recorded after the watering, including:

common brown butterfly	cabbage white
common grass blue	saltbush blue
greenish grass-dart	

Frogs: five species of frogs were recorded, including:

eastern banjo frog (pobblebonk)	common froglet
Peron's tree frog	plains froglet
spotted marsh frog	

Mammals: swamp wallaby, common brushtail possum and the eastern grey kangaroo were all recorded.

Reptiles: boulengers skink, tree skink and lace monitors were spotted after watering.

(Not recorded: a partridge in a pear tree!)

North Central CMA Acting Loddon and Avoca Catchment Executive Manager Greg Barber said the watering would have obvious long-term benefits for the lake.

"This watering is really good news for the lake and nearby community," he said.

"Not only has one of our main objectives been achieved in prompting hundreds of red gum seedlings to emerge, but conditions have been perfect for these rare and threatened wetland-dependent species to prosper."

Below: Spotted marsh frog, by Damien Cook.

the living murray icon sites

Waterway manager:
Goulburn–Broken, Mallee and North Central catchment management authorities

Storage manager:
Goulburn–Murray Water, River Murray Water, South Australian Water Corporation and New South Wales State Water Corporation

The Living Murray program is one of Australia's most significant long-term river restoration programs. It aims to achieve a healthy working River Murray system for the benefit of all Australians. Four sites in Victoria have been identified as 'icon sites' for restoration under the Living Murray program. These sites include Hattah Lakes, Lindsay-Wallpolla Islands (including Mulcra Island), Gunbower Forest and Barmah Forest.

Hattah Lakes

All of the 12 Ramsar-listed Hattah Lakes received environmental water over 2013–14 and 2014–15, including Lake Kramen, which sits high on the floodplain surrounded by an important black box community.

Environmental watering helped to achieve a range of ecological objectives for the system, particularly inundating fringing river red gum and black box woodlands, which have been in a stressed condition following the drought.

Environmental watering facilitated nutrient exchange between the floodplain and lakes, stimulating a 'pulse' of productivity in the wetlands. The plants, fish and birds using the lakes have thrived and reproduced in response to the watering. With the ability to provide water more frequently to the floodplain, it is expected that the condition of the floodplain vegetation will continue to improve.

Besides the improved condition of red gum and black box from the last two watering events, one of the significant responses observed was cormorant breeding on the lakes for the second consecutive year. Cormorants and darters have been present in the system in small numbers in recent years but this is the first time breeding has been observed in about 10 years.

The watering provided connectivity between the lakes, allowing fish to move in and out of the lake system. Murray cod, golden perch and silver perch were recorded in the lakes.

Anecdotal feedback from a prominent apiarist in the area suggested bees produce excellent honey after being "rested" at Hattah Lakes when environmental flows are in Chalka Creek and the lakes.

"Watering Hattah Lakes has achieved some remarkable and beautiful results, which has been made possible by working closely with the community and partner agencies," Mallee CMA Chair, Sharyon Peart, said.

Site and volume delivered (ML)	VEWH	CEWH	Living Murray	Total
Hattah Lakes	14,651	19,087	27,306	**61,044**
Hattah Lakes – Lake Kramen	-	15,152	-	**15,152**

Lindsay–Wallpolla Islands (including Mulcra Island)

In 2014–15, recently constructed environmental infrastructure allowed water to be provided to the Mulcra Island floodplain, giving life to severely stressed lignum (spiny shrubland) communities.

The completion of infrastructure at Lindsay and Mulcra islands aims to improve flows in the upper reaches of the anabranches, improving fish passage and connectivity between the anabranches and the Murray River.

Monitoring suggests there has been improvement in the condition of vegetation in watered areas although observations indicate parts of the system are still stressed, with lignum and black box in some areas being in very poor condition.

Over 6,200 ML of environmental water was delivered to Mulcra Island in spring and early summer 2014. The delivery helped to restore connectivity between the river and floodplain habitats and provided water to the higher elevation and severely stressed lignum communities. Both native and non-native fish were recorded moving through the new infrastructure on the upper Potterwalkagee Creek, part of the Mulcra Island system.

Wallpolla Island's Horseshoe Lagoon received 400 ML of environmental water in late autumn 2015. The delivery aimed to support the growth of aquatic plants and fringing vegetation.

"Mulcra and Wallpolla islands have really responded well to the watering events, with the infrastructure at Mulcra Island making it possible to return flows to Potterwalkagee Creek in an efficient and effective way," Mallee CMA Chair, Sharyon Peart, said.

Anecdotal feedback from community members indicates that the environmental watering at Mulcra and Wallpolla islands provide excellent opportunities for kayaking.

Site	VEWH (ML)	CEWH (ML)	Total (ML)
Mulcra Island	2,516	3,761	**6,277**
Wallpolla Island – Horseshoe Lagoon	400	-	**400**

Above: Wallapolla East Regulator, by Mallee CMA.
Opposite: Darter at North Hattah Lakes, by Mallee CMA.

Gunbower Forest

2014–15 saw the largest ever delivery of environmental water to Gunbower Forest.

Between May and December 2014, 98,000 ML was delivered through the forest, made possible with the newly-constructed Hipwell Road Channel works. Around 37,000 ML of this water remained in Gunbower, inundating 3,800 hectares of the forest, filling wetlands and flowing across vast areas of river red gum floodplain.

Anna Parker, Gunbower Forest Project Manager with the North Central CMA, said the ecological response to this historic watering event was unmistakable.

“The footprint of the flooding in the forest is very clear. There is fresh new growth on the river red gums, and lush tall sedges across much of the forest floor, even after summer, creating important habitat for ground-dwelling animals,” Anna said.

“Ecological monitoring clearly shows a higher diversity of native vegetation in areas of the river red gum forest that were flooded, including a good cover of aquatic, amphibious and mudflat species.”

“In the wetland sites, five rare and threatened plant species were also observed, including large and dense swards of the vulnerable river swamp wallaby grass.”

Another important aim of the environmental watering was to enable movement of native fish between Gunbower Forest and Gunbower Creek, so fish could take advantage of the productive floodplain.

“Native fish also clearly responded well to the environmental watering,” Anna said.

“In a two-hour sample, approximately 14,000 fish moved through the fish lock on Gunbower Creek, including 8,000 Australian smelt and 6,000 carp gudgeons.”

Winter flows were also delivered through Gunbower Creek to maintain connectivity and habitat to help native fish such as golden perch and Murray cod survive the winter period.

"During winter, while there is no irrigation demand, there is no flow in Gunbower Creek and these winter conditions are stressful for native fish," Anna said.

"Environmental watering in the creek during winter is aimed at increasing the survival of fish, especially juvenile fish."

Site	VEWH (ML)	Living Murray (ML)	Total (ML)
Gunbower Forest	15,896	21,498	**37,394**
Gunbower Creek	862	-	**862**

Barmah Forest

While no managed environmental water was delivered to Barmah Forest in 2014–15, natural flooding built on the benefits of a five-year legacy of environmental watering within the forest.

Environmental water has been released into Barmah Forest every year since 2009 with excellent results. These results have included wide-scale bird breeding, the recovery of native fish populations in and around the forest, and in particular, an improvement in the health of river red gums and growth of Moira grass – a severely threatened native plant community.

Two natural flood peaks occurred in July 2014, followed by brief periods of overbank flows in August and November 2014 and January 2015, which meant the active release of environmental water was not required.

An estimated 25 percent of the floodplain was inundated in the July and August events, benefiting wetland vegetation, frogs, fish and turtles, while the November fresh created flow variability that caused golden perch to spawn. (Had the natural fresh not occurred, it was planned to draw on environmental water and other river management options to support the spawning).

Keith Ward, Living Murray Project Manager (Barmah)

with the Goulburn-Broken CMA, said in 2014–15, waterbirds were attracted to the forest wetlands. Unfortunately many abandoned their nests – a natural response to changing seasonal conditions.

"Approximately 500 Australian white ibis initiated nesting at one wetland in Barmah Forest (which is a lot less than the thousands we usually see with managed environmental watering). Unfortunately nesting was prematurely abandoned just as egg-laying had commenced in the earliest nests," he said.

"We knew that ibis had also abandoned their nests a week earlier on the north side of the river, where water levels had been retained at a significant level. The weather pattern then became quite dry. We are now investigating to pinpoint exactly what triggered the birds leaving the wetlands, so that we can try to extend nesting in future."

Keith said waterbird nesting numbers in Barmah Forest fluctuate in line with the frequency and continuity of flooding during the spring-summer nesting season.

Throughout the year, the nationally endangered Australasian bittern was also frequently heard and occasionally sighted within the forest wetlands, including one photographed by a time-scheduled camera on site.

Above: Red River Gum on Little Rushy Swamp, by Keith Ward. Opposite: Myriophyllum flower, Gunbower Forest, by North Central CMA.

Ovens system

Commonwealth environmental water in the Ovens system was released from Lake William Hovell and Lake Buffalo in 2014–15, providing the opportunity to maintain and improve the natural variability in the height of the river.

The environmental water release created natural connectivity between pools and riffles and reinstated natural variability of flows to provide food, resources and habitat for macroinvertebrates (waterbugs) and other aquatic plants and animals. The flow also helped to maintain good water quality within the river.

In 2015, the North East CMA led a thorough stakeholder and community engagement program to develop an environmental water management plan for the Ovens River. Local councils and Landcare groups were among those who provided feedback on the proposed values, threats and issues associated with environmental watering in the river.

The 'umbrella' ecological objective of the plan is to manage the Ovens River's iconic threatened fish species – Macquarie perch, trout cod and Murray cod – and ensure the river's connection to the River Murray. Delivery of the environmental entitlement is part of the ongoing management of the fish community in the lower reaches of the Ovens River.

Macquarie perch are now being introduced into the river in the second year of a five-year project with Victoria's Department of Environment, Land, Water and Planning.

Andrew Briggs, North East CMA's Ovens/King Catchment Co-ordinator, said: "There's a high potential for the successful re-establishment of this species in the Ovens, given the scattered remnant populations in the Buffalo River, environmental conditions and availability of suitable habitats in the broader Ovens/Buffalo/King catchments.

"Macquarie perch will be a major focus species over the next few years within this system."

Waterway manager:
North East Catchment Management Authority

Storage manager:
Goulburn–Murray Water

Site	VEWH (ML)	CEWH (ML)	Total (ML)
Ovens River	-	70	**70**

Left and opposite: Lower Ovens River and floodplain below Wangaratta in the Ovens-Warby National Park, by Water Technology.

glossary

Acoustic monitoring – A monitoring technique using a 'listening post' on a river bank. Individual fish or platypuses are tagged and detected when they swim past the post.

Amphibious – Living or able to live both on land and in water.

Anabranch – A section of a river or stream that diverts from the main channel or stem and rejoins the main stem downstream.

Azolla – A native aquatic fern which grows in waterways in dense patches. Its presence usually indicates high levels of nutrients.

Baseflows – A relatively stable, sustained and low flow in a river. (Generally its minimum natural level.)

Biofilms – Slimy films of bacteria, other microbes and organic materials that cover underwater surfaces.

Carryover – Allows entitlement holders to retain ownership of unused water into the following season, according to specified rules.

Catchment management authority – A statutory authority established to manage river health, regional and catchment planning, and to manage waterways, floodplains, salinity and water quality.

Cease-to-flow – The period in which there is no discernible flow in a river with partial or total drying of the river channel.

Commonwealth Environmental Water Office – A federal agency that manages water entitlements recovered by the Australian Government through a combination of investments in water-saving infrastructure, water purchases and other water recovery programs. The entitlements are held by the Commonwealth Environmental Water Holder (CEWH).

Cultural values mapping – Identifying and documenting cultural values in a particular region according to a particular Traditional Owner group.

Electrofishing – Uses electricity to stun fish before they are caught. It is a common monitoring method used to sample fish populations to determine abundance, density and species composition.

El Niño – Refers to the extensive warming of the central and eastern Pacific that leads to a major shift in weather patterns across the Pacific. In Australia (particularly eastern Australia), El Niño events are associated with an increased probability of drier conditions.

Environmental DNA (eDNA) – Genetic material obtained in a non-invasive way directly from environmental samples (soil, sediment, water).

Environmental flow regime – The timing, frequency, duration and magnitude of flows for a particular river or wetland system. Can include drying phases.

Environmental flow study – A scientific study of the flow requirements of a particular river or wetland system used to inform environmental water decisions.

Environmental water entitlement – An entitlement to water used to achieve environmental objectives. It could be termed an environmental entitlement, an environmental bulk entitlement, a water share, a section 51 licence or a supply agreement.

Estuary – A partially enclosed body of water along the coast where fresh water from rivers and streams meets and mixes with salt water from the ocean.

Fish ladder / fishway – A series of pools built like steps to enable fish to travel through a particular waterway, dam or waterfall.

Floodplain – An area of low-lying ground adjacent to a river and subject to flooding.

Freshes – Small or short duration peak flow events which exceed the baseflow and last for one or several days.

Gigalitre (GL) – One billion (1,000,000,000) litres.

Groundwater – Water held underground in the soil or in pores and crevices in rock.

Hydrodynamic model – An assessment model to predict the influence of a given flow on various factors, including salinity, temperature and water level.

In-stream – The component of a river within the river channel including pools, riffles, woody debris, the river bank and benches.

Lignum – A plant native to inland Australia. It is associated with wetland habitats, especially those in arid and semi-arid regions subject to cycles of intermittent flooding and drying out.

Macroinvertebrates – Animals without a backbone and which can be seen with the naked eye including worms, snails, mites, bugs, beetles, dragonflies and freshwater crayfish.

Managed releases – Releases of water available under Water Holdings (environmental water entitlements). This water is stored in reservoirs and released to achieve environmental outcomes.

Megalitre (ML) – One million (1,000,000) litres.

Millennium Drought – One of the worst droughts recorded since settlement from approximately 1995 to 2012.

Priority watering action – A component of the environmental flow regime (e.g. a low flow, or a high flow) that has been identified as a priority for a particular system in a particular year.

Pulse – A gradual build in the flow of water, typically to replicate optimal conditions for water species such as fish to travel and spawn.

Ramsar-listed wetland – A wetland listed as internationally significant under the Convention on Wetlands signed in Ramsar, Iran in 1971.

Reach – A stretch or section of a river, generally defined in an environmental flows study.

Refuge pool – A small pool of water that aquatic species can use in dry river sections. Environmental water can be used to provide refuge pools, or they can form naturally after larger areas of water have subsided or dried (remnant pools).

Riffle – Relatively shallow section of stream where water flows at a higher velocity with increased turbulence, causing many ripples to be formed in the water surface.

Riparian vegetation – Vegetation located in the area of land that adjoins, regularly influences or is influenced by a river.

Salinity – The measure of salt content in soil or water.

Shared benefits – The shared benefits that environmental watering provides. For instance, kayaking on a high flow fresh, or catching native fish that spawned as a result of an environmental flow release.

Spawning – The process of species releasing eggs and sperm to reproduce.

Storage manager – Appointed by the Minister for Environment, Climate Change and Water to operate major water storages in a particular river basin to deliver to entitlement holders.

Terrestrial vegetation – Land-based plants.

The Living Murray program – An intergovernmental program which holds an average of 500,000 ML of environmental water per year, for use at six iconic sites along the River Murray.

Threatened species – A native species that is facing threats to their survival and may be at risk of extinction in the near future.

Totem species – Totem species are plants or animals inherited by members of an Indigenous Nation or family as their spiritual 'emblem'. Totems help to define roles, responsibilities and relationships. Each member of a Nation or family is responsible for caring for their totem.

Tributary – Smaller river or creek that flows into a larger river.

Victorian Environmental Flows Monitoring and Assessment Program (VEFMAP) – Assesses the effectiveness of environmental flows in delivering ecological outcomes.

Watering action – A component of the environmental flow regime (e.g. a low flow, or a high flow) in a particular system in a particular year.

Waterways – A river, creek, stream, watercourse or a natural channel where water regularly flows, whether or not the flow is continuous (as defined in the Water Act 1989). Includes rivers, wetlands, creeks, floodplains and estuaries.

Water Holdings – Environmental water entitlements held by the Victorian Environmental Water Holder.

Waterway manager – Agency responsible for the environmental management of catchments and waterways (includes catchment management authorities and Melbourne Water).

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Acknowledgment of Country

The Victorian Environmental Water Holder acknowledges Aboriginal Traditional Owners within Victoria, their rich culture and their spiritual connection to Country. The contribution and interests of Aboriginal People and organisations in the management of land and natural resources is also recognised and acknowledged.

Summary of environmental water delivery 2014–15

		Total (ML)	VEWH (ML)	Living Murray (ML)	CEWH (ML)	Other source (ML)[1]
Gippsland region						
Snowy River[2]		**155,308**	-	-	-	155,308
Latrobe system	Latrobe River	**3,984**	3,984	-	-	-
	Latrobe wetlands	**N/A[3]**	-	-	-	-
Thomson River		**13,479**	13,479	-	-	-
Macalister River		**11,409**	11,409	-	-	-
Gippsland region total		**184,180**	**28,872**	**-**	**-**	**155,308**
Central region						
Yarra River		**29,251**	29,251	-	-	-
Tarago River		**1,842**	1,842	-	-	-
Werribee River		**714**	714[4]	-	-	-
Upper Jacksons Creek[5]		**610**	610	-	-	-
Moorabool River		**1,685**	1,685	-	-	-
Lower Barwon wetlands		**N/A[6]**	-	-	-	-
Central region total		**34,102**	**34,102**	**-**	**-**	**-**
Western region						
Glenelg River		**15,449**	15,449	-	-	-
Wimmera system		**18,159**	18,159	-	-	-
Wimmera-Mallee wetlands[7]		**112**	112	-	-	0.4[8]
Western region total		**33,720**	**33,720**	**-**	**-**	**0.4**

Summary of environmental water delivery 2014–15

			Total (ML)	VEWH (ML)	Living Murray (ML)	CEWH (ML)	Other source (ML)[1]
Northern region							
Victorian Murray	River Murray		**23,500**	-	-	23,500	-
	Gunbower Forest		**37,394**	15,896	21,498	-	-
	Gunbower Creek[9]		**862**	862	-	-	-
	Central Murray wetlands	Hirds Swamp	**945**	945	-	-	-
		Johnson Swamp	**1,500**	1,500	-	-	-
		Lake Elizabeth	**675**	675	-	-	-
		Lake Murphy	**2,983**	2,983	-	-	-
		McDonalds Swamp	**904**	904	-	-	-
		Round Lake	**556**	556	-	-	-
		Wirra-Lo wetland complex	**140**	140	-	-	-
	Lower Murray wetlands	Brickworks Billabong	**200**	100	-	100	-
		Bridge Creek	**800**	567	-	233	-
		Bullock Swamp	**481**	181[10]	-	300	-
		Burra Creek North	**317**	317	-	-	-
		Burra Creek South	**535**	220	-	315	-
		Cardross Lake	**577**	288	-	288	-
		Neds Corner Central	**124**	124	-	-	-
		Neds Corner East	**88**	88	-	-	-
		Nyah Floodplain	**1,266**	1,266	-	-	-
		Psyche Lagoon	**1,015**	597	-	418	-
		Sandilong Creek	**137**	137	-	-	-
		Vinifera Floodplain	**500**	500	-	-	-
		Woorlong Wetland	**369**	34	-	334	-

Summary of environmental water delivery 2014–15

			Total (ML)	VEWH (ML)	Living Murray (ML)	CEWH (ML)	Other source (ML)[1]
Northern region (continued)							
Victorian Murray	Hattah Lakes[9]		**76,196**	14,651	27,306	34,239	-
	Mulcra Island[9]		**6,277**	2,516	-	3,761	-
	Wallpolla Island – Horseshoe Lagoon		**400**	400	-	-	-
Ovens River[11]			**70**	-	-	70	-
Goulburn River			**309,371**	29,139[12]	54,349	225,884	-
Broken system	Lower Broken Creek		**34,306**	1,678	-	32,629	-
	Upper Broken Creek		**387**	387	-	-	-
	Moodies Swamp		**500**	250	-	250	-
Campaspe system	Campaspe River		**30,729**	22,364	2,574	5,791	-
	Coliban River		**441**	441	-	-	-
Loddon system	Loddon River		**11,870**	9,000	-	2,870	-
	Birchs Creek		**100**	100	-	-	-
	Boort wetlands	Lake Meran	**2,000**	2,000	-	-	-
		Lake Yando	**558**	558	-	-	-
Northern region total			**549,073**	**112,365**	**105,727**	**330,981**	**-**
TOTAL WATER USE			801,075	209,059	105,727	330,981	155,308.4

1 Other source refers to water that is either delivered outside of Victoria, or delivered in Victoria but not accounted for under the environmental Water Holdings. The VEWH/CEWH/Living Murray columns only account for environmental water delivered through Victorian accounts.

2 Environmental water delivery occurred in New South Wales reaches of the Snowy River. The delivery was aimed to achieve outcomes in the New South Wales reaches of the River, however provided some downstream benefits to the Victorian reaches.

3 Use of the Holdings in the Latrobe system are based on the river height at the Swing Bridge, rather than a volumetric entitlement.

4 Includes use of 330 ML of allocation made available for use by Melbourne Water.

5 In 2013–14, water allocations purchased by Melbourne Water and the VEWH contributed to the delivery of 610 ML of environmental water to meet objectives in Upper Jacksons Creek, in the Maribyrnong system, where no permanent Water Holdings are currently held.

6 Use of the Holdings in the Barwon system are based on the river height in the Barwon River, rather than a volumetric entitlement.

7 Refer to page 38 for a list of the wetlands watered.

8 Water delivered to the Wimmera Mallee wetlands in supply system 5 was made available from GWMWater allocation.

9 Return flows contributed to delivery at these sites.

10 Includes use of 12 ML of allocation donated to the VEWH by a local landholder in the Mallee region.

11 The VEWH has no Water Holdings in the Ovens system.

12 Includes use of 34.5 ML of allocation donated to the VEWH by Parks Victoria.

environmental health

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