Cormorant colony at Harbours Lake, by Keith Ward

Section 1

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1.1 The Victorian environmental watering program

The Victorian environmental watering program is the ongoing collaborative management of water available under environmental entitlements and used to improve the health of Victoria's rivers and wetlands and the native plants and animals that depend on them.

This seasonal watering plan previews the potential environmental watering that may be delivered across Victoria under the program in the coming year.

In this section …

- **Who is involved in the Victorian environmental watering program?**
- **What is the program aiming to achieve?**
- **What is the role of the Victorian Environmental Water Holder?**
- **Where can I find more information about the Victorian environmental watering program?**

1.1.1 Who is involved in the Victorian environmental watering program?

The Victorian environmental watering program involves a range of people and organisations. Relationships between local communities, waterway managers, storage managers environmental water holders and land managers are the foundation of the program.

Many public authorities collaborate to deliver the program. These authorities are referred to as program partners.

Waterway managers (catchment management authorities [CMAs] and Melbourne Water) are the linchpin of the program. In consultation with local communities, waterway managers develop proposals for environmental watering in rivers and wetlands in their region. Waterway managers also order environmental water from storage managers and monitor the outcomes.

Storage managers (some water corporations) deliver water for all water users, including for waterway managers / environmental water holders.

Environmental water holders (the Victorian Environmental Water Holder [VEWH], Commonwealth Environmental Water Holder [CEWH] and the Murray-Darling Basin Authority [MDBA]) commit environmental water to different rivers and wetlands. They work together to ensure the coordinated delivery of water available under different environmental entitlements, and often have to prioritise across large regions (such as northern Victoria).

Public land managers (such as Parks Victoria, Department of Environment, Land, Water and Planning, and Traditional Owner land management boards) are closely involved in environmental water planning and delivery for public land such as state forests or national parks. They may have a variety of responsibilities including controlling infrastructure (such as pumps, outlets, gates and channels) and ensuring appropriate public signage.

To effectively manage environmental water, it is important to understand the environmental values of Victoria's rivers and wetlands. This understanding draws on the knowledge of local communities and scientists.

Local communities help to identify the important environmental values in each region, and help to monitor the success of environmental watering. Their input is important because they are often actively involved with local rivers and wetlands and bring a range of environmental, cultural, social and economic perspectives to the program.

Scientists provide indispensable advice about how environmental watering will support native plants and animals in the short and long terms, and work with waterway managers to monitor, evaluate and report on the outcomes of environmental watering.

Lower Ovens billabong, by North East CMA

Whiskered tern at Lake Murphy, by North Central CMA

1.1.2 What is the program aiming to achieve?

The Victorian environmental watering program seeks to collaboratively manage environmental water to improve the environmental values and health of water ecosystems, including their biodiversity, ecological functioning, water quality and other uses that depend on environmental condition.

1.1.3 What is the role of the Victorian Environmental Water Holder?

The VEWH is an independent statutory authority set up under the Victorian *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 (see section 1.3.2)
- commit water and authorise waterway managers to implement watering decisions (see section 1.4.2)
- work with storage managers and other water holders to coordinate and maximise environmental outcomes from the delivery of all water (see section 1.3)
- 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.

The VEWH consists of three part-time Commissioners, supported by a small team.

The Commissioners are Denis Flett (Chairperson), Geoff Hocking (Deputy Chairperson) and Chris Chesterfield (Commissioner). Commissioners were appointed by the Governor in Council on the recommendation of the Minister for Environment and Climate Change.

1.1.4 Where can I find more information about the Victorian environmental watering program?

More information about the program can be found on the VEWH website at www.vewh.vic.gov.au or by contacting VEWH on (03) 9637 8951 or by email to general.enquiries@vewh.vic.gov.au.

More detailed information about environmental watering in a specific region of Victoria can be found by contacting your local waterway manager using the contact details (Section 6.3).

1.1.5 Environmental watering fact sheets

The VEWH has produced a series of fact sheets which seek to answer questions people have about environmental watering, including:

- What is environmental water?
- Why is environmental watering important?
- What does environmental watering aim to achieve?
- What does environmental watering involve?
- How do we know if environmental watering is successful?

These fact sheets can be found on the VEWH website and hard copies can be requested by email to general.enquiries@vewh.vic.gov.au.

1.2 The seasonal watering plan

The seasonal watering plan is a statewide plan that guides environmental watering decisions in Victoria. It provides program partners, stakeholders and communities with a sense of what to expect during the water year.

In this section …

- **What does 'seasonal' mean?**
- **How does the seasonal watering plan fit into the planning process?**
- **Who contributes to the seasonal watering plan?**
- **Can the seasonal watering plan be changed?**
- **What kinds of changes don't require a formal variation of the plan?**

The plan previews the potential environmental watering that could be implemented using water available under all environmental water entitlements held in Victoria. This includes water available under the VEWH's environmental water entitlements and water held by other environmental water holders (see section 1.3.1).

The plan for the upcoming water year is released by 30 June each year. The 2015–16 plan, and any variations, are valid for this water year (1 July 2015 to 30 June 2016) or until the subsequent seasonal watering plan is released.

Nature doesn't keep to strict timelines, so some potential environmental watering scoped in a seasonal watering plan may begin before, or continue beyond, the year of the plan. This means environmental watering actions that start either before July 2015 or continue after June 2016 are still consistent with the plan, especially if there are unforeseen delays in the release of the *Seasonal Watering Plan 2016–17*.

1.2.1 What does 'seasonal' mean?

'Seasonal' refers to the variability of climatic conditions in a given year. Environmental watering objectives and water availability may differ depending on seasonal conditions, so it is important that environmental water planning considers the range of potential seasonal condition or water availability scenarios that may unfold, ranging from drought to wet (see Figure 1.2.1). This scenario planning provides a guide for the VEWH and waterway managers throughout the year when it comes to deciding what environmental watering to go ahead with.

For each river and wetland system, the potential environmental watering under each water availability scenario is captured in the Scenario planning section of the relevant chapter.

Figure 1.2.1 Examples of environmental watering objectives under different planning scenarios

1.2.2 How does the seasonal watering plan fit in the planning process?

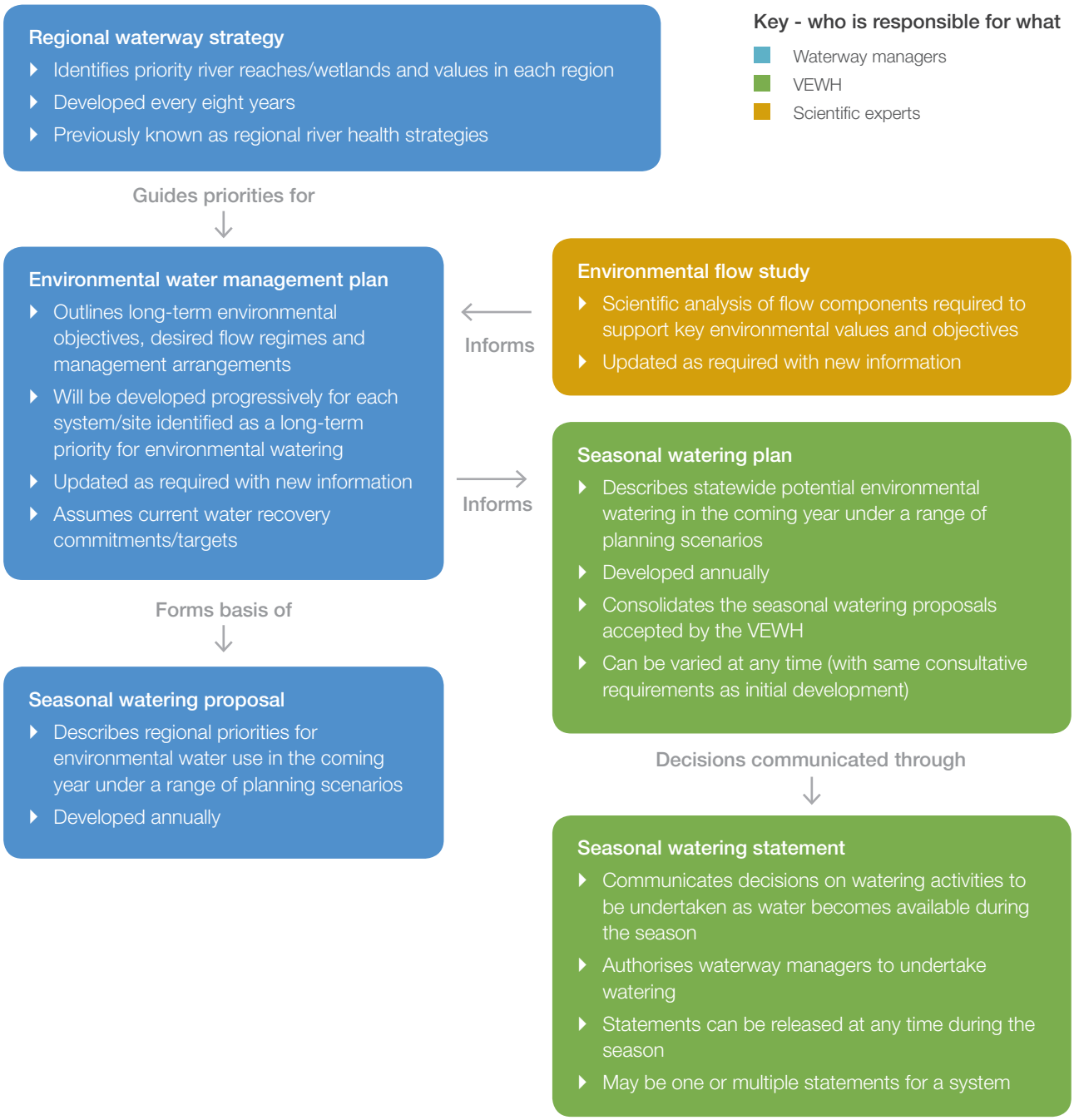
Each year, waterway managers scope the potential environmental watering actions for their regions for the coming year in seasonal watering proposals. The proposals draw on environmental flow studies, and longer term plans such as environmental water management plans and regional waterway strategies.

The proposals incorporate information and advice from local communities.

This seasonal watering plan is a collated summary of the seasonal watering proposals.

The different stages of environmental water planning, including the different strategies and plans, are shown in Figure 1.2.2. More information about each of these strategies and plans can be found at www.vewh.vic.gov.au.

Figure 1.2.2 Victorian environmental watering program planning and management framework



1.2.3 Who contributes to the seasonal watering plan?

Stakeholder engagement on potential environmental watering actions occurs during the development of regional seasonal watering proposals. The level and method of engagement varies across the state, reflecting the differing systems, watering actions and stakeholders. In some regions, formal environmental water advisory groups provide the opportunity for waterway managers and interested community members to discuss potential environmental watering in their system or locality for the coming year. In other systems, engagement occurs one-on-one between waterway managers and interested stakeholders.

Land managers and storage managers also consider and endorse the seasonal watering proposals to ensure that planned watering aligns with land and storage management objectives and can feasibly be delivered through planned system operations.

The engagement activities undertaken by waterway managers during the development of the seasonal watering proposals are summarised in sections 2 to 5 of this plan.

1.2.4 Can the seasonal watering plan be changed?

Under the Victorian *Water Act 1989*, the VEWH can only authorise use of environmental water where it is consistent with a seasonal watering plan. This is to ensure transparency about what environmental watering is planned.

However, to also ensure flexibility to adapt to changing conditions, under the Act the VEWH can vary any section of a seasonal watering plan. This could be to incorporate new knowledge or to address any circumstances not identified before the start of the water year. For example, in 2014–15 the VEWH varied the seasonal watering plan to revise the potential environmental watering in the Campaspe River in light of an updated scientific study of its environmental flow requirements.

All variations are made publicly available at www.vewh.vic.gov.au as separate attachments to the original seasonal watering plan. Printed copies can be requested at general.enquiries@vewh.vic.gov.au.

1.2.5 What kinds of changes don't require a formal variation to the seasonal watering plan?

Changes that do not require a variation to the seasonal watering plan include:

- minor operational adjustments to specific environmental watering actions
- environmental water being used for environmental emergency management situations
- small volumes of environmental water being used for technical investigations
- facilitating the delivery of water held by other water holders for downstream objectives.

As it is not possible to anticipate the specifics of these demands, it is not possible to include details about them in this plan.

Minor operational adjustments

Minor operational adjustments to environmental watering actions may occur from time to time and do not require a formal variation to the seasonal watering plan. For example, the targeted river reaches, flow rates, timing and durations detailed in sections 2 to 5 may need to be adjusted slightly due to changes in predicted rainfall or other water orders, or delivery infrastructure constraints. In all cases, environmental watering actions will still aim to maximise the environmental outcomes achieved.

Environmental emergency management situations

Environmental water may be needed for an environmental emergency management situation. This may include reducing the impact of natural blackwater or bushfire events, preventing fish deaths or mitigating the effects of blue-green algae blooms. It could also include smoothing the transition to or from a high natural flow event (for example, supplementing natural flows with environmental water to provide a more gradual rise and fall to minimise the threat of river banks slumping).

Small technical investigations

There may be instances where a small volume of environmental water may be used for research and development purposes. Such instances are considered on a case-by-case basis. The project must aim to enhance knowledge and improve environmental water management. It must not compromise the potential to achieve the environmental objectives in the seasonal watering plan.

Facilitating the delivery of water held by other water holders for downstream objectives

Some water held by other water holders is stored in Victorian storages and is sometimes called on to meet downstream demands beyond the scope of this plan (such as for the Coorong, Lower Lakes and Murray Mouth region in South Australia). Delivery of this water is sometimes needed at a time and flow rate that was not scoped in the seasonal watering plan. The VEWH facilitates and authorises such deliveries, provided the risk of adverse impacts on Victoria's rivers, wetlands and floodplains and other risks are appropriately managed.

1.3 Managing available environmental water

Environmental water entitlements are held in 15 water supply systems across Victoria (see Figure 1.3.1). Sections 2 to 5 detail where the water made available under these entitlements may be delivered in 2015–16.

In this section …

- **How much water is available to use as part of the Victorian environmental watering program?**
- **What options are available to effectively and efficiently manage environmental water?**

To the extent possible, the VEWH and other environmental water holders attempt to avoid water supply shortfalls through the efficient use of environmental water, and tools such as carryover and trade. However, if there is still a shortfall of water despite these measures, the VEWH, in collaboration with waterway managers (and other water holders if relevant) must prioritise environmental watering actions.

1.3.1 How much water is available to use as part of the Victorian environmental watering program?

VEWH environmental entitlements

Environmental water is made available under the environmental water entitlements held by the VEWH which are known as Water Holdings. Table 1.3.1 details the entitlements held by the VEWH as at 30 June 2015, including those held in trust for the Living Murray program. The VEWH's environmental water entitlements can be viewed at http://waterregister.vic.gov.au/water-entitlements/bulk-entitlements.

The water available to use under these entitlements varies from year to year, depending on entitlement rules, seasonal conditions (including rainfall and runoff in the catchments) and the water already available in storages.

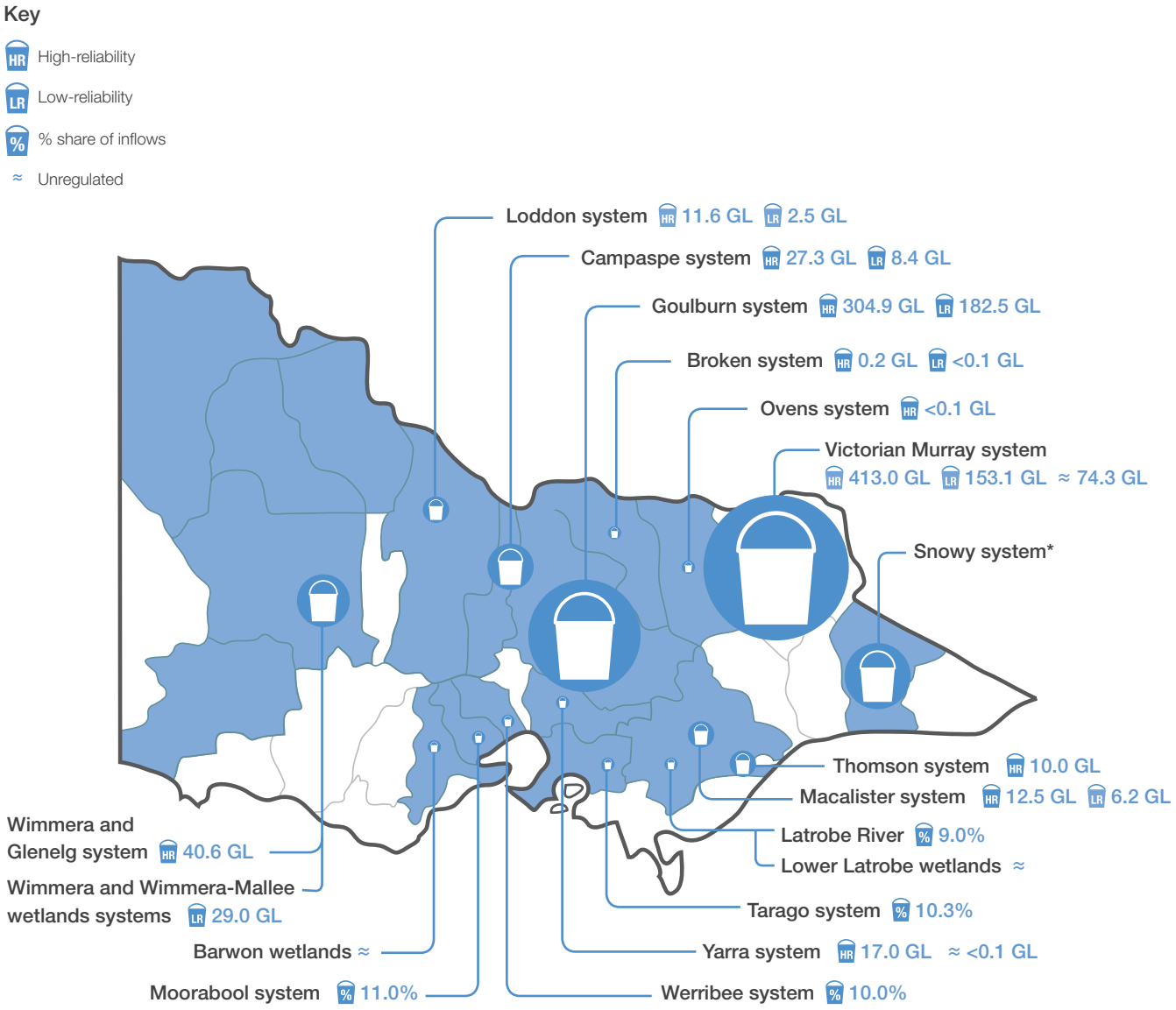
West Barwon River, by Saul Vermeeren

Table 1.3.1 Environmental water entitlements held by the VEWH (as at 30 June 2015)[1]

System	Entitlement	Volume (ML)	Class of entitlement
Gippsland Region			
Latrobe	Latrobe River Environmental Entitlement 2011	n/a[2]	Unregulated
	Blue Rock Environmental Entitlement 2013	18,737[3]	Share of inflow
Thomson	Bulk Entitlement (Thomson River – Environment) Order 2005[4]	10,000	High
Macalister	Macalister River Environmental Entitlement 2010	12,461 6,230	High Low
Central Region			
Yarra	Yarra Environmental Entitlement 2006[4]	17,000 55	High Unregulated
Tarago	Tarago and Bunyip Rivers Environmental Entitlement 2009	3,000[3]	Share of inflow
Werribee	Werribee River Environmental Entitlement 2011	n/a[3]	Share of inflow
Moorabool	Moorabool River Environmental Entitlement 2010[4]	7,086[3]	Share of inflow
Barwon	Barwon River Environmental Entitlement 2011	n/a[2]	Unregulated
Western Region			
Wimmera and Glenelg	Wimmera and Glenelg Rivers Environmental Entitlement 2010[4,5]	40,560 1,000	Pipeline product Wetland product
Northern Region			
Murray	Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999	29,782 3,894 40,000	High Low Unregulated
	Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999 – Barmah-Millewa Forest Environmental Water Allocation	50,000 25,000	High Low
	Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999 – Living Murray	9,589 101,850 34,300	High Low Unregulated
	Environmental Entitlement (River Murray – NVIRP Stage 1) 2012	21,965[6]	High
	Bulk Entitlement (River Murray – Snowy Environmental Reserve) Conversion Order 2004	29,794	High
	Water shares – Snowy Environmental Reserve	14,671 6,423	High Low
Goulburn	Goulburn River Environmental Entitlement 2010	8,851 3,140	High Low
	Environmental Entitlement (Goulburn System – Living Murray) 2007	39,625 156,980	High Low
	Environmental Entitlement (Goulburn System – NVIRP Stage 1) 2012	31,679[6]	High
	Bulk Entitlement (Goulburn System – Snowy Environmental Reserve) Order 2004	30,252 8,156	High Low
	Water Shares – Snowy River Environmental Reserve	8,321 17,852	High Low
	Silver and Wallaby Creeks Environmental Entitlement 2006[4]	0	Passing flow only
Campaspe	Environmental Entitlement (Campaspe River – Living Murray Initiative) 2007	126 5,048	High Low
	Campaspe River Environmental Entitlement 2013	20,652 2,966	High Low
Loddon	Bulk Entitlement (Loddon River – Environmental Reserve) Order 2005[5]	8,270 2,024	High Low
	Environmental Entitlement (Birch Creek – Bullarook System) 2009[4,5]	100	n/a[7]
	Water Shares – Snowy River Environmental Reserve	470	High

1 While the VEWH does not hold any entitlements in the Maribyrnong system, water allocation was purchased in this system (together with Melbourne Water) in 2013–14 and 2014–15.
2 Use of these entitlements is dependent upon suitable river heights, as specified in both the Latrobe and Barwon environmental entitlements.
3 Water is accumulated continuously according to a share of inflows (Blue Rock 9%, Tarago system 10.3%, Werribee system 10%, Moorabool system 11.9%) and this volume represents the maximum that can be stored at any time. The actual volume available in any year varies according to inflows.
4 In addition to volumetric entitlement, the entitlement also includes passing flows.
5 In addition to volumetric entitlement, the entitlement also includes unregulated water.
6 This entitlement volume is equal to one-third of the total water savings from GMW Connections Project Stage 1, as verified in the latest audit (including mitigation water).
7 Allocation against this entitlement is made subject to specific triggers, as specified in the entitlement.

Figure 1.3.1 The sum of environmental water entitlements held in Victoria (including by the Victorian Environmental Water Holder, the Commonwealth Environmental Water Holder and the Murray-Darling Basin Authority under the Living Murray program) as at 30 June 2015



*See page 36 for futher information about water available for environmental flows in the Snowy system.

Water donations

The VEWH may receive water donations from individuals, community groups and other organisations. This water could be used for environmental watering in the water year it was donated (including for actions identified in the seasonal watering plan), or it could be carried over for use in the future (see section 1.3.2 for more information on carryover). Some donors may identify a specific use for the water they donate (such as environmental watering in a specific wetland or using environmental water to protect a certain tree species). The costs and benefits of each donor proposal is considered by the VEWH. These donations may be authorised by the VEWH if considered environmentally beneficial.

Water available from other environmental water holders

In northern and western Victoria, the VEWH coordinates with other environmental water holders to deliver environmental outcomes at the broader Murray-Darling Basin scale. One of the VEWH's important roles is to coordinate with Murray-Darling Basin environmental water holders (the CEWH, MDBA and environmental water managers in New South Wales and South Australia) to maximise the benefits of all environmental water delivery in Victorian waterways. The seasonal watering plan considers the use of all water holders' water held in Victorian river systems.

In most cases, when Commonwealth or Living Murray water is to be delivered in Victoria, the CEWH and MDBA transfer the agreed amount of water to the VEWH. That amount then becomes part of the Victorian Water Holdings until used or transferred back.

Table 1.3.2 shows the environmental entitlements held by the CEWH and MDBA in Victoria. The CEWH and MDBA also hold water in New South Wales and South Australia, which could potentially be made available for environmental watering in Victoria.

Table 1.3.2 Environmental water entitlements held in Victoria by other water holders at 30 April 2015

System	Volume (ML)	Class of entitlement
Living Murray entitlements (held by MDBA)		
Murray	12,267	High-reliability water share
Goulburn	5,559	High-reliability water share
Commonwealth Environmental Water Holdings		
Ovens	70	High-reliability water share
Murray	293,492 20,117	High-reliability water share Low-reliability water share
Broken	157 4	High-reliability water share Low-reliability water share
Goulburn	250,846 22,379	High-reliability water share Low-reliability water share
Campaspe	6,547 395	High-reliability water share Low-reliability water share
Loddon	3,356 527	High-reliability water share Low-reliability water share
Wimmera-Mallee	28,000	Low-reliability water share

1.3.2 What options are available to effectively and efficiently manage environmental water?

Other water sources

Environmental water is not the only type of water that can support river, wetland and floodplain health. Waterway managers and environmental water holders, in consultation with storage managers, consider the potential for environmental watering objectives to be met by other types of water. Timing environmental releases can also be combined with other types of water to achieve greater benefits than an environmental release alone could produce.

System operating water (including passing flows) maintains a baseflow in many rivers to which environmental water can be added.

Heavy rainfall (resulting in unregulated flows) can naturally meet an environmental objective, so water available under environmental water entitlements is not needed.

The timing and route for delivery of consumptive water can sometimes be altered to achieve environmental objectives without impacting consumptive water users.

These types of water are considered in the development and implementation of the seasonal watering plan to ensure effective system operations and efficient use of environmental water, and to achieve the maximum benefit to the environment.

Return flows

In some systems, environmental water delivered through upstream sites can be used again downstream. This helps to ensure environmental water is used efficiently and effectively to achieve optimal environmental benefits, as the Goulburn River example below illustrates.

This reuse policy, known as return flows, is available in many systems across northern Victoria. It increases the efficiency of environmental water use and helps reduce the volume of water needed to be recovered for the environment from consumptive water users.

The VEWH's access to return flows is enabled through rules in its environmental entitlements. Reuse of return flows is also available to the CEWH and MDBA when the VEWH delivers water on their behalf.

Where possible, return flows are reused to provide benefits at Victorian environmental sites. If not needed in Victoria, VEWH, Living Murray and CEWH return flows will continue to flow across the border to South Australia, where they will be used to provide environmental benefits at sites such as the Coorong, Lower Lakes and Murray Mouth region.

Reusing return flows

Environmental water is delivered in the Goulburn River to provide environmental benefits such as stimulating fish to breed and promoting the growth of vegetation on river banks. The water flows down the Goulburn River and into the River Murray. The VEWH can apply to the storage manager (Goulburn-Murray Water) to have the volume of environmental water that reached the River Murray re-credited in its accounts as a return flow. This water can then be reused at a priority environmental site in Victoria (such as at Hattah Lakes near Mildura) or used for River Murray environmental outcomes in South Australia. If the water is to be reused in South Australia, the VEWH trades the re-credited return flow volume to environmental water holders in South Australia.

Carryover

Some entitlements allow the VEWH to carry over unused water to the following water year. This means that water allocated in one year can be kept in storages for use in the following year, subject to certain conditions.

Carryover provides flexibility and enables environmental water to be delivered at a time that is of the greatest value to the environment. For example, carryover can help ensure environmental water holders can meet high winter and spring demands when there is a risk there will be little water available under entitlements at the beginning of the water year.

Water trade

Water trading allows the VEWH to move water to the systems where it is most needed, and to smooth out some of the variability in water availability across systems and across years. The VEWH can trade water allocated to its entitlements by:

- administrative water transfers between VEWH entitlements
- administrative water transfers with other environmental water holders
- purchasing water allocation
- selling water allocation.

Administrative water transfers are the most common trades the VEWH undertakes. These occur between VEWH entitlements (or accounts) to move water to where it is most needed. Other environmental water holders also transfer their water to the VEWH for delivery in Victoria. These types of water trades are often referred to as administrative transfers as there is no financial consideration associated with the trade.

The VEWH can also buy or sell water allocation where it is in line with the VEWH's statutory objectives: that is, if it benefits the environment. The VEWH has bought or sold a small amount of water allocation each year since it was established in 2011.

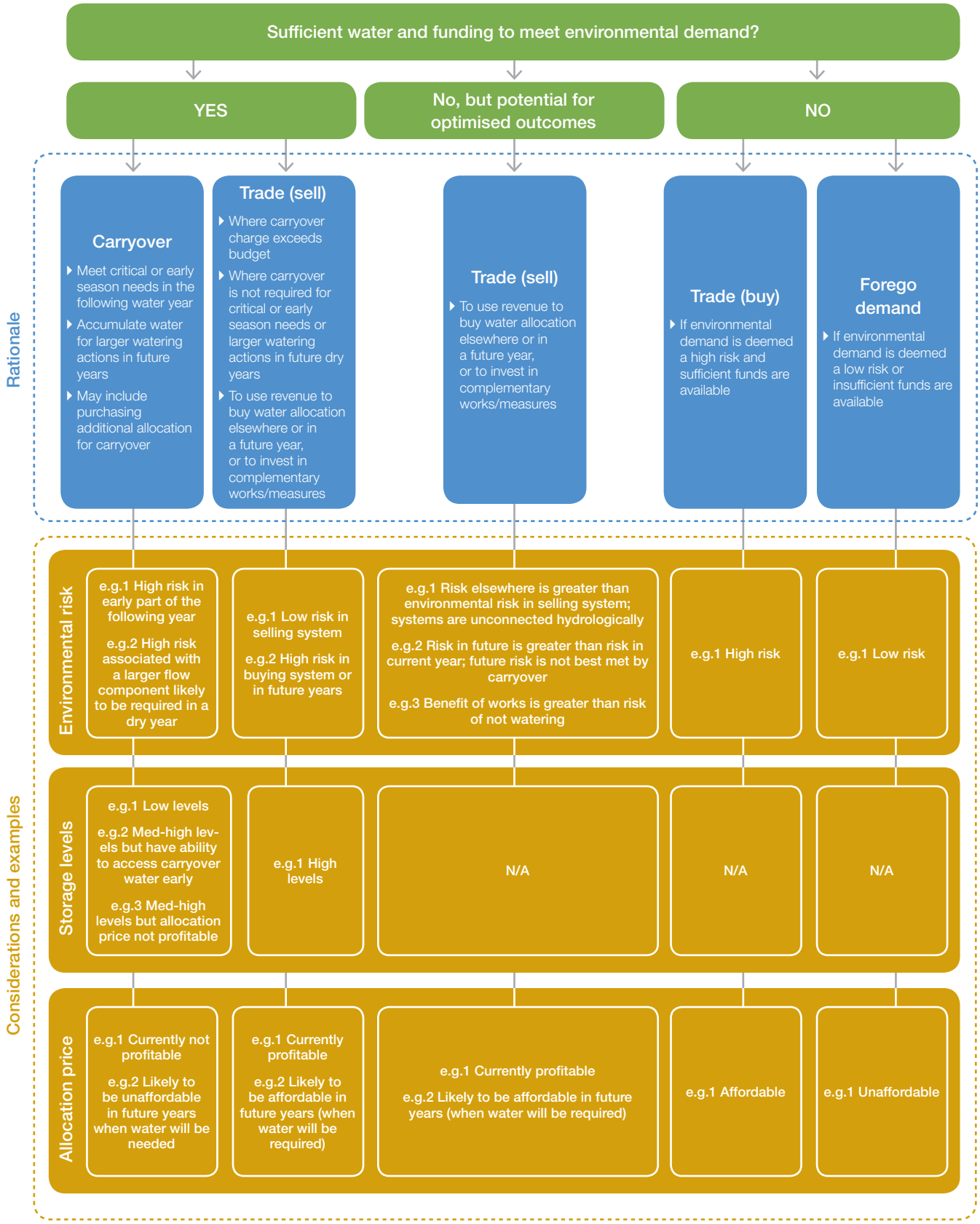
Water has been purchased to enhance environmental outcomes in systems where insufficient environmental water was available, and it has been sold where all foreseeable environmental demands were able to be met. Revenue raised by selling water allocation can be used to purchase water to meet shortfalls in any Victorian system, or to invest in measures (such as monitoring, technical or small structural works, or other improvements to the performance of Victoria's environmental watering program).

Subject to the approval of the Minister for Environment, Climate Change and Water, the VEWH can also trade its water entitlements, referred to as a permanent trade. However, permanent trades are infrequent.

The VEWH has developed a decision tree (Figure 1.3.2) that shows key considerations guiding carryover and trade decisions.

More information about the VEWH's trading activity, including its annual trading strategy for northern Victoria, can be found on the VEWH website at www.vewh.vic.gov.au.

Figure 1.3.2 Key considerations in carryover and trade decisions



1.4 Implementing the seasonal watering plan

The seasonal watering plan scopes potential environmental watering for the coming year, but many factors influence decisions about what environmental water is actually committed and delivered.

These include:

- seasonal conditions, weather forecasts and catchment conditions
- river and system operations (such as unregulated flows, catchment inflows, storage levels, other water users' needs and potential delivery constraints)
- ecological or biological factors and triggers (such as plant and animal responses to natural flows or temperature)
- water availability
- risks associated with an environmental watering action (such as deteriorating water quality).

It is important that there is flexibility to respond to these different factors, as they can significantly influence the environmental outcomes that can be achieved.

In this section ...

- **How do program partners decide which watering actions are delivered?**
- **When does the VEWH commit and authorise its water for use?**
- **How are recreational, Indigenous cultural and economic benefits considered in environmental watering?**
- **How are risks managed?**
- **What if there is not enough environmental water available?**

1.4.1 How do program partners decide which watering actions are delivered?

As the season unfolds, many of the uncertainties associated with seasonal conditions, water availability and operational context become clearer, and inform decisions about what environmental watering should proceed. Many on-ground factors do not become clear until very close to the anticipated time of water delivery.

Waterway managers, environmental water holders, storage managers and land managers all play a role in deciding which watering actions are or can be delivered during the year. These decisions are often taken collaboratively, as each program partner has a role in approving the delivery of environmental water.

For example, waterway managers are best placed to determine the local environmental requirements and risks of a watering action. Storage managers know the delivery feasibility and operational risks, as they are responsible for delivering water to all entitlement holders. Land managers know the risks and feasibility of watering their land. Environmental water holders advise on the availability of environmental water, and must understand how much water is needed when to inform water commitment decisions.

If decisions are required as a result of unforeseen or consequential changes to planned watering during the season, further scientific or community input may be sought to inform decision makers.

Regularly updated information about current and anticipated environmental watering actions is published on the VEWH website at www.vewh.vic.gov.au.

1.4.2 When does the VEWH commit and authorise its water for use?

The VEWH, like other environmental water holders, can commit its water at any point before or during the water year. The VEWH commits water via seasonal watering statements which authorise waterway managers to use environmental water. Seasonal watering statements are published on the VEWH website at www.vewh.vic.gov.au.

A seasonal watering statement can be made at any time of the year. Depending on the nature of the system and the entitlement being used, there may be one or multiple statements made for a particular system. Before issuing a seasonal watering statement, the VEWH must be sure that the required delivery arrangements (including any risk management measures) are in place, and that any costs to be met by the VEWH are acceptable.

The VEWH aims to commit as much water as possible, as early as possible, to provide waterway managers with as much certainty as possible to enable them to proceed with the planned environmental watering actions.

Where many environmental watering actions planned across different systems require access to the same environmental water entitlement, decisions to commit water to particular actions may require more thorough consideration. This may require one river or wetland to be prioritised over another. See section 1.4.5 for further information about how prioritisation decisions are made.

In some instances, VEWH may commit water very close to the anticipated delivery time. This may be necessary because the water demand arises at short notice due to environmental, operational or weather conditions triggering the need for environmental water. For example, if colonial waterbirds start nesting in Barmah Forest, this may trigger a need for environmental water to maintain shallow flooding long enough for the birds to breed and fledge.

There may also be instances where no environmental water is committed to a particular site. This could be due to many factors, such as an ecological trigger or seasonal conditions that indicate watering should not proceed, or because there is insufficient water to achieve the planned watering action.

The CEWH and MDBA (through the Living Murray program) commit water for use in Victoria with similar logic to that outlined above. The VEWH then formally authorises the use of that water through seasonal watering statements.

Can environmental water holders change their minds after a seasonal watering statement has been issued?

The VEWH may withdraw a seasonal watering statement at any point in the year. Such an action is undertaken in consultation with the relevant waterway manager and storage manager for that river or wetland system. This may occur due to factors such as emerging risks or changes in operating conditions or water availability.

Similarly, a waterway manager or storage manager may decide, in consultation with the VEWH, not to proceed with an environmental watering action after a seasonal watering statement has been issued. This could occur as a result of environmental triggers indicating the water was no longer required, resourcing constraints or new information that the potential environmental or public risk of watering was too high.

Werribee River, by Erin Ashcroft

1.4.3 How are recreational, Indigenous cultural and economic benefits considered in environmental watering?

In planning for environmental watering, the primary purpose is to maximise environmental benefit. However, where consistent with this purpose, program partners also consider whether other benefits can be achieved.

Environmental watering provides a range of shared benefits including recreational, Indigenous cultural and economic benefits. By improving the health of rivers, wetlands and floodplains, environmental watering increases opportunities for recreational pursuits (such as fishing, water skiing and bushwalking). Similarly, environmental watering helps to sustain healthy Country for Indigenous communities that have a continuing connection to the land and waterways. Environmental watering also improves water quality which can have indirect economic benefits for irrigation.

When planning for and delivering environmental water, the VEWH and program partners look for opportunities to achieve these shared benefits, where environmental outcomes are not compromised.

Waterway managers work with communities to identify the environmental, social, Indigenous cultural and economic values of waterways through regional waterway strategies, environmental water management plans and seasonal watering proposals. A summary of these values in each system is identified in sections 2 to 5. Program partners will continue to work with stakeholders to look for opportunities to achieve shared benefits from environmental watering.

1.4.4 How are risks managed?

Risk management is an integral part of environmental watering, and is considered by program partners throughout environmental water management (that is, during long-term and annual planning, implementation and review).

The seasonal watering proposals, on which this *Seasonal Watering Plan 2015–16* is based, identify potential risks associated with the specific watering actions proposed for the coming water year. They include an assessment of risks and identify mitigating actions. Often, the management of risks associated with environmental watering is shared between program partners as it requires a collaborative risk management approach.

Table 1.4.1 shows the main shared risks of environmental watering. Program partners consider and reassess these and other potential risks as the season unfolds and planned watering actions are due to commence.

Canoeing on the Thomson River, by Jake Marler

Table 1.4.1 Main shared risks of environmental watering

Type of risk	Example mitigating actions
Environmental watering contributes to third-party impacts	▸ Identify and understand water system capacities and monitor water levels at critical locations to inform daily water release decisions and ensure impacts do not eventuate. ▸ Consider potential catchment runoff from forecast rainfall before deciding on timing of environmental water releases. ▸ Implement a communication strategy including media releases, public notices and signage before environmental watering, to ensure people are informed of significant environmental water deliveries and can adjust their behaviour as necessary. This includes early liaison with potentially affected stakeholders. ▸ Restrict access through gate and track closures.
Inability to achieve or demonstrate ecological outcomes from environmental watering	▸ Undertake intervention monitoring within available resources to capture ecological response. ▸ Conduct research to better understand environmental watering responses. ▸ Communicate outcomes of monitoring and incorporate learnings into future environmental watering.
Environmental watering has negative effects on the environment (e.g. blackwater, bank erosion, spread of weeds)	▸ Monitor outcomes of environmental watering and reassess future deliveries and/or scientific recommendations if necessary. ▸ Plan the timing, frequency, duration and variability of environmental watering to limit conditions that are favourable to non-native plants and animals or which have negative effects.

Some risks may only eventuate at the time of delivery. For example, if there is significant rain forecast, there is a risk that this could cause nuisance flooding if combined with a scheduled environmental watering action. To avoid this, risks are always reconsidered by program partners within the specific environmental and operational contexts of a watering action to inform decisions about whether delivery should proceed. Any measures or actions required to mitigate the risks identified are implemented as agreed by the responsible program partner. Watering actions will not be implemented if an unacceptable risk to the public or the environment is identified.

Even with best practice risk management controls in place, there may be unintended impacts from environmental watering or situations where environmental watering cannot occur as planned. In these situations, it is imperative that partners work together to respond to risks, and then learn and adapt their management of risks. An agreed approach to incident management has been developed to help program partners report, investigate and respond to risks.

1.4.5 What if there is not enough environmental water available?

In any given year, the need for environmental water as outlined in the seasonal watering plan can be higher than the water available to use, so it is important to consider where water is most needed and how it can be used most efficiently to achieve the best environmental outcomes.

A shortfall in supply might arise because of:

- significant, high-value environmental water demands
- drought or low water availability.

If there is still a shortfall of water, the VEWH, in collaboration with waterway managers and other water holders if relevant, must prioritise environmental watering actions.

What are some examples of prioritisation decisions program partners may have to make?

When the demand for environmental water is higher than the available supply, program partners may need to make watering trade-offs between:

- different environmental watering actions within one river or wetland (see example 1)
- different river reaches or wetlands in one river system (that is, deciding to commit water to one river reach or wetland over another in the same system) (see example 2)
- different regions (that is, deciding to commit water to a river or wetland in one region over a river or wetland in another region) (see example 3).

The timing of environmental watering may also affect such decisions. There may need to be trade-offs between earlier or later actions within the current year, or trade-offs between water years (such as forgoing some environmental watering in the current year to ensure a higher-priority watering can be achieved in the following year) (see example 4).

Prioritisation decisions are influenced by many factors such as the previous watering history in that river or wetland, environmental or public risk considerations, or seasonal conditions in that region. They can be extremely difficult, and often involve trading off the potential risks of particular watering actions.

In making the decision to prioritise one environmental watering action and site over another, the VEWH always seeks to maximise environmental outcomes across the state.

Example 1: Prioritising between actions within one river or wetland

Environmental water needs in the Goulburn River can be higher than the anticipated water available to use. Such circumstances require program partners to prioritise which environmental watering actions are most critical in a given water year, based on factors such as ecological or climate conditions at the time. A spring fresh might be prioritised over a winter fresh in a particular year because it is more important to encourage fish to spawn that year than to provide winter flows for water bug habitat, or because climate forecasts indicate there is more likelihood that the winter flow will occur naturally. However, in another year, the priority may change because spawning occurred the year before and does not need to occur every year, and dry conditions mean the winter flow is unlikely to occur naturally.

Example 2: Prioritising between river reaches or wetlands within the same system

A significant number of wetlands, creeks and floodplains across northern Victoria can be supplied by environmental water held in the Murray system. However, during the Millennium Drought, environmental water availability was extremely low. As there was not enough water to deliver to every site, program partners worked together to decide on the most effective use of the water and how it would be delivered. Murray environmental water was prioritised for delivery to selected wetlands and floodplains to avoid critical loss of species and to protect refuge areas. This included delivery to the wetland sites that supported the critically endangered Murray hardyhead fish and to localised sections of floodplains to provide key drought refuge for animals and prevent the irreversible loss of river red gums.

Example 3: Prioritising between rivers or wetlands in different regions

For consecutive years there was not enough environmental water to provide spring freshes in the Thomson River to encourage the migration of juvenile Australian grayling. In 2014, the VEWH decided to transfer just under 4,000 ML of environmental water from the Yarra system to the Thomson system to ensure the priority environmental watering action could be delivered.

Australian grayling spawn in downstream reaches of coastal river systems and the juvenile fish then spend time in the sea before migrating back upstream. Flows of specific duration and magnitude are required to trigger both spawning and returning migrations. In recent years, there have been regular spawning opportunities provided for Australian grayling in the Thomson River, and monitoring showed that successful spawning and recruitment of Australian grayling had occurred. However, flows that trigger the return of juvenile grayling to the upstream reaches had been absent since 2010–11.

Unused environmental water had been carried over in the Yarra system from previous years, and there was sufficient water remaining to provide the planned environmental watering in the Yarra system that year. A risk assessment determined that the transfer posed a low risk to achieving environmental outcomes in the Yarra system, while it would provide added benefits in the Thomson system.

This transfer is an example of how water may be prioritised across different regions. It also shows how use, trade and carryover decisions can maximise the value of available water across the state to achieve environmental outcomes.

Example 4: Prioritising between watering actions this year and next year

Inflows to waterways and storages in the Western Region were extremely low in 2014–15. There was a significant risk that conditions would remain very dry leading into 2015–16, with a high likelihood of low water availability. As a result, program partners decided to reduce, and in some waterways temporarily cease, environmental watering in the Wimmera and Glenelg systems in the last quarter of 2014–15 to carry over water for higher-priority watering in 2015–16. Although there were environmental risks associated with ceasing deliveries, trialling such an action during the cooler autumn months (when water quality risks are lower) was preferable to potentially not being able to provide flows during the hotter months of 2015–16 when risks to native fish and other animals from poor water quality will be much more significant. Carrying over this water may prove critical for ensuring environmental watering can occur during summer and autumn 2015–16 to help protect native fish and other animals that rely on the rivers and creeks in the Wimmera and Glenelg systems.

What criteria are used to guide prioritisation decisions?

The criteria below are considered when making the above trade-off decisions and prioritising the range of potential environmental watering actions.

- Extent and significance of the environmental benefit expected from the watering action: for example, the area watered, the size of the breeding event to be triggered and the conservation status of the species that will benefit.
- Certainty of achieving the environmental benefit from the watering action and ability to manage other threats: for example, a flow has been provided in the past with demonstrated benefits and relevant complementary measures are being undertaken at the site.
- Ability to provide ongoing benefits at the site at which the watering action is to take place: for example, where the management arrangements provide for watering in the long term.
- Watering history at the site and the implications of not undertaking the potential watering action at the site: for example, the potential for critical or irreversible loss of important environmental values.
- Feasibility of the watering action: for example, the flexibility of timing of the delivery, operational requirements and constraints, and infrastructure capacity.
- Overall cost-effectiveness of the watering action: for example, considering the likely benefit to be achieved against the cost of the watering action (including the volume of water to be used and any delivery and risk management costs).

How are recreational, Indigenous cultural and economic considerations included in the prioritisation process?

Environmental benefits are the key consideration in the watering prioritisation process. However, opportunities are sought to achieve shared recreational, Indigenous cultural and economic benefits, provided environmental outcomes are not compromised. The VEWH and waterway managers are interested in seeking and developing robust methods to better incorporate these values in the watering prioritisation process.

Who is involved in the prioritisation process?

Waterway managers, environmental water holders, storage managers and communities all have a role in prioritising environmental watering actions, depending on the nature and scale of the decision being made.

During the season, prioritisation decisions are typically made by waterway managers and environmental water holders in consultation with other program partners. Assessments of the risks and benefits of different prioritisation decisions are collaborative because each program partner is involved in delivering the environmental water. These decisions are also informed by long-term environmental watering objectives and priorities which have been identified in consultation with local communities.

Waterway managers are best placed to advise about the extent and significance of an environmental watering action and the highest priorities in their region.

VEWH and other environmental water holders determine the highest watering priorities across regions and have a mandate to commit environmental water to particular watering actions and sites over others. VEWH's decisions are intended to provide the best possible environmental outcomes for the state. The VEWH makes these decisions in consultation with waterway managers as the primary environmental watering representatives of their regions, and with other program partners as relevant.

Advice from storage managers is generally the key to understanding the feasibility of delivering a watering action, including the flexibility of delivery timing, or operational constraints.

Land managers provide consent to environmental water delivery on their land and will advise on delivery feasibility in light of land management activities, public access and the risks and benefits of the environmental watering action.

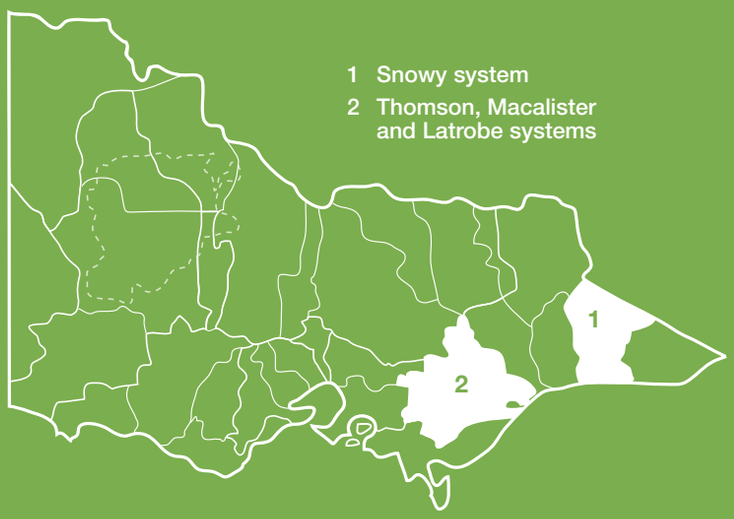
The annual prioritisation process is informed by longer-term site prioritisation by waterway managers in consultation with their communities. This prioritisation is in plans such as regional waterway strategies and environmental water management plans. These plans draw on community and scientific knowledge and prioritise sites for environmental watering (and other river health activities) that have high environmental, cultural, social and economic value to the community.

Additional input from the community on prioritisation of environmental watering is provided annually where needed.

Upper Gunbower Forest, by Anna Chatfield

Section 2

Gippsland Region



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2.1 Gippsland Region overview

There are four systems in the Gippsland Region that can receive water from the Water Holdings (see sections 2.2–2.5): the Thomson, Macalister and Snowy systems, and the Latrobe system (including the Latrobe River and lower Latrobe wetlands).

The Latrobe, Thomson and Macalister rivers become linked near Sale, where the Macalister and Thomson rivers join the Latrobe River and flow past the lower Latrobe wetlands (Sale Common, Heart Morass and Dowd Morass) before entering Lake Wellington. These waterways and wetlands contain a range of significant environmental values and also support irrigated agriculture, tourism and mining industries.

The Snowy River flows south from the Snowy Mountains in New South Wales and into Victoria and Bass Strait. The Snowy Mountains Hydro-electric Scheme contains storages that are connected to the Murray and Murrumbidgee systems via a network of tunnels, pipelines and aqueducts. Water from the Snowy is transferred to the Murray and Murrumbidgee to supply irrigated agriculture in those systems.

There is some interconnectedness between systems in the Gippsland Region, and there are therefore opportunities to move water between systems through trade or substitution. Although moving water between systems is possible, most environmental water in these systems is prioritised to provide benefits in the waterways downstream of the storages in which the water is held.

Seasonal outlook 2015–16

Environmental water available for use in the Latrobe, Thomson and Macalister systems is held in Blue Rock Reservoir, Thomson Reservoir and Lake Glenmaggie respectively. Water allocations are made through various rules and mechanisms in each system. The Thomson system has relatively secure allocation, largely irrespective of catchment conditions. In the Latrobe and Macalister systems, water availability is more heavily dependent on seasonal conditions. However, the outlook for water availability in 2015–16 is reasonable, with environmental water availability likely to be sufficient to meet most identified demands in these systems, particularly considering available carryover. There may be a need for additional environmental water to be made available in the Thomson system to support important migration triggers for Australian grayling, which may be met through the planned recovery of an additional 8,000 ML of environmental water in the Thomson system in 2015–16. However, if necessary, additional water could be made available by transfer from another Gippsland system or from another region.

The Latrobe wetlands are not reliant on a volume set aside in upstream storages to meet environmental water demands. The wetlands have access to end-of-system flows whereby water can be actively diverted into Sale Common, Heart Morass or Dowd Morass when a river-level trigger in the Latrobe River is achieved. By and large, the Latrobe wetlands receive water from natural and unregulated flows.

Victorian environmental water available for use in the Snowy system is held in the Murray, Goulburn and Loddon systems. This water is made available for environmental flows in the Snowy River via a substitution method whereby Victorian environmental water replaces water that was earmarked for transfer from the Snowy to Victoria to support irrigation demands. Due to high allocations in Victorian systems in 2014–15, the full volume of high-reliability allocations held by the VEWH will be substituted to the Snowy system and made available for use in the Snowy River by the New South Wales Office of Water.

2.2 Latrobe system

Waterway manager – West Gippsland Catchment Management Authority

Storage manager – Southern Rural Water

Environmental water holder – Victorian Environmental Water Holder

Considered one of the most significantly modified rivers in Victoria, the Latrobe River system (which includes the Latrobe River and lower Latrobe wetlands) supports a range of plant and animal species of high conservation significance including several threatened vegetation types, waterbirds and fish and frog species. The Latrobe River also provides an essential source of fresh water to the Ramsar-listed Gippsland Lakes system, of which the lower Latrobe wetlands are an important component.

Engagement

West Gippsland CMA engaged key stakeholders when preparing the seasonal watering proposal for the Latrobe River and the lower Latrobe wetlands. Table 2.2.1 shows these stakeholders.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 2.2.1 Key stakeholders engaged in the development of the Latrobe River and wetlands seasonal watering proposal

Stakeholder engagement
▸ Wetlands Environmental Taskforce, a registered environmental organisation that purchases and restores wetlands in Australia
▸ Field and Game Australia
▸ Southern Rural Water
▸ Parks Victoria
▸ Victorian Environmental Water Holder

2.2.1 Latrobe River

Environmental values

The Latrobe River contains a range of important estuarine and freshwater fish species including black bream, Australian bass and short and long-finned eel. Considerable habitat is provided in the lower Latrobe River through a diverse range of riparian vegetation including intact stands of swamp scrub, an endangered vegetation type that is characterised by dense stands of swamp paperbark and tea tree. The upstream reaches contain larger and more continuous stands of river red gums and a tall shrub layer. These mature river red gums adjacent to the lower Latrobe wetlands also provide nesting habitat for birds of prey (such as sea eagles) that hunt and range over the wetlands.

Social and economic values

The Latrobe River contains several important recreational fishing species including black bream and estuary perch. Research is under way to track black bream movement and spawning activities in the Latrobe River to improve flow recommendations and increase the population, which would have the flow-on benefit of improving fishing opportunities. The lower Latrobe River is also commercially fished for eel and carp. The waterways in the Latrobe system (including the Latrobe River) continue to hold significance for Traditional Owners. Waterways and wetlands in the region are important ceremonial places and for thousands of years the Latrobe River has provided resources such as food and materials to the Gunaikurnai people.

Environmental watering objectives in the Latrobe River

- Enable formation of instream bars to help stabilise the structure and condition of the river channel. This will help to reduce the load of sediment and nutrients flowing into the Gippsland Lakes
- Establish native plants on bars and lower parts of the banks to stabilise the river channel
- Improve habitat for native fish including black bream and estuary perch

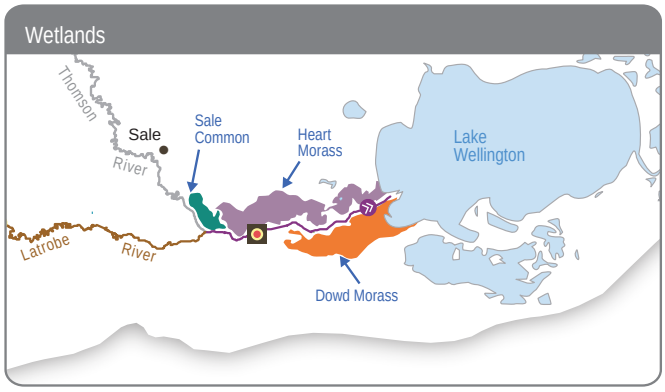
System overview

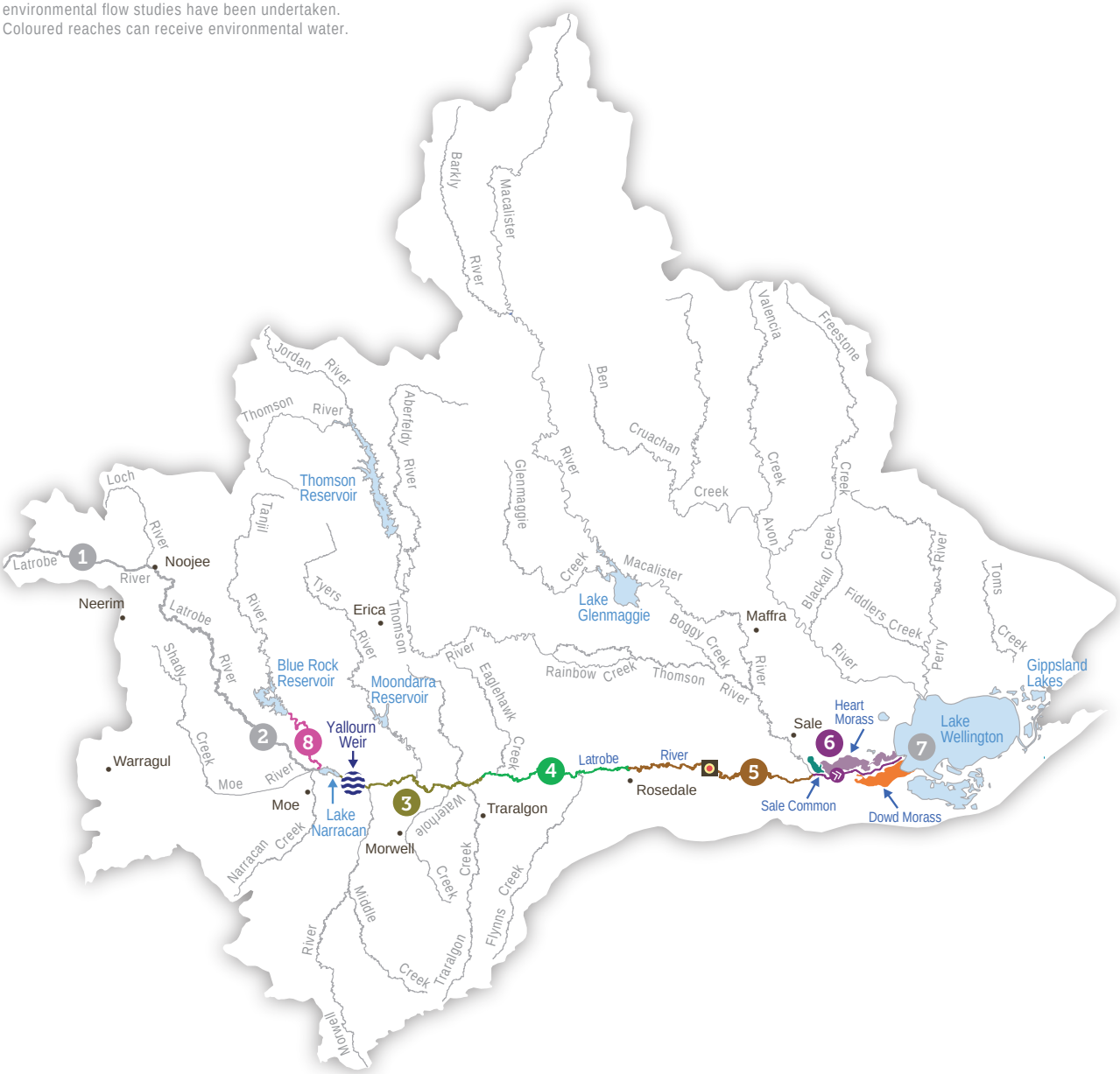
The Latrobe River arises on the Mount Baw Baw Plateau near Powell Town in West Gippsland and flows into Lake Wellington, the westernmost point of the Gippsland Lakes. While the upper Latrobe River is relatively intact, the lower Latrobe River that flows through the Latrobe Valley is modified and degraded due to past river and land management practices (including river desnagging and channelisation) that have reduced habitat availability and diversity.

Figure 2.2.1 The Latrobe system

Reach 1 Upstream of Willow Grove
Reach 2 Willow Grove to Lake Narracan
Reach 3 Lake Narracan to Scarnes Bridge
Reach 4 Scarnes Bridge to Rosedale
Reach 5 Rosedale to Thomson River confluence
Reach 6 Downstream of Thomson confluence
Reach 7 Lake Wellington
Reach 8 Tanjil River
Water infrastructure
Measurement point
Town
Indicates direction of flow

Grey river reaches have been included for context. The numbered reaches indicate where relevant environmental flow studies have been undertaken. Coloured reaches can receive environmental water.





Major tributaries of the Latrobe River include the Tanjil River, Narracan Creek, Morwell River, Tyers River, Traralgon Creek and Thomson River. Environmental water is stored in, and can be released from, Blue Rock Reservoir.

Due to its good stands of endangered riparian vegetation, the Latrobe River from Rosedale to the Thomson River confluence (reach 5) is the priority reach for environmental watering. This reach also has the highest potential to improve its environmental condition through environmental watering, due to the degrading processes of past river management practices. The measurement point for environmental flows delivered to reach 5 is the Latrobe River at the Kilmany South streamflow gauge.

Recent conditions

The Latrobe catchment received average rainfall during 2014–15, with summer inflows being above-average. Throughout most of winter and spring, Blue Rock Reservoir was full and spilled regularly, resulting in most small- to medium-sized environmental watering targets being achieved naturally. The largest natural flow occurred in December 2014 and this caused some minor flooding of the lower Latrobe River. Larger floods that have been seen in recent years did not occur during 2014–15.

The first-ever delivery of environmental water from Blue Rock Reservoir occurred during April and May 2014. The release provided an autumn fresh of 1,300 ML per day to improve vegetation condition and channel structure in the Latrobe River. The flow was also delivered to improve water quality in the lower Latrobe River by flushing a salt wedge that forms during summer and autumn low-flow conditions.

There is evidence that the structure and condition of the river channel in the most downstream sections of the Latrobe River is improving, with instream bars being formed and vegetation being re-established. During the 2014 release of water to the Latrobe River, West Gippsland CMA also collected information about the duration and magnitude of the river flows. This helped the CMA understand how much water made it to the bottom reaches, how long the water took to travel through the system, and how the release affected the salinity and water quality of the Latrobe River estuary. This information will assist in the planning and optimisation of future environmental watering including the coordination of releases from the Latrobe, Thomson and Macalister systems to achieve the greatest benefits in the Latrobe River estuary.

Scope of environmental watering

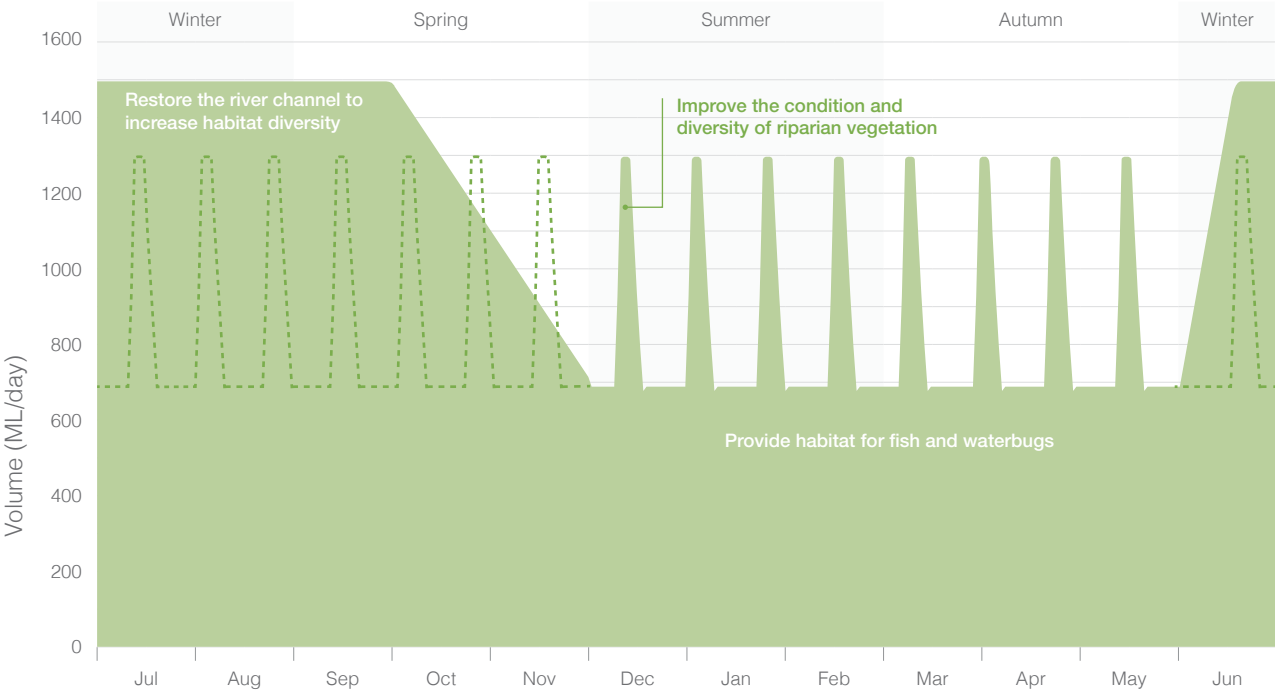
Potential environmental watering actions and their environmental objectives are explained in Table 2.2.2 and illustrated in Figure 2.2.2.

Table 2.2.2 Potential environmental watering actions and objectives for the Latrobe River

Potential environmental watering	Environmental objectives
Spring/summer freshes (up to 8 freshes of 1,300 ML/day for 2–4 days during September–February)	▸ Improve vegetation diversity, condition and abundance along lower banks and increase recruitment of instream vegetation
Autumn/winter freshes (up to 8 freshes of 1,300 ML/day for 2–4 days during March–August)	
Winter/spring baseflows (690–1,500 ML/day from June–November)	▸ Facilitate the formation of instream bars (elevated deposits of sediment and gravel in the river channel)
Summer/autumn baseflows (up to 690 ML/day from December–May)	▸ Provide instream habitat for aquatic biota, especially macroinvertebrates, fish and vegetation

Release from Blue Rock Reservoir, by Chloe Wiesenfeld

Figure 2.2.2 Potential environmental watering in the Latrobe River reach 5



Note: This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Scenario planning

Table 2.2.3 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

Environmental water availability in the Latrobe River will start well this year with at least 15,700 ML of water available in Blue Rock Reservoir on 1 July 2015. Even if a low inflow year eventuates, it is expected that allocations will reach the full entitlement volume.

Climatic conditions from July to November are an important driver for decision making and prioritising use of environmental water in the Latrobe River. The long-term aim for the Latrobe River is to rehabilitate vegetation and channel structure and so, in dry years, spring freshes are most important because they aid the establishment of riparian vegetation. It is likely that in dry years there will be low natural achievement of spring and early summer freshes, and therefore environmental water will be delivered to supplement flows to achieve desired flow rates and long-term environmental outcomes.

In contrast, if good inflows in winter and spring eventuate, Blue Rock Reservoir is likely to spill and most early-season watering actions are likely to be delivered naturally, reducing the amount of environmental water required to achieve the associated objectives. This would mean that there is little need to call on environmental water for spring flows, reserving water for use in late summer and autumn.

The variable volumes of environmental water required under each scenario reflect the different duration and timing of the potential watering actions and the expected river conditions during the delivery periods.

Risk management

In preparing its seasonal watering proposal, West Gippsland CMA considered and assessed risks, and identified mitigating strategies, relating to implementing environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Table 2.2.3 Potential environmental watering for the Latrobe River under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	▸ Small contributions from unregulated reaches and tributaries of the Latrobe River with little opportunity for freshes to occur naturally ▸ Consumptive demand from Blue Rock Reservoir will be very high and regular releases to the Tanjil River will contribute substantially to baseflows	▸ There will be some unregulated flows that contribute to baseflows and freshes, however extended periods of high flow will be absent, and freshes will be infrequent ▸ Consumptive demand from Blue Rock Reservoir will be high and contribute to baseflows	▸ Unregulated flows will provide baseflows and multiple freshes, most likely during winter and spring ▸ A moderate amount of spills are likely and there will be releases for consumptive users which will partially contribute to baseflows	▸ Multiple spills from Blue Rock Reservoir will provide extended durations of high flow and overbank flow ▸ No significant releases from consumptive entitlements in Blue Rock Reservoir are likely
Expected availability of environmental water	▸ 16,200 ML	▸ 18,200 ML	▸ 18,700–23,200 ML	▸ 18,700–31,200 ML
Potential environmental watering	▸ 1 spring/summer fresh ▸ 1 autumn/winter fresh ▸ Winter/spring baseflows	▸ Up to 3 spring/summer freshes ▸ Up to 2 autumn/winter freshes ▸ Winter/spring baseflows ▸ Summer/autumn baseflows	▸ Up to 3 spring/summer freshes ▸ Up to 3 autumn/winter freshes ▸ Winter/spring baseflows ▸ Summer/autumn baseflows	▸ Up to 4 spring/summer freshes ▸ Up to 4 autumn/winter freshes ▸ Winter/spring baseflows ▸ Summer/autumn baseflows
Possible volume of environmental water required to achieve objectives	▸ 12,300 ML	▸ 11,200 ML	▸ 15,900 ML	▸ 0–11,000 ML

2.2.2 Lower Latrobe wetlands

Environmental values

The Latrobe River provides a large source of freshwater to the Gippsland Lakes Ramsar site, of which the lower Latrobe wetlands are an important component. The lower Latrobe wetlands provide a variety of habitats to suit different birds at different times. For example, colonial waterbirds such as royal spoonbill, straw-necked and Australian white ibis find suitable breeding habitat among swamp paperbark trees in spring. Over summer during a drying phase, the mudflats provide feeding habitat for migratory shorebirds such as sandpipers, and open water is important all year round for waterfowl and fish-eating birds such as egrets.

In recent years, following the breaking of drought conditions, rare and threatened species such as freckled duck and green and golden bell frog have been found at Heart Morass.

Social and economic values

Sale Common is a state game refuge located close to the town of Sale that provides an excellent opportunity to observe plants and animals. Dowd Morass is a state game reserve and, along with Heart Morass, is commonly used by hunters. Preservation of an appropriate water regime in the lower Latrobe wetlands will, in the long term, increase waterbird abundance and provide opportunities for bird watching and hunting when the wetlands are in a wetting phase. The waterways in the Latrobe system (including the lower Latrobe wetlands) continue to hold significance for Traditional Owners. Waterways and wetlands in the region are important ceremonial places and for thousands of years the lower Latrobe wetlands have provided resources such as food and materials to the Gunaikurnai people.

Environmental watering objectives in the lower Latrobe wetlands

	Promote dispersal and germination of wetland plants
	Provide habitat for waterbirds
	Control carp abundance, particularly at Sale Common and Dowd Morass

System overview

The lower Latrobe wetlands are situated on the floodplain of the Latrobe River between its confluence with the Thomson River and Lake Wellington. River regulation and water extraction from the Latrobe, Thomson and Macalister rivers has reduced the frequency of small- to medium-sized floods that would naturally inundate the wetlands. Construction of levees and drains and the filling in of natural depressions have also substantially altered water movement.

The lower Latrobe wetlands that can be actively managed with environmental water are Sale Common and Heart Morass on the northern floodplain and Dowd Morass on the southern floodplain.

Recent conditions

During the four to five years before 2014–15, the lower Latrobe wetlands were continuously inundated with only partial drawdowns occurring each summer. No managed environmental watering was undertaken in 2014–15, as a summer drying remained the priority. However, Dowd Morass and Sale Common received natural flows in September 2014, and all three wetlands were partially inundated again in December. The climate in summer 2014–15 was mild and as a consequence the summer drying was not fully achieved; however, dry conditions persisted in autumn resulting in partial drawdown across all wetlands.

In general, there has been a decline in the diversity of native plants due to continuous inundation for several years. As a result, the value of the wetlands as feeding habitat for waterbirds is somewhat diminished. At Dowd Morass, the stands of swamp paperbark, which are important rookery habitat for waterbirds, are showing signs of stress and dieback due to constant inundation. Ibis and spoonbills which are typically abundant and breeding in the rookeries were absent in 2014–15.

At Sale Common, the mostly high water levels controlled the abundance of giant rush, which is a positive outcome. The high water levels have also dispersed plant propagules through the entire wetland complex; these are expected to germinate when suitable conditions arise.

Despite some negative impacts due to a prolonged wet phase, the wetlands still provided important habitat for waterbirds. Restoring an appropriate regime of wetting and drying will eventually assist in promoting germination and growth of a range of vegetation to support a high diversity of birdlife in the wetlands.

Australian white ibis hatchlings, by West Gippsland CMA

Sale Common, by Eleisha Keogh

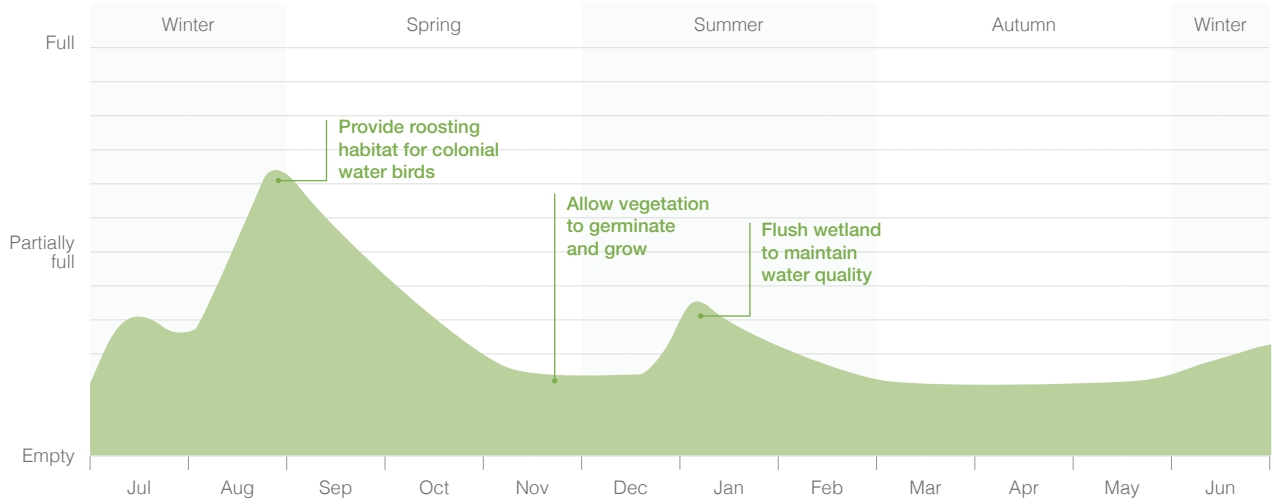
Scope of environmental watering

Potential environmental watering actions and their environmental objectives are explained in Table 2.2.4 and illustrated in Figure 2.2.3.

Table 2.2.4 Potential environmental watering actions and objectives for the lower Latrobe wetlands

Potential environmental watering	Environmental objectives
Sale Common	
Complete drawdown (primarily August–March)	▸ Promote oxygenation of surface soils, breakdown of accumulated organic matter and nutrient recycling ▸ Encourage the growth and reproduction of wetland plants across the wetland bed ▸ Reduce the number and size of European carp
Wetting flow (February–May)	▸ Provide feeding and sheltering habitat for wetland fauna, particularly waterbirds and frogs ▸ Discourage the spread of giant rush
Partial wetting flow (August–November)	▸ Encourage the growth and reproduction of wetland plants, particularly tall marsh, aquatic herbland and aquatic sedgeland ▸ Provide feeding and breeding habitat for wetland fauna, particularly waterbirds and frogs
Wetting flow (anytime)	▸ Mimic the natural inundation regime ▸ Control invasive vegetation
Dowd Morass and Heart Morass	
Substantial drawdown (primarily August–March)	▸ Promote oxygenation of surface soils, breakdown of accumulated organic matter and nutrient recycling ▸ Encourage the growth and reproduction of wetland plants, particularly swamp shrub, tall marsh, aquatic herbland and brackish herbland ▸ Reduce the number and size of European carp
Wetting flow (February–May)	▸ Provide feeding habitat for wetland fauna, particularly waterbirds
Wetting flow (anytime)	▸ Avoid/mitigate risks to wetland plants and waterbird habitat from adverse salinity and exposure of acid sulphate sediment ▸ Mimic the natural inundation regime
Partial wetting flow (August–November)	▸ Encourage colonial waterbird breeding ▸ Reduce salinity ▸ Encourage the growth and reproduction of wetland plants, particularly swamp scrub, tall marsh, aquatic herbland and brackish herbland ▸ Provide feeding and breeding habitat for wetland fauna, particularly waterbirds and frogs

Figure 2.2.3 Potential environmental watering in the lower Latrobe wetlands



Note: This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Scenario planning

Table 2.2.5 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

It is expected that the primary objective for substantial drawdowns will be achievable under drought or dry scenarios and partial drawdown will be achieved under an average scenario. Natural conditions are very influential in the Latrobe wetlands. If conditions are wet, the ability to manage drawdown is diminished and uncontrolled flows will provide widespread inundation throughout the year.

Under these conditions, it is unlikely that environmental water will be required to contribute to wetting flows, as they will be achieved naturally.

The approach to achieve the objectives in 2015–16 is to allow water levels to fluctuate according to seasonal conditions, and to selectively undertake environmental watering and drawdown to augment this if required and when feasible.

Wetting flows may be delivered in the event that some inundation is needed to achieve the objectives (such as mitigating the risks associated with increasing salinity and acid sulphate soils and to provide habitat for waterbirds).

Royal spoonbill at Dowd Morass, by West Gippsland CMA

Table 2.2.5 Potential environmental watering for the lower Latrobe wetlands under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected catchment conditions	▸ No natural flows from the Latrobe River ▸ Wetlands are likely to dry completely		▸ Moderate winter and spring flows and flushing flows ▸ Wetlands could be filled or partially filled with a minor drawdown in summer	▸ Major flows in winter/spring and possibly autumn/winter ▸ Wetlands will be filled naturally with very little drawdown over summer
Sale Common				
Potential environmental watering	▸ Complete drawdown (July–June) ▸ Wetting flow (anytime)	▸ Complete drawdown (August–April) ▸ Wetting flow (February–May) ▸ Wetting flow (anytime)	▸ Complete drawdown (August–March) ▸ Wetting flow (February–May) ▸ Wetting flow (August–November) ▸ Wetting flow (anytime)	▸ Flushing/wetting flow (August–November) ▸ Partial drawdown (December–March) ▸ Wetting flow (February–May) ▸ Wetting flow (anytime)
Possible volume of environmental water required to achieve objectives	▸ 0–1,300 ML	▸ 0–1,300 ML	▸ 1,300 ML	▸ 0 ML
Dowd Morass				
Potential watering actions	▸ Complete drawdown (July–June) ▸ Wetting flow (anytime)	▸ Substantial drawdown (August–April) ▸ Wetting flow (February– May) ▸ Wetting flow (anytime)	▸ Substantial drawdown (August–March) ▸ Wetting flow (February–May) ▸ Wetting flow (August–November) ▸ Wetting flow (anytime)	▸ Flushing/wetting flow (August–November) ▸ Partial drawdown (December–March) ▸ Wetting flow (February–May) ▸ Wetting flow (anytime)
Possible volume of environmental water required to achieve objectives	▸ 0–5,800 ML	▸ 0–5,800 ML	▸ 5,800 ML	▸ 0 ML
Heart Morass				
Potential watering actions	▸ Complete drawdown (July–June) ▸ Wetting flow (anytime)	▸ Substantial drawdown (August–April) ▸ Wetting flow (February–May) ▸ Wetting flow (anytime)	▸ Substantial drawdown (August–March) ▸ Wetting flow (February–May) ▸ Wetting flow (August–November) ▸ Wetting flow (anytime)	▸ Flushing/wetting flow (August–November) ▸ Partial drawdown (December–March) ▸ Wetting flow (February–May) ▸ Wetting flow (anytime)
Possible volume of environmental water required to achieve objectives	▸ 0–7,100 ML	▸ 0–7,100 ML	▸ 7,100 ML	▸ 0 ML

Risk management

In preparing its seasonal watering proposal, West Gippsland CMA considered and assessed risks, and identified mitigating strategies, relating to implementing environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

2.3 Thomson system

Waterway manager – West Gippsland Catchment Management Authority

Storage managers – Melbourne Water (Thomson Reservoir), Southern Rural Water (Cowarr Weir)

Environmental water holder – Victorian Environmental Water Holder

Environmental values

The Thomson River contains an abundant and diverse native fish population with seven species of migratory fish including the protected Australian grayling, short-finned eel and common galaxia.

Vegetation is intact and near-natural upstream of Thomson Dam in the Baw Baw National Park. Riparian vegetation upstream of Cowarr Weir is mostly in good condition, but infestations of blackberry and gorse are increasing. Downstream of the Cowarr Weir, the vegetation is threatened and degraded due to stock access and widespread weed invasions.

Social and economic values

The Thomson River between Thomson Reservoir and Cowarr Weir is a designated canoeing river. During high-flow releases, canoeists and kayakers benefit from improved conditions for paddling. West Gippsland CMA provides flow information to groups before releases so they can take advantage of the increased flows. Popular angling species (including Australian bass) have been introduced to the Thomson River. The waterways in the Thomson system (including the Thomson River) continue to hold significance for Traditional Owners. Waterways and wetlands in the region are important ceremonial places and for thousands of years the Thomson River has provided resources such as food and materials to the Gunaikurnai people.

Environmental watering objectives in the Thomson system
Protect and boost populations of native fish, specifically Australian grayling, by providing pool habitat and flows for fish to move upstream and downstream, and by encouraging fish to spawn (release eggs)
Scour silt build-up within the river bed to provide increased and diverse habitat for plants and animals to colonise
Provide water to for plant life to germinate, establish and grow on the river bank

System overview

The Thomson River flows from the slopes of Mt Whitelaw on the Baw Baw Plateau to join the Latrobe River south of Sale. The major tributaries of the Thomson River are the Aberfeldy, Jordan and Macalister rivers, with most of its unregulated flows originating from the Aberfeldy River. There are two major structures on the Thomson River: the Thomson Reservoir and Cowarr Weir.

Two sections of the Thomson River (which are upstream of Cowarr Weir) as well as the Aberfeldy River in the Baw Baw National Park are listed as heritage rivers for their significant environmental, recreational and cultural values.

Environmental water in the Thomson system is held in Thomson Reservoir, which is also the largest storage used for urban water supply for Melbourne. The Thomson Reservoir also supplies downstream irrigation districts.

The priority river reach for environmental watering in the Thomson system is from the Aberfeldy River confluence to Cowarr Weir (reach 3) due to its heritage river status, native riparian vegetation and fish populations. The measurement point for flows is at the Coopers Creek streamflow gauge.

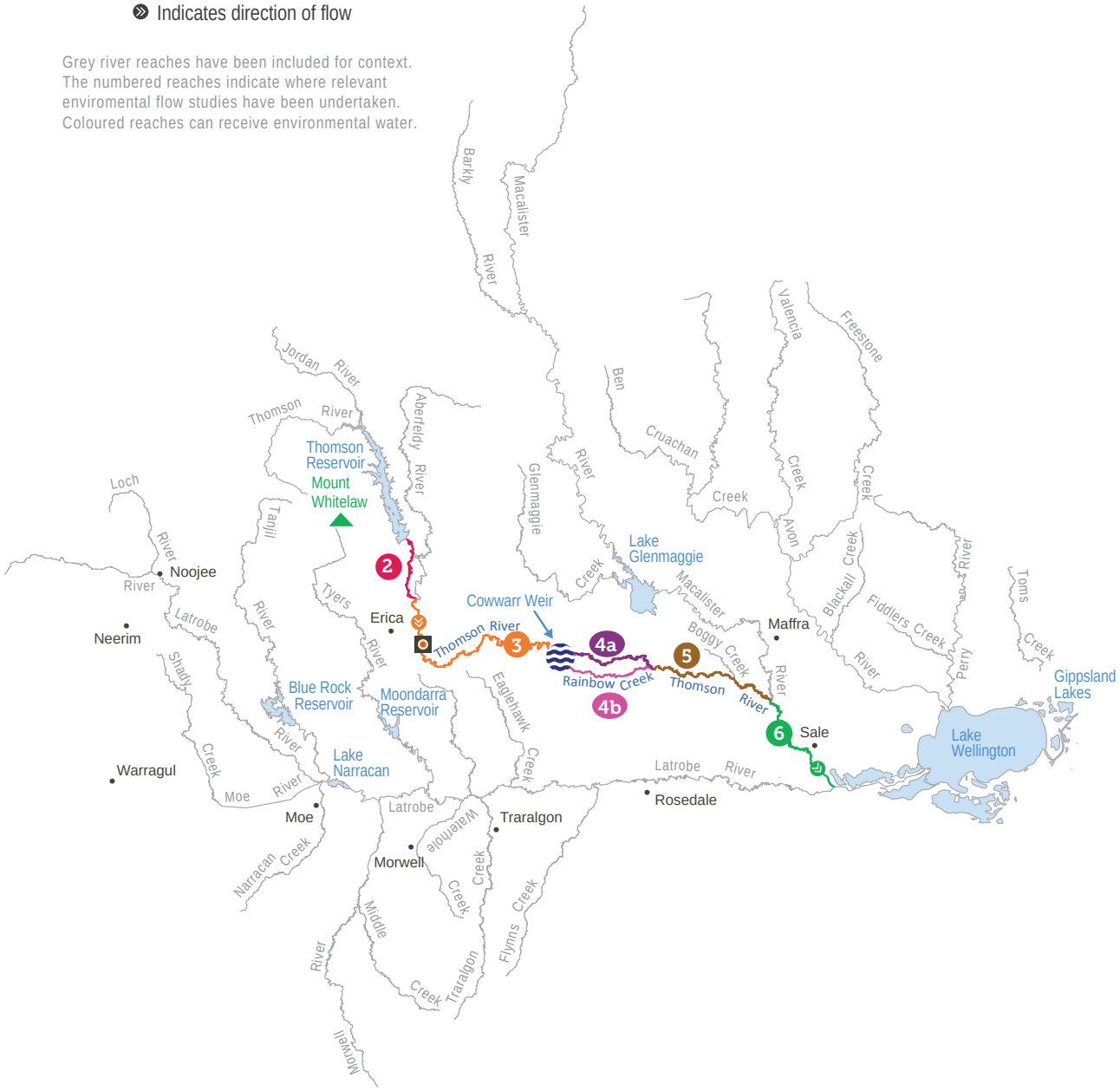
At Cowarr Weir, the Thomson River splits in two and water can move down the old Thomson course (reach 4a) and Rainbow Creek (reach 4b). The preference is to pass environmental water down the old Thomson course to enable fish migration, as Cowarr Weir prevents migration through the Rainbow Creek course.

Thomson River, by West Gippsland CMA

Figure 2.3.1 The Thomson system

Reach 2 Thomson River: Thomson Dam to Aberfeldy River
Reach 3 Thomson River: Aberfeldy River to Cowwarr Weir
Reach 4a Old Thomson River: Cowwarr Weir to Rainbow Creek
Reach 4b Rainbow Creek: Cowwarr Weir to Thomson River
Reach 5 Thomson River: Rainbow Creek/Old Thomson confluence to Macalister River
Reach 6 Thomson River: Macalister River to Latrobe River
Water infrastructure
Measurement point
Town
Indicates direction of flow

Grey river reaches have been included for context. The numbered reaches indicate where relevant enviromental flow studies have been undertaken. Coloured reaches can receive environmental water.



Recent conditions

In 2014–15 the Thomson River catchment received average-to-above-average rainfall throughout winter and spring, followed by a dry summer which resulted in high irrigation releases.

In recent years, environmental watering has focused on promoting migration and spawning of Australian grayling in autumn, by providing baseflows and freshes. However, spring flows that trigger the return of juvenile Australian grayling to upstream reaches have been absent since 2010–11. A spring fresh was provided using environmental water for the first time in 2014–15, in addition to the migration and spawning flows.

Monitoring in 2014 detected Australian grayling spawning activity, corresponding to the release of an autumn fresh in the Thomson River. Monitoring has also tracked the downstream migration of Australian grayling during the autumn fresh, indicating that the delivery of environmental water was successful in providing a trigger for the fish to migrate and spawn.

Vegetation surveys have identified natural recruitment of some native shrubs and trees among patches of remnant vegetation on the river bank. Waterway rehabilitation work to protect and restore riparian zones is undertaken to complement environmental watering outcomes.

Scope of environmental watering

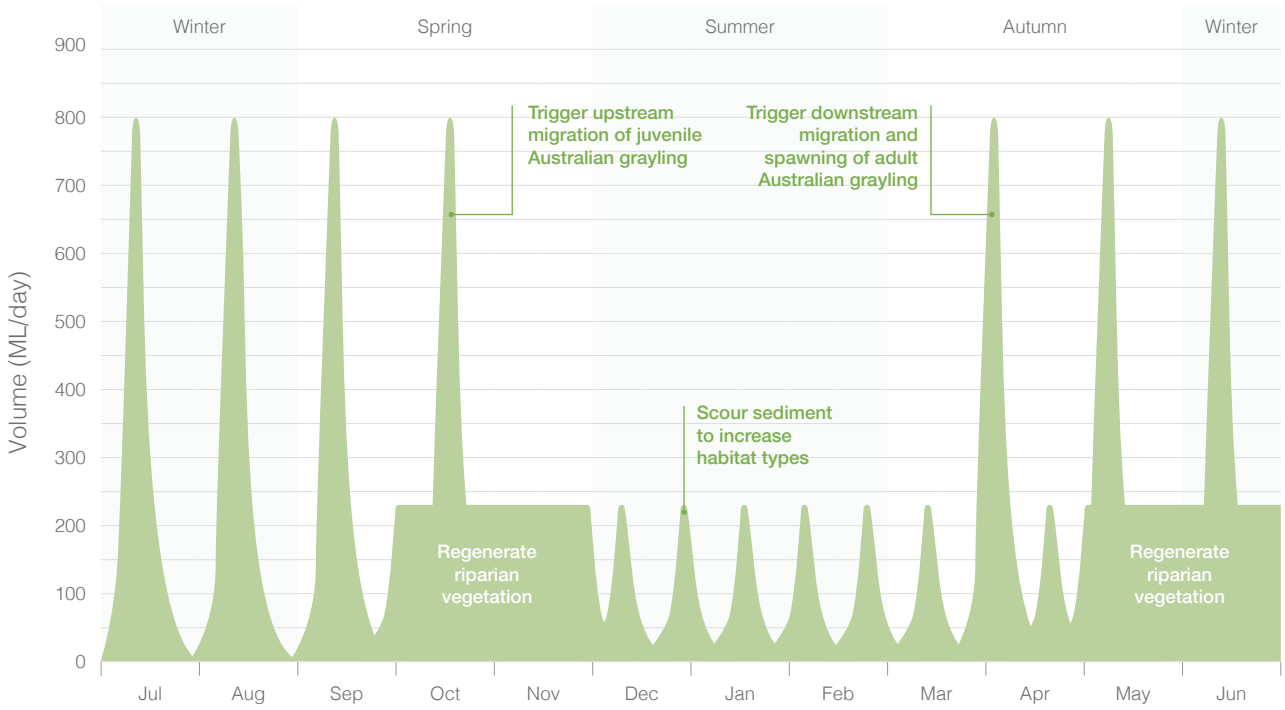
Potential environmental watering actions and their environmental objectives are explained in Table 2.3.1 and illustrated in Figure 2.3.2.

Table 2.3.1 Potential environmental watering actions and objectives for the Thomson River

Potential watering actions	Environmental objectives
Autumn freshes (1–2 freshes of 800 ML/day for 4 days each during April–May)	▸ Maintain/enhance native fish community structure by providing a migration and spawning cue for Australia grayling and other aquatic species ▸ Regeneration and inundation of riparian vegetation ▸ Sediment scour exposing fresh habitat areas
Autumn/winter baseflows (230 ML/day from May–June)	
Spring freshes (1–2 freshes of 800 ML/day for 4 days each during September–October)	▸ Maintain/enhance native fish community structure by providing habitat availability, large woody debris inundation and fish migration cues for juvenile Australian grayling ▸ Regenerate and inundate riparian vegetation ▸ Sediment scour exposing fresh habitat areas
Spring baseflows (230 ML/day from October–November)	
Summer/autumn freshes (up to 7 freshes of 230 ML/day for 4 days during December–April)[1]	▸ Maintain/enhance native fish community structure by providing habitat availability, large woody debris inundation ▸ Regenerate and inundate riparian vegetation ▸ Sediment scour exposing fresh habitat areas
Winter freshes (up to 4 freshes of 800 ML/day for 4 days during June–August)	▸ Maintain/enhance native fish community structure by providing opportunities for localised fish movement between habitats

1 Whilst this flow component is a priority in the Thomson system, it is unlikely that sufficient environmental water will be available to meet this demand, and therefore these freshes will only be achieved through natural events.

Figure 2.3.2 Potential environmental watering in the Thomson River reach 3



Note: This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Scenario planning

Table 2.3.2 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

Due to the short (2–3 years) lifespan of Australian grayling, regular spawning and the provision of flows to promote recruitment are critical to sustain a viable population. These flows have been achieved regularly in the last five years. This means, under a drought scenario, there is less urgency to provide a spawning flow release for Australian grayling, with releases focusing on the delivery of baseflows and reserving water through carryover to support the delivery of spawning flows in the following year.

Spring and summer flow components are important for providing habitat and encouraging the upstream migration of juvenile Australian grayling. The ability to deliver these flows depends on water availability as autumn freshes and baseflows are the highest priority. Under wetter scenarios, water will be used for all flow components to maximise opportunities for the upstream migration and spawning of Australian grayling, increasing the amount of environmental water required to achieve these objectives.

Critical carryover under drought and dry scenarios has been identified in the Thomson system to ensure baseflows and freshes can be delivered in 2016–17 for Australian grayling, particularly if the flows are not provided in 2015–16.

Table 2.3.2 Potential environmental watering for the Thomson River under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	▸ Unregulated flows very limited ▸ Large volumes of consumptive water released from storage	▸ Unregulated flows from the Aberfeldy River and other tributaries contribute to baseflows and freshes ▸ Moderate volumes of consumptive water released from storage	▸ Unregulated flows from the Aberfeldy River and other tributaries contribute to baseflows, freshes and high flows ▸ Some consumptive water released from storage	▸ Unregulated flows from the Aberfeldy River and other tributaries contribute to baseflows, freshes and sustained high-flows ▸ Possible spills from Thomson Reservoir and minimal consumptive water released from storage
Expected availability of environmental water[1]	▸ 10,000–12,000 ML	▸ 10,000–14,000 ML	▸ 10,000–18,000 ML	▸ 18,000 ML
Potential environmental watering	▸ Spring and autumn baseflows	▸ 1 autumn fresh ▸ Spring and autumn baseflows	▸ 1 autumn fresh ▸ Spring and autumn baseflows ▸ 2 spring freshes	▸ 1 autumn fresh ▸ Spring and autumn baseflows ▸ 2 spring freshes ▸ 1 winter fresh
Possible volume of environmental water required to achieve objectives	▸ 5,600 ML	▸ 10,500 ML	▸ 18,000 ML	▸ 23,000 ML
Critical carryover into 2016–17	▸ 6,400 ML	▸ 3,500 ML	▸ 0 ML	▸ 0 ML

1 The first 10,000 ML of Thomson Reservoir inflows is allocated to the environment at the beginning of the water year. An additional 8,000 ML may be available in the system, subject to an entitlement amendment being completed to facilitate its use.

Risk management

In preparing its seasonal watering proposal, West Gippsland CMA considered and assessed risks, and identified mitigating strategies, relating to implementing environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Engagement

West Gippsland CMA consulted key stakeholders when preparing the seasonal watering proposal for the Thomson system. Table 2.3.3 shows these stakeholders.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 2.3.3 Key stakeholders engaged in the development of the Thomson River seasonal watering proposal

Stakeholder engagement
▸ Southern Rural Water ▸ Melbourne Water ▸ Victorian Environmental Water Holder

2.4 Macalister system

Waterway manager – West Gippsland Catchment Management Authority

Storage manager – Southern Rural Water

Environmental water holder – Victorian Environmental Water Holder

Environmental values

Native fish are the main focus in the Macalister system. There are six species of migratory native fish in the Macalister River that must move between freshwater and marine environments to complete their life cycle. Australian grayling is a vulnerable fish species and a high priority for environmental water actions. Other migratory fish in the Macalister system include short- and long-finned eel, tupong and common galaxia. River blackfish and small-bodied fish (such as flat-headed gudgeon and southern pygmy perch) are also present.

The Macalister River contains some areas of dense woody riparian vegetation dominated by shrubs. In areas where stock exclusion has been undertaken, vegetation is in good condition but it is degraded in other sections. The distribution of non-woody plants that colonise the fringes of the river (such as reeds, sedges and rushes) appears to have reduced in recent years. The same can be said for instream aquatic vegetation. Environmental watering aims to assist with the recovery of these vegetation types, to improve habitat and biodiversity.

Social and economic values

The Macalister Irrigation District is the major economic driver in the area and water from the Macalister system is highly valued by the community. As a result, there is a genuine interest in the health of the Macalister River, particularly in relation to water quality, erosion and vegetation condition. The waterways in the Macalister system (including the Macalister River) continue to hold significance for Traditional Owners. Waterways and wetlands in the region are important ceremonial places and for thousands of years the Macalister River has provided resources such as food and materials to the Gunaikurnai people.

Environmental watering objectives in the Macalister system
Protect and boost populations of native fish (including Australian grayling, river blackfish and short-finned eel) prompting fish to move upstream and downstream and between the river and the ocean, and to spawn (release eggs)
Enable plants to germinate, establish and grow on the river bank
Restore communities of waterbugs, which break down organic matter, provide a source of food for other animals and support the river's food chain

System overview

The Macalister River extends from Mt Howitt in the Alpine National Park to join the Thomson River south of Maffra. The major storage on the Macalister River is Lake Glenmaggie, which supplies water to the Macalister Irrigation District. Lake Glenmaggie also stores water for the Macalister environmental entitlement, so environmental water can only be actively managed downstream of this storage.

Downstream from Lake Glenmaggie, the Macalister River meanders through an extensively cleared floodplain to the confluence with the Thomson River. The major land use in this section is dairy farming on pastures.

Before the operation of the Macalister Irrigation District, the Macalister River would regularly receive large floods in winter and spring. These are now rare. A notable impact is reversed seasonality, with high and sustained flows now occurring in summer rather than winter. The changed hydrology affects the migration patterns of fish as well as growth and dispersal opportunities for aquatic and riparian plants.

Maffra Weir is a major human-made barrier that prevents fish migrating to reach 1 during the irrigation season from August to May. Due to the obstruction caused by Maffra Weir, the priority reach for environmental water releases is downstream from Maffra Weir to the confluence with the Thomson River (reach 2). The measurement point for environmental water releases is at Maffra Weir.

Recent conditions

Rainfall and inflows in the Macalister River catchment in 2014–15 were not typical. Inflows were low during winter and spring, but recovered with higher rainfall in summer. At the beginning of autumn conditions turned dry once again, with March inflows to Lake Glenmaggie just 15 percent of the long-term average. Inflows to Lake Glenmaggie had improved sufficiently by mid-late autumn for late-season allocations of low-reliability entitlements to occur, increasing water availability.

Figure 2.4.1 The Macalister system

Winter baseflows in July 2014 were provided using water carried over from 2013–14. Delivery of autumn freshes and baseflows occurred in April to June 2015. These releases were made with the objective of restoring populations of native fish including Australian grayling.

Monitoring in 2014 showed that the abundance of adult Australian grayling was the highest since annual surveys started in 2005. Australian grayling spawning also occurred, with eggs detected during monitoring activities.

Environmental watering in the Thomson and Macalister rivers was coordinated to increase opportunities for Australian grayling to spawn, and these findings reinforce the well-known relationship between autumn high flows and the spawning success of Australian grayling.

Scope of environmental watering

Potential environmental watering actions and their environmental objectives are explained in Table 2.4.1 and illustrated in Figure 2.4.2.

Table 2.4.1 Potential environmental watering actions and objectives for the Macalister River

Potential environmental watering	Environmental objectives
Autumn freshes (1–2 freshes of 350 ML/day for 7 days each during April–May)	▸ Restore and maintain self-sustaining populations of Australian grayling, long-finned eel and river blackfish ▸ Rehabilitate native riparian vegetation ▸ Rehabilitate the macroinvertebrate community ▸ Maintain the water quality in pools
Autumn/winter baseflows (140 ML/day during May–July)	
Spring baseflows (140 ML/day during October–November)	
Summer fresh (1 fresh of 350 ML/day for 7 days each during December–February)	

Scenario planning

Table 2.4.2 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

Autumn freshes and autumn/winter baseflows are the highest priority watering actions under all scenarios, except drought, when freshes are not planned to be delivered. Autumn freshes for Australian grayling have been delivered consistently in recent years and therefore are not critical in a drought scenario in 2015–16. Autumn/winter flows are most impacted by the filling of Lake Glenmaggie at that time of year, particularly under dry conditions, and are important to increase native fish populations.

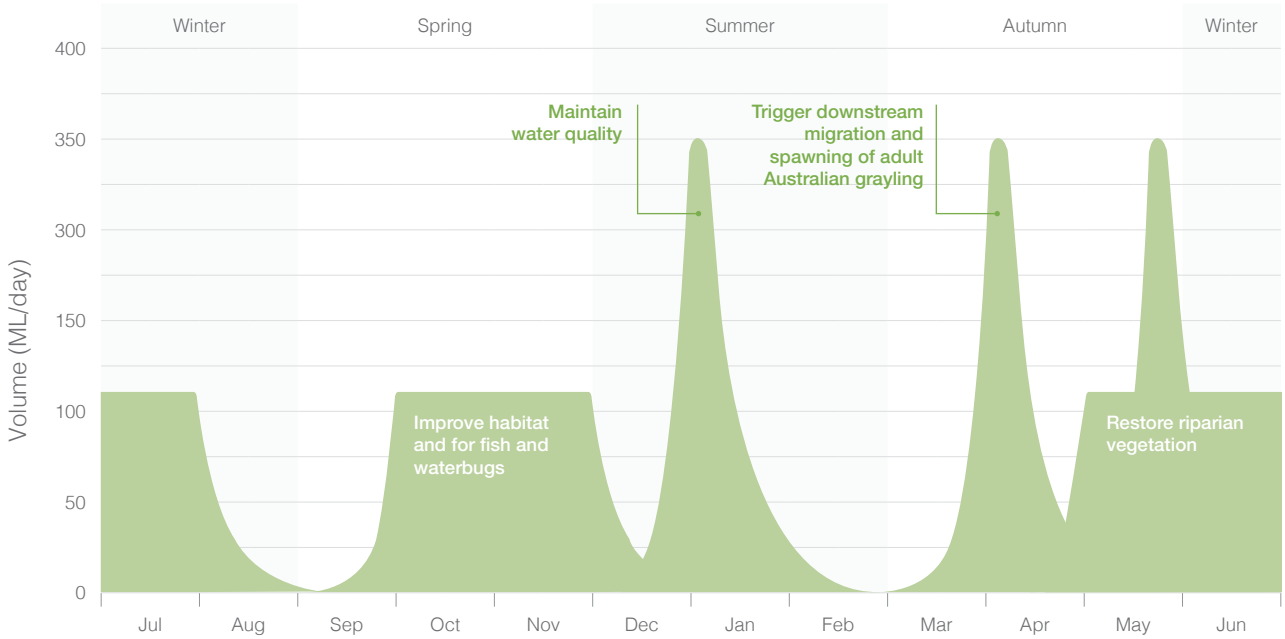
Under average and wet conditions, there is scope to provide summer freshes and spring baseflows, which have not previously been actively managed in the system. Under these scenarios, it is expected that irrigation demand will be low and therefore these flows will not be met by the delivery of consumptive use water to downstream users. If conditions are suitable, passing flows will be reduced during summer and accrued to support the delivery of autumn freshes. Environmental water releases during the irrigation season are challenging, with flexibility being critical to balance irrigation and environmental demands, and optimise the use of all water in the system to achieve objectives.

Environmental water demands increase as potential watering actions change from drought to wet scenarios. Lake Glenmaggie is a small storage in relation to its inflows and regularly spills, so some loss of water carried over from 2014–15 to spills is expected.

Risk management

In preparing its seasonal watering proposal, West Gippsland CMA considered and assessed risks, and identified mitigating strategies, relating to implementing environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Figure 2.4.2 Potential environmental watering in the Macalister River reach 2



Note: This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Table 2.4.2 Potential environmental watering for the Macalister River system under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	▸ No unregulated flows ▸ Passing flows at Maffra Weir reduced	▸ Possible spills from Lake Glenmaggie in spring, minor flood levels may occur ▸ Passing flows at Maffra Weir may be reduced	▸ Regular spills from Lake Glenmaggie in spring, minor flood levels may occur ▸ Passing flows at Maffra Weir may be reduced, with savings accrued during summer for use during autumn	▸ Large and frequent spills from Lake Glenmaggie, moderate to major flood levels may occur ▸ Passing flows at Maffra Weir may be reduced, with savings accrued during summer for use during autumn
Expected availability of environmental water	▸ 12,200 ML	▸ 15,900 ML	▸ 20,500 ML	▸ 25,300 ML
Potential environmental watering	▸ Autumn/winter baseflows	▸ 2 autumn freshes ▸ Autumn/winter baseflows	▸ 1 autumn fresh ▸ Autumn/winter baseflows ▸ 1 summer fresh ▸ Spring baseflows	▸ 2 autumn freshes ▸ Autumn/winter baseflows ▸ 1 summer fresh ▸ Spring baseflows
Possible volume of environmental water required to meet objectives	▸ 7,500 ML	▸ 12,000	▸ 18,200 ML	▸ 20,800 ML

Engagement

West Gippsland CMA consulted key stakeholders when preparing the seasonal watering proposal for the Macalister system. Table 2.4.3 shows these stakeholders.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 2.4.3 Key stakeholders engaged in the development of the Macalister River seasonal watering proposal

Stakeholder engagement
▸ Southern Rural Water ▸ Victorian Environmental Water Holder

Macalister River, by West Gippsland CMA

2.5 Snowy system

Waterway managers – New South Wales Office of Water and East Gippsland Catchment Management Authority

Storage manager – Snowy Hydro Limited

Environmental values

The lower reaches of the Snowy River in Victoria (including the floodplain wetlands and river estuary) provide a diverse range of habitats for endangered plants and animals as well as feeding and breeding areas for migratory birds.

Over time, managed releases will improve ecosystem function, by promoting the scouring of fine sediment to improve instream habitat, flushing leaf litter and other material into the river to increase productivity and stimulate the food chain, mixing of pools in the upper reaches, and improving the salinity dynamics in the Snowy Estuary. By repairing these functions, it is hoped that the river will be able to support healthier aquatic communities, such as bacteria, plants, water bugs, fish and platypuses.

Social and economic values

The Snowy River is a renowned rafting and canoeing river and is ideally situated for bushwalking in the Snowy River National Park. Recreational fishing for native species (such as Australian bass) is also popular. The Snowy River is an iconic and culturally significant Australian river made famous by Banjo Patterson's poem *The Man from Snowy River*. The waterways of the Snowy system continue to hold significance for Traditional Owners and their Nations in the region.

System overview

The Snowy River originates on the slopes of Mount Kosciuszko and drains the eastern slopes of the Snowy Mountains in New South Wales before flowing through the Snowy River National Park in Victoria and emptying into Bass Strait.

The Snowy Mountains Hydro-electric Scheme was constructed in the Snowy Mountains in New South Wales between 1949 and 1974. The scheme resulted in the construction of four major dams (Guthega, Island Bend, Eucumbene and Jindabyne) and multiple diversion weirs in the Snowy River catchment. The scheme diverts water to the Murrumbidgee and River Murray valleys and resulted in the diversion of 99 percent of the Snowy River's mean annual natural flow (MANF) at Jindabyne until 2002. The relative hydrological effects of the construction of the scheme decrease along the course of the Snowy River with reductions in MANF to about 65 percent in the lower Snowy River. This difference is mainly due to the contribution to streamflow by the tributaries downstream of Dalgety.

While being essential for electricity generation and irrigation supply, flow diversion and other activities have affected all aspects of the river's hydrology and resulted in a deterioration in the health of the Snowy River and its tributaries in the Snowy Mountains.

The New South Wales, Victorian and Commonwealth governments have completed water recovery projects to attribute water to three environmental water release programs associated with the scheme:

- Snowy River Increased Flows (up to 212,000 ML per year)
- Snowy Montane River Increased Flows (150 gigawatt hours of foregone electricity generation equivalent of up to 117,800 ML per year)
- River Murray Increased Flows (70,000 ML per year).

The Victorian entitlements are held by the VEWH in trust for the Snowy River Increased Flows program partners.

A substitution arrangement is in place for VEWH Water Holdings in the Murray, Loddon and Goulburn systems to increase environmental flows in the Snowy system. Water savings in the Murray, Loddon and Goulburn systems provide additional water that can be supplied for consumptive use in northern Victoria. Similar arrangements apply for the New South Wales Murray and Murrumbidgee systems. This reduces the volume of water that must be supplied from the Snowy system to the Murray and Murrumbidgee rivers, thereby freeing up water for environmental flows in the Snowy.

Recent conditions

Daily flow targets are set on an annual basis to occur from May to April each water year in New South Wales. These daily flow targets are designed to maximise the environmental outcomes to the Snowy River using the available water for the year. The New South Wales Office of Water develops the daily flow targets and the Victorian and Australian governments and stakeholder groups are consulted about environmental water released to the Snowy River.

During the 2014–15 water year, 155,308 ML of water was released to the Snowy River in line with the daily flow targets. The releases aim to facilitate the rehabilitation of the Snowy River below Jindabyne Dam into a smaller but healthy river, recognising that it is not possible to restore or maintain the Snowy River to its former size with one-fifth of its former flow volume.

Scope of environmental watering

Environmental water releases occur every day during May 2015 to April 2016 and aim to mimic the typical flow pattern of a mixed snowmelt/rainfall river system

Figure 2.5.1 The Snowy system

characteristic of the Snowy Mountains. The flow regime provides hourly, daily, seasonal and annual flow variability within the bounds of a natural but smaller Snowy Montane river.

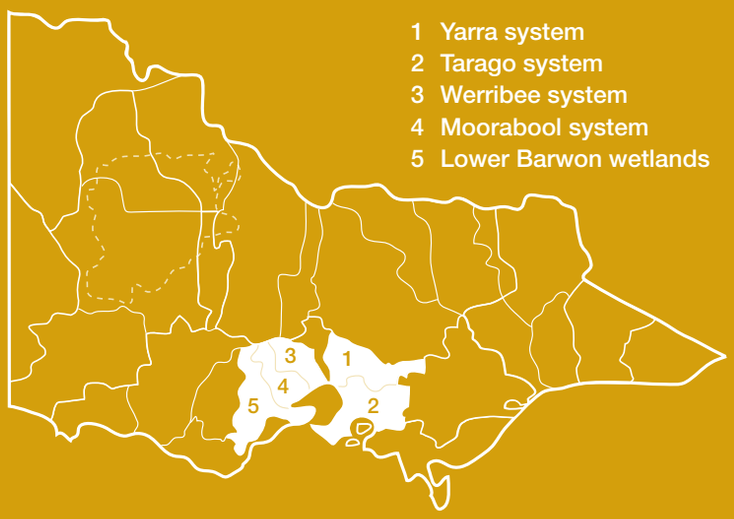
Five high flows are scheduled in winter/spring 2015. The larger flushing flow is scheduled for late October 2015 and includes an eight-hour peak of over 7,500 ML per day. This high-flow peak aims to improve the physical attributes of the river by scouring sediment and limiting the growth of riparian plants that can block the river channel.

High flows are sustained from July to December to assist with water mixing in the estuary for the benefit of plants and fish (such as Australian bass and estuary perch). Low flows will then continue to be released until the completion of the water year in April 2016.

The total annual volume planned for release in 2015–16 is 147,741 ML.

Section 3

Central Region



1 Yarra system
2 Tarago system
3 Werribee system
4 Moorabool system
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3.1 Central Region overview

There are five systems that can receive environmental water in the Central Region of Victoria – the Yarra and Tarago systems in the east and the Werribee, Moorabool and Barwon (lower Barwon wetlands) systems in the west.

These waterways provide drinking water to Melbourne and surrounding towns and cities and support a range of activities including walking, cycling, fishing and camping, as well as areas of irrigated agriculture. Platypuses and fish are two examples of animals that attract community interest to the health of the waterways.

Environmental water is held in storage and delivered to support the plants and animals that live in and along the rivers. There is some interconnectedness between systems in the region, and there are therefore opportunities to move water between systems through trade or substitution. Although moving water between systems is possible, most environmental water in these systems is prioritised to provide benefits in the river below the storages in which the water is held. With the west of Melbourne generally drier than the east, quite different conditions can exist between river systems within the Central Region at the same time.

Seasonal outlook 2015–16

Some entitlements, such as in the Yarra system, are more reliable than others, providing greater certainty of water availability irrespective of catchment conditions. However, systems in the west (such as the Werribee and Moorabool) rely on inflows and dry conditions will result in a lower water availability in these systems. With most inflows into storages occurring in winter and spring, the likely water availability in these systems should be evident early in 2015–16.

If dry conditions prevail throughout 2015–16, carryover from 2014–15 will provide an important source of water to meet environmental demands, as allocations in some systems may be low. Under dry conditions, environmental water deliveries will focus on maintaining water quality and protecting habitat for fish and other water-dependent species, particularly during the summer/autumn period. If conditions improve, environmental releases will also seek to provide flows that help to trigger migration, and in some cases spawning, of native fish. Opportunities to optimise the use of environmental water within the region, and between regions, may be considered through trade.

Tarago River fresh, by Sarah Gaskill

3.2 Yarra system

Waterway manager – Melbourne Water

Storage manager – Melbourne Water

Environmental water holder – Victorian Environmental Water Holder

Environmental values

The Yarra River supports many important environmental values including terrestrial and aquatic vegetation, billabongs, birds, frogs, platypuses and several nationally significant native fish species (such as the Australian grayling and the Macquarie perch).

The upper system (reaches 1–3) provides habitat for a range of native fish species including river blackfish, spotted galaxias and common galaxias and contains good-quality riparian and aquatic vegetation. The lower system (reaches 4–6) contains Australian grayling, Macquarie perch and tupong.

There are several billabongs in the Yarra system which are an important feature of the Yarra River floodplain downstream of Millgrove. The billabongs support a variety of distinct vegetation communities, providing foraging and breeding habitat for waterbirds and frogs. Except in very high flows, the billabongs are disconnected from the Yarra River.

Social and economic values

The upper reaches of the Yarra River are an important water supply catchment, supplying up to 70 percent of Melbourne's drinking water. There are more than four million people who live in and travel to Greater Melbourne and the river provides social and recreational opportunities such as swimming and kayaking, as well as aesthetic appeal for walkers and cyclists. The waterways of the Yarra system (including the Yarra River) continue to hold significance for Traditional Owners and their Nations in the region.

Environmental watering objectives in the Yarra system
Rebuild, strengthen and maintain plant life on the river bank and in the channel, as well as on the upper Yarra floodplains and in the river's billabongs
Protect and boost populations of native fish including threatened species (such as Australian grayling and Macquarie perch)
Maintain the form of the river bank and bed Scour silt build-up and clean cobbles in the river to ensure fish, platypuses and other water animals have healthy habitat pools and places to shelter
Restore communities of waterbugs, which provide energy, break down dead organic matter and support the river's food chain
Boost water quality in river pools, ensuring there is plenty of dissolved oxygen in the water to support water animals and bugs

System overview

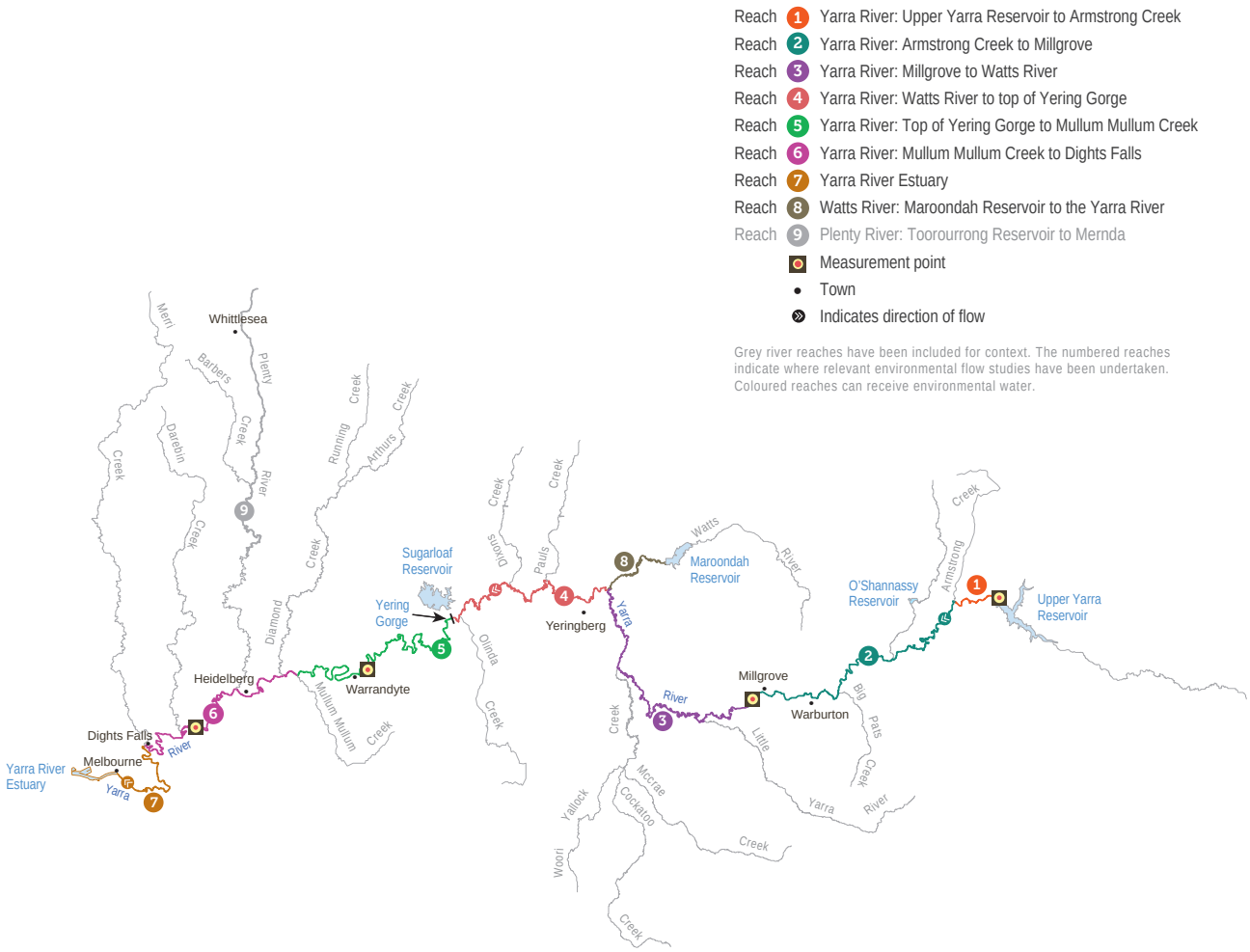
Flows through the Yarra system have become highly regulated due to the construction of water storages that capture natural runoff and allow the controlled release of water for consumptive uses. Over time, the lower Yarra River has been straightened, widened and cleared of natural debris as Melbourne grew around its banks, with the earliest alterations to its course occurring as far back as 1879. Environmental watering aims to reinstate flows that support ecological outcomes throughout the length of the system.

Environmental water can be released from the Upper Yarra, Maroondah and O'Shannassy reservoirs. Priority reaches for environmental watering are reaches 2 and 5, as delivery of water to these reaches is expected to achieve flow targets in neighbouring reaches. The environmental flow reaches in the Yarra system are shown in Figure 3.2.1. In the upper reaches, the system is influenced by tributaries such as the Woori Yallock Creek, Watts River and Little Yarra River. In the lower reaches, urbanised tributaries such as Diamond Creek, Plenty River and Merri Creek provide additional water to the Yarra River.

Recent conditions

2014–15 began with a wet winter that resulted in high storage volumes. This was followed by a very dry spring, with streamflows dropping to below-forecast levels expected under a dry scenario. The dry conditions persisted in the Yarra system into summer and early autumn.

Figure 3.2.1 The Yarra system



Year-round low flows were largely met by passing flows, except during spring in reach 2 where the lack of natural runoff resulted in flows fluctuating above and below the ideal minimum flow over the three months. Unregulated flows resulted in the natural achievement of winter/spring freshes, however the spring high-flow event that supports Macquarie perch spawning peaked below the target of 2,500 ML (reaching 2,074 ML). This was a result of the dry spring conditions and lack of forecast rain, meaning releases from storages alone were insufficient to meet the target. Despite this, preliminary monitoring has shown that Macquarie perch in the Yarra system did have a successful recruitment season in 2014.

Summer/autumn freshes were delivered to maintain water quality and fish habitat during the dry summer, with an autumn fresh for grayling spawning delivered in May 2015.

It is expected that the recent dry conditions in the Yarra system will continue into 2015-16, with average or below-average streamflows.

Scope of environmental watering

Potential environmental watering actions and their environmental objectives are explained in Table 3.2.1 and illustrated in Figure 3.2.2.

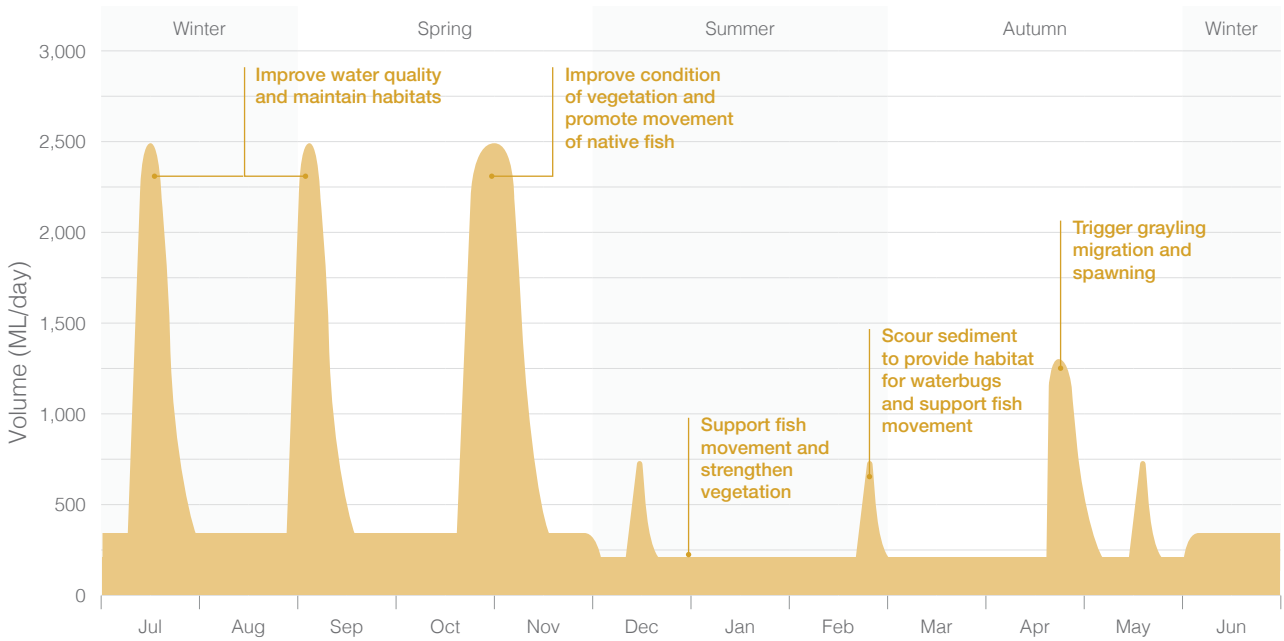
Yarra River at Warburton, by Melbourne Water

Table 3.2.1 Potential environmental watering actions and objectives for the Yarra system

Potential environmental watering[1]	Environmental objectives
Year-round low flows[2] (varying rates from 10–>350 ML/day during December–May)	▸ Provide sufficient access to riffle habitat ▸ Allow river bank vegetation to dry ▸ Limit the growth of fringing/riparian/terrestrial vegetation into the stream channel ▸ Maintain and/or rehabilitate instream vegetation
Summer/autumn freshes (2–5 freshes of varying rates between 60–750 ML/day for 2–4 days each during December–May)	▸ Maintain habitat by scouring sediments and cleaning cobbles in faster-flowing areas ▸ Provide suitable habitat and migration opportunities for native fish ▸ Promote flood-tolerant vegetation ▸ Improve water quality in pools
Autumn high flows (1 high flow of varying rates between 560–1,300 ML/day for 7–14 days during April–May)	▸ Stimulate Australian grayling spawning
Targeted billabong watering	▸ Support native vegetation and improve habitat availability for wetland flora and fauna
Winter/spring freshes (2–3 [or more] freshes of varying rates between 100–2,500 ML/day for at least 2–7 days during June–November)	▸ Maintain habitat by scouring sediments and cleaning cobbles in faster-flowing areas ▸ Promote flood-tolerant vegetation ▸ Provide suitable habitat and migration opportunities for native fish ▸ Improve water quality in pools
Spring high flow (1 high flow of 700–2,500 ML/day for 14 days during October–November)[3]	▸ Maintain riffle habitat by scouring sediments and cleaning cobbles ▸ Promote flood tolerant vegetation growth ▸ Promote migration of native fish and spawning of Macquarie perch

1 The magnitude and duration of potential environmental watering depends on the reach being targeted, with the lower range generally occurring in the upper reaches (for example, reach 1), and higher range in the lower reaches (for example, reach 6).
2 Low flows are generally provided by passing flows under the environmental entitlement but during dry conditions it may be necessary to supplement low flows using environmental water.
3 A spring high flow will only be achieved with significant unregulated flow due to release constraints in the upper reaches of the system. However, ceasing harvesting at Yering during a natural high flow may assist in the desired flow being achieved.

Figure 3.2.2 Potential environmental watering in the Yarra River reach 5



Note: This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Scenario planning

Table 3.2.2 outlines the potential watering and expected water usage under a range of planning scenarios.

Under a dry scenario, low flows and summer/autumn freshes are key watering actions that maintain habitat and water quality. Under average and wet conditions, autumn and spring high-flow events as well as targeted billabong watering may be delivered. These aim to improve conditions for Australian grayling (autumn high flow), support bank vegetation, scour sediment and promote Macquarie perch spawning (spring high flow) and growth of wetland plants in the billabongs.

The volumes of environmental water required to meet objectives under dry and average scenarios are similar, with a slightly reduced requirement under an average scenario due to unregulated flows, which are expected to assist in the delivery of additional watering actions. Under a wet scenario, the environmental water requirement reduces as a result of the increased contribution of unregulated flows.

A minimum of 8,000 ML carryover is required to deliver an autumn high-flow event to support Australian grayling in 2016–17, if not met in 2015–16.

Table 3.2.2 Potential environmental watering for the Yarra system under a range of planning scenarios

Planning scenario	Dry	Average	Wet
Expected river conditions	▸ Low streamflows year round	▸ High winter flows ▸ Unregulated flows may provide some freshes but duration and/or magnitude will likely be less than target flows	▸ High winter and spring flows with good variability ▸ Unregulated flows over summer/autumn will provide freshes and possibly high flows ▸ Some natural inundation of billabongs may occur
Expected availability of environmental water		▸ 14,000 ML carryover ▸ 17,000 ML allocation ▸ 31,000 ML total	
Potential environmental watering	▸ Summer/autumn low flows ▸ Summer/autumn freshes ▸ Winter/spring low flows ▸ Winter/spring freshes	▸ Summer/autumn low flows ▸ Summer/autumn freshes ▸ Winter/spring low flows ▸ Autumn high flow ▸ Targeted billabong watering ▸ Spring high flow ▸ Winter/spring freshes	
Possible volume of environmental water required to achieve objectives	▸ 23,000 ML	▸ 24,000 ML	▸ 14,000 ML
Critical carryover into 2016–17	▸ 8,000 ML		

Risk management

In preparing its seasonal watering proposal, Melbourne Water considered and assessed risks and identified mitigating strategies relating to implementing environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Engagement

Melbourne Water has engaged with key stakeholders and other relevant individuals in preparing the seasonal watering proposal for the Yarra system. These stakeholders are included in Table 3.2.3.

The seasonal watering proposals are informed by longer term plans such as regional waterway strategies and environmental water management plans. These longer term plans incorporate a range of environmental, cultural, social and economic perspectives.

Table 3.2.3 Key stakeholders engaged in the development of the Yarra system seasonal watering proposal for the Yarra system

Stakeholder engagement
▸ Yarra River Environmental Water Advisory Group including representatives of local governments, Native Fish Australia, VR Fish, Environment Victoria, Yarra Valley Water, Melbourne Water and Parks Victoria ▸ Melbourne Water (Water Supply Operations and Integrated Planning) ▸ Victorian Environmental Water Holder

3.3 Tarago system

Waterway manager – Melbourne Water

Storage manager – Melbourne Water

Environmental water holder – Victorian Environmental Water Holder

Environmental values

The Tarago system contains several significant and threatened native plant and animal species including populations of Australian grayling and vegetation species such as long pink-bells, tree geebung and swamp bush-pea. The upper catchment contains healthy riparian vegetation and instream habitat diversity, supporting native fish including river blackfish and mountain galaxias. While the lower catchment has been highly modified, it contains good patches of remnant vegetation, and healthy populations of Australian grayling and platypus.

Social and economic values

There are several reserves, picnic areas and designated fishing locations along the length of the Tarago system, as well as a popular caravan park and public land in the headwaters, which all contribute to the social and recreational value of the Bunyip and Tarago rivers. Many irrigators also rely on water from the Tarago system which is managed by Southern Rural Water. The waterways of this region have been, and continue to be, places of significance for Traditional Owners in the region.

Environmental watering objectives in the Tarago system

	Encourage healthy and diverse riverside vegetation
	Protect and boost native fish populations including threatened species (Australian grayling and river blackfish) by providing habitat and encouraging fish to migrate and spawn (release eggs)
	Provide habitat and nourishment for waterbugs which provide energy, break down dead organic matter and support the river's food chain
	Maintain and improve habitat for platypuses

System overview

The Tarago River is a major tributary of the Bunyip River, which rises in the Bunyip State Forest. The Tarago River headwaters are the Tarago State Forest and flow into the Tarago Reservoir at Neerim. Downstream of the reservoir, the Tarago flows through the town of Rokeby before meeting the Bunyip River at Longwarry North. The downstream reach towards Western Port Bay supplies many irrigators in the catchment.

Water available under the Tarago environmental entitlement is stored in and released from Tarago Reservoir and provides direct benefit to reaches 2 and 6. Reach 2 is the target reach for environmental watering as it has high ecological value, with a diversity of native fish and patches of native fringing vegetation. Deliveries to reach 2 often result in the desired flows also occurring downstream at reach 6.

Recent conditions

Tarago Reservoir started to spill in June 2014 and continued spilling into January 2015. The unregulated flows provided increased flow and variability in the river downstream of the reservoir, resulting in natural achievement of most of the target flows during winter, spring and early summer. Late-summer and autumn were drier-than-average, and once spills ceased, flows below the reservoir were reduced.

Environmental watering provided a summer fresh in January 2015, to improve habitat availability for animals and keep sand bars clear of encroaching vegetation. An autumn fresh was delivered in April 2015 and although the release was reduced due to forecast rainfall, the rainfall runoff combined with the released flow to produce a peak flow for the desired duration. Initial monitoring results indicate that the release was successful in triggering Australian grayling spawning.

Significant monitoring continues to be undertaken in the Tarago River, with the results aiming to show the influence of environmental watering on Australian grayling and platypus populations.

Scope of environmental watering

Potential environmental watering actions and their environmental objectives are explained in Table 3.3.1 and illustrated in Figure 3.3.2.

Figure 3.3.1 The Tarago system

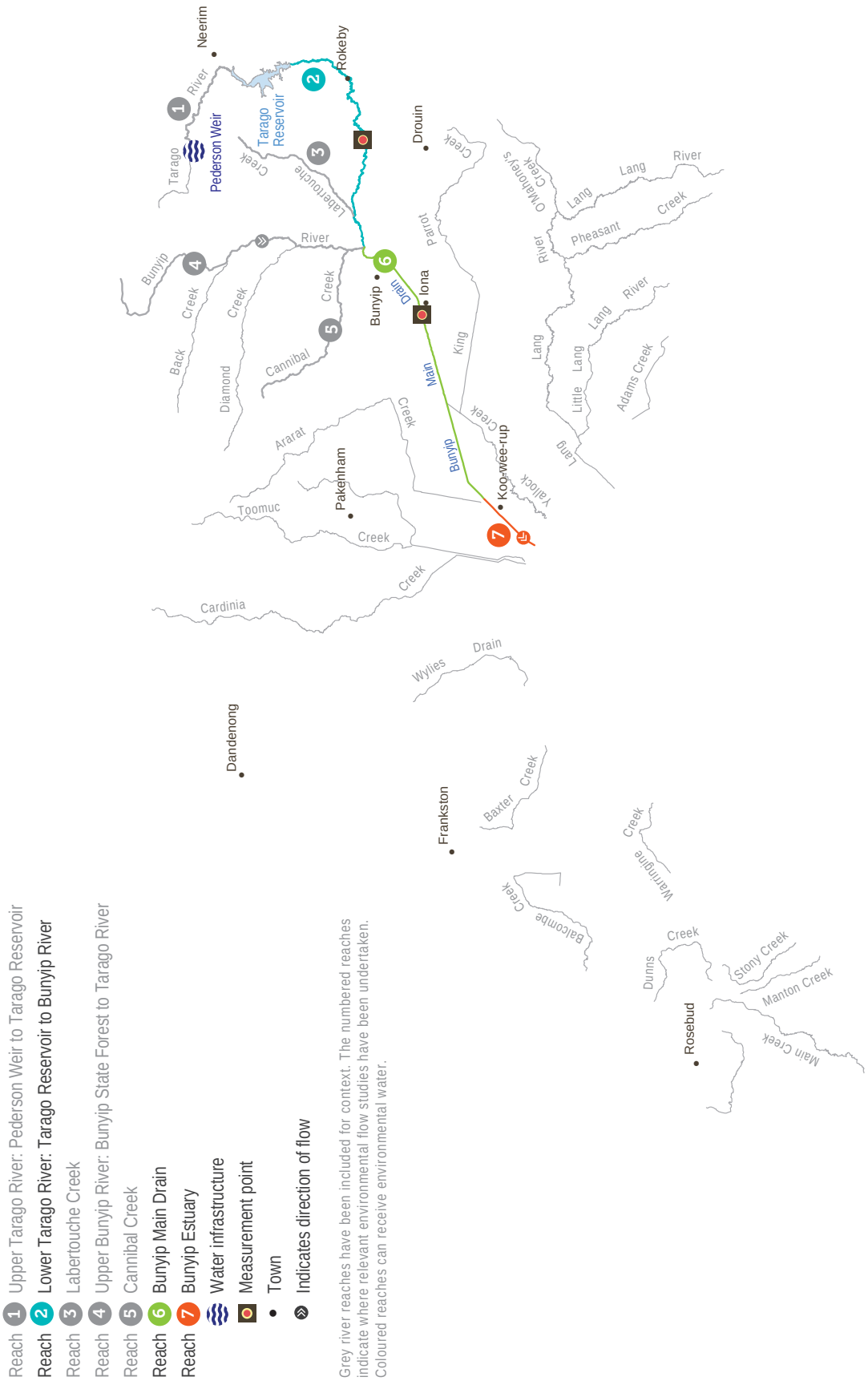
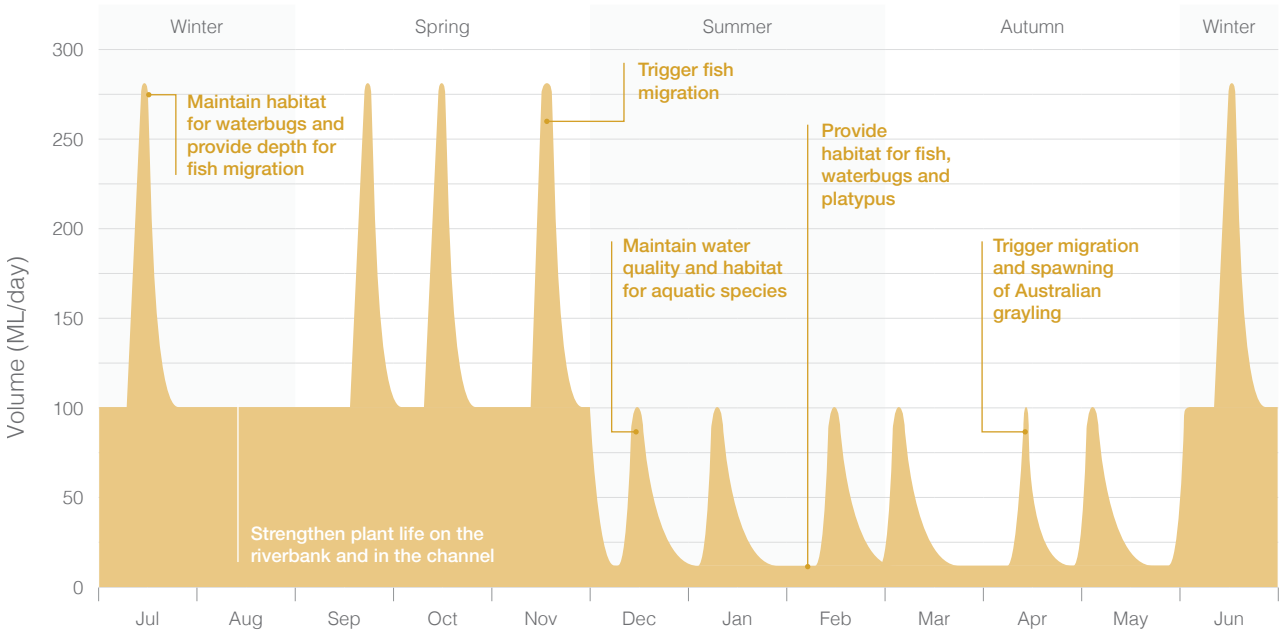


Table 3.3.1 Potential environmental watering actions and objectives for the Tarago River

Potential environmental watering	Environmental objectives
Summer/autumn freshes (5 freshes of 100 ML/day for 4 days each during December–May)	▸ Prevent vegetation growing on sand bars, encourage scour hole creation and improve water quality and maintain habitat for aquatic species, particularly fish
Autumn high flow (1 high flow of 100 ML/day for 2 days during April–May)	▸ Trigger downstream dispersal and spawning of Australian grayling
Spring/summer high flow (1 high flow of 280 ML/day for 4 days during October–December)	▸ Migration of Australian grayling and inundation of barriers, providing for fish passage
Winter/spring freshes (up to 4 freshes of 280 ML/day for 3 days during June–November)	▸ Generate habitat variability for macroinvertebrates, prevent sedimentation and provide sufficient depth for fish passage
Summer/autumn low flows (12 ML/day [or natural] during December–May)[1]	▸ Maintain water quality and provide habitat for river blackfish, Australian grayling, platypus and macroinvertebrates
Winter/spring low flows (100 ML/day [or natural] during June–November)[2]	▸ Inundate marginal habitats for juvenile fish ▸ Bed habitat availability for macroinvertebrates ▸ Promote establishment and recruitment of diverse riparian vegetation types and prevent terrestrial vegetation encroachment

1 Summer/autumn low flows are generally provided by passing flows under the environmental entitlement, but during dry conditions it may be necessary to supplement these flows using environmental water.
2 Winter/spring low flows are unlikely to be delivered as the volume required would severely affect the ability to provide other environmental flow events.

Figure 3.3.2 Potential environmental watering in the Tarago system



Note: This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Scenario planning

Table 3.3.2 outlines the potential watering and expected water usage under a range of planning scenarios.

The highest priority releases in the Tarago system are summer/autumn freshes and autumn high flows, to provide habitat and migration cues for Australian grayling. An autumn high flow is important to ensure survival of the Australian grayling population in the system. Under drought conditions, there may not be sufficient water to deliver the event, however as this flow has been provided in four of the past five years, absence of the flow in 2015–16 does not pose a significant risk. Under wetter conditions, it is expected that in addition to summer/autumn releases, environmental water may contribute to delivery of some winter/spring flows, building on natural flows in the system.

The number of watering actions increases from a drought scenario to a wet scenario, consequently increasing the volume of environmental water required. Carrying water over into 2016–17 is important under all scenarios, to provide security in the ability to deliver summer and autumn freshes.

Table 3.3.2 Potential environmental watering for the Tarago system under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	▸ Very low streamflows ▸ Reduced passing flows ▸ Consumptive releases likely	▸ Low streamflows ▸ Some reduction to passing flows ▸ Consumptive releases likely	▸ Average streamflows ▸ Partial freshes naturally provided ▸ Some consumptive releases likely	▸ Above-average streamflow ▸ Partial-to-full freshes naturally provided ▸ Consumptive releases unlikely
Expected availability of environmental water	▸ 1,500 ML carryover ▸ 200 ML allocation ▸ 1,700 ML total	▸ 1,500 ML carryover ▸ 500–1,000 ML allocation ▸ 2,000–2,500 ML total	▸ 1,500 ML carryover ▸ 1,000–2,200 ML allocation ▸ 2,500–3,700 ML total	▸ 1,500 ML carryover ▸ 2,200–3,500 ML allocation ▸ 3,700–5,000 ML total
Potential environmental watering	▸ Summer/autumn freshes	▸ Summer/autumn freshes ▸ Autumn high flow	▸ Summer/autumn freshes ▸ Autumn high flow ▸ Spring high flow (partial achievement)	▸ Summer/autumn freshes ▸ Autumn high flow ▸ Spring high flow ▸ Winter/spring freshes
Possible volume of environmental water required to achieve objectives	▸ 1,000 ML	▸ 1,000–1,500 ML	▸ 1,500–2,700 ML	▸ Up to 3,500 ML
Critical carryover into 2016–17	▸ 1,000 ML			

Risk management

In preparing its seasonal watering proposal, Melbourne Water considered and assessed risks and identified mitigating strategies relating to implementing environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Engagement

Melbourne Water has engaged with key stakeholders and other relevant individuals in preparing the seasonal watering proposal for the Tarago system. These stakeholders are included in Table 3.3.3.

The seasonal watering proposals are informed by longer term plans such as regional waterway strategies and environmental water management plans. These longer term plans incorporate a range of environmental, cultural, social and economic perspectives.

Table 3.3.3 Key stakeholders engaged in the development of the Tarago system seasonal watering proposal

Stakeholder engagement
▸ Tarago and Bunyip Rivers Environmental Flow Advisory Group including representatives of local councils, irrigators, landholders and Landcare groups ▸ Melbourne Water (Water Supply – Optimisation and Support) ▸ Southern Rural Water ▸ Victorian Environmental Water Holder

3.4 Werribee system

Waterway manager – Melbourne Water

Storage manager – Southern Rural Water

Environmental water holder – Victorian Environmental Water Holder

Environmental values

The Werribee system supports several native fish including large populations of black bream and other species such as river blackfish, flathead gudgeon, short-finned eels, tupong, Australian smelt and several species of galaxiids. A diverse community of frogs and macroinvertebrates inhabit the upper reaches and platypuses are present in the lower reaches. The freshwater-saltwater interface of the Werribee River estuary is a regionally significant ecosystem due to the high diversity of aquatic plants and animals it supports

Social, cultural and recreational values

The Werribee River provides a range of recreational activities including fishing, bird watching, passive boating and bushwalking. The system also provides irrigation water for agricultural industries throughout the Bacchus Marsh and Werribee areas and domestic water for the towns of Melton and Bacchus Marsh. Significant Indigenous cultural heritage sites have been found along the riverbank and escarpments including fish traps, artefacts and burial sites. The Werribee River continues to be a place of significance for Traditional Owners and their Nations in the region.

Environmental watering objectives in the Werribee system

	Maintain diverse macrophytes (large water plants) and shrubs to provide shade and food for organisms further up the food chain
	Protect and boost native fish populations including black bream, by providing pool habitat, flows for fish to move up and downstream and encouraging fish to spawn (release eggs)
	Maintain habitat for frogs, macroinvertebrates and platypuses
	Maintain pool water quality for fish and platypuses and inundate estuary salt marsh with brackish water
	Move built-up silt from riffles (shallower parts of the river)

System overview

The Werribee River flows south-east from the Wombat State Forest to the undulating plains north of Ballan before flowing into Port Phillip Bay at Werribee. The Lerderderg River is a major tributary that joins the river at Bacchus Marsh.

The priority river reaches for the Werribee system are the reach downstream of Lake Merrimu (reach 6) and the estuary as they support a diverse range of native fish species, macroinvertebrates and platypuses. Flows targeting the estuary are expected to provide some benefits to reaches 8 and 9, however water may also be delivered to target environmental objectives in these reaches under suitable conditions. Flows are measured downstream of Lake Merrimu (reach 6), downstream of Melton Reservoir (reach 8) and at the Werribee Diversion Weir for reach 9 and the estuary.

Recent conditions

Rainfall in the Werribee catchment has been lower-than-average since the wet years of 2010–2012. Melton Reservoir has not spilled since October 2012 and consequently there has been minimal natural outflow to the bay, with environmental watering making up a large portion of flows in reach 9 and the estuary. The dry conditions persisted in 2014–15 with environmental watering focused on the most critical objectives with the aim of protecting the health of the system under dry conditions.

Baseflows from July to December 2014, a spring fresh and spring high flow were provided to Pyrites Creek (reach 6) using both environmental water and through the manipulation of storage transfers being made by Southern Rural Water. Maintaining the baseflow was important in providing suitable frog habitat during winter/spring, while the freshes targeted outcomes for pygmy perch and macroinvertebrates. A persistent trickle flow occurred throughout summer in the upper parts of Pyrites Creek as a result of leakage from Lake Merrimu, with constant cease-to-flow conditions occurring in the lower section of the reach.

Natural baseflows and freshes were below target levels for most of the time through reaches 8 and 9 and in the estuary, although irrigation releases partially achieved some outcomes in reach 8. A fresh was delivered in November 2014, targeting the estuary (with benefits to the upstream reaches), to support black bream recruitment. A summer fresh occurred in January 2015 in response to a blue-green algae outbreak near Werribee Zoo (reach 9) which successfully flushed the river and improved water quality.

Scope of environmental watering

Potential environmental watering actions and their environmental objectives are explained in Table 3.4.1 and illustrated in figures 3.4.2 to 3.4.4.

Figure 3.4.1 The Werribee system

Reach 1 Werribee River: Upstream of Upper Werribee Diversion Weir
Reach 2 Pykes Creek: Pykes Creek Reservoir to Werribee River
Reach 3 Werribee River: Upper Werribee Diversion Weir to Pykes Creek
Reach 4 Werribee River: Pykes Creek to Bacchus Marsh Weir
Reach 5 Werribee River: Bacchus Marsh Weir to Lerderderg River
Reach 6 Pyrites Creek: below Lake Merrimu to Melton Reservoir
Reach 7 Djerriwarrh Creek: below Djerriwarrh Weir to Melton Reservoir
Reach 8 Werribee River: Melton Reservoir to Lower Werribee Diversion Weir
Reach 9 Werribee River: Lower Werribee Diversion Weir to estuary
Reach Werribee Estuary
Measurement point
Water infrastructure
Town
Indicates direction of flow

Grey river reaches have been included for context. The numbered reaches indicate where relevant environmental flow studies have been undertaken. Coloured reaches can receive environmental water.

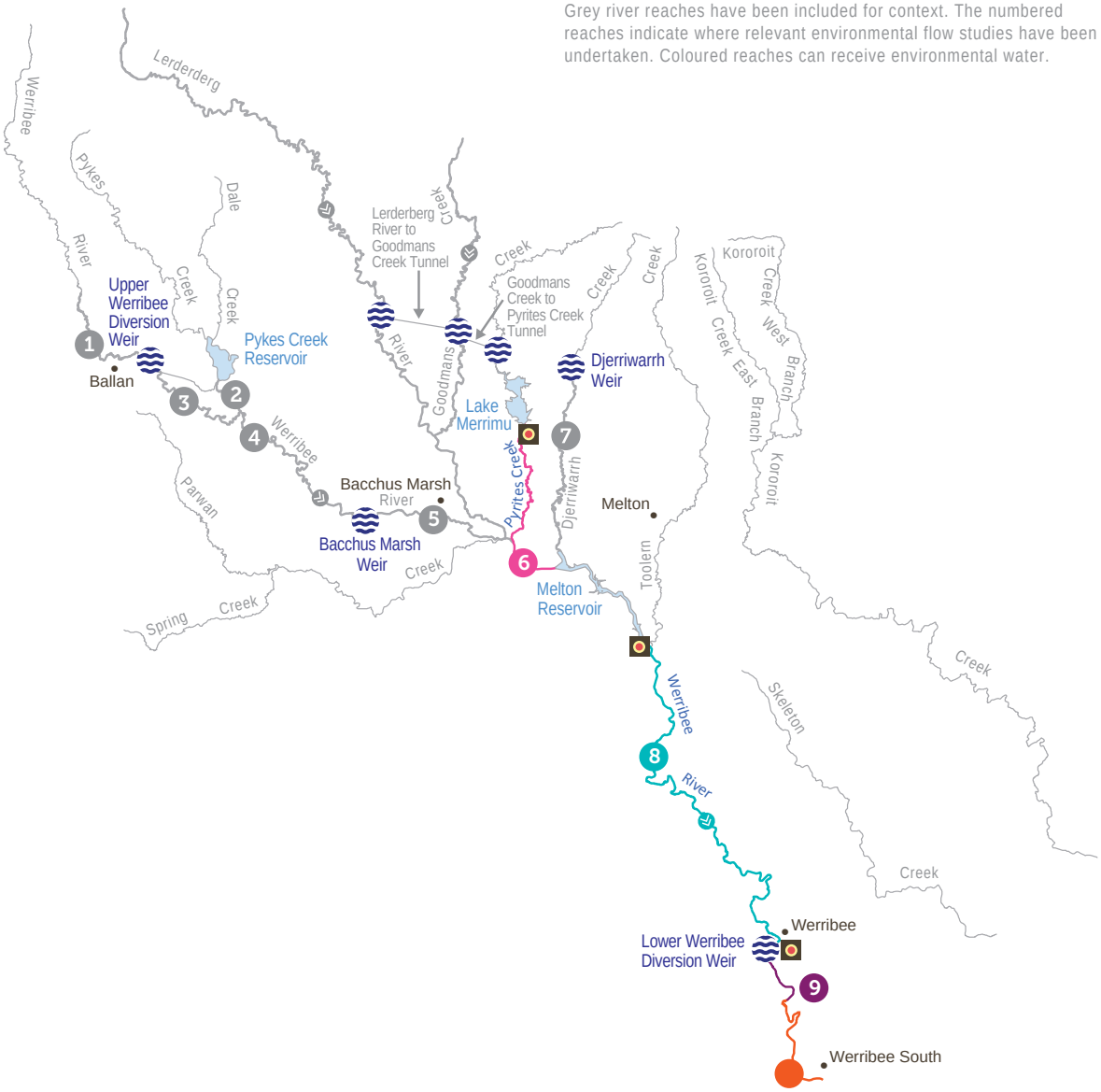


Table 3.4.1 Potential environmental watering actions and objectives for the Werribee system

Potential environmental watering	Environmental objectives
Pyrites Creek (reach 6)	
Spring/summer freshes (up to 3 freshes of 30 ML/day for 2 days during September–December)	▸ Scour silt and sand from riffles ▸ Promote vegetation growth
Spring/Summer high flow (130 ML/day for 2 days during September–December)	▸ Inundate fringing habitat for frogs and macroinvertebrates
Winter/spring/summer baseflow (2 ML/day [or natural][1] during July–December)	▸ Provide macroinvertebrate and frog habitat
Werribee River estuary	
Spring/summer freshes (2 freshes of between 50 and 80 ML/day for 2 days during November–January)	▸ Promote juvenile black bream recruitment
Winter/spring baseflows (15 ML/day continuously during June–November)	▸ Provide black bream habitat
Autumn freshes in the estuary (2–4 freshes of 89 ML/day[2] for 2 days during March–May)	▸ Provide fish passage between estuary and freshwater reaches
Winter/spring freshes (8 freshes of 100 ML/day for 1 day during June–November)	▸ Inundate salt marsh with brackish water to support aquatic vegetation
Werribee River reaches 8 and 9	
Summer/autumn freshes in reach 9 (3 freshes of 137 ML/day [or natural][1] for 1 day during January–April)	▸ Maintain pool water quality for fish and platypuses ▸ Allow for fry dispersal and mobilise silt from riffles
Winter/spring/summer baseflows (81 ML/day during June to December)	▸ Provide fish passage and spawning habitat ▸ Maintain macrophytic and shrub vegetation mosaic ▸ Mobilise sand from riffles ▸ Promote platypus habitat
Winter/spring/summer freshes (4 freshes of 350 ML/day for 3 days during June–December)[3]	

1 The specification of 'or natural' means that in the absence of any upstream extraction or diversion the potential watering action may still be deemed to be met when the inflows are 'naturally' providing less than the recommended magnitude, duration or frequency of streamflow.
2 A trial delivering lower flows in 2014–15 will be monitored to determine its success supporting fish passage. If successful, this may reduce the flow rate required for this event in 2015–16
3 It is unlikely that sufficient environmental water will be available to achieve these flow events, but opportunistic watering may occur to supplement flows in the river to achieve these outcomes.

Lerderderg diversion weir, by Melbourne Water

Figure 3.4.2 Potential environmental watering in Pyrites Creek reach 6

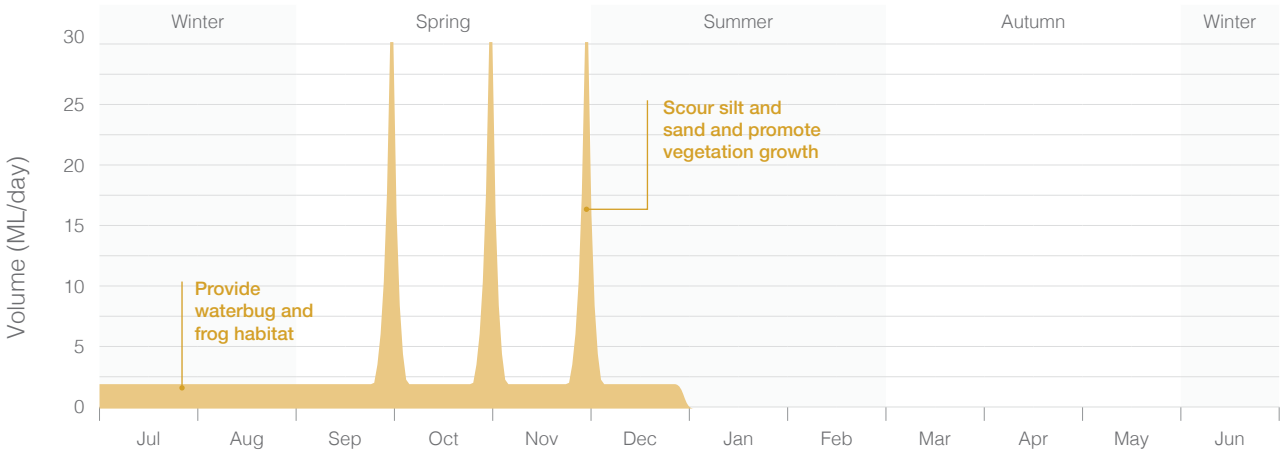


Figure 3.4.3 Potential environmental watering in the Werribee River reaches 8 and 9

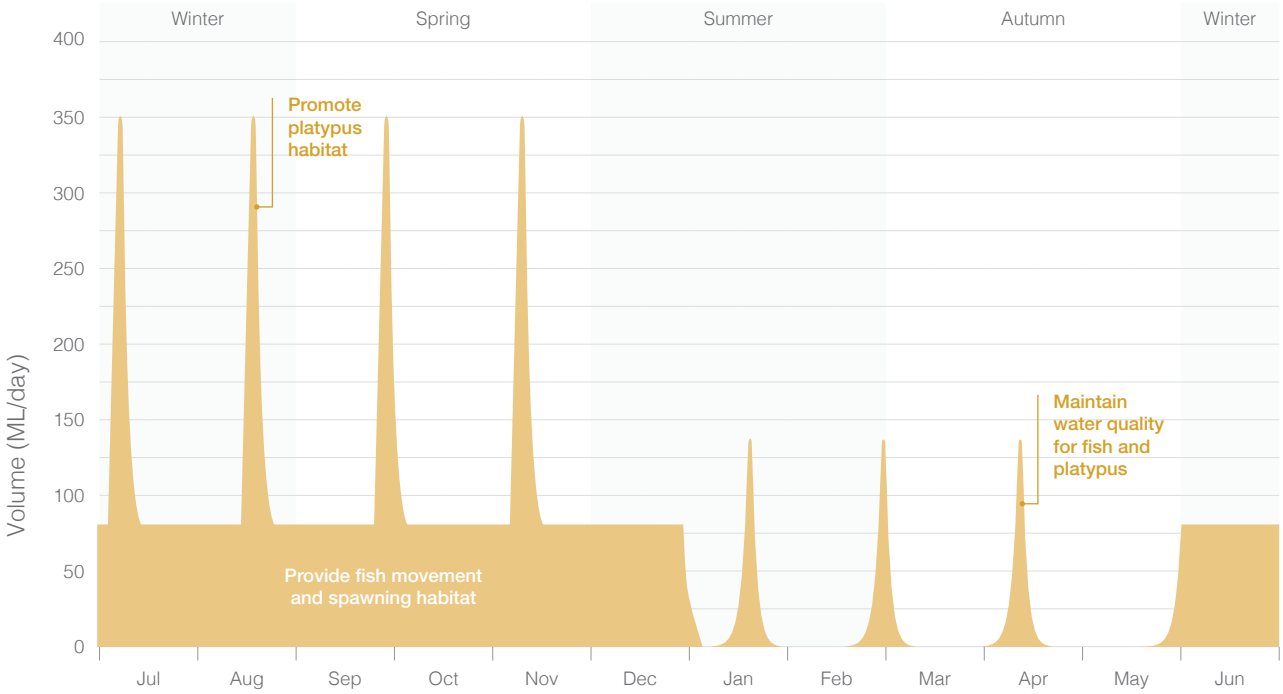
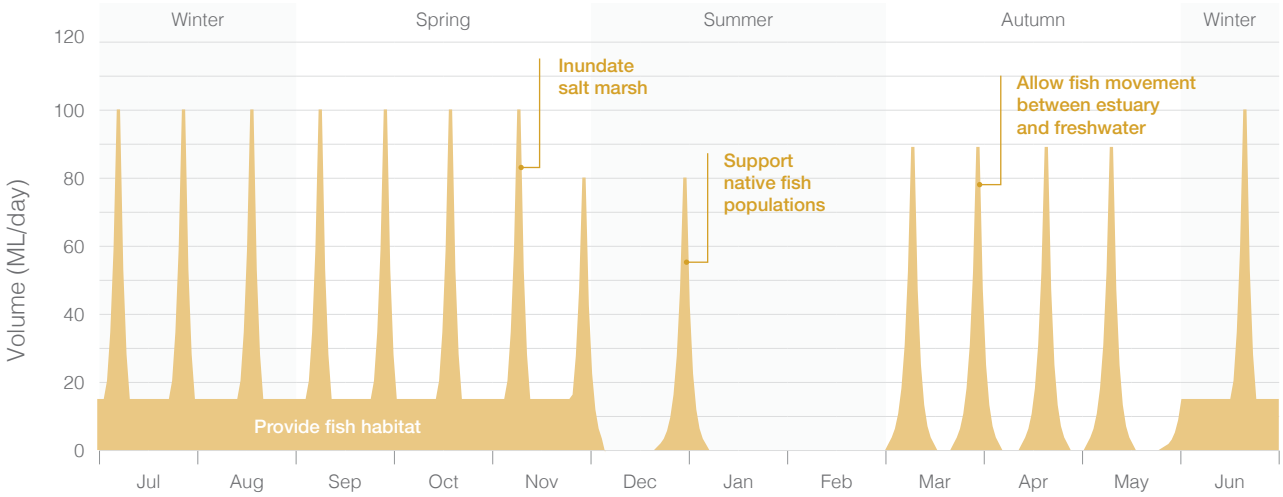


Figure 3.4.4 Potential environmental watering in the Werribee Estuary



Note: These figures are for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Scenario planning

Table 3.4.2 outlines the potential watering and expected water usage under a range of planning scenarios.

As seasonal conditions improve across the planning scenarios from dry to wet, additional watering actions become a priority for environmental watering. The critical flows planned to be delivered under a drought and dry scenario focus on deliveries to Pyrites Creek (reach 6) and the Werribee River estuary, as well as freshes through reaches 8 and 9 to maintain water quality. However, the amount of water available may not be sufficient to meet all these demands, particularly under drought conditions. The expected volume of environmental water required to achieve the desired objectives is consistent across all scenarios. However the actual volumes delivered will vary depending on water availability and seasonal conditions, with the additional watering actions under average and wet scenarios only likely to be achieved by unregulated flows.

When possible, winter releases from Lake Merrimu targeting Pyrites Creek (reach 6) will be captured in Melton Reservoir, making the volume that reaches the reservoir available for releases downstream later in the water year. Under an average or wet scenario Melton Reservoir is likely to be spilling, meaning releases from upstream will spill through the reservoir and provide a small increase in unregulated flow downstream.

Carrying over some water into 2016–17 is considered important, in case of drought or dry conditions, when the focus will be on protecting or maintaining the health of the river system.

Table 3.4.2 Potential environmental watering for the Werribee system under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	▸ No unregulated flows ▸ Minimal consumptive releases out of storage into reach 8 in summer/autumn ▸ Environmental water released from Lake Merrimu will be temporarily held in Melton Reservoir	▸ No unregulated flows ▸ Consumptive releases out of storage into reach 8 in summer/autumn ▸ Environmental water released from Lake Merrimu will be temporarily held in Melton Reservoir	▸ Unregulated spills in winter/spring from Melton into reach 8, 9 and the estuary. ▸ Consumptive releases out of storage into reach 8 in summer/autumn ▸ Environmental water released from Lake Merrimu is likely to pass over the Melton Reservoir spillway	▸ Unregulated spills in winter/spring from Melton into reach 8, 9 and the estuary; possible spills from Merrimu into reach 6 ▸ Consumptive releases out of storage into reach 8 in summer/autumn ▸ Environmental water released from Lake Merrimu is likely to pass over the Melton Reservoir spillway
Expected availability of environmental water	▸ 600 ML carryover ▸ 500 ML allocation ▸ 200 ML inflows ▸ 1,200 ML total	▸ 600 ML carryover ▸ 700 ML allocation ▸ 400 ML inflows ▸ 1,700 ML total	▸ 600 ML carryover ▸ 800 ML allocation ▸ 400–900 ML inflows ▸ 1,800–2,300 ML total	▸ 600 ML carryover ▸ >800 ML allocation ▸ >900 ML inflows ▸ >2,300 ML total
Potential environmental watering	▸ Pyrites Creek (reach 6): ▸ Winter/spring/summer low flows ▸ Spring/ summer fresh	▸ Pyrites Creek (reach 6): ▸ Winter/spring/summer low flows ▸ Spring/ summer fresh	▸ Pyrites Creek (reach 6): ▸ Winter/spring/summer low flows ▸ Spring/summer fresh	▸ Pyrites Creek (reach 6): ▸ Spring/ summer fresh ▸ Spring/summer high flow[1]
	▸ Reach 8 and 9: ▸ Summer/autumn fresh	▸ Reach 8 and 9: ▸ Summer/autumn fresh	▸ Reach 8 and 9: ▸ Summer/autumn fresh ▸ Winter/spring/ summer baseflows ▸ Winter/spring/ summer freshes	▸ Reach 8 and 9: ▸ Summer/autumn fresh ▸ Winter/spring/ summer baseflows ▸ Winter/spring/ summer freshes
	▸ Estuary: ▸ Spring/summer fresh ▸ Autumn fresh ▸ Winter/spring/summer baseflow	▸ Estuary: ▸ Spring/summer fresh ▸ Autumn fresh ▸ Winter/spring/summer baseflow	▸ Estuary: ▸ Spring/summer fresh ▸ Autumn fresh ▸ Winter/spring/summer fresh ▸ Winter/spring/summer baseflow	▸ Estuary: ▸ Spring/summer fresh ▸ Autumn fresh ▸ Winter/spring/summer fresh ▸ Winter/spring/summer baseflow
Possible volume of environmental water required to achieve objectives	▸ Up to 1,500 ML			
Critical carryover into 2016–17	▸ ~300 ML			

1 This watering action may be opportunistically delivered in other scenarios through consumptive water deliveries.

Risk management

In preparing its seasonal watering proposal, Melbourne Water considered and assessed risks and identified mitigating strategies relating to implementing environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Engagement

Melbourne Water consulted key stakeholders when preparing the seasonal watering proposal for the Werribee system. Table 3.4.3 shows these stakeholders.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 3.4.3 Key stakeholders engaged in the development of the Werribee system seasonal watering proposal

Stakeholder engagement
▸ Werribee River Community Advisory Group including representatives of local governments, 'friends of' groups, Landcare groups, fishing clubs and Western Water ▸ Southern Rural Water and licensed diverters ▸ Victorian Environmental Water Holder

Upper Werribee estuary, by Melbourne Water

3.5 Moorabool system

Waterway manager – Corangamite Catchment Management Authority

Storage manager – Central Highlands Water

Environmental water holder – Victorian Environmental Water Holder

Environmental values

The Moorabool River is home to a number of native fish species including Australian grayling, river blackfish, Australian smelt, southern pygmy perch, short-finned eel and tupong. The system contains extensive areas of endangered remnant vegetation, including stream bank shrubland and riparian woodland ecological vegetation communities. Diverse populations of macroinvertebrates, platypuses and water rats are also present. The Moorabool River flows into the Barwon River, connecting it to the Ramsar-listed lower Barwon wetlands.

Social and economic values

The Moorabool River system is valued for its environmental values and supports a range of recreational activities with parks, picnic sites, lookouts, swimming holes, fishing and camping spots and historic bridges located along its length. Water is also delivered via the Moorabool River to supply urban users from She Oaks Weir. The Moorabool River continues to be place of importance for Traditional Owners and their Nations in the region.

Environmental watering objectives in the Moorabool system

	Maintain remnant vegetation communities including a range of macrophytes (large plants) within the river channel. These communities also provide shade and food for organisms further up the food chain
	Protect and boost native fish populations (including Australian grayling, southern pygmy perch, spotted galaxias, tupong and short-finned eel) by providing flows for fish to move upstream and downstream and encouraging fish to spawn (release eggs)
	Reshape the river bank and bed and ensure fish and other water animals have a range of habitat pools and places to shelter
	Maintain water quality during the year, particularly during summer
	Maintain a wide range of waterbugs to provide energy, break down dead organic matter and support the river's food chain

System overview

The Moorabool River is a highly regulated river that, despite substantial extraction and many years of drought, still retains significant environmental values. It flows southward from the Central Highlands between Ballarat and Ballan to join the Barwon River at Fyansford. The catchment is heavily farmed with about three-quarters of its catchment area used for agriculture.

Water allocated to the Moorabool River environmental entitlement is stored in Lal Lal Reservoir and includes passing flows that help maintain baseflows during winter. The Moorabool is also a water supply catchment for Barwon Water with releases from Lal Lal Reservoir being reharvested for urban water supply at She Oaks Weir. These releases contribute to environmental flow targets for reach 3 before being reharvested at the start of reach 4.

There are several large water storages in the upper reaches of the river including Lal Lal Reservoir. In the lower reach, between She Oaks and Batesford, there are nine private diversion weirs that are a significant barrier to fish. These barriers have increased the extent of slow-flowing habitat and reduced habitat diversity in the lower reach of the Moorabool.

Environmental water can be used to manage flows in reaches 3 and 4. The priority reach for environmental water management in the system is reach 3 from Lal Lal Reservoir to She Oaks diversion weir, as this is the reach where the small amount of environmental water in the system can have the most beneficial impact. At She Oaks diversion weir, environmental water continues into reach 4 then joins the Barwon River outside Geelong.

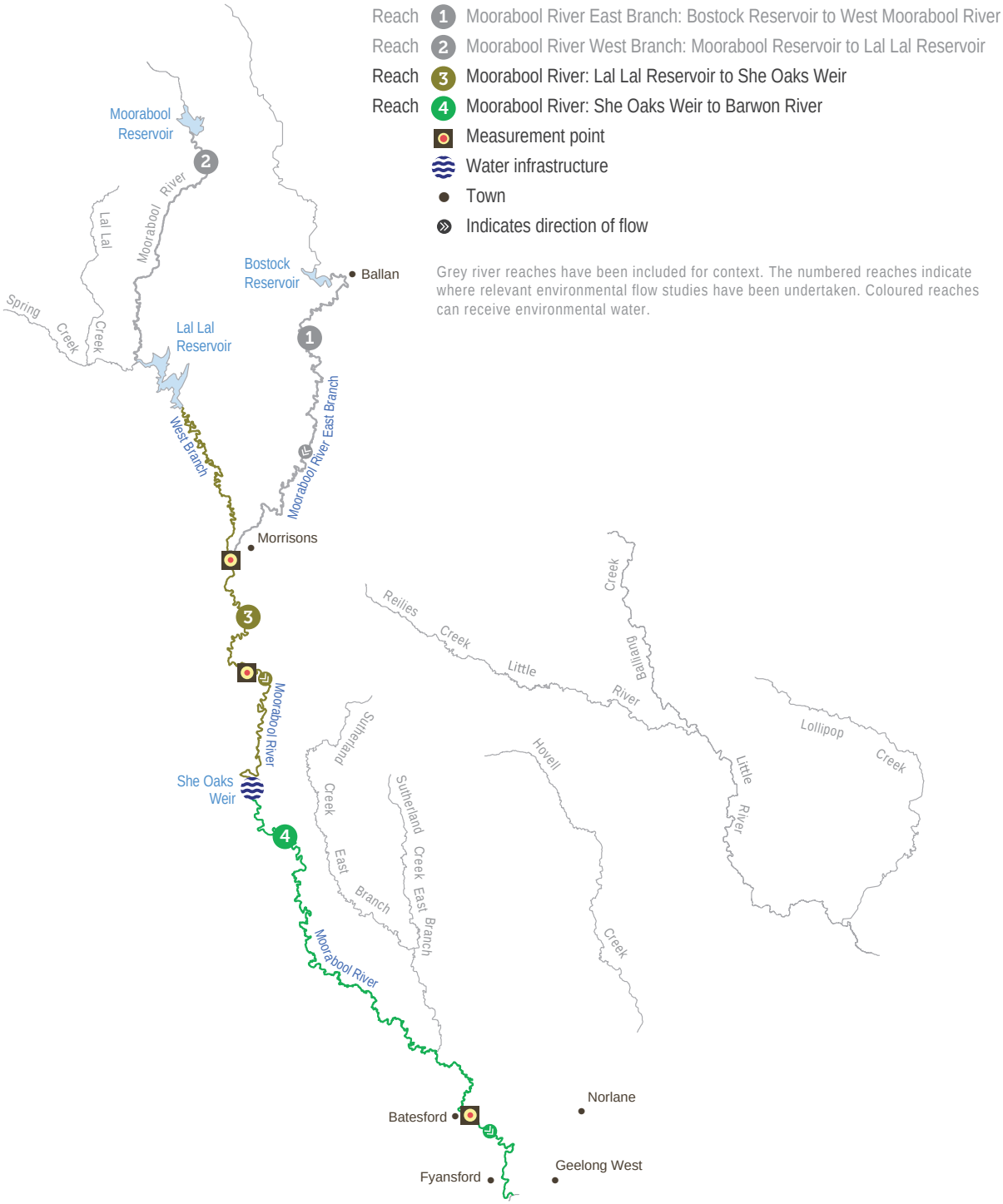
Recent conditions

Dry conditions continued in the Moorabool system over 2014–15 with lower-than-average rainfall in the latter part of 2014 and correspondingly low streamflows. As a result, there was a high reliance on environmental watering to meet objectives.

Summer flows were the priority for the Moorabool River in 2014–15 as it was a higher-risk period from a water quality perspective due to the small amount of water available in the system. Environmental watering supported summer low flows and freshes in reach 3; it commenced in December 2014 and continued until March 2015. Consumptive water releases from Lal Lal Reservoir also contributed to meeting low-flow targets during this period. A small winter fresh was delivered in June 2015.

Recent investigations undertaken in the Moorabool system have identified significant improvements in the diversity and abundance of native fish species in reaches 3 and 4 with a number of migratory small-bodied fish found that have not been previously recorded in the system.

Figure 3.5.1 The Moorabool system



The presence of these fish has been linked to environmental flows delivered since 2010 and the natural high-flow events that occurred in 2010–11 that provided connectivity for fish passage, enabling migratory and estuarine fish species to recolonise the system. This information helped to confirm the values present in the system and will help to inform future watering.

Scope of environmental watering

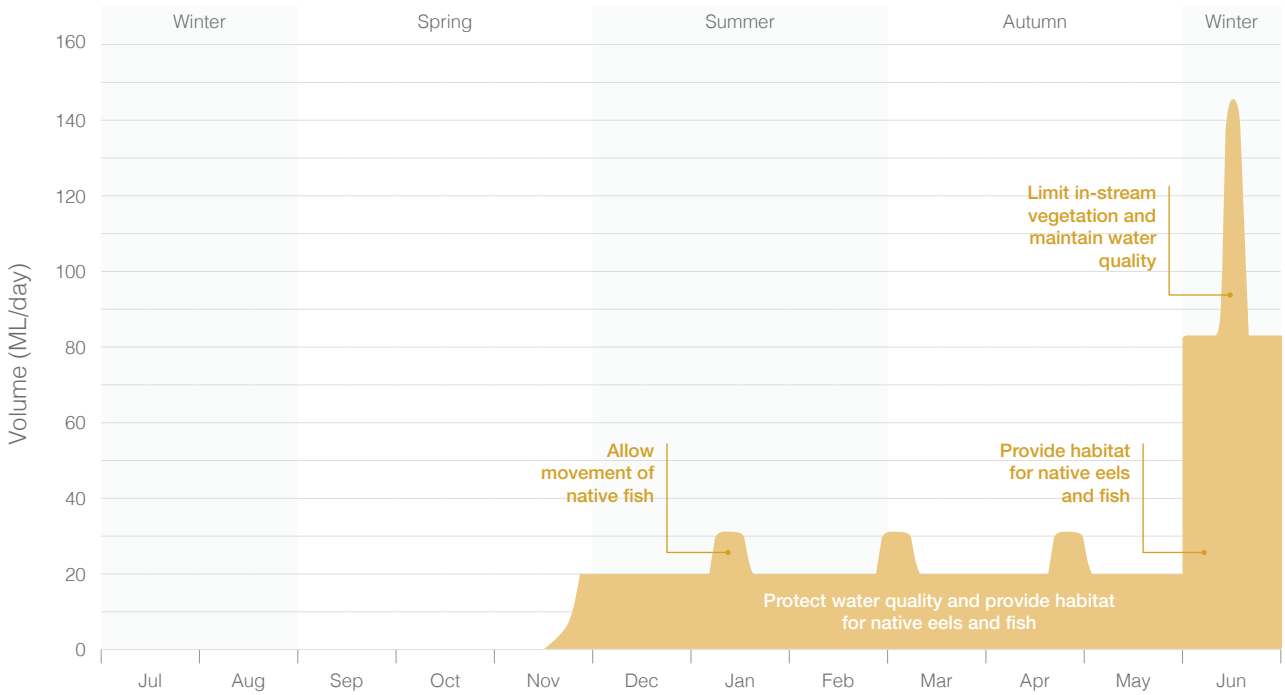
Potential environmental watering actions and associated environmental objectives are provided in Table 3.5.1 and illustrated in Figure 3.5.2.

Table 3.5.1 Potential environmental watering actions and objectives for the Moorabool system

Potential environmental watering[1]	Environmental objectives
Summer/autumn freshes (3 freshes targeting more than 31 ML/day for 10 days during December–May)	▸ Allow upstream movement of Australian smelt ▸ Reshape in-channel forms to maintain physical processes and physical habitat diversity and complexity
Summer/autumn low flows (average of 20 ML/day during December–May)[2]	▸ Provide adequate habitat for short-finned eel, southern pygmy perch and Australian smelt ▸ Maintain in-stream macrophyte species diversity and woody debris/snag habitat; rehabilitate water quality
Winter fresh (1 fresh targeting more than 146 ML/day for 5 days during June)[2]	▸ Maintain diverse macroinvertebrate community ▸ Limit encroachment of in-stream vegetation and species common to non-flowing water-bodies ▸ Rehabilitate water quality
Summer/autumn freshes in reach 4 (3 freshes targeting more than 32 ML/day for 10 days during December–May)[2]	▸ Maintain self-sustaining populations of Australian grayling (spawning) ▸ Movement of common/spotted galaxias ▸ Maintain diverse communities of macroinvertebrates ▸ Improve water quality
Winter low flows (83 ML/day during June)[2]	▸ Provide adequate habitat for short-finned eel, southern pygmy perch and Australian smelt ▸ Maintain in-stream macrophyte species diversity and woody debris/snag habitat

1 The target reach for environmental watering is reach 3 of the Moorabool system unless otherwise stated.
2 Delivery of this flow component will be subject to water availability.

Figure 3.5.2 Potential environmental watering in the Moorabool River reach 3



Note: This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Scenario planning

Table 3.5.2 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

Due to the limited volume of environmental water available in the Moorabool system, the priority is typically during the higher-risk summer/autumn period to protect water quality and fish. Over summer in a dry year, trigger levels for dissolved oxygen, electrical conductivity and water temperature are monitored and used to inform environmental watering. If a wetter scenario eventuates, unregulated flows may contribute more to the watering actions and winter freshes or low flows may become a priority.

Although environmental watering focuses on reach 3, some releases will benefit reach 4. Where possible, deliveries to reach 3 will be planned to maximise the benefit for reach 4, for instance by increasing summer fresh volumes when water availability allows.

Depending on the water available under each scenario, different watering actions will be prioritised. Under a drought scenario, the possible volume required from the Water Holdings is less than under a wet scenario to reflect the lower water availability and the use of smaller actions. Under a wet scenario it is likely that all available water would be delivered.

Table 3.5.2 Potential environmental watering for the Moorabool system under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	▸ Minimal catchment inflows ▸ Limited passing flows	▸ Low catchment inflows ▸ Passing flows	▸ Moderate catchment inflows ▸ Unregulated and passing flows	▸ High catchment inflows ▸ Unregulated and passing flows
Expected availability of environmental water	▸ 500–2,000 ML	▸ 2,000–3,500 ML	▸ 3,500–5,000 ML	▸ 5,000–7,000 ML
Potential environmental watering	▸ Trigger-based freshes ▸ Summer/autumn freshes ▸ Summer low flow (if sufficient water is available)	▸ Summer/autumn freshes ▸ Summer/autumn low flow ▸ Late winter fresh flow (if sufficient water is available)	▸ Summer/autumn freshes (reaches 3 and 4) ▸ Summer/autumn low flow ▸ Winter freshes (reaches 3 and 4) ▸ Winter low flow	
Possible volume of environmental water required to achieve objectives	▸ 250–1,000 ML	▸ 1,000–2,500 ML	▸ 2,500 ML	▸ 2,500 ML

Risk management

In preparing its seasonal watering proposal, Corangamite CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Engagement

Corangamite CMA has consulted stakeholders in the preparation of the seasonal watering proposal for the Moorabool system. These stakeholders are shown in Table 3.5.3.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 3.5.3 Key stakeholders engaged in the development of the Moorabool system seasonal watering proposal

Stakeholder engagement
▸ Australian Platypus Conservancy ▸ Barwon Water ▸ Central Highlands Water ▸ Department of Environment, Land, Water and Planning ▸ Moorabool Stakeholder Advisory Committee (with representatives of Geelong Landcare Network, Southern Rural Water, Central Highlands Water, Barwon Water, VEWH and the local community) ▸ People for a Living Moorabool (community group) ▸ Southern Rural Water ▸ Victorian Environmental Water Holder

3.6 Lower Barwon wetlands

Waterway manager – Corangamite Catchment Management Authority

Environmental water holder – Victorian Environmental Water Holder

Environmental values

Reedy Lake and Hospital Swamps support aquatic vegetation communities that provide important feeding and breeding habitat for native fish including Australian grayling, dwarf galaxias and other estuarine and freshwater species. They also support wetland-dependent bird species including the threatened Australian painted snipe, Latham's snipe, Caspian tern and whiskered tern. These wetlands form part of the internationally recognised Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site.

Reedy Lake supports a diversity of vegetation communities including coastal saltmarsh, herbfields and reed beds, which provide important habitat for a variety of animal species. Maintaining the ecological character of the wetland requires a suitable watering regime to achieve a balance between these vegetation communities. At present, a number of these communities are in decline.

Hospital Swamps supports large areas of threatened coastal saltmarsh and many fish and waterbird populations. Vegetation communities in Hospital Swamps have remained largely unchanged over time, with the environmental values of the wetland being in good condition.

Social and economic values

Hospital Swamps and Reedy Lake are part of a wildlife reserve and highly valued for their recreational opportunities including recreational duck hunting and bird watching. The wetlands also support a commercial eel fishery. The waterways in the lower Barwon wetland system have been, and continue to be, significant for Traditional Owners and their Nations in the area.

Environmental watering objectives in the lower Barwon wetlands
Provide suitable habitat including mud flats and shallow water for wading birds, and feeding opportunities and refuge for waterbirds and shorebirds
Promote habitat for fish breeding and growth and improved conditions for migration and dispersal when wetlands are connected to the Barwon River
Provide varying water levels and conditions to promote soil salinisation to support the persistence and growth of threatened saline-dependant ecological vegetation communities
Maintain the high diversity of ecological vegetation communities in the wetlands Promote the growth of coastal saltmarsh, herbfields and lignum shrubland ecological vegetation communities

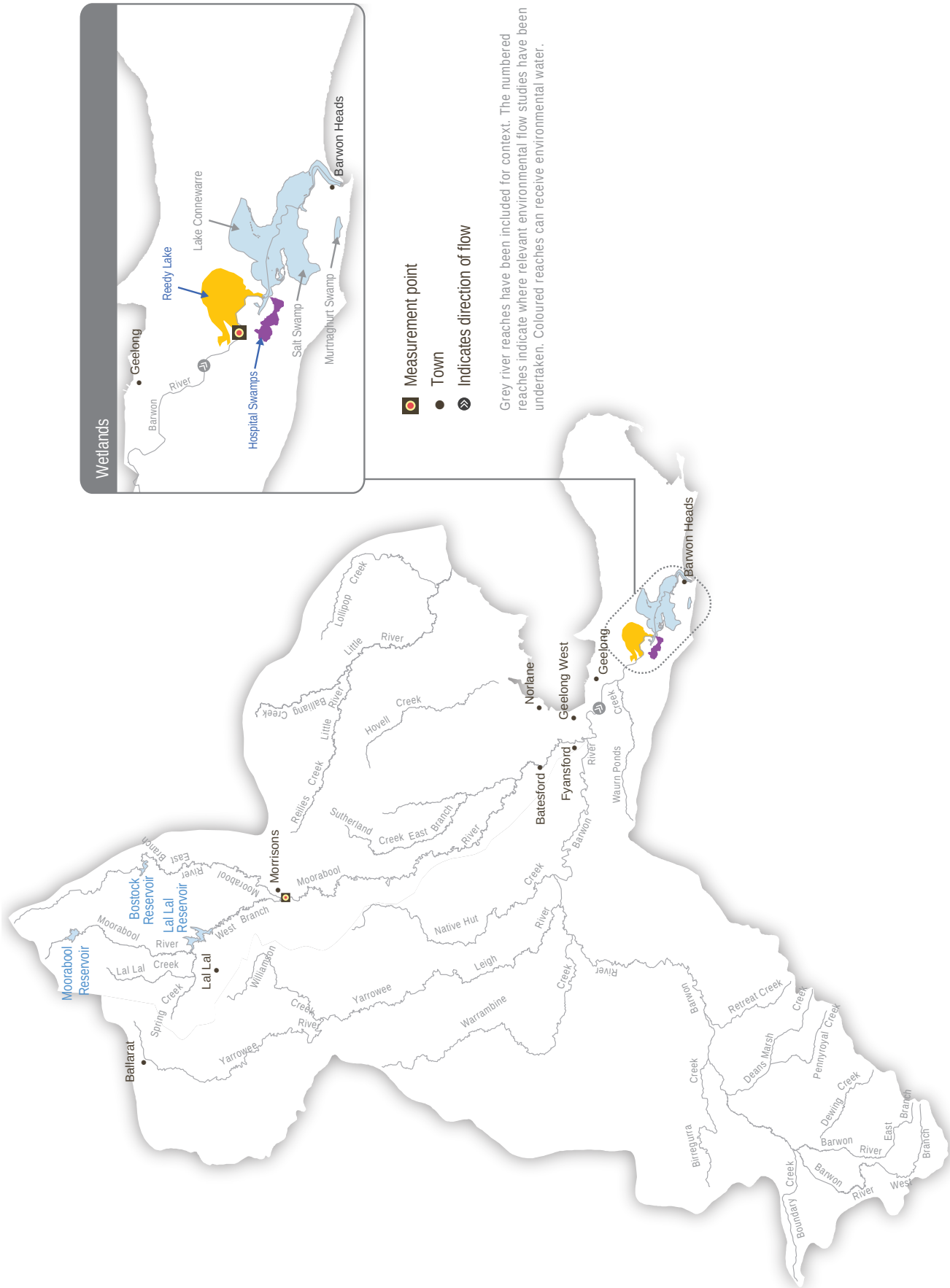
System overview

The estuarine reach of the Barwon River incorporates a system of wetlands and lakes including Lake Connewarre, Reedy Lake, Hospital Swamps, Salt Swamp and Murtnaghurt Lagoon (Figure 3.6.1). Environmental water can be actively managed at Reedy Lake and Hospital Swamps.

Unlike many other systems, the environmental entitlement does not provide access to water held in storage. Instead, it allows water to be diverted via regulators from the Barwon River into Reedy Lake and Hospital Swamps when river levels are above 0.7 m Australian height datum.

Outflows from Reedy Lake can be managed by manipulating the outlet regulator. There is limited ability to manage outflows from Hospital Swamps due to the small capacity of the outlet regulator. High rainfall and floods in the Barwon River can cause overbank flows allowing water into the wetlands in an uncontrolled manner, regardless of how the regulators are manipulated.

Figure 3.6.1 Lower Barwon wetlands



Recent conditions

Despite lower water levels in the Barwon River and low rainfall in the catchment throughout 2014–15, Reedy Lake remained full throughout the year and Hospital Swamps remained close to full over winter.

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.

Reedy Lake was connected to the Barwon River throughout the year, with the level remaining full and largely static. The establishment of channel works, culvert installation and levees has resulted in Reedy Lake remaining full most years in the recent past. This has changed the natural wetting and drying cycle of the wetland and reduced its habitat diversity.

Scope of environmental watering in 2015–16

Potential environmental watering actions and associated environmental objectives are provided in Table 3.6.1.

Based on investigations and stakeholder consultation, a trial lowering of water levels at Reedy Lake and corresponding partial drying of the wetland is proposed for the 2015–16 year. Given the site has not been dried for 10 years, a monitoring program will be undertaken to monitor acid sulphate soils during the trial event. This monitoring program will also collect information about surface water, groundwater and contaminant levels, and ecological baseline data to inform future watering actions.

Concerns have been expressed about the impact that lowering water levels in Reedy Lake may have on commercial eel fishing interests. The Corangamite CMA is continuing to work with relevant government stakeholders and the affected eel fisher on this matter in relation to future watering activities for the site. This issue needs to be resolved before fully implementing the *Seasonal Watering Plan 2015–16*.

Coastal saltmarsh, Hospital Swamps, by Saul Vermeeren

Table 3.6.1 Potential environmental watering actions and objectives for the lower Barwon wetlands

Potential environmental watering[1]	Environmental objectives
Reedy Lake	
Autumn/winter/spring filling flows (during March/April–October)	▸ Maintain connectivity with the Barwon River ▸ Provide spring feeding for waterbirds in flooded vegetation and the wetland fringe ▸ Promote fish reproduction
Trial spring/early summer drawdown (during October–January) and continued low water levels throughout summer/autumn (January–March/April)[2,3]	▸ Provide wading bird habitat during summer ▸ Allow recruitment of aquatic macrophytes at wetland fringes ▸ Provide summer waterbird refuge and foraging habitat ▸ Improve lake shore salinity and promote soil salinisation ▸ Promote suitable conditions for threatened vegetation communities (such as coastal saltmarsh, herbfields and lignum shrubland) ▸ Provide increased habitat diversity (including salt pans, mudflats and shallow water) ▸ Reduce the threat of tall reeds in the system by increasing the salt content of the water and soil ▸ Reduce the threat of carp and associated impacts on flora and fauna ▸ Decay organic matter on wetland bed, to increase lake productivity when it is re-flooded ▸ Improve soil health and allow weathering of heavy metals in lake fringe soils
Hospital Swamps	
Autumn/winter filling flows (during May–November) Hospital Swamps will be connected to the Barwon River as much as possible by keeping the inlet and outlet open	▸ Create habitat and support macroinvertebrate populations ▸ Stimulate fish and waterbird breeding ▸ Allow fish to colonise the wetland from the river ▸ Allow soil and surface water salts to be diluted over winter ▸ Promote and sustain growth of important wetland vegetation communities
Summer/autumn drawdown (during December–March/April) The inlet to Hospital Swamps will be closed to allow water levels to drop through evaporation. During this period, the outlet will be opened for short periods of time if a summer storm increases water levels above 0.85 m Australian height datum	▸ Allow soil and surface water salts to accumulate over summer ▸ Initiate decomposition of organic matter on the wetland bed ▸ Promote suitable conditions for threatened vegetation communities such as coastal saltmarsh, herbfields and lignum shrubland ▸ Provide summer waterbird refuge and foraging habitat

1 Inflows to the wetlands will cease when levels in the Barwon River reach 0.7m Australian height datum, in line with provisions for accessing water under the environmental entitlement.

2 Concerns have been expressed about the impact that lowering water levels in Reedy Lake may have on commercial eel fishing interests. The Corangamite CMA is continuing to work with relevant government stakeholders and the affected eel fisher on this matter in relation to future watering activities for the site. This issue needs to be resolved before fully implementing the Seasonal Watering Plan 2015–16.

3 Water levels in the Big Hole area of the wetland will be maintained at a minimum of 0.4 m Australian height datum to provide summer refuge and ensure contaminants are not released from the soil.

Scenario planning

Table 3.6.2 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

The priority watering actions in the lower Barwon wetlands remain consistent under all scenarios, with a winter fill and summer drawdown planned. However, catchment conditions and unregulated flows will influence the extent to which the desired water levels can be achieved. For example, in a wet scenario it is unlikely that a substantial drawdown in Reedy Lake or Hospital Swamps will be achievable. As a result, the wetlands will be managed adaptively throughout the year based on the prevailing climatic conditions.

Corangamite CMA has undertaken a number of studies to determine the best way to manage the water regime at the wetlands, and particularly at Reedy Lake, in consultation with stakeholders. These studies have recommended more regular low water levels in Reedy Lake as the best approach to protect and improve the ecological values of the wetland. However, it is important to note that concerns have been expressed through continuing stakeholder consultation of the impact lowering water levels in Reedy Lake may have on commercial eel fishing interests. The Corangamite CMA is continuing to work with relevant government stakeholders and the affected eel fisher on this matter in relation to future watering activities for the site. This significant issue needs to be resolved prior to fully implementing the *Seasonal Watering Plan 2015–16*.

Table 3.6.2 Potential environmental watering for the lower Barwon wetlands under a range of planning scenarios

Planning scenario	Dry	Average	Wet
Expected river conditions	▸ Some natural inflows from the Barwon River in winter/spring ▸ Mild conditions over summer may assist in facilitating some drawdown of the wetland water levels	▸ Some natural inflows from the Barwon River in winter/spring ▸ Mild conditions over summer may assist in facilitating some drawdown of the wetland water levels	▸ Overbank flows likely to inundate the wetlands as a result of higher river flows, stormwater inflows and local rain/runoff ▸ Extensive drawdown of wetlands is unlikely
Reedy Lake			
Potential environmental watering	▸ Autumn/winter/spring filling flows (March/April–October) ▸ Trial spring/early summer/autumn drawdown (January–March/April)		
Hospital Swamps			
Potential environmental watering	▸ Autumn/winter/spring filling flows (May–November) ▸ Summer/autumn drawdown (December–March/April)		

Risk management

In preparing its seasonal watering proposal, Corangamite CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Engagement

The Corangamite CMA has engaged with key internal and external stakeholders and other relevant individuals in preparing the seasonal watering proposal for the Lower Barwon wetlands. These stakeholders are listed in Table 3.6.3.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 3.6.3 Key stakeholders engaged in the development of the Lower Barwon wetlands seasonal watering proposal

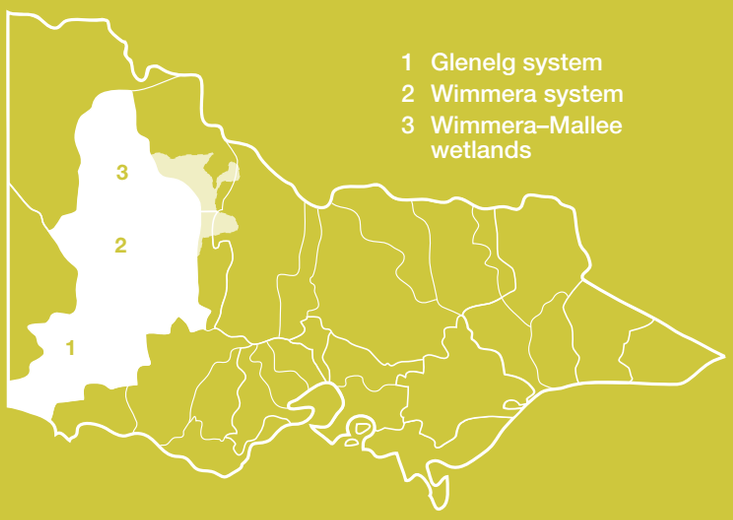
Stakeholder engagement
▸ Commercial eel fishers ▸ Department of Economic Development, Jobs, Transport and Resources (formerly DEPI Fisheries) ▸ Department of Environment, Land, Water and Planning ▸ Local landowners ▸ Lower Barwon Community Advisory Committee (with representatives of Field and Game Geelong Branch, Geelong Environment Council, Geelong Field Naturalists Club, Geelong Gun and Rod Association, Federation University, RMIT University, local landowners, community members, local commercial eel fishing licence holders, Parks Victoria, DELWP and VEWH plus additional invitees from the Department of Economic Development, Jobs, Transport and Resources and Environment Victoria ▸ Minister for Environment, Climate Change and Water, members for South Barwon and Bellarine, members for Western Victoria Region ▸ Parks Victoria ▸ Scientific and engineering consultants ▸ Victorian Environmental Water Holder

Reedy Lake, by the VEWH

Hospital Swamps, by Corangamite CMA

Section 4

Western Region



4.1 Western Region overview 65

4.2 Glenelg system 66

4.3 Wimmera system 72

4.4 Wimmera–Mallee wetlands 82

4.1 Western Region overview

Environmental water in the Western Region is shared between the Wimmera and Glenelg river systems and the Wimmera–Mallee wetlands. Important waterways that receive environmental water include sections of the Glenelg, Wimmera and MacKenzie rivers, and Mount William, Burnt and Bungalally creeks, as well as priority wetlands formerly supplied by the Wimmera–Mallee channel system.

Environmental water is supplied from the Wimmera–Mallee headworks system which also supplies towns, industries and farms across the Western Region. The complex network of channels and pipelines in the water supply and distribution systems managed by GWMWater enables water to be shifted between storages and delivered in different catchments, including from the Glenelg catchment to the Wimmera catchment.

Waterways in the Western Region are highly valued by local residents and visitors for their environmental and aesthetic values, and are widely used for recreational activities such as fishing, camping, swimming, boating, bushwalking and wildlife watching.

Seasonal outlook 2015–16

Inflows to the Wimmera–Mallee headworks system are highly variable. Though the system experienced significant floods in September 2010 and January 2011, which significantly boosted streamflows and storage levels, this was followed by a sequence of dry years. Due to the low rainfall and catchment inflows during this period, environmental water carried over from previous years was important in meeting demands in 2014–15. Conditions in 2015–16 are again expected to be dry, with a high likelihood of low allocations being available to support environmental watering in the region, especially in the early part of the season. Again, carryover from 2014–15 will be critical for supplying demand in the coming year.

If the forecast dry conditions prevail in 2015–16, environmental watering in the Western Region in 2015–16 will be limited to protecting the water quality in the Wimmera and Glenelg rivers to maintain habitat for native fish. Due to the likely low water availability, deliveries will largely be restricted to the summer/autumn period, when water quality risks are highest. There will likely be periods of cease-to-flow in both river systems. Opportunities will be assessed to protect critical environmental values across the system, including consideration of supplementing water availability through trade. The focus of environmental watering in the Wimmera–Mallee wetlands will be providing refuges within the dry landscape to support local fauna.

Delivering outcomes under the Murray-Darling Basin Plan

The Wimmera system forms part of the larger Murray-Darling Basin and water diversions and environmental water deliveries in this region are also subject to the requirements of the Murray-Darling Basin Plan.

The VEWH's environmental planning and delivery is consistent with the requirements of the Basin Plan. The potential environmental watering outlined in section 4 fulfil Victoria's obligations under section 8.26 of the plan to identify annual environmental watering priorities for Victoria's water resource areas.

Refer to section 5 for further information about the Murray-Darling Basin Plan.

Platypus near the MacKenzie River, by Josh Griffiths

4.2 Glenelg system

Waterway manager – Glenelg Hopkins Catchment Management Authority

Storage manager – GWMWater

Environmental water holder – Victorian Environmental Water Holder

Environmental values

The lower section of the Glenelg River has been recognised as one of two biodiversity hotspots in Victoria due to the high-value aquatic life it supports, including the endangered Glenelg freshwater mussel and Glenelg spiny crayfish. It is also home to platypuses and important native fish populations including river blackfish, estuary perch and pygmy perch, some of which migrate long distances upstream from the Glenelg River estuary to complete their lifecycles. Frasers Swamp is another important feature of the upper Glenelg system, supporting a healthy growling grass frog population.

The Glenelg River supports a variety of riparian vegetation communities including the endangered Wimmera bottlebrush. Riparian and floodplain vegetation is comprised of river red gums with paperbark and tea-tree understorey.

Social and economic values

The Glenelg system is valued for a wide range of fishing opportunities. From Rocklands Reservoir down to the estuary, the river is about 380 km long. Several fishing competitions are held on the river, in addition to other recreational activities including canoeing, bird watching and camping. Many landholders rely on the Glenelg River for stock water and use the productive floodplains for grazing. The river also provides tourism opportunities and supports businesses within townships such as Harrow, Casterton, Dartmoor and Nelson. The waterways in the Glenelg system continue to be places of importance for Traditional Owners and their Nations in the region.

Environmental watering objectives in the Glenelg system
Maintain a healthy and diverse mix of riverside plant life
Protect and boost populations of native fish including the threatened variegated pygmy perch. Provide flows for fish to move upstream and downstream and between the river and the ocean, encouraging fish such as eel, bream, estuary perch and tupong to spawn (release eggs)
Maintain a wide range of waterbugs to provide energy, break down organic matter and support the river's food chain
Move sand built up on the river bed to provide healthy habitat pools and places to shelter for fish, platypus and other water animals such as the critically endangered Glenelg freshwater mussel and endangered Glenelg spiny crayfish

System overview

The Glenelg River supports a wide range of flow-dependent environmental values including rare and threatened flora and fauna. This diversity is driven by the range of landforms, climate conditions and connection with the estuary.

The Glenelg River is an integral part of the Wimmera–Mallee headworks system. It is regulated at Moora Moora Reservoir and Rocklands Reservoir. Water is also diverted from the Glenelg catchment to the Wimmera catchment by the Moora Moora channel and the Rocklands–Toolondo–Taylors channel, and at three weirs on the upper Wannon River. Environmental water is managed in the main stem of the Glenelg River below Rocklands Reservoir.

Due to their high environmental value, the priority river reaches in the Glenelg system are reach 1a (Rocklands Reservoir to 5-Mile Outlet), reach 1b (5-Mile Outlet to Chetwynd River) and reach 2 (Chetwynd River to Wannon River). Environmental water in the Glenelg system is released from Rocklands Reservoir for reach 1a via the reservoir wall outlet and for reach 1b via the 5-Mile and 12-Mile outlets, with through flow-delivering water to reach 2. The Glenelg River reach 3 and estuary also benefit from environmental water releases.

Although currently not managed for environmental needs, the Glenelg River above Rocklands Reservoir (reach 0) runs mostly through the Grampians National Park which retains significant environmental values. Further work is being undertaken to document these values and the flow requirements of this reach.

Figure 3.6.1 The Glenelg system

Recent conditions

The Glenelg catchment was dry in 2014–15 despite strong inflows to the system in July and early August 2014. Inflows fell significantly after this period although a minor rainfall event in January 2015 resulted in a small increase in inflows.

The low inflows resulted in low allocations of 48 per cent (to May 2015) and severely restricted passing flows from Rocklands Reservoir. Actions in 2014–15 relied heavily on environmental water carried over from 2013–14.

In July and August 2014, environmental water was used to supplement unregulated and passing flows to maintain baseflows through winter. Following the delivery of a spring fresh in October, flows transitioned to lower summer baseflows. The transition to summer baseflows was earlier than usual and was based on the hot, dry climatic conditions and resulting vegetation responses, with plants flowering much earlier than usual.

The bulk of summer and autumn flows was provided by environmental releases. Summer storms contributed to some river flow but a dry catchment severely restricted runoff. In light of the low allocations across the Wimmera–Glenelg system, and low forecast allocations in 2015–16, watering priorities were reviewed and revised throughout the 2014–15 year. Particular emphasis was placed on managing threats to key values, particularly water quality, as Glenelg River releases were scaled back to target a limited range of flows, mostly in reach 1b.

A cease-to-flow was trialled in autumn 2015 when temperatures reduced and the risk of poor water quality lessened. Knowledge gained through this trial will be used to inform management in drier years when there may be longer cease-to-flow periods.

Saline groundwater intrusion in deep pools is an ongoing threat to the unique ecology of the Glenelg River. Water quality monitoring was undertaken at key sites in reach 1b to monitor salinity and dissolved oxygen levels. The information was used to inform and monitor the impact of releases. Monitoring demonstrated that a layer of fresh and well-oxygenated water was maintained at the surface of key sites in the reach due to environmental water releases. Water quality at depth did decline after periods of lower flow but fresh events were effective at breaking down stratification and restoring water quality in these pools.

Glenelg River native fish populations continue to recover in response to environmental watering. Fish monitoring has shown that diadromous species (those that use both the estuary and freshwater part of the system, such as eel,

bream, estuary perch and tupong) have responded strongly to environmental watering and a suite of complementary river health works in the system, including the installation of fishways. Since 2011, estuary perch have increased their upstream range in the Glenelg River by 160 km. Other non-migratory fish species (such as variegated pygmy perch) showed a strong spawning response and were the most abundant species caught in 2015 Glenelg River fish surveys.

Scope of environmental watering

The full range of potential environmental watering actions and their environmental objectives are explained in Table 4.2.1 and illustrated in Figure 4.2.2. The environmental watering proposed to be undertaken in 2015–16 is discussed under Scenario planning below.

Table 4.2.1 Potential environmental watering actions and objectives for the Glenelg system

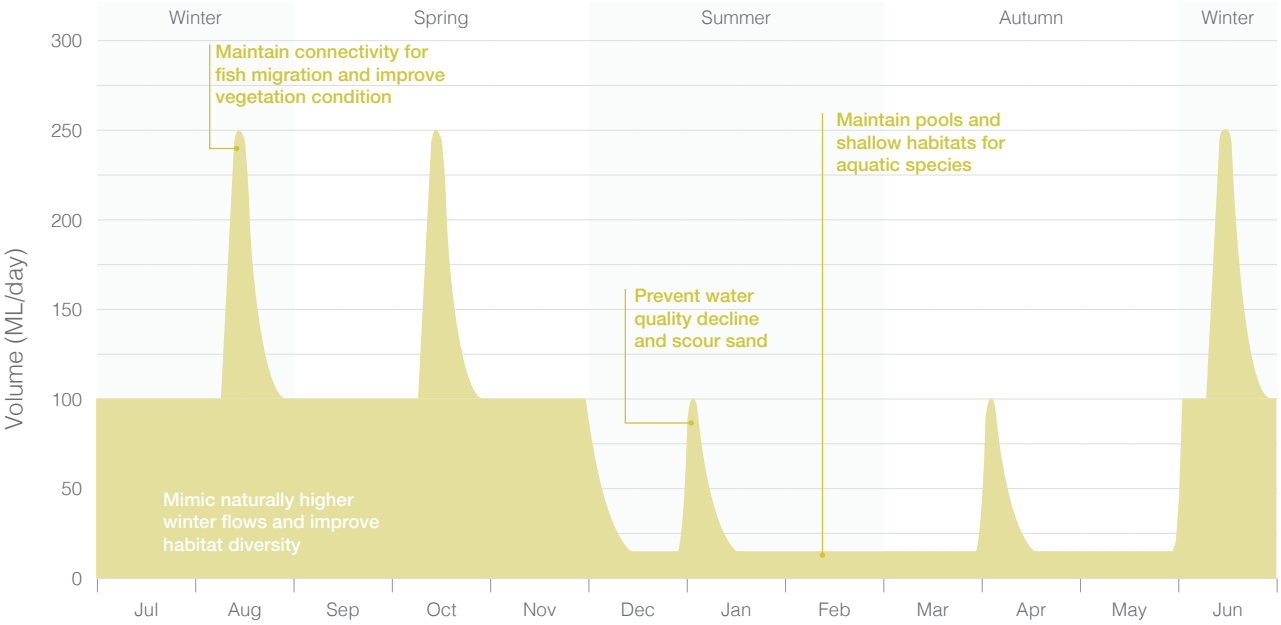
Potential environmental watering	Environmental objectives
Summer/autumn freshes targeting reach 1a (2 freshes of 60 ML/day for 2–3 days each during December–May)	▸ Provide variable flow during low-flow season to support macroinvertebrates, diverse habitats and water quality ▸ Facilitate localised scouring of sand for fish habitat ▸ Maintain condition of emergent vegetation by wetting lower banks ▸ Flush pools to prevent water quality decline during low flows
Summer/autumn freshes targeting reaches 1b (2 freshes of 100 ML/day for 2–3 days each during December–May)	
Summer/autumn freshes targeting reach 2 (2 freshes of 150 ML/day for 2–3 days each during December–May)	
Summer/autumn baseflows targeting reach 1a (10 ML/day or natural during December–May)[1]	▸ Protect against rapid water quality decline over low-flow period ▸ Maintain edge habitats, pools and shallow water habitat availability for fish, macroinvertebrates and platypuses ▸ Maintain a near-permanent inundated stream channel to prevent excessive instream terrestrial species growth and promote instream vegetation
Summer/autumn baseflows targeting reach 1b (15 ML/day or natural during December–May)[1]	
Summer/autumn baseflows targeting reach 2 (25 ML/day or natural during December–May)[1]	
Winter/spring freshes targeting reach 1b (1–5 freshes of 250 ML/day for 1–5 days during June–November)	▸ Wet benches to improve condition of emergent vegetation and maintain habitat diversity ▸ Increase the baseflow water depth and connectivity to provide stimulus and opportunity for fish movement ▸ Facilitate localised scouring of sand for fish habitat ▸ Maintain pools and inundate benches to improve instream habitat and vegetation diversity
Winter/spring freshes targeting reach 2 (1–5 freshes of 300 ML/day for 1–5 days during June–November)	
Winter/spring baseflows targeting reach 1a (60 ML/day or natural during June–November)[1,3]	▸ Provide desirable water quality conditions for fish, macroinvertebrates and aquatic vegetation ▸ Maintain seasonality of flow and improve habitat diversity by increasing wetted area from summer period ▸ Maintain shallow water habitat availability for fish and macroinvertebrates and facilitate annual dispersal of juvenile platypuses
Winter/spring baseflows targeting reach 1b (100 ML/day or natural during June–November) [1,3]	
Winter/spring baseflows targeting reach 2 (160 ML/day or natural during June–November) [1,3]	

1 Cease-to-flow events occur naturally in the Glenelg system and may be actively managed. In the most recent flows study, the recommendation is that cease-to-flow events should occur as infrequently as possible and not exceed the duration of events that might have occurred naturally, to reduce stress on environmental values. Cease-to-flow events should be followed with a fresh.

2 Winter/spring freshes in reach 1a are important to the health of the Glenelg River but due to operational constraints and potential flooding risks achievement relies solely on natural events.

3 Passing flows provided under the environmental entitlement generally provide winter/spring baseflows. However, if passing flows are reduced, managed environmental water releases may be required to supplement them or to ensure appropriate rates of rise and fall and provide appropriate conditions during fresh events.

Figure 4.2.2 Potential environmental watering in the Glenelg River reach 1b



Note: This figure is for illustrative purposes only and depict watering that has been identified under the average planning scenario. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Scenario planning

Table 4.2.2 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

The potential watering actions identified in Table 4.2.2 reflect most flow recommendations from the Glenelg River flows study under different climatic scenarios and have not been constrained by the available supply of environmental water. While the actions are similar in each climatic scenario, the magnitude, duration and/or frequency differ between scenarios, and therefore the volume required under each scenario also differs. For example, for Glenelg River in a drought scenario, a 250 ML per day winter/spring fresh for one day is recommended once per year, however in the wet scenario the same fresh is recommended to occur five times per year for five days each time.

In light of the limited water availability expected, it will not be possible to fully deliver all potential environmental watering actions outlined in Table 4.2.2. The focus in 2015–16 will be on protecting water quality in the river to maintain habitat for native fish.

Environmental water deliveries will likely be targeted to manage threats during high-risk periods, with limited scope to undertake winter watering unless there are significant inflows and allocations in the early part of the water year. While the aim is to maintain environmental values in the system, there is still a high risk of poor water quality and associated adverse impacts at times due to shortfalls in water availability. Environmental watering will typically occur in response to triggers, particularly associated with managing water quality risks, as there is unlikely be sufficient water to deliver the full recommended flows.

Under most scenarios, there will likely be periods of cease-to-flow in summer due to the low water availability. Where possible, the duration of these cease-to-flow periods will be carefully managed and monitored to minimise adverse impacts. Due to the expected low water availability, this may not be possible in all cases and prolonged cease-to-flow periods may be experienced.

If the wet scenario eventuates, watering is likely to be more extensive, reflecting the increased water availability. However, given the low water availability compared to previous years, there may be a focus on reserving some water for use in the early part of the 2016–17 water year. Wet conditions will also reduce the need to use regulated allocations, due to increased passing and unregulated flows.

Glenelg spiny crayfish, by Glenelg Hopkins CMA

Table 4.2.2 Potential environmental watering for the Glenelg system under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	▸ No passing, compensation or unregulated flows	▸ Restricted passing and compensation flows and limited unregulated flows	▸ Some passing, compensation and unregulated flows, particularly during winter/spring	▸ Some passing flows and compensation flow and significant unregulated flows during winter/spring resulting in sustained baseflows
Expected availability of environmental water[1]	▸ 8,000 ML carryover ▸ 5,273 ML VEWH allocation ▸ 0 ML CEWH allocation[2] ▸ 13,273 ML total[3]	▸ 8,000 ML carryover ▸ 12,878 ML VEWH allocation ▸ 0 ML CEWH allocation[2] ▸ 20,878 ML total[3]	▸ 8,000 ML carryover ▸ 25,553 ML VEWH allocation ▸ 0 ML CEWH allocation[2] ▸ 33,553 ML total[3]	▸ 8,000 ML carryover ▸ 40,560 ML VEWH allocation ▸ 560 ML CEWH allocation[2] ▸ 49,120 ML total[3]
Potential environmental watering	▸ Summer/autumn fresh flows reaches 1a & 1b ▸ Winter/spring fresh flows reach 1b ▸ Summer/autumn baseflows reaches 1a & 1b ▸ Winter/spring baseflows reaches 1a & 1b	▸ Summer/autumn fresh flows reaches 1a & 1b ▸ Winter/spring fresh flows reach 1b ▸ Summer/autumn baseflows reaches 1a & 1b ▸ Winter/spring baseflows reaches 1a & 1b	▸ Summer/autumn fresh flows reaches 1a, 1b & 2 ▸ Summer/autumn baseflows reaches 1a, 1b & 2 ▸ Winter/spring fresh flows reaches 1b & 2 ▸ Winter/spring baseflows reaches 1a, 1b & 2	▸ Summer/autumn fresh flows reaches 1a, 1b & 2 ▸ Summer/autumn baseflows reaches 1a, 1b & 2 ▸ Winter/spring fresh flows reaches 1b & 2 ▸ Winter/spring baseflows reaches 1a, 1b & 2
Glenelg system				
Possible volume of environmental water required to achieve objectives	▸ 25,500 ML	▸ 27,350 ML	▸ 40,980 ML[4]	▸ 39,540 ML[4]
Wimmera system				
Possible volume of environmental water required to achieve objectives	▸ 42,337 ML	▸ 47,330 ML	▸ 55,423 ML[4]	▸ 58,713 ML[4]
Total possible environmental water requirements in the Wimmera and Glenelg systems				
Possible volume of environmental water required to achieve objectives[5]	▸ 67,837 ML	▸ 74,680 ML	▸ 96,403 ML	▸ 98,253 ML

1 Environmental water in the Wimmera–Glenelg system is shared between the Glenelg and Wimmera systems. The volumes specified indicate the likely availability across the shared systems.
2 Commonwealth environmental water is only available for use in the Wimmera system.
3 This volume is a forecast of the total water likely to be available under the VEWH entitlement in 2015–16, including carryover and the forecast allocation for the complete water year. The forecast opening allocation for each climate scenario is 0 ML under all scenarios, meaning the only water available is likely to be the carryover of about 8,000 ML at the start of the water year.
4 This volume assumes that passing flows make some contribution to achieving the potential watering actions. The volume of passing flows is highly variable from year to year and depends on allocations and inflows received. The compensation flow has not been included in this assumption as the likely volume this year is expected to be very low given the low forecast allocations.
5 Figures take into account the possible volume required in both the Glenelg and Wimmera systems. A prioritisation process will be undertaken in consultation with the Wimmera and Glenelg Hopkins CMAs to determine the potential watering actions that will be undertaken in each system in the 2015–16 year.

Risk management

In preparing its seasonal watering proposal, Glenelg Hopkins CMA considered and assessed risks and identified mitigating strategies relating to implementing environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Engagement

The Glenelg Hopkins CMA engaged key stakeholders when preparing the seasonal watering proposal for the Glenelg system. Table 4.2.3 shows these stakeholders.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 4.2.3 Key stakeholders engaged in the development of the Glenelg system seasonal watering proposal key stakeholders

Stakeholder engagement
▸ Indigenous groups – Gunditj Mirring (Registered Aboriginal Party)
▸ Parks Victoria
▸ Glenelg Hopkins CMA Advisory Group (including representatives of key stakeholder groups and landholders in the region)
▸ Community members (through direct engagement)
▸ GWMWater
▸ Wimmera CMA
▸ Victorian Environmental Water Holder

Sandford weir and fishway on the Glenelg River, by Glenelg Hopkins CMA

Tupong, by Glenelg Hopkins CMA

4.3 Wimmera system

Waterway manager – Wimmera Catchment Management Authority

Storage manager – GWMWater

Environmental water holders – Victorian Environmental Water Holder and Commonwealth Environmental Water Holder

Environmental values

The Wimmera River and its tributaries boast a wide range of environmental and social values. The Wimmera system is home to many significant plant and animal species including one of Victoria's few self-sustaining populations of freshwater catfish. It also contains self-sustaining endemic fish species including flat-headed gudgeon and Australian smelt.

The MacKenzie River contains the only stable population of platypus in the Wimmera and also supports good populations of native fish as well as macroinvertebrates and turtles. Given the diverse habitat and fish species found in the MacKenzie River, in dry times in particular, it acts as a refuge for fish populations.

Protecting and restoring riparian vegetation communities is an environmental water objective for the Burnt and Bungalally creeks. Upper Burnt Creek contains an important native fish community and a population of threatened western swamp crayfish. Burnt Creek in particular provides important habitat corridors for both aquatic and terrestrial species. Mount William Creek is a priority reach to assist in maintaining the creek's healthy populations of endemic fish, in both the upper and lower sections.

Social and economic values

The Wimmera River system offers many popular recreational activities such as boating, rowing, water skiing, fishing and camping. It also provides important amenity for Wimmera residents in what is a very dry landscape. There are several events held on the waterways in the Wimmera catchment including the annual Kanamaroo Festival and Horsham fishing competition on the Wimmera River at Horsham. The waterways in the Wimmera system continue to be important for Traditional Owners and their Nations in the region.

Environmental watering objectives in the Wimmera system
Protect and boost diverse populations of native fish including one of Victoria's few self-sustaining populations of freshwater catfish
Maintain water quality to provide suitable conditions for fish and other water-dependent plants and animals
Provide flows to support platypuses, maximising habitat in which they can rest, breed and feed
Improve the condition, abundance and diversity of aquatic, emergent and riparian vegetation
Support communities of waterbugs which provide energy, break down dead organic matter and support the river's food chain

System overview

The Wimmera River commences in the Pyrenees Range near Elmhurst and receives flow from several tributaries including the MacKenzie River and the Mount William, Burnt and Bungalally creeks. All of these can receive environmental water, as can the Wimmera River downstream of lower Mount William Creek. Just east of Mt Arapiles the Wimmera River swings to the north and continues through Dimboola and Jeparit to Lake Hindmarsh, Victoria's largest freshwater lake. During exceptionally wet periods, Lake Hindmarsh overflows into Outlet Creek and on to Lake Albacutya, an internationally recognised, Ramsar-listed wetland, extending to the Wirrengren Plain in the southern Mallee.

Water in the Wimmera system is stored in three onstream reservoirs: Lake Wartook on the MacKenzie River, Lake Lonsdale on Mount William Creek and Lake Bellfield on Fyans Creek, as well as in several offstream storages: Taylors Lake, Lake Fyans and Toolondo Reservoir. The channel system enables water movement between storages and from the Glenelg to the Wimmera system. Inter-basin transfers of water can occur from Rocklands Reservoir (in the Glenelg system) via the Rocklands–Toolondo Channel and from Moora Moora Reservoir via the Moora Channel to the Wimmera system. Water from the system is also delivered to towns and several Wimmera–Mallee wetlands in the Loddon, Avoca and Mallee catchments.

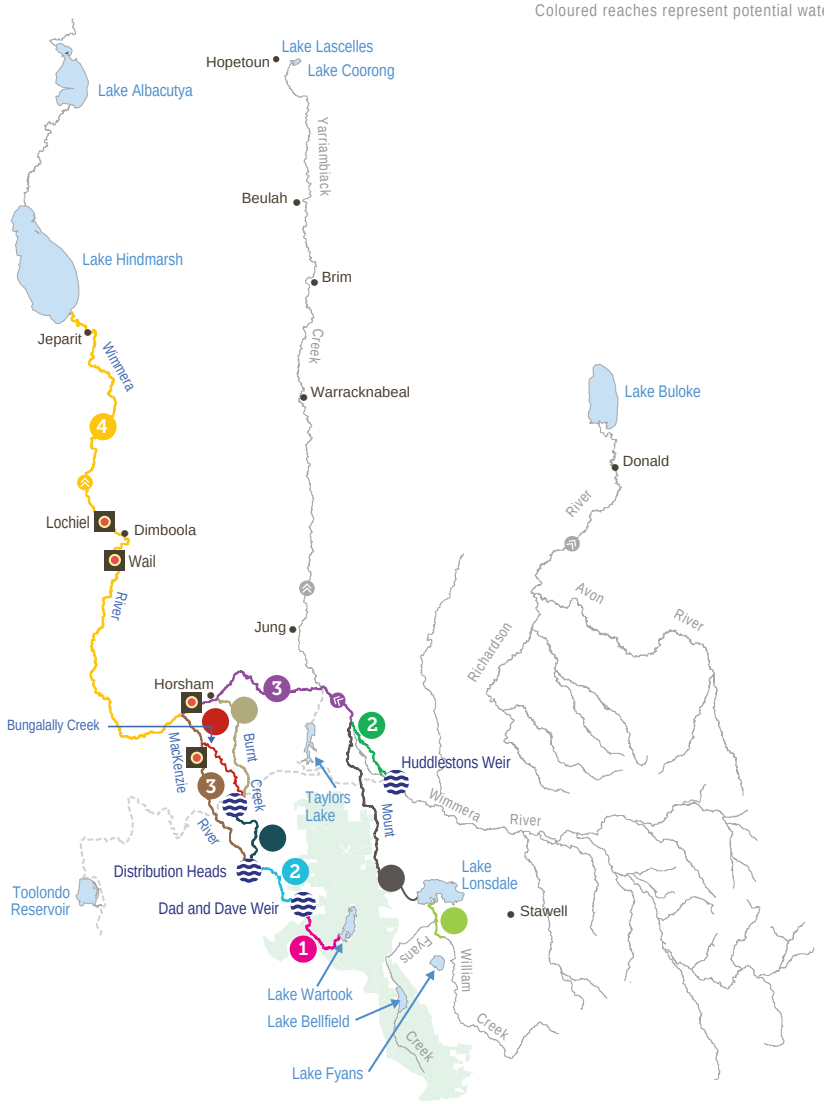
Passing flows are provided to the Wimmera River and to Mount William and Fyans creeks. Where possible, environmental water releases will be combined with passing flows, unregulated flows and the delivery of consumptive use water en route, to optimise environmental outcomes.

Priority reaches for environmental watering in the Wimmera system are the Wimmera River reach 4, MacKenzie River reaches 2 and 3, upper and lower Mount William Creek, upper and lower Burnt Creek and Bungalally Creek, due to the range of environmental values they support.

Figure 4.3.1 The Wimmera system

Reach 2 — Wimmera River: Huddlestons Weir to Mt William Creek
Reach 3 — Wimmera River: Mt William Creek to MacKenzie River
Reach 4 — Wimmera River: MacKenzie River to Lake Hindmarsh
Reach 1 — MacKenzie River: Lake Wartook to Dad and Dave Weir
Reach 2 — MacKenzie River: Dad and Dave Weir to Distribution Heads
Reach 3 — MacKenzie River: Distribution Heads to Wimmera River
Upper Burnt Creek: Distributions Heads to Toolondo Channel
Lower Burnt Creek: Toolondo Channel to Wimmera River
Bungalally Creek: Toolondo Channel to MacKenzie River
Lower Mount William Creek: Lake Lonsdale to Wimmera River
Upper Mount William Creek: upstream of Lake Lonsdale
Measurement point
Water infrastructure
Town
Indicates direction of flow

Grey river reaches have been included for context. The numbered reaches indicate where relevant environmental flow studies have been undertaken. Coloured reaches represent potential watering sites.



Recent conditions

Dry conditions prevailed in the Wimmera system throughout 2014–15 with minimal rainfall and catchment inflows. Allocations to May 2015 remained low (48 per cent) and passing flows were largely absent. The low inflows resulted in low allocations of 48 per cent (to May 2015) and severely restricted passing flows from Lake Lonsdale. Actions in 2014–15 relied heavily on environmental water carried over from 2013–14. Given the low water availability, the focus in 2014–15 was on building resilience in fish, platypus, crayfish, turtle, macroinvertebrate and plant communities in preparation for potentially dry conditions in 2015–16.

Environmental watering occurred in the Wimmera and MacKenzie rivers and upper and lower Mount William and Burnt creeks in 2014–15. While many flow targets were not completely achieved due to low water availability, the releases assisted in maintaining water quality and a diverse range of habitats, leading to several positive environmental outcomes.

Recent fish surveys in the Wimmera River show an increase in native fish populations since 2010, with the flathead gudgeon populations increasing by 98 percent and golden perch by 91 percent. A significant increase in abundance and diversity was also found in the MacKenzie River.

In February 2015, Lake Lonsdale effectively dried and water could no longer be delivered to lower Mount William Creek. In May 2015, water was delivered to a refuge pool at Mokepilly on upper Mount William Creek (upstream of Lake Lonsdale) to provide drought refuge for the native fish in this area.

In March 2015, three female platypuses were found in the MacKenzie River, providing further evidence of the growth in the population of platypuses found in this river. A population of Peron's tree frog was also found in Burnt Creek in 2014, the first time this species has been found in the Wimmera catchment.

In response to the recent and forecast dry conditions, environmental releases were scaled back in March 2014 with cease-to-flow events implemented in all creeks and rivers except Burnt Creek and MacKenzie River (reach 2). The risk to the plants and animals at this cooler time of year was considered less than the risk in the summer months if the water was not available for use in summer 2015–16. Throughout this period, water was delivered to Burnt Creek and MacKenzie River (reach 2) to maintain some habitat for fish and platypuses. Wimmera CMA closely monitored the water quality in all waterways to manage risks to environmental values.

Scope of environmental watering

The full range of potential environmental watering actions and their environmental objectives are explained in Table 4.3.1 and illustrated in figures 4.3.2 to 4.3.6. The environmental watering proposed to be undertaken in 2015–16 is discussed in the Scenario planning section below.

Table 4.3.1 Potential environmental watering actions and objectives for the Wimmera system

Potential environmental watering	Environmental objectives
Wimmera River (reach 4)	
Summer/autumn baseflows (15 ML/day or natural during December–May)[1]	▸ Maintain edge habitats in deeper pools and runs, and shallow water habitat availability for macroinvertebrates and native fish from the local area ▸ Maintain near-permanent inundated stream channel for riparian vegetation and to prevent excessive instream terrestrial species growth
Winter/spring baseflows (30 ML/day during June–November)	▸ Provide flow variability to maintain diversity of habitats
Summer/autumn freshes (1–3 freshes of 70 ML/day for 2–7 days during December–May)	▸ Provide variable flow during low-flow season for macroinvertebrates, fish movement and to maintain water quality and diversity of habitat
Winter/spring freshes (1–5 freshes of 70 ML/day for 1–4 days during June–November)	▸ Increase the baseflow water depth to provide stimulus for fish movement ▸ Provide flow variability to maintain water quality and diversity of fish habitats
Moderate winter/spring freshes (1–3 freshes of 200 ML/day for 1–3 days during June–November)[2]	▸ Wet lower benches, entraining organic debris and promoting diversity of habitat
Higher winter/spring freshes (1–2 freshes of up to 1,300 ML/day for 2–3 days during June–November)	▸ Flush surface sediments from hard substrates to support macroinvertebrates ▸ Wet higher benches, entraining organic debris and promoting diversity of habitat
MacKenzie River (reach 2 and 3)	
Year-round baseflows (of 2–27 ML/day or natural, year-round)[1]	▸ Maintain edge habitats and deeper pools and runs for macroinvertebrates ▸ Maintain inundated stream channel to protect and restore riparian and floodplain vegetation communities including the Wimmera bottlebrush and support aquatic vegetation for fish habitat ▸ Maintain sufficient area of pool habitat for intact fish communities and shallow water habitats for small-bodied fish ▸ Facilitate annual dispersal of juvenile platypuses into the Wimmera River

Potential environmental watering	Environmental objectives
Summer/autumn freshes (3–4 freshes of 5–50 ML/day for 2–7 days each during December–May)	▸ Provide variable flow during low-flow season for macroinvertebrates, fish movement and to maintain water quality and diversity of habitat
Winter/spring freshes (5 freshes of 35–55 ML/day for 2–7 days during June–November)	▸ Stimulate fish movement, maintain water quality and diversity of habitat
Higher winter/spring freshes (1–5 freshes of up to 190 ML/day for 1–4 days during June–November)	▸ Stimulate fish movement and maintain water quality ▸ Flush surface sediments from hard substrates to support macroinvertebrates ▸ Wet higher benches, entraining organic debris and promoting diversity of habitat
Burnt Creek	
Year-round baseflows targeting upper Burnt Creek (1 ML/day or natural, year-round)[1]	▸ Maintain edge habitats and deeper pools and runs for macroinvertebrates ▸ Maintain inundated stream channel to protect and mimic riparian and floodplain vegetation communities, and prevent excessive stream bed colonisation by terrestrial vegetation species ▸ Maintain sufficient area of pool habitat for intact fish communities and shallow water habitats for small-bodied fish
Summer/autumn freshes targeting upper Burnt Creek (3 freshes of 30 ML/day for 2–7 days each during December–May)	▸ Prevent water quality decline by flushing pools during low flows
Winter/spring freshes targeting upper Burnt Creek (1–5 freshes of 55 ML/day for 3–7 days during June–November)	▸ Provide variable flow for fish movement and diversity of habitat ▸ Flush surface sediments from hard substrates for macroinvertebrates
Higher winter/spring freshes targeting upper Burnt Creek (1–3 freshes of up to 160 ML/day for 1–3 days during June–November)	▸ Disturb biofilms present on rocks or woody debris to support macroinvertebrates
Year-round fresh targeting lower Burnt Creek (1 fresh of 45 ML/day or natural for 2 days at any time)	▸ Inundate riparian vegetation to maintain condition and facilitate recruitment ▸ Entrain organic debris in the channel to support macroinvertebrates ▸ Maintain structural integrity of channel
High-flow fresh targeting lower Burnt Creek (1 fresh of 90 ML/day for 1 day during August–November)	▸ Inundate floodplain vegetation to maintain condition and facilitate recruitment ▸ Entrain organic debris from the floodplain to support macroinvertebrates ▸ Maintain floodplain geomorphic features
Mount William Creek	
Summer/autumn top-up of upper Mount William Creek pools (December–May)	▸ Maintain habitat for native fish
Year-round baseflows targeting lower Mount William Creek (5 ML/day or natural, year-round)[1]	▸ Maintain edge habitats and shallow water habitat for macroinvertebrates and endemic fish ▸ Maintain inundated stream channel to protect and restore riparian and floodplain vegetation communities and prevent excessive stream bed colonisation by terrestrial vegetation species
Summer/autumn freshes targeting lower Mount William Creek (3 freshes of 20–30 ML/day for 2–7 days during December–May)	▸ Prevent water quality decline by flushing pools during low flows ▸ Provide variable flow during low-flow season for macroinvertebrates, fish movement and to maintain water quality and diversity of habitat
Winter/spring freshes targeting lower Mount William Creek (1–5 freshes of up to 100 ML/day for 1–7 days during June–November)	▸ Wet benches, entrain organic debris and promote diversity of habitat ▸ Flush surface sediments from hard substrates to support macroinvertebrates
Higher winter/spring freshes targeting lower Mount William Creek (1–3 freshes of up to 500 ML/day for 1–3 days during June–November)	▸ Wet highest benches, entrain organic debris and promote diversity of habitat
Bungalally Creek	
Year-round fresh (1 fresh of 60 ML/day for 1–2 days at any time)	▸ Inundate riparian zone to maintain condition and facilitate recruitment for riparian vegetation communities ▸ Maintain structural integrity of channel and prevent loss of channel capacity

1 Cease-to-flow events occur naturally in the Wimmera system and may be actively managed. In the most recent flows study, the recommendation is that cease-to-flow events should occur as infrequently as possible and not exceed the duration of events that might have occurred naturally, to reduce stress on environmental values. Cease-to-flow events should be followed with a fresh lasting at least seven days.

2 Dependent on catchment conditions, the timing of this fresh may vary to optimise environmental outcomes.

Figure 4.3.2 Potential environmental watering in the Wimmera River reach 4

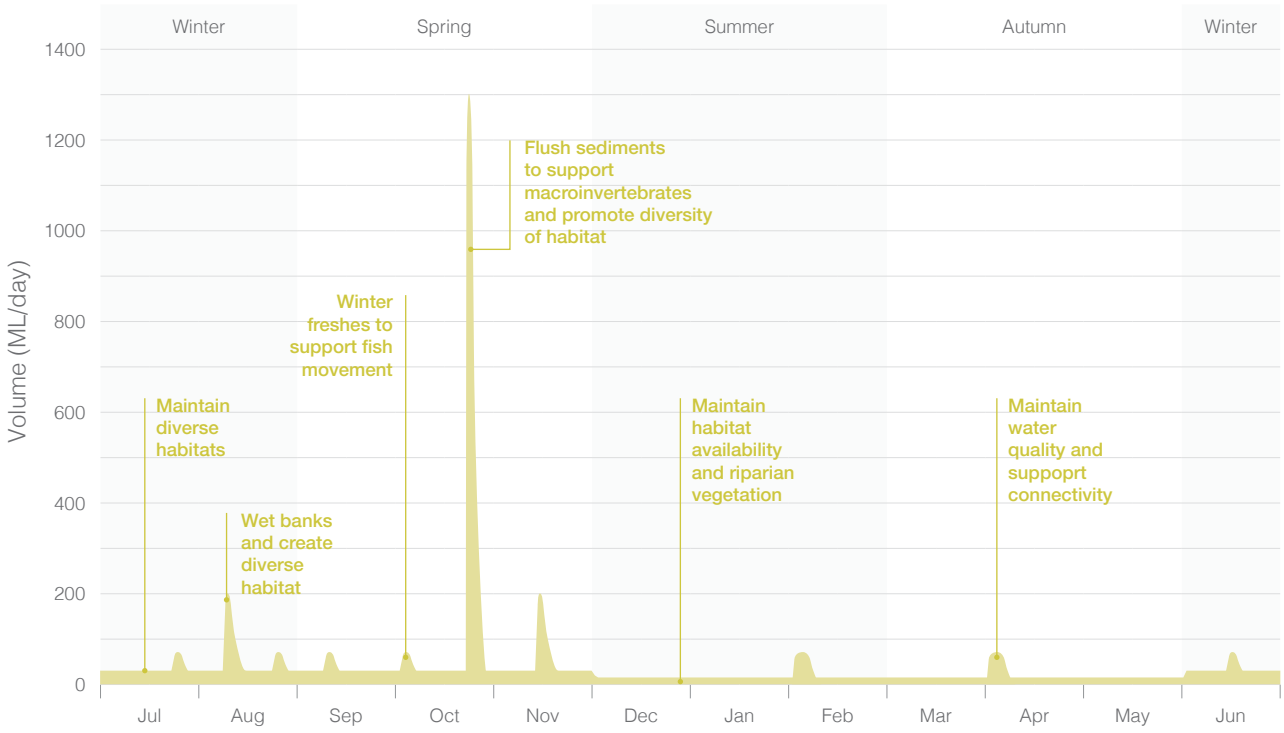


Figure 4.3.3 Potential environmental watering in the MacKenzie River reach 3

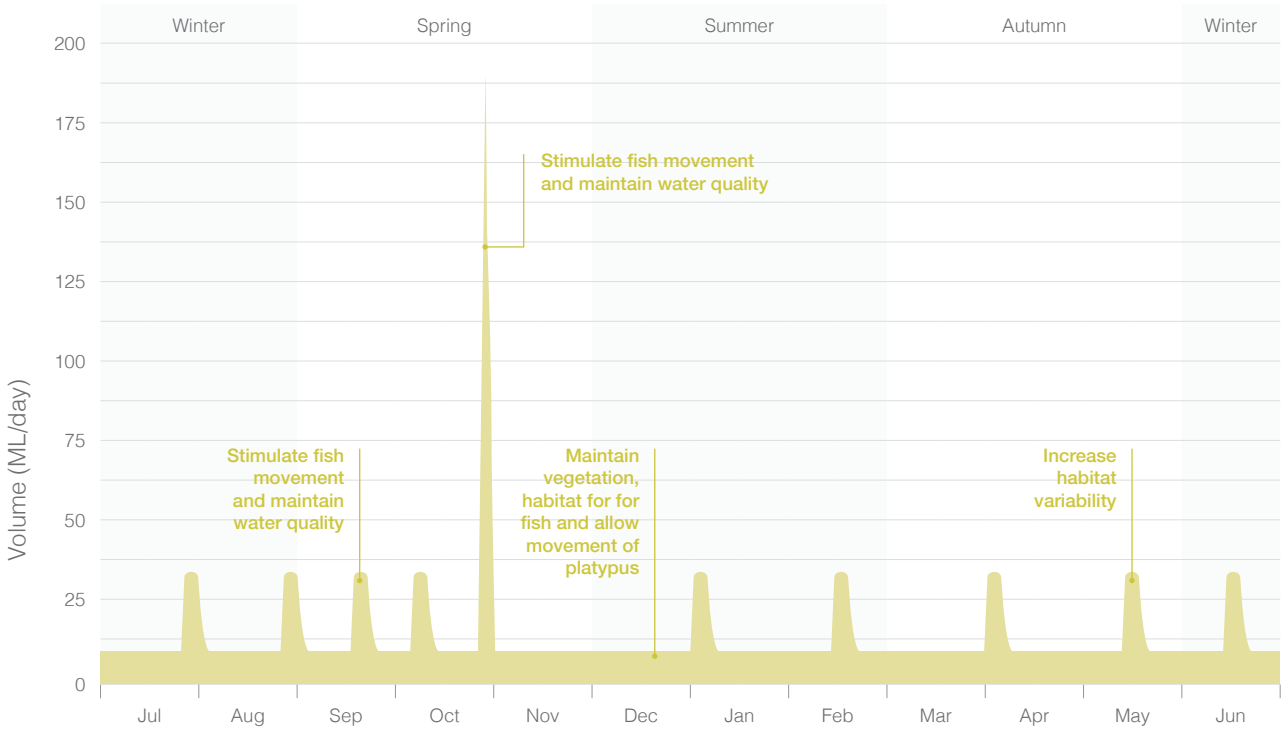


Figure 4.3.4 Potential environmental watering in upper Burnt Creek

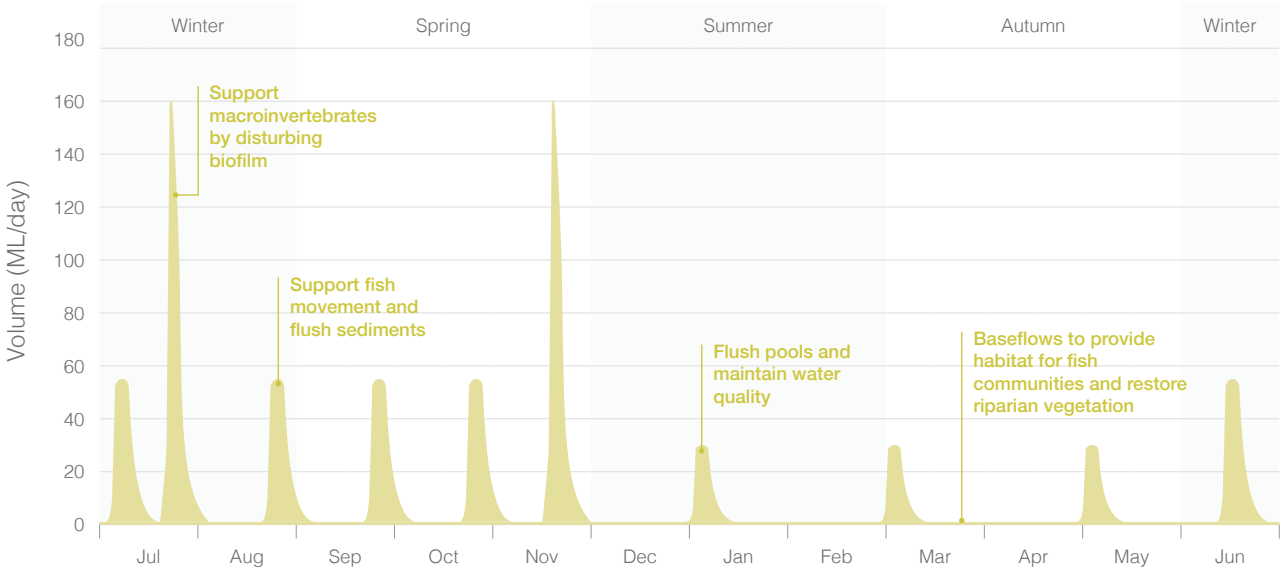


Figure 4.3.5 Potential environmental watering in lower Mount William Creek

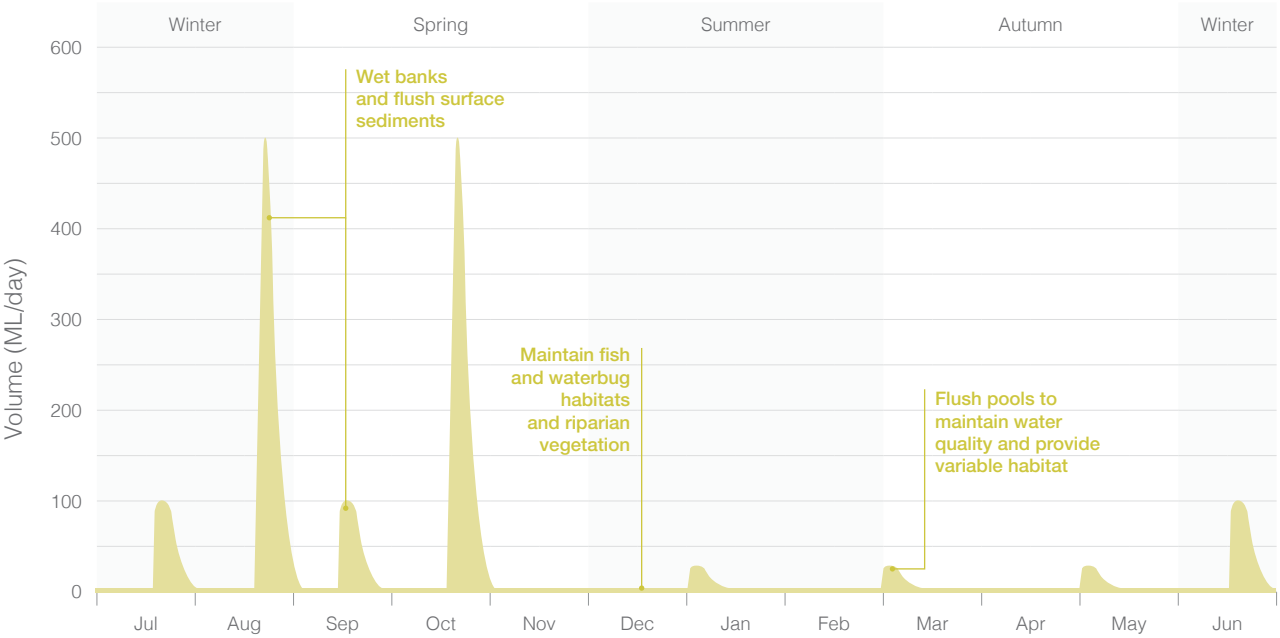
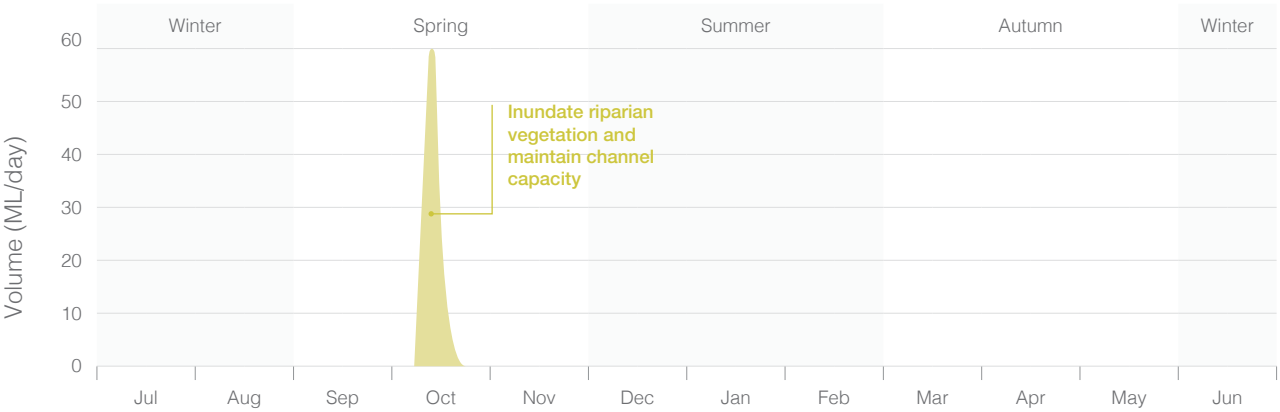


Figure 4.3.6 Potential environmental watering in Bungalally Creek



Note: These figures are for illustrative purposes only and depict watering that has been identified under the average planning scenario. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Scenario planning

Table 4.3.2 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

Water resource management in the Wimmera system is complex with numerous storages and variable release points for supplying environmental, consumptive use and recreational water. Planning for and delivery of environmental water requires flexible and adaptive management. There are supply routes that maximise environmental outcomes throughout the system, although it may be impractical to deliver via these routes during certain periods due to storage levels or water quality issues. This may limit the feasibility of some environmental watering. Wimmera CMA will work closely with GWMWater to maximise environmental outcomes.

Yarriambiack Creek is a distributary of the Wimmera River, flowing northwards into the Mallee. Historically, the creek would only receive flows during high-flow events in the Wimmera River. The Yarriambiack Creek offtake has since been modified, resulting in flows entering the creek on a more-frequent basis. When delivering environmental water to the Wimmera River reach 4, losses are incurred into Yarriambiack Creek. As has been past practice, it may be necessary to block flows entering the creek to ensure efficient and effective environmental watering in the Wimmera River.

The potential watering actions identified in Table 4.3.2 reflect most flow recommendations from the Wimmera River flows study under different climatic scenarios and have not been constrained by the available supply of environmental water. While the actions are similar in each climatic scenario, the magnitude, duration and/or frequency differ between scenarios, and therefore the volume required under each scenario also differs. For example, for Wimmera River reach 4 in a drought scenario, a 70 ML per day summer/autumn fresh for two to seven days is recommended once per year; in the wet scenario, the same fresh is recommended to occur three times per year.

In light of the limited allocation volume expected, it will not be possible to fully deliver all potential environmental watering actions. The focus in 2015–16 will be on protecting the water quality and wetting pools in rivers and creeks to maintain habitat for native fish and other fauna such as platypuses.

Environmental water deliveries will likely be restricted to high-risk periods in summer/autumn when stress on biota from poor water quality and limited habitat are greatest. There will likely be limited scope to undertake winter watering unless there are significant inflows and allocations in the early part of the water year. While the aim is to maintain environmental values in the rivers and creeks, there is still a high risk of poor water quality and associated adverse impacts at times, due to shortfalls in water availability. Environmental watering will typically occur in response to triggers, particularly associated with managing water quality risks, as there is unlikely to be sufficient water to deliver the full recommended flows.

Under most scenarios, there will likely be periods of cease-to-flow in summer due to the low water availability. Where possible, the duration of these cease-to-flow periods will be carefully managed and monitored to minimise adverse impacts. Due to the expected low water availability, this may not be possible in all cases and prolonged cease-to-flow periods may be experienced.

If the wet scenario eventuates, watering is likely to be more extensive, reflecting the increased water availability. However, given the low level of water available compared to previous years, particularly as a result of low carryover, there is likely to be a focus on reserving some water for use in the early part of the 2016–17 water year. Wet conditions will also reduce the need to use regulated allocations due to increased passing and unregulated flows.

Upper MacKenzie River at Wartook Reservoir, by Wimmera CMA

Table 4.3.2 Potential environmental watering for the Wimmera system under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected availability of Water Holdings[1]	▸ 8,000 ML carryover ▸ 5,273 ML VEWH allocation ▸ 0 ML CEWH allocation[2] ▸ 13,273 ML total[3]	▸ 8,000 ML carryover ▸ 12,878 ML VEWH allocation ▸ 0 ML CEWH allocation[2] ▸ 20,878 ML total[3]	▸ 8,000 ML carryover ▸ 25,553 ML VEWH allocation ▸ 0 ML CEWH allocation[2] ▸ 33,553 ML total[3]	▸ 8,000 ML carryover ▸ 40,560 ML VEWH allocation ▸ 560 ML CEWH allocation[2] ▸ 49,120 ML total[3]
Expected river conditions	▸ No passing or unregulated flows	▸ Restricted passing and limited unregulated flows	▸ Some passing and unregulated flows particularly during winter/spring	▸ Some passing flows and significant unregulated flows during winter/spring resulting in sustained baseflows
Wimmera River (reach 4)				
Potential environmental watering	▸ Year-round baseflows ▸ Summer/autumn freshes ▸ Winter/spring freshes	▸ Year-round baseflows ▸ Summer/autumn freshes ▸ Winter/spring freshes ▸ Moderate winter/spring freshes	▸ Year-round baseflows ▸ Summer/autumn freshes ▸ Winter/spring freshes ▸ Moderate winter/spring freshes ▸ Higher winter/spring freshes	▸ Year-round baseflows ▸ Summer/autumn freshes ▸ Winter/spring freshes ▸ Moderate winter/spring freshes ▸ Higher winter/spring freshes
Possible volume of environmental water required to achieve objectives	▸ 24,150 ML	▸ 25,940 ML	▸ 28,310 ML	▸ 33,220 ML
MacKenzie River (reaches 2 and 3)				
Potential environmental watering	▸ Year-round baseflows ▸ Summer/autumn freshes ▸ Winter/spring freshes ▸ Higher winter/spring freshes	▸ Year-round baseflows ▸ Summer/autumn freshes ▸ Winter/spring freshes ▸ Higher winter/spring freshes	▸ Year-round baseflows ▸ Summer/autumn freshes ▸ Winter/spring freshes ▸ Higher winter/spring freshes	▸ Year-round baseflows ▸ Summer/autumn freshes ▸ Winter/spring freshes ▸ Higher winter/spring freshes
Possible volume of environmental water required to achieve objectives	▸ 9,010 ML	▸ 10,415 ML	▸ 12,550 ML	▸ 14,050 ML
Burnt Creek (upper and lower)				
Potential environmental watering	▸ Year-round baseflows ▸ Summer/autumn freshes ▸ Winter/spring freshes	▸ Year-round baseflows ▸ Summer/autumn freshes ▸ Winter/spring freshes ▸ Higher winter/spring freshes	▸ Year-round baseflows ▸ Summer/autumn freshes ▸ Winter/spring freshes ▸ Higher winter/spring freshes ▸ Lower Burnt Creek all year freshes	▸ Year-round baseflows ▸ Summer/autumn freshes ▸ Winter/spring freshes ▸ Higher winter/spring freshes ▸ Lower Burnt Creek all year and high-flow freshes
Possible volume of environmental water required to achieve objectives	▸ 3,767 ML	▸ 4,375 ML	▸ 6,363 ML	▸ 8,543 ML

Planning scenario	Drought	Dry	Average	Wet
Mount William Creek (upper and lower)				
Potential environmental watering	▸ Year-round baseflows ▸ Summer/autumn freshes ▸ Winter/spring freshes ▸ Upper Mount William Creek top-ups	▸ Year-round baseflows ▸ Summer/autumn freshes ▸ Winter/spring freshes ▸ Higher winter/spring freshes ▸ Upper Mount William Creek top-ups	▸ Year-round baseflows ▸ Summer/autumn freshes ▸ Winter/spring freshes ▸ Higher winter/spring freshes ▸ Upper Mount William Creek top-ups	▸ Year-round baseflows ▸ Summer/autumn freshes ▸ Winter/spring freshes ▸ Higher winter/spring freshes ▸ Upper Mount William Creek top-ups
Possible volume of environmental water required to achieve objectives	▸ 5,650 ML	▸ 6,900 ML	▸ 8,160 ML	▸ 9,760 ML
Bungalally Creek				
Potential environmental watering	▸ None	▸ None	▸ Year-round freshes	▸ Year-round freshes
Possible volume of environmental water required to achieve objectives	▸ 0 ML	▸ 0 ML	▸ 500 ML	▸ 500 ML
Wimmera system				
Possible volume of environmental water required to achieve objectives	▸ 42,337 ML	▸ 47,330 ML	▸ 55,423 ML[4]	▸ 58,713 ML[4]
Glenelg System				
Possible volume of environmental water required to achieve objectives	▸ 25,500 ML	▸ 27,350 ML	▸ 40,980 ML[4]	▸ 39,540 ML[4]
Total possible environmental water requirements				
Possible volume of environmental water required to achieve objectives[5]	▸ 67,837 ML	▸ 74,680 ML	▸ 96,403 ML	▸ 98,253 ML

1 Environmental water in the Wimmera–Glenelg system is shared between the Glenelg and Wimmera systems. The volumes specified indicate the likely availability across the shared systems.
2 Commonwealth environmental water is only available for use in the Wimmera system.
3 This volume is a forecast of the total water likely to be available under the VEWH entitlement in 2015–16, including carryover and the forecast allocation for the complete water year. The forecast opening allocation for each climate scenario is 0 ML under all scenarios, meaning the only water available is likely to be carryover of about 8,000 ML at the start of the water year.
4 This volume assumes that passing flows make some contribution to achieving the potential watering actions. The volume of passing flows is highly variable from year to year and depends on allocations and inflows received.
5 Figures take into account the possible volume required in both the Glenelg and Wimmera systems. A prioritisation process will be undertaken in consultation with the Wimmera and Glenelg Hopkins CMAs to determine the potential watering actions that will be undertaken in each system in the 2015–16 year.

Risk management

In preparing its seasonal watering proposal, Wimmera CMA considered and assessed risks and identified mitigating strategies relating to implementing environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Engagement

Wimmera CMA engaged key stakeholders when preparing the seasonal watering proposal for the Wimmera system. Table 4.3.3 shows these stakeholders.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 4.3.3 Key stakeholders engaged in the development of the Wimmera system seasonal watering proposal

Stakeholder engagement
▸ Glenelg Hopkins CMA
▸ Local governments (including Horsham Rural City Council and Hindmarsh Shire Council)
▸ GWMWater
▸ Victorian Environmental Water Holder

Wimmera River at Jeparit, by Chloe Wiesenfeld

Wimmera River at Dimboola Weir, by Wimmera CMA

4.4 Wimmera–Mallee wetlands

Waterway managers – Mallee, North Central and Wimmera catchment management authorities

Storage manager – GWMWater

Environmental water holder – Victorian Environmental Water Holder

Environmental values

There is great variation in the character of wetlands in the Wimmera–Mallee system, which provide habitat, feeding and breeding opportunities for a range of waterbirds and animals. Important vegetation species (such as spiny lignum, ridged water milfoil and cane grass) are also present in some wetlands.

The Wimmera–Mallee wetlands include a wide range of wetland types (such as freshwater meadows, open freshwater lakes and freshwater marshes). They also vary in size and consist of many different vegetation communities which are home to native waterbird populations including of brolga, egret, blue-billed duck, freckled duck, Australian painted snipe and glossy ibis. The wetlands provide a valuable source of water for other native animals including the vulnerable growling grass frog, turtles and many other species that rely on these wetlands as drought refuges and drinking holes.

Social and economic values

These wetlands are highly valued by the community and provide places for recreational activities including canoeing, yabbying, duck and quail hunting and bird watching.

Environmental watering objectives in the Wimmera–Mallee wetlands
Provide watering holes for native land animals
Strengthen and maintain plant life in and around the wetlands, including to provide shade, shelter and food for native animals
Provide habitat and food for frogs and turtles
Create shallow and deep wetlands to provide habitat for a wide range of waterbirds

System overview

The Wimmera–Mallee wetlands include 51 dams and wetlands spread across the dry north-western area of Victoria on public and private land. Historically, the wetlands received water from the open channel system before the Wimmera–Mallee pipeline was completed. As part of the pipeline project, all stock and domestic supply dams were replaced with tanks and the open channel distribution system was replaced by pipeline. The project achieved significant water savings for environmental watering of the area's flow-stressed rivers and creeks, and created development opportunities; but it also substantially reduced the open water in the formerly channel-supplied areas. To counteract the loss of open water in the landscape, a 1,000 ML environmental entitlement was created to supply dams associated with wetlands; the entitlement is supplied via the Wimmera–Mallee pipeline system. A project was completed to identify priority wetlands to be connected to the pipeline system, and all 51 dams and wetlands are now connected to the pipeline.

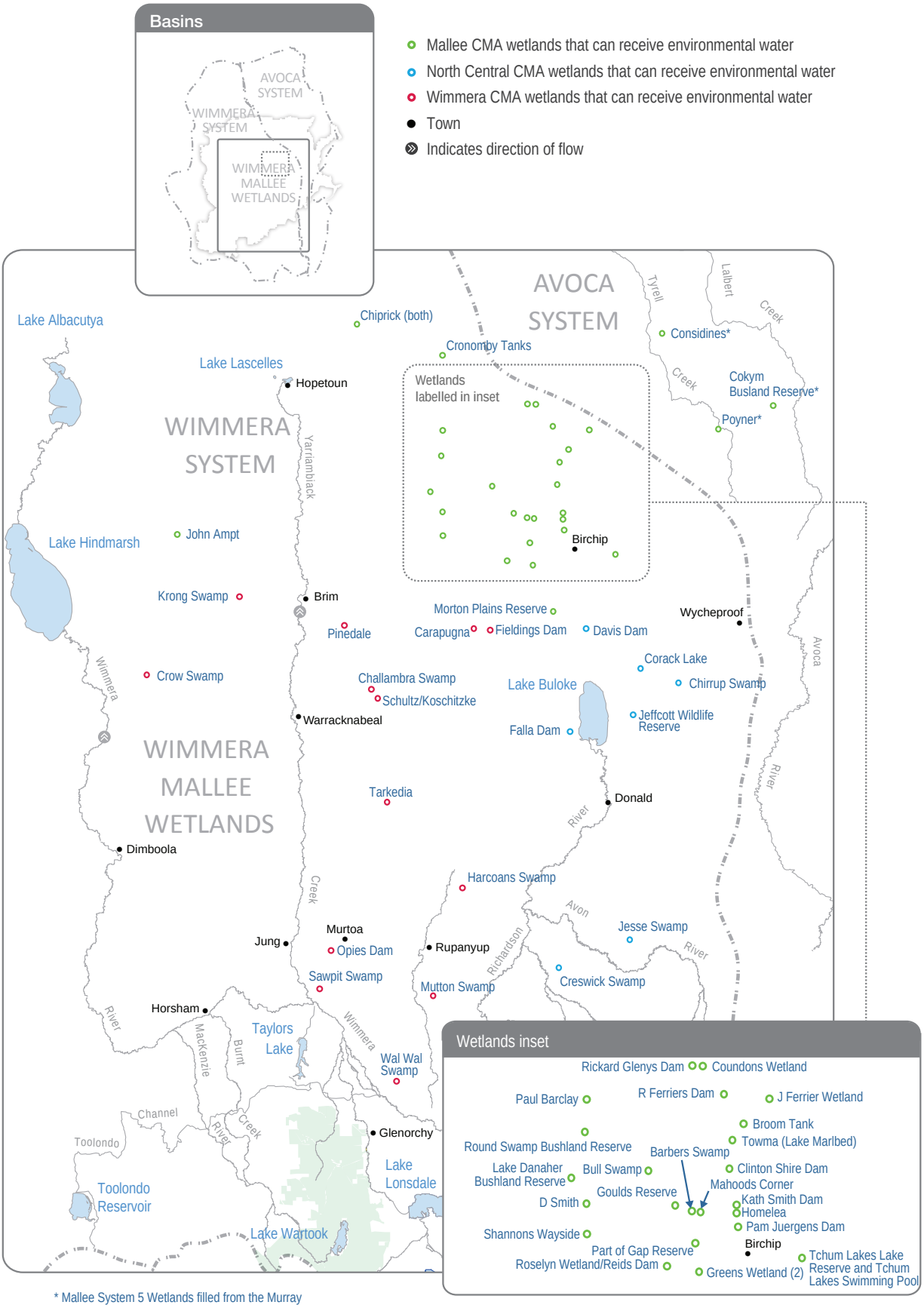
Recent conditions

The Wimmera–Mallee area was very dry in 2014–15 with no allocation made to the wetland environmental entitlement. Despite this, due to carryover from allocations in previous years and the time required to connect all the wetlands to the pipeline—all wetlands were connected by the end of 2013–14—there was still a significant volume of environmental water available for use in 2014–15.

To the end of autumn 2015, environmental deliveries were made to a total of 17 wetlands in 2014–15 including seven wetlands in the North Central area and ten wetlands in the Wimmera system. Deliveries were planned for an additional wetland in the Wimmera system and six wetlands in the Mallee system during winter. 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 dams received water in autumn 2014 which meant that water requirements in early 2014–15 were reduced.

For the Mallee CMA area, there was a rain event in January 2015 that at least partially filled many of the dams, extending the period of inundation from the previous watering and reducing the requirement for environmental deliveries. The water planned to be delivered to the six wetlands (Barbers Swamp, John Ampt, Morton Plains Reserve, R Ferriers Dam, Poyner and Considines) in the Mallee was intended to increase the inundation period of wetlands that still contained water in autumn 2015.

Figure 4.4.1 The Wimmera–Mallee wetlands



* Mallee System 5 Wetlands filled from the Murray

Jeffcott Wildlife Reserve, by Chloe Wiesenfeld

The Wimmera–Mallee wetlands in the North Central and Wimmera areas received negligible natural inflow in 2014–15. In the Wimmera area, many of the wetlands have dried out since the floods in September 2010 and January 2011. Water was delivered to the ten wetlands (Carapugna, Crow Swamp, Fieldings Dam, Harcoans, Krong Swamp, Mutton, Pinedale, Sawpit Swamp, Tarkedia and Wal Wal Swamp) to autumn 2014–15 to provide drought refuges across the landscape. Infrastructure was installed and used at several wetlands this year to maximise delivery efficiency and environmental outcomes.

In the North Central area, all seven dams—Chirrup Swamp, Corack Lake, Creswick Swamp, Davis Dam, Falla Dam, Jeffcott Wildlife Reserve and Jesse Swamp—were watered, providing a spread of water in the landscape. Parts of the wetlands at Jesse Swamp and Corack Lake were also inundated.

Many different animals (such as brolgas, wedge tailed eagles, herons, yabbies, parrots, ducks, turtles, kangaroos and wallabies) used the Wimmera–Mallee wetlands in 2014–15. Vegetation (both submerged in the wetlands and on the banks) responded well at the wetlands that were watered. In the Mallee, photographic and anecdotal evidence indicated an improvement in vegetation condition with increased foliage vigour, emergence of native vegetation and a reduction in exotic flora. Waterbird activity and breeding has been pronounced with shorebirds and wading birds using the wetlands.

Scope of environmental watering

Potential environmental watering actions and their environmental objectives are explained in Table 4.4.1.

Table 4.4.1 Potential environmental watering actions and objectives for the Wimmera–Mallee wetlands

Potential environmental watering	Environmental objectives
North Central wetlands	
Davis Dam	▸ Support black box and cane grass vegetation ▸ Maintain as drought refuge and a watering point for fauna
Creswick Swamp	▸ Support a diversity of aquatic plants including re-establishment of marbled marshwort ▸ Provide refuge, feeding and breeding opportunities for frog and turtles
Chirrup Dam	▸ Provide drought refuge and a watering point for fauna (particularly frogs and turtles) to facilitate recolonisation of Chirrup Swamp when it is naturally inundated
Corack Lake	▸ Provide conditions that support an abundance of aquatic plants ▸ Provide refuge and nursery habitat for turtles and frogs ▸ Provide variety of feeding conditions for waterbirds (such as drawdown zones and shallows)
Falla Dam	▸ Maintain as a drought refuge for turtles and frogs
Jeffcott Wildlife Reserve	▸ Maintain the diversity of aquatic plants ▸ Provide refuge and breeding conditions for water-dependent species (such as frogs, macroinvertebrates, turtles and waterbirds)
Jesse Swamp	▸ Promote native aquatic plant growth including re-establishment of marbled marshwort ▸ Provide shallow foraging habitat for waterbirds (including brolgas) and feeding opportunities for frogs

Potential environmental watering	Environmental objectives
Wimmera wetlands	
Carapugna	▸ Retain water in the dam to sustain fauna (especially frogs and wetland and woodland birds) ▸ Sustain and where possible increase the abundance of wetland flora, especially threatened species
Challambra Swamp	
Crow Swamp	
Fieldings Dam	
Krong Swamp	
Mutton Swamp	
Pinedale	
Sawpit Swamp	
Schultz/Koschitzke	
Tarkedia	
Wal Wal Swamp	
Harcoans Swamp	▸ Retain water in the dam to sustain fauna (especially frogs and wetland and woodland birds) ▸ Sustain and where possible increase the abundance of wetland flora
Opies Dam	▸ Retain water in the dam to sustain fauna, especially growling grass and other frogs
Mallee wetlands	
Barbers Swamp	▸ Maintain the health of fringing lignum and black box communities ▸ Provide suitable feeding and breeding habitat for various waterbird guilds
Bull Swamp	
Cokym Bushland Reserve	
Tchum Lakes Lake Reserve (North Lake - Wetland)	
Tchum Lakes Swimming Pool (North Lake – Dam)	
Broom Tank	▸ Maintain the health of fringing lignum and black box communities ▸ Improve the diversity and quality of wetland vegetation communities
Poyner	
Towma (Lake Marlbed)	
Clinton Shire Dam	▸ Maintain the health of fringing lignum and black box communities ▸ Provide watering points for terrestrial and aerial fauna
Pam Juergens Dam	
Goulds Reserve	▸ Maintain the health of fringing lignum and black box communities
Greens Wetland (2)	
J Ferrier Wetland	
Part of Gap Reserve	
Roselyn Wetland	
Round Swamp Bushland Reserve	
Mahoods Corner	▸ Provide suitable feeding and breeding habitat for various waterbird guilds ▸ Improve the diversity and quality of wetland vegetation communities
Shannons Wayside	

Potential environmental watering	Environmental objectives
Chiprick (both)	▸ Provide watering points for terrestrial and aerial fauna
D Smith Wetland	
Homelea Wetland	
John Ampt	
Kath Smith Dam	
Paul Barclay	
R Ferriers Dam	
Rickard Glenys Dam	
Considines	▸ Maintain the health of fringing lignum and black box communities ▸ Provide watering points for terrestrial and aerial fauna ▸ Improve the diversity and quality of wetland vegetation communities
Coundons Wetland	▸ Maintain the health of fringing lignum and black box communities ▸ Maintain habitat opportunities for turtles and frogs ▸ Provide watering points for terrestrial and aerial fauna
Cronomby Tanks	▸ Maintain the health of fringing lignum and black box communities ▸ Maintain habitat opportunities for turtles and frogs
Lake Danaher Bushland Reserve	▸ Maintain the health of fringing lignum and black box communities ▸ Maintain habitat opportunities for turtles and frogs ▸ Improve the diversity and quality of wetland vegetation communities
Morton Plains Reserve	▸ Maintain the health of fringing lignum and black box communities ▸ Improve the diversity and quality of wetland vegetation communities ▸ Provide suitable feeding and breeding habitat for various waterbird guilds

Scenario planning

Table 4.4.2 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

Most Wimmera–Mallee wetlands are considered off-stream wetlands, meaning they do not receive water from a recognised watercourse. Unlike connected floodplain wetlands, catchment conditions may not strongly influence environmental water requirements unless there is a flooding event that reduces the need for water in the wetlands.

Environmental water delivery to the wetlands relies on capacity in the Wimmera–Mallee pipeline system. CMAs continue to work closely with GWMWater and land managers (including Parks Victoria and landowners) to deliver environmental water to these wetlands.

The wetlands considered for potential environmental watering in 2015–16 have been determined after assessing their scientific watering requirements and watering history, and considering climatic conditions, water availability and the likely capacity in the Wimmera–Mallee pipeline system.

Under a drought scenario, the wetlands in Table 4.4.2 would receive a small volume, in many cases topping up water levels from previous environmental watering. As conditions become wetter, the number of sites and extent of watering increases, with some wetland watering also aiming to inundate some of the surrounding vegetation. As a result, the expected water use increases as resources and conditions improve.

Due to the lower reliability of environmental water in the Wimmera–Mallee wetland system, carrying over water following wetter periods is considered important to assist in managing supply during dry times. A critical carryover volume of 223 ML has been identified which is the equivalent of the expected drought level demand in 2015–16. This has been identified to ensure there is sufficient water to provide at least the drought level objectives in 2016–17.

Table 4.4.2 Potential environmental watering for the Wimmera–Mallee wetlands under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected catchment conditions	▸ No rainfall or catchment inflows are likely to contribute to water levels in the wetlands	▸ No rainfall or catchment inflows are likely to contribute to water levels in the wetlands	▸ Some localised catchment inflows may contribute to water levels in some wetlands	▸ Catchment inflows are likely to contribute to water levels in the wetlands
Expected availability of environmental water	▸ 900 ML carryover ▸ 0 ML allocation ▸ 900 ML available	▸ 900 ML carryover ▸ 0 ML allocation ▸ 900 ML available	▸ 900 ML carryover ▸ 40 ML allocation ▸ 940 ML available	▸ 900 ML carryover ▸ 900 ML allocation ▸ 1,900 ML available
Potential environmental watering	▸ Barbers Swamp ▸ Broom Tank ▸ Bull Swamp ▸ Carapugna ▸ Challambra Swamp ▸ Chirrup Swamp ▸ Chiprick (both) ▸ Clinton Shire Dam ▸ Cokym Bushland Reserve ▸ Considines ▸ Corack Lake ▸ Creswick Swamp ▸ Cronomby Tanks ▸ Crow Swamp ▸ D Smith Wetland ▸ Davis Dam ▸ Fieldings Dam ▸ Greens Wetland (2) ▸ Harcoans Swamp ▸ Homelea ▸ J Ferrier Wetland ▸ Jeffcott Wildlife Reserve ▸ Jesse Swamp ▸ John Ampt ▸ Krong Swamp ▸ Lake Danaher Bushland Reserve ▸ Mahoods Corner ▸ Morton Plains Reserve ▸ Mutton Swamp ▸ Opies Dam ▸ Part of Gap Reserve ▸ Paul Barclay ▸ Pinedale ▸ Poyner ▸ R Ferriers Dam ▸ Rickard Glenys Dam ▸ Roselyn Wetland/Reids Dam ▸ Round Swamp Bushland Reserve ▸ Sawpit Swamp ▸ Schultz/Koschitzke ▸ Shannons Wayside ▸ Tarkedia Dam ▸ Towma (Lake Marlbed) ▸ Wal Wal Swamp	▸ Barbers Swamp ▸ Broom Tank ▸ Bull Swamp ▸ Carapugna ▸ Challambra Swamp ▸ Chirrup Swamp ▸ Chiprick (both) ▸ Clinton Shire Dam ▸ Cokym Bushland Reserve ▸ Considines ▸ Corack Lake ▸ Creswick Swamp ▸ Cronomby Tanks ▸ Crow Swamp ▸ D Smith Wetland ▸ Davis Dam ▸ Fieldings Dam ▸ Greens Wetland (2) ▸ Harcoans Swamp ▸ Homelea ▸ J Ferrier Wetland ▸ Jeffcott Wildlife Reserve ▸ Jesse Swamp ▸ John Ampt ▸ Kath Smith Dam ▸ Krong Swamp ▸ Lake Danaher Bushland Reserve ▸ Mahoods Corner ▸ Morton Plains Reserve ▸ Mutton Swamp ▸ Opies Dam ▸ Pam Juergens Dam ▸ Part of Gap Reserve ▸ Paul Barclay ▸ Pinedale ▸ Poyner ▸ R Ferriers Dam ▸ Rickard Glenys Dam ▸ Roselyn Wetland/Reids Dam ▸ Round Swamp Bushland Reserve ▸ Sawpit Swamp ▸ Schultz/Koschitzke ▸ Shannons Wayside ▸ Tarkedia Dam ▸ Tchum Lakes Lake Reserve (North Lake - Wetland) ▸ Tchum Lakes Swimming Pool (North Lake - Dam) ▸ Towma (Lake Marlbed) ▸ Wal Wal Swamp	▸ Barbers Swamp ▸ Broom Tank ▸ Bull Swamp ▸ Carapugna ▸ Challambra Swamp ▸ Chiprick (both) ▸ Clinton Shire Dam ▸ Cokym Bushland Reserve ▸ Considines ▸ Coundons Wetland ▸ Creswick Swamp ▸ Cronomby Tanks ▸ Crow Swamp ▸ D Smith Wetland ▸ Falla Dam ▸ Fieldings Dam ▸ Goulds Reserve ▸ Greens Wetland (2) ▸ Harcoans Swamp ▸ Homelea ▸ J Ferrier Wetland ▸ Jeffcott Wildlife Reserve ▸ Jesse Swamp ▸ John Ampt ▸ Kath Smith Dam ▸ Krong Swamp ▸ Lake Danaher Bushland Reserve ▸ Mahoods Corner ▸ Morton Plains Reserve ▸ Mutton Swamp ▸ Opies Dam ▸ Pam Juergens Dam ▸ Part of Gap Reserve ▸ Paul Barclay ▸ Pinedale ▸ Poyner ▸ R Ferriers Dam ▸ Rickard Glenys Dam ▸ Roselyn Wetland/Reids Dam ▸ Round Swamp Bushland Reserve ▸ Sawpit Swamp ▸ Schultz/Koschitzke ▸ Shannons Wayside ▸ Tarkedia Dam ▸ Tchum Lakes Lake Reserve (North Lake - Wetland) ▸ Tchum Lakes Swimming Pool (North Lake - Dam) ▸ Towma (Lake Marlbed) ▸ Wal Wal Swamp	▸ Barbers Swamp ▸ Broom Tank ▸ Bull Swamp ▸ Carapugna ▸ Challambra Swamp ▸ Chiprick (both) ▸ Clinton Shire Dam ▸ Cokym Bushland Reserve ▸ Considines ▸ Coundons Wetland ▸ Creswick Swamp ▸ Cronomby Tanks ▸ Crow Swamp ▸ D Smith Wetland ▸ Falla Dam ▸ Fieldings Dam ▸ Goulds Reserve ▸ Greens Wetland (2) ▸ Harcoans Swamp ▸ Homelea ▸ J Ferrier Wetland ▸ Jeffcott Wildlife Reserve ▸ Jesse Swamp ▸ John Ampt ▸ Kath Smith Dam ▸ Krong Swamp ▸ Lake Danaher Bushland Reserve ▸ Mahoods Corner ▸ Morton Plains Reserve ▸ Mutton Swamp ▸ Opies Dam ▸ Pam Juergens Dam ▸ Part of Gap Reserve ▸ Paul Barclay ▸ Pinedale ▸ Poyner ▸ R Ferriers Dam ▸ Rickard Glenys Dam ▸ Roselyn Wetland/Reids Dam ▸ Round Swamp Bushland Reserve ▸ Sawpit Swamp ▸ Schultz/Koschitzke ▸ Shannons Wayside ▸ Tarkedia Dam ▸ Tchum Lakes Lake Reserve (North Lake - Wetland) ▸ Tchum Lakes Swimming Pool (North Lake - Dam) ▸ Towma (Lake Marlbed) ▸ Wal Wal Swamp
Possible volume of environmental water required to achieve objectives	▸ 223 ML	▸ 368 ML	▸ 597.5 ML	▸ 846.5 ML
Critical carryover into 2016–17	▸ 223 ML			

Risk management

In preparing its seasonal watering proposal, the Wimmera, Mallee and North Central CMAs considered and assessed risks and identified mitigating strategies relating to implementing environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Engagement

The Wimmera, Mallee and North Central CMAs engaged key stakeholders when preparing the seasonal watering proposal for the Thomson system. Table 4.4.3 shows these stakeholders.

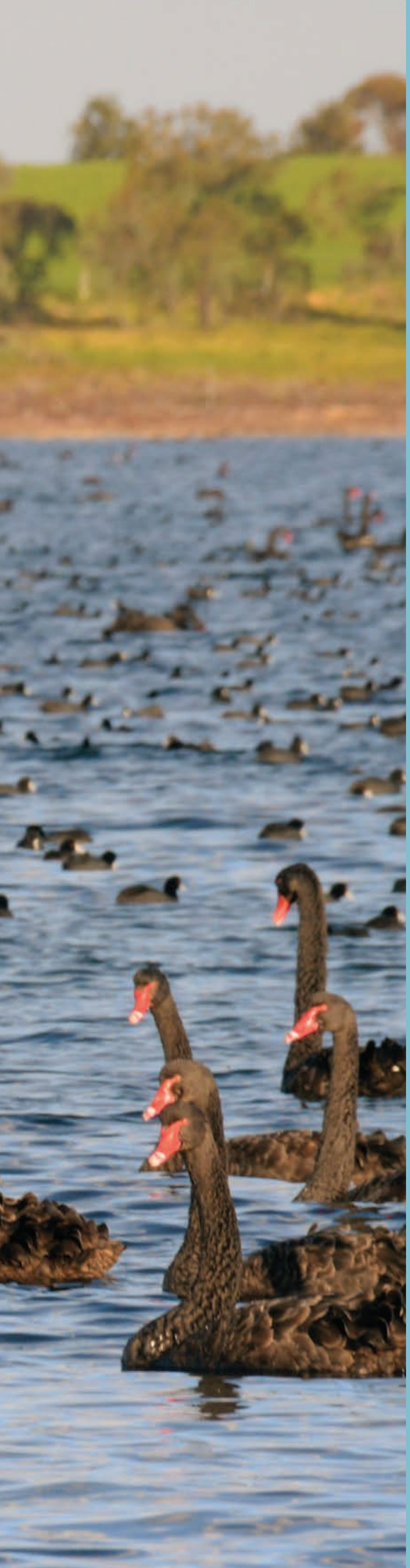
Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 4.4.3 Key stakeholders engaged in the development of the Wimmera–Mallee wetlands seasonal watering proposals

Stakeholder engagement
▸ GWMWater ▸ Parks Victoria ▸ Victorian Environmental Water Holder
Mallee CMA
▸ Mallee CMA Aboriginal Reference Group, an advisory committee to Mallee CMA comprising Indigenous representatives from across the region ▸ Mallee CMA Land and Water Advisory Committee, an advisory group to Mallee CMA comprising community members from across the region ▸ Department of Environment, Land, Water and Planning ▸ Landholders with wetlands on their properties in the Mallee ▸ Local community at a public information session in Birchip
North Central CMA
▸ Wimmera–Mallee Wetlands Environmental Water Advisory Group comprising community members; interest groups; North Central CMA Natural Resource Management Committee representatives; Department of Environment, Land, Water and Planning and VEWH ▸ North Central CMA Natural Resource Management Committee, a community advisory group to the North Central CMA Board ▸ Landholders with wetlands on their properties in the North Central area
Wimmera CMA
▸ Landholders with wetlands on their properties in the Wimmera area

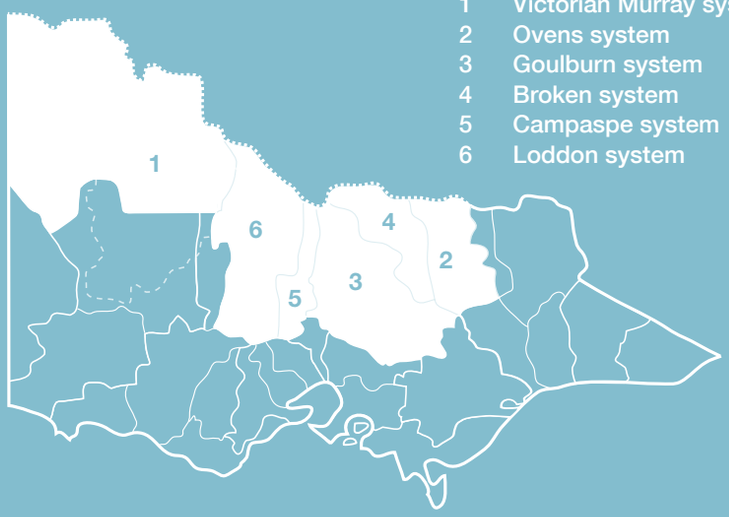
Bull Swamp, by Mallee CMA

Jesse Swamp and surrounding wetland, by Chloe Wiesenfeld



Section 5

Northern Region



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5.1 Northern Region overview

The northern region has a vital network of rivers, wetlands and floodplains that provide homes for ancient river red gums and a diversity of other plants and animals. Priority sites include the Goulburn, Broken, Loddon and Campaspe rivers as well as wetlands and floodplains on these systems and on the Victorian Murray system, including Barmah Forest, Gunbower Forest, Hattah Lakes and Lindsay, Wallpolla and Mulcra islands.

Local Indigenous communities have an enduring connection to these sites, many of which have important heritage values (such as scar trees, middens, burial sites, artefacts and ovens). Waterways across the northern region provide highly-valued amenity and recreational opportunities for residents and visitors, as well as business opportunities from tourism. Importantly, these waterways also support irrigated agriculture, which contributes significantly to Australia's prosperity through food and fibre production.

Environmental water available for use in the northern Victorian systems is held in the Ovens, Murray, Goulburn, Broken, Loddon and Campaspe storages, which also hold water for consumptive water entitlements. The water systems of the northern region are highly connected. Infrastructure and water trading allows water to move from one system to another. This allows environmental water to move between systems for delivery to priority environmental sites across northern Victoria, if needed. However most environmental water in these systems is prioritised to provide benefits in the regions in which the water is held.

Seasonal outlook 2015–16

Each year on 15 May, the Northern Victorian Resource Manager releases a water availability outlook for northern Victoria for the coming year. These seasonal outlooks are updated monthly once the season begins, and are available at www.nvrm.net.au.

The 2015–16 outlook suggests water availability will potentially be lower than in recent years, with allocations against high-reliability entitlements likely to be slower to reach 100 per cent. Under a dry inflow scenario (for example, assuming inflows remain similar to the lowest 10 per cent of inflows on record), only the Goulburn and Loddon systems are expected to reach 100 per cent allocations against high-reliability entitlements for the year. If inflows are worse than this, allocations could be lower.

Environmental demands in northern Victoria are generally highest in winter and spring. As the outlook indicates, water availability early in the season may be relatively low, so carryover from 2014–15 will be important to help meet early season demands. If conditions remain very dry across the northern region, environmental watering will likely focus on delivery of actions planned under a dry scenario. Carryover planning for 2016–17 will also be essential under continuing dry conditions.

The Victorian Environmental Water Holder (VEWH) coordinates with other environmental water holders in northern Victoria, New South Wales and South Australia to deliver environmental outcomes at the broader Murray-Darling Basin scale.

The VEWH liaises with the Murray-Darling Basin Authority and the Commonwealth Environmental Water Office to maximise the benefits of environmental water delivery in Victorian systems. Delivery of Living Murray and Commonwealth environmental water to meet Victorian environmental water objectives is covered in the following sections.

Environmental water delivered through northern Victorian waterways can sometimes be reused to achieve further environmental benefits downstream (see section 1.3.3 on return flows). If return flows are not to be reused at Victorian environmental sites, VEWH, Living Murray and Commonwealth Environmental Water Holder (CEWH) return flows will continue to flow across the border to South Australia where they will be used to provide environmental benefits at sites such as those in the Coorong, Lower Lakes and Murray Mouth region.

The VEWH may also authorise waterway managers to order Living Murray and Commonwealth water for downstream sites, provided there are no adverse impacts on Victorian waterways.

What is the Murray-Darling Basin Plan?

Northern Victoria is a part of the Murray-Darling Basin and environmental water deliveries in this region are subject to the requirements of the Murray-Darling Basin Plan. The Basin Plan was developed by the Murray-Darling Basin Authority under the *Commonwealth Water Act 2007* and became law in November 2012. The Basin Plan sets legal limits on the amount of water that can be taken from the Murray-Darling Basin's surface and groundwater resources. Chapter 8 of the Basin Plan also sets out a high-level environmental watering plan which defines environmental objectives to protect, restore and build the resilience of water-dependent ecosystems and their associated functions. The Victorian Environmental Water Holder's environmental planning and delivery is consistent with the requirements of the Basin Plan. The potential environmental watering outlined in sections 4.3, 4.4 and 5 fulfil Victoria's obligations to identify annual environmental watering priorities for Victoria's water resource areas under section 8.26 of the Basin Plan.

5.2 Victorian Murray system

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

Storage managers – Goulburn-Murray Water, Lower Murray Water*, Murray-Darling Basin Authority River Murray Operations

Environmental water holders – Victorian Environmental Water Holder, Murray-Darling Basin Authority (the Living Murray program), Commonwealth Environmental Water Holder

**Lower Murray Water are a delivery partner for the lower Murray wetlands*

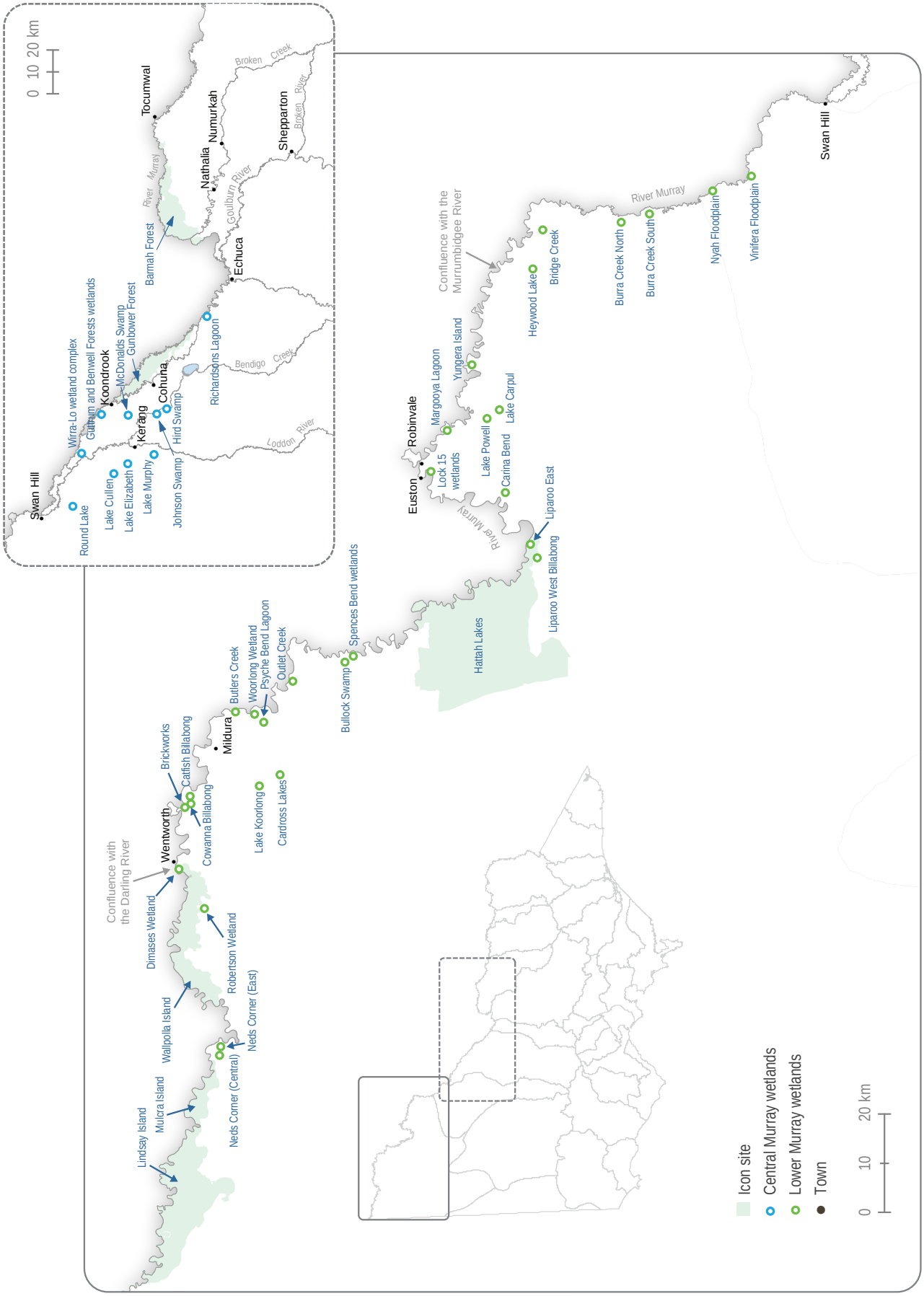
Region overview

The Victorian Murray system contains a myriad of significant floodplains and wetland systems covering the Goulburn Broken, North Central and Mallee catchment management authority (CMA) regions (see Figure 5.2.1). The system contains floodplains and wetlands that are of international importance and include the iconic Hattah Lakes, Barmah Forest and Kerang wetlands, as well as several nationally and regionally significant sites. The system provides a wide range of habitat types that support rare and threatened waterbird species including the painted snipe, brolga, royal spoonbill and white-bellied sea eagle. They are also home to the endangered Murray hardyhead fish. The Victorian Murray system supports a variety of recreational activities (such as camping, fishing, water sports, bird watching and recreational hunting) and Indigenous cultural heritage values (such as scar trees, middens, burial sites, artefacts and ovens).

Environmental water can be supplied from a range of sources to meet demands in the Victorian Murray system. This includes entitlements held by the VEWH, the Living Murray program and the CEWH; reuse of return flows; and in some instances use of consumptive water en route. The source of the water and ability to deliver all watering actions will depend on water availability, water commitments by other environmental water holders, and operational conditions. As a result, the following Victorian Murray system sections do not specify the expected environmental water availability.

Little Rushy Swamp, by Keith Ward

Figure 5.2.1 The Victorian Murray system



5.2.1 Barmah Forest

Environmental watering objectives in Barmah Forest
Enhance the health of river red gum communities and aquatic vegetation within the wetlands and watercourses and on the floodplain Encourage germination of Moira grass
Allow colonial waterbirds to successfully fledge their young
Use flows to connect floodplains to the river, boosting floodplain animal and bird habitats and providing bugs and other food resources for native fish species, waterbirds, frogs and turtles
Protect and boost populations of native fish (including the threatened southern pygmy perch) by providing flows to encourage fish to spawn

Environmental values

The Barmah–Millewa Forest is the largest river red gum forest in Australia and the most intact freshwater floodplain system along the River Murray. The forest is a significant feeding and breeding site for waterbirds including egrets, spoonbills and night herons, as well as for significant fish, frog and turtle populations.

The forest also supports a broad range of floodplain vegetation communities including river red gum forest, river red gum woodland, wetlands and the threatened Moira grass plains.

Social and economic values

The Barmah Forest supports a variety of recreational and tourism activities (such as camping, bushwalking, fishing, water sports, river cruises and bird watching).

The forest is valued in recognition of its importance as part of Australia's heritage and natural values. Both Indigenous and European cultural heritage values are present. Indigenous sites of significance include scar trees, middens, burial sites, artefacts and ovens. Non-Indigenous artefacts are largely associated with previous forestry and grazing in the forest. The Barmah Forest continues to be a place of significance for Traditional Owners and their Nations in the region.

System overview

The Barmah–Millewa Forest covers 66,000 ha and straddles the Murray and Edwards rivers between the townships of Tocumwal, Deniliquin and Echuca. The Victorian component is the Barmah National Park and River Murray Regional Park covering 28,500 ha of forest and wetlands.

Water management in the Barmah–Millewa Forest depends on gravity distribution from the River Murray. When river flows are above 15,000 ML per day downstream of Yarrawonga Weir both sides of the forest are managed as a whole. When flows are below this each side of the forest can be managed separately by operating the regulators individually. Below flows of 10,300 ML per day downstream of Yarrawonga Weir all regulators usually remain closed.

River regulation and water extraction from the River Murray has reduced the frequency, duration and magnitude of flood events in the Barmah–Millewa Forest. This has affected the diversity, extent and condition of vegetation communities and the habitat and health of dependent animal species.

Environmental water releases seek to build on unregulated flows and the delivery of consumptive water en route to maximise environmental outcomes at Barmah Forest. As Barmah Forest is located in the upper reaches of the River Murray, environmental water delivered to the forest can often be used again at sites further downstream as part of multi-site watering events; this occurs through the use of return flows.

Recent conditions

No environmental water was released in Barmah–Millewa Forest in 2014–15. However, in July 2014, very high rainfall in the upper Murray system led to flooding in the Barmah–Millewa Forest. Unregulated conditions persisted until early-August, after which all Barmah–Millewa Forest regulators were closed. Despite wet conditions occurring over the subsequent months, river releases were kept mostly within the river channels, reducing forest inundation. Notable exceptions included three small rain-rejection events in November 2014, January 2015 and March 2015 which caused some low-level flooding in the forest. This natural peak flow event created sufficient flow variability in the River Murray channel to trigger golden perch spawning.

Australasian bittern, a nationally endangered bird species, was frequently heard and occasionally sighted at Boals Deadwoods, an important wetland in the Barmah Forest.

Some 500 Australian white ibis started nesting at Boals Deadwoods in Barmah Forest and Reed Beds Swamp in Millewa Forest but both nesting sites were prematurely abandoned. This coincided with a brief but rapid period of lower-than-normal flows, which may have been why the birds abandoned their nests.

Scope of environmental watering

Potential environmental watering actions and their environmental objectives are shown in Table 5.2.1.

Table 5.2.1 Potential environmental watering actions and objectives for Barmah Forest

Potential environmental watering	Environmental objectives
Spring/summer pulsed flows in the River Murray channel (3 pulses of up to 500 ML/day for 8 days each during October–December)	▸ Provide flow variability within the main river channel to encourage spawning of native fish species, primarily perch
Spring baseflow in Gulf, Smiths, Big Woodcutter and Boals creeklines (targeting about 500 ML/day for 2–3 months during September–November)	▸ Allow lateral connectivity for native fish species to provide access to a variety of floodplain habitats and food resources that allows them to complete their life cycles, focused on meeting the requirements of southern pygmy perch ▸ Provide connectivity and inundated habitats for other wetland-dependent fauna (such as waterbirds, frogs and turtles)
Winter/spring inundation of wetlands (variable flow rates to extend the duration and inundation extent of natural flooding during August–September)	▸ Enhance the health of aquatic vegetation within the wetlands, watercourses and fringing forest areas of the lower terraces of the Barmah Forest floodplain
Spring inundation of Moira grass plains (variable flow rates to extend the duration and inundation extent of natural flooding during October–November)	▸ Provide flooding of sufficient duration to encourage the establishment of new Moira grass germinants, building on the outcomes of the seed-bank created by the 2013–14 environmental watering
Spring/summer inundation to support bird breeding in Boals Deadwoods wetland (targeting flow of about 200 ML/day to maintain appropriate inundation extent for about 3 months during October–December)	▸ Maintain water levels to allow colonial waterbirds to successfully fledge their young should breeding occur in response to natural flooding
Spring/summer inundation of Barmah Forest floodplain (variable flow rates to extend the duration and inundation extent of natural flooding during October–November)	▸ Enhance the health of river red gum communities on the lower terraces of the Barmah Forest floodplain by extending the tail of naturally occurring floods

Scenario planning

Table 5.2.2 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

Environmental water requirements vary significantly in Barmah Forest in response to natural conditions. Under drier conditions, objectives focus on improving river and creek conditions to sustain fish movement and recruitment.

As conditions become wetter, the focus shifts to the provision of larger-scale outcomes (such as extending the duration of natural flooding to promote the germination of Moira grass seedlings and providing benefits to broader floodplain vegetation communities including river red gum forests). Similarly, if natural flooding stimulates a colonial bird breeding event in Barmah Forest, environmental water will be delivered to support the colony through to fledging.

Table 5.2.2 Potential environmental watering for Barmah Forest under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	▸ Unregulated flow periods very unlikely ▸ Flows in the River Murray will remain within channel all year	▸ Low probability of small, unregulated flows in spring ▸ Small chance of overbank flows in spring	▸ Likely chance of unregulated flows in winter/spring ▸ Likely chance of overbank flows	▸ High probability of moderate-to-large unregulated flows during winter/spring ▸ Expected overbank flows
Potential environmental watering	▸ Spring/summer pulsed flows in the River Murray channel	▸ Spring baseflow in Gulf, Smiths, Big Woodcutter and Boals creeklines	▸ Winter/spring inundation of wetlands ▸ Spring inundation of Moira grass plains ▸ Spring/summer inundation to support bird breeding	▸ Spring/summer inundation of Barmah Forest floodplain
Possible volume of environmental water required to achieve objectives[1]	▸ 12,000 ML ▸ (with 12,000 ML return flow)	▸ 45,000 ML ▸ (with 30,000 ML return flow)	▸ 560,000 ML ▸ (with 369,000 ML return flow)[2]	▸ 300,000 ML ▸ (with 210,000 ML return flow)[2]

1 The possible volumes of environmental water required in Barmah Forest are estimates; the actual volumes required are highly dependent on natural conditions.
2 The volumes identified include the volume required to achieve Moira grass and floodplain objectives in both the Barmah and Millewa forests.

Risk management

In preparing its seasonal watering proposal, the Goulburn Broken CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Engagement

The Goulburn Broken CMA consulted key stakeholders when preparing the seasonal watering proposal for Barmah Forest. Table 5.2.3 shows these stakeholders.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies which incorporate environmental, cultural, social and economic considerations.

Table 5.2.3 Key stakeholders engaged in the development of the Barmah Forest seasonal watering proposal

Stakeholder engagement
▸ Department of Environment, Land, Water and Planning
▸ Murray-Darling Basin Authority (River Murray Operations and Living Murray program)
▸ NSW National Parks and Wildlife Service
▸ Parks Victoria
▸ Victorian Environmental Water Holder
▸ Yorta Yorta Nation Aboriginal Corporation

5.2.2 Gunbower Creek and Forest

Environmental values

Gunbower Forest contains a range of important environmental values including diverse and rare wetland habitats, vulnerable and endangered plant and animal species and large areas of remnant vegetation communities (such as river red gum forest). The forest provides a diversity of habitats for birds and is known to support several internationally recognised migratory waterbirds.

Gunbower Creek is an integral part of the Gunbower system, providing important habitat for native fish (such as Murray cod, trout cod and freshwater catfish). Due to the high diversity of fish in the creek, it is considered to be a valuable refuge and source of fish for the recolonisation of surrounding waterways.

Social and economic values

Gunbower Creek and Forest are both valuable sites from a cultural and socioeconomic perspective. Local Aboriginal communities have had, and continue to have, a strong connection to the Gunbower Forest area. The forest provides social and economic values through timber production, apiculture (bee keeping), recreation and tourism. The creek supports recreational activities (such as boating, fishing and bird watching) and is a major carrier of irrigation water to the surrounding productive lands.

Environmental watering objectives in Gunbower Creek and Forest
Improve the resilience of wetland plant life and help river red gums recover from damage they experienced in the Millennium Drought
Provide feeding, breeding and refuge habitat for waterbirds including colonial nesting species
Maintain populations of small-bodied fish species in forest wetlands and support the life cycles of large and small-bodied fish in Gunbower Creek
Use flows to connect Gunbower Forest to Gunbower Creek enabling fish, insects, crustaceans, molluscs, worms and carbon to move between them, supporting the life cycle of Gunbower's native fish

System overview

Gunbower Forest is a large flood-dependent forest situated on the River Murray floodplain in northern Victoria between Torrumbarry and Koondrook. Covering 19,450 ha, it is bounded by the River Murray to the north and Gunbower Creek to the south. It is an internationally significant site under the Ramsar Convention and forms part of the Living Murray Gunbower-Koondrook-Perricoota icon site. River regulation and water extraction from the River Murray and Gunbower Creek has reduced the frequency, duration and magnitude of flood events in Gunbower Forest over the long term. This has affected the extent and condition of habitat and the health of dependent animal communities.

Gunbower Creek is managed primarily as an irrigation carrier and supplies the Torrumbarry Irrigation Area from the River Murray. The highly regulated nature of Gunbower Creek has changed the creek's hydrology, resulting in significant ecological impacts including impacts on native fish populations. Environmental water is used to improve flows in the creek to support fish migration and breeding, and to promote other ecological processes. Flows linking the creek to the Gunbower Forest floodplain can be restored through environmental water and are considered vital to enhance ecosystem functioning (such as carbon exchange).

Structural works under the Living Murray program in the middle and lower forest were completed in 2013. The works allow up to 3,800 ha of the wetlands and floodplain to be watered with considerably less water than would be required under natural conditions. The works enable efficient watering of the forest, through Gunbower Creek, to maintain wetland and floodplain condition.

Recent conditions

Gunbower Forest has received three years of consecutive flooding through both natural and managed events. From late May to early December 2014, the largest environmental watering ever undertaken at Gunbower Forest was delivered through the Hipwell Road channel regulator. Environmental water was delivered to improve vegetation condition, provide feeding habitat for waterbirds and enable native fish movement and carbon and nutrient cycling

between the creek and forest. The delivery also facilitated commissioning of the newly constructed infrastructure.

A total of 98 gigalitres (GL) of consumptive water was delivered through the Hipwell Road channel, inundating about 3,800 ha of the forest. About 50 GL of this nutrient and carbon rich water was returned to the River Murray, some via Gunbower Creek.

At least 2,500 ha of the river red gums in Gunbower Forest have now received flooding in four of the past ten years: in three of these years by natural floods. Field observations showed that the river red gums have responded with a flush of new growth. Follow-up watering is still required to assist canopies to thicken and continue to recover from the Millennium Drought.

Wetland plants responded strongly, with diversity increasing significantly when compared to previous surveys. Two threatened species—wavy marshwort and river swamp wallaby-grass—responded particularly well to the environmental watering.

The high-value permanent and semipermanent wetlands in the lower part of Gunbower Forest have provided critical refuge areas for waterbirds and source populations of vegetation. The importance of these areas was shown by the strong response to the 2014 environmental watering. A large number of waterbirds utilised the resources in the wetlands for feeding and breeding during the 2014 watering event. However, no significant colonial waterbird breeding was recorded.

Environmental water was provided through Gunbower Creek to support native fish in autumn and winter, during the off-irrigation season. Traditionally, the creek is drawn down to a series of disconnected deep pools at the end of the irrigation season, which is now understood to be a major factor limiting the survival of juvenile fish, particularly Murray cod. Providing environmental flows during this period enables continued connectivity between habitats and food resources to support native fish species.

Strong recruitment of Murray cod in Gunbower Creek was observed through monitoring in 2014, corresponding to the delivery of environmental watering intended specifically to trigger spawning of Murray cod in spring and early summer 2013–14. Despite this, the overall Murray cod population in Gunbower Creek requires ongoing environmental management for it to recover and become self-sustaining in the long term.

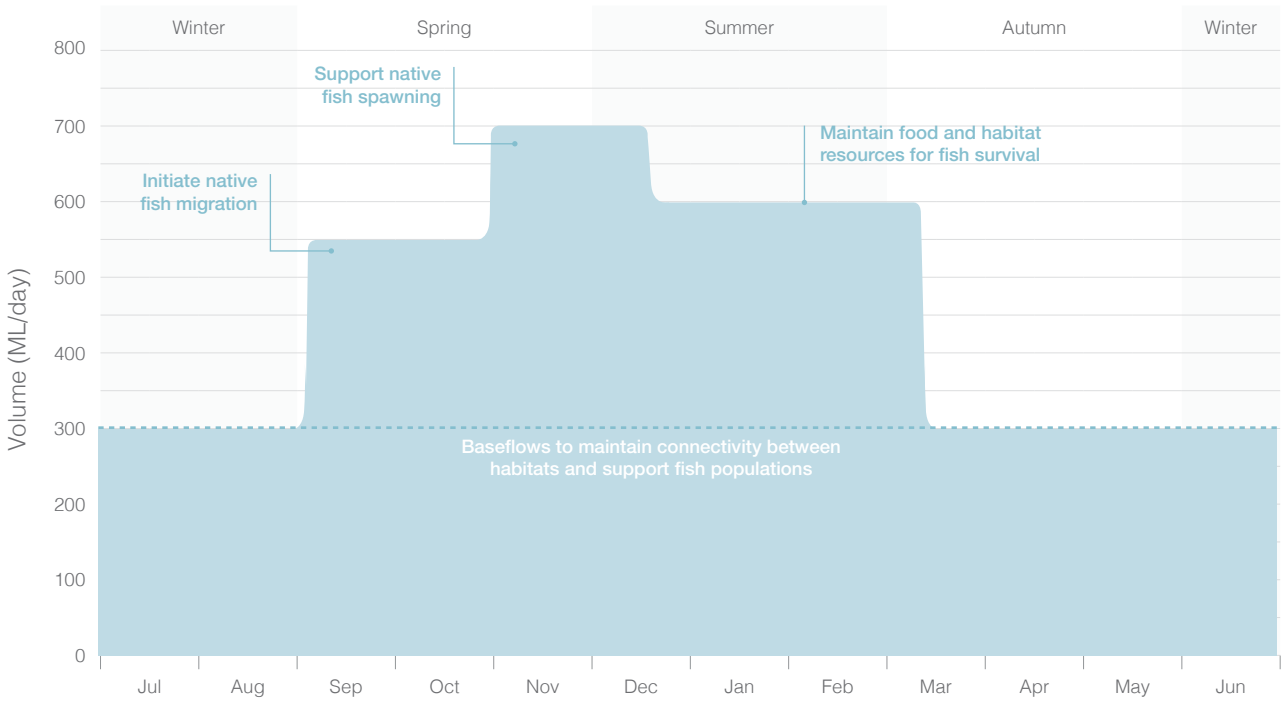
Scope of environmental watering

Potential environmental watering actions and their environmental objectives are shown in Table 5.2.4 and illustrated in Figure 5.2.2.

Table 5.2.4 Potential environmental watering actions and objectives for Gunbower Creek and Forest

Potential environmental watering	Environmental objectives
Gunbower Forest	
Winter/spring/summer watering of Reedy Lagoon and Black Swamp (top-up flows as required during July–December)	▸ Maintain the health and resilience of vegetation communities in permanent wetlands ▸ Maintain suitable feeding and refuge habitat for waterbirds
Winter/spring/summer watering of Reedy Lagoon, Black Swamp, Little Reedy Lagoon wetland complex and Little Gunbower complex (top-up flows as required during July–December)	▸ Maintain/enhance the health and resilience of vegetation communities in permanent and semipermanent wetlands ▸ Maintain/enhance healthy populations of native fish in wetlands and increase opportunities for riverine fish to access floodplain resources ▸ Maintain suitable feeding, breeding and refuge habitat for waterbirds including colonial nesting species ▸ Support a significant bird breeding event if one is triggered naturally
Winter/spring inundation of Gunbower Forest floodplain, floodrunners and wetlands (variable flow rates to maintain appropriate inundation extent for 2–5 months during June–September)	▸ Improve the health of river red gum communities ▸ Maintain/enhance healthy populations of native fish in wetlands and increase opportunities for riverine fish to access floodplain resources ▸ Maintain suitable feeding, breeding and refuge habitat for waterbirds including colonial nesting species ▸ Support a significant bird breeding event if one is triggered naturally
Gunbower Creek	
Summer/autumn/winter baseflows (up to 300 ML/day between January and August)	▸ Maintain food and habitat resources for native fish including the recently recruited Murray cod in Gunbower Creek ▸ Maintain native fish access to resources
Spring/summer high flows (targeting a gradual increase in flow up to 700 ML/day including various periods of stable flow during August–January)	▸ Promote conditions for spawning and larvae survival
Connectivity flows (manipulation of Gunbower Creek regulators to provide lateral connectivity during forest watering)	▸ Carbon transfer and lateral fish movement between Gunbower Forest and Gunbower Creek

Figure 5.2.2 Potential environmental watering in Gunbower Creek



Note: This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Scenario planning

Table 5.2.5 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

The scale of the floodplain watering in Gunbower Forest will be determined by the preceding climatic conditions, capacity, and environmental water availability.

If natural flooding occurs, or sufficient environmental water is available, the provision of follow-up floodplain watering in Gunbower Forest remains the priority. This will continue to build resilience and improve condition of the floodplain ecosystem still recovering from the Millennium Drought, and promote lateral connectivity between the forest, creek and the Murray system. Alternatively, if the floodplain watering action is not undertaken in 2015–16, environmental water delivery will target key permanent and semipermanent wetlands in Gunbower Forest.

If a significant bird breeding event is triggered, environmental water may be delivered to assist in maintaining an appropriate inundation depth and area to support the waterbirds to fledging.

As Gunbower Creek is a highly regulated system, natural conditions do not greatly influence the objectives or flow requirements in the system. Environmental water management will aim to provide sufficient habitat and food resources for native fish throughout the year (particularly important during autumn/winter), promote opportunities for breeding and larval survival, and provide lateral and longitudinal connectivity to support fish movement on and off the floodplain.

Potential watering in Gunbower Creek and Forest remain the same in dry, average and wet scenarios. Under wetter scenarios less environmental water is expected to be required to achieve the same ecological objectives, due to the contribution of natural inflows. In a drought scenario, environmental watering will focus on providing critical flows to ensure the survival of key threatened species (such as Murray cod).

Table 5.2.5 Potential environmental watering for Gunbower Creek and Forest under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	▸ No natural inflows into Gunbower Forest	▸ Natural inflows into Gunbower Forest unlikely	▸ Natural inflows into Gunbower Forest are likely in winter/spring but unlikely to be significant	▸ Overbank flows may occur in winter/spring
Potential environmental watering	▸ Top-up watering of Reedy Lagoon and Black Swamp ▸ Gunbower Creek baseflows (winter period only)	▸ Top-up watering of Reedy Lagoon, Black Swamp, Little Reedy Lagoon wetland complex and Little Gunbower complex ▸ Winter/spring inundation of Gunbower Forest floodplain, floodrunners and wetlands ▸ Gunbower Creek summer/autumn/winter baseflows ▸ Gunbower Creek spring/summer high flows ▸ Gunbower Creek connectivity flows ▸ Support bird breeding if triggers are met		
Possible volume of environmental water required to meet objectives[1]	▸ 8,000 ML	▸ 49,600 ML	▸ 49,600 ML	▸ 44,600 ML

1 Represents the estimated volume of water required to underwrite the losses associated with the delivery of consumptive use water en route (with the exception of discrete wetland watering actions).

Risk management

In preparing its seasonal watering proposal, North Central CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Engagement

The North Central CMA consulted key stakeholders when preparing the seasonal watering proposal for Gunbower Creek and Gunbower Forest. Table 5.2.6 shows these stakeholders.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 5.2.6 Key stakeholders engaged in the development of the Gunbower Creek and Forest seasonal watering proposal

Stakeholder engagement
▸ Commonwealth Environmental Water Office ▸ Gannawarra Shire Council, Progress Association and Murray Tourism Board ▸ Gunbower Island Community Reference Group (with representatives of the Progress Association, bird observers and irrigators, and general community members) ▸ Gunbower Operations Advisory Group (with representatives of Goulburn-Murray Water; Parks Victoria; Department of Environment, Land, Water and Planning [regional]; Vic Forests; State Forests New South Wales, North Central CMA; Murray-Darling Basin Authority; the Commonwealth Environmental Water Holder; and VEWH) ▸ Gunbower Technical Working Group (with representatives of Department of Environment, Land, Water and Planning [Threatened Flora and Fauna]; Goulburn Broken CMA; and specialist fish, vegetation and bird consultants and ecologists) ▸ North Central CMA Natural Resource Management Committee, an advisory group to the North Central CMA Board comprising regional community members ▸ Victorian Environmental Water Holder ▸ Yorta Yorta and Barapa Barapa Traditional Owners

5.2.3 Central Murray wetlands

Environmental values

The wetlands within the central Murray system are considered highly significant, supporting several vulnerable or endangered species including the Murray hardyhead fish, the Australian painted snipe and the growling grass frog. The wetlands provide habitat for many threatened bird species listed under legislation and international agreements, including the great egret and white-bellied sea eagle. There are several internationally recognised, Ramsar-listed wetlands within the system including Lake Cullen, Hird Swamp and Johnson Swamp, while many of the others are of regional significance.

Social, cultural and recreational values

The Barapa Barapa and Wamba Wamba Nations are the Traditional Owner groups of the central Murray wetlands. The area is considered one of the most archaeologically important areas of Victoria with numerous documented middens, mounds, artefacts, scar trees and surface scatters.

The wetlands are used extensively for recreational activities including bird watching, bushwalking and duck hunting in some wetlands. Tourism to the region supports the local economy and other indirect economic benefits are derived from groundwater recharge and carbon storage that the wetlands support.

Environmental watering objectives in central Murray wetlands
Rehabilitate river red gum and wetland plant communities Provide appropriate wetting and drying conditions that support seed germination, seedling survival and recruitment including semi-aquatic plant species in damp areas of wetlands
Provide habitat for waterbird resting, feeding and breeding
Maintain habitat for the critically endangered Murray hardyhead fish
Provide habitat for the endangered growling grass frog

System overview

The central Murray wetland system consists of ten wetlands on the River Murray floodplain. Nine of these can receive environmental water: Lake Cullen, Hird Swamp, Johnson Swamp, Round Lake, McDonalds Swamp, Lake Elizabeth, Lake Murphy, Richardsons Lagoon and the Wirra-Lo wetland complex. All of these are wetlands of regional significance.

The central Murray wetlands are almost wholly contained within the Torrumbarry Irrigation Area. As this area has experienced dramatic changes since European settlement with the construction of levees, roads and channels, most of the wetlands are now cut off from natural flooding and rely on the provision of environmental water to maintain their ecological character and health.

Guttrum and Benwell forests are a regionally significant wetland system and border the River Murray. There is currently no permanent infrastructure in either forest for the delivery of environmental water although some semipermanent wetlands can be watered via temporary pumping from the River Murray.

Recent conditions

Low rainfall and high temperatures, and barriers that prevent natural runoff (such as channels, roads and levees), meant that minimal natural inflows were received in the central Murray wetlands during 2014–15. Environmental water was the only water source provided during 2014–15.

Environmental watering in 2014–15, included top-ups flows to Round Lake and Lake Elizabeth to maintain and establish suitable conditions for the Murray hardyhead fish species; and to Hird Swamp (west), Lake Murphy and McDonalds Swamp to support a diversity of waterbirds and other animal and plant species typical of temporary freshwater marshes. A partial fill was provided to Johnson Swamp to assist in managing ecological risks associated with expected early-season capacity constraints in 2015–16, and to the Wirra-Lo wetland complex to improve vegetation condition.

Two of the wetlands in the central Murray system were dried in 2014–15: Richardsons Lagoon and Lake Cullen. A drying regime for these wetlands is important to help promote germination and establishment of vegetation in and around the wetland, and also to promote productivity and provide a food source for wading waterbirds.

Round Lake remained permanently inundated during the season to support the resident Murray hardyhead population. Surveys in November 2014 did not detect any Murray hardyhead individuals, unlike surveys in previous years. However, opportunistic sightings of this species were noted outside of the formal surveys. This result may reflect the difficulties associated with sampling for this species, or simply reflect the natural boom and bust population cycles.

An increase in waterbird species was recorded at Round Lake, Lake Murphy, McDonalds Swamp and Lake Elizabeth. This included several significant species (such as the Victorian *Flora and Fauna Guarantee Act 1988* listed Caspian tern, blue-billed duck, white-bellied sea eagle and brolga). Other threatened species such as the musk duck, hardhead and Australasian shoveler were recorded at the wetlands.

River red gum saplings established after the 2010–11 floods at several wetlands show positive signs of healthy tree condition.

Hird Swamp west received a top-up in late spring/early summer. Upon review of the environmental watering response (including a low presence of waterbirds) and additional research and knowledge on cumbungi and cane grass, the watering was adapted and further deliveries did not occur for the remainder of the water year. The commencement of the drying phase at Hird Swamp provided significant feeding habitat for wading and foraging waterbirds, supported juvenile river red gum growth and will also assist in reducing the growth of cumbungi and common reed. These reeds currently cover a large portion of the wetland (a combined total of 37 percent) and threaten habitat diversity. This change in water regime will ensure better environmental outcomes for the long-term health of the wetland, including for its waterbirds.

A drying phase was completed at Richardsons Lagoon (one year duration) in 2014–15 with a small amount of water still present in the centre of the wetland. Despite low water levels, birds (such as the white-faced heron, black-fronted dotterel and whistling kite) were recorded visiting the wetland in February 2015.

Guttrum and Benwell forests have not received natural inflows since the heavy rains and consequent high flows in the River Murray in 2010–11. Although the natural inundation assisted the forest to recover from the Millennium Drought, recent observations suggest that the forests are still in a recovery phase.

Scope of environmental watering

Potential environmental watering actions (including wetland drying) and their environmental objectives are shown in Table 5.2.7.

Table 5.2.7 Potential environmental watering actions and objectives for central Murray wetlands

Potential environmental watering	Environmental objectives
Wetland watering	
Round Lake (top-up flows as required to maintain water quality targets)	▸ Maintain habitat for Murray hardyhead fish species ▸ Maintain suitable waterbird habitat
Lake Elizabeth (top-up flows as required to maintain water quality targets)	▸ Provide conditions suitable for Murray hardyhead fish species translocation ▸ Support submerged salt-tolerant aquatic plant assemblage
Johnson Swamp (fill in winter/spring and provide top-ups if required)	▸ Promote mosaic of plant communities including lignum and black box communities ▸ Provide an open water habitat to support a diverse range feeding and breeding habitats for waterbirds
Richardsons Lagoon (fill from empty in winter/spring and provide top-ups if required)	▸ Promote a variety of vegetation communities (such as river red gum, black box and low sedgy wetlands) that support water-dependent species including fish, waterbirds, frogs and turtles
McDonalds Swamp (fill from empty in autumn and provide top-ups if required)	▸ Maintain a diverse vegetation community by supporting recruitment of young river red gums and reducing coverage of common reed and cumbungi communities through environmental water management
Wirra-Lo wetland complex (fill in winter/spring and provide top-ups if required)	▸ Rehabilitate river red gum and aquatic vegetation communities, providing habitat for the growling grass frog and a diversity of waterbirds
Guttrum and Benwell forests (semipermanent wetlands only; fill in winter/spring and provide top-ups if required)[1]	▸ Rehabilitate semipermanent wetland vegetation communities; provide feeding and breeding habitat for waterbird species
Wetland drying	
Hird Swamp, Lake Cullen and Lake Murphy (drawdown and drying)	▸ These wetlands will not be actively watered during 2015–16 ▸ The drying will assist in maintaining a diversity of habitats to support a wide range of wetland-dependent birds and animals, and promote the growth and establishment of vegetation in and surrounding the wetland

1 Guttrum and Benwell forests contain wetlands that may receive environmental water in 2015–16 pending further investigation and stakeholder engagement by North Central CMA. Infrastructure projects for Guttrum and Benwell forests are being assessed as part of the Sustainable Diversion Limit Offset component of the Murray-Darling Basin Plan. Until works are approved and completed, environmental watering will only consider impermanent wetlands that can receive water from temporary pumping of water from the River Murray.

Scenario planning

Table 5.2.8 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

Landscape-scale planning for these wetlands has been undertaken by the North Central CMA to optimise the wetland watering regimes over multiple years. An important consideration in this planning includes ensuring that there is a diversity of habitat types available across the region to support waterbirds and other water-dependent fauna at any point in time.

In a given year, multiple wetlands may require environmental water at the same time. Interannual planning helps to manage the risk of increased pressure on environmental water resources, particularly if there is a return to drought conditions. It also helps support waterbird populations by ensuring that suitable habitat for breeding, feeding and nesting is available across northern Victoria.

The wetlands of highest priority for environmental water management in the central Murray wetlands are Round Lake and Lake Elizabeth. Round Lake currently supports the critically endangered Murray hardyhead fish species and is considered to have the only stable population in the Kerang area. Lake Elizabeth has been prioritised as a recipient of environmental water to maintain suitable conditions for the possible translocation of Murray hardyhead in 2015–16. It is essential that the wetlands are maintained so that future stocking and translocation programs can be implemented to prevent the regional loss of the species.

In drier scenarios, environmental water will be required to fill and maintain water depth in wetlands, to support the needs of wetland-dependent vegetation, fish and bird species. As conditions become wetter, catchment inflows are expected to contribute to water levels in the wetlands but environmental water will be required to maintain water depth to support waterbird breeding and vegetation condition.

No environmental water is planned to be delivered to Lake Cullen, Lake Murphy or Hird Swamp in 2015-16, as these wetlands are in a dry or drying phase. Hird Swamp and Lake Murphy require a drying phase to promote a diversity of habitat for waterbirds. Lake Cullen is scheduled for watering in 2016–2017. If wet catchment conditions eventuate and natural inundation of these wetlands occurs, water levels may need to be maintained to reduce the potential detrimental impact from a short, shallow inundation. An assessment will be undertaken to inform the most appropriate management option considering the timing, extent and duration of the natural inundation.

Table 5.2.8 Potential environmental watering for central Murray wetlands under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected catchment conditions	▸ Catchment runoff and unregulated flows into the wetlands is unlikely	▸ Catchment runoff and unregulated flows into the wetlands is unlikely	▸ Some catchment runoff and unregulated flows into the wetlands is likely, particularly during winter/spring	▸ Catchment runoff and unregulated flows into the wetlands may significantly contribute to water levels in the wetlands, particularly during winter/spring
Potential environmental watering	▸ Round Lake ▸ Lake Elizabeth ▸ Johnson Swamp ▸ Richardsons Lagoon ▸ McDonalds Swamp ▸ Wirra-Lo wetland complex ▸ Guttrum and Benwell forests			
Possible volume of environmental water required to meet objectives	▸ Up to 11,000 ML			

Risk management

In preparing its seasonal watering proposal, North Central CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Engagement

The North Central CMA consulted key stakeholders when preparing the seasonal watering proposal for the central Murray wetlands. Table 5.2.9 shows these stakeholders.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 5.2.9 Key stakeholders engaged in the development of the central Murray wetlands seasonal watering proposal

Stakeholder engagement
▸ Birdlife Australia
▸ Central Murray Wetlands Environmental Water Advisory Group (comprising community members, interest groups, North Central CMA project staff, Board and Natural Resource Management Committee representatives)
▸ Commonwealth Environmental Water Office
▸ Community members
▸ Department of Environment, Land, Water and Planning
▸ Field and Game Australia
▸ Gannawarra Shire Council
▸ Goulburn-Murray Water
▸ North Central CMA Natural Resource Management Committee, an advisory group to the North Central CMA Board comprising regional community members
▸ Parks Victoria
▸ Swan Hill Rural City Council
▸ Victorian Environmental Water Holder

5.2.4 Hattah Lakes

Environmental values

Hattah Lakes is recognised for its waterbird breeding habitat and is a high-value drought refuge for wetland-dependent waterbirds and other threatened plants and animals in the Mallee. The lakes provide important habitat for colonial waterbird species including the spoonbill, egret, night heron, bittern, and for migratory bird species. Nine fish species have been reported present in the lakes; five of these have conservation significance in Victoria including the eel-tailed catfish and fly-specked hardyhead.

Flood-dependent vegetation at Hattah Lakes ranges from wetland communities that require frequent flooding to those that require only periodic inundation (such as lignum and black box-dominated communities). The lakes support 115 significant plant species. One of these species, winged peppercress is listed as nationally endangered under the *Environmental Protection and Biodiversity Conservation Act 1999*.

Social and economic values

The Hattah Lakes hold great significance to Traditional Owners in the region, who have a continuing connection to the lakes and surrounding areas. There are more than 1,000 registered sites of significance including burial sites, scar trees and shell middens.

Social and recreational activities undertaken at the lakes include nature-based tourism such as camping, picnicking, four-wheel driving, trail bike riding, hunting, horse riding, walking, bird watching, fishing and boating. Parks Victoria open sections of the Murray-Sunset National Park throughout the year and wood collection and apiary (bee-keeping) are common practices, with licences issued by the Department of Environment, Land, Water and Planning.

Environmental watering objectives for the Hattah Lakes	
	Restore a healthy and diverse mix of wetland and floodplain plant life to maintain the ecological character of this internationally protected site
	Provide feeding and breeding habitat for a range of waterbird species including threatened and migratory species, and colonial species such as the spoonbill and egret
	Maintain high-quality habitat for native fish in wetlands Use flows to connect the lakes to the river so large-bodied fish (including Murray cod and perch) can move, feed and breed

System overview

The Hattah Lakes are adjacent to the River Murray between Mildura, Robinvale and Ouyen. They consist of over 20 semipermanent freshwater lakes that cover an area of 48,000 ha and form part of the Hattah-Kulkyne National Park. The ecology of the lakes and floodplain communities are strongly influenced by their flooding regimes.

Under natural conditions, the lakes were fed from high River Murray flows and influenced by all major Murray tributaries upstream of the Murrumbidgee; the lakes then held water for several years after floods receded. However, these events have been significantly reduced with river regulation and water extraction.

Large-scale engineering works were completed in 2013 and now allow water to be pumped from the Murray system into the Hattah Lakes to support the important environmental values in the system. The new infrastructure includes permanent pumps that can deliver up to 1,000 ML per day to the floodplain and water retention structures that can hold water on the floodplain and regulate the drawdown.

Recent conditions

Environmental water was delivered to Hattah Lakes in 2013–14 and 2014–15, with all the lakes in the Hattah system (including Lake Kramen) receiving water.

The environmental watering contributed to meeting a range of ecological objectives for the system, particularly aiming to inundate fringing river red gum and black box woodlands, which have been in a stressed condition following the Millennium Drought.

Environmental watering facilitated nutrient exchange between the floodplain and lakes, providing a productivity pulse to 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 events 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 ten years.

The watering provided connectivity between the lakes, allowing fish to move in and out of the lake system. Three large-bodied native species were recorded in the lakes (Murray cod, golden perch and silver perch).

Scope of environmental watering

Potential environmental watering actions and their environmental objectives are shown in Table 5.2.10.

Table 5.2.10 Potential environmental watering actions and objectives for the Hattah Lakes

Potential environmental watering	Environmental objectives
Winter/spring inundation of semipermanent wetlands (provide top-up flows as required targeting a water level of 42.5 m Australian height datum July–November)	▸ Maintain deeper water for piscivorous waterbird breeding events ▸ Maintain potential breeding habitat for fish including golden perch ▸ Provide connectivity between the Hattah Lakes system and the River Murray channel
Winter/spring fresh in Chalka Creek south	▸ Provide connectivity between the main channel and the Hattah Lakes

Hattah Lakes, by Mallee CMA

Scenario planning

Table 5.2.11 outlines potential environmental watering and expected water usage under a range of planning scenarios.

Following two consecutive years of watering, the ecological requirements for the red gum forest and woodlands have been met and both communities now need time to dry and allow new understory to develop. Therefore, the priority for the Hattah Lakes in 2015–16 is to provide top-ups to the semipermanent and temporary wetlands to maintain habitat to support both waterbird and fish breeding.

Under a drought scenario, environmental watering will focus on protecting key ecological functions in the lakes, such as connectivity for native fish to the River Murray, requiring a much smaller volume compared to dry, average and wet conditions. Under the wetter scenarios, potential environmental watering will build on natural cues to maintain and improve the ecological health of the lakes and their river red gum, black box and wetland vegetation communities by increasing the extend and duration of inundation.

Table 5.2.11 Potential environmental watering for the Hattah Lakes under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	▸ Unregulated flow periods very unlikely ▸ No natural inflows expected into wetlands or floodplain	▸ Low probability of small unregulated flows in spring ▸ No natural inflows expected into wetlands or floodplain	▸ Likely unregulated flows in winter/spring ▸ Some wetlands and the floodplain may fill from natural inflows	▸ High probability of moderate-to-large unregulated flows during winter/spring ▸ Wetlands and floodplain may fill from natural inflows
Potential environmental watering	▸ Winter/spring fresh in Chalka Creek south ▸ Winter/spring inundation of semipermanent wetlands (partial fill)	▸ Winter/spring fresh in Chalka Creek south ▸ Winter/spring inundation of semipermanent wetlands ▸ Winter/spring inundation of temporary wetlands (partial fill)	▸ Winter/spring fresh in Chalka Creek south ▸ Winter/spring inundation of semipermanent wetlands ▸ Winter/spring inundation of temporary wetlands	▸ Winter/spring fresh in Chalka Creek south ▸ Winter/spring inundation of semipermanent wetlands ▸ Winter/spring inundation of temporary wetlands
Possible volume of environmental water required to meet objectives	▸ 10,000 ML	▸ 15,000 ML	▸ 20,000 ML	▸ 30,000 ML

Risk management

In preparing its seasonal watering proposal, Mallee CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Engagement

Mallee CMA consulted key stakeholders when preparing the seasonal watering proposal for the Hattah Lakes. Table 5.2.12 shows these stakeholders.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 5.2.12 Key stakeholders engaged in the development of the Hattah Lakes seasonal watering proposal

Stakeholder engagement
▸ Commonwealth Environmental Water Office ▸ Community reference groups (provide input and engagement to Mallee CMA's initiatives with representation of Traditional Owners and the Living Murray Icon Site Manager groups) ▸ Goulburn-Murray Water ▸ Lower Murray Water ▸ Mallee CMA community committees (advisory groups to the Mallee CMA Board with community representatives) ▸ Murray-Darling Basin Authority ▸ New South Wales Office of Water ▸ Parks Victoria ▸ SA Water ▸ Victorian Environmental Water Holder

5.2.5 Lower Murray wetlands

Environmental values

The lower Murray wetlands span more than 700 km of linear floodplain along the River Murray. The vast area makes the wetlands regionally significant because the individual wetlands, creeks and billabongs identified for watering contain a diverse range of values that vary in composition and quality.

The dominant tree species found at most wetland sites are river red gum and black box. These trees form significant forests on the floodplain which provide habitat, particularly for birds, reptiles and mammals. River red gums are tolerant to regular flooding, and black box less so, and a regular watering regime is required to maintain both species in good health. Many sites also contain lignum, a dominant shrub that provides habitat for small woodland birds.

The wetland types are varied. Depending on their location in the landscape, the interaction with groundwater and their management history, wetlands may be permanent, temporary, fresh or saline. These differences in water regime and water quality provide a diverse range of habitats for different plants and animals. For example, permanent, saline wetlands (such as Brickworks Billabong) provide vital habitat for the critically endangered Murray hardyhead fish. Sandilong Creek is a permanent freshwater wetland that contains the endangered freshwater catfish. In contrast to permanent wetlands, temporary freshwater wetlands (such as Nyah floodplain and Neds Corner) may be filled and dried over the course of one to two years. These wetlands provide short-term conditions that allow wetland plants to grow, spread and provide feeding and breeding habitat for frogs, turtles and birds.

Social and economic values

Camping, fishing and other water-based recreational activities are popular along the River Murray, including at some wetlands in the lower Murray system. Increases in waterbird abundance resulting from environmental watering in the landscape provide improved opportunities for bird watching and hunting. Increased visitation is important for the economy of small communities and nearby towns. Aboriginal culture is strongly linked to the floodplain of the River Murray, which for many thousands of years would have maintained a concentrated population due to the abundant resources it provided.

Environmental watering objectives in the lower Murray wetlands
Increase the diversity, extent and abundance of wetland plant life
Provide feeding and breeding habitat for a range of waterbird species including threatened and migratory species and colonial species (such as the egret)
Improve water quality and increase habitat for fish
Improve the condition of river red gums, black box and lignum to provide habitat for large animals (such as lace monitors and bats)

System overview

The lower Murray wetlands are distributed on the River Murray floodplain between Swan Hill and the South Australian border. They include creeks, wetlands and floodplains that are ecologically important and reflect the natural character and attributes of the River Murray floodplain. Some of these wetlands and waterways can be managed with environmental water.

The regulation and diversion of River Murray flows has substantially altered the hydrology of the lower Murray wetlands. Compared to conditions before river regulation, the frequency and duration of high river flows that are needed to activate anabranches and fill billabongs and floodplain land have been substantially reduced. This long-term change to the water regime has caused a decline in the environmental values of floodplain wetland sites.

Environmental water can be delivered to the lower Murray wetlands through a combination of direct pumping from the River Murray and through use of irrigation supply infrastructure at some wetlands. All the wetlands can be managed independently of each other.

Recent conditions

The last time there were sustained high flows in the River Murray—sufficient to flood vast areas of wetlands and floodplains—was in 2010 and 2011. Those floods came at the end of the Millennium Drought and helped improve ecosystem health after a long period of environmental stress. Since then, rainfall in the region has been consistently low and high river flows have mostly been absent, so wetlands have relied on the delivery of environmental water to build on the benefits derived from the flooding and help maintain their environmental condition.

In 2014–15, lower Murray wetlands watered included Sandilong Creek and Billabong, Cardross Lakes, Brickworks Billabong, Woorlong wetlands, Psyche Bend Lagoon, Burra Creek North, Burra Creek South, Bridge Creek, Bullock Swamp, Lake Koorlong, Neds Corner Central, Neds Corner East, Nyah floodplain and Vinifera floodplain.

This watering achieved a range of positive outcomes. 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 vital habitat for Murray hardyhead. At other floodplain sites (such as Vinifera floodplain and Nyah floodplain), there have been improvements in the condition of vegetation that provides habitat for terrestrial and aquatic animals.

Scope of environmental watering

Potential environmental watering actions and their environmental objectives are shown in Table 5.2.13.

Environmental watering will focus on maintaining and improving vegetation condition, habitat quality and availability throughout the wetlands, floodplains and waterways in the lower Murray region, and in some cases, rehabilitating salt-affected wetlands.

Table 5.2.13 Potential environmental watering actions and objectives for the lower Murray wetlands

Potential environmental watering	Environmental objectives
Wetland watering	
Brickworks Billabong (top-up as required to maintain water quality targets)	▸ Maintain and improve the condition of aquatic vegetation and water quality for Murray hardyhead
Cardross Lakes (top-up as required to maintain water quality targets)	
Lake Koorlong (top-up as required to maintain water quality targets)	
Neds Corner Central and East (top-up in spring)	▸ Provide breeding and roosting habitat for colonial waterbirds
Dimases wetland (fill in autumn)	▸ Maintain and improve the health of river red gums ▸ Provide habitat for native fish following a drying phase in Butlers Creek
Cowanna Billabong (fill in winter)	
Butlers Creek (top-up in winter/spring)	
Psyche Bend Lagoon (fill in winter/spring, top-up in autumn and discharge return flows to the River Murray in line with agreed operation triggers)	▸ Provide freshwater inflows and flushing flows to reduce salinity levels and improve the condition and diversity of wetland vegetation, improving ecological function ▸ Establish aquatic vegetation and improve the condition of fringing vegetation, particularly lignum in the Woorlong floodplain ▸ Maintain adequate water levels to control the spread of cumbungi in Woorlong wetland ▸ Provide suitable habitat for native fish and frogs
Woorlong wetland (fill in autumn)	
Woorlong floodplain (fill in autumn)	
Outlet Creek (fill in winter/spring)	
Bullock Swamp (fill in winter/spring and discharge return flows to the River Murray in line with agreed operation triggers, if required)	
Liparoo West Billabong (fill in winter/spring)	▸ Maintain and improve the health of river red gum and black box and lignum
Carina Bend (fill in winter/spring)	
Margooya Lagoon (fill in spring)	▸ Improve river red gum condition ▸ Improve the native fish assemblage of the lagoon ▸ Restore submerged aquatic vegetation in the open water areas of the wetland
Lock 15 wetlands (fill in winter/spring)	▸ Maintain aquatic habitat and provide refuge for a range of aquatic fauna species ▸ Improve the productivity of connected riparian zones and wetlands ▸ Maintain resident populations of frogs and small fish in wetlands ▸ Provide reliable breeding and feeding habitat for waterbirds including colonial nesting species ▸ Restore floodplain productivity to maintain resident populations of vertebrate fauna including carpet python and insectivorous bats ▸ Contribute to the carbon requirements of the River Murray channel ecosystem

Potential environmental watering	Environmental objectives
Lake Powell (fill in spring)	▸ Provide productive lake habitat for waterbirds ▸ Restore floodplain productivity to maintain resident populations of vertebrate fauna including carpet python and insectivorous bats ▸ Promote emergent and semi-emergent aquatic vegetation in Burra Creek
Lake Carpul (fill in spring)	
Burra Creek North (fill in winter/spring)	
Burra Creek South (fill in winter/spring)	
Nyah floodplain (fill in winter)	▸ Improve condition and structure of wetland vegetation ▸ Provide seasonal feeding and reproductive opportunities for native fish ▸ Provide breeding habitat for waterbirds including colonial nesting species ▸ Restore floodplain productivity to maintain resident populations of vertebrate fauna including carpet python, sugar glider and grey-crowned babbler
Vinifera floodplain (fill in winter)	
Wetland drying	
Robertsons wetland, Catfish Lagoon, Spences Bend wetland, Liparoo East, Yungera wetland, Heywood Lake, Bridge Creek	▸ These wetlands will not be actively watered throughout 2015–16 ▸ Drying will assist in maintaining a diversity of habitats to support a wide range of wetland-dependent birds and animals and promote the growth and establishment of vegetation in and surrounding the wetland

Scenario planning

The lower Murray wetlands are still recovering from the Millennium Drought. The approach in 2015–16 is to continue recovery and build resilience to endure future dry conditions. Under a drought scenario, the highest-priority wetlands for environmental watering in the lower Murray area are Cardross Lakes, Lake Koorlong and Brickworks Billabong, as these sites currently support the critically endangered Murray hardyhead. Depending on seasonal conditions and water availability, remaining wetlands are proposed to receive environmental water, in line with their recommended watering regimes.

For some temporary wetlands, the desired wet phase has been achieved consistently in recent years. In these cases the wetlands will not be actively watered in 2015–16 and will be allowed time to dry (refer to Table 5.2.14). This will allow time for vegetation to germinate and establish, to increase the diversity of habitats available for aquatic plants and animals during the next wet phase. At the same time, the dry phase will provide opportunities for terrestrial animals to access resources within a temporarily dry wetland.

Table 5.2.14 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

Psyche Lagoon, by Mallee CMA

Table 5.2.14 Potential environmental watering for lower Murray wetlands under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	▸ No unregulated flows in the River Murray year-round ▸ Wetlands rely on environmental water delivery		▸ Sustained periods of high flow in the River Murray in late winter and early spring will provide some opportunity for low-lying wetlands to be naturally inundated, however most wetlands will still rely on environmental water delivery	▸ Lengthy periods of high flows and floods with major spills from storages, resulting in widespread inundation of the floodplain and inundating most wetlands ▸ Some reliance on environmental water delivery to achieve target water levels
Potential environmental watering	▸ Brickworks Billabong ▸ Cardross Lakes ▸ Lake Koorlong	▸ Brickworks Billabong ▸ Cardross Lakes ▸ Lake Koorlong ▸ Neds Corner Central and East ▸ Nyah floodplain ▸ Vinifera floodplain	▸ Brickworks Billabong ▸ Cardross Lakes ▸ Lake Koorlong ▸ Neds Corner Central and East ▸ Nyah floodplain ▸ Vinifera floodplain ▸ Dimases wetland ▸ Psyche Bend Lagoon ▸ Cowanna Billabong ▸ Butlers Creek ▸ Woorlong wetland ▸ Woorlong floodplain ▸ Bullock Swamp ▸ Liparoo West Billabong ▸ Carina Bend ▸ Margooya Lagoon ▸ Lock 15 wetlands ▸ Lake Powell ▸ Lake Carpul ▸ Burra Creek North ▸ Burra Creek South	▸ Brickworks Billabong ▸ Cardross Lakes ▸ Lake Koorlong ▸ Neds Corner Central and East ▸ Nyah floodplain ▸ Vinifera floodplain ▸ Dimases wetland ▸ Psyche Bend Lagoon ▸ Cowanna Billabong ▸ Butlers Creek ▸ Woorlong wetland ▸ Woorlong floodplain ▸ Bullock Swamp ▸ Liparoo West Billabong ▸ Carina Bend ▸ Margooya Lagoon ▸ Lock 15 wetlands ▸ Lake Powell ▸ Lake Carpul ▸ Burra Creek North ▸ Burra Creek South ▸ Outlet Creek
Possible volume of environmental water required to achieve objectives	▸ 1,650 ML	▸ 3,000 ML	▸ 18,500 ML	▸ 19,100 ML

Risk management

In preparing its seasonal watering proposal, Mallee CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Engagement

Mallee CMA has consulted stakeholders when preparing the seasonal watering proposal for the lower Murray wetlands. These stakeholders are shown in Table 5.2.15.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 5.2.15 Key stakeholders engaged in the development of the lower Murray wetlands seasonal watering proposal

Stakeholder engagement
▸ Burra Creek South Proper landholder ▸ Burra Creek South Proper syndicate ▸ Commonwealth Environmental Water Office ▸ Lower Murray Water ▸ Mallee CMA Aboriginal Reference Group, an advisory committee to Mallee CMA comprising Indigenous representatives ▸ Mallee CMA Land and Water Advisory Committee, an advisory group to Mallee CMA comprising community members ▸ Murray-Darling Basin Authority ▸ Nangiloc Irrigation Association ▸ New South Wales Office of Water ▸ Parks Victoria ▸ Victorian Environmental Water Holder

5.2.6 Lindsay, Wallpolla and Mulcra islands

Environmental values

The Lindsay, Wallpolla and Mulcra island system includes semipermanent and ephemeral waterways and wetlands which support a range of vegetation types including river red gum and black box woodlands and lignum shrublands. The surrounding creeks and streams are important in maintaining flowing water habitat for fish species such as the iconic Murray cod. The island system also provides resources for the growth and breeding of another four fish species (freshwater catfish, silver perch, Murray-Darling rainbowfish and unspecked hardyhead) listed under the *Flora and Fauna Guarantee Act 1988*. When flooded, waterways and wetlands within this system provide important habitat for a range of wetland-dependent species including many waterbirds. Of these bird species, 40 are considered threatened in Victoria including the great egret and red-necked stint.

Social and economic values

The island floodplains are popular recreation sites for the local communities and camping, canoeing, bird watching, photography, fishing and four-wheel driving are all popular pursuits.

The floodplain and wetland systems still have many sites of Indigenous significance (such as shell middens, burial sites and scar trees). Lindsay Island is listed as a special protection area due to the presence of many archaeological sites. The floodplain and wetland systems continue to be places of significance for Traditional Owners and their Nations in the region.

Environmental watering objectives for Lindsay, Wallpolla and Mulcra islands
Increase the diversity, extent and abundance of wetland plant life
Provide feeding and breeding habitat for a range of waterbird species including threatened and migratory species and colonial species such as the egret
Increase abundance, diversity and movement of native fish; provide flows for large-bodied fish (including Murray cod and perch) to swim, feed and breed

System overview

Lindsay, Wallpolla and Mulcra islands cover over 26,100 ha of River Murray floodplain, forming part of the Chowilla floodplain and Lindsay–Wallpolla Island Living Murray icon site.

The islands are fed by high River Murray flows that are influenced by the upper Murray tributaries and flows in the Darling River. The islands are located in a reach of the River Murray that is highly regulated through a series of locks and weirs; locks 6–9 all affect the natural hydrology. A combination of large floods, structural works, weir manipulation and temporary pumping allow the islands to receive environmental water. Structural works have been completed at Mulcra, Wallpolla and Lindsay islands that can be used to control flow through the anabranches and manage water to specific wetlands (such as Lake Wallawalla).

Recent conditions

In 2013–14 and 2014–15, the newly-commissioned structures allowed water to be provided to the Mulcra Island floodplain, including some inundation of the fringing lignum shrublands.

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

Mulcra was the only island to receive environmental water in 2014–15 with around 6,300 ML delivered in spring and early summer. The delivery helped restore connectivity between the river and floodplain habitats and provided water to the higher elevation and severely stressed lignum communities. A range of waterbirds were recorded during the watering although species that feed on small fish were not present.

Wallpolla Island's Horseshoe Lagoon received about 400 ML of environmental water in late autumn 2014–15. The delivery aimed to assist in supporting the growth of aquatic plants and fringing vegetation.

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 River Murray. Movement of both native and non-native fish has been recorded through the new infrastructure on the upper Potterwalkagee Creek, part of the Mulcra Island system.

Scope of environmental watering

Potential environmental watering actions and their environmental objectives are shown in Table 5.2.16.

Table 5.2.16 Potential environmental watering actions and objectives for Lindsay, Wallpolla and Mulcra islands

Potential environmental watering	Environmental objectives
Lindsay Island	
Year-round baseflows through Mullaroo Creek and northern Lindsay River (up to 700 ML/day year-round)[1,2]	▸ Maintain native fish habitat
Spring fresh through Mullaroo Creek and Lindsay River including flows in the southern Lindsay River (up to 900 ML/day for 3 months during August–October)[1]	▸ Stimulate native fish movement and spawning
Winter/spring inundation of Lake Wallawalla (filling flows during August–October)	▸ Maintain condition of the lakebed herbland and provide opportunities for waterbird breeding and frogs
Mulcra Island	
Year-round baseflows through Potterwalkagee Creek (up to 100 ML/day year-round)[2]	▸ Maintain large-bodied fish habitat
Spring fresh through Potterwalkagee Creek (up to 300 ML/day for up to 3 months during August–October)	▸ Stimulate large-bodied native fish movement and spawning
Wallpolla Island	
Winter/spring inundation of Wallpolla East (filling flows during July–November)	▸ Increase diversity and extent of littoral zone vegetation ▸ Provide habitat for waterfowl

1 As well as targeting environmental benefits, watering actions in Lindsay Island are aimed at commissioning the new environmental water management structures with the final offtake at Mullaroo Creek planned to be commissioned in 2015–16.

2 Year-round baseflows in Mullaroo Creek, northern Lindsay River and Potterwalkagee Creek are typically provided by the delivery of consumptive water en route in the Murray system. Any additional losses associated with the deliveries will be met using environmental water.

Scenario planning

Table 5.2.17 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

Specific flow rates and lock heights in the River Murray are required to facilitate environmental watering in many parts of Lindsay, Wallpolla and Mulcra islands. As such, it will depend on sufficient flows occurring down the River Murray. Under a wet scenario, high flows in the Murray system are likely to naturally inundate the wetlands or significantly contribute to achieving the desired watering regimes.

Under dry scenarios, environmental watering will focus on the provision of baseflows in the waterways and on low-level inundation of Lake Wallawalla to provide critical habitat for waterbirds and other water-dependent animal species. Under wetter scenarios, freshes are proposed to be delivered in waterways and wetland watering will be more extensive, building on wetter catchment conditions and expected high flows in the Murray system.

Mulcra Island, by Mallee CMA

Table 5.2.17 Potential environmental watering for Lindsay, Wallpolla and Mulcra islands under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	▸ Unregulated flow periods very unlikely ▸ No natural inflows expected into semipermanent wetlands or the floodplain	▸ Low probability of small unregulated flows in spring ▸ No natural inflows expected into semipermanent wetlands or the floodplain	▸ Likely chance of unregulated flows in winter/spring ▸ Some wetlands and the floodplain may receive some natural inflows	▸ High probability of moderate-to-large unregulated flows during winter/spring ▸ Wetlands and the floodplain may receive some natural inflows
Potential environmental watering	▸ Year-round baseflows in the Mullaroo Creek, northern Lindsay River and Potterwalkagee Creek ▸ Winter/spring inundation of Lake Wallawalla	▸ Year-round Baseflows in the Mullaroo Creek and northern Lindsay River, and Potterwalkagee Creek ▸ Winter/spring inundation of Lake Wallawalla ▸ Winter/spring inundation of Wallpolla East	▸ Spring fresh through the Mullaroo Creek and Lindsay River ▸ Winter/spring inundation of Lake Wallawalla ▸ Spring fresh through Potterwalkagee Creek ▸ Winter/spring inundation of Wallpolla East	▸ Spring fresh & high flows through the Mullaroo Creek and Lindsay River ▸ Winter/spring inundation of Lake Wallawalla ▸ Spring fresh & high flows through Potterwalkagee Creek ▸ Winter/spring inundation of Wallpolla East
Possible volume of environmental water required to meet objectives[1]	▸ 2,000 ML	▸ 5,000 ML	▸ 10,000 ML	▸ 23,000 ML

1 Volume includes the estimated volume of environmental water required to underwrite the losses associated with the delivery of consumptive water en route (for flows within the Mullaroo Creek, Lindsay River and Potterwalkagee Creek)

Wallpolla, by Mallee CMA

Risk management

In preparing its seasonal watering proposal, Mallee CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Engagement

The Mallee CMA has consulted stakeholders when preparing the seasonal watering proposal for the Lindsay, Wallpolla and Mulcra islands system. These stakeholders are shown in Table 5.2.18.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 5.2.18 Key stakeholders engaged in the development of the Lindsay, Wallpolla and Mulcra islands seasonal watering proposal

Stakeholder engagement
▸ Commonwealth Environmental Water Office
▸ Goulburn-Murray Water
▸ Lower Murray Water
▸ Mallee CMA Aboriginal Reference Group, an advisory committee to Mallee CMA comprising Indigenous representatives
▸ Mallee CMA Land and Water Advisory Committee, an advisory group to Mallee CMA comprising community members
▸ Murray-Darling Basin Authority
▸ New South Wales Office of Water
▸ Parks Victoria
▸ SA Water
▸ Victorian Environmental Water Holder

Mulcra Island, by Mallee CMA

5.3 Ovens system

Waterway manager – North East Catchment Management Authority

Storage manager – Goulburn-Murray Water

Environmental water holder – Commonwealth Environmental Water Holder

Environmental values

The Ovens River system supports a wide range of self-sustaining native fish populations including Murray cod, trout cod, golden perch and fly-specked hardyhead. The Buffalo River is important for large fish species during part of their breeding cycle while trout cod are found as far up the King River as Whitfield. The Ovens system has been the focus of a successful recovery project for trout cod, with efforts to reintroduce Macquarie perch currently underway.

Frogs (such as the giant bullfrog and growling grass frog) are abundant in the lower Ovens River and associated wetlands and in the King River upstream of Cheshunt. The lower wetlands support birds such as egrets, herons, cormorants, bitterns and treecreepers while the river-red-gum-dominated riparian vegetation along the rivers is among the healthiest examples in north-east Victoria.

Social and economic values

Recreational activities include fishing, boating, kayaking, water skiing, swimming and bushwalking, while irrigation supports the food and wine industries that attract many tourists to the region. Lake Mulwala, at the confluence of the Murray and Ovens rivers, is another tourist drawcard. There are also significant Indigenous cultural heritage values with scar trees and artefact scatters as the physical evidence of Aboriginal people living along the river. The Ovens River continues to be a place of significance for Traditional Owners and their Nations in the region.

Environmental watering objectives in the Ovens system
Provide flow for native fish to move between pools and over rocky or shallow parts of the river
Maintain the form of the river bank and channel, plus a range of different river bed surfaces to support all stream life. Scour silt build-up and clean cobbles in river bed pools to maintain habitat for native plants and animals
Maintain water quality for all river life
Provide habitat for a wide range of waterbugs which provide energy, break down dead organic matter and support the river's food chain

System overview

The Ovens River system rises in the Great Dividing Range near Mount Hotham and flows about 150 km to join the River Murray in the backwaters of Lake Mulwala. Two small water storages have been constructed in the system: Lake Buffalo on the Buffalo River and Lake William Hovell on the King River. The regulated reaches of the Ovens River system include the Buffalo River below Lake Buffalo, the King River below Lake William Hovell and the Ovens River from its confluence with the Buffalo River to Lake Mulwala (see Figure 5.3.1).

The Ovens River system maintains relatively natural flows and has good lateral and longitudinal connectivity. This is a result of relatively small storages that spill every year and allow unregulated flows to the rivers.

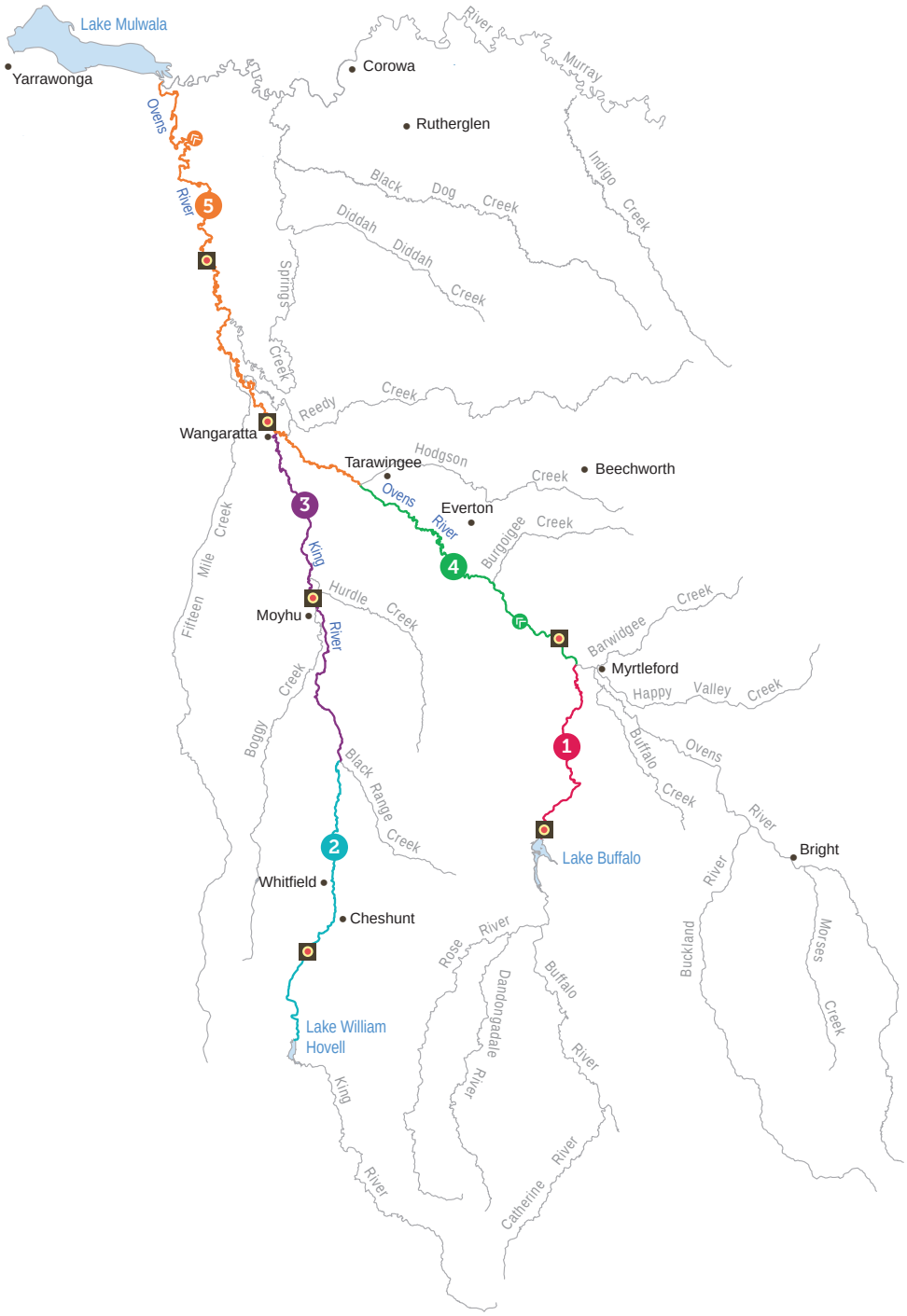
The Ovens River system contributes significantly to the water resources of the River Murray. The water that flows out of the Ovens River system is regulated by the largest weir pool (Lake Mulwala) on the Murray regulated river system. Ovens River flows contribute to the reliability and the variability of the flow regime for the River Murray and support many downstream uses (such as irrigation, urban supply and watering of iconic sites such as Barmah Forest).

Environmental water is held in Lake Buffalo and in Lake William Hovell and can be released under regulated conditions, when the storages are not spilling. There are five reaches identified in the Ovens River system that can benefit from environmental water releases. While all are important, there are relatively small environmental holdings available in the system to meet the needs of all reaches. When water is only available from the holdings, outcomes in the reaches immediately downstream of the storages are targeted. When paired with consumptive water en route, benefits are likely to be achieved downstream to the River Murray.

Figure 5.3.1 The Ovens system

Reach 1 Buffalo River: Lake Buffalo to the Ovens River
Reach 2 King River: Lake William Hovell to Moyhu
Reach 3 King River: Moyhu to the Ovens River
Reach 4 Ovens River: Buffalo River to Everton/Tarrawingee
Reach 5 Ovens River: Everton/Tarrawingee to the Murray River at Lake Mulwala
Measurement point
Town
Indicates direction of flow

Grey river reaches have been included for context. The numbered reaches indicate where relevant environmental flow studies have been undertaken. Coloured reaches can receive environmental water.



Recent conditions

Unregulated flows occurred in the Ovens River until early spring 2014. Rainfall over spring, summer and autumn was low and consequently inflows to the storages were also very low. Releases from storage generally remained at low, stable levels during the irrigation season.

The stable, low releases from Lake William Hovell presented an opportunity to add some variability by releasing 50 ML of Commonwealth environmental water over two days in early April.

The bulk drawdown of water—a large release from Lake Buffalo to deliver consumptive use water downstream and make additional space in the storage—did not occur due to the dry conditions. Consequently, 20 ML of Commonwealth environmental water was released at the end of April to provide some variability to the releases downstream of the storage.

A key aspect of achieving managed environmental outcomes for reaches 1, 4 and 5 is the release of the bulk drawdown of water by the storage manager. Without this event, the impact of the small holdings is localised, providing some flow variability below the storages.

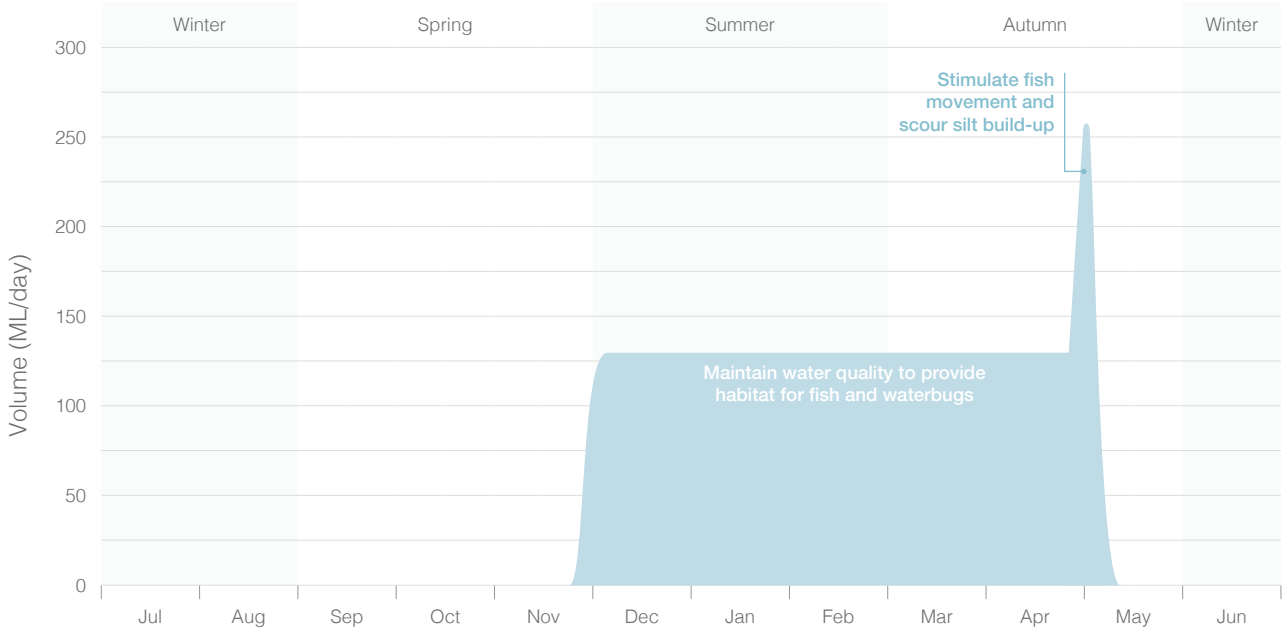
Scope of environmental watering

Potential environmental watering actions and their environmental objectives are shown in Table 5.3.1 and illustrated in Figure 5.3.2.

Table 5.3.1 Potential environmental watering actions and objectives for the Ovens system

Potential environmental watering	Environmental objectives
Summer/autumn low-flow fresh in reach 5 (1 fresh of 130–260 ML/day for at least 3 days during April–May)	▸ Maintain flow cues to stimulate movement of native fish ▸ Maintain short-term fluctuations in discharge to move sediment and maintain macroinvertebrate habitat ▸ Maintain connectivity between pools and riffles ▸ Scour biofilm from river bed
Supporting summer/autumn low flows targeting reaches 1, 2 and 3 (10 ML–985 ML/day during December–May)	▸ Maintain adequate habitat for native fish ▸ Maintain natural connectivity between pools and riffles ▸ Maintain short-term fluctuations in discharge to move sediment and maintain macroinvertebrate habitat

Figure 5.3.2 Potential environmental watering in the Ovens system



Note: This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Table 5.3.2 Potential environmental watering for the Ovens system under a range of planning scenarios

Planning scenario	Dry	Average	Wet
Expected river conditions	▸ Possible winter/early spring unregulated flows ▸ Highly likely low summer/autumn flows ▸ Bulk water release unlikely	▸ High winter/spring unregulated flows ▸ Possible summer/autumn low flows ▸ Bulk water release likely	▸ High unregulated flows throughout most of the year ▸ Bulk water release likely
Expected availability of environmental water		▸ Lake William Hovell: 50 ML ▸ Lake Buffalo: 20 ML ▸ Total: 70 ML	
Potential environmental watering	▸ Summer/autumn low flows	▸ Summer/autumn low flow freshes	▸ All objectives achieved naturally ▸ Spill conditions and/or risk of overbank flows mean environmental water may not be released
Possible volume of environmental water required to meet objectives	▸ 70 ML	▸ 70 ML	▸ 0 ML

Scenario planning

Table 5.3.2 outlines the potential environmental waterings and expected water usage under a range of planning scenarios.

The climatic conditions and inflow into storages have a large effect on how environmental water is likely to be used. Under dry conditions, environmental water aims to provide low-flow variability below the storages. As conditions become wetter, there are increased opportunities to piggyback environmental releases on the bulk drawdown of water from Lake Buffalo and achieve environmental outcomes for the length of the regulated river. Environmental water cannot be released if the storages are spilling and under wet conditions the additional risk of overbank flows may result in environmental water not being released at all. However, the desired flows through the Ovens system are likely to be achieved naturally under wet conditions. The Commonwealth holding in the Ovens system has a high level of security and is expected to be available under all scenarios.

Risk management

In preparing its seasonal watering proposal, North East CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Engagement

The North East CMA consulted key stakeholders when preparing the seasonal watering proposal for the Ovens system. These stakeholders are shown in Table 5.3.3.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 5.3.3 Key stakeholders engaged in the development of the Ovens system seasonal watering proposal

Stakeholder engagement
▸ Commonwealth Environmental Water Office ▸ Goulburn-Murray Water ▸ North East CMA Board ▸ Victorian Environmental Water Holder

5.4 Goulburn system

Waterway manager – Goulburn Broken Catchment Management Authority

Storage manager – Goulburn-Murray Water

Environmental water holders – Victorian Environmental Water Holder, Commonwealth Environmental Water Holder, Murray-Darling Basin Authority (the Living Murray program)

The Goulburn is Victoria's largest river basin, covering over 1.6 million ha or 7.1 percent of the state. The Goulburn River flows for 570 km from the Great Dividing Range upstream of Woods Point to the River Murray east of Echuca. It is an iconic heritage river because of its environmental, recreational and Indigenous cultural heritage values. It supports large areas of intact river red gum forest and provides habitat for threatened and endangered bird and fish species. It also contains important cultural heritage sites, provides water for Victoria's largest irrigation district and supports recreational activities such as fishing and canoeing. There are several wetlands within the Goulburn Broken catchment formally recognised for their conservation significance.

Environmental water is held and released from Lake Eildon and flows can be regulated at the Goulburn Weir.

Engagement

The Goulburn Broken CMA has consulted stakeholders when preparing the seasonal watering proposals for the Goulburn system. These stakeholders are shown in Table 5.4.1.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 5.4.1 Key stakeholders engaged in the development of the Goulburn system seasonal watering proposal

Stakeholder engagement
▸ Commonwealth Environmental Water Office
▸ Goulburn-Murray Water
▸ Parks Victoria
▸ Victorian Environmental Water Holder
▸ Yorta Yorta Nation Aboriginal Corporation

5.4.1 Goulburn River

Environmental values

The Goulburn River supports a range of native fish, including golden perch, silver perch, Murray cod, trout cod, Macquarie perch and freshwater catfish. Its aquatic vegetation and submerged logs provide great diversity of habitat to support adult and juvenile fish. The bank vegetation is dominated by river red gums which provide habitat for many species including squirrel gliders. Birds such as egrets, herons and cormorants use the river to feed while frogs benefit from shallow areas.

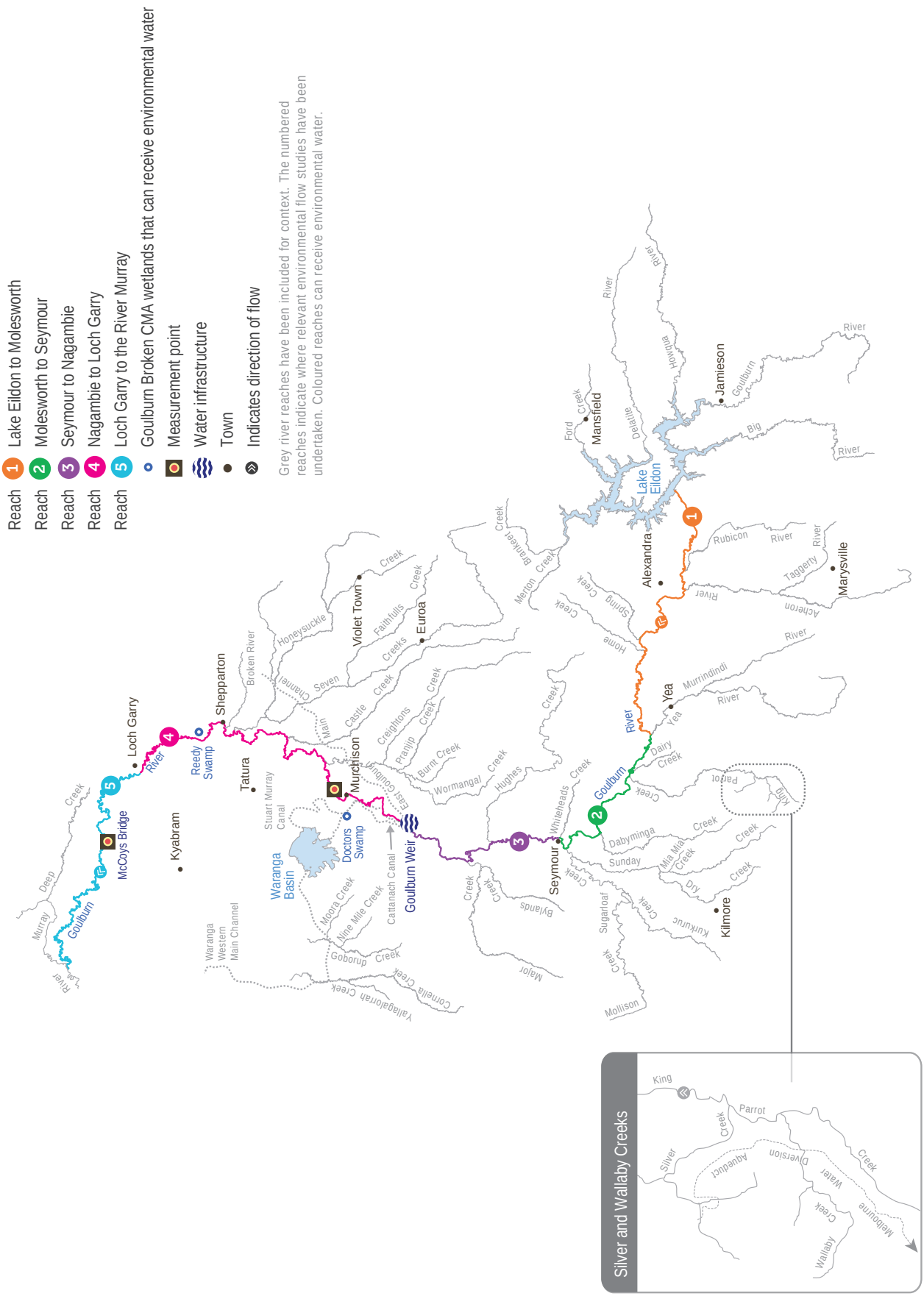
The mid-Goulburn River between Lake Eildon and Goulburn Weir is an important reach for Macquarie perch spawning, while freshwater catfish can be found in adjacent lagoons. The lower Goulburn River below Goulburn Weir is a significant source of golden perch recruitment, with monitoring showing successful spawning in response to environmental flows.

Social and economic values

The Goulburn River is popular for recreation, fishing and boating. Fishing in particular provides substantial economic and social benefits to the region, and the river supplies water for towns, stock and domestic users and irrigators. The river's floodplain also has many important Indigenous cultural heritage sites such as scar trees, mounds, stone artefact scatters and middens. The Goulburn River continues to be a place of importance for Traditional Owners and their Nations.

Environmental watering objectives in the Goulburn River	
	Increase macrophytes (large plants) and flood-tolerant plants within the river channel and lower banks, to provide shade and food for organisms further up the food chain
	Protect and boost populations of native fish (including golden perch) by providing habitat flows and encouraging fish to migrate to spawn
	Maintain the form of the river bank and channel, and a diversity of river-bed surfaces to support all stream life
	Provide habitat and nourishment for waterbugs which provide energy, break down dead organic matter and support the river's food chain

Figure 5.4.1 The Goulburn River system



Golden perch, by Jarod Lyon

System overview

Lake Eildon and Goulburn Weir have significantly modified the Goulburn River's flow pattern. Due to the impact of water harvesting, lower flows now occur in the Goulburn River in winter and spring, while higher flows occur in summer and autumn due to releases to meet irrigation and consumptive demands. This reverses what would happen naturally. The river flow regime is also affected by land use changes and by the construction of small dams and drainage schemes. Levees and other structures prevent water inundating the floodplain. Tributaries downstream of major infrastructure (such as Seven Creeks and the Broken River) help contribute natural flows to the Goulburn River in the lower reaches downstream of Goulburn Weir.

Environmental water in the Goulburn system is held by the VEWH and Commonwealth Environmental Water Holder (CEWH) and the Murray-Darling Basin Authority on behalf of the Living Murray program. The CEWH is the largest holder of environmental water in the Goulburn system. Availability and use of Commonwealth environmental water is critical to achieving outcomes in the Goulburn River. Environmental water held on behalf of the Living Murray program may also assist in meeting objectives in the Goulburn system en route to icon sites in the Murray system.

Environmental water may need to be delivered through the Goulburn system to meet a downstream environmental demand. Where possible, these releases are managed to achieve outcomes in the Goulburn system before being reused downstream.

Environmental targets can also be met by consumptive water delivered from Lake Eildon to meet downstream demands in the River Murray (known as intervalley transfers). Goulburn intervalley transfers are expected to occur at times during the irrigation season, from spring to autumn. These flows may assist in achieving the desired environmental objectives without the need to release environmental water.

The priority reaches are reach 4 and 5 in the lower Goulburn River as they are the most flow-stressed sections of the river. Delivery of environmental flows to these target reaches also provides benefit and meets some targets in other reaches en route.

Recent conditions

Some catchment runoff occurred in winter before dry conditions commenced in spring and persisted for the rest of 2014–15. Water was released from Lake Eildon for downstream irrigation and environmental demands and remained within the river channel.

Environmental water was delivered downstream of Goulburn Weir to provide baseflows which support fish and macroinvertebrate habitat. Two spring freshes and one autumn fresh were delivered to support the recovery of amphibious bank vegetation and trigger golden perch spawning. In addition, environmental water was passed down the Goulburn River to meet environmental needs in the River Murray and other downstream locations. The delivery of consumptive (mainly irrigation) water also provided significant flows during spring, summer and early autumn. Where possible, the delivery of consumptive water was managed to support ecological outcomes.

Monitoring found successful golden perch spawning in response to environmental releases in November 2014, building on spawning that occurred in 2013. Amphibious bank vegetation is continuing its slow recovery following the Millennium Drought and subsequent flood events, with some new vegetation established below the 3,000 ML per day flow level in 2014–15.

While the delivery of freshes has been managed to reduce notching along banks, there are still anecdotal reports of erosion and slumping in the lower reaches. Monitoring will aim to determine the reasons for this bank instability.

Scope of environmental watering

Potential environmental watering actions and their environmental objectives are shown in Table 5.4.2 and illustrated in figures 5.4.2 to 5.4.4.

In addition to the watering actions, environmental water may be used to slow the recession of unregulated flows or operational releases to reduce damage to banks and vegetation from rapid drops in water levels. This also helps prevent macroinvertebrates and fish from being stranded in small pools on river banks or benches following higher flows.

Table 5.4.2 Potential environmental watering actions and objectives for the Goulburn system

Potential environmental watering	Environmental objectives
Lower Goulburn River	
Year-round baseflows (500 ML/day in reach 4 and/or 540 ML/day in reach 5)	▸ Maximise habitat and movement opportunities for large- and small-bodied native fish ▸ Provide conditions that support macroinvertebrate habitat and food resources including maintaining suitable water quality, encouraging the establishment of aquatic vegetation, submerging snags and encouraging planktonic production
Spring/summer fresh (1 fresh of up to 15,000 ML/day with flows above 5,600 ML/day for 14 days in reach 4 and reach 5 during October–December)	▸ Support establishment of amphibious bank vegetation ▸ Maintain aquatic macrophyte, macroinvertebrate and fish habitat by mobilising fine sediments, submerging snags and replenishing slackwater habitat ▸ Initiate spawning and prespawning migration and support recruitment of golden perch
Winter fresh (1 fresh of up to 15,000 ML/day with flows above 6,600 ML/day for 14 days in reach 4 and reach 5 during June–August)	▸ Maintain aquatic macrophyte, macroinvertebrate and fish habitat by mobilising fine sediments, submerging snags and replenishing slackwater habitat
Summer/autumn fresh (1 fresh of up to 5,600 ML/day for 2 days in reach 4 and reach 5 during February–April)	▸ Maintain aquatic macrophyte, macroinvertebrate and fish habitat by mobilising fine sediments, submerging snags and replenishing slackwater habitat ▸ Support establishment of amphibious bank vegetation
Spring/summer fresh (1 fresh of up to 15,000 ML/day for 2 days in reach 4 and reach 5 during November–December)	▸ Initiate spawning and pre-spawning migrations and recruitment of golden perch ▸ Support establishment of amphibious bank vegetation ▸ Maintain aquatic macrophyte, macroinvertebrate and fish habitat by mobilising fine sediments, submerging snags and replenishing slackwater habitat
Increased baseflows (830 ML/day in reach 4 and/or 940 ML/day in reach 5 year-round)	▸ As for 500–540 ML/day baseflows, plus ... ▸ Submerge additional snags for macroinvertebrate food and habitat ▸ Maintain pool depths and sediment distribution ▸ Provide area of slackwater habitat in spring/summer to support spring-spawned larvae and juvenile fish
Seasonal baseflows/fresh (up to 5,000 ML/day in reach 4 and/or reach 5 year-round depending on climatic conditions)	▸ Maintain pool depth and natural rates of sediment deposition
Mid-Goulburn River	
Seasonal baseflows (400 ML/day in reach 1 and/or 800 ML/day in reach 3 year-round)	▸ Wet and maintain riffles for macroinvertebrates and small-bodied fish ▸ Maintain wetted perimeter and aquatic vegetation
Seasonal fresh (2,500–3,500 ML/day for 5–7 days in reach 1 and/or reach 3 year-round)	▸ Reduce algal build up and refresh biofilms ▸ Maintain areas of riffle habitat
Spring/summer fresh (1 fresh targeting a ~0.5m increase in river height in reach 3 for 2 days [7 day rise] from October–December)	▸ Provide flows to promote large-bodied native fish colonisation

Figure 5.4.2 Potential environmental watering in the lower Goulburn River

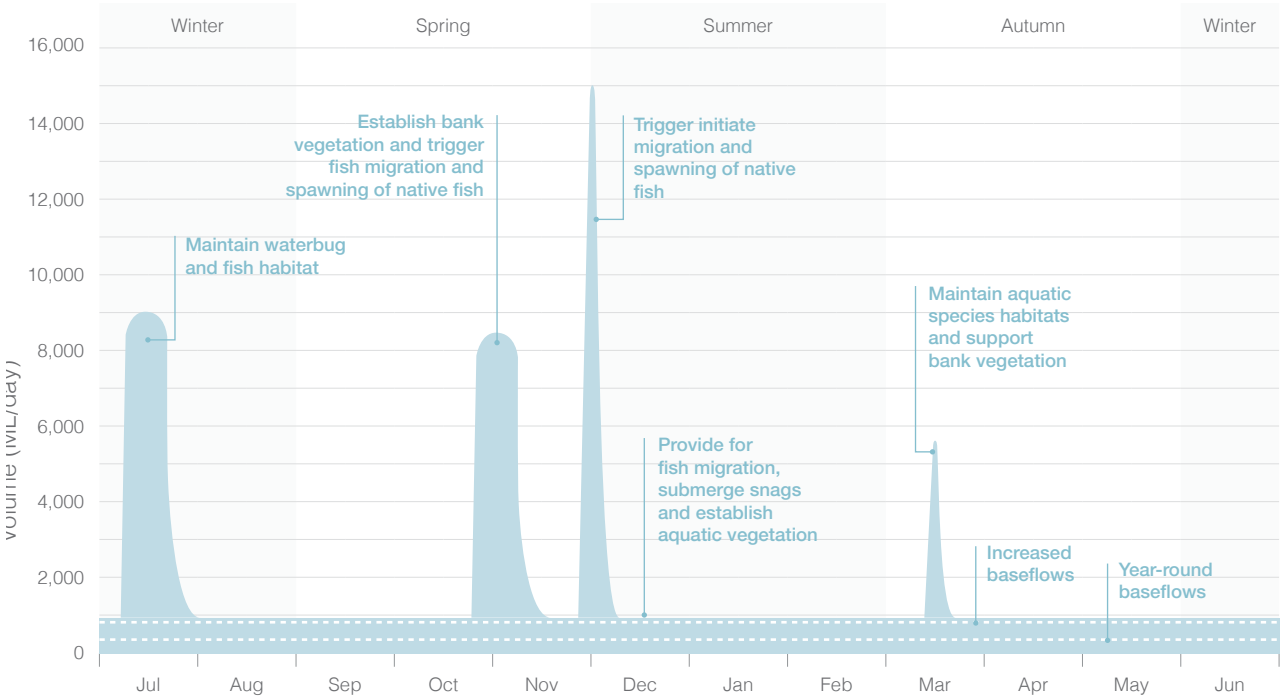
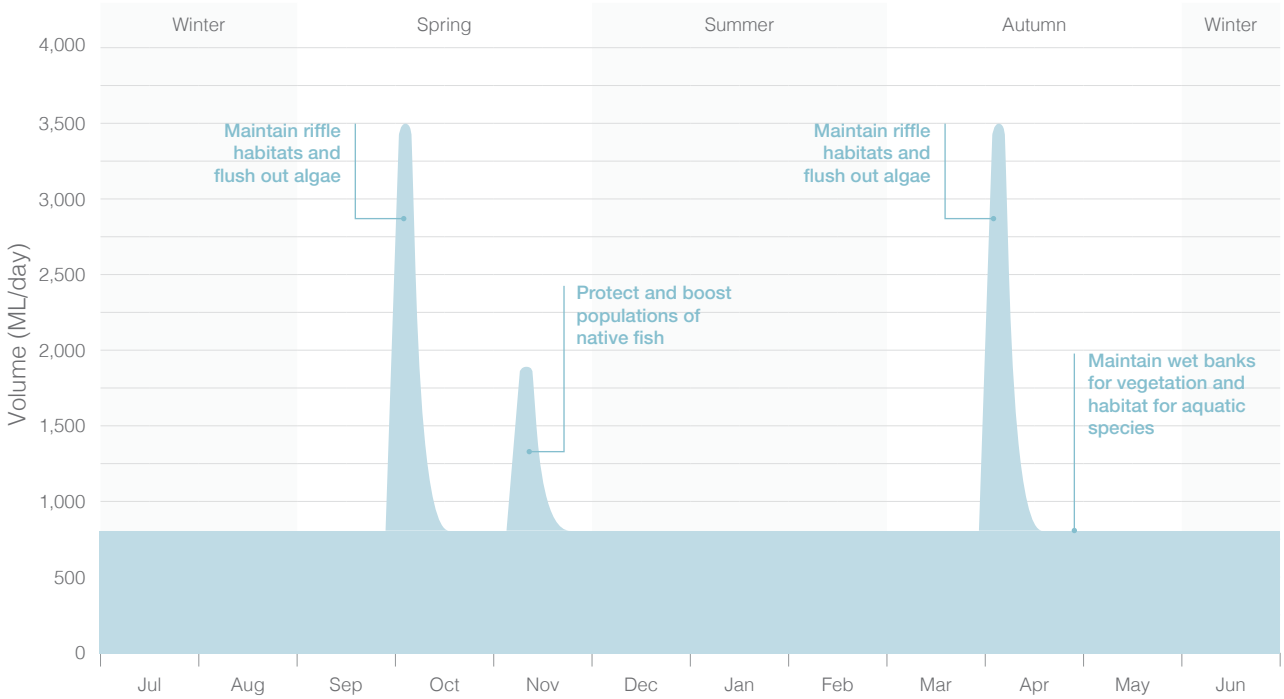


Figure 5.4.2 Potential environmental watering in the mid Goulburn River



Note: These figures are for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Goulburn River upstream of Yambuna Outfall, by Goulburn Broken CMA

Scenario planning

Table 5.4.3 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

Various triggers for action are applied as part of the adaptive management of environmental water in the Goulburn system. For example, the second spring fresh targeting golden perch spawning may not be delivered if monitoring shows spawning was achieved during the earlier, longer-duration spring fresh.

Under severe drought conditions, the highest priority for environmental watering in 2015–16 will be providing year-round baseflows, the extended duration spring fresh and the winter fresh finishing in July 2015. These provide improved habitat for animals in the river channel and support vegetation on the river banks. If better conditions occur, the additional summer/autumn fresh, shorter spring fresh and increased baseflows become achievable, targeting spawning of golden perch, macroinvertebrate and fish habitat and additional enhancement of bank vegetation.

Environmental water availability, unregulated flows and consumptive deliveries have a significant influence on the achievement of environmental watering objectives in the Goulburn system. Whilst watering actions have been proposed for the mid-Goulburn River, the primary focus will be on the achievement of lower Goulburn River objectives. Environmental water availability will be relatively high in 2015–16 and environmental watering will aim to continue to improve the overall health of the system, rather than restricting delivery to critical flows under drier scenarios.

Under wetter scenarios, unregulated flows are expected to increase, contributing to the achievement of additional objectives. As total water availability increases, the opportunity to maintain or improve the health of the river increases with the additional objectives that can be achieved. Tier-2 actions are included as desirable objectives if more water becomes available under each scenario.

In determining potential watering actions for 2015–16, consideration was given to critical carryover into 2016–17. In drought and dry scenarios, carryover is a priority to ensure baseflows can be provided from July to September 2016. If average or wet conditions occur in 2015–16, the increase in water availability for 2016–17 would mean this carryover would not be essential. If this occurs, no greater need exists in 2016–17 than 2015–16, so under these scenarios there is no targeted carryover volume for 2016–17.

Risk management

In preparing its seasonal watering proposal, Goulburn Broken CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Table 5.4.3 Potential environmental watering for the Goulburn system under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	▸ No unregulated flows	▸ Unregulated flows expected to provide baseflows in winter to mid-spring and likely winter-spring freshes	▸ Unregulated flows expected to provide baseflows, several freshes and overbank flows in winter/spring	▸ Unregulated flows expected to provide high baseflows and multiple overbank flow events in winter/spring
	▸ Normal minimum passing flows at reach 5 of 400 ML/day from July–October and 350 ML/day from November–June.			
Expected availability of environmental water	▸ 48,000 ML VEWH ▸ 222,000 ML CEWH ▸ 20,000 ML Living Murray ▸ 290,000 ML total		▸ 48,000 ML VEWH ▸ 346,000 ML CEWH ▸ 39,000 ML Living Murray ▸ 433,000 ML total	
Potential environmental watering (tier 1)	▸ Winter 2015/spring baseflow ▸ Spring fresh ▸ Summer baseflow ▸ Autumn/winter 2016 baseflow ▸ Winter 2015 fresh ▸ Summer/autumn fresh (partial achievement) ▸ Summer increased baseflow	▸ Winter 2015/spring baseflow ▸ Spring fresh ▸ Summer baseflow ▸ Autumn/winter 2016 baseflow ▸ Winter 2015 fresh ▸ Summer/autumn fresh ▸ Spring fresh ▸ Winter 2015/spring increased baseflow ▸ Summer increased baseflow ▸ Autumn/winter 2016 increased baseflow	▸ Winter 2015/spring baseflow ▸ Spring fresh ▸ Summer baseflow ▸ Autumn/winter 2016 baseflow ▸ Winter 2015 fresh ▸ Summer/autumn fresh ▸ Spring fresh ▸ Winter 2015/spring increased baseflow ▸ Summer increased baseflow ▸ Autumn/winter 2016 increased baseflow ▸ Recession flow management	▸ Winter 2015/spring baseflow ▸ Spring fresh ▸ Summer baseflow ▸ Autumn/winter 2016 baseflow ▸ Winter 2015 fresh ▸ Summer/autumn fresh ▸ Spring fresh ▸ Winter 2015/spring increased baseflow ▸ Summer increased baseflow ▸ Autumn/winter 2016 increased baseflow ▸ Recession flow management ▸ Winter 2016 fresh
Potential environmental watering (tier 2)	▸ Summer/autumn fresh ▸ Spring fresh ▸ Winter 2015/spring increased baseflow ▸ Autumn/winter 2016 increased baseflow ▸ Recession flow management ▸ Winter 2016 fresh ▸ Spring baseflow[1] ▸ High summer baseflow ▸ Spring fresh[1] ▸ Autumn fresh[1] ▸ Spring/summer fresh[1]	▸ Recession flow management ▸ Winter 2016 fresh ▸ Spring baseflow ▸ High summer baseflow ▸ Spring fresh[1] ▸ Autumn fresh[1] ▸ Spring/summer fresh[1]	▸ Winter 2016 fresh ▸ Spring baseflow[1] ▸ High summer baseflow ▸ Spring fresh[1] ▸ Autumn fresh[1] ▸ Spring/summer fresh[1]	▸ Spring baseflow[1] ▸ High summer baseflow ▸ Spring fresh[1] ▸ Autumn fresh[1] ▸ Spring/summer fresh[1]
Possible volume of environmental water required to achieve objectives	▸ 288,000 ML (tier 1) ▸ 439,000 ML (tier 2)	▸ 432,000 ML (tier 1) ▸ 274,000 ML (tier 2)	▸ 388,000 ML (tier 1) ▸ 191,000 ML (tier 2)	▸ 433,000 ML (tier 1) ▸ 57,000 ML (tier 2)
Critical carryover into 2016–17	▸ 23,000 ML	▸ 23,000 ML	▸ 0 ML	▸ 0 ML

1 Mid-Goulburn River watering (reaches 1, 2 and/or 3)

5.4.2 Goulburn wetlands

Environmental values

There are a large number of natural wetlands across the Goulburn catchment. They include several wetlands formally recognised for their conservation significance such as Reedy Swamp, Doctors Swamp and the Corop wetlands (comprising One Tree Swamp, Two Tree Swamp, Wallenjoe Swamp and Mansfield Swamp). The wetlands contain vegetation communities ranging from swamps dominated by river red gums, and cane-grass wetlands. Reedy Swamp and Doctors Swamp receive environmental water but the Corop wetlands are not currently a priority to receive environmental water due to infrastructure limitations.

Reedy Swamp (part of the Lower Goulburn National Park and also part of the lower Goulburn River floodplain) contains a mosaic of vegetation types including tall marsh, floodway pond herbland and rushy riverine swamp. It is an important colonial nesting waterbird breeding site and drought refuge. It is also an important stopover site for migratory birds (such as sharp-tailed and marsh sandpipers).

Doctors Swamp is a bioregionally significant swamp and is considered one of the most intact red gum swamps in Victoria.

The Corop wetlands are a large hydrologically-connected system and are valued for their size, species diversity and waterbird habitat. Of note, One Tree and Two Tree swamps provide important breeding habitat for brolga and One Tree Swamp is the largest cane-grass wetland in the Goulburn Broken catchment.

Social and economic values

Visitor activities at the wetlands include bird watching, picnicking, camping and walking. Doctors Swamp is a state game reserve.

The Goulburn wetlands are identified as a culturally sensitive areas under the Victorian *Aboriginal Heritage Act 2006*. The Goulburn wetlands have been, and continue to be, places of significance for the Traditional Owners of the Yorta Yorta Nation. The area traditionally supported a rich and diverse supply of plant and animal resources for food, medicines, shelter, clothing and tools. The larger Corop catchment contains a known Aboriginal quarry where greenstone was obtained to make stone axes.

Environmental watering objectives in the Goulburn wetlands
Improve the range of native plant life, including river red gum and grassy wetland species
Provide drought refuge, habitat and breeding and feeding opportunities for migratory and colonial nesting waterbirds

Black Swamp in August 2014, by Jo Wood

System overview

Both Doctors Swamp and Reedy Swamp can receive environmental water via irrigation supply infrastructure in the Shepparton and Central Goulburn irrigation districts. The volume delivered at any one time depends on available capacity in the irrigation supply network. Reedy Swamp is naturally inundated during high flows in the Goulburn River (about 20,000 ML per day). Doctors Swamp can only receive environmental water if the Cattanach Canal is running at 2,500 ML per day and there is available capacity after irrigation demand is met, which is also influenced by the operation of Waranga Basin. Consequently, the opportunity to deliver environmental water is greater in autumn and winter.

The Corop wetlands are not currently a priority to receive environmental water due to limitations on the existing delivery infrastructure that mean the desired inundation extent cannot be achieved. In addition, the delivery of environmental water will inundate some areas of private land, which requires agreement with affected landholders. Delivery of environmental water will not occur in this system until these constraints are overcome.

Recent conditions

Delivery of environmental water to the Goulburn wetlands has not been required in recent years due to natural flooding and inflows meeting water requirements. Reedy Swamp was wet until October 2014 and naturally drew down and dried completely in December 2014. Doctors Swamp remained dry throughout 2014–15.

One Tree Swamp, Two Tree Swamp, Mansfield Swamp and Wallenjoe Swamp have been dry since February 2013 and will remain reliant on natural inflows until infrastructure works are undertaken to assist in controlling water movement in the system.

Scope of environmental watering

Potential environmental watering actions and their environmental objectives are shown in Table 5.4.4.

Table 5.4.4 Potential environmental watering actions and objectives for the Goulburn wetlands

Potential environmental watering	Environmental objectives
Doctors Swamp (fill in late winter/spring 2015 or autumn 2016 and provide top-ups in spring/summer and as required)	▸ Maintain/ improve the condition of aquatic vegetation and river red gums ▸ Maintain water levels to support bird breeding
Reedy Swamp (fill in late winter/spring and provide top-ups in spring/summer as required)	▸ Maintain as a drought refuge for waterbirds ▸ Maintain/improve/promote the growth of aquatic vegetation to encourage and maintain water levels to support bird breeding

Scenario planning

Table 5.4.5 outlines potential environmental watering and expected water usage under a range of planning scenarios.

In wetter periods, the ecological and hydrological objectives of a wetland may be largely met by natural inflows and only small volumes of environmental water may be required. In drier periods when irrigation demand is high, there may be capacity constraints in the irrigation networks that may affect environmental water deliveries in the Goulburn wetlands. As such, the volume of environmental water that may be required reduces under the average and wet scenarios.

The decision to deliver environmental water to Reedy and Doctors swamps will be based on their hydrological condition and waterbird breeding activity, and the potential impact of environmental watering on wetland vegetation communities.

Table 5.4.5 Potential environmental watering for the Goulburn wetlands under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected catchment conditions	▸ No natural inflows into the wetlands	▸ Limited natural inflows into the wetlands	▸ Some catchment inflows to the wetlands	▸ Wetlands likely to fill from catchment inflows and natural flooding
Potential environmental watering	▸ Doctors Swamp ▸ Reedy Swamp			
Possible volume of environmental water required to achieve objectives	▸ Up to 3,360 ML		▸ Up to 1,680 ML	

Risk management

In preparing its seasonal watering proposal, Goulburn Broken CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

A male yellow billed spoonbill at Black Swamp in August 2014, by Jo Wood

5.5 Broken system

Waterway manager – Goulburn Broken Catchment Management Authority

Storage manager – Goulburn-Murray Water

Environmental water holders – Victorian Environmental Water Holder, Commonwealth Environmental Water Holder

The Broken system includes the Broken River, lower Broken Creek, upper Broken Creek and wetlands. It supports threatened plant and animal species including six native fish species of state and national conservation significance and iconic species such as the Murray cod. The system also supports riparian vegetation, especially in the lower reaches of the Broken Creek. It forms an important part of the irrigation distribution system, delivering water from the Murray and Goulburn systems into the Murray Valley and Shepparton irrigation districts. It contains important Indigenous cultural heritage sites and is also popular for recreation.

Engagement

The Goulburn Broken CMA has consulted stakeholders when preparing seasonal watering proposals for the Broken system. These stakeholders are shown in Table 5.5.1.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 5.5.1 Key stakeholders engaged in the development of the Broken system seasonal watering proposal

Stakeholder engagement
▸ Broken Environmental Water Advisory Group (comprising community members)
▸ Commonwealth Environmental Water Office
▸ Goulburn Broken Catchment Wetland Advisory Group (with representatives of Goulburn Valley Landcare, Field and Game Australia, Goulburn-Murray Water, Moira Shire, Council of Greater Shepparton, Turtles Australia, Parks Victoria and Tackle World)
▸ Murray-Darling Basin Authority (River Murray Water)
▸ Victorian Environmental Water Holder
▸ Yorta Yorta Nation Aboriginal Corporation

5.5.1 Upper Broken Creek

Environmental values

The upper Broken Creek area is dominated by unique box riparian vegetation and supports remnant plains grassy woodland. Much of this area also lies in the Broken–Boosey State Park, which contains high quality native vegetation. The creek supports a variety of threatened fauna, including fish species such as carp gudgeon, Murray cod, golden perch and Murray–Darling rainbowfish.

Social and economic values

Most of upper Broken Creek is in the Broken–Boosey State Park which contains a range of Indigenous cultural heritage values including scar trees and sites of significance for the Yorta Yorta and Bangerang people. The system also support a range of recreational and tourism values, providing opportunities for bushwalking, fishing and bird watching.

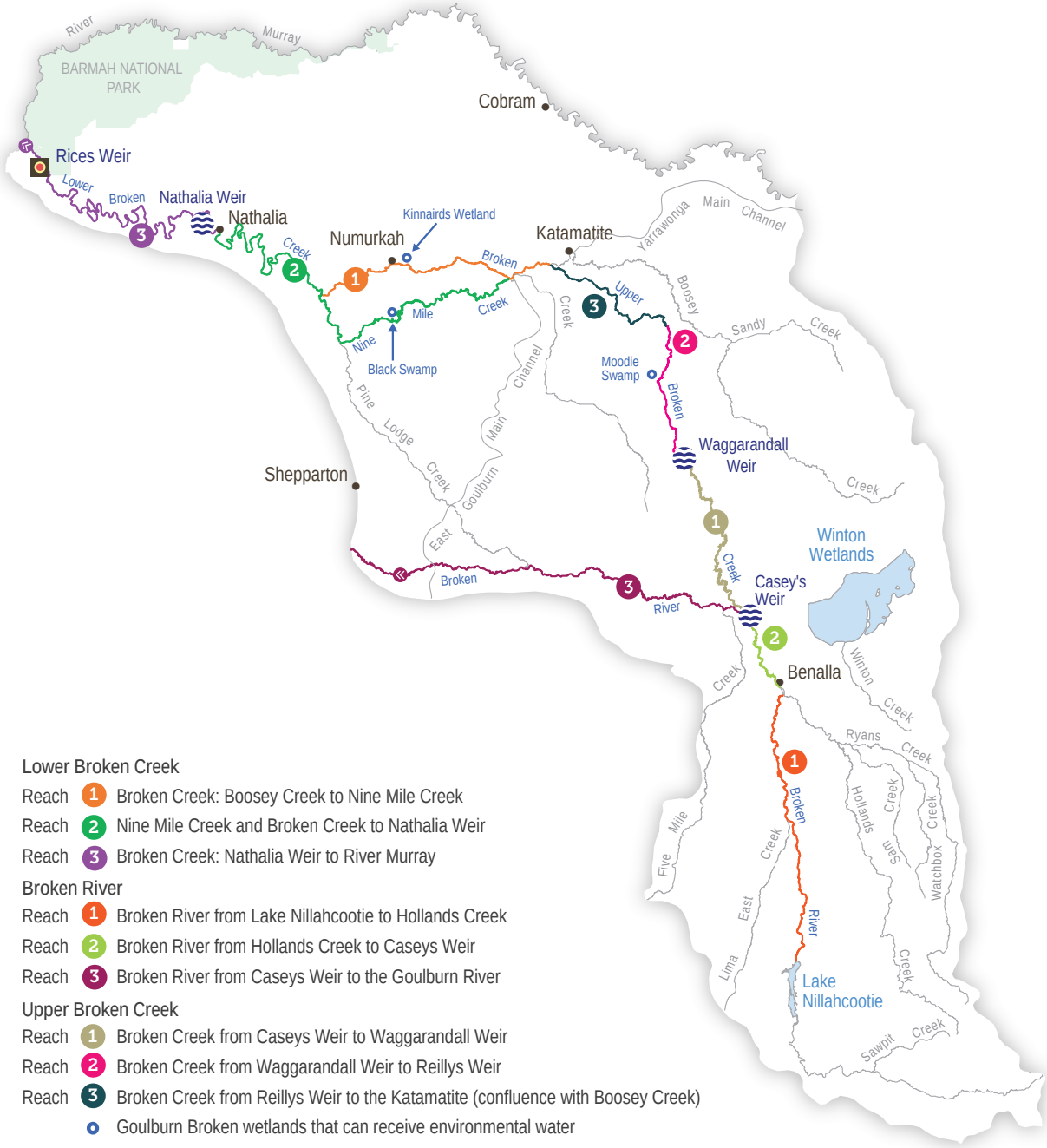
Environmental watering objectives in the upper Broken Creek system
Move built-up sand and clay material to restore deep pools and provide habitat for water animals
Improve and maintain plants on the riverbank and in the river channel
Protect and boost populations of native fish—including threatened Murray cod and golden perch—by improving pool habitat
Maintain water quality
Support a wide range of waterbugs to provide energy, break down dead organic matter and support the river's food chain

System overview

The Broken Creek diverges from the Broken River downstream of Benalla and flows to the River Murray near Barmah Forest. The creek is located on a flat riverine plain and has naturally low runoff from its local catchment. It also receives flood flows from the Broken River although these are much less frequent than occurred naturally, due to earthworks and road construction.

Upper Broken Creek is the section of creek from Casey's Weir to Katamatite that extends about 65 km. The creek has been used for water supply from the Broken River for more than 100 years although irrigation entitlements have been significantly reduced (by more than 80 percent) as part of water savings projects in the last 10 years. There are now low flows all year round at the top of the creek (from Casey's Weir to Waggarandal Weir) as water can only be supplied from Broken River based on orders from customers along the creek. In the lower reaches (from

Figure 5.5.1 The Broken system



Lower Broken Creek

Reach 1 Broken Creek: Boosey Creek to Nine Mile Creek

Reach 2 Nine Mile Creek and Broken Creek to Nathalia Weir

Reach 3 Broken Creek: Nathalia Weir to River Murray

Broken River

Reach 1 Broken River from Lake Nillahcootie to Hollands Creek

Reach 2 Broken River from Hollands Creek to Caseys Weir

Reach 3 Broken River from Caseys Weir to the Goulburn River

Upper Broken Creek

Reach 1 Broken Creek from Caseys Weir to Waggarandall Weir

Reach 2 Broken Creek from Waggarandall Weir to Reillys Weir

Reach 3 Broken Creek from Reillys Weir to the Katamatite (confluence with Boosey Creek)

Goulburn Broken wetlands that can receive environmental water

Measurement point

Water infrastructure

Town

Indicates direction of flow

Grey river reaches have been included for context. The numbered reaches indicate where relevant environmental flow studies have been undertaken. Coloured reaches can receive environmental water.

Waggarandal Weir to Reilly's Weir and from Reilly's Weir to Katamatite), the system is most influenced by rainfall and catchment runoff, which provide infrequent flow variability. Diverting water from the Broken River to the top reach achieves environmental objectives for the entire system (including the lower reaches) and allows for bankfull flows, freshes and high-flow periods.

Recent conditions

Over the last nine years, flows in the upper Broken Creek have not exceeded 70 ML per day, with minimal high-flow variability.

New rules now allow trading in the upper Broken trading zones, subject to conditions, providing some opportunity for improved environmental water availability and flow benefits. In 2014–15, 387 ML of environmental water could be transferred to upper Broken Creek from the Murray system. The water was delivered on top of irrigation demands to assist with mitigation of water quality risks following a bushfire in the region in December 2014. The fresh increased and stabilised low dissolved oxygen levels in the creek system, minimising impacts on native fish and other aquatic species in the creek.

Scope of environmental watering

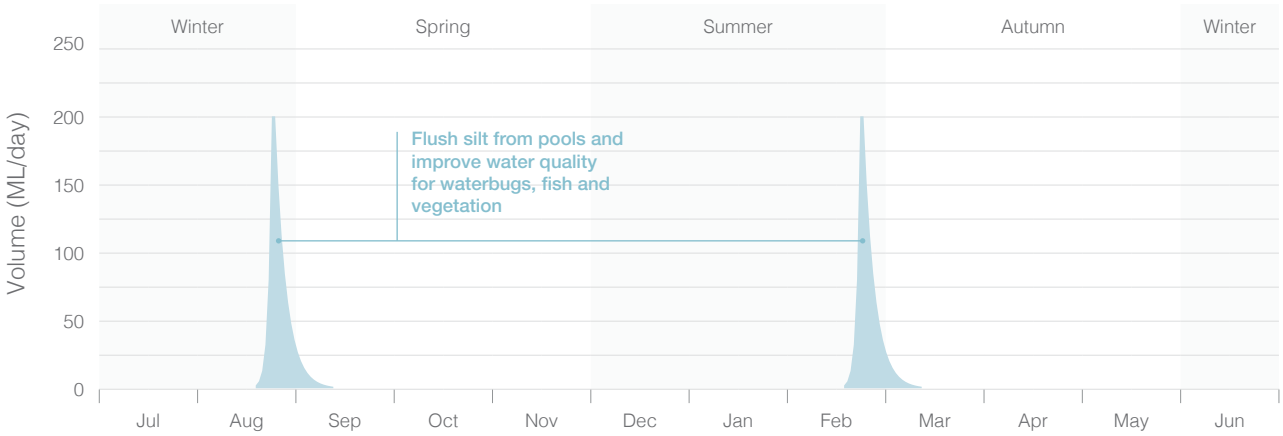
Potential environmental watering actions and their environmental objectives are shown in Table 5.5.2 and illustrated in Figure 5.5.2.

Table 5.5.2 Potential environmental watering actions and objectives for the upper Broken Creek system

Potential environmental watering	Environmental objectives
Winter/spring fresh (1 fresh of up to 200 ML/day for 2 days during June–November)	▸ Rehabilitate deep-pool habitats and facilitate the movement of sediments ▸ Maintain and enhance riparian and in-channel vegetation (water ribbons and river red gum communities) with variable wet and dry zones ▸ Maintain water quality, particularly in refuge pools ▸ Maintain and restore macroinvertebrate habitats by providing intermittent freshes to complete lifecycles
Summer/autumn fresh (1 fresh of up to 200 ML/day for 2 days during December–May)	▸ Rehabilitate deep pool habitats and facilitate the movement of sediments ▸ Maintain and enhance riparian and in-channel vegetation (water ribbons and river red gum communities) with variable wet and dry zones ▸ Maintain water quality, particularly in refuge pools ▸ Maintain and restore macroinvertebrate habitats by providing intermittent freshes to complete lifecycles

Broken River, by Goulburn Broken CMA

Figure 5.5.2 Potential environmental watering in the upper Broken Creek system



Note: This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Scenario planning

Table 5.5.3 outlines the potential environmental watering actions and expected water usage under a range of planning scenarios.

Use of the full 121 ML of Commonwealth environmental water available in the upper Broken Creek system is planned under all scenarios; however, this may need to be prioritised against delivery to Moodie Swamp (see section 5.5.3).

More water is required to achieve the identified potential watering actions, with an extra 280 ML required to deliver a summer/autumn fresh and more required if the winter/spring fresh is also to be delivered.

Table 5.5.3 Potential environmental watering for the upper Broken Creek system under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	▸ No unregulated flows	▸ Minimal unregulated flows	▸ Some contribution of unregulated flows in upper Broken Creek, particularly during winter/spring	
Expected availability of environmental water	▸ 29 ML	▸ 117 ML	▸ 121 ML	
Potential environmental watering	▸ Summer/autumn fresh			▸ Summer/autumn fresh ▸ Winter/spring fresh
Possible volume of environmental water required to achieve objectives	▸ Up to 400 ML			▸ Up to 800 ML

Risk management

In preparing its seasonal watering proposal, Goulburn Broken CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

5.5.2 Lower Broken Creek

Environmental values

Lower Broken Creek and Nine Mile Creek support a diverse and abundant native fish community including the threatened Murray cod, golden perch, silver perch, unspecked hardyhead and crimson-spotted rainbowfish. The associated floodplain and wetland habitats support box-dominated grassy woodland communities and numerous threatened species of state and national conservation significance including buloke, bush stone-curlew and brolga.

Social and economic values

The lower Broken and Nine Mile creeks and associated floodplain and wetland habitats contain many important Indigenous cultural heritage sites, provide water for agriculture and urban centres and support a variety of recreational activities such as fishing and bushwalking.

Environmental watering objectives in the lower Broken Creek system
Promote an increase in the cover and range of native water and riverside plants Control excessive build up of azolla, a native aquatic plant that can lower water quality in the creek when significant blooms occur
Protect and boost populations of native fish (including the threatened Murray cod, golden perch and silver perch) by providing flows for fish to move upstream and downstream, encouraging fish to spawn (release eggs)
Maintain healthy water oxygen levels

System overview

The lower Broken and Nine Mile creeks have been regulated for over 100 years, significantly altering their flow regimes. The lower Broken Creek is operated separately to the upper Broken Creek and Broken River because regulated water is delivered to the lower Broken Creek from the Goulburn and Murray systems via the irrigation channel network (rather than from the Broken River). Under natural conditions, the creeks would have flowed in response to significant rainfall (mainly in winter and spring) and would have ceased to flow for extended periods during summer and autumn. Today, significant flows are maintained throughout summer and autumn to supply water for irrigation, domestic and stock use. From east of Nathalia downstream, the Broken Creek has eight managed shallow weirs providing a near-constant water level that facilitates the extraction of irrigation and consumptive water. While the weir pools provide important native fish habitat, their water quality is often poor in summer and autumn.

Environmental water provided in the lower Broken Creek can be sourced from both the Goulburn and Murray systems. Environmental water is released from the Goulburn system through the East Goulburn main channel and from the Murray system through the Yarrawonga main channel. The priority river reach for environmental watering is reach 3 (from Nathalia Weir Pool to the River Murray), with flows to this reach expected to also deliver the desired flows in reaches 1 and 2. The measurement point for target flows in the lower Broken Creek is at Rices Weir.

Recent conditions

Unregulated winter flows of between 100–200 ML per day in July and August 2014 were higher than in previous winters and resulted from local rainfall and catchment runoff. There were no further significant rainfall events that triggered unregulated flows in the systems for the remainder of the irrigation season.

Environmental watering commenced in late August 2014 and flows increased towards the upper target of 250 ML per day at Rices Weir in October, at which level they remained until April 2015 when cooler conditions reduced the risk of low dissolved oxygen levels. Releases dropped to 200 ML per day in April then 150 ML per day in late April before ceasing at the end of the irrigation season.

Environmental and consumptive use water were delivered primarily via the Goulburn system with some consumptive water delivered from the River Murray to bypass the Barmah choke. This helped maintain flows, resulting in the 250 ML per day target (mid-spring to mid-autumn) being met or exceeded for most of the year, and much more consistently than in previous years.

Increased levels of azolla growth occurred in spring 2014 but the flows successfully flushed them through the system, preventing a build-up. Dissolved oxygen levels fell below the target of 5 mg per litre for most of summer but did not fall below 3 mg per litre, and no impacts on native fish populations were recorded.

Scope of environmental watering

Potential environmental watering actions and their environmental objectives are shown in Table 5.5.4 and illustrated in Figure 5.5.3.

Table 5.5.4 Potential environmental watering actions and objectives for the lower Broken Creek

Potential environmental watering	Environmental objectives
Year-round low flows (40 ML/day during August–May)	▸ Provide native fish passage
Winter/spring medium flows (120 ML/day during August–November)	▸ Minimise azolla growth
Spring/summer/autumn medium flows (150–250 ML/day during October–May)	▸ Maintain water quality, including dissolved oxygen levels above 5 mg/l
Winter/spring freshes (120–250 ML/day for up to 14 days during August–November)	▸ Remove large azolla blooms
Spring/summer high flows (250 ML/day during September–December)	▸ Increase native fish habitat during migration and breeding seasons

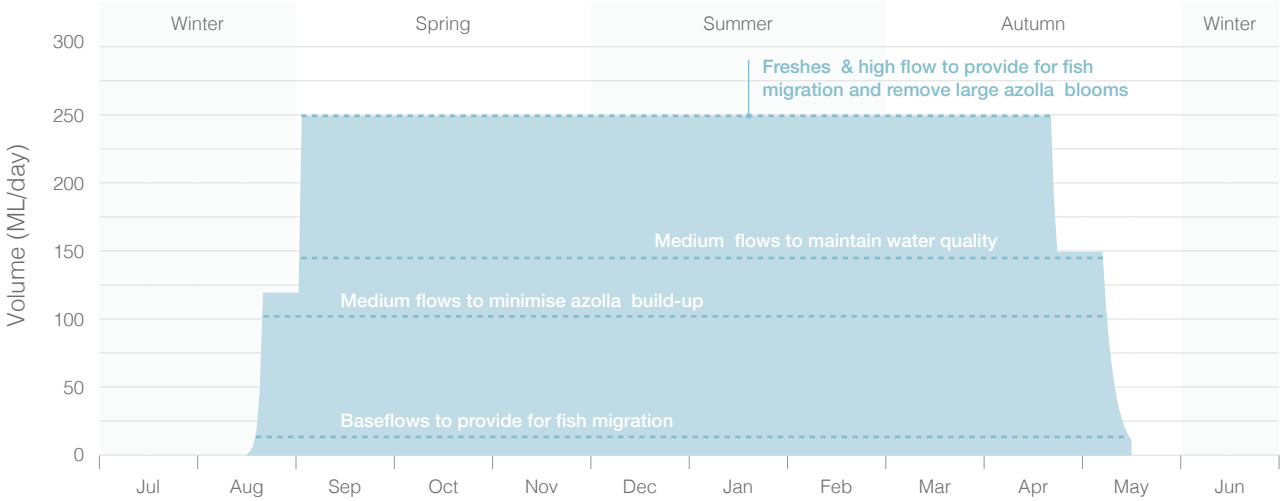
Scenario planning

Table 5.5.5 outlines the potential environmental waterings and expected water usage under a range of planning scenarios.

Due to regulation of the lower Broken and Nine Mile creeks, their environmental water needs are relatively fixed from year to year and independent of annual climatic conditions.

During the season, the environmental water flows of the lower Broken Creek can vary and focus on maximising the habitat and movement of fish, maintaining water quality and flushing azolla through the system. The required volume to meet these objectives decreases from a dry to a wet scenario as unregulated flows would contribute a greater amount under wetter conditions.

Figure 5.5.3 Potential environmental watering in the lower Broken Creek



Note: This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Broken Creek at Wrights Bridge, by Goulburn Broken CMA

Table 5.5.5 Potential environmental watering for the lower Broken Creek under a range of planning scenarios

Planning scenario	Dry	Average	Wet
Expected river conditions	▸ Some unregulated flows during winter ▸ No unregulated flows throughout the irrigation season (mid-August–May) ▸ No diversion of unregulated River Murray flows available	▸ Unregulated flows during winter/spring ▸ No unregulated flows from October–May ▸ Diversion of unregulated River Murray flows available mid-August–October	▸ Unregulated flow during winter/spring ▸ No unregulated flows from November–May ▸ Diversion of unregulated River Murray flows available mid-August–November
Potential environmental watering		▸ Year-round low flows ▸ Winter/spring medium flows ▸ Summer/autumn medium flows ▸ Winter/spring fresh ▸ Spring/summer high flows	
Possible volume of environmental water required to achieve objectives	▸ Up to 65,000 ML	▸ Up to 61,000 ML	▸ Up to 50,000 ML

Risk management

In preparing its seasonal watering proposal, Goulburn Broken CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Spoonbill on Lower Broken Creek, by Keith Ward

5.5.3 Broken wetlands

Environmental values

The Broken wetlands, which include Moodie Swamp, Kinnairds wetland and Black Swamp, support a diversity of vegetation communities ranging from swamps dominated by river red gum to cane-grass wetlands. The wetlands contain several state and nationally threatened species and communities, including rigid water milfoil, slender water milfoil and river swamp wallaby-grass. The wetlands also provide food resources and breeding habitat for several bird species (such as the brolga and royal spoonbill) listed in international agreements and conventions.

Social and economic values

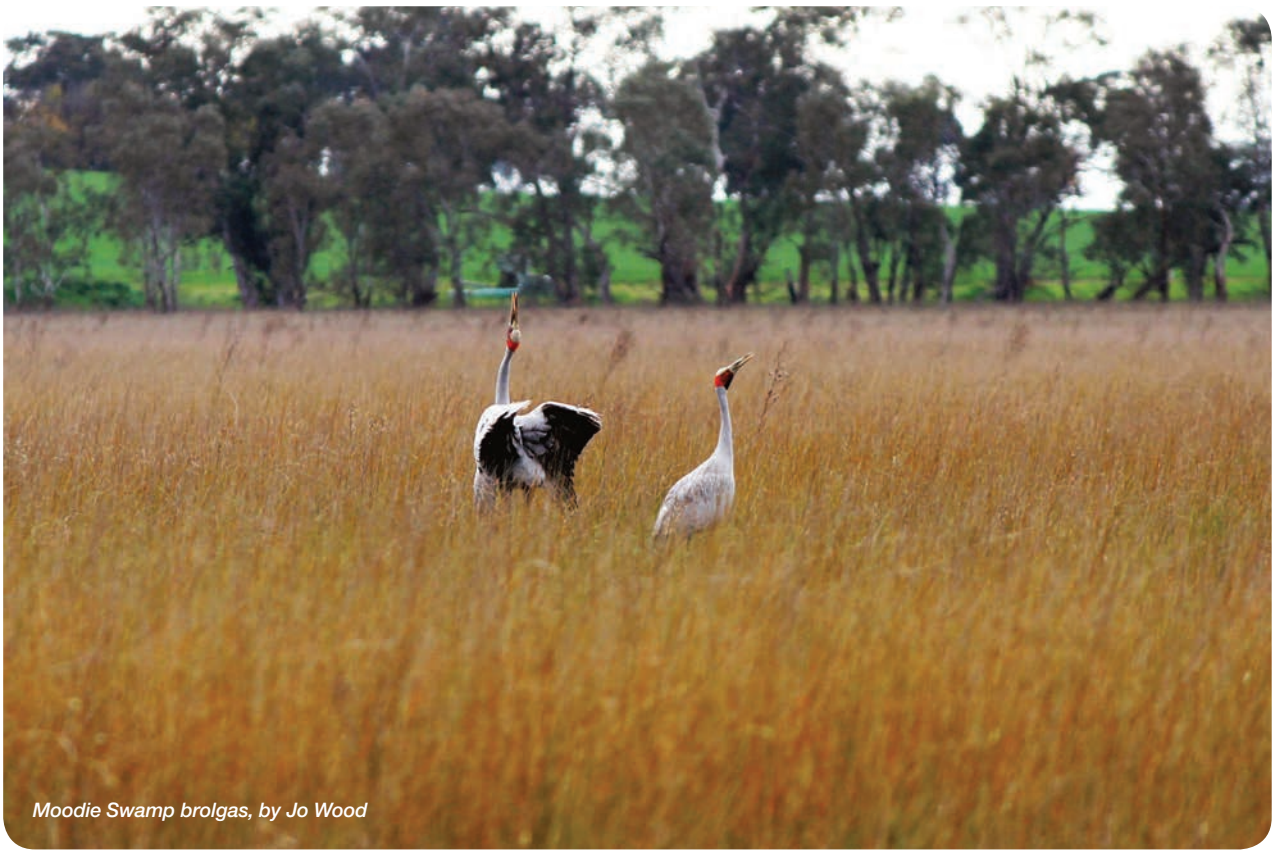
The Broken wetlands have been, and continue to be, places of significance for the Traditional Owners of the Yorta Yorta Nation. The wetlands traditionally provided a rich and diverse supply of plant and animal resources for food, medicines, shelter, clothing and tools, and some of the sites have artefacts and scar trees recorded in or adjacent to them.

The wetlands support a range of recreational activities including bird watching, bike riding, bush walking and camping. Moodie Swamp and Black Swamp are state game reserves.

Environmental watering regime objectives in the Broken wetlands
Trigger wetland vegetation recovery and growth following the 2014 fire Promote the growth of nationally threatened plant species (such as ridged water milfoil, slender water milfoil and river swamp wallaby grass)
Maintain water levels and provide vegetation to promote feeding and breeding of water birds (such as brolga)

System overview

Of some 2,000 natural wetlands in the Goulburn Broken area, only three in the Broken catchment (Black Swamp, Kinnairds wetland and Moodie Swamp) can receive environmental water. The natural water regimes of these wetlands have been greatly influenced by their positions in the surrounding Shepparton, Central Goulburn and Murray Valley irrigation districts, which have changed the timing, frequency, volume and duration of inundation. Environmental watering aims to replace some of the more natural patterns of wetting and drying of the wetlands. Water is delivered to the wetlands using irrigation supply infrastructure.



Moodie Swamp brolgas, by Jo Wood

Recent conditions

Natural flows into Kinnairds wetland and Black Swamp meant that no environmental water was needed to meet their ecological and hydrological objectives in 2014–15.

Moodie Swamp received a delivery of 500 ML in October 2014, the largest-ever environmental water delivery to the wetland. The delivery was able to support brolga breeding and encourage the growth of southern cane-grass and rigid water milfoil. Brolga were seen courting on numerous occasions and the wetland provided a food source for other wetland bird species. The Australasian bittern was also recorded calling in the wetland in September 2014.

Scope of environmental watering

Potential environmental watering actions and their environmental objectives are shown in Table 5.5.6.

Table 5.5.6 Potential environmental watering actions and objectives for the Broken wetlands

Potential environmental watering	Environmental objectives
Moodie Swamp (fill in late winter/spring if it has remained dry and the maximum drying regime has been reached; provide top-ups as required)	▸ Promote growth of rigid water milfoil and southern cane-grass to provide habitat for Australasian bitterns and encourage brolga breeding ▸ Maintain water levels to support bird breeding for Australasian bittern and brolga if significant waterbird breeding events occur
Kinnairds wetland (fill in late winter/spring if it has remained dry and the maximum drying regime has been reached; provide top-ups as required)	▸ Promote growth of rigid water milfoil and slender water milfoil ▸ Promote wetland vegetation growth after 2014 fire, especially in seasonal herbaceous wetland areas ▸ Maintain water levels to support bird breeding for royal spoonbills and Australasian shoveler if significant waterbird breeding events occur
Black Swamp (fill in late winter/spring if it has remained dry and the maximum drying regime has been reached; provide top-ups as required)	▸ Promote/encourage growth of river swamp wallaby grass ▸ Promote wetland vegetation growth after 2014 fire ▸ Maintain water levels to support bird breeding, if significant waterbird breeding events occur

Scenario planning

Table 5.5.7 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

Environmental water requirements vary according to climatic conditions. If natural inflows do not occur in the wetlands over the autumn/winter 2015 period, environmental water will be required to inundate the wetlands in winter/spring to provide conditions that promote vegetation growth and provide feeding and breeding opportunities for waterbirds.

Under drier conditions, less inflows to the wetlands mean that more environmental water will be required to achieve objectives. As catchment conditions become wetter, natural inflows to the wetlands will reduce the amount of environmental water required to be delivered to achieve the desired inundation.

Environmental water may be required to support bird breeding by maintaining stable water levels in the wetlands. The need for this action will be assessed considering the significance of the expected breeding, ecological benefits, water requirements and the potential impacts on the wetland vegetation communities.

Female scarlet robin at Moodies Swamp in April 2014, by Jo Wood

Table 5.5.7 Potential environmental watering for the Broken wetlands under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected catchment conditions	▸ No natural inflows into the wetlands	▸ Limited natural inflows into the wetlands	▸ Some catchment inflows to the wetlands	▸ Wetlands likely to fill from catchment inflows and natural flooding
Potential environmental watering	▸ Moodie Swamp ▸ Kinnairds wetland ▸ Black Swamp			
Possible volume of environmental water required to achieve objectives	▸ Up to 2,200 ML		▸ Up to 1,100 ML	

Risk management

In preparing its seasonal watering proposal, Goulburn Broken CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Upright spotted marsh frog at Moodie Swamp, by Steve Wilson

5.6 Campaspe system

Waterway manager – North Central Catchment Management Authority

Storage manager – Goulburn-Murray Water, Coliban Water

Environmental water holders – Victorian Environmental Water Holder, Commonwealth Environmental Water Holder, the Murray-Darling Basin Authority (the Living Murray program)

The Campaspe River catchment extends from the Great Dividing Range in the south to the River Murray in the north, a total distance of about 150 km. The major waterways of the catchment are the Upper Campaspe River and the Coliban River (both upstream of Lake Eppalock) and the lower Campaspe River (downstream of Lake Eppalock). Major tributaries are McIvor and Pipers creeks upstream of Lake Eppalock, and Mount Pleasant and Axe creeks downstream of Lake Eppalock.

Malmsbury Reservoir on the Coliban River provides water for towns and stock and domestic consumption. Lake Eppalock was constructed in 1965 on the Campaspe River below the confluence with the Coliban River. It has traditionally secured water for the Campaspe Irrigation District and safeguarded the Coliban supply system for Bendigo.

Engagement

The North Central CMA has consulted stakeholders when preparing seasonal watering proposals in the Campaspe system. These stakeholders are shown in Table 5.6.1.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 5.6.1 Key stakeholders engaged in the development of the Campaspe system seasonal watering proposals

Stakeholder engagement
▸ Campaspe Environmental Water Advisory Group (comprising community members, Department of Environment, Land, Water and Planning, Goulburn-Murray Water, North Central CMA, the VEWH and the Commonwealth Environmental Water Office)
▸ Coliban Water
▸ Commonwealth Environmental Water Office
▸ Goulburn-Murray Water
▸ North Central CMA Natural Resource Management Committee, an advisory group to the North Central CMA Board comprising community members
▸ Victorian Environmental Water Holder

5.6.1 Campaspe River

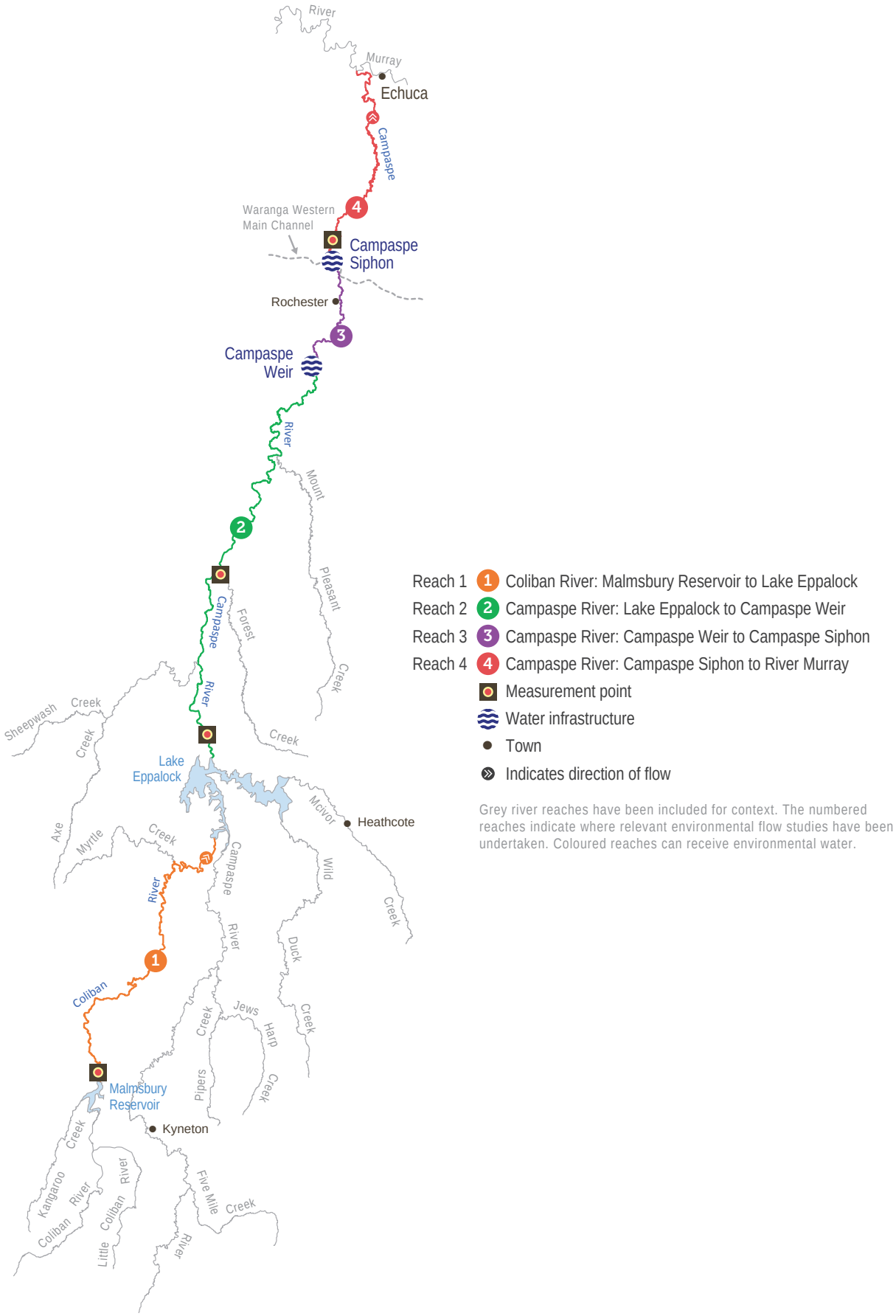
Environmental values

The Campaspe River below Lake Eppalock provides important habitat for several fish species including Murray cod, silver perch, golden perch, Murray-Darling rainbowfish and flat-headed gudgeon. Connectivity along the river and to the River Murray is an important feature to maintain migration opportunities and dispersal of juveniles. Platypuses also benefit from this connectivity and continuous flow. Turtles and frogs inhabit the river and there is a highly-connected, intact river red gum canopy along the river banks that supports terrestrial species (such as squirrel gliders).

Social, cultural and recreational values

Popular recreational activities along the Campaspe River include camping, boating, kayaking, fishing, swimming, bush walking and bird watching. These activities draw locals and tourists alike, providing economic benefit to towns along the river. The river is also valued for being an important source of water and a delivery mechanism for rural and town water. The Campaspe River is culturally significant, with Indigenous cultural heritage sites such as shell deposits, scar trees, mounds and some artefacts recorded along the banks.

Figure 5.6.1 The Campaspe system



Environmental watering objectives in the Campaspe River system
Sustain adult river red gums and encourage growth of new plants Maintain and increase the cover of in-stream and riverside plants
Provide habitat to help protect and boost populations of native fish Promote the return of native fish species (such as trout cod, river blackfish and Macquarie perch)
Support the resident platypus population by providing places to rest, breed and feed, as well as dispersal opportunities to the River Murray
Provide connection along the length of the Campaspe River and into the River Murray
Control salinity and maintain healthy levels of oxygen in deep pools
Support a wide range of waterbugs to provide energy, break down dead organic matter and support the river's food chain

System overview

The construction and operation of Lake Eppalock has significantly altered downstream river flows and reversed the seasonal flows. The storage captures rainfall runoff and reduces natural winter and spring flows downstream. Environmental water is held and released from Lake Eppalock, with some limited ability to regulate flows further downstream at the Campaspe Weir.

While the decommissioning of the Campaspe Irrigation District in 2010 significantly reduced irrigation demand in the system, consumptive water deliveries in late spring, summer and early autumn (including delivery of intervalley transfers to the Murray system) often result in higher-than-desirable flows at this time of year.

Providing the desired flows in all reaches below Lake Eppalock is important to maintain connectivity throughout the length of the Campaspe system and to the Murray River, however environmental watering usually targets reach 4, which will also achieve the desired flow objectives in reaches 2 and 3. Primary measurement points are at Barnadown (reach 2) and downstream of the Campaspe siphon (reach 4). In specific circumstances, water can be delivered to reach 4 from the Goulburn system via the Waranga western main channel.

Recent conditions

Rainfall was variable during 2014–15, with August, October and December all recording falls very much below average. While rainfall was closer-to-average in other months, streamflows for the year to the beginning of March 2015 were very low, equating to the driest three percent of years.

Delivery of winter/spring low flows continued throughout the winter 2014 period to maintain connectivity along the river and provide habitat for fish, with the target flow rate increasing to the top of the identified flow range in spring as water availability increased. Three winter/spring high-flow events were delivered during August to November, aiming to trigger fish migration, improve water quality, provide macroinvertebrate habitat and support the desired bank vegetation composition.

The delivery of consumptive water to meet downstream demands in the Murray system in late spring and summer resulted in higher-than-desirable flows, particularly in reach 2. These flows reduced the amount of slackwater habitat, which is particularly important for juvenile fish. However, some of these deliveries also supported environmental targets.

Two summer/autumn freshes were achieved in reach 4, the first in January 2015 as a result of local rainfall runoff and the second in March using consumptive water en route to water users. Consumptive water via the Waranga western main channel helped maintain 50 ML per day below the Campaspe siphon in March, before flows dropped towards the lower end of the target range in all reaches. A third summer/autumn fresh was delivered from Lake Eppalock in May, benefiting all reaches. These freshes supported in-channel and bank vegetation and improved connectivity for fish and platypuses.

Fish surveys in autumn found good numbers of Murray-Darling rainbowfish above Campaspe Weir, as well as Murray cod, turtles and platypuses. Water quality remained reasonable, with no significant low dissolved oxygen levels detected.

Scope of environmental watering

Potential environmental watering actions and their environmental objectives are shown in Table 5.6.2 and illustrated in Figure 5.6.2.

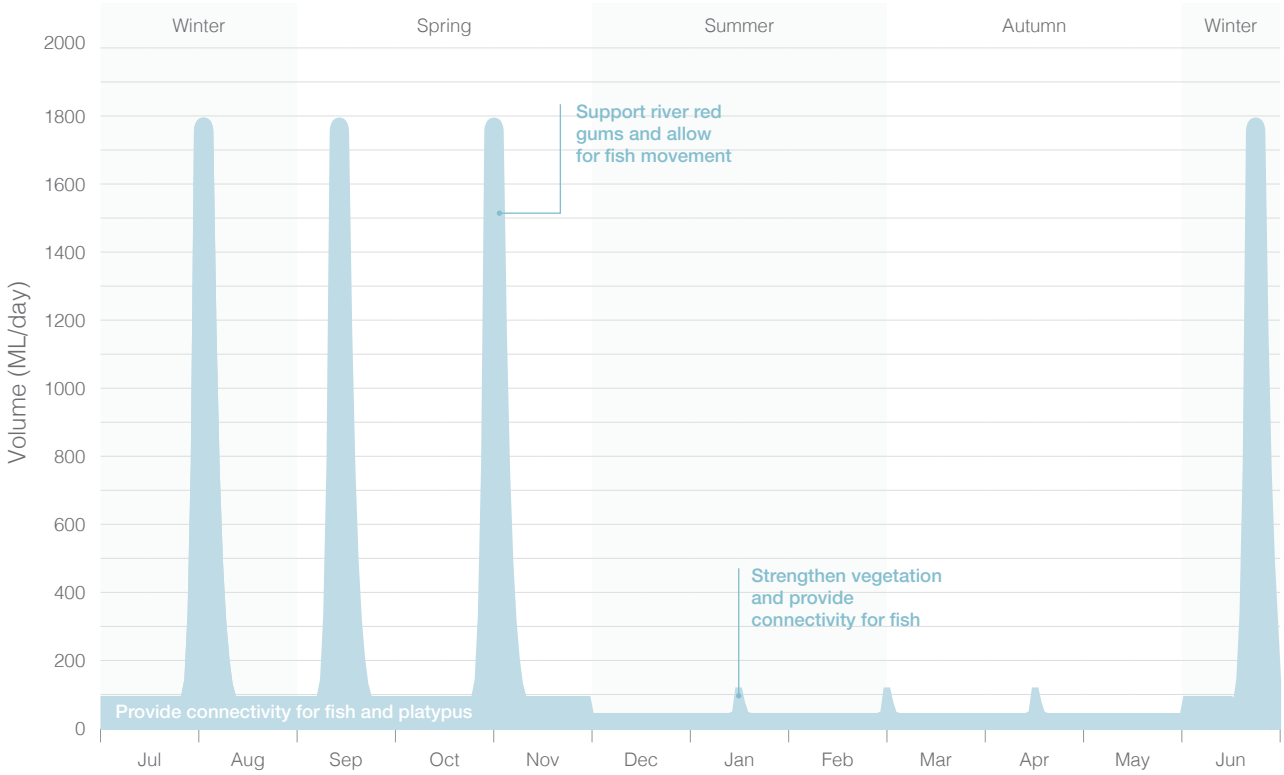
Table 5.6.2 Potential environmental watering actions and objectives for the Campaspe River system

Potential environmental watering	Environmental objectives
Summer/autumn low flows (10–50 ML/day during December–May)	▸ Maintain aquatic vegetation ▸ Maintain fish habitat and reinstate slack waters (areas with minimal water movement) ▸ Limit the effect of cold water pollution from Lake Eppalock on fish ▸ Maintain access to riffle habitat and water quality for macroinvertebrates ▸ Maintain permanent connectivity for water quality ▸ Maintain permanent connectivity for platypus movement
Winter/spring high flows (up to 4 events at 1,000–1,800 ML/day for up to 7 days each during June–November)	▸ Reduce encroachment of exotic and terrestrial vegetation ▸ Enhance river red gum recruitment ▸ Stimulate fish movement, allow movement to downstream reaches and provide spawning triggers ▸ Flush and mix river pools for water quality ▸ Flush organics from bank and benches to reduce the risk of blackwater events in summer ▸ Mix and flush river pools for macroinverbrates ▸ Inundate additional snags and flush sediment off biofilms (groups of microorganisms) for macroinvertebrates
Winter/spring low flows (50–200 ML/day [or natural[1]], during June–November)	▸ Provide longitudinal connectivity for fish ▸ Maintain access to riffle habitat and water quality for macroinvertebrates ▸ Maintain permanent longitudinal connectivity of river for improved water quality ▸ Facilitate platypus breeding opportunities
Summer/autumn freshes (up to 3 freshes of 50–200 ML/day for up to 3 days each during December–May)	▸ Maintain riparian and in-channel recruitment vegetation ▸ Increase extent of / maintain in-stream aquatic vegetation ▸ Provide longitudinal connectivity for fish during periods of low flow ▸ Maintain macroinvertebrate habitat and wash organics matter into river to drive aquatic food webs ▸ Respond to blackwater events as required

1 'Or natural' means that flow rates may be above or below the specified target rates depending on inflows and climatic conditions.

Campaspe River, by North Central CMA

Figure 5.6.2 Potential environmental watering in the Campaspe River system



Note: This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Scenario planning

Table 5.6.3 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

Potential watering actions in 2015–16 range from those considered critical under extreme drought conditions, through those aimed at recovery, to those that seek to improve the ecological health of the river under wetter conditions, making it better-placed to withstand future stress events. The potential watering actions are similar across scenarios but the target magnitude and duration of the flows increase under wetter conditions, resulting in more environmental water being required as conditions improve. Additional winter high flows will be provided under average/wet conditions.

There is no required carryover for 2016–17 but unregulated flows and consumptive use water deliveries may result in some environmental water being carried over from 2015–16. Summer low flows in 2016–17 are a high priority in the Campaspe system but can be met by a very high-reliability allocation that will be available in full on 1 July 2016. No other 2016–17 watering actions will provide greater ecological outcomes than what can be achieved in 2015–16.

Table 5.6.3 Potential environmental watering for the Campaspe River system under a range of planning scenarios

Planning scenario	Drought	Dry	Average/Wet
Expected river conditions	▸ No unregulated flows ▸ High consumptive water deliveries in reach 2 and moderate deliveries in reaches 3 and 4 during summer	▸ Some unregulated flows in winter/spring ▸ High consumptive use water deliveries in reach 2 and moderate deliveries in reaches 3 and 4 during summer	▸ Frequent unregulated river flows particularly during winter/spring ▸ Moderate summer consumptive use water flows in all reaches
Expected availability of environmental water	▸ 10,200 ML VEWH ▸ 2,700 ML CEWH ▸ 50 ML Living Murray ▸ 6,800 ML carryover ▸ 19,750 ML total	▸ 11,300 ML VEWH ▸ 3,300 ML CEWH ▸ 75 ML Living Murray ▸ 6,800 ML carryover ▸ 21,475 ML total	▸ 20,700 ML VEWH ▸ 6,500 ML CEWH ▸ 125 ML Living Murray ▸ 0 ML carryover ▸ 27,325 ML total
Potential environmental watering	▸ Summer/autumn low flows ▸ Winter/spring high flows ▸ Winter/spring low flows ▸ Summer/autumn fresh		▸ Summer/autumn low flows ▸ Winter/spring high flows ▸ Winter/spring low flows ▸ Summer/autumn fresh ▸ Additional winter high flows
Possible volume of environmental water required to achieve objectives	▸ 15,300 ML	▸ 17,700 ML	▸ 29,100 ML

Risk management

In preparing its seasonal watering proposal, North Central CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Campaspe fishway, by North Central CMA

5.6.2 Coliban River

Environmental values

The Coliban River contains a diverse range of macroinvertebrates supported by stands of emergent and submergent aquatic vegetation. It is bordered by remnant patches of stream bank shrubland vegetation providing habitat for a diverse range of terrestrial species. Historical records show that a diverse range of native freshwater fish (including Murray cod, river blackfish, Macquarie perch and Australian smelt) inhabited the river, as do populations of platypuses and native water rats.

Social and economic values

Local communities highly value the Coliban River, including Malmsbury, Taradale and Metcalfe. Of particular interest are the platypus and native water rat populations and the aesthetic and recreational values of the river (including Ellis Falls and the Cascades). Popular recreational activities in the area include camping, fishing and bird watching. The storages supply urban, stock and domestic demands in the surrounding area.

Environmental watering objectives in the Coliban system
Maintain water, riverside and in-stream plants
Protect and boost populations of native fish by providing flows for them to move upstream and downstream, encouraging spawning (release of eggs)
Improve water quality
Maintain habitat for waterbugs which provide energy, break down dead organic matter and support the river's food chain

System overview

Reach 1 of the Coliban River below Malmsbury Reservoir to Lake Eppalock can benefit from environmental watering. An important distinction between the Coliban River and other regulated Victorian systems is the lack of irrigation demand in the river, as Coliban Water deliver water from the Malmsbury Reservoir via a pipe-and-channel network. Therefore, the river below this point is not subject to the high summer flows that other regulated systems experience; delivering summer flows is reliant on environmental water releases.

The VEWH does not have any environmental entitlements in the Coliban system but the ability to flexibly manage passing flows in the system provides an opportunity to help mitigate summer low-flow risks. There is a small volume of Commonwealth environmental water held in the system but the high cost of delivery means it is not planned to be used in 2015–16.

Recent conditions

In 2014–15, conditions were dominated by below-average rainfall in most months and corresponding low volumes of inflow to the storage. The river remains in a recovery phase following the Millennium Drought, with some species (such as platypus) taking years to recover.

Passing flows were withheld in late spring/early summer to safeguard water for emergency events. These withheld flows were then used to deliver a baseflow to maintain river connectivity in the upper reaches over summer. A late-summer-autumn fresh was also delivered in March 2015 which restored connectivity with Lake Eppalock for the season.

The flows delivered were generally well below the environmental flow recommendations for the system. However, water availability in 2014–15 was limited and management aimed to balance the current needs of the river and the risk of prolonged cease-to-flow periods in summer.

Scope of environmental watering

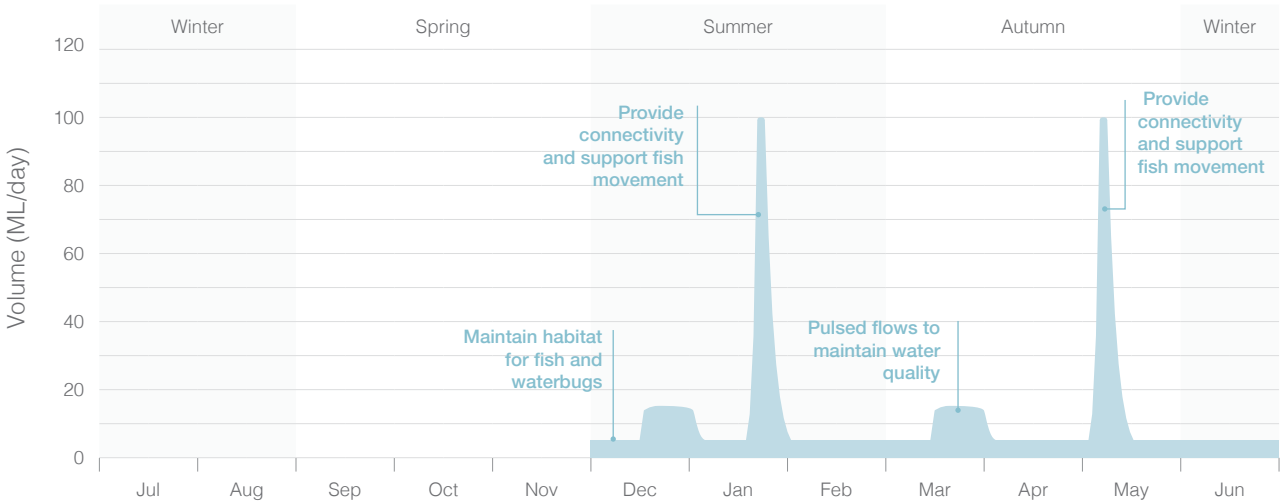
Potential environmental watering actions and their environmental objectives are shown in Table 5.6.4 and illustrated in Figure 5.6.3.

Table 5.6.4 Potential environmental watering actions and objectives for the Coliban system

Potential environmental watering	Environmental objectives
Summer/autumn pulsed flows (5–15 ML/day for up to 2 weeks during December–May as required)[1]	▸ Maintain water quality (including dissolved oxygen levels) and habitat for aquatic animals
Summer/autumn low flows (2.5–5 ML/day during December–May)	▸ Maintain aquatic vegetation ▸ Maintain fish habitat for survival and spawning ▸ Maintain permanent longitudinal connectivity of river for improved water quality ▸ Maintain aquatic habitat for macroinvertebrates
Summer/autumn freshes (of 50–100 ML/day for 3 days each during December–May)	▸ Maintain riparian and in-channel recruiting vegetation ▸ Provide longitudinal connectivity for fish during periods of low flow ▸ Stimulate upstream and downstream fish movement and or spawning ▸ Maintain water quality for macroinvertebrates

1 The actual volume and duration of pulsed flows will depend on available water resources, climatic conditions and conditions within the river.

Figure 5.6.3 Potential environmental watering in the Coliban system



Note: This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Scenario planning

Table 5.6.5 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

Water availability in the Coliban system relies on withheld passing flows during winter/spring for use in the high-risk summer period, when issues such as poor water quality are more likely and providing constant low flows can maintain habitat below the reservoir. The volume of water available will vary depending on inflows and the volume of passing flows available, with a lower volume likely to be available under a dry scenario. Water is therefore not likely to be available to provide summer/autumn freshes except under average or wet conditions. The target flow and duration of freshes to manage a potentially catastrophic water quality problem will vary depending on water availability and climate and river conditions. There is insufficient water available to meet all the environmental water requirements of the Coliban system.

Table 5.6.5 Potential environmental watering for the Coliban system under a range of planning scenarios

Planning scenario	Dry	Average/wet
Expected river conditions	▸ No unregulated flows	▸ Some unregulated river flows from tributary inflows
Expected availability of environmental water	▸ Minimal passing flows and low volume to withhold for use at other times in the season	▸ Moderate-to-high passing flows with good volumes available but reduced ability to bank flows due to possible storage spills ▸ Withheld flows for use at other times in the season
Potential environmental watering	▸ Summer/autumn pulsed flows ▸ Summer/autumn low flows	▸ Summer/autumn low flows ▸ Summer/autumn freshes
Possible volume of environmental water required to achieve objectives	▸ The volume required is highly variable based on seasonal conditions and the volume of withheld flows	

Risk management

In preparing its seasonal watering proposal, North Central CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

5.7 Loddon system

Waterway manager – North Central Catchment Management Authority

Storage manager – Goulburn-Murray Water

Environmental water holders – Victorian Environmental Water Holder, Commonwealth Environmental Water Holder

The Loddon system contains several native fish species and various vegetation types and supports tourism and irrigation industries. River blackfish occur in the upper catchment of the Loddon system with Birchs Creek containing a regionally significant population. Pyramid Creek is a tributary of the Loddon River, entering the system near Kerang. Along with the lower Loddon River, Pyramid Creek provides important habitat for fish (including the bony herring, golden perch and Murray cod). The Boort wetlands, located on the floodplain of the Loddon River, are important for waterbird habitat and contain high-value fringing river red gums and wetland vegetation.

Engagement

North Central CMA has engaged key stakeholders and relevant individuals in preparation of the seasonal watering proposals in the Loddon system. These stakeholders are shown in Table 5.7.1.

Seasonal watering proposals are informed by longer-term regional waterway strategies, environmental water management plans and environmental flow studies, which incorporate environmental, cultural, social and economic considerations.

Table 5.7.1 Key stakeholders engaged in the development of the Loddon system seasonal watering proposal

Stakeholder engagement
▸ Bullarook Environmental Water Advisory Group (comprising community members and representatives of Goulburn-Murray Water and the Victorian Environmental Water Holder)
▸ Goulburn-Murray Water
▸ Loddon Environmental Water Advisory Group (comprising community members and representatives of Field and Game Victoria, Department of Environment, Land, Water and Planning, Goulburn-Murray Water, North Central CMA, the Victorian Environmental Water Holder and Commonwealth Environmental Water Office)
▸ North Central CMA Natural Resource Management Committee, an advisory group to North Central CMA Board comprising community members
▸ Victorian Environmental Water Holder

5.7.1 Loddon River, Tullaroop Creek and Pyramid Creek

Environmental values

The Loddon River system upstream of Laanecoorie Reservoir contains populations of platypus, river blackfish and small native fish (such as flat-headed gudgeon, Australian smelt and mountain galaxia). River blackfish are also found in parts of Serpentine Creek with the middle and lower sections of the Loddon River having the highest fish abundance. An exciting finding in 2014–15 was the collection of River Murray rainbowfish in annual fish surveys in the lower Loddon River, which were previously not recorded in the system. Pyramid Creek supports large-bodied fish (such as golden perch) and is an important pathway for fish migration to and from the Loddon and Murray systems.

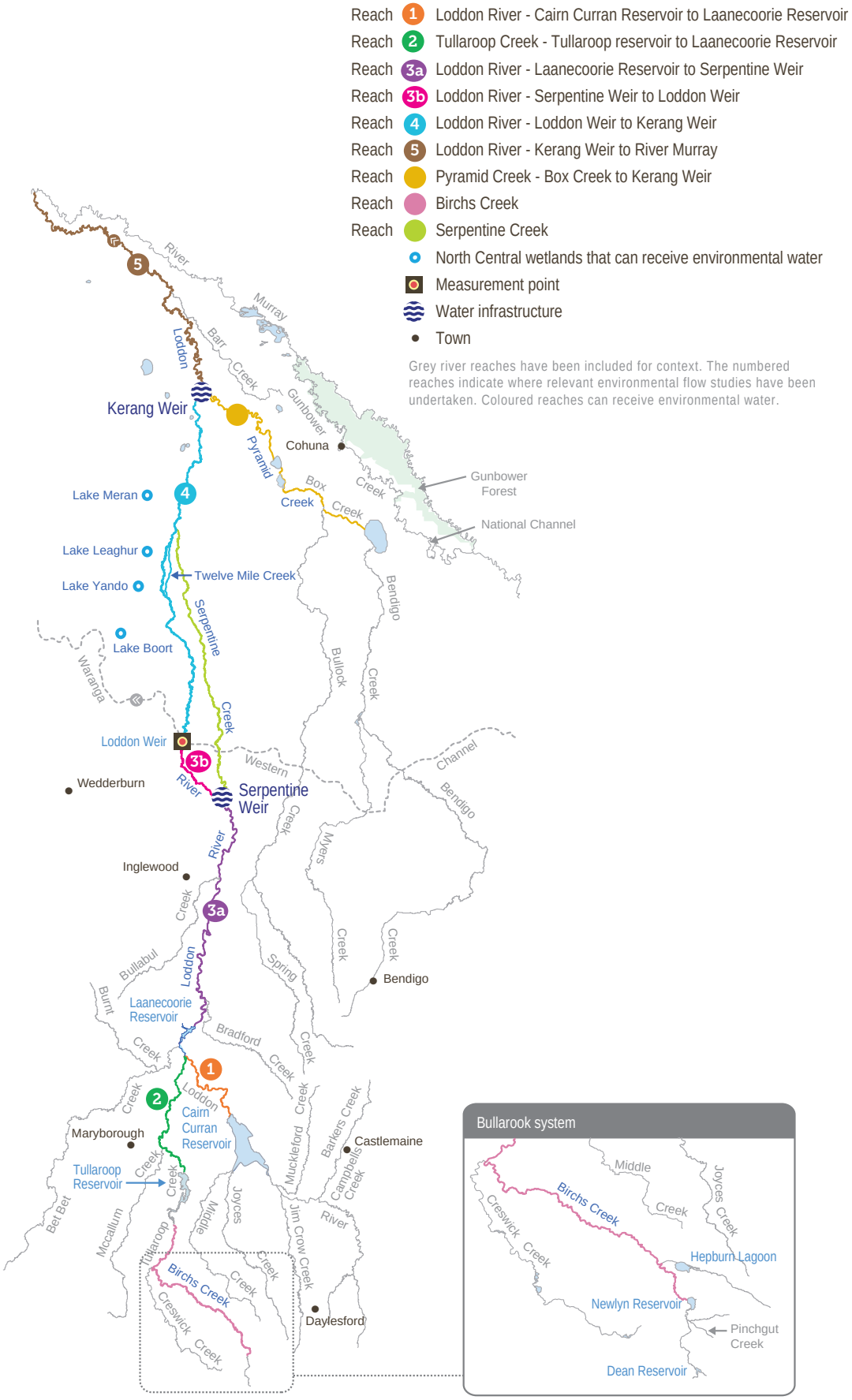
Vegetation condition is variable throughout the Loddon River system, with some reaches showing good-quality riparian and in-stream vegetation and extensive regeneration since the end of the Millennium Drought. Other reaches remain degraded and have a simplified structure, often due to the impacts of grazing, fragmentation of the riparian zone and weed invasion.

Social and economic values

Murray cod and golden perch are regularly stocked throughout the Loddon system and are an important recreational fishing species, particularly in Pyramid Creek. Bridgewater on Loddon attracts visitors to annual sporting competitions that take place on the Loddon River (such as water skiing and triathlon). The Loddon River is also rich in Aboriginal heritage with numerous heritage sites including scar trees and shell middens throughout the system.

Environmental watering objectives in the Loddon River system	
	Maintain river red gum, tea tree and lignum and provide opportunities for new plants to germinate and grow
	Protect and boost populations of native fish by providing flows for them to move upstream and downstream and encourage spawning (release of eggs)
	Create opportunities for young platypuses to disperse to new, high-quality habitat so they are not competing for space and food and become more resilient to threats, such as predation from foxes

Figure 5.7.1 The Loddon system



System overview

The Loddon River is Victoria's second-longest river. From its headwaters in the Great Dividing Range in central Victoria, it flows north to the River Murray (see Figure 5.7.1). The system includes the Loddon River, Tullaroop Creek, Birchs Creek and Pyramid Creek and the major storages are Cairn Curran, Tullaroop and Laanecoorie reservoirs.

Environmental water can be delivered to the Loddon River from either the Loddon or the Goulburn systems, due to the Loddon River connection with the Goulburn via the Waranga western channel. Water is also provided to Pyramid Creek and reach 5 of the Loddon River from the Murray system via the national channel.

Reach 4, between Loddon Weir and Kerang Weir, is the highest-priority reach for environmental watering because in-stream and riparian habitat has been heavily affected by river regulation. Reaches 1 (Loddon River) and 2 (Tullaroop Creek) are also a priority because they provide habitat for river blackfish and platypuses. Downstream of Kerang in reach 5 the Loddon River benefits from flows from Pyramid Creek and the upper Loddon River. Serpentine Creek is a distributary channel of the Loddon River that can receive diversions from the Loddon River at Serpentine Weir.

The complicated nature of the water distribution system in the Loddon provides both challenges and opportunities for effective environmental water delivery. When system operations permit, it is possible to manipulate the timing and location of releases to achieve environmental outcomes throughout the system. In 2014–15, the flow recommendations for the Loddon River, Serpentine Creek and Pyramid Creek were updated. As experience in managing to the new recommendations is gained in coming years, it is expected that water use efficiency and effectiveness will be improved.

Recent conditions

The Loddon system was very dry in 2014–15, particularly in summer when inflows to the Loddon storages were almost the lowest on record. Despite conditions being so dry, there was sufficient environmental water available to deliver several spring, summer and autumn freshes to improve habitat and channel form in reach 4. Environmental water also contributed to passing flows to provide low flows and maintain hydrological connectivity for the whole year.

The spring fresh delivered to reach 4 in October 2014 was carefully managed to ensure water remained in channel and did not break out and cause inconvenience to landholders. Target rates were deliberately lower than environmental flow recommendations. Monitoring of the release found that there were no impacts on private land and environmental outcomes were not compromised. North Central CMA will continue to test the delivery of freshes to this reach and liaise with landholders to maximise environmental outcomes.

In 2014–15, the construction of two fishways commenced on Pyramid Creek and the Loddon River. When completed the fishways will increase the benefit of environmental flows by providing increased migration opportunities for fish and improve the outcomes of future environmental water deliveries in the Loddon River and Pyramid Creek.

Scope of environmental watering

Potential environmental watering actions and their environmental objectives are shown in Table 5.7.2 and illustrated in figures 5.7.2 and 5.7.3.

Table 5.7.2 Potential environmental watering actions and objectives for the Loddon River system

Potential environmental watering	Environmental objectives
Loddon River (reach 1)	
Year-round low flows (10 to 80 ML/day year-round)[1]	▸ Allow fish movement through the reach and maintain depth of pool habitat for native fish ▸ Facilitate long-distance movement of male platypuses during the August–October breeding season ▸ Maintain suitable water quality in pools during summer
Summer/autumn freshes (up to 3 freshes of 35–80 ML/day for 1–3 days during December–May)	▸ Promote movement of fish so they access alternate habitats ▸ Wash organic matter into the stream to drive the aquatic food webs ▸ Mix and re-oxygenate pools and dilute concentrated salt ▸ Inundate lower banks to wet the soil and promote establishment, growth and survival of sedges and reeds
Winter/spring freshes (1–2 freshes of more than 400 ML/day for 1–5 days during July–October)	▸ Promote recruitment of riparian vegetation ▸ Stimulate movement of native fish and enhance Murray cod breeding ▸ Flush accumulated leaf litter from banks and low benches into the channel to drive aquatic food webs
Loddon River (reach 4)	
Summer/autumn low flow (25–50 ML/day during December–May)	▸ Continuous flow through the reach to maintain water quality in pools ▸ Maintain pool habitat for large-bodied fish (such as Murray cod, golden perch and bony herring) ▸ Maintain shallow water habitats for small-bodied fish (such as gudgeons and galaxia) ▸ Maintain a connecting flow for aquatic plant propagules to disperse and establish

Potential environmental watering	Environmental objectives
Summer/autumn freshes (up to 3 freshes 50–100 ML/day for 3–4 days during December–May)	▸ Facilitate upstream movement of juvenile golden perch ▸ Wet submerged wood and flush silt and biofilms from hard surfaces to promote new biofilm growth and increase macroinvertebrate populations ▸ Facilitate downstream dispersal of platypus in April–May
Spring high flow (one high flow of 450–750 ML/day with a 7-day peak during September–October)[2]	▸ Inundate banks, flood-runners and low-lying parts of the floodplain to promote growth and recruitment of riparian vegetation ▸ Provide a cue for golden perch and Murray cod to migrate and breed ▸ Flush leaf litter and organic material from the banks to drive aquatic food webs
Autumn high flow (1 high flow of 400 ML/day with a 6-day peak during April–May)	▸ Provide a cue for fish from the River Murray to swim upstream and colonise the Loddon River ▸ Help juvenile platypuses disperse from the upper Loddon River to the lower Loddon River and the River Murray
Winter/spring low flow (50–100 ML/day during June–November)	▸ Prevent terrestrial plants from encroaching into the channel ▸ Assist the growth of fringing vegetation (such as sedges and reeds) ▸ Provide foraging and resting habitat for platypuses
Tullaroop Creek (reach 2)	
Year-round low flows (5–40 ML/day year-round)[1]	▸ Allow fish movement through the reach and maintain the depth of pool habitat for river blackfish ▸ Facilitate long-distance movement of male platypuses during the August–October breeding season ▸ Maintain suitable water quality in pools during summer
Summer/autumn fresh (up to 3 freshes of 30–40 ML/day for 1–3 days during December–May)	▸ Promote movement of fish so they access alternate habitats ▸ Wash organic matter into the stream to drive aquatic food webs ▸ Mix and re-oxygenate pools and dilute concentrated salt ▸ Inundate lower banks to wet the soil and promote establishment, growth and survival of sedges and reeds
Winter/spring fresh (1–2 freshes of more than 200 ML/day for 1–5 days during July–October)	▸ Promote recruitment of riparian vegetation ▸ Stimulate movement of native fish and enhance Murray cod breeding ▸ Flush accumulated leaf litter from banks and low benches into the channel to drive aquatic food webs
Serpentine Creek	
Summer/autumn fresh (2 freshes of 40 ML/day for 1–3 days during December–May)	▸ Allow fish, platypuses and turtle to move through the reach ▸ Inundate benches and fringing vegetation ▸ Inundate wood and promote biofilm development ▸ Maintain water quality and prevent low dissolved oxygen conditions
Winter fresh (1 fresh of 120–150 ML/day for 1 day during July–August	▸ Flush organic material from banks to prevent risk of blackwater during summer ▸ Inundate benches and water-fringing vegetation ▸ Inundate wood and scour biofilms from the stream bed ▸ Inundate benches to provide breeding habitat for frogs
Pyramid Creek and Loddon River reach 5[3]	
Spring high flow (1 high flow 900 ML/day for 10 days during September)	▸ Trigger and facilitate fish movement
Autumn high flow (1 high flow of 900 ML/day for 10 days during March–May)	

1 Low flows in reaches 1 and 2 may need to be actively provided using environmental water, if consumptive water or passing flows are insufficient.
2 Due to potential inundation of private land, environmental flows above 450 ML per day in reach 4 will not be provided without agreement of potentially affected landholders
3 Delivery of potential watering actions to Pyramid Creek and Loddon River reach 5 are contingent on the construction of the Box Creek fishway that allows fish movement to and from Kow Swamp.

Figure 5.7.2 Potential environmental watering in the Loddon River reach 4

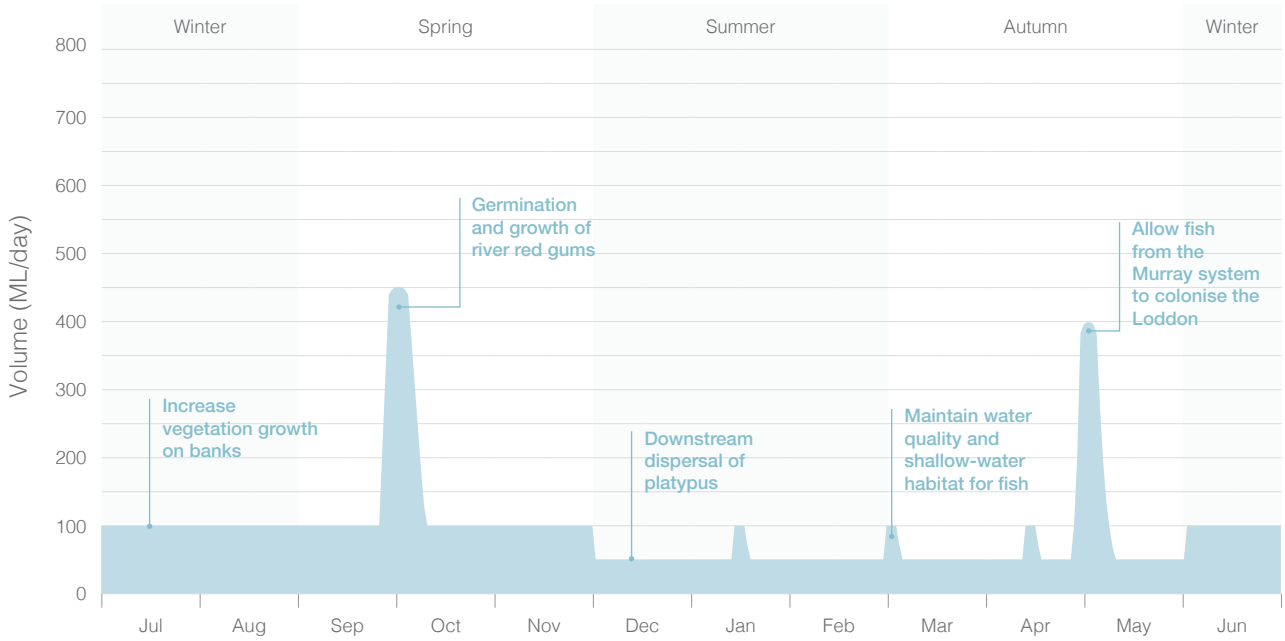
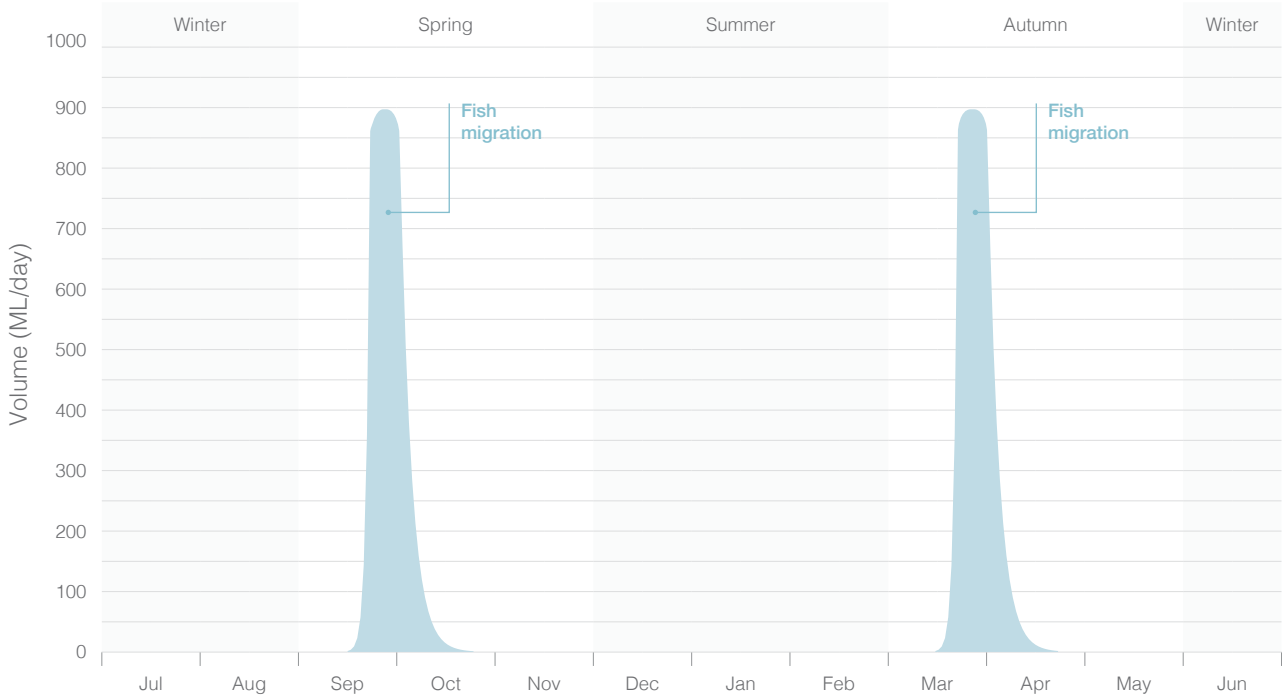


Figure 5.7.3 Potential environmental watering in the Pyramid Creek



Note: These figures are for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Scenario planning

Table 5.7.3 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

Environmental watering will be flexibly managed throughout the year depending on water availability, unregulated flows and management of consumptive water through the system.

Although a dry year occurred in 2014–15 it is expected that full allocations will be made in the Loddon system in all but the driest of outlooks for 2015–16. Passing flows that contribute substantially to low-flow requirements in the Loddon system are not expected to be restricted due to low storage volumes and therefore water made available under entitlements can mostly be used for other discretionary releases. Environmental water may be made available from the Murray system to contribute to the achievement of objectives in Pyramid Creek, as this system does not rely on delivery via the Loddon system.

Environmental water demands in the Loddon River and Serpentine Creek vary under the different scenarios. Marginally increased water availability is predicted under the average and wet scenarios and therefore the frequency of deliveries increases and extra flow components are added. The objective under these scenarios is to maximise environmental outcomes, focusing on increased fish movement and breeding. In a very wet year it is likely that many flows will be achieved naturally and therefore the possible volume of water required to meet the objectives may be lower than anticipated. If conditions remain dry, the scope of watering lessens and management will focus on protecting refuge habitat and ensuring there is water available to support important flows at the beginning of 2016–17.

Opportunities to optimise environmental water use (such as timing freshes to reach 4 to coincide with freshes from the upper Loddon system) will be explored in 2015–16. In Pyramid Creek and reach five of the Loddon River, it will be necessary to coordinate releases with consumptive water deliveries to achieve the required flow thresholds and durations.

Tullaroop Creek at Forbes Road, by Phil Slessar

Table 5.7.3 Potential environmental watering for the Loddon River system under a range of planning scenarios

Planning scenario	Dry	Average	Wet
Expected river conditions	▸ Small contributions from unregulated reaches and tributaries of the Loddon River contributing to low flows	▸ Unregulated flows will provide baseflows and multiple freshes, most likely during winter and spring	▸ Multiple spills from Loddon system storages will provide extended durations of high flow and overbank flow at any time of year
Expected availability of environmental water[1]	▸ 12,470–12,810 ML VEWH ▸ 2,517–3,356 ML Commonwealth ▸ 14,987–16,166 ML total	▸ 13,290 ML VEWH ▸ 3,356 ML Commonwealth ▸ 16,646 ML total	▸ 14,160 ML VEWH ▸ 3,356 ML Commonwealth ▸ 17,516 ML total
Loddon River (reach 1)			
Potential environmental watering	▸ 2 summer/autumn freshes	▸ 2 summer/autumn freshes ▸ 1 winter/spring fresh	▸ 3 summer/autumn freshes ▸ 1 winter/spring fresh
Loddon River (reach 4)			
Potential environmental watering	▸ Winter/spring high flow ▸ 2 summer/autumn freshes	▸ Winter/spring high flow ▸ 3 summer/autumn freshes ▸ 1 autumn high flow	▸ Summer/autumn low flows ▸ Winter/spring low flows ▸ Winter/spring high flow ▸ 3 summer/autumn freshes ▸ 1 autumn high flow
Tullaroop Creek (reach 2)			
Potential environmental watering	▸ 2 summer/autumn freshes	▸ 2 summer/autumn freshes ▸ 1 winter/spring fresh	▸ 3 summer/autumn freshes ▸ 1 winter/spring fresh
Serpentine Creek			
Potential environmental watering	▸ 2 summer/autumn freshes	▸ 2 summer/autumn freshes ▸ 1 winter/spring fresh	▸ 2 summer/autumn freshes ▸ 1 winter/spring fresh
Loddon River, Tullaroop Creek and Serpentine Creek			
Possible volume of environmental water required to achieve objectives	▸ 7,500 ML	▸ 14,500 ML	▸ 8,000–16,900 ML
Pyramid Creek			
Potential environmental watering	▸ None	▸ 1 spring high flow	▸ 1 spring high flow ▸ 1 autumn high flow
Possible volume of environmental water required to achieve objectives	▸ 0 ML	▸ 13,650 ML	▸ 27,300 ML

1 Does not include water available in the Goulburn and Murray systems that could be made available to support the achievement of environmental objectives in the Loddon system, subject to trading rules

Risk management

In preparing its seasonal watering proposal, North Central CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

5.7.2 Boort wetlands

Environmental values

The Boort wetlands contain important habitat for a range of bird, reptile and amphibian species. Significant bird species that have been recorded in the Boort wetlands include the white-bellied sea eagle, Major Mitchell's cockatoo and eastern great egret. Native vegetation values include several threatened ecological vegetation types and important plant species such as cane grass and river red gum. Two rare water-dependent plants were recently found at Lake Yando, the jerry-jerry and water nymph. This discovery expands the known range of these water-dependent species much further south than was previously known.

Social, cultural and recreational values

The Boort wetlands provide recreational opportunities including for boating, camping, fishing, bird watching and hunting, and Lake Meran and Lake Boort are state game reserves. The Boort wetlands also contain important resources traditionally used by Aboriginal people and there are numerous sites that have Indigenous cultural heritage significance.

Environmental watering objectives in the Boort wetlands
Assist growth of river red gum trees (at Lake Boort) and tall marsh vegetation (at Lake Meran) and provide opportunities for aquatic plants to germinate and disperse
Restore habitat and provide breeding opportunities

System overview

The Boort wetlands are located on the floodplain to the west of the Loddon River, downstream of Loddon Weir. They include lakes Boort, Leaghur, Meran and Yando. The natural water regimes of wetlands in the Loddon system have been substantially modified. Environmental watering aims to reinstate a more natural hydrology to the wetlands (including by providing wetting and drying cycles) to improve their environmental condition and habitat value.

Recent conditions

The Loddon catchment was extremely dry in 2014–15, and the Boort wetlands did not receive any significant natural inflows. A drying phase is currently preferred for most wetlands and so the absence of inflows is not a concern right now. Lakes Meran and Yando contain water at present, whilst lakes Boort and Leaghur are dry.

Two wetlands received environmental water in 2014–15: lakes Meran and Yando. Lake Meran is a permanent wetland and was provided with a top-up—as the lake level had dropped below the desired level—to support tall marsh vegetation over summer. Lake Meran salinity levels are continuing to be monitored to inform environmental watering decisions. Lake Yando received environmental water to promote the growth of aquatic vegetation and provide opportunities for bird breeding.

Scope of environmental watering

Potential environmental watering actions and their environmental objectives are shown in Table 5.7.4.

Lake Meran, by Phil Slessar

Table 5.7.4 Potential environmental watering actions and objectives for the Boort wetlands

Potential environmental watering	Environmental objectives
Wetland watering	
Lake Boort (partial fill in spring 2015 or autumn 2016)	▸ Restore river red gum distribution and the associated plant community including rehabilitation of southern cane grass populations ▸ Restore and rehabilitate vegetation species diversity typical of aquatic and semiaquatic environments ▸ Promote native vegetation growth to reduce the likelihood of recolonisation by mustard weed
Lake Meran (provide top-up flows in autumn 2016)	▸ Maintain emergent aquatic plant communities currently persisting at the channel outfall ▸ Restore open water/submerged aquatic plant habitat in the deeper sections of the wetland ▸ Restore tall marsh habitat across a greater area of the lake ▸ Restore habitat and breeding opportunities for waterbirds (such as pied cormorants), fish, frogs and invertebrates
Wetland drying	
Lake Leaghur and Lake Yando (promote natural drawdown and drying)	▸ These wetlands will be in a drying phase throughout 2014–15 ▸ The drying will help maintain a diversity of habitats to support a wide range of wetland-dependent birds and animals and to promote the establishment and growth of vegetation in and around the wetland

Scenario planning

Table 5.7.5 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

If wet conditions eventuate, environmental water requirements are expected to be small as unregulated flows are expected to result in inundation of all wetlands. In this case, the drying regime specified for Lake Leaghur, Little Lake Meran and Lake Yando may not be achieved.

The water level at Lake Meran will be monitored throughout the year to determine if and when environmental water may be required to top up the wetland. A top-up in autumn may be provided depending on water availability, lake levels and the outcomes of an investigation into the lake's salinity response to environmental watering and irrigation diversions.

Risk management

In preparing its seasonal watering proposal, North Central CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Table 5.7.5 Potential environmental watering for the Loddon wetlands under a range of planning scenarios

Planning scenario	Dry	Average	Wet
Expected catchment conditions	▸ No contribution from unregulated flows	▸ No substantial unregulated flows with localised catchment contributions expected to provide some inflows	▸ Multiple spills from Loddon system storages will provide extended durations of high flow and overbank flow at any time of year ▸ There may be an opportunity to divert flood flows into the Boort wetlands ▸ Top-ups from environmental water are unlikely to be needed
Priority watering actions	▸ Lake Boort ▸ Lake Meran		
Possible volume of environmental water required to meet objectives	▸ Up to 4,000 ML		

5.7.3 Birchs Creek

Environmental values

Birchs Creek supports several native fish species including a significant population of the regionally vulnerable river blackfish as well as mountain galaxia, flat-headed gudgeon and Australian smelt. Platypuses are present in the catchment but they are in low numbers and the population is considered to be recovering from the effects of the Millennium Drought.

Social and economic values

Birchs Creek is popular among the nearby community for its aesthetic appeal and intrinsic value.

Environmental watering regime objectives in Birchs Creek

Maintain suitable water quality to support river blackfish and other native fish

System overview

Birchs Creek in the Bullarook system is a tributary of Tullaroop Creek. There are two main storages in the system—Newlyn Reservoir and Hepburn Lagoon—which regulate stream flow for urban and irrigation supply. Environmental water is held in and delivered from Newlyn Reservoir. The target reach is reach 3 because it contains the vulnerable river blackfish population.

Recent conditions

During winter/spring 2014 rainfall in the catchment was close to average and Newlyn Reservoir spilled but a dry summer/autumn resulted in the lowest flows in the creek for several years.

The low flows and declining water quality prompted the release of an autumn fresh to Birchs Creek in April 2015, which was the first managed environmental watering in this system since May 2012. Monitoring of the flow during and following the flush demonstrated that the release was effective in lowering salinity and improving dissolved oxygen levels in the system.

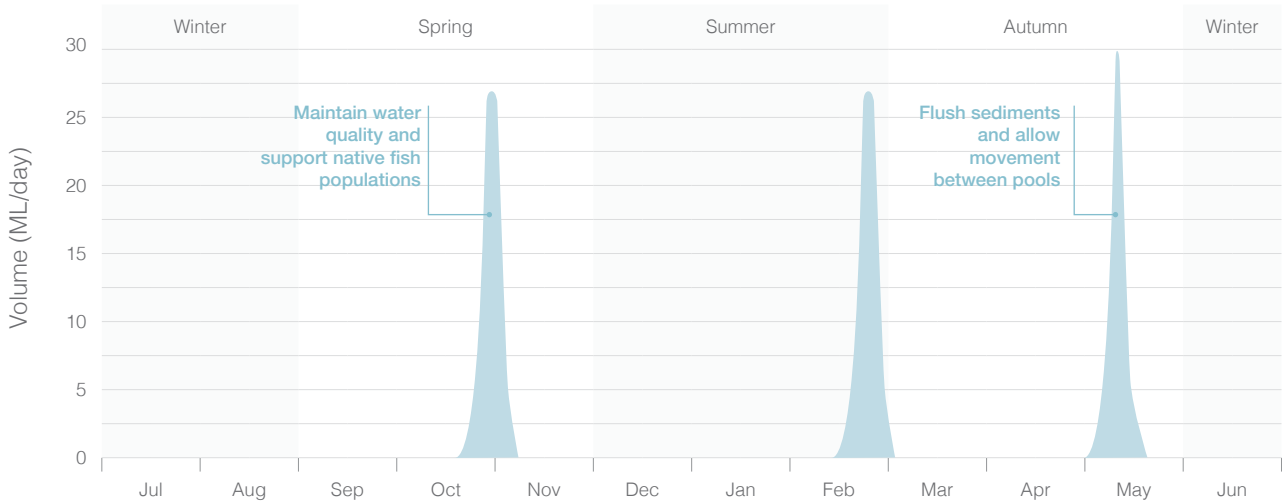
Scope of environmental watering

Potential environmental watering actions and their environmental objectives are shown in Table 5.7.6 and Figure 5.7.4.

Table 5.7.6 Potential environmental watering actions and objectives for Birchs Creek

Potential environmental watering	Environmental objectives
Two spring/summer/autumn freshes (27 ML/day for 3–4 days during November and February–March)	▸ Support native fish (including river blackfish) population structure, composition, age classes and abundance ▸ Minimise low dissolved oxygen and temperature risks for fish
Autumn pulse (30 ML/day for 1 day during March and May)	▸ Flush sediment from riffles to restore or maintain macroinvertebrate communities ▸ Allow movement between pools to maintain native fish community composition and abundance ▸ Create disturbance to rehabilitate current complexity and diversity of in-stream vegetation ▸ Rehabilitate riparian vegetation extent, structure and composition
Autumn fresh (27 ML/day for 3–4 days during March–May)	▸ Support native fish (including river blackfish) population structure, composition, age classes and abundance ▸ Flush sediment from riffles to restore or maintain macroinvertebrate communities ▸ Allow movement between pools to maintain native fish populations and abundance ▸ Create disturbance to rehabilitate the diversity of habitat, ecological diversity and physical diversity of in-stream vegetation ▸ Rehabilitate riparian vegetation extent, diversity and population structure and composition ▸ Minimise low dissolved oxygen and temperature risks for fish

Figure 5.7.4 Potential environmental watering in Birchs Creek



Note: This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Scenario planning

Unregulated flows and passing flows provide most flows in Birchs Creek. The small volume of environmental water available in the system is reserved and called on to alleviate deteriorating water quality in summer as required, under any scenario.

Table 5.7.7 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

Table 5.7.7 Potential environmental watering for Birchs Creek under a range of planning scenarios

Planning scenario	Dry	Average	Wet
Priority watering actions	▸ 2 spring/summer/ autumn freshes	▸ 2 spring/summer freshes ▸ 1 autumn pulse	▸ 1 autumn fresh
Possible volume of environmental water required to achieve objectives	▸ 0–100 ML	▸ 0–100 ML	▸ 0–100 ML

Risk management

In preparing its seasonal watering proposal, North Central CMA considered and assessed risks and identified mitigating strategies relating to the implementation of environmental watering. Risks and mitigating actions are continually reassessed by program partners throughout the water year (see section 1.4.4).

Birchs Creek at Nelsons Bridge, by Phil Slessar