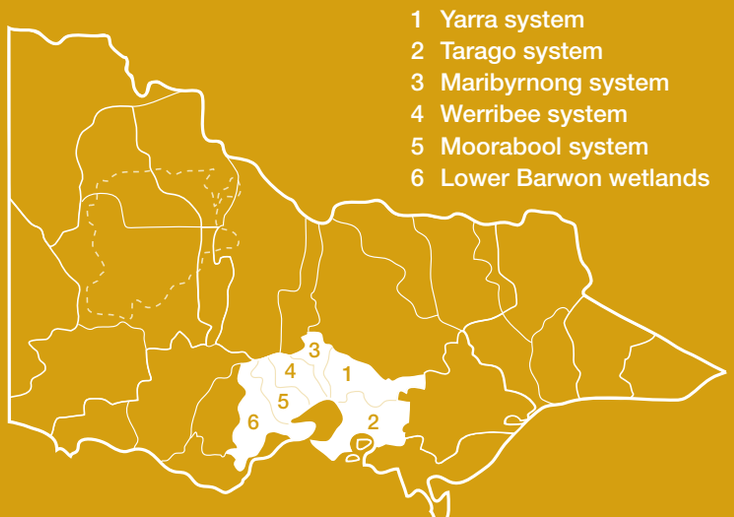
Section 3

Central Region



1 Yarra system
2 Tarago system
3 Maribyrnong system
4 Werribee system
5 Moorabool system
6 Lower Barwon wetlands

3.1 Central Region overview

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

The waterways in these systems provide drinking water to greater Melbourne, Ballarat and Geelong and support a range of activities including walking, cycling, fishing and camping, as well as areas of irrigated agriculture. Platypus and fish are two examples of animals that attract community interest in 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 are some links between systems in the region, and there are therefore opportunities to move water between systems through trade. Although moving water between systems is possible, most environmental water in these systems is prioritised to provide benefits in the river below where it is stored. While there is no dedicated environmental entitlement in the Maribyrnong system, in the past three years water allocation has been purchased from licence holders in the system for environmental outcomes.

Seasonal outlook 2016–17

The western systems in Central Region are generally drier than those in the east and quite different conditions can exist between them at the same time. Entitlements in some systems (such as the Yarra) 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 systems) rely on inflows and continuing dry conditions result in a lower water availability: carryover is an important source of water to meet demands in these systems, if conditions remain dry. With most inflows into storages in the Central Region occurring in winter and spring, the likely water availability in these systems should be evident early in 2016–17. Opportunities to optimise the availability and use of environmental water within the region, and between regions, may be considered through trade. This is likely to be the case in the Maribyrnong system, where the VEWH does not hold any environmental water, and so depends on trade to meet demands.

If dry conditions prevail throughout 2016–17, environmental water deliveries will focus on maintaining water quality and protecting habitat for fish, platypus and other water-dependent species, particularly in summer/autumn. If conditions improve, environmental releases will also seek to provide flows that help to improve the health of the environment by providing improved habitat for animals and triggering migration, and sometimes spawning, of native fish.

Platypus, by Healesville Sanctuary

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 for Melbourne. 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) hold significance for Traditional Owners and their Nations in the region.

System overview

Flows through the Yarra system have become highly regulated due to the construction of water storages that capture natural run-off and allow the controlled removal 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 and delivery of water to these reaches is also 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 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.

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 the 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, platypus 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

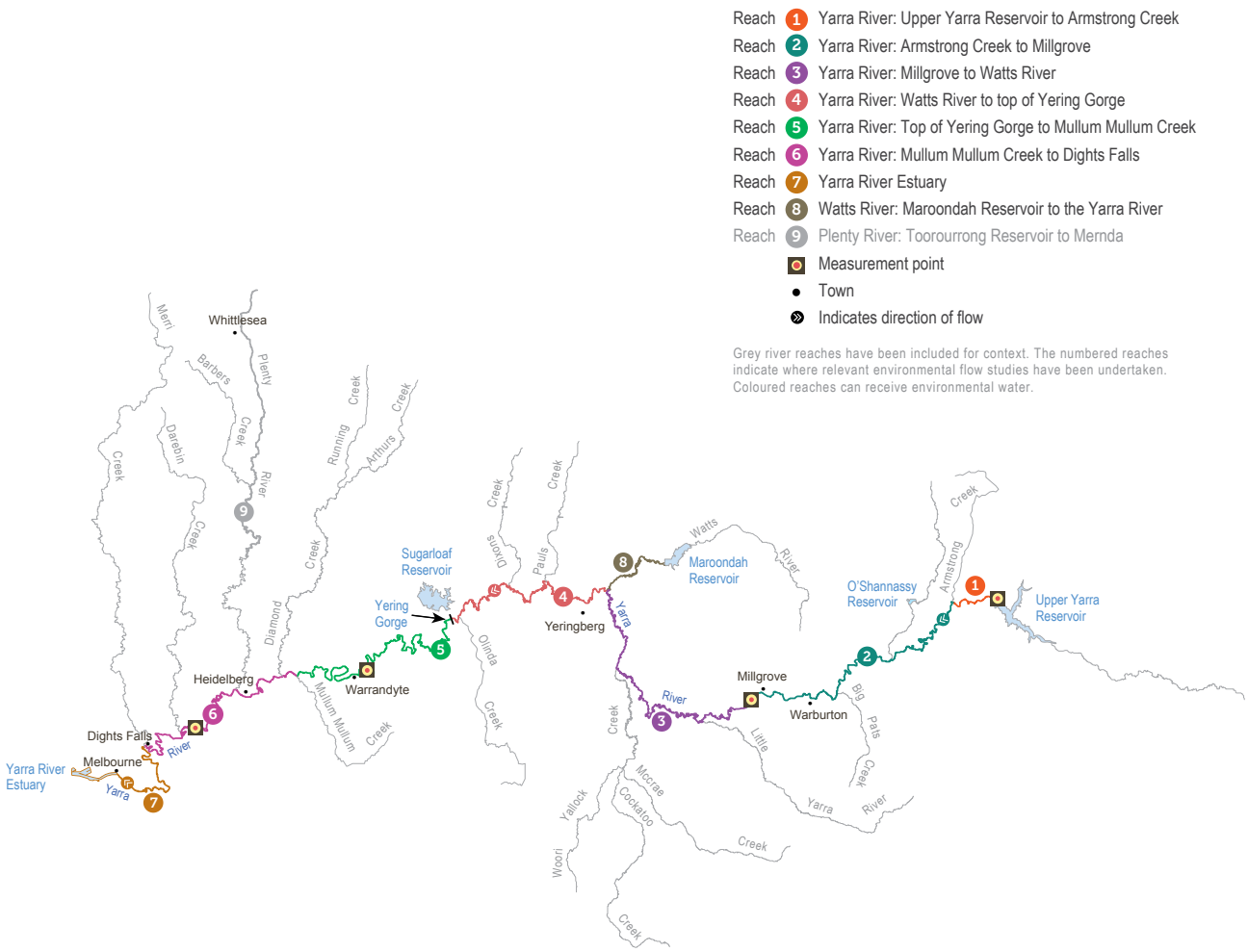
Recent conditions

Dry conditions persisted from 2014–15 into 2015–16 and resulted in low flows falling below target levels at times, as well as an absence of higher unregulated flows in winter/spring. The volume of environmental water required to maintain target low-flow levels was too large, so intermittent freshes were released during the year to maintain habitat and some movement opportunities for animals.

Four freshes were delivered in 2015–16, one in spring and three over summer/autumn. These releases successfully maintained aquatic plants and habitat for waterbugs and fish. Releases over summer were able to maintain water quality (particularly in reach 6) and environmental water also helped allow fish to move up and down the river.

Given the dry conditions and lack of unregulated flows, higher spring and autumn releases primarily targeting fish (Australian grayling) migration and spawning were not delivered. These higher releases were less important in 2015–16 as they had been delivered in previous years.

Figure 3.2.1 The Yarra system



Scope of environmental watering

Potential environmental watering actions and their environmental objectives are shown in Table 3.2.1.

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)	• 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 in-stream vegetation
Summer/autumn freshes (2–5 freshes of varying rates between 60–750 ML/day for 2–4 days each in 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
Winter/spring freshes (2–3 [or more] freshes of varying rates between 100–2,500 ML/day for at least 2–7 days in 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
Autumn high flow (1 high flow of varying rates between 560–1,300 ML/day for 7–14 days in April–May)	• Stimulate Australian grayling spawning
Targeted billabong watering	• Support native vegetation and improve habitat availability for wetland plants and animals
Spring high flow (1 high flow of 700–2,500 ML/day for 14 days in October–November)[3]	• Maintain riffle habitat by scouring sediments and cleaning cobbles • Promote flood-tolerant vegetation growth • Promote migration of native fish

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

Scenario planning

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

Watering actions across all scenarios are similar in 2016–17. Given the dry conditions, the autumn high flow and billabong watering did not occur in 2015–16, making them high-priority watering actions in 2016–17, including in dry conditions. Sufficient environmental water will be available to deliver these actions under all planning scenarios, due to the high security of the environmental entitlement in the Yarra system.

Less environmental water is expected to be required under average and wet conditions as natural flows following rainfall contribute significantly to meeting the environmental flow objectives. An additional spring high flow is planned under these conditions. Under wet conditions, priorities such as billabong watering may occur naturally.

A minimum of 3,000 ML carryover into 2017–18 is required (in addition to the 17,000 ML annual entitlement) to deliver the highest-priority flows if dry conditions continue into the following year.

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 • Lack of unregulated freshes and high flows • Minimum passing flow requirements not likely to meet low-flow requirements	• High winter flows with small storages likely to spill • 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	• 22,000 ML carryover • 17,000 ML allocation • 39,000 ML total		
Potential environmental watering	• Summer/autumn low flows • Summer/autumn freshes • Winter/spring low flows • Winter/spring freshes • Autumn high flows • Targeted billabong watering	• Summer/autumn low flows • Summer/autumn freshes • Winter/spring low flows • Autumn high flows • Targeted billabong watering • Winter/spring freshes • Spring high flows	
Possible volume of environmental water required to achieve objectives	• 32,000 ML	• 24,000 ML	• 8,000 ML
Critical carryover into 2016–17	• 3,000 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 1.3.6).

Engagement

Table 3.2.3 shows the partners and stakeholder organisations with which Melbourne Water engaged when preparing the Yarra system seasonal watering proposal.

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 Partners and stakeholders engaged in developing the Yarra system seasonal watering proposal

Partner and stakeholder engagement
• Yarra River Environmental Water Advisory Group including representatives of local government, Native Fish Australia, VR Fish, Environment Victoria, Yarra River Keeper, 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 the Australian grayling, long pink-bells, tree geebung and swamp bush-pea. The upper catchment has healthy riparian vegetation and in-stream habitat diversity that supports 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. These all contribute to the social and recreational value of the Bunyip and Tarago rivers. Many irrigators rely on water from the Tarago system and urban supplies are also provided from the storage.

The Tarago River runs through the traditional lands of the Kurnai and Kulin Nations. The waterways of this region would have been a focus for Aboriginal communities before European settlement due to their permanent water supply and associated resources. Aboriginal people have a continuing connection to the waterways of this region. In recent times the Robin Hood Reserve on the Tarago River has been an important meeting place for Traditional Owners.

Environmental watering objectives in the Tarago system

	Encourage healthy and diverse riverside vegetation
	Protect and boost native fish populations including threatened species (the Australian grayling and river blackfish) by providing habitat and encouraging fish to migrate and spawn
	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 platypus

System overview

The Tarago River has its headwaters in the Tarago State Forest and it flows into the Tarago Reservoir at Neerim. Downstream of the reservoir, the river flows close to the town of Rokeby before meeting the Bunyip River (of which it is a major tributary) 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. Reach 2 is the target reach 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 in reach 6.

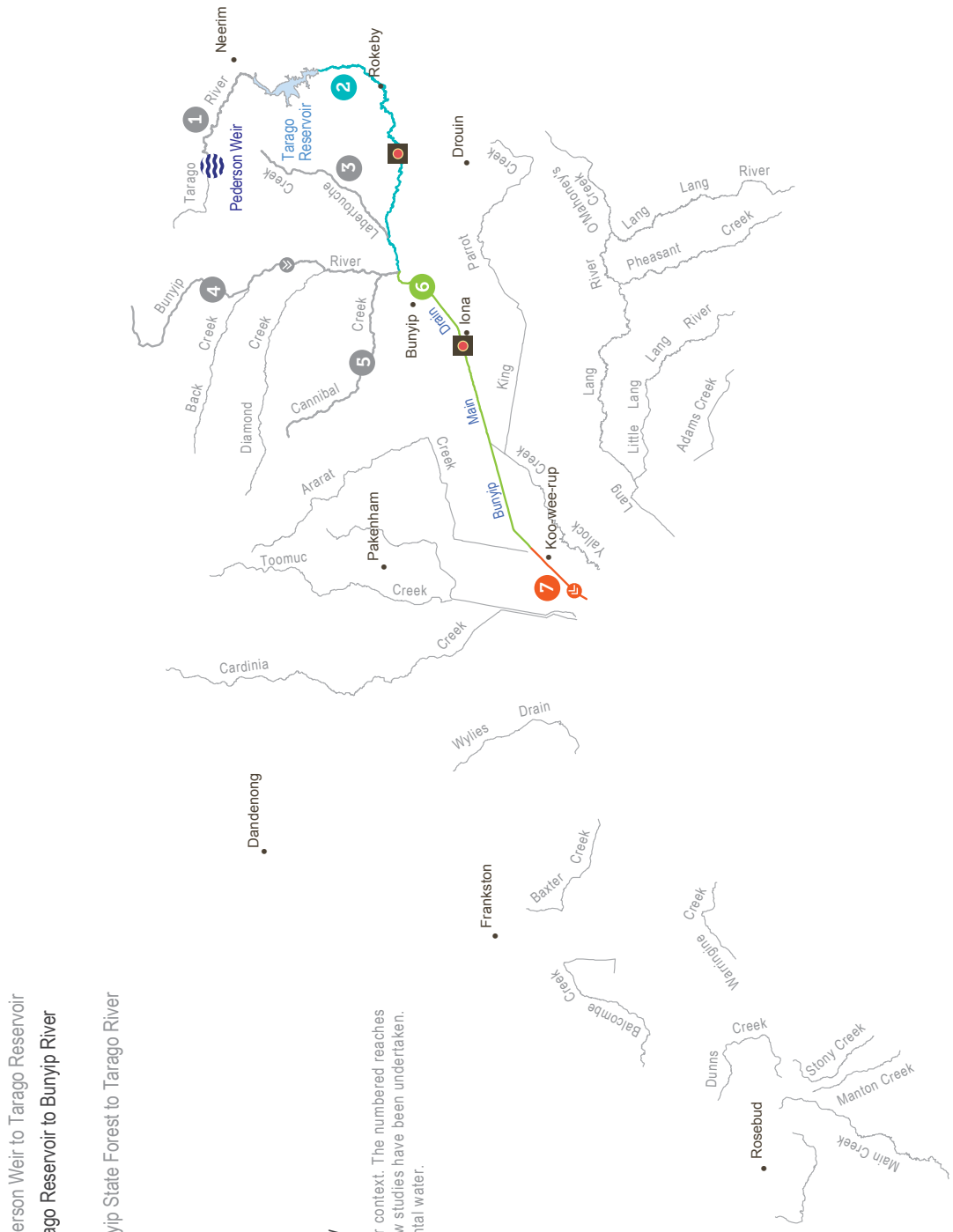
Recent conditions

Spills from Tarago Reservoir between June and November 2015 provided increased flows and variability in the river downstream of the reservoir, resulting in achievement of most of the targeted environmental flows in winter. While small spills occurred into late spring, conditions began to dry due to below-average spring rainfall. The dry conditions continued in summer and autumn.

Environmental water was released to provide two summer freshes, the first in December 2015 and the second in February 2016. These events improved habitat availability for animals and helped clear sand bars of encroaching vegetation. An autumn fresh was delivered in April and piggybacked on some unregulated flows following local rainfall. Initial monitoring results showed that the release was successful in triggering Australian grayling spawning.

Significant monitoring continues to be undertaken in the Tarago system. The results show a clear link between environmental flow pulses and Australian grayling spawning with the length of the pulse being critical to successful spawning. Monitoring of platypus also showed the environmental watering has substantial benefits for this iconic animal including improvements to habitat, increased movement opportunity and more food (in the form of waterbugs).

Figure 3.3.1 The Tarago system



Scope of environmental watering

Potential environmental watering actions and their environmental objectives are shown in Table 3.3.1.

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 in 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 waterbugs, 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 waterbugs
Winter/spring low flows (100 ML/day [or natural] during June–November)[2]	• Inundate marginal habitats for juvenile fish • Increase riverbed habitat availability for waterbugs • 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.

Scenario planning

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

The highest-priority releases in the Tarago system are summer/autumn freshes (to provide habitat and improve water quality) and an autumn high flow (to provide migration cues for Australian grayling). An autumn high flow is important to deliver in most years as Australian grayling are short-lived (to around three years old) so regular successful breeding is needed. There may not be sufficient water in drought conditions to deliver the event but this flow has been provided in five of the past six years so absence of the flow in 2016–17 does not pose a significant risk. Under wetter conditions, we expect 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 to improve habitat for waterbugs and fish movement along the river.

Another priority release is the spring freshes to support the movement of juvenile Australian grayling back into the Tarago system. This event usually occurs naturally but drier springs have led to only the partial delivery of this flow. Anecdotal evidence suggests that the fish move on these partial events, which will be monitored in spring 2016.

The number of watering actions increases from the drought to the wet scenarios, thus increasing the volume of environmental water required. Carrying water over into 2017–18 is important under all conditions, to provide a secure ability to deliver summer and autumn freshes in the following year.

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 • Irrigation releases likely	• Low streamflows • Some reduction to passing flows • Irrigation releases likely	• Average streamflows • Partial freshes naturally provided • Some irrigation releases likely	• Above-average streamflows • Partial-to-full freshes naturally provided • Irrigation 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 – tier 1 (high priorities)	• Summer/autumn freshes	• Summer/autumn freshes • Autumn high flows (partial event)	• Summer/autumn freshes • Autumn high flows • Spring high flows (partial event)	• Summer/autumn freshes • Autumn high flows • Spring high flows • Winter/spring freshes
Potential environmental watering – tier 2 (additional priorities)	• Spring high flows (partial event)	• Spring high flows (partial event) • Autumn high flows (full event)	• Spring high flows (full event)	• N/A
Possible volume of environmental water required to achieve objectives[1]	• 1,000 ML (tier 1) • 800 ML (tier 2)	• 1,000–1,500 ML (tier 1) • 1,200 ML (tier 2)	• 1,500–2,700 ML (tier 1) • 1,200 ML (tier 2)	• Up to 3,500 ML (tier 1)
Priority carryover requirements	• 500 ML		• 1,000 ML	

1 Environmental water requirements for tier 2 actions are additional to tier 1 requirements.

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 1.3.6).

Engagement

Table 3.3.3 shows the partners and stakeholder organisation with which Melbourne Water engaged when preparing the Tarago system seasonal watering proposal.

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

Table 3.3.3 Partners and stakeholders engaged in developing 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 Maribyrnong system

Waterway manager – Melbourne Water

Storage manager – Southern Rural Water

Environmental water holder – N/A

Environmental values

The upper Maribyrnong catchment contains areas of relatively intact streamside vegetation which provide important habitat for native fish including migratory short-finned eels, common and ornate galaxias, flathead gudgeon, tupong and Australian smelt. A diverse community of waterbugs and a significant platypus population occur in several reaches of the system.

Social and economic values

The Maribyrnong River is located in the western suburbs of Melbourne and provides water (primarily from Rosslynne Reservoir on Jacksons Creek) to urban and rural users. Recreational opportunities such as boating, fishing, cycling, walking and picnicking in the adjacent parklands are popular. The waterways of the Maribyrnong system hold significance for Traditional Owners and their Nations in the region.

Settlement Road drought pool, by Bill Moulden, Melbourne Water

Environmental watering objectives in the Maribyrnong system

- Maintain or restore in-stream vegetation and reduce invasive terrestrial vegetation populations
- Allow for small-bodied fish passage through the system
- Maintain self-sustaining waterbug populations and suitable habitats
- Maintain water quality by flushing pools

System overview

Close to Tullamarine Airport, Jacksons Creek (flowing from the west) and Deep Creek (flowing from the north) join to form the Maribyrnong River. The river runs south through Yarraville in inner Melbourne before meeting the Yarra and flowing into Port Phillip Bay. Rosslynne Reservoir is the only major storage in the Maribyrnong catchment, located in the upper reaches of Jacksons Creek.

The priority river reaches for environmental watering in the Maribyrnong system are reaches 6 and 7 (upper and lower Jacksons Creek respectively) downstream of Rosslynne Reservoir. The release capacity of 20 ML per day from Rosslynne Reservoir is a significant constraint on the outcomes that can be achieved by environmental deliveries.

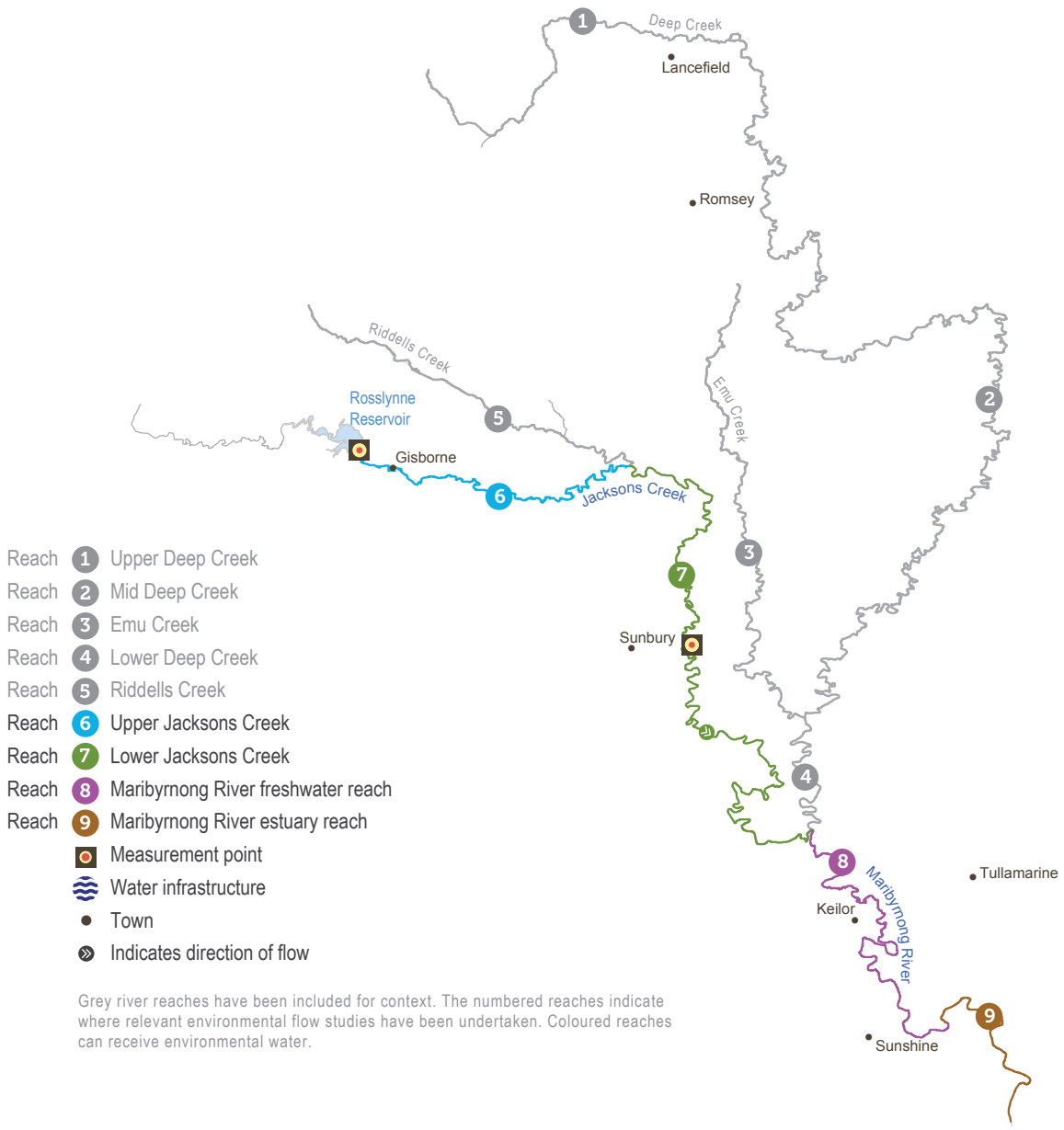
The VEWH does not hold an environmental entitlement in the Maribyrnong system. Over the past three years, Melbourne Water and the VEWH have worked with local diversion licence holders to purchase unused water that can then be delivered specifically for environmental outcomes in the system. This arrangement is negotiated each year and will only occur with the agreement of all parties involved.

Recent conditions

Since 2012 rainfall and run-off into the waterways of the Maribyrnong system have been decreasing with drier conditions. The lack of flow in the waterways has resulted in poor water quality in Jacksons Creek, particularly over summer below Rosslynne Reservoir. Environmental water has been released from the reservoir to freshen up the creek and prevent low oxygen levels in the water causing problems for fish, waterbugs and platypus. Without environmental water, the condition of the animals and plants in Jacksons Creek would have continued to decline.

Over summer and autumn low dissolved oxygen levels can occur, causing stress to aquatic animals, and prolonged very low flows can negatively impact in-stream vegetation. In 2015–16, 300 ML of water was delivered in two freshes to Jacksons Creek, primarily to maintain water quality to protect aquatic animals and in-stream vegetation in dry conditions.

Figure 3.4.1 The Maribyrnong system



Scope of environmental watering

Potential environmental watering actions and their environmental objectives are shown in Table 3.4.1.

Table 3.4.1 Potential environmental watering actions and objectives for the Maribyrnong River

Potential environmental watering[1]	Environmental objectives
Summer/autumn low-flow freshes (up to 3 events of 20–40 ML per day for up to 4 days) in December–May	• Maintain water quality by flushing pools • Support in-stream vegetation • Provide passage for small-bodied native fish
Low flows (4–6 ML per day continuously) in December–May	• Maintain self-sustaining waterbug populations and pool run habitats
Winter/spring low flows (20–40 ML per day continuously) in June–November	• Maintain or restore in-stream vegetation and disturb invasive terrestrial vegetation populations • Maintain channel morphology • Allow for small-bodied fish passage through the system

1 The range in flow requirements represent the target flow requirements for reaches 6 and 7.

Scenario planning

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

Under drier climate scenarios, any available environmental water would be delivered to protect or maintain aquatic habitat in Jacksons Creek through the delivery of low-flow freshes and, under drought conditions, delivery of low flows. These deliveries aim to ensure the in-stream plants and animals have refuge to survive.

Under average and wet conditions it is expected unregulated flows will contribute to meeting the flow objectives. Environmental water could still be beneficial for filling in gaps between unregulated events or to continue small-scale unregulated events for a longer duration.

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 1.3.6).

Engagement

Table 3.4.3 shows the partners, stakeholder organisations and individuals with which Melbourne Water engaged when preparing the Maribyrnong system seasonal watering proposal.

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 3.4.3 Partners and stakeholders engaged in developing the Maribyrnong system seasonal watering proposal

Stakeholder engagement
• Melbourne Water (Diversions group) • Southern Rural Water • Keilor irrigators • Department of Environment, Land, Water and Planning • Victorian Environmental Water Holder

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

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	• Minimal unregulated flows • Passing flows ceased	• Low volumes of unregulated flows • Passing flows partially to fully meet low flows	• Unregulated flows partially meet most objectives • Passing flows partially to fully meet low flows	• Unregulated flows meet most objectives • Passing flows partially to fully meet low flows
Potential environmental watering	• Summer/autumn low flows • Summer/autumn low-flow freshes	• Summer/autumn low-flow freshes	• Summer/autumn low-flow freshes • Winter/spring low flows	• Summer/autumn low-flow freshes • Winter/spring low flows
Volume of environmental water required to achieve objectives	• 300 ML	• 300 ML	• 600 ML	• 600 ML

3.5 Werribee system

Waterway manager – Melbourne Water

Storage manager – Southern Rural Water

Environmental water holder – Victorian Environmental Water Holder

Environmental values

The Werribee system supports a range of native fish including large populations of black bream and other species (such as the river blackfish, flathead gudgeon, short-finned eel, tupong and Australian smelt and several species of galaxiids). A diverse community of frogs and waterbugs inhabit the upper reaches and platypus are present in the lower reaches. The freshwater-saltwater interface of the Werribee River estuary is a regionally significant ecosystem due to the many aquatic plants and animals it supports, providing juvenile habitat and for the successful recruitment of fish such as black bream.

Social and economic values

The Werribee River provides the opportunity for recreational activities including fishing, bird watching, passive boating (canoeing, kayaking) and bushwalking. The system also provides irrigation water for agricultural industries throughout the Bacchus Marsh and Werribee areas and domestic water for Melton and Bacchus Marsh. Significant Aboriginal 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 and galaxiids) by providing pool habitat and flows for fish to move up and downstream and encouraging fish to spawn
	Maintain habitat for frogs, waterbugs and platypus
	Maintain pool water quality for fish and platypus and inundate estuary salt marsh with brackish water
	Move built-up silt from riffles (in the shallower parts of the river)

System overview

The Werribee River flows south-east from the Wombat State Forest near Ballan before dropping through the Werribee Gorge to Bacchus Marsh and then 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 environmental flow delivery in the Werribee system are the reach downstream of Lake Merrimu (reach 6), the reach within Werribee (reach 9) and the estuary: these support a diverse range of native fish species, waterbugs and platypus. Flows targeting the estuary are expected to provide some benefits to reach 8 and water may also be delivered for environmental objectives in this reach under suitable conditions. Environmental water released from Lake Merrimu can be re-harvested in Melton Reservoir, minus en route losses. It can then be held and re-released from Melton at a later date for specific lower Werribee River outcomes. 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 into the Werribee system has been below-average for the past four years. Melton Reservoir has not spilled since October 2012 and consequently there has been minimal natural outflow to Port Phillip Bay. Environmental watering has been required to provide a large portion of flows in reach 9 and the estuary. Dry conditions persisted in 2015–16 with environmental watering focusing on the most critical objectives to help protect the health of the system under dry conditions.

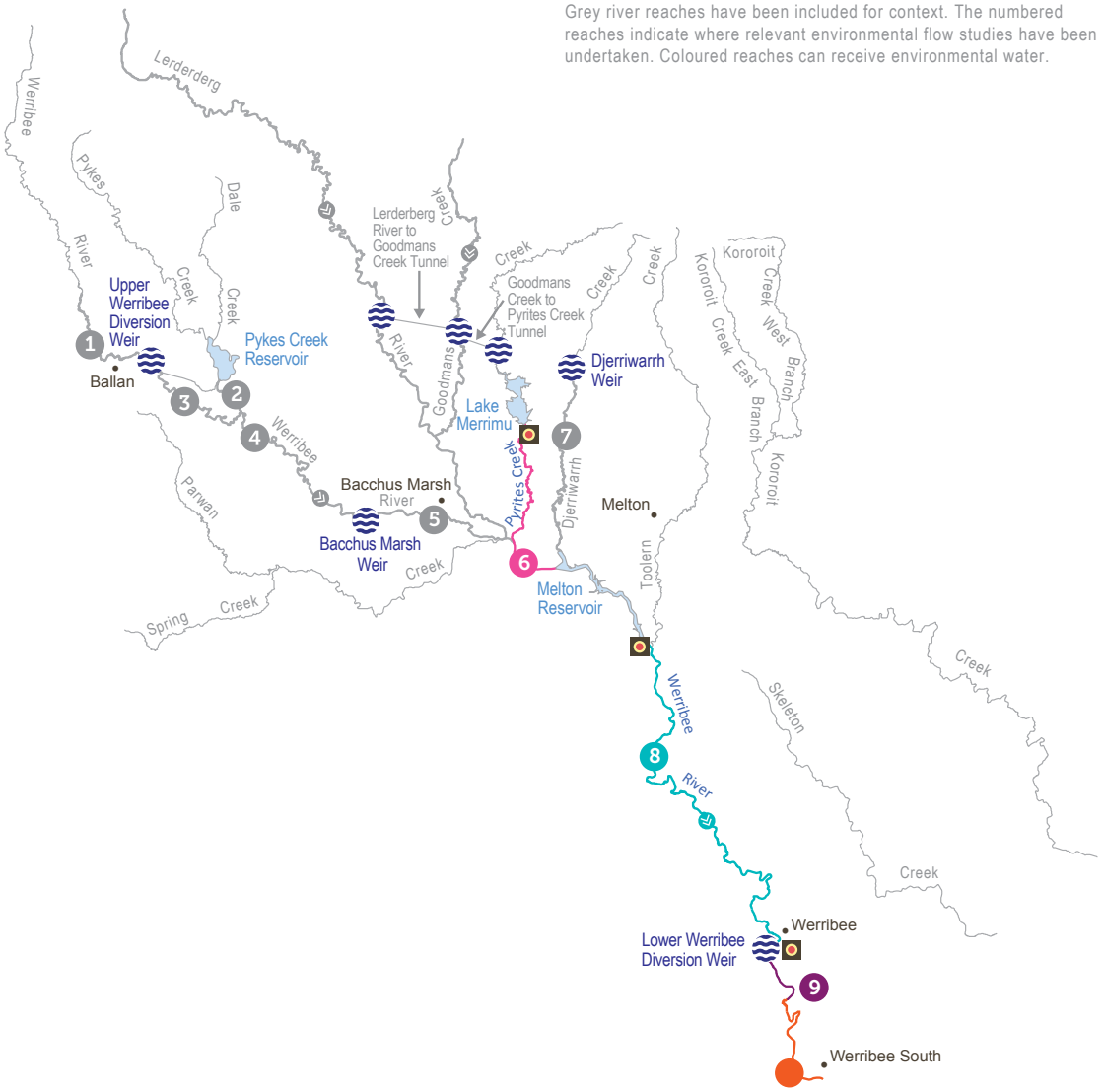
Baseflows and two freshes were provided to Pyrites Creek (reach 6) using environmental water. Maintaining baseflows is important to provide suitable frog habitat in winter/spring, while the freshes targeted outcomes for pygmy perch and waterbugs. The dry conditions affected deliveries, with significant losses resulting in the freshes not meeting the target flows and noticeably less of the releases from Lake Merrimu reaching Melton Reservoir downstream. A persistent trickle flow occurred throughout summer in the upper parts of Pyrites Creek as a result of leakage from Lake Merrimu while the lower section of the reach ceased to flow for extended periods.

With continuing dry conditions and low environmental water availability, it is becoming increasingly difficult each year to meet the flow objectives for the lower Werribee River. Issues such as blue-green algae and floating aquatic weeds were again evident in reach 9 through the Werribee township. These issues highlight the low-flow and high-nutrient loads in the river and affect fishing, boating and the general enjoyment people have from being near the river. Two freshes to the lower Werribee River were delivered in January and March 2016; while primarily aimed at

Figure 3.5.1 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.



maintaining water quality and supporting fish passage, they also flushed the blue-green algae. These freshes were too small to have a significant or long-lasting effect on reducing the aquatic weed build-up.

The Werribee River will benefit from an additional 1,100 ML of water made available from Lake Merrimu in 2015–16. At the time of writing, this water was planned to be delivered in winter 2016, primarily to provide a large fresh event to the lower Werribee River, an event that has not occurred since 2012. This larger fresh is aimed at providing a significant flush to the river, improving habitat for fish and platypus and removing the aquatic weed accumulation. This will improve water quality in the lower Werribee River and is expected to result in less weed, algae and other issues in 2016–17, although follow-up flows are likely to be important to achieving this.

Scope of environmental watering

Potential environmental watering actions and their environmental objectives are shown in Table 3.5.1.

Table 3.5.1 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 in September–December)	• Improve waterbug habitat by scouring silt and sand from riffles • Promote vegetation growth
Spring/summer high flows (130 ML/day for 2 days in September–December)	• Flush organic matter from benches • Promote recruitment and growth of riparian vegetation
Winter/spring/summer baseflows (2 ML/day [or natural] in June–December)	• Provide waterbug and frog habitat
Lower Werribee River (reaches 8, 9 and the estuary)	
Spring/summer freshes (up to 2 freshes of 50–80 ML/day for 2 days in November–December)	• Promote juvenile black bream recruitment • Promote longer-distance movement of fish through reach 9
Winter/spring/summer baseflows (10 ML/day in June–December)	• Provide black bream habitat for spawning • Provide habitat for waterbugs and fish and support vegetation growth in reach 9
Autumn baseflows 10 ML/day during March–May	• Promote downstream migration of diadromous fish (fish that move between freshwater and saltwater to complete their life cycle) to the estuary • Provide habitat for waterbugs and fish and to support vegetation growth in reach 9
Summer/autumn freshes (up to 3 freshes of 80 ML/day[1] for 2 days during January–April)	• Maintain pool water quality for fish and platypus in reach 9 • Promote recruitment of juvenile black bream in the estuary • Scour silt and algae from riffles in reach 8
Winter/spring/summer freshes (up to 4 freshes of 350 ML/day for 3 days during June–December)[2]	• Promote diversity of riparian vegetation in reaches 8 and 9 • Provide fish movement cues (all) • Inundate saltmarsh vegetation with brackish water in the estuary

1 Recommendation is for 137 ML delivered in one day. The recommendation has been revised due to operational constraints to be 160 ML delivered over 2 days. Monitoring has shown that this achieves the hydraulic and water quality objective.

2 If this watering action is not delivered in 2015–16, it may be delivered in 2016–17 using the 1,100 ML of additional water provided in 2015–16. This is not shown in the scenario planning table below as it is intended to be delivered in 2015–16 at the time of writing.

Scenario planning

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

As seasonal conditions improve across the planning scenarios from drought to wet, additional actions become a priority for environmental watering. The critical flows planned to be delivered under the drought and dry scenarios focus on deliveries to Pyrites Creek (reach 6) and freshes to protect the lower Werribee River, by maintaining 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 increases as conditions become wetter, as re-harvesting Lake Merrimu releases in Melton Reservoir cannot occur when Melton Reservoir is spilling.

When possible, winter releases from Lake Merrimu to 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. This is an essential management option to enable the best use of very limited environmental water under drought and dry conditions. Under average or wet conditions 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 2017–18 is essential to help protect the health of Pyrites Creek (reach 6) in the following year under dry conditions.

Table 3.5.2 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	• No unregulated flows below Melton Reservoir, minimal passing flows to reach 6 • Consumptive releases out of storage into reach 8 in summer/ autumn	• Unregulated spills in winter/spring from Melton into reaches 8 and 9 and the estuary; most reach 6 baseflows met by passing flows • Consumptive releases out of storage into reach 8 in summer/autumn	• Unregulated spills in winter/spring from Melton into reaches 8 and 9 and the estuary; all reach 6 baseflows provided • Consumptive releases out of storage into reach 8 in summer/autumn
Expected availability of environmental water	• 350 ML carryover • 0 ML allocation • 50 ML inflows • 400 ML total	• 350 ML carryover • 500 ML allocation • 200 ML inflows • 1,050 ML total	• 350 ML carryover • 700 ML allocation • 400 ML inflows • 1,450 ML total	• 350 ML carryover • >800 ML allocation • >900 ML inflows • >2,050 ML total
Potential environmental watering – tier 1 (high priorities)	• Winter/spring/summer baseflows (reach 6) • Two spring/ summer freshes (reach 6) • Two summer/autumn freshes (lower reaches)	• Winter/spring/summer baseflows (reach 6) • Three spring/ summer freshes (reach 6) • Two summer/autumn freshes (lower reaches) • Autumn baseflows (lower reaches) • Spring/summer freshes (lower reaches)	• Three spring/summer freshes (reach 6) • Two summer/autumn freshes (lower reaches) • Autumn baseflows (lower reaches) • Two spring/summer freshes (lower reaches) • Winter/spring/summer baseflows (lower reaches)	• Three spring/summer freshes (reach 6) • Spring/summer high flows (reach 6) • Two summer/autumn freshes (lower reaches) • Autumn baseflows (lower reaches) • Two spring/summer freshes (lower reaches) • Winter/spring/summer baseflows (lower reaches)
Potential environmental watering – tier 2 (additional priorities)	• Winter/spring/summer freshes (lower reaches) • Autumn baseflows (lower reaches)	• Winter/spring/ • summer freshes (lower reaches)	• Additional winter/spring/ summer freshes (lower reaches)	• Additional winter/spring/ summer freshes (lower reaches)
Possible volume of environmental water required to achieve objectives[1]	• 350 ML (tier 1) • 1,500 ML (tier 2)	• 700 ML (tier 1) • 1,300 ML (tier 2)	• 900 ML (tier 1) • 1,300 ML (tier 2)	• 1,200 ML (tier 1) • 1,300 ML (tier 2)
Priority carryover requirements	• 200 ML			

1 Environmental water requirements for tier 2 actions are additional to tier 1 requirements.

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 1.3.6).

Engagement

Table 3.5.3 shows the partners, stakeholder organisations and individuals with which Melbourne Water engaged when preparing the Werribee system seasonal watering proposal.

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 Partners and stakeholders engaged in developing the Werribee system seasonal watering proposal

Partner and stakeholder engagement
• Werribee River Community Advisory Group including representatives of Melton, Wyndham and Moorabool councils, Waterwatch, Werribee Riverkeeper, Western Melbourne Catchment Network, Friends of Werribee Gorge and Longforest Mallee, Pinkerton Landcare, Friends of Toolern Creek, Werribee South Fishing Club, Werribee Anglers Club and Port Phillip and Westernport CMA
• Southern Rural Water and licensed diverters
• Victorian Environmental Water Holder

Pyrites Creek, by Bill Moulden, Melbourne Water

3.6 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 native fish species including the Australian grayling, river blackfish, Australian smelt, flat-headed gudgeon, 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 waterbugs, platypus 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 system has important environmental values and supports a range of recreational activities with parks, walking trails, picnic sites, lookouts, swimming holes, fishing and camping spots and historic bridges located along its length. Lal Lal Reservoir is used to supply water to the Ballarat region. Water from Lal Lal is also delivered via the Moorabool River to She Oaks Weir to supply towns in the Geelong region. The Moorabool River is a 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 water plants) within the river channel; these communities 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
	Reshape the river bank and bed and ensure fish and other water animals have a range of habitat pools and places to shelter
	Improve 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 the 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 flows in the river. The Moorabool is also a water supply catchment for Barwon Water with releases from Lal Lal Reservoir being diverted for urban water supply at She Oaks Weir. These releases contribute to environmental outcomes in reach 3a and 3b and allow more efficient delivery of environmental water to reach 4. Barwon Water and Corangamite CMA work together to maximise these benefits.

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, reducing the diversity and abundance of migratory fish in this part of the river.

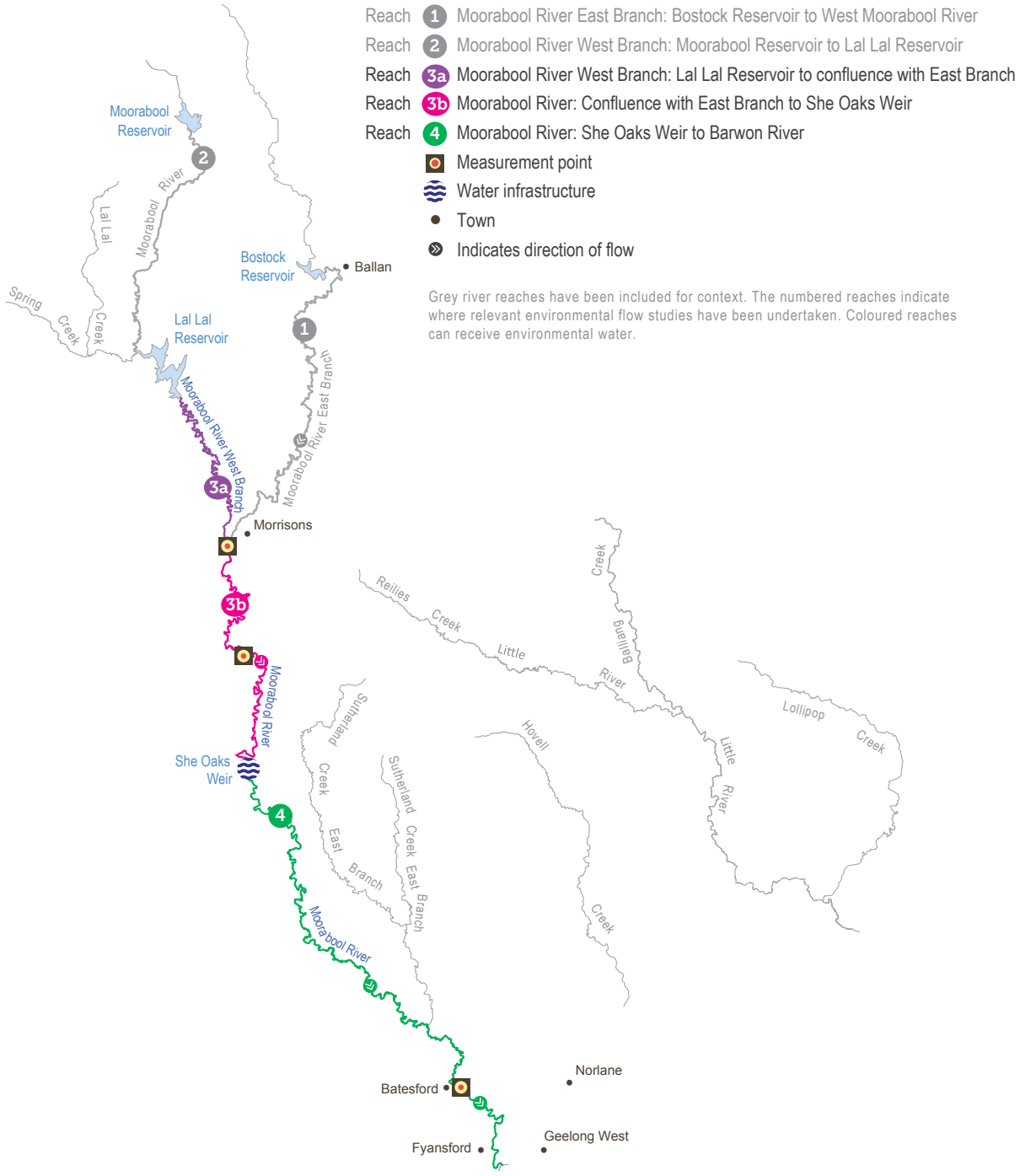
Environmental water can be used to manage flows in reaches 3a, 3b and 4. The priority reaches for environmental water delivery are the reaches between Lal Lal Reservoir and She Oaks Weir (reaches 3a and 3b, as shown on the map), as these are where the small amount of available environmental water can have the most beneficial impact. Environmental water delivered also provides benefits to significant flow-dependant values in reach 4 (which flows from She Oaks Weir, Meredith down to the confluence with the Barwon River in Geelong).

Recent conditions

There was a sharp decline in rainfall in the Moorabool catchment in 2015–16, with minimal river flows even in typically higher-flow periods in winter and spring. Water available under the entitlement relied heavily on water carried over from 2014–15 with only minor increases through the year. The lack of catchment inflows and warm weather caused cease-to-flow periods in summer for the first time since the millennium drought, resulting in a stretch of dry river bed near Batesford.

Trigger-based summer freshes were the priority for the Moorabool River in 2015–16, to improve water quality and top up habitat refuge pools as much as possible given the limited environmental water available. In summer, the trigger-based freshes restored flow connectivity between the Moorabool and Barwon rivers, highlighting the value of these small releases in dry periods.

Figure 3.6.1 The Moorabool system



Three trigger-based freshes were delivered to the Moorabool River in 2015–16, one in mid-December, one in March and one in May. Barwon Water's consumptive water releases from Lal Lal Reservoir also helped to meet low-flow targets in the summer period.

Scope of environmental watering

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

Table 3.6.1 Potential environmental watering actions and objectives for the Moorabool system

Potential environmental watering[1]	Environmental objectives
Summer/autumn low flows (5–20 ML per day in December–May)	• Provide pool and riffle habitats for fish, waterbugs, platypus and submerged aquatic vegetation • Maintain water quality
Summer/autumn freshes (2–3 freshes targeting 30–60 ML per day for 3–5 days in December–May)[2]	• Allow fish and platypus movement and maintain access to habitat • Flush silt and scour biofilms and algae from streambed • Maintain fringing marginal zone vegetation • Trigger downstream spawning migration of adult short-finned eel and grayling • Maintain water quality, fill up habitat refuge pools and avoid critical loss of biota
Winter/spring low flows (60–86 ML per day in June – November)	• Allow fish movement throughout the reach • Maintain clear flow path and control intrusions by terrestrial vegetation
Winter/spring freshes (2–3 freshes targeting more than 162 ML per day for 10 days in June - November)	• Allow fish and platypus movement through the reach and maintain access to habitat • Trigger downstream spawning migration of adult tupong and upstream migration of juvenile galaxias, tupong, short-finned eel and grayling • Flush silt and scour biofilms and algae from streambed and transport of organic matter • Promote growth and recruitment of native riparian vegetation including woody shrubs and promote strong vegetation zonation on the banks
Winter/spring high flow (1 fresh targeting 500 to 3,000 ML per day for 1–2 days in June–November)	• Scour pools and maintain channel form and dimensions • Flushing of sediment to improve spawning sites • Inundate billabongs

1 The target reaches for environmental watering are reach 3a, 3b and 4 of the Moorabool system unless otherwise stated.
2 Due to the low water availability in the Moorabool system, trigger-based freshes will be provided as required to maintain water quality, particularly in important refuge pools. These events are likely to be significantly lower than the recommended magnitude and duration.

Scenario planning

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

Due to the limited volume of environmental water expected to be available in the Moorabool system, the priority for environmental water delivery is to protect water quality and fish in the higher-risk summer/autumn period. Over summer in a dry year, trigger levels for dissolved oxygen, electrical conductivity and water temperature are monitored and used to inform the release of freshes to improve water quality. If wetter conditions eventuate, unregulated flows are likely to help meet minimum environmental flow requirements, and winter freshes or low flows may become a priority.

Although environmental watering focuses on reaches 3a and 3b, some releases will benefit reach 4. Where possible, deliveries to reaches 3a and 3b will be planned to maximise the benefit for reach 4, for instance by increasing summer fresh volumes when water availability allows. The CMA prioritises carryover of 750 ML each year (if possible) to allow delivery of trigger-based freshes in the following years if low inflows continue. Given low inflows in 2015–16, only about 700 ML was available to carry over into 2016–17.

Table 3.6.2 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	• 700 ML carryover • 300 ML inflows • ~1,000 ML total	• 700 ML carryover • 1,800 ML inflows • ~2,500 ML total	• 700 ML carryover • 4,300 ML inflows • ~5,000 ML total	• 700 ML carryover • 6,386 ML inflows • ~7,086 ML total
Potential environmental watering – tier 1 (high priorities)	• Summer/autumn freshes (trigger-based)	• Summer/autumn freshes (trigger-based) • Winter/spring freshes • Summer/autumn low flows	• Summer/autumn freshes • Winter/spring freshes • Summer/autumn low flows	• Summer/autumn freshes • Winter/spring freshes • Summer/autumn low flows
Potential environmental watering – tier 2 (additional priorities)	• Summer/autumn freshes • Winter/spring freshes • Summer/autumn low flows • Winter/spring low flows	• Summer/autumn freshes • Summer/autumn Low flows • Winter/spring freshes • Winter/spring low flows	• Summer/autumn low flows • Summer/autumn freshes • Winter/spring freshes • Winter/spring low flows • Winter/spring high flows	• Winter/spring low flows • Winter/spring high flows
Possible volume required to achieve objectives[1]	• 240 ML (tier 1) • 5,500 ML (tier 2)	• 1,670 ML (tier 1) • 4,070 ML (tier 2)	• 2,500 ML (tier 1) • 7,870 ML (tier 2)	• 2,500 ML (tier 1) • 5,600 ML (tier 2)
Priority carryover requirements	• 750 ML	• 750 ML	• 750 ML	• 750 ML

1 Environmental water requirements for tier 2 actions are additional to tier 1 requirements.

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 1.3.6).

Engagement

Table 3.6.3 shows the partners and stakeholder organisations with which Corangamite CMA engaged when preparing the Moorabool system seasonal watering proposal.

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 Partners and stakeholders engaged in developing the Moorabool system seasonal watering proposal

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

3.7 Lower Barwon wetlands

Waterway manager – Corangamite Catchment Management Authority

Environmental water holder – Victorian Environmental Water Holder

Environmental values

Reedy Lake and Hospital Swamps form part of the internationally recognised Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site and provide a home for many thousands of migratory birds from around the world.

The wetlands support about 47 threatened species and communities. These include some of Victoria's rarest species (such as the brolga, orange-bellied parrot, Australasian bittern, growling grass frog, Australian grayling and dwarf galaxias) and subtropical and temperate coastal saltmarsh communities.

Reedy Lake supports a range of vegetation communities including coastal saltmarsh, herbfields and reed beds, which provide important habitat for a variety of animal species. The relative extent of these vegetation communities is changing due to the absence of suitable wetting and drying cycles. Reed beds are continuing to expand, reducing freshwater habitat and the diversity of birds, fish and other animals the system supports.

Hospital Swamps is made up of five unique wetland basins that support a diversity of ecological values and processes. Large areas of threatened coastal saltmarsh and diverse fish and waterbird populations are present at the site. Vegetation communities in Hospital Swamps have remained largely unchanged over time due to the maintenance of natural wetting and drying cycles, which has protected the important environmental values of the wetlands.

Social and economic values

The lower Barwon wetlands are located close to Geelong, the second biggest city in Victoria. They form a very important part of the region's social fabric. The wetlands are valued by many people for their intrinsic beauty, ecological significance and recreational uses. In particular, the wetlands are used heavily by Geelong Field and Game and Geelong Field Naturalists for conservation activities and events, bird watching, game hunting and passive recreation. The system also supports a commercial eel fishery and is of significance to 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 contains a system of wetlands and lakes including Lake Connewarre, Reedy Lake, Hospital Swamps, Salt Swamp and Murtnaghurt Lagoon. Environmental water can be actively managed at Reedy Lake and Hospital Swamps using regulating structures at the wetlands.

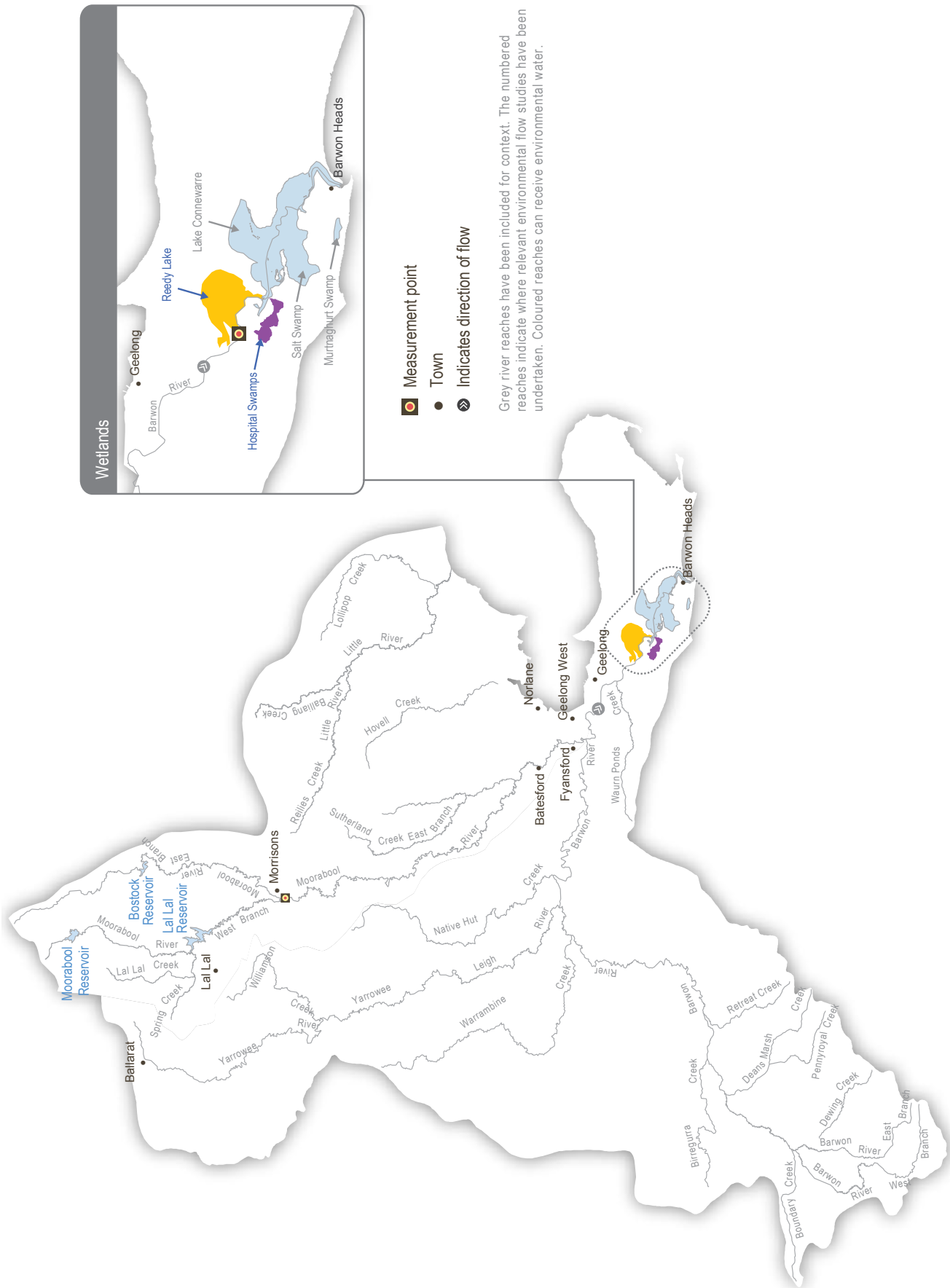
Unlike many other systems, the environmental entitlement does not provide access to water held in storage. Instead, it allows water to be diverted via regulators from the Barwon River into Reedy Lake and Hospital Swamps when river levels are above 0.7 m AHD (Australian Height Datum). High water levels in the Barwon River can also result in natural inundation of the wetlands.

Recent conditions

Dry conditions in the Barwon River catchment resulted in lower river flows than normal in 2015–16, meaning that the water levels in both Reedy Lake and Hospital Swamps were lower than in previous years, as less water could be diverted into the wetlands.

As in previous years, a natural pattern of wetting and drying was implemented in Hospital Swamps which meant inflows from the Barwon River entered the wetland in the winter/spring period and were actively drawn down (reducing the water level) over the drier summer months. This drying cycle helped to support important ecological processes: drying of the wetland is essential for maintaining the balance between fresh and salt water processes, which is necessary to support the diverse mix of vegetation communities and provide feeding and breeding habitat for waterbirds and native fish.

Figure 3.7.1 The Lower Barwon wetlands



Water was delivered to Reedy Lake whenever the levels in the Barwon River were above 0.7 m AHD. As the river level dropped below 0.7 m AHD quite regularly over summer 2015–16, water levels in Reedy Lake naturally fell to about half-full. Heavy rain in January 2016 resulted in high water levels in the Barwon River, increasing inflows to Reedy Lake, with water levels fluctuating in response to natural conditions.

Reedy Lake has largely remained in a constantly wet state since the 1970s. This has altered the soil and water chemistry allowing the extent of tall reed communities to nearly double. While reed beds form an important part of the lake's ecosystem, their continued expansion is reducing habitat diversity as they have taken over areas that previously supported different vegetation types and open water. In turn, this is reducing the number and diversity of internationally important migratory waterbirds the wetland supports. Unfortunately the carp population has also steadily increased and is now at a level where carp are diminishing the health of the lake. Carp prey on native fish and compete with them for habitat and food. They also damage aquatic vegetation.

Scope of environmental watering in 2016–17

Potential environmental watering actions and associated environmental objectives are provided in Table 3.7.1.

A more natural cycle of varying water levels is planned for both Hospital Swamps and Reedy Lake in 2016–17. The cycle will include delivering water in winter/spring and then lowering water levels over summer until the Barwon River level increases in autumn.

At Reedy Lake, introducing a more natural cycle of varying water levels will improve conditions to foster the growth of threatened vegetation communities while also managing the expansion of tall reeds which are seriously reducing habitat. This cycle will also support internationally significant bird species and most lake users. Temporarily lowering water levels at Reedy Lake will affect some users, including a local eel fisher. However, continuing to maintain high water levels in the lake poses a significant long-term risk to the health of the internationally important wetland, including the 47 threatened species and communities the lake supports.

If a more natural cycle of varying water levels is not initiated, the spread of reed beds could ultimately prevent recreational and commercial user access, and reduce populations of waterbirds and fish. This will lessen the fishing, hunting and birdwatching opportunities now available. With lower water levels there will also be the opportunity to control carp numbers, which will further benefit the user groups at Reedy Lake, improve native fish populations and reduce the damage that carp are causing to aquatic vegetation, ultimately benefiting bird populations as well.

Lowering water levels at Reedy Lake is the single most important management action to mitigate threats to the system and ensure all user groups can continue to value and use the lake into the future.

The Corangamite CMA has undertaken extensive consultation about the planned watering regimes for Reedy Lake and Hospital Swamps over the last six years with a broad range of stakeholders and interest groups representing over 1,500 people. These people have been involved in developing the environmental flow study and in additional scientific work exploring ecological risks, vegetation monitoring, alternative management approaches and infrastructure operations. The results from this comprehensive work show that lowering water levels at Reedy Lake is the only feasible management practice that will mitigate threats to the ecological health of the wetland and ensure all user groups can continue to use the system into the future.

No alternative water regime or management approaches could be identified that would enable the environmental health of the wetland to be protected while at the same time mitigating impacts to eel fishing. Corangamite CMA is continuing to work with state water and fisheries managers and the eel fisherman to explore alternative arrangements for eel fishing in the region.

Table 3.7.1 Potential environmental watering actions and objectives for the lower Barwon wetlands

Planning scenario	Environmental objectives
Reedy Lake	
Autumn/winter/spring filling flows (March/April–October)[1] *The inlet to Reedy Lake will be opened in autumn in response to a sustained increase in flows in the Barwon* River	• Maintain connectivity with the Barwon River • Provide feeding habitat for waterbirds in flooded vegetation and the wetland fringe • Promote fish reproduction
Spring/early summer drawdown (October–January) and continued low water levels throughout summer/autumn (January–March/April) *The inlet to Reedy Lake will be closed to allow water levels to drop through evaporation; during this period, the outlet may be manipulated if required to maximise the drawdown or to introduce saltwater to the lake*	• 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 plants and animals • Provide increased habitat diversity (including salt pans, mudflats and shallow water) • Provide wading bird habitat in summer • Provide summer waterbird refuge and foraging habitat • Improve lake shore salinity and promote soil salinisation • Initiate decomposition of organic matter on the wetland bed, to increase lake productivity when it is refilled • Improve soil health and allow weathering of heavy metals in lake fringe soils • Promote suitable conditions for threatened vegetation communities (such as coastal saltmarsh, herbfields and lignum shrubland) • Allow seasonal recruitment of aquatic macrophytes at wetland fringes
Hospital Swamps	
Autumn/winter filling flows (May–November)[1] *Hospital Swamps will be connected to the Barwon River for at least 6 weeks by keeping the inlet and outlet open*	• Create habitat and support waterbug 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 (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 AHD*	• Reduce the threat of carp and associated impacts on plants and animals • Reduce the threat of tall reeds in the system by increasing the salt content of the water and soil • Provide increased habitat diversity (including salt pans, mudflats and shallow water) • Provide wading bird habitat in early summer • Provide early summer waterbird refuge and foraging habitat • Improve lake shore salinity and promote soil salinisation • Initiate decomposition of organic matter on the wetland bed, to increase lake productivity when it is refilled • Improve soil health and allow weathering of heavy metals in lake fringe soils • Promote suitable conditions for threatened vegetation communities (such as coastal saltmarsh, herbfields and lignum shrubland) • Allow seasonal recruitment of aquatic macrophytes at wetland fringes

1 Water can only be diverted into the lower Barwon wetlands when water levels in the Barwon River are above 0.7 m AHD at the lower Barrage Gauging Station, in line with provisions for accessing water under the environmental entitlement.

Scenario planning

Table 3.7.2 outlines the potential environmental watering and expected water usage under a range of planning scenarios.

Inundation of the wetlands over the winter period and drawdown in summer are a priority under all scenarios but the extent of the wetting and drying will vary in response to natural conditions. For example, in a wet scenario it is unlikely that a substantial drawdown in Reedy Lake or Hospital Swamps will be achievable. However, some degree of drying is still important to promote vegetation diversity and soil salinisation and to provide a variety of feeding and breeding habitat for waterbirds. The wetlands will be managed adaptively throughout the year in response to climatic conditions to maximise environmental outcomes.

The planned action will be carefully managed throughout the drawdown by the Corangamite CMA, with monitoring in place to ensure that the drawdown can be adaptively managed as needed.

Table 3.7.2 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 • Dry conditions over summer will assist in the drawdown of the wetlands	• 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/run-off • Extensive drawdown of wetlands is unlikely
Reedy Lake			
Potential environmental watering	• Autumn/winter/spring filling flows (March/April–October) • Spring/early summer/autumn drawdown and low water levels (October–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 1.3.6).

Engagement

Table 3.7.3 shows the partners, stakeholder organisations and individuals with which Corangamite CMA engaged when preparing the lower Barwon wetlands seasonal watering proposal.

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 3.7.3 Partners and stakeholders engaged in developing the lower Barwon wetlands seasonal watering proposal

Partner and stakeholder engagement
• 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, Department of Environment, Land, Water and Planning, Environment Victoria, VR Fish, Barwon Water, local landowners, community members, local commercial eel fishing licence holders (until late 2015), Parks Victoria, Southern Rural Water and the VEWH. Additional stakeholders are invited on an as needs basis, including science and engineering consultants and the Department of Economic Development, Jobs, Transport and Resources.
• Other stakeholders include commercial eel fishers and the members for South Barwon, Bellarine, and Western Victoria.

Hospital swamps, by Saul Vermeeren, Corangamite CMA

Glenelg River, by Chloe Wiesenfeld, Victorian Environmental Water Holder