7

This chapter outlines actions to better target environmental water recovery, use environmental water more efficiently and ensure an adaptive, integrated approach to protect our most important environmental assets.

Loddon River

Photographer: Alison Pouliot

High-value rivers, wetlands and floodplains

Guide to the chapter

Section 7.1 Environmental water

- Targeted recovery of environmental water
- Efficient use of environmental water

Section 7.2 Complementary restoration measures

- Managing water quality
- Protecting riparian land
- Safeguarding in-stream habitat

Section 7.3 Adaptive and integrated management

- The seasonally adaptive approach
- Ongoing monitoring and evaluation
- Adaptive management over the next 10 years
- Process for reviewing environmental objectives

What is the issue with the existing arrangements?

Climate change will reduce the environment's share of water far more than that of water users. Environmental flows could be halved in the Murray and reduced by up to 70 per cent in the Goulburn system. The uncertainty and potential severity of climate change requires much more adaptive and targeted management. Just as it may not be possible to maintain current irrigation levels in the region, ultimately, it may not be possible to meet all of our current environmental objectives in a climate change world.

What improvements does the Strategy make?

- Builds on existing commitments that will increase environmental flows by an average of 400 GL a year.
- Identifies a range of tools, including carryover, reuse, structural works and complementary restoration measures, to ensure more efficient use of environmental water – to get as much benefit as we can from every drop.
- Applies lessons from the recent drought to improve future decisions about river and wetland health. In particular, decisions about where to use available environmental water in any year will be guided by the 'seasonally adaptive approach'.
- Uses an innovative 6-category approach to identify priorities for the next stage of water recovery. These 'targets' will be a valuable input to increase the benefits from the Commonwealth Government's $3.1 billion water purchase program.
- As part of an adaptive management approach, identifies a reasoned and transparent process for changing environmental objectives if necessary.
- No matter what happens, we must be able to protect our most valued environmental assets for current and future generations to enjoy.

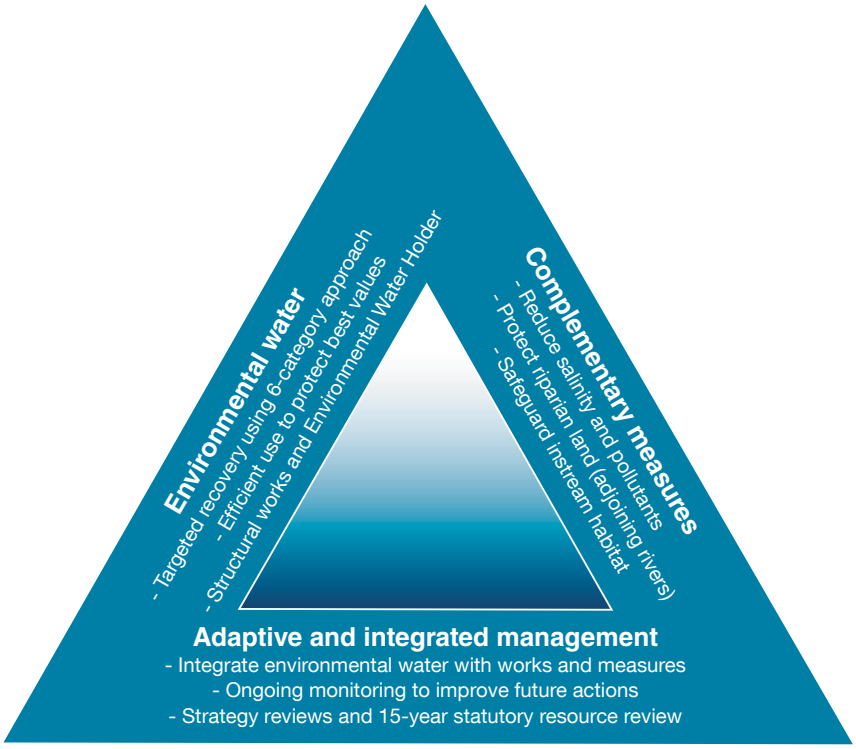
Communities in the Northern Region rely on healthy rivers and wetlands to provide reliable, high-quality water for households, farms and industry, to maintain social, cultural and heritage assets and for recreational and tourism opportunities. The community derives considerable economic benefits from our rivers – and pays a considerable cost when their condition declines.

Drought and climate change mean that a stronger approach is required for managing rivers, wetlands and floodplains (see Figure 7.1). This will focus on three ways to improve environmental management:

1. Targeted recovery and efficient use of environmental water.
2. Complementary river restoration works and measures.
3. Integrated and adaptive management of environmental water and works.

This chapter outlines each of these aspects. The first section discusses regulated river systems where environmental flows can be held in storage, with the ability to control the timing and rate of release. The second and third sections cover both regulated and unregulated river systems. Unregulated river systems, where flows cannot be actively managed in this way, are discussed in more detail in Chapter 4.

Figure 7.1 A stronger approach to environmental management



7.1 Environmental water

In Victoria, environmental water is referred to as the 'environmental water reserve' or EWR (see page 10). Existing environmental entitlements provide on average 232 GL a year (see Appendix 4). This is the portion of the EWR that can be called out of storage when needed and actively managed to maximise benefits. It accounts for about six per cent of the average Murray environmental flows of 4,089 GL a year (see Appendix 2). The remainder is provided by unregulated flows and spills from storages. Spills from storages are particularly reduced under climate change because emptier storages can capture a greater proportion of inflows. As a result, climate change will impact the environment's share of water far more than that of water users. Environmental flows could be halved in the Murray and reduced by up to 70 per cent in the Goulburn system (see page 24).

"We are concerned that the environment's share of water entitlements is disproportionately affected in dry times… [and] that this 'balance' between consumptive use and the environment does not meet community expectations."

– Draft Strategy submission DS129

7.1.1 Targeted recovery of environmental water

In many systems, the amount of water in the EWR is insufficient to protect the environmental assets that communities value. These assets are identified by catchment management authorities through consultation on their regional river health strategies. The Victorian Government has committed significant investment to protect them by recovering an expected 400 GL of water in the region (see Table 7.1). Three-quarters of this will be provided by 2013; the timing of the remaining 100 GL is still to be agreed with the Commonwealth Government.

Table 7.1 Existing initiatives to recover water for the environment in the Northern Region

Project name	Volume (GL/year)*, reliability~ and holder			Project description and comments
Living Murray Initiative	67 120 27	HR/LR LR LR – unreg§	VEWH^	Focuses on environmental benefits in six significant ecological assets (icon sites). Victoria has committed $115m over five years to recover 214 GL of water for the River Murray by June 2009. Total Basin commitment is $500m for 500 GL by 2009.
Snowy Water Recovery Project	35	LR	CEWH#	About 1,000 GL/year of water is diverted from the Snowy River to the River Murray. Through the Snowy River Water Recovery Project, the Victorian, New South Wales and Commonwealth Governments committed $375m to return 21 per cent of the original flows (212 GL) to the Snowy River by 2013. 70 GL of this will go to environmental flows in the River Murray (shared commitment from Victoria and New South Wales).
Northern Victoria Irrigation Renewal Project (Stage 1)	75	HR/LR	VEWH^	Water savings are generated by modernising the distribution system (see page 119 for full details). Total commitment is $1b for 225 GL by 2013 (with cost share between Victorian Government, Goulburn-Murray Water and Melbourne Water). A third of the savings will be allocated to the environment.
Northern Victoria Irrigation Renewal Project (Stage 2)	100	HR/LR	CEWH#	Water savings are generated by modernising the distribution system (see page 113 for full details). Total commitment is $1b for 200 GL (with commitment by Commonwealth Government). Half the savings will be allocated to the environment.
Total recovery (GL/year)	424			

* Estimate of the average amount of water provided each year assuming long-term average water availability. Outlines the volume of water recovered in Victoria only (not interstate projects).
~ High-reliability or low-reliability.
§ Low-reliability entitlement from unregulated flows.
# Commonwealth Environmental Water Holder.
^ Victorian Environmental Water Holder (once established – see page 137).

The Victorian Government's approach to environmental water recovery has been to generate water savings that can be converted to environmental entitlements because savings have little (if any) impact on entitlement-holders and regional communities. However, water savings are finite and other approaches are now required.

One alternative to water savings projects is the purchase of water entitlements. In 2008, the Commonwealth Government committed $3.1 billion to purchase water entitlements for the environment. Chapter 3 outlines recommendations to limit the socio-economic impacts of this water purchase by targeting and integrating water purchase with irrigation modernisation. The remainder of this chapter addresses ways to maximise the environmental benefits from such purchases.

Once the projects in Table 7.1 are complete and assuming the Commonwealth Government achieves its aim of purchasing 460 GL over the next five years (see page 45), the volume provided by environmental entitlements could be increased to about 960 GL*. This would increase the proportion of the EWR held as environmental entitlements from six to 20 per cent, better equipping environmental managers to maximise benefits by actively managing environmental flows.

The 6-category approach to guide water recovery and works

A more targeted approach is required to guide where Victoria wants water recovery in regulated systems to occur and identify what the benefits would be; the 6-category approach had been developed to achieve this. Figure 7.2 outlines the potential environmental outcomes and the necessary flow components to achieve them. Environmental health progressively improves from Category 1 through to Category 6 as more water is provided for environmental flows.

The healthiest systems (Categories 5 and 6) retain the majority of natural connections between the river and its floodplain wetlands. Category 6 means the full scientific flow recommendations are met[50]. This does not mean it is in pristine condition, but the important values and functions identified by catchment management authorities are maintained and self-sustaining. At Category 5, the floodplain is provided with some overbank flows, likely supplemented with flows delivered by structural works such as pumps and/or regulators. An example of these is the Living Murray works and measures program for the icon sites along the River Murray.

For the in-stream river system, Categories 3 and 4 fit the concept of a 'working river' where environmental values are traded off to meet community needs. Categories 1 and 2 represent a 'survival' regime where only enough water is provided to get through a dry period. This type of flow is insufficient in the long term and would lead to a rapid and continued deterioration of river health and likely loss of many species at a local and regional scale.

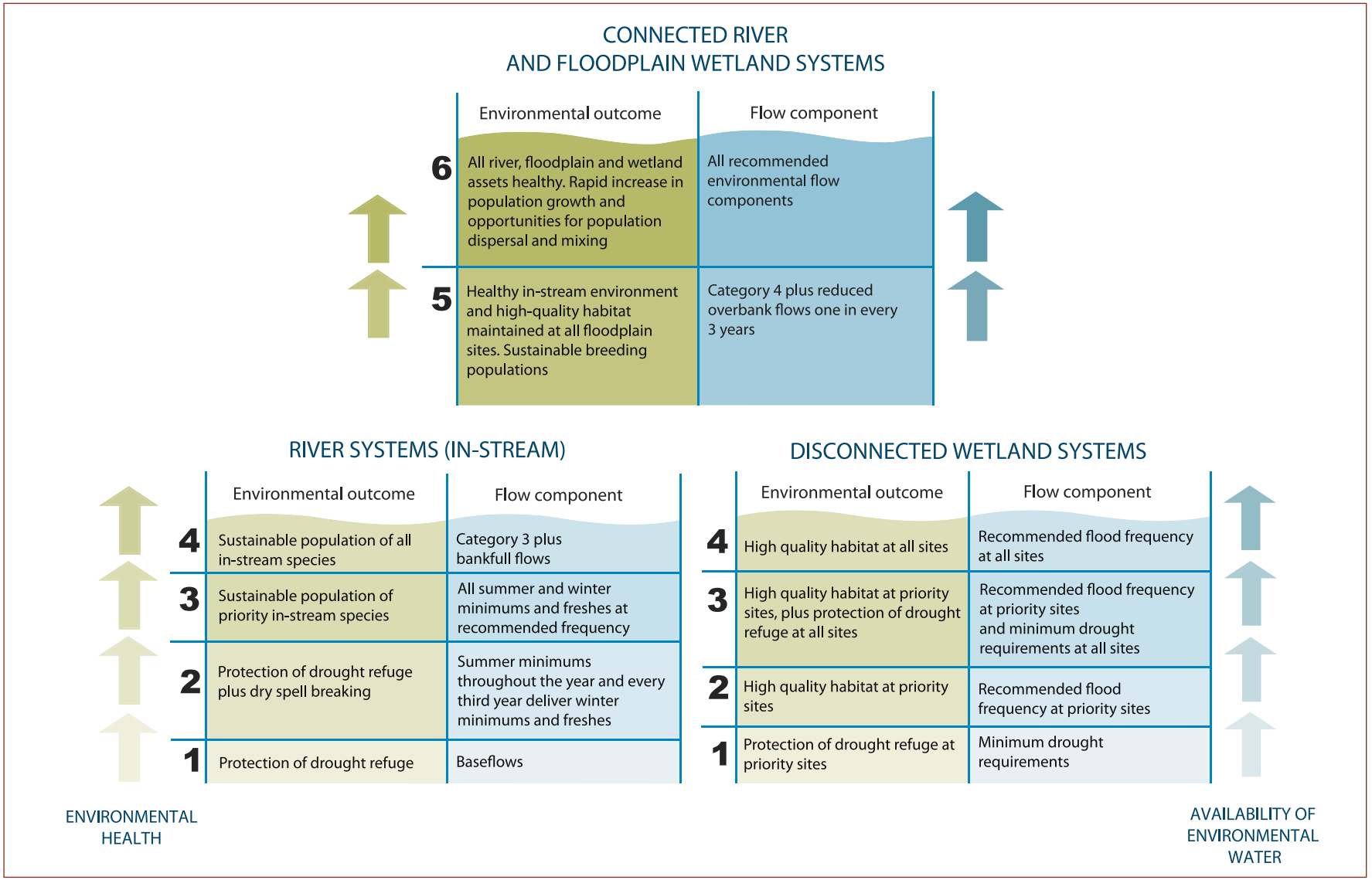
For wetland systems that are disconnected from the river, Categories 3 and 4 provide sufficient water through structural works to maintain all or some sites (defined as a high-value wetland within a system). Category 2 aims to support high quality habitats at a limited number of priority sites, while Category 1 focuses on maintaining the priority sites as drought refugia. Again, this type of flow is insufficient in the long term. If water recovery has secured these sites, the focus moves to the remaining wetlands.

Ducks, Butlers Creek

Photographer: Bob Merlin, Mallee Catchment Management Authority

Footnote:
* The total of 960 GL includes 232 GL from existing entitlements (see Appendix 4), 94 GL from Living Murray projects still to be completed, 75 GL from NVIRP Stage 1, 100 GL from NVIRP Stage 2 and 460 GL from assumed Commonwealth purchases.

Figure 7.2 The 6 category approach to guide investment in water recovery and works



Setting water recovery targets for river and wetland systems

A water recovery target of a particular volume will provide different outcomes under different climate scenarios. If water availability decreases with climate change, so does the reliability of recovered entitlements, and environmental benefits are reduced. The objective of water recovery for rivers was proposed and agreed through the Draft Strategy.

In river systems where the current EWR does not meet scientific recommendations, water recovery targets aim to:

- *significantly improve the health of priority reaches to at least a Category 4 under the current climate (base case)*
- *at least maintain drought refugia at a Category 2 for the highest value reaches under a continuation of recent low inflows (Scenario D).*

The public forums and submissions elicited mixed views on the category approach to guide water recovery targets. Many people agreed that there needed to be an appropriate balance of environmental and socio-economic considerations. Some believed water recovery targets would not go far enough in protecting the region's rivers and wetlands. Others were concerned that this level of water recovery would significantly impact on the regional economy. The agreed objective provides a balance because:

- there will be opportunities over the next 10 years to amend targets if required (see page 150)
- the Victorian and Commonwealth Governments are working together to minimise the impacts of water recovery on the region's economy (see page 167).

The 6-category approach has been applied to the major river systems in the Northern Region, assuming that the water recovery commitments in Table 7.1 are complete. Using this approach, it has been calculated that an extra 305 GL per year is required to achieve at least a Category 4 under the base case and at least a Category 2 under the most severe climate scenario (see Table 7.2 and Figure 7.3). To place this in context, about 4,095 GL a year is able to be taken for consumptive use, with 4,089 GL provided for environmental flows (see Appendix 2)*. Ideally, the Commonwealth purchase program would be used to at least partially address this overall water recovery target.

The Kiewa River currently has its recommended required flow components met, with the exception of freshes which are affected by the timing of hydro-power releases. While no extra water recovery is sought, the Victorian Government will continue to protect and enhance the Kiewa River through the development of local management rules (see page 64).

The Ovens River is currently considered to be in a Category 5 condition so no extra water recovery is sought. To protect this high-value river and ensure continued compliance with the Murray-Darling Basin Cap, the Victorian Government does not support enlarging Lake Buffalo (see Appendix 10). To address low flow issues in the upper Ovens, an integrated management plan is proposed (see page 65).

Comprehensive flow recommendations have not been developed for the Broken River, which will be largely unregulated following the decommissioning of Lake Mokoan. River regulation had minimal environmental impacts when the Broken River bulk entitlements were developed in 2004. As such, no extra water recovery is sought.

More detail on the 6-category approach, and the water recovery targets required to meet the different categories, can be found in Background Report 8. The environmental flow studies for each river can be found at www.ourwater.vic.gov.au/environment/rivers/flows.

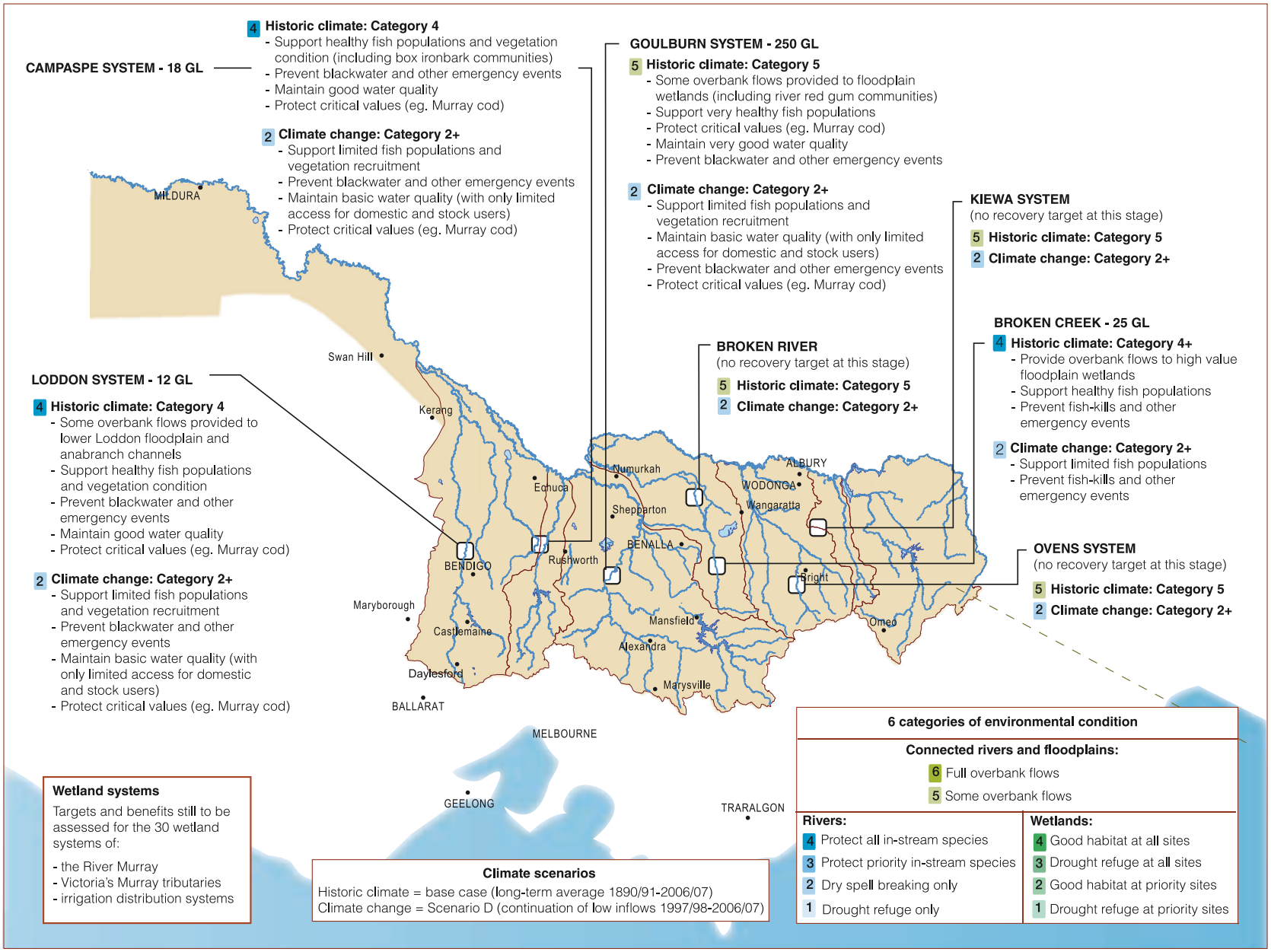
Table 7.2 Water recovery targets for river systems in the Northern Region+

River	Water recovery target (GL)	Category under base case*	Category under Scenario D*
Murray	N/A^	N/A^	N/A^
Ovens	0	Category 5	Category 2 (or higher)
Kiewa	0	Category 5	Category 2 (or higher)
Broken Creek	25	Category 4 (or higher)	Category 2 (or higher)
Broken	0#	Category 5	Category 2 (or higher)
Goulburn	250	Category 5	Category 2 (or higher)
Campaspe	18	Category 4	Category 2 (or higher)
Loddon	12	Category 4	Category 2 (or higher)

Notes:
+ Targets assume that the initiatives in Table 7.1 are fully implemented.
* Refer to Figure 7.2 for category definitions, Figure 7.3 for expected benefits and Background Report 8 for the full range of potential water recovery targets.
^ See page 136 for process to assess River Murray needs.
# Estimation based on recent management arrangements in place and expert opinion – modelled numbers are not available due to inadequate flow data.

Footnote:
* This includes the provision of environmental flows from Snowy Water Recovery projects completed by mid-2007, and the Living Murray Initiative's 120 GL 'sales deal' and 25 GL reconfiguration savings.

Figure 7.3 Water recovery targets and expected benefits for river reaches and wetlands in the Northern Region#



These targets assume that the initiatives in Table 7.1 are already fully implemented.

Work has begun to develop water recovery targets for the wetland systems associated with:

- the River Murray floodplain (of particular interest are those *not* identified as icon sites through the Living Murray Initiative)
- Victoria's tributary floodplain
- irrigation distribution systems.

The past 12 years have highlighted the need to prioritise sites and the increasing importance of structural works to deliver environmental water. Given the large number of wetlands in the Northern Region, it is important the right amount and mix of wetland types are chosen to invest limited resources. The focus needs to shift from managing individual wetlands to wetland systems or complexes within a broader landscape context.

400 high-value wetlands that are potentially feasible to water have been identified in 30 major wetland systems[55] (see Appendix 6). Specific processes to develop water recovery targets for these can be found in Background Report 8, but in general, the next steps are:

1. Across the region, identify the assets that we want to protect (for example, river red gum communities or migratory birds). This will be done for the next round of regional river health strategies in 2012 and will need to take into account the implications of climate change.
2. For each wetland system, identify the priority floodplains and wetlands taking into account environmental values, wetland type, number and geographic spread. The aim should be to maintain representative classes of wetlands across the region and the full range of assets identified in Step 1. The wetlands identified in this step will be the priority sites to protect under Categories 1 and 2 (see Figure 7.2).
3. Determine the water requirements (including minimum drought requirements and recommended flooding frequency) for each wetland and the works or system operating requirements to deliver water to the sites.
4. Develop water recovery targets for each wetland system. In addition, any complementary land management requirements should be identified (for example, stock fencing).

Victoria will also develop a prospectus of structural works opportunities to guide Commonwealth and State Government investment (see page 45).

Action 7.1: Water recovery targets for rivers and wetlands

Who: Minister for Water; Department of Sustainability and Environment; catchment management authorities

Timeframe: 2010

Victoria will put forward water recovery targets to guide the Commonwealth Government's $3.1 billion water purchase program and Basin Plan.

For river systems with an inadequate EWR, water recovery targets have been identified in Table 7.2.

Where the EWR is inadequate in wetland systems, water recovery targets will be developed following community consultation, including with Traditional Owner groups. Consultation and public communication will occur through regional river health strategies. The initial objective of the water recovery targets will be the same as the river systems (that is, achieve at least Category 4 under the base case and at least Category 2 under Scenario D).

What about the River Murray 'icon sites'?

As the River Murray is a shared resource, its management is an interstate responsibility.

The environmental water requirements for the icon sites have been developed through the Living Murray process. For three of the sites (Gunbower-Pericoota, Hattah and Chowilla-Lindsay-Wallpolla), modelling has been undertaken to assess whether the 500 GL of water recovered under the 'First Step' would be adequate to meet their requirements. It also assessed whether the proposals (which include structural works to deliver water as well as a water demand) were effective under climate change scenarios.

The results so far demonstrate that under historic conditions, there is more than enough water to meet at least the minimum flow objectives of the three icon sites under medium climate change. This meets the needs of river red gums but not black box communities (which occur at higher elevations and require more water to flood). Further modelling is underway to determine for these wetlands the ability of the recovered water to meet:

- full environmental flow objectives with structural works under medium climate change
- minimum environmental flow objectives with structural works under severe climate change
- full environmental flow objectives with structural works under severe climate change (equivalent to Scenario D).

Modelling is still in progress for Barmah-Millewa and the Lower Lakes-Coorong-Murray Mouth. As Barmah-Millewa already has an environmental water allocation, Living Murray water would be used to build on outcomes from that water. If the modelling shows that water requirements are not met, it is expected that these would be considered as part of the Murray-Darling Basin Plan (see page 42). A key decision will be whether to try and retain the Lower lakes as an artificial freshwater system or allow them to become estuarine. For the remaining sites, meeting the full environmental flow objectives will continue to be a priority, given the value of the sites and existing investment in structural works.

Feedback from consultation on the Draft Strategy suggested there was a need to look beyond the icon sites. This has been particularly strong from Traditional Owner groups. In its final recommendations[56], the Victorian Environmental Assessment Council (VEAC) highlights the environmental water needs of the entire River Murray floodplain. While VEAC indicates that the optimal provision of water is through overbank flooding, it acknowledges that this may not always be feasible, particularly under climate change scenarios. VEAC recognises that structural works can provide for some targeted watering of specific sites of conservation significance. VEAC has focused its attention on comprehensive mapping of all flood-dependent ecosystems and their water requirements. This will be used in the development of water recovery and works targets to guide the Commonwealth Government's investment.

What about run-off and groundwater-fed wetlands?

The Strategy will not set water recovery targets for wetlands that receive water solely from runoff or groundwater because there is no practical means of delivering water to these sites. Many of these wetlands will no longer be high value, having been drained, used for water storages or for cropping. Where they are high value and close to distribution systems, it may be possible to build channels to supply them. In this case, their water requirements would be considered in the development of water recovery targets identified on page 133. Where they are high value but not close to distribution systems, protection could focus on informing planning decisions and preventing the drainage of wetlands. For groundwater-fed wetlands, more information will help to improve groundwater management decisions and several projects and processes are already underway, including:

- identifying the location and extent of groundwater-dependent ecosystems across Victoria and the relative importance of groundwater to these ecosystems (see page 33)
- mitigating the impacts of reduced seepage or outfalls as a result of modernisation projects (see page 113)
- considering groundwater-dependent ecosystems in the setting of groundwater trigger levels for allocations/restrictions (see page 69).

7.1.2 Efficient use of environmental water

Just as it is the responsibility of all users to ensure they are using water as efficiently as possible, so it is for environmental managers. The following sections outline several tools to improve the efficiency of environmental water use, including:

- establishing an Environmental Water Holder to coordinate its delivery across the region
- structural works to deliver environmental water
- carryover of water from one year to the next
- the reuse of return flows
- use of consumptive water en route for environmental benefits.

Horseshoe Lagoon regulator Photographer: DSE

Establishing a Victorian Environmental Water Holder (VEWH)

There are various sources of environmental water, and entitlements are held by the Victorian and Commonwealth Governments. In the Northern Region, environmental water can be supplied to connected river systems that cross the boundaries of four catchment management authorities. To maximise the benefits of environmental water, its use must be coordinated across the whole region.

Establishing a VEWH will optimise the delivery of environmental water and direct it to its highest value use. When there is limited water available during droughts, the VEWH will be able to identify the highest priorities, having regard for catchment management authority watering proposals, and ensure that critical drought refuges across the region are protected. The VEWH will make decisions on the best use of environmental water independently from Ministers, but in line with high-level rules established by the Minister for Environment. The VEWH will coordinate the delivery of Victorian and Commonwealth environmental water (see page 52) with the Commonwealth Environmental Water Holder (CEWH).

It is important that decisions on the allocation, use and management of environmental water are made as locally as possible. The respective roles and responsibilities between catchment management authorities, the Department of Sustainability and Environment and the VEWH must be clear (see Table 7.3).

Action 7.2: Establishing a Victorian Environmental Water Holder (VEWH)

Who: Department of Sustainability and Environment **Timeframe:** 2011

A VEWH will be established as an independent statutory body responsible for holding and managing environmental water entitlements and allocations and making decisions on their best use, including trade and carryover, to achieve the highest environmental value. In undertaking its functions, the objective of the VEWH will be to promote efficient investment and management to protect and enhance the value of water-dependent ecosystems throughout Victoria.

The VEWH will make decisions independently from, but accountable to, the State Government in accordance with high-level rules established by the Minister for Environment. It must have regard for catchment management authority annual watering proposals.

Legislative changes and Ministerial rules will be developed in consultation with catchment management authorities, water corporations and other relevant stakeholders. The rules will be developed by 1 July 2010 and as far as practical, will be applied to the use of environmental water across Victoria in advance of the establishment of the VEWH.

Table 7.3 Responsibilities in management of Victoria's rivers, wetlands and floodplains

Area of Responsibility	Organisaiton		
	Catchment management authorities (CMAs) and Melbourne Water	Department of Sustainability & Environment (DSE)	Victorian Environmental Water Holder (VEWH)
Policy / objectives	• Understand ecology and values of sites • Propose environmental objectives and undertake community engagement through regional river health strategies (RRHS)* – to be endorsed by Minister for Environment and Minister for Water	• Develop river and wetland management policy through Victorian Strategy for Healthy Rivers, Estuaries and Wetlands (VSHREW) – to be approved by Minister for Environment and Minister for Water • Develop water resource policy through sustainable water strategies (SWS) – to be approved by Minister for Water • Advise ministers of consistency of RRHS and VEWH watering plan with state policy • Develop rules to govern VEWH decisions – to be approved by Minister for Environment	
Environmental water / structural works	• Develop environmental flow studies to identify watering requirements to meet agreed objectives of sites • Input to SWS on preferred environmental watering regime for priority sites • Identify opportunities for, prioritise local investment in, build and maintain structural works to use environmental water efficiently • Develop and publish annual watering proposals (including any structural works) consistent with RRHS, for consideration by VEWH • Negotiate system operation changes or use of consumptive water en route • Call out and deliver environmental allocations in accordance with VEWH optimised watering plan	• Set standards for and fund environmental flow studies and develop the policy framework • Understand the extent that watering requirements are met by existing arrangements and identify investment priorities for water recovery through SWS • Identify investment priorities for structural works in line with VSHREW • Allocate funding to VEWH • Advise VEWH on consistency of CMA annual watering proposals with state policy and RRHS	• Hold and manage environmental entitlements and allocations • Following consideration of CMA annual watering proposals, develop and publish an optimised annual watering plan for best use of environmental allocations annually (including distribution to sites, carryover and trade) • Fund the delivery, monitoring and management associated with its environmental water • Ensure coordinated use of CEWH and Living Murray Initiative allocations
Complementary restoration measures	• Prioritise local investment in, undertake and maintain complementary measures and ensure integration with watering	• Identify investment priorities for complementary restoration measures in line with VSHREW#	
Monitoring and reporting	• Undertake monitoring programs • Report to Minister for Environment on the benefits provided by the river and wetland activities undertaken • Provide information to the VEWH on the delivery of environmental water, including volumes, variations from the approved plan, outcomes and costs	• Allocate investment in monitoring • Report to Minister for Environment and Minister for Water	• Report to Minister for Environment on implementation of the integrated watering plan, including rationale for variations from CMA watering plans

Notes:
* In their next review, these will be renamed regional strategies for healthy rivers and wetlands (RSHRW).
# In line with the Victorian River Health Strategy prior to the release of VSHREW.

Structural works to deliver environmental water

In some instances, structural works, such as pumps and regulators, can be used to deliver environmental water and achieve environmental outcomes with much less water. This is particularly true for wetland and floodplain anabranches, which have become disconnected from the main river channels or where overbank flow frequency is inadequate to meet environmental flow objectives. Structural works offer a pragmatic supplement to overbank floods and could be a more effective alternative than purchasing water to meet environmental flow objectives, particularly if water availability is reduced as a result of climate change.

"The use of structural works to deliver environmental water becomes increasingly important under the more severe climate change scenarios and experience with The Living Murray program shows how effective they can be."

– Draft Strategy submission DS161

Case study – structural works for Lindsay Island

Lindsay Island is a high-value floodplain ecosystem on the River Murray, just east of the South Australian border. Chapter 2 illustrated that climate change could reduce the area of river red gum forest by 72 per cent, and the area of blackbox and lignum by 85 per cent (see page 32).

A program of structural works has been developed that would allow environmental water to be delivered to 5,000 ha or 30 per cent of Lindsay Island. The $43 million works will reduce the amount of environmental water required to flood these areas from 1,000 GL to 92 GL per watering event. The water already recovered under the First Step of the Living Murray Initiative would be sufficient to meet a 92 GL requirement. Works would be effective even with reduced river flows as a result of climate change. The works have been developed as part of the Living Murray program, however there is currently insufficient program funding to construct the works.

There is no doubt that with increasing water scarcity, structural works will be an important solution for flooding high-value floodplains and wetlands. However, while they are pragmatic when there is insufficient environmental water, potentially negative impacts need to be considered. For example, while structures provide a means to water isolated sites, they often result in a disconnection between the river and the floodplain and may act as a barrier to fish movement and migration. This reduces the ability of plant and animal populations to disperse and recolonise, and often requires the costly construction of fishways to minimise their impact and enable fish passage. Structures that disconnect a river from its floodplain also reduce carbon and nutrient exchanges with the river, which are important to maintain ecological function. As such, the decision to use structural works requires careful consideration and planning. Construction, operation and maintenance costs need to be taken into account, and the environmental benefits and potential impacts need to be evaluated.

In some instances, it may be necessary to upgrade existing water infrastructure to ensure that it is capable of delivering the environmental water required. This is particularly true for some regulating structures such as dams and weirs, which may not be capable of releasing larger quantities of water required for environmental flows. For example, a study across the Goulburn Murray Irrigation District has indicated that the outlets on the Campaspe's Lake Eppalock would need to be upgraded to be able to deliver bankfull flows.

In identifying opportunities for structural works and infrastructure upgrades to facilitate environmental watering, each option will be assessed on its potential benefits (particularly in reducing the amount of environmental water required), feasibility and cost effectiveness.

Action 7.3: Structural works and infrastructure upgrades

Who: Department of Sustainability and Environment **Timeframe:** 2010

Priority structural works and infrastructure upgrades will be developed into a prospectus for investment to complement the Strategy's water recovery targets (see pages 133 and 135). This prospectus will be put forward to guide investment by the Commonwealth Government (see page 45) and as part of NVIRP (see page 118).

Carryover of environmental water

Flexible carryover will help to ensure a minimum supply in drought years, provide baseflows in river systems and top-up watering of wetlands for drought refuge. The introduction of SWAs reduces the risk of entitlement-holders losing their carryover in full allocation years (see page 100). It also allows water to be built up over a number of years, provided the storage does not spill. This is particularly useful for the environmental manager, who can selectively deliver high flows or floods that are not required every year.

To demonstrate this, meeting the Goulburn River water recovery target would allow the lower Goulburn River to be flooded for up to three months every three years. Modelling has shown that with current carryover rules, about 20 per cent of the three-month events are successfully completed. With the SWA, this is increased to at least 40 per cent. More liberal rules which would enable the SWA to be accessed earlier in the year, say around August, would increase this to about 60 per cent. Further detail of this analysis can be found in Background Report 7. The SWA implementation committee will assess the most appropriate spill rules. Rules that allow access as early as possible will maximise environmental benefits, but further assessment is needed to ensure this does not have unacceptable impacts on reliability.

Reuse of environmental return flows

Chapter 4 outlined new policy to allow entitlement-holders to retain ownership of their return flows and reuse them downstream (see page 84); this is particularly important for the environmental manager. When using structural works (see page 139), it takes 165 GL of water to flood Gunbower Forest for one month. But only about 16 GL of this is retained on-site; the remaining 144 GL of water flows back to river. The new policy allows environmental managers to reuse these return flows for floods and other environmental watering downstream. This significantly reduces the amount of water recovery required to meet environmental objectives.

Water quality considerations associated with environmental return flows are discussed on page 144.

Using consumptive water en route

An innovative way to achieve environmental or social benefits without requiring additional water is to make use of consumptive water – on its way to being delivered to water users.

There are many opportunities for this type of multi-benefit use of water. Natural water carriers such as rivers, creeks and wetlands are sometimes used to deliver consumptive water from storages to water users, with significant environmental benefits. Environmental water, for example, can be used to 'piggyback' irrigation flows to provide river red gum watering. There are also opportunities to deliver consumptive water directly through floodplain runners and even using environmental assets such as mid-river storages (for example, the Kerang Lakes), provided this takes into account the needs of both the environment and users.

Consistent with the guiding principle of the Strategy to seek multiple benefits (see page 5), system operators and environmental managers should seek opportunities to use consumptive water en route to meet ecological objectives and broader public benefits, provided that this is not detrimental to water users. It may also be possible to provide social benefits (for example, for cultural needs or recreational opportunities such as boating) without impacting on water users. These opportunities have become most apparent during the water scarcity of recent years, but they should be actively sought by water managers even during times of normal water availability.

The use of consumptive water en route reduces the amount of additional environmental water required to meet specified objectives (see page 133). In some cases, changes to system operations to provide environmental benefits may result in additional requirements for system operating water (previously known as 'system losses' – see page 72). In these instances and where the environmental manager agrees, it is appropriate that water from the EWR is used to cover these additional requirements.

Case study: Providing flows in lower Broken Creek

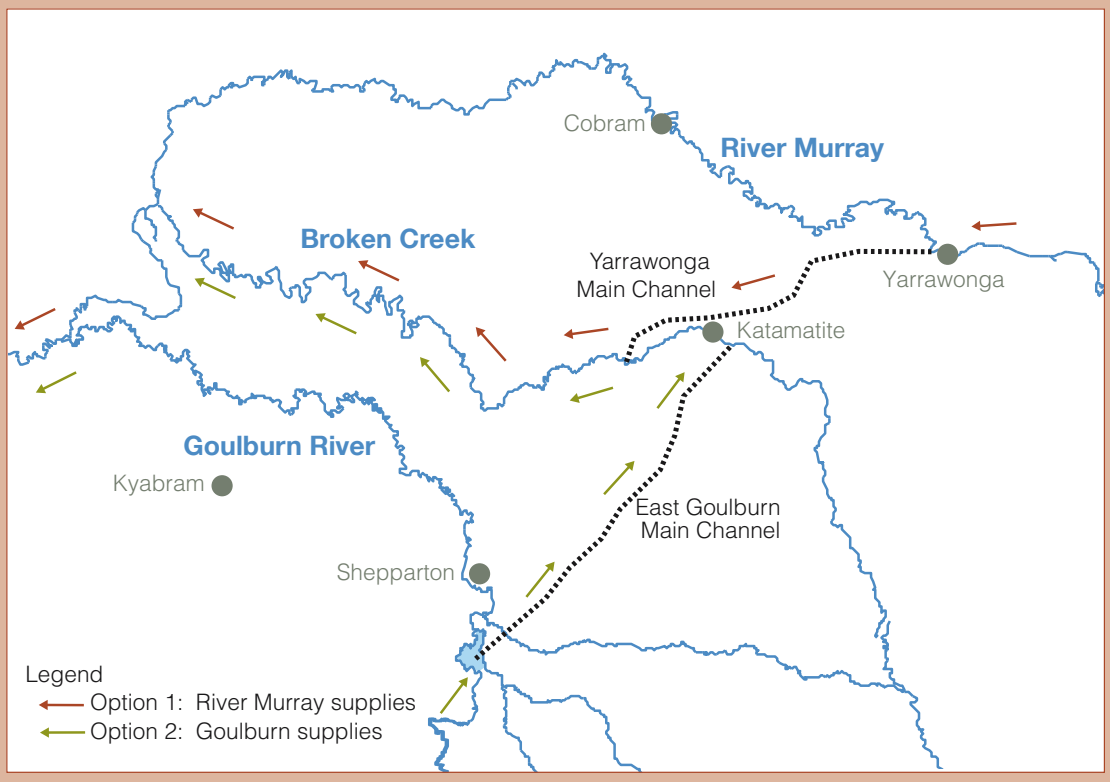
The Broken Creek breaks from the Broken River near Benalla and flows into the River Murray downstream of Barmah. The lower Broken Creek is used to deliver irrigation supplies, resulting in a changed flow pattern. Low winter flows and high nutrient concentrations are thought to result in the large accumulation of azolla (a native fern), which can lead to low oxygen levels and fish deaths.

An additional 25 GL a year of environmental flows are required to protect the in-stream environment if the historic climate continues, or maintain the drought refuges under climate change (see page 133). Instead of recovering this water through investment in water savings or purchase, it is possible to provide a large proportion of it using consumptive water en route (see Figure 7.4).

Option 1: River Murray supplies could be diverted via the Yarrawonga Main Channel, through the Murray Valley Irrigation District and down the Broken Creek before returning to the River Murray. The merits of increasing channel and outfall capacities to facilitate this could be assessed as part of NVIRP (see page 114). If feasible and cost effective, this could reduce the water recovery target for the Broken Creek from 25 GL to 8 GL.

Option 2: Water from the Goulburn system could be diverted down the Broken Creek for delivery down the Murray. Further work is needed to determine the additional losses that would need to be covered by the environmental manager and how much of the 25 GL water recovery target could be addressed by this option.

Figure 7.4 Using consumptive water en route for the Broken Creek



No formal process exists to ensure that opportunities for multi-use benefits are actively sought. Current arrangements rely on the initiative and collaboration of system operators and environmental managers. A key challenge is to develop a process that provides additional certainty to environmental managers without hindering the flexibility of system operators to adapt to changing conditions. Given the clear benefits, it is reasonable to expect that opportunities to use all water en route will be implemented, unless there is a material impact on the system operator or existing entitlement-holders.

The use of consumptive water en route for environmental and social benefit will occasionally incur additional costs. To date, these have been minor and the system operator has decided to waive them. It is expected this would continue to be the case.

Policy 7.1: Using consumptive water en route

The following principles will apply to the delivery of water for multiple benefits:

a) Where possible all water will be managed in a manner that protects or enhances ecological values and provides broader community benefit.

b) System operators, catchment management authorities and other interested parties will seek opportunities to use water en route to meet ecological or social objectives, provided there is no material impact on existing entitlement-holders or any other third party impact.

c) Where there are additional defined losses and the environmental manager agrees, these will be covered by the EWR.

Action 7.4: Using consumptive water en route

Who: Department of Sustainability and Environment; catchment management authorities; rural water corporations

Timeframe: 2011

Guidelines will be prepared to formalise the use of water en route for environmental and social benefits. These will aim to provide certainty for the environmental manager, while ensuring flexibility for the system operator. They will encourage new opportunities for en route uses to be actively sought. Operating arrangements will be formalised through existing planning processes, such as the environmental programs in bulk entitlements.

7.2 Complementary restoration measures

Environmental flows are not the only factor in a healthy river, wetland or floodplain. Equally important are complementary restoration measures that protect other aspects, including water quality, riparian land and in-stream habitat. It is important that complementary measures and environmental watering are integrated and targeted to achieve the best possible environmental outcomes.

Complementary measures can include:

- revegetation of waterways to provide habitat and prevent erosion
- streamside fencing to protect habitat from livestock damage and allow regeneration
- provision of fish passage to allow breeding and recolonisation
- better management of river banks to maintain and improve water quality.

While not a substitute for adequate environmental flows in stressed systems, complementary measures can help to ensure that, where they are provided, environmental flows achieve the maximum environmental benefit possible. For example, there is little point in providing environmental flows in a river reach where there is significant habitat damage due to a lack of fencing.

Complementary works and measures are a particularly important focus in unregulated river systems where there is little scope to provide additional environmental flows. Unregulated systems account for about 26,000 km or 90 per cent of stream length in Victoria.

River health activities in each catchment are currently directed by the *Victorian River Health Strategy* and various regional river health strategies. These set long-term objectives, and priorities for investment in environmental flows and complementary measures. In recognition of the importance of complementary measures, the Victorian Government has invested $172 million since the launch of the *Victorian River Health Strategy* in 2002 as part of an integrated program to improve the health of Victoria's rivers and wetlands.

This includes $38 million for large-scale river restoration projects in Victoria, contributing to:

- 800-1,000 km/year of work on the riparian zone including fencing, revegetation and weed control
- 60-80 km/year of instream habitat rehabilitation (for example, fishways and reinstatement of logs)
- 40-60 km/year of stream erosion control.

In 2008, the State Government committed a further $46 million over four years towards these large-scale river restoration works.

7.2.1 Managing water quality

The major risks to water quality are described in Chapter 2. Arrangements to address these vary depending on who can most effectively mitigate the risks or who will be most impacted. For example, irrigation activities are a significant contributor to salinity and improvements to salinity management are therefore discussed in Chapter 6. This section outlines the water quality considerations predominantly relevant to environmental managers.

Flows can be used to 'flush' a river system to manage pollution events. For example, in the Goulburn system, a 30 GL water quality contingency reserve exists to manage severe events such as blue-green algal blooms, provided conditions in the Goulburn Bulk Entitlement are met. In some instances, water being delivered to entitlement-holders could be redirected to improve water quality in an alternative route (see page 140). Where possible and provided it does not impact on entitlement-holders (for example, through increased system operating water requirements), this approach should be adopted, as it does not reduce the amount of water available for consumptive use or for the environmental manager.

If this is not possible, entitlement-holders have the discretion to use water from their own entitlements. For example, an environmental manager might use water from the EWR if there was a risk of fish deaths. An urban water corporation might use some water from their bulk entitlement if water quality was unsuitable for drinking. The Minister for Water has the power to qualify rights (see page 11) to manage a water quality problem if required, although this is intended to be a last resort.

Policy 7.2: Managing water quality

The following principles will apply when using water to manage water quality issues:

a) The system operator will manage water quality as much as possible using water en route provided this does not reduce the amount of water provided to entitlement-holders. The system operator is obliged to work with interested parties (for example, the environmental manager or recreational interest groups) to investigate options to manage water quality in this way.

b) Individual entitlement-holders (including water corporations or the environmental manager) have the discretion to use water from their own entitlement to improve water quality to a 'fit for purpose' standard.

c) The Minister for Water may qualify rights (as a last resort) to provide water to manage quality, in line with the *Water Act 1989*.

Water quality risks of environmental return flows

Floods are essential to the ecological functioning of rivers and wetlands, and the return flows from environmental watering events contribute valuable energy sources to the channel ecosystem; these energy sources are particularly important for native fish populations. While these benefits are critical, it was also highlighted in the Draft Strategy that in some cases, environmental return flows may cause water quality issues. The potential risks can include increased salinity, increased nutrients, blackwater events and acid sulphate conditions. There are currently no water quality standards applicable to environmental return flows.

Further analysis has now been completed which indicates that the volume of return flows from environmental entitlements will generally be small compared to return flows from the remaining natural floods. As such, they are within the bounds of what occurs under existing conditions. Where there are water quality implications, they can be adequately managed by existing water quality processes and environmental watering programs.

Salinity impacts should be managed under the BSMS (see page 123). The impact of natural events such as floods and bushfires on drinking water supplies are managed through water corporation's water quality contingency plans. With natural events, there is generally sufficient warning time for water corporations to activate these plans. The potential impacts of return flows from environmental watering events should also be managed by these plans, provided the potential risks are identified by the environmental manager and there is good communication between the parties concerned.

Existing environmental water delivery programs analyse the potential for negative impacts of watering including salt deposits, saline or acidic wetlands and black water events. A program is then developed to minimise the identified risks where possible, and floodplain monitoring during the watering focuses on these risks. Environmental watering programs are collaborative in nature and are dependent on a close working relationship between environmental managers, land managers and water corporations. Environmental managers will continue to ensure good communication with affected parties and their obligations will be formalised through the principles in Policy 7.3.

In the longer term, water quality risks could be managed by reinstating a more natural flooding regime to improve the health of floodplains and wetlands, reducing the occurrence of conditions that favour poor water quality.

Managing impacts of acid sulphate soils

The Murray-Darling Basin Authority is conducting a Basin-wide assessment of the risks posed by acid sulphate soils, to be completed in 2010. This project was initiated because of the emergence of acidity problems caused by acid sulphate soils in some wetlands in the lower Murray area, which dried out during the drought. The project will assess the extent of acid sulphate soils and the associated risks to priority wetlands in the River Murray system, Ramsar wetlands and other key environmental sites in the Murray-Darling Basin. The project will also identify and assess options to manage risks and mitigate impacts, however, options are likely to be limited. Once sites with acid sulphate soils have been identified and the risk of acidification quantified, this information will be incorporated into future river and wetland management decisions.

Desktop assessments have already been completed to prioritise the agreed list of wetlands for further assessment. The next steps include:

- rapid assessments with field sampling of soil and water to measure pH, salinity and sulphate concentrations
- detailed assessments with additional field sampling of soil and salt crusts and preliminary laboratory tests to identify the presence of acid sulphate soils
- additional laboratory tests to assess the nature and severity of environmental risks where required.

Rapid assessments will be carried out at more than 400 sites in Victoria – over half the assessments had been completed by April 2009. Field sampling for detailed assessments has been carried out at all Ramsar sites and initial analysis has been completed. Further tests and interpretation of results are currently underway.

Policy 7.3: Water quality risks of environmental watering

The following principles will apply in making decisions about environmental watering:

a) Environmental managers will continue to identify water quality risks associated with environmental watering.

b) Environmental managers will identify risks to downstream drinking water supplies, determine mitigating actions where required and communicate these risks and actions to affected water corporations (or other parties as relevant, including domestic and stock users).

c) Environmental managers will identify salinity impacts of environmental watering and manage these through Basin Salinity Management Strategy processes.

7.2.2 Protecting riparian land

Riparian land is defined as the area of land that adjoins, regularly influences or is influenced by a river. Riparian land with intact vegetation is vitally important to the health of a waterway because it provides:

- organic matter to a river, a major food source for aquatic fauna
- a supply of woody debris within the river, which forms key habitat areas for many fish and invertebrates
- a source of shade in upland areas which influences water temperature and light penetration producing suitable conditions for aquatic flora and fauna
- assistance in bank stabilisation, reducing erosion in many areas
- a buffer between the catchment and the river so it can filter nutrients and sediment
- a wildlife corridor to link habitats, especially in cleared catchments.

The *Victorian River Health Strategy* set the overall direction for the management of all riparian land and established a process for setting objectives, priorities and targets for restoration and protection. It also established catchment management authorities as the caretakers of riparian land and set direction for specific issues such as weed management.

A key impact on river health is stock watering at the river, which is allowed under Section 8 of the *Water Act 1989* without a licence or charges (see page 56). The removal of stock from the river (through fencing) may require a land-holder to find alternative watering points, especially if stock access to the waterway was the primary method of watering. In most instances, the loss of watering capacities under Section 8 acts as a deterrent for land-holders to fence and revegetate the riparian zones.

7.2.3 Safeguarding in-stream habitat

Plant and animal populations that live in rivers are affected by the physical in-stream habitat including:

- the presence of pools, riffles, cobbles and sand
- channel shape
- presence of woody debris and riparian vegetation
- connectivity and the ability for animals, organic material and sediments to move along the river and into floodplains and wetlands.

Safeguarding in-stream habitat requires decisions on how much investment should be put into preventing bed and bank erosion, restoring in-stream habitat and connectivity and the management of fish resources. This includes investment in fishways, management of non-indigenous fish, stocking and fishing. See the *Victorian River Health Strategy* and regional river health strategies for more information about safeguarding in-stream habitat (see www.ourwater.vic.gov.au/environment/rivers).

Stock watering in river Photographer: DSE

Action 7.5: Crown frontage management

Who: Rural water corporations; catchment management authorities; Department of Sustainability and Environment **Timeframe:** 2011

Programs will continue to be identified and implemented for land-holders who wish to improve land management practices and fence off riparian zones, including providing access to water for stock. The provision of water for stock will be implemented in line with the 'Policies for Managing Take and Use Licences'.

7.3 Adaptive and integrated management

Environmental objectives will not be achieved in the short term, nor is there a single solution. Figure 7.5 outlines Victoria's adaptive and integrated management approach to environmental management.

Adaptive management involves learning from management actions and using that learning to improve the next stage of management[57]. It is an iterative process that requires ongoing re-evaluation. Not only does this allow the community to reassess their values and adjust at an acceptable rate, it also allows environmental managers to make more informed decisions about what is required.

Integrated management focuses on achieving environmental outcomes through an appropriate mix of environmental water, structural works to deliver water and complementary (non-flow related) measures. Each of these aspects is discussed in the previous sections.

The following sections outline how this approach will be refined by:

- adapting watering decisions to prevailing climate conditions in any year
- improving ongoing monitoring and evaluation and using this to inform policy development
- identifying a clear and transparent process to change environmental objectives if current objectives are no longer feasible under climate change.

7.3.1 The 'seasonally adaptive' approach

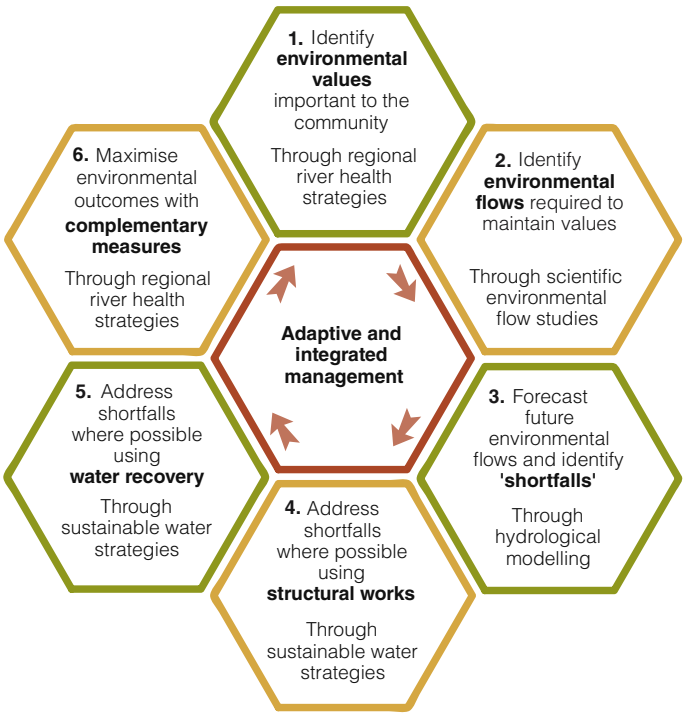
River and wetland management decisions are based on recent climate history, climate outlook and available environmental water. This Strategy outlines an approach to guide these decisions – the 'seasonally adaptive' approach (see Table 7.4). In any given year, the approach identifies the priorities for environmental watering, works and complementary measures, depending on the amount of water available. It is a flexible way to deal with short-term climatic variability.

In drought years the focus is to avoid catastrophic events, such as major fish kills, and protect drought refugia where plants and animals can survive and begin recolonisation of other areas when conditions improve. At the other end of the spectrum, in wet years the focus is to provide high flows and floods to restore values that were not maintained in drier periods, such as bird breeding events.

Complementary measures, such as additional fencing to keep out stock, may be used in drought years to protect refugia. It may also be possible to transfer animal populations to areas that can sustain them (this is known as 'translocation'). In very wet years, the focus may be on revegetation when newly-established plants will naturally receive plenty of water.

The seasonally adaptive approach is similar to the way urban water corporations change their levels of service during droughts by introducing restrictions. It helps to guide annual priorities and manage droughts, but ultimately additional water recovery may be required if water scarcity continues due to climate change (similar to supply augmentations for towns and cities).

Figure 7.5 Victoria's adaptive management approach to improving environmental values



Action 7.6: The seasonally adaptive approach to river and wetland management

Who: Department of Sustainability and Environment; catchment management authorities

Timeframe: 2012

The seasonally adaptive approach will be incorporated into the Victorian Strategy for Healthy Rivers, Estuaries and Wetlands and the next review of regional river health strategies to guide annual planning and investment at a regional scale.

Table 7.4 The 'seasonally adaptive' approach to river and wetland management

	Drought	Dry	Average	Wet to very wet
Long-term ecological objectives	Long-term objectives to move towards ecologically healthy rivers - set through regional river health strategies and sustainable water strategies and reviewed through the 15-year resource review			
Short-term ecological objectives	• Priority sites have avoided irreversible losses and have capacity for recovery	• Priority river reaches and wetlands have maintained their basic functions	• The ecological health of priority river reaches and wetlands has been maintained or improved	• The health and resilience of priority river reaches and wetlands has been improved
Annual management objectives	• Avoid critical loss • Maintain key refuges • Avoid catastrophic events	• Maintain river functioning with reduced reproductive capacity • Maintain key functions of high priority wetlands • Manage within dry-spell tolerances	• Improve ecological health and resilience	• Maximise recruitment opportunities for key river and wetland species • Minimise impacts of flooding on human communities • Restore key floodplain linkages
Environmental water reserve	• Water critical refuges • Undertake emergency watering to avoid catastrophic events • Provide carryover (for critical environmental needs the following year) • If necessary, use the market to sell or purchase water	• In priority river reaches provide summer and winter baseflows • Water high priority wetlands • Provide river flushes where required to break critical dry spells • Provide carryover (for critical environmental needs the following year) • If necessary, use the market to sell or purchase water	• Provide all aspects of the flow regime • Provide sufficient flows to promote breeding and recovery • Provide carryover to accrue water for large watering events • If necessary, use the market to sell or purchase water	• Provide overbank flows • Provide flows needed to promote breeding and recovery • If necessary, use the market to sell or purchase water
River and wetland catchment activities	• Protect refuges (including stock exclusion) • Increase awareness of the importance of refuges • Enhanced monitoring of high risk areas and contingency plans in place • Investigate feasibility of translocations • Environmental emergency management plans in place • Protect high priority river reaches and wetlands through fencing; pest, plant and animal management; and water quality improvement works • Implement post-bushfire river recovery plans	• Protect refuges • Protect high priority river reaches and wetlands through fencing, revegetation, pest plant and animal management, water quality improvement and in-stream habitat works • Environmental emergency management plans in place • Improve connectivity • Implement post-bushfire river recovery plans	• Protect and restore high priority river reaches and wetlands through fencing, revegetation, pest plant and animal management, water quality improvement and in-stream habitat works • Monitor and survey river and wetland condition • Improve connectivity between rivers and floodplain wetlands	• Protect and restore high priority river reaches and wetlands through fencing, revegetation, pest plant and animal management, water quality improvement and in-stream habitat works • Monitor and survey river and wetland condition • Improve connectivity between rivers and floodplain wetlands • Emergency flood management plans in place • Implementation of post-flood river restoration programs

7.3.2 Ongoing monitoring and evaluation

In the longer term, river and wetland management needs to constantly adapt as we continue to learn. Adaptive management in light of new and emerging information will increase environmental outcomes. The Strategy identifies a range of actions to enhance the condition of the region's rivers, wetlands and floodplains. The effectiveness of these actions will need to be monitored and future actions improved in light of this information.

For example, the water recovery targets in Table 7.2 are based on a range of assumptions, including how existing recovery projects will be implemented, and when and where this water will be used. These assumptions may or may not be validated and this could result in the need for *more* or *less* water recovery. The benefits from meeting these targets are also highly dependent on climate conditions. It is important to note that, if the most severe climate change scenario prevails, managing rivers at drought flow levels (Category 1 to 2) is not a viable solution. The recovery and use of environmental water must be informed by ongoing monitoring of climate conditions and river health.

In 2008/09, the State Government committed $1.6 million over four years to the Victorian Environmental Flow Monitoring and Assessment Program (VEFMAP). This will co-ordinate the monitoring of ecosystem responses to environmental flows in eight high-priority regulated rivers, including the Goulburn, Broken, Campaspe and Loddon systems. The result will be state-wide data to inform future management of environmental flows.

7.3.3 Adaptive management over the next 10 years

There are a number of clear milestones for adaptive management over the next 10 years (see Figure 7.6). Chapter 10 outlines the process to implement and review the Strategy. The next review is expected to be complete by 2019 before the Commonwealth Government's Basin Plan is implemented in Victoria.

A review before 2019 would also provide input to the first '15-year review'. This is Victoria's statutory long-term review of water resources under the *Water Act 1989* (see page 11). It provides an opportunity for the community to decide if it accepts the environmental impact of current water use and the appropriate action to be taken in response to climate change. This could include further increases to the EWR and/or a formal review of environmental objectives (see following section).

The 15-year review could well be the vehicle that Victoria uses to ensure compliance with the Commonwealth Government's new limits on diversions developed through the Basin Plan. Implementation of the Commonwealth's $3.1 billion water purchase will help to ensure compliance with the new limits, but additional water recovery may also be necessary (see page 42). Preferably this would be done through the implementation of further water savings projects but, depending on the severity of the new limits, it may be necessary to resize and/or purchase additional entitlements.

It is important to note that this review is not the only solution for environmental issues. In fact, while it provides an important opportunity to take action if required, this is not the preferred avenue. A number of steps will be taken over the next 10 years to continue to improve environmental condition (see Figure 7.6). Ideally these would be sufficient with little or no action required through the 15-year review.

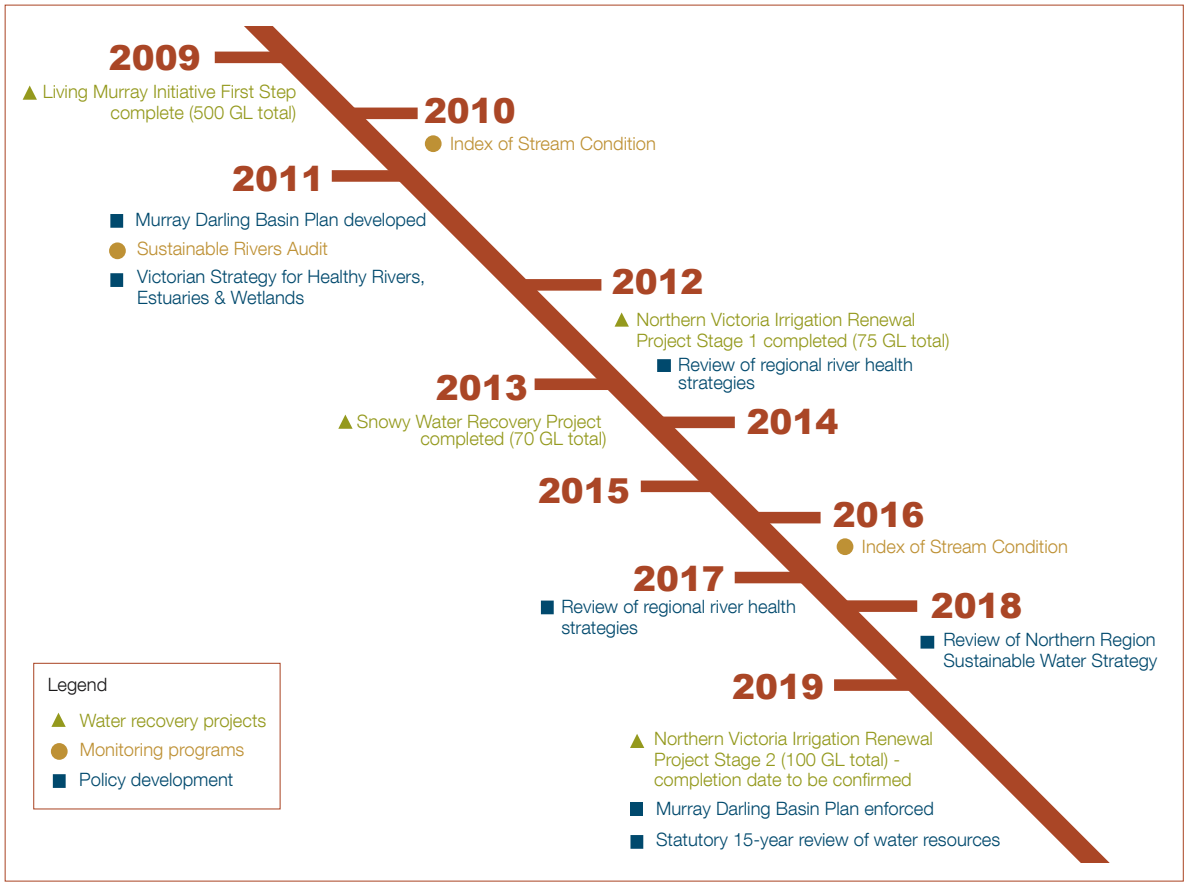
As a start, environmental water will become available from water recovery projects that are already underway. This includes 500 GL Basin-wide from the Living Murray Initiative (plus $275 million investment in structural works), 70 GL from the Snowy Water Recovery Project and up to 175 GL from Stage 1 and 2 the Northern Victoria Irrigation Renewal Project.

The benefits of river and wetland activities, including environmental watering, will be confirmed through ongoing ecological monitoring programs. These programs will improve future management decisions. Longer-term assessments include Victoria's Index of Stream Condition and Murray-Darling Basin Authority's Sustainable Rivers Audit. These will be supplemented with annual monitoring and the coordination of environmental flows data through VEFMAP (see page 148).

All of this information, together with updated climate forecasts, will inform the review of key policy documents. The existing Victorian River Health Strategy will be replaced with the first integrated Victorian Strategy for Healthy Rivers, Estuaries and Wetlands. This will guide the next two reviews of regional river health strategies*, when catchment management authorities engage local communities, including Traditional Owner groups, to determine the environmental assets they value the most. The first reviews of regional river health strategies will incorporate the seasonally adaptive approach (see page 146), identify key drought refugia and include recent lessons about managing environmental flows through drought. Among other things, the second such reviews will prepare for the 15-year review.

Importantly, these will input to the next review of the Northern Region Sustainable Water Strategy, which will again identify ways to improve environmental outcomes, including increases to the EWR if necessary.

Figure 7.6 Key milestones in adaptive environmental management (indicative timing only)



Footnote:
* In their next review, these will be renamed regional strategies for healthy rivers and wetlands (RSHRW).

7.3.4 Process for reviewing environmental objectives

Through the development of this Strategy, the potential severity of climate change impacts has become clear – for the environment, households, urban industry, irrigators and the communities that depend on them. Chapter 9 discusses these broader community adjustment issues. As far as the environment is concerned, the following problem has become most apparent:

> *With climate change, there could be insufficient water to meet current environmental objectives – even if all the available water in a system is provided to the environment.*

In each of the systems where analysis has been possible, the Ovens, Goulburn, Campaspe and Loddon, it is impossible to meet the full scientific recommendations (a Category 6 outcome) under the most severe climate scenario. For example, environmental water in the Loddon system could be reduced from long-term average availability of 109 GL to 17 GL a year under the most severe climate scenario (see page 24). With only 34 GL available for consumptive use under this scenario, it is impossible to compensate for the environmental reduction of 92 GL, even if the community were willing to give up all their water.

If it becomes apparent that current objectives cannot be met due to climate change, there needs to be a clear, reasoned and transparent process to change them. This must be linked to a broader review of water resource management, such as the 15-year review. Where changes are proposed to ecological objectives, the goal could still be a healthy working river but the reference point for this may change (for example, from a healthy perennial river to a healthy ephemeral river). It could entail a formal acceptance of permanent and irreversible loss of environmental assets in some areas. As such, it is important that environmental objectives are not changed prematurely.

Further work and consultation will be done as part of the Victorian Strategy for Healthy Rivers, Estuaries and Wetlands to assess the benefits of changing objectives through regional river health strategies, rather than the 15-year review.

It may also be necessary to change the environmental management objectives and watering plans of the Living Murray 'icon sites'. Similarly to Victoria's management objectives, a clear process should be identified to ensure these decisions are made when there is information to show it is warranted.

Action 7.7: Changing environmental management objectives

Who: Catchment management authorities; Department of Sustainability and Environment

Timeframe: 2019

Should it become apparent that environmental objectives can no longer be feasibly met as a result of a long-term or permanent reduction in water availability, amendment of these objectives will be formally considered as part of the statutory 15-year review of water resources.

Regional river health strategies will be reviewed by catchment management authorities in 2011/12 and 2017/18. These will be used to consult with regional communities, including Traditional Owners, on river, wetland and floodplain values in preparation for the 15-year review and potential changes to environmental objectives.