



Australian Government
Productivity Commission

Environmental
management

Supporting Paper C

National Water Reform 2020
Draft Report

February 2021

GUIDE TO THE SUPPORTING PAPERS (AND DESCRIPTOR)

SP A Water entitlements and planning (*Entitlements and planning*)

SP B Water trading and markets (*Trading*)

SP C Environmental management (*Environment*)

SP D Securing Aboriginal and Torres Strait Islander people's interests in water (*Cultural access*)

SP E Ensuring the integrity of water resource management (*Integrity*)

SP F Urban water services (*Urban*)

SP G Urban water services: regional and remote communities (*Regional*)

SP H Water reform in rural Australia (*Rural*)

SP I Government investment in major water infrastructure (*Infrastructure*)

SP J Community engagement (*Engagement*)

SP K Knowledge, capacity and capability building (*Knowledge*)

© Commonwealth of Australia 2021



Except for the Commonwealth Coat of Arms and content supplied by third parties, this copyright work is licensed under a Creative Commons Attribution 3.0 Australia licence. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/3.0/au>. In essence, you are free to copy, communicate and adapt the work, as long as you attribute the work to the Productivity Commission (but not in any way that suggests the Commission endorses you or your use) and abide by the other licence terms.

Use of the Commonwealth Coat of Arms

Terms of use for the Coat of Arms are available from the Department of the Prime Minister and Cabinet's website: www.pmc.gov.au/government/commonwealth-coat-arms

Third party copyright

Wherever a third party holds copyright in this material, the copyright remains with that party. Their permission may be required to use the material, please contact them directly.

An appropriate reference for this publication is:

Productivity Commission 2021, *Environmental management, Supporting Paper C* to National Water Reform 2020, Draft Report, Canberra.

Publications enquiries:

Media, Publications and Web, phone: (03) 9653 2244 or email: mpw@pc.gov.au

Contents

Key points	4
1 Progress and outcomes of national water reform	6
1.1 The environment is established as a legitimate water user	6
1.2 Progress under the NWI	6
1.3 Most environmental water is ‘planned’	7
1.4 Significant long-term progress in water recovery	12
1.5 Outcomes of the provision of water for the environment	13
2 Achieving agreed environmental outcomes	16
2.1 Requirements in all systems	17
2.2 Requirements in systems with additional held environmental water	28
3 Water system managers should use their best endeavours to achieve agreed outcomes	47
4 Effective monitoring, evaluation and reporting	49
4.1 Commitment to adaptive management	50
References	54

Key points

- Environmental water provision and management have delivered benefits to the environment and these have yielded direct and consequential cultural, economic and social benefits.
- In some systems environmental rehabilitation has been hampered by drought. In the Murray–Darling Basin this has been accentuated by incomplete water recoveries, and governance and compliance failures in some jurisdictions.
- Planning reforms and adaptation are required to ensure that environmental water objectives can be agreed and met given a changing climate and more extreme drying events.
- Whether environmental water is planned or held, the focus for the next phase of reform should be to ensure that environmental water is managed efficiently and effectively to deliver agreed (and where possible, better) environmental outcomes.
- In all systems (whether a simple unregulated river or a complex water system) management requirements that are important to achieve agreed outcomes include:
 - a focus on clearly specifying environmental objectives and outcomes
 - the provision of environmental water, established through planning
 - the integration of environmental water, waterway and catchment management
 - effective compliance regimes
 - clearly identifying institutional responsibility for waterway management
 - processes to adapt environmental management objectives, when necessary, in a changing climate.
- In addition, in complex, highly developed regulated systems (with held environmental water), further requirements to achieve the best outcomes from the management of environmental water entitlements include:
 - effective outcomes-based planning and priority-setting processes
 - coordinated water delivery in shared water systems
 - capacity to actively trade environmental water allocations, including between years
 - innovative market approaches
 - capacity to vary the entitlement portfolio to match ecological requirements
 - delivery of shared community benefits wherever they are compatible with achieving environmental outcomes
 - good governance, including the independence of environmental water holders and independent audit.
- Environmental management is a young discipline but is evolving rapidly. Effective risk-based monitoring, evaluation, and reporting arrangements, and a commitment to adaptive management are crucial, especially in the context of a drying and more variable climate.

In its 2017 assessment of national water reform, the Commission reported that, although ecological restoration is a long-term process, the benefits of having more water available for the environment had started to be realised. But the Commission also emphasised that to achieve the best use of water provided for the environment, a significant enhancement of policy settings was required and, associated with this, considerable effort by all governments to make the necessary changes (PC 2017, pp. 20–21, 141).

In the 17 years since the National Water Initiative (NWI) was agreed, environmental management has evolved rapidly and a disconnect between the agreement and current management practices has emerged. Embedding current best-use principles in a renewed NWI, and ensuring that environmental water managers can continue to evolve their frameworks and practices through experience and adaptation to new knowledge, would provide a stronger platform for achieving agreed outcomes.

Furthermore, in the three years since the Commission's 2017 assessment, the challenges facing environmental water managers have intensified. Severe drought and bushfires of unprecedented magnitudes have strained Australia's water management regimes in a number of areas. For example, in the Murray–Darling Basin (MDB):

An intense drought, significant upstream water extraction, an apparent climate shift and the rules in the Water Sharing Plan for the Barwon-Darling Unregulated and Alluvial Water Sources 2012 (the Plan) have all contributed to poor ecological, social and cultural outcomes. (NRC (NSW) 2019, p. 1)

It is important to now reflect on the lessons learnt during this challenging period and evaluate where environmental management policy principles, frameworks and practices have room for improvement. The recent drought conditions are a timely reminder that managing our water-dependent ecosystems requires continuous learning and adaptation. The intensifying challenge of a variable and changing climate provides further impetus for improvement of this key water management component through a renewed NWI. The provision and future management of environmental water will be critical in managing Australia's water-dependent ecosystems to enable them to deal with drought and adapt to a changing climate.

This paper builds upon the Commission's 2017 work on environmental management by providing first-principles guidance on what is required (under a renewed NWI) to achieve agreed (and, where possible, better) environmental outcomes from providing water for the environment, within the context of Australia's highly variable and changing climate and the necessity for adaptive environmental management.

This paper:

- considers the progress made by jurisdictions in environmental management of water-dependent ecosystems under the NWI (section 1)
- outlines the environmental management requirements to achieve environmental objectives and agreed outcomes (section 2)
- considers the role of the system manager in an environmental management context (section 3)
- discusses the importance of monitoring, evaluation and reporting for adaptive management (section 4).

1 Progress and outcomes of national water reform

1.1 The environment is established as a legitimate water user

From the late 1960s, recognition of the need for improved environmental management of Australia's rivers, wetlands and other aquatic ecosystems began to grow, as community concerns about environmental degradation (such as erosion, sedimentation, and generally poor river and wetland health) increased. In the 1980s, severe river salinity issues resulting from irrigation development became apparent and low flows caused a build-up of sand that closed the mouth of the River Murray for the first time in recorded history (Walker 2002). Environmental concerns again intensified in the 1990s with extensive toxic algal blooms in the Lower Darling (PC 2017, p. 142).

In response to the poor health of Australia's water-dependent ecosystems, and the resulting social and economic impacts, Australian, State and Territory Governments have undertaken a range of initiatives (both individually and collaboratively) to improve environmental conditions and the balance between environmental and consumptive uses of water. In 1994, COAG reforms sought to: establish the environment as a legitimate water user; deliver legally-recognised provisions of water for the environment; and achieve a better balance in 'overallocated systems' (that is, systems where allocation levels are deemed to exceed an environmentally sustainable level of extraction). Its successor, the NWI, continued and extended these policy directions, requiring governments to:¹

- identify the share of water for the environment in water planning
- return overallocated and overused surface water and groundwater systems to environmentally sustainable levels of extraction
- establish effective and efficient management and institutional arrangements to ensure the achievement of environmental and other public benefit outcomes.

1.2 Progress under the NWI

All jurisdictions (with the exception of Western Australia) have identified, and legally recognised, a share of water for the environment through legislation that allows for water plans or equivalent instruments. Although Western Australia provides water for the environment through water allocation plans and extraction limits, the lack of statutory backing of these arrangements makes provisions for the environment less secure.

The Commission's assessment of progress against the relevant NWI commitments is discussed in the *Assessment* (environmental water provided through water plans is also discussed in *SP A Entitlements and planning*).

¹ NWI paragraph 78.

1.3 Most environmental water is ‘planned’

Across Australia, provision of water for the environment to meet agreed environmental outcomes takes two main forms.

- *Planned environmental water* is established in water plans by placing constraints or obligations on consumptive users to leave a residual flow in a river or stream, or to limit water extraction from aquifers to protect groundwater-dependent ecosystems.
- *Held environmental water* is established through the provision of water access entitlements for specific environmental uses. Held environmental water generally has the same rights and conditions as water entitlements owned by irrigators and other consumptive users. Environmental water managers need to actively manage these entitlements. Managers establish priority uses for the entitlements in their portfolio and have considerable discretion in how, where and when they are used (PC 2017, p. 145).

The provision of water for the environment (as planned, or both planned and held) varies across jurisdictions and between systems, reflecting differences in water allocation processes and the level of system development (*Report* chapter 5, figure 1).

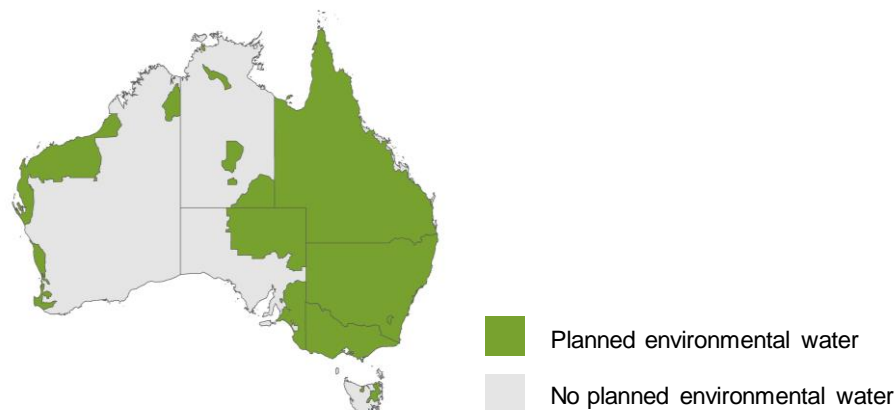
In all jurisdictions, and in most systems, planned environmental water constitutes the majority of water dedicated to achieving environmental outcomes. Water planning covers the vast majority of water use in Australia. But the coverage of water use by water plans varies by jurisdiction — from almost 100 per cent in New South Wales, Victoria, South Australia and the ACT to about 30 per cent in the Northern Territory, Tasmania and Western Australia where there is less development (table 1).

In systems covered by water planning processes, sustainable extraction is the key goal when agreeing the balance of water between environmental and consumptive uses. Under the NWI, an environmentally sustainable level of extraction is defined as the level which, if exceeded, would compromise key environmental assets or ecosystem functions and the productive base of the resource.²

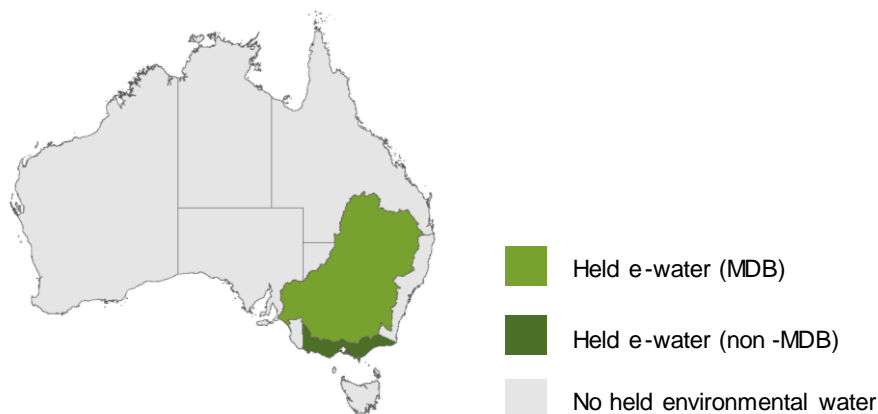
² NWI schedule B(i).

Figure 1 Environmental water areas in Australia

Systems with planned environmental water^a



Systems with held environmental water^{b,c}



^a Each state manages environmental water through different planning mechanisms. For example, Victoria has a state-wide entitlement licencing system, and New South Wales manages planned water through valley-level water sharing plans. The map illustrates the geographical coverage of state-level planning that caps consumption to protect environmental water. In some cases, water plans do not cover all water sources within a geographic area. ^b The shaded areas illustrate the ownership of held environmental water by region but do not provide a precise spatial representation of entitlements. ^c Commonwealth holdings are as at 30 November 2020, Department of Primary Industries and the Environment (NSW) holdings are as at 30 June 2017, Victorian Environmental Water Holder holdings are as at 6 May 2020, Department of Environment and Water (SA) holdings are as at 29 June 2020.

Sources: ABS (*State and Territory ASGS, July 2016, Cat. no. 1270.0.55.001*) (2016); CEWO (2020a); DENR (NT) (2020b); DEW (SA) (2020); DNRME (Qld) (2020); DPIE (NSW) (2019); DPIPWE (Tas) (2020); DWER (WA) (2020); VEWH (2020b).

Table 1 Coverage of water plans^a in Australia, as at December 2020

<i>Jurisdiction</i>	<i>Coverage (%)</i>	<i>Comment</i>
NSW	>99	Percentage of water entitlement volumes covered by water sharing plans. ^b
Vic	100	Water management is conducted through the entitlements and planning system, which covers all water sharing in the state. ^c
Qld	98	Percentage of water entitlement volumes covered by statutory plan areas. ^d Data are not comparable to 2017.
SA	100	Percentage of water extractions entitlement volumes covered by water sharing plans. ^e Data are not comparable to 2017.
WA	35	Percentage of water entitlement volumes covered by non-statutory plan areas. ^f Data are not comparable to 2017.
Tas	34	Percentage of water entitlement volumes covered by statutory plan areas. ^g
NT	28	Percentage of water entitlement volumes covered by statutory plan areas. ^h Data are not comparable to 2017.
ACT	100	Percentage of water volumes identified in legislation.

^a Estimates of water plan coverage are indicative only. Estimates are not directly comparable across all jurisdictions due to different approaches to calculating coverage. ^b The approximately 0.2 per cent of water volume that is not covered by water sharing plans includes four coastal floodplain alluvial water sources and some legacy *Water Act 1912* (NSW) licences that have not been transferred to coverage by the *Water Management Act 2000* (NSW) for various reasons. ^c Victoria allocates 6016 GL of entitlements to consumptive use of an estimated 12 072 GL of available surface water, groundwater and recycled water. Thus, all consumptive water entitlements are covered by planning arrangements. ^d Queensland has 6727 GL allocated in statutory plan areas out of a total 6853 GL allocated statewide. ^e In South Australia, 2870 GL is licensed for extraction in prescribed water resources that are managed through water allocation plans. Water extraction outside of prescribed areas is not licensed. ^f In Western Australia, 1409 GL of licensed water is covered by water allocation plans out of 3997 GL of total licensed water. In 2017, the coverage estimate was based on the count of licences within and without water allocation plans, rather than the share of licensed volumes. In 2020, 80 per cent of total licences were covered by plans, similar to the coverage in 2017. ^g DPIPW (Tas) estimated approximately 455 GL (including 19 GL groundwater) is allocated in statutory plan areas and a total of 1332 GL is allocated statewide. ^h In the Northern Territory, there are 136 GL of entitlements within plans and 489 GL entitlements in the whole of the territory.

Sources: DENR (2020a); responses to the Commission's State and Territory information requests.

Underpinning environmentally sustainable extraction are the concepts of environmental water provisions, trade-offs and ecological risk.

- Environmental water provisions are made as environmental flows (encompassing the quantity, quality and timing of water flows) and/or groundwater levels, provided to maintain or improve the condition of water-dependent ecosystems.
- Trade-offs need to be made in decisions about the sharing of water between environmental water provisions and consumptive uses and between different stakeholders and spatial locations.
- Ecological risks arise due to the potential adverse impacts on water-dependent ecosystems of using water for consumption. Water extraction reduces surface water

quantity and quality, alters the natural flows of waterways and can reduce groundwater levels. Ecological risk increases as the volume of water allocated for consumptive use increases. The timing of extractions for consumptive use can also impact the natural flow pattern of waterways and groundwater levels in wetlands.

Agreeing on a sustainable level of extraction recognises these concepts, and generally aims to provide a water regime that can maintain key environmental assets and ecosystem functions while accepting a degree of ecological risk.

While such an approach seeks to maintain these key assets and functions at an agreed level of risk, some diminution of general waterway health is implicit:

All water in our environment supports, directly or indirectly, freshwater ecosystems and biodiversity, and diversions for consumptive use inevitably diminish this. (Wentworth Group of Concerned Scientists, sub. 68, p. 2)

Table 2 summarises the water provision arrangements used to protect the environment. In the MDB and some parts of Victoria, held environmental water entitlements are included as part of the environmental water provisions and are actively managed to deliver environmental and other public benefit outcomes. Planned environmental water arrangements vary by jurisdiction and system but broadly include cease to pump rules, flow sharing arrangements, passing flow releases from water storages, environmental water allowances and groundwater access rules. Where water plans are not in place, water access is still regulated through licensing arrangements. Licences are provided after considering other consumptive demands on a particular water resource and the potential environmental impacts of the licence. However, in these areas, extraction levels (relative to the available water resources) are often low, meaning risks to the environment from extraction are also generally low (table 2). In some jurisdictions, a precautionary approach is used restricting the annual take as a share of the total resource to limit potential adverse impacts on the environment. As licences increase and systems are developed, more sophisticated planning arrangements should be introduced (*Report*: chapter 5).

Table 2 Provision of water for the environment, jurisdictional summary

Jurisdiction	Held environmental water ^a	Number of water plans ^b	Types of rules and constraints	
			Entitlement face value (GL)	Within water plans (planned environmental water)
NSW	2 523	56 water sharing plans; 20 MDB water resource plans (WRPs)	<ul style="list-style-type: none"> Daily minimum flow by catchment 'Above cap' water^c Redirected high flows 	N/A
Vic	2 001	Entitlement system ^d ; 5 WRPs	<ul style="list-style-type: none"> Obligations on consumptive entitlements 'Above cap' water 	N/A
Qld	294	23 water plan areas; 3 WRPs	<ul style="list-style-type: none"> Storage volume thresholds for release Optimising water quality when releasing 'Above cap' water 	Water access requires licences which protect environmental water
SA	253	16 water allocation plans; 3 WRPs	<ul style="list-style-type: none"> Annual consumptive allocation limits Buffer and exclusion zones for groundwater well construction 	Water access requires licenses which protect environmental water
WA	N/A	26 water allocation plans (non-statutory)	<ul style="list-style-type: none"> Monthly cease-to-take limits Abstraction rates and timing restrictions Buffer and exclusion zones for groundwater well construction 	Water licences constrain annual take
Tas	N/A	12 water management plans	<ul style="list-style-type: none"> Monthly cease-to-take limits Monthly minimum flows Groundwater well permitting 	Water access requires licences which protect environmental water
NT	N/A	6 water allocation plans in effect, 3 under development	<ul style="list-style-type: none"> Annual consumptive allocation limits Residual water protections Redirected high flows 	Water licences constrain annual take
ACT	N/A	1 water resources determination; 2 WRPs	<ul style="list-style-type: none"> Annual environmental allocation 	N/A

^a Held environmental water by jurisdiction is the combination of entitlements held by State and Commonwealth environmental water holders. ^b 'Water plans' is used as a generic term, noting that water planning arrangements vary by jurisdiction. Jurisdictions within the MDB are obliged under the Basin Plan to develop water resource plans (WRPs) that are separate from, but consistent with, state-level planning arrangements. ^c Includes water that is left over after diversion limits have been reached and unregulated flows that cannot be stored. ^d The provision of planned water for the environment is defined through Victoria's entitlement system. Ten catchment management authorities are then responsible for environmental water reserve management. Sources: CEWO (2020a); DELWP (Vic) (2020b, pp. 16, 18); DEW (SA) (2020); DPIE (NSW) (2019); Selection of water plans across jurisdictions; VEVH (2020b).

1.4 Significant long-term progress in water recovery

In some highly developed and regulated systems in New South Wales, Victoria, South Australia and Queensland (that are also, in some cases, overallocated) planned environmental water is supplemented with held environmental water.

Addressing overallocated systems requires difficult trade-offs between environmental and consumptive uses of water. During the Millennium Drought, recognising the need for urgent environmental rehabilitation, the Australian Government announced a major initiative to rebalance the share of water between the environment and consumptive use in the MDB. This resulted in the \$13 billion Basin Plan and the targeted surface water recovery of 2750 GL of water entitlements across the Basin by 2024 to meet a range of environmental outcomes with an adjustment mechanism (PC 2018).

In 2018, this target was revised down to 2075 GL³, partly due to the use of ‘supply measures’ (operating under the adjustment mechanism) aimed at delivering the same environmental outcomes with less environmental water (MDBA 2020b).⁴ These highly ambitious supply measures are not on track to be fully implemented by 2024 (MDBA 2020a; PC 2018, p. 2).⁵

Although progress on water recovery in the MDB has slowed in the last three years — with states requiring time to negotiate outcomes and water recovery mechanisms with water users — there has been significant progress over the longer-term (figure 2). The stock of held environmental water has grown significantly over the past decade, currently yielding a long-term average of 3000 GL (MDBA 2020d).⁶ The Commonwealth Environmental Water Holder (CEWH) holds entitlements that yield the majority (62 per cent) of this water (MDBA 2020b). The New South Wales and Victorian Governments also hold significant volumes of environmental water, while the South Australian Government has a relatively small amount (Victoria also holds some entitlements outside the MDB).

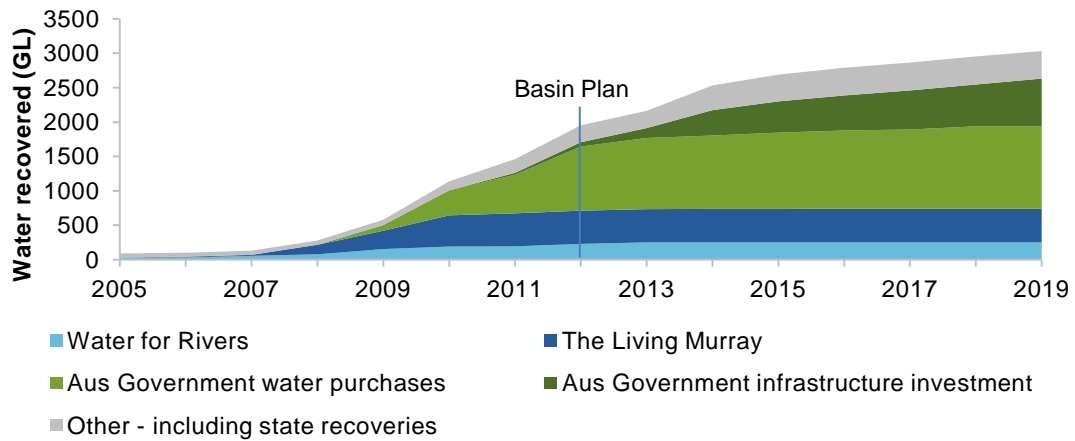
³ This recovery target includes both entitlement purchases and infrastructure measures.

⁴ The decrease in the surface water recovery target is made up of two components: 1) a review of the northern Basin target recommended reducing it from 390 GL to 320 GL (a 70 GL decline) and 2) supply contributions of 605 GL. Examples of supply contributions include pumping stations, regulators and levees to deliver water to lakes and floodplains without creating overbank flooding. Against the revised target, there has been 2098 GL contracted for recovery as of 2018-19, but these contracts are not yet fully implemented.

⁵ In addition to this target, the Commonwealth is separately seeking to deliver 450 GL of surface water entitlements to the pool of held environmental water through on- and off- farm efficiency measures by 2024.

⁶ Includes the Basin Plan, the Living Murray, Water for Rivers, and state-specific schemes.

Figure 2 **Held environmental water recovery in the Murray-Darling Basin^{a,b}**



^a Volumes recovered to 30 June 2019 in terms of long-term average annual yield. ^b State recoveries include programs such as New South Wales Riverbank and other small recoveries.

Source: MDBA (pers. comm., 30 September 2020).

1.5 Outcomes of the provision of water for the environment

Provision of water for the environment is starting to yield benefits ...

In many parts of Australia, environmental water provisions (both held and planned) have contributed to a range of positive ecological outcomes such as: improved native vegetation and wetland condition; protection of rare and threatened biodiversity such as in groundwater-dependent ecosystems; and the migration and breeding of native fish, frogs and waterbirds (CEWO 2020b; Hart and Butcher 2018, p. 2; Thurgate et al. 2019). For example, in the MDB, an average of 1905 GL per year of held environmental water was delivered between 2012-13 and 2018-19. Of this delivered water, 21 per cent was used to support ecosystems that rely on wetland and overbank flooding, mostly in the southern MDB (Chen et al. 2020, p. F-G).

The provision of water for the environment has helped to avoid environmental degradation that would have otherwise occurred through unconstrained water access (Chen et al. 2020, p. H). For example, the decline of platypus habitats has varied between jurisdictions; there was a decline of 32 per cent since 1990 in New South Wales but just 7 per cent over the same period in Victoria (Hawke, Bino and Kingsford 2020, p. 18). Some of this difference can be attributed to the provision of planned environmental water maintaining habitats and river connectivity. During the drought of recent years, sites that have received environmental water have had critical ecosystem functions protected. The provision of refuges has been particularly important in maintaining breeding grounds during drought (SCEBWC 2019). Ecosystem resilience was therefore supported until rain started to return to some parts of the country.

However, it is not simply the provision of larger volumes of water that generates improved environmental outcomes; enhanced land and river management actions are also required to deliver outcomes (Dale Chapman, sub. 5, p. 3; ADF, sub. 43, p. 1; Engineers Australia, sub. 63, p. 14). Improved monitoring, management and coordination techniques are increasing the effectiveness of environmental water provision. In particular, the delivery of watering events is increasingly integrating Aboriginal and Torres Strait Islander knowledges to improve the delivery of environmental outcomes and to achieve distinct cultural and spiritual outcomes (MDBA 2019b, 2020c).

In addition to environmental benefits, environmental water can provide other public benefits to a range of water users (box 1).

Box 1 Other public benefits of environmental water

Environmental water provision has the potential to deliver other public benefits that contribute to cultural, social and economic outcomes, in addition to those that accrue to the environment.

It can provide cultural outcomes for Aboriginal and Torres Strait Islander people. The Gayini Nimmie–Caira wetlands are an example where a consortium including the Nari Nari Tribal Council and the Nature Conservancy has successfully tendered for the management of the floodplain in southern New South Wales. The cultural significance of these wetlands and their ecological health is demonstrated by the presence of burial mounds, campsites and evidence of interventions that generations of Nari Nari have used to increase fish, bird and vegetation growth. The provision of environmental water by the New South Wales and Australian Governments has helped to support the return of wildlife to these sites, contributing to cultural outcomes for the Nari Nari people.

Recreational and commercial fishers and the tourism industry can also benefit from improved native fish breeding and the amenity of riverbank vegetation. For Murray–Darling Basin communities, the Basin Plan evaluation found there were several instances where timed releases of environmental water to support wetlands and other environmental assets induced additional tourism demand. The construction of environmental water infrastructure, such as inlet regulators, has created additional flows that support recreational activities such as kayaking and other waterborne activities.

And, although difficult to quantify, healthy rivers, lakes and wetlands provide amenity benefits — that is, pleasure derived by those who use or view them.

Sources: Hayter (2020); MDBA (2017); The Nature Conservancy (2018).

... but, the environment has been hampered by recent drought and other factors

There is also evidence that ecological conditions have declined in some waterways since 2017. In particular, in the MDB environmental rehabilitation has been hampered by drought, incomplete water recoveries, and governance and compliance failures in some jurisdictions.

- The most prominent example of environmental distress during the recent drought was fish deaths in the Lower Darling. This is discussed in more detail in section 4.1.
- The long-term decline in populations of Macquarie perch, once the most abundant native fish in the MDB, was showing signs of stabilising in late-2019 in the Snowy Mountains region (Silva et al. 2018). As the rains broke over the bushfires in early 2020, ash and mud was washed into the river system, suffocating much of the remaining population (Doyle et al. 2020).
- In other waterways, there is an increased risk of algal blooms. The drought and bushfires mean rains have generated larger runoffs taking sediments and nutrients like phosphorous into waterways that can trigger algal blooms. Algal blooms can produce toxins and reduce the oxygen content of water, affecting fish and other oxygen-dependent organisms.

Drought and prolonged dry periods place significant strain on Australia's ecosystems. To an extent, these climatic extremes are a natural feature of Australia's landscape, causing water systems to contract to a series of drought refuges and recover in wetter periods. However, the natural stresses of drought are amplified by water extraction for consumptive use and compounded by loss of habitat and poor environmental condition. In the overallocated MDB, the drier conditions of a changing climate coupled with constraints on environmental water management have meant that, even in wetter periods, the flooding of wetlands (particularly at Ramsar sites) has not met objectives (Chen et al. 2020, p. N). Continued commitment to completing agreed water recovery programs is important, particularly given the uncertainties of a changing climate.

Even though environmental water provision has achieved considerable positive outcomes in avoiding degradation in many systems, planning and management deficiencies remain, contributing to negative outcomes in some systems. In New South Wales, rules in water sharing plans have been shown to inadequately protect environmental water (*Assessment*). The efficacy of environmental watering under the Basin Plan has also been called into question (Chen et al. 2020); and remaining challenges are driven by 'a range of policy, practice and climate change impacts' (Engineers Australia, sub. 63, p. 14). A lack of commitment to compliance and enforcement is likely to also have contributed to negative environmental outcomes in these systems by allowing water take that may be unsustainable and, in some cases, illegal (SP E *Integrity*).

Moving forward, it is important to understand the extent to which recent environmental decline (in some areas) was an inevitable consequence of the severity and longevity of the recent drought (and outside the bounds of planning), a failure of water management or an indication that current environmental water provisions are inadequate.

2 Achieving agreed environmental outcomes

In general, water planning processes consider possible environmental outcomes and then the water required to meet those outcomes together with consumptive requirements. The environmental and consumptive outcomes of the plan are agreed by making trade-off decisions between these competing uses of water.

But, the provision of a water regime alone will not achieve agreed environmental outcomes. It needs to be part of an integrated river or wetland management program that includes complementary habitat and water quality management. The ultimate objective of providing water for the environment is to improve the health of environmental systems — not simply a volume of water. Whether environmental water is planned or held, the focus for the next phase of reform should be to ensure that environmental water is managed efficiently and effectively to deliver agreed (and where possible, better) environmental outcomes.

Extreme events and climate change pose significant threats and future challenges to ecological sustainability. Over the next 20 years, an expected drying climate in large parts of the country, together with more frequent extreme events, is likely to affect the provision and reliability of environmental water. There is no panacea for these threats. To achieve current agreed outcomes from environmental water (both planned and held) there is a need for consistent policy principles and fit-for-purpose management frameworks. These will enable environmental management to best respond to weather extremes and adapt to a changing climatic baseline. Even with this in place, over time (in some cases) the required response is likely to include reassessing and resetting the balance between environmental and consumptive water uses (SP A *Entitlements and planning*) and redefining agreed environmental outcomes.

The NWI has an important role to play in achieving agreed environmental outcomes by establishing the principles that can be used by all jurisdictions to guide their individual environmental management frameworks and practices. In 2017, the Commission recommended that Australian, State and Territory Governments ensure their policy frameworks provide for the efficient and effective use of environmental water. And these frameworks should also provide for community outcomes (where this does not compromise the achievement of environmental outcomes) relating to cultural values, recreation and economic benefits (PC 2017, p. 149).

Drawing on current and emerging issues, this section outlines management requirements that are critical to achieving agreed environmental outcomes, ensuring accountability and building public confidence in the use of environmental water. First, it discusses those that are important in all systems, whether environmental water is provided through planning or held entitlements. Second, additional guiding requirements for complex, highly developed systems with additional held environmental water are examined.

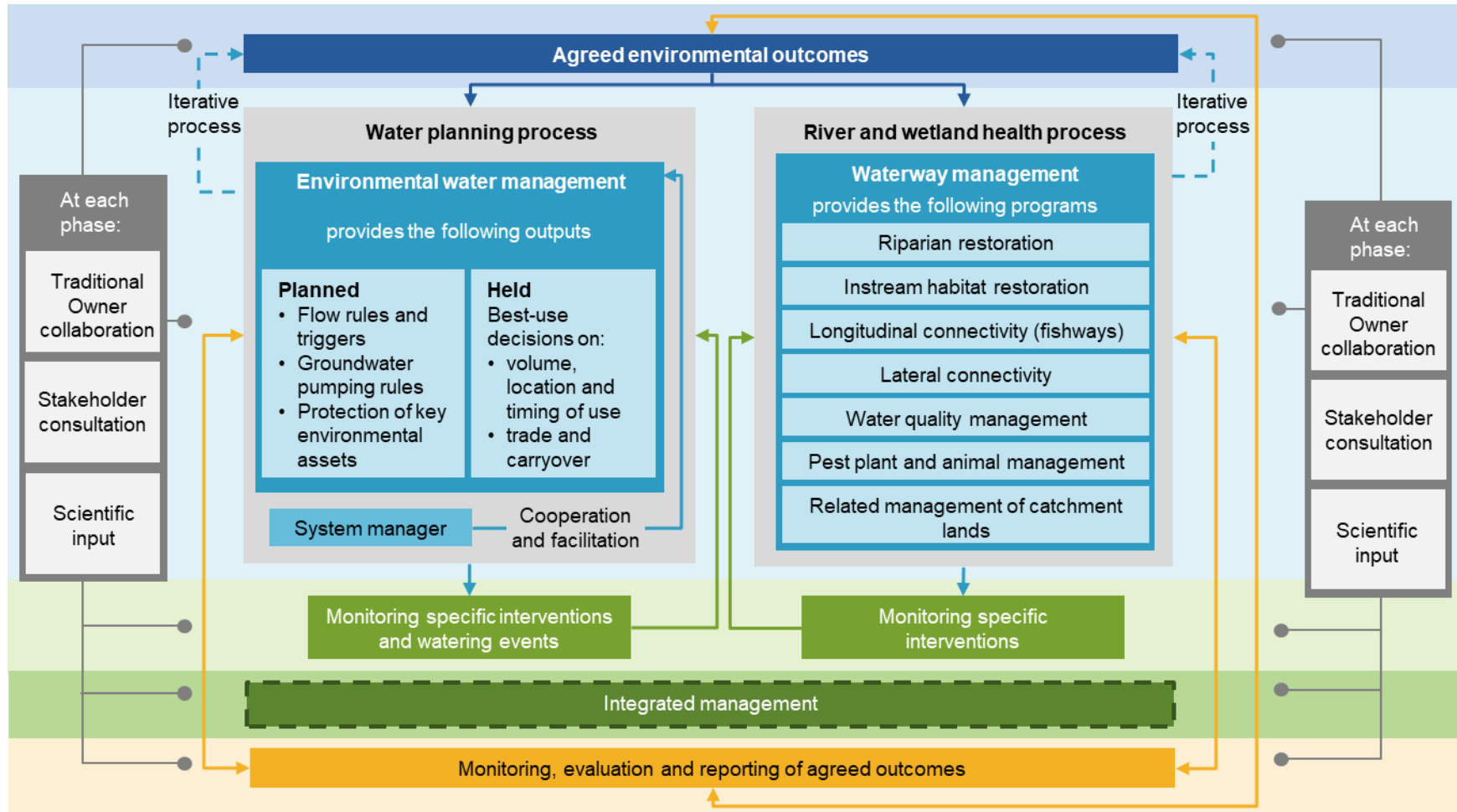
2.1 Requirements in all systems

State and Territory Governments have policy frameworks in place for determining environmental objectives and outcomes for their river, wetland and other water-dependent ecosystems. Agreed environmental water outcomes and provisions are established in water planning processes and managed by environmental water managers. River and wetland health management (referred to as ‘complementary waterway management’) is undertaken as a separate process under state and territory natural resource management (NRM) frameworks. To achieve environmental objectives and agreed environmental outcomes, environmental management and waterway management must act in concert. This is illustrated in figure 3 and is a key environmental management reform theme presented in this section.

A number of other key elements of environmental management that are required to achieve agreed environmental outcomes (in all water systems) are also introduced and brought together in figure 3 including:

- clearly specifying environmental objectives and outcomes and the provision of water for the environment (discussed below)
- the importance of essential knowledge-based inputs to water planning and wetland health processes including Traditional Owner collaboration, scientific input and stakeholder consultation (discussed below)
- a flexible, cooperative and innovative water system manager who is committed to facilitating the achievement of agreed environmental outcomes, subject to managing third-party impacts and open to experimentation as opportunities arise (discussed in section 3)
- effective, risk-based monitoring, evaluation and reporting arrangements (for both specific interventions and agreed outcomes) to assess whether agreed outcomes are being achieved (accountability) and to enable an adaptive management feedback loop into management processes (discussed in section 4).

Figure 3 **The integration of environmental and complementary waterway management**
At the local level, to achieve agreed outcomes



A focus on clearly specifying environmental objectives and outcomes

Under the NWI, water planning is recognised as ‘an important mechanism to assist governments and the community to determine water management and allocation decisions to meet productive, environmental and social objectives’.⁷ Water planning is intended to ‘provide for secure ecological outcomes by describing the environmental and other public benefit outcomes for water systems and defining the appropriate water management arrangements to achieve those outcomes’.⁸

Outcomes and objectives define the basis for determining how much water is expected to be required for the environment and guiding environmental management. Objectives provide a broad description of what a plan is aiming to achieve and agreed outcomes are the specific results being sought by stakeholders once the plan has been agreed.

Under the water planning process, the goal is to protect the key environmental assets and functions agreed by stakeholders. Stakeholders can include individuals and interest groups that are located outside of the designated water resource planning area.

The selection of environmental objectives and agreed outcomes through planning processes is essentially a societal choice involving trade-offs that should be guided by science in terms of what is achievable (Acreman 2016) and consultation and valuation in terms of the relative importance of outcomes to the community. Through this, communities will identify the key assets and ecosystem functions that they would like to protect, and the risks that they are willing to tolerate in achieving this. This results in the prioritisation of environmental assets to guide planning and active management. To enable stakeholder confidence and ‘buy-in’ to environmental water programs, it is important that these trade-offs and their associated ecological risks are well understood and accepted.

Agreed outcomes should be transparent, logical, and easily understood by stakeholders. Establishing agreed outcomes in planning processes requires effective engagement with stakeholders to ensure that priorities relevant to water plan areas are adequately considered and where necessary fed up to the state, territory or basin scale. However, in practice, reaching agreement on objectives and outcomes can be very difficult, even if good collaborative processes are in place.

The process of negotiation can be socially inclusive, but is often nonspecific and subjective. People may want the river to be natural, or they may have a golden age in mind (i.e., a view of the landscape in a painting from 1850), or memories of how nice the river was when they were young, which can influence their vision. Desires are often driven by a cultural or spiritual connection with the river. Given the high demand for water in many river basins it is often impossible to meet everyone’s needs, and compromises are required. Reaching agreement can be very difficult if expectations are unrealistic, for example, if the river has been heavily managed and will continue to be so for local or national economic prosperity. Setting objectives for

⁷ NWI paragraph 36.

⁸ NWI paragraph 37.

environmental water through stakeholder engagement is thus a socio-political process rather than a solely scientific procedure. (Acreman et al. 2017, p. 23)

Science, data and qualitative information is an important precursory input to the process of reaching agreement on plan objectives and outcomes. This information plays an important role in identifying ecological risks, and the value of environmental assets to the community when determining alternative uses of environmental water and setting environmental priorities (valuation techniques for water use are discussed in SP A *Entitlements and planning*). This is particularly important in systems where agreement on objectives and outcomes is difficult to achieve (for example, in overallocated and overused systems where the use of environmental water is highly contested), and to avoid the setting of unachievable objectives and outcomes.

To ensure some consistency of approach in the identification of key environmental assets, criteria for the prioritisation of environmental assets, based on conservation planning practice, should be embedded in the NWI (box 2). And these criteria should be used to identify water-dependent ecological features of significance as a precursor to determining objectives and agreed environmental outcomes.

Applied scientific analyses and good data are also key to the monitoring and evaluation of outcomes. Environmental outcomes should be specific and defined well, to enable clear long-term performance indicators to be set and monitored (monitoring, evaluation and reporting is discussed in section 4).

Box 2 Prioritisation criteria for identification of key environmental assets

Waterways or water-dependent ecosystems should be considered high environmental priority if they have one, or more, of the following characteristics:

- formally recognised significance (under Australian or State government legislation)
- the presence of highly threatened or rare species and ecological communities (under Australian or State government legislation)
- high naturalness values (for example, aquatic invertebrate communities or riparian vegetation)
- vital habitat (for example, drought refuges or important bird habitat and key sites for connectivity).

Source: Productivity Commission criteria adapted from the principles of conservation planning and reflecting Commonwealth and State government practices.

Ecological risks and environmental conditions vary under different climatic conditions. Recent dry conditions have called into question whether water planning has adequately considered the impacts of extreme water scarcity when establishing agreed environmental outcomes and objectives. The assessment of whether agreed environmental outcomes have been achieved will need to be based on a long-term assessment over a range of climatic conditions.

Water planning should consider objectives and agreed outcomes under different climate conditions (wet, average and dry years). The Western Australian Government reported:

Environmental water provisions are set in most cases at a low-level risk factored with drying climate projections. In drought conditions consumptive use and the environment share the burden of reduced water availability, however critical water refuges are maintained. For example, releases from large dams are tailored to reflect inflows to the dam, while providing minimum critical flows to downstream refuge pools.

At key wetlands on the Gngangara Mound supplementation programs maintain Lakes Nowergup and Jandabup. In self-supply farm dam catchments in the South-West low flows are maintained through low-bypasses and a winter-fill period policy, allowing dams to only capture water between July and October. In drought years the Department of Water and Environmental Regulation implements a dry-season response which may include higher levels of monitoring and compliance of licensees, and biological monitoring of critical summer refuges. (Western Australian Government, pers. comm., 21 September 2020)

Best-practice principles to establish environmental objectives and agreed outcomes, including understanding any environmental trade-offs during dry climate scenarios should be embedded in the NWI.

DRAFT NWI RENEWAL ADVICE 8.1: BEST-PRACTICE ENVIRONMENTAL OBJECTIVES AND OUTCOMES

Environmental objectives and outcomes agreed in water plans should be guided by established criteria on the identification of key environmental assets and the values communities place on those assets.

- Waterways or water-dependent ecosystems should be considered high environmental priority if they have one, or more, of the following characteristics.
 - Formally recognised significance (under Australian or State government legislation).
 - The presence of highly threatened or rare species and ecological communities (under Australian or State government legislation).
 - High naturalness values (for example, aquatic invertebrate communities or riparian vegetation).
 - Vital habitat (for example, drought refuges or important bird habitats and key sites for connectivity).
- Environmental objectives and agreed environmental outcomes should then:
 - be set through a collaborative, stakeholder and community process that considers the relative community value of outcomes
 - be based on good scientific, objective and on-the-ground knowledge
 - clearly identify any risks and potential environmental trade-offs under different climate scenarios (including average and dry years)
 - be transparent, logical, and easily understood by stakeholders
 - be specific and defined well, enabling clear long-term performance indicators to be set and monitored.

The provision of environmental water, established through planning

The water planning trade-off process results in objectives and agreed environmental outcomes with supporting environmental water arrangements and a defined share of water resources to be allocated (either as held environmental entitlements, planned environmental water or both). As discussed in section 1.3, planned environmental water is established in water plans by placing constraints or obligations on consumptive users that limit extractions from waterways, overland flows or groundwater systems to leave a residual water provision for environmental purposes.

Environmental water provisions are central to achieving ecological outcomes. The environmental impact of the recent drought in New South Wales has shown that in some catchments there has been an inadequate understanding of the importance of low-flow provisions to achieve environmental outcomes during periods of water scarcity. This was particularly evident in the Barwon–Darling, where there were substantial fish deaths and algal blooms in 2018 and 2019 due to cease-to-flow events.

Flow targets to protect critical ecosystems and river health need to be managed, not just for long-term averages, but for a range of climatic conditions including the very dry extremes. This includes managing water extraction during critically low flows to protect ecologically important refuges, protecting the resumption of flows, enabling small flushes at appropriate frequencies and managing connectivity across the landscape.

The process for achieving this is through water planning (SP A *Entitlements and planning*). Future water plans and water reviews need to ensure that water sharing arrangements during low flow and prolonged dry periods are explicitly considered and clearly described.

The integration of environmental water, waterway and catchment management

The environmental condition of waterways — such as rivers, wetlands, floodplains and estuaries — is dependent on a range of factors including water extraction and land use and management within the catchment and riparian zone. Waterways face threats like nutrient pollution, salinity, increased sedimentation, habitat degradation and invasive species.

Waterway management aims to protect and manage waterways and their adjoining riparian zones, so that their physical condition and ecological health are maintained or improved over time. Managing and protecting waterways is important as a precautionary approach (to prevent irreversible environmental damage) and because it is less costly (in terms of sustained effort, investment and time) than restoring degraded waterways (DWER (WA) nd).

Non-flow waterway management activities (such as water quality improvement, restoration of habitat and connectivity and the management of pest species) will have a critical impact on the achievement of environmental outcomes.

Inquiry participants discussed the benefits of non-flow measures to improve environmental outcomes. For example, Dale Chapman (sub. 5, p. 3) commented:

Increasing the volume of water used for environmental purposes should not be viewed as a substitute for achieving actual environmental outcomes ... The ‘just add water’ approach has been much criticised. Actual river health should be monitored rather than focusing predominantly on volumes of environmental water.

Measures like carp control, feral animal control in wetlands and fish migration facilities may produce significant environmental outcomes with lower economic and social costs compared with taking water out of productive use in rural economies.

The NSW Irrigators’ Council (sub. 27, p. 21) expressed a need for a greater focus on non-flow waterway management activities:

The irrigation industry has long advocated for complementary or non-flow measures to improve the health of river systems. Such measures include: habitat restoration, feral and invasive species management, carp control, cold water pollution management, improvements to fish passage, and native species breeding programs. Programs such as these have received far less attention than required, given the current volumetric focus.

In a similar vein, the Wentworth Group of Concerned Scientists (sub. 68, p. 5) noted the increasing importance of investing in non-flow measures in a changing climate.

Greater investment is needed in non-volumetric freshwater ecosystem conservation measures that will increase resilience of biodiversity under a changing climate. The NWI should include provisions for such measures including: restoration of indigenous vegetation along riparian corridors, removal of redundant infrastructure, removal of structures which reduce connectivity on floodplains where possible, provision of fish passage, and thermal pollution control devices.

To deliver agreed environment outcomes it is essential that environmental water is managed within an integrated waterway management framework (figure 3, above). In the absence of integration, the long-term benefits of environmental water (including environmental rehabilitation and resilience) may be eroded or not realised. Providing environmental water to a particular wetland is likely to be more effective in increasing native fish populations if waterway managers maintain wetland vegetation, reduce weeds and install screens to exclude invasive species such as carp. Similarly, the benefits of providing water to stimulate regeneration of red gum forests may be completely eroded if grazing then eliminates the seedlings. For example, a recent report on the *Victorian Environmental Flows Monitoring and Assessment Program* found that:

- the benefits of environmental water are dependent on complementary works
- non-flow related factors (such as fish stocking, angling and habitat condition) influence trends in fish populations therefore, understanding how these factors interact with flows to influence fish populations is important to achieve environmental outcomes
- the ‘strategic delivery of environmental flows, when considered together with weed and grazing management, can maximise benefits to native riparian plants.’ (DELWP (Vic) 2020a, pp. 7 and 11).

Integrating environmental water with complementary waterway management activities is critical to achieving agreed environmental outcomes but, is not adequately covered in the NWI. Waterway managers are generally responsible for waterway and catchment management activities under state and territory NRM frameworks but, except for Victoria, may not be involved in environmental water management.

To facilitate the achievement of agreed environmental outcomes, State and Territory Governments should ensure that consistent management objectives govern the use of environmental water and complementary waterway management activities, and that NRM programs give priority to the assets identified in water planning processes, provide funding and undertake the required works.

Complementary NRM programs are important to deliver long-term outcomes, as well as to manage changing conditions. During periods of water scarcity, NRM should focus on the protection of reserves and refuges and making sure that the regenerative capacity of water-dependent ecosystems is protected. This could include (during periods of low flow) banning of fishing in fish refuge pools, fencing of key refuge areas, captive breeding programs and increased compliance monitoring and enforcement. Environmental water management and NRM approaches to adaptation must operate in concert to achieve agreed outcomes. This is especially important in the context of Australia's drying and highly variable climate.

DRAFT NWI RENEWAL ADVICE 8.2: INTEGRATED MANAGEMENT

The management of environmental water should be integrated with complementary waterway management at the local level by ensuring that consistent management objectives govern both the use of environmental water and complementary waterway management activities.

DRAFT RECOMMENDATION 8.1: NATURAL RESOURCE MANAGEMENT

Natural resource management (NRM) programs should give priority to the key environmental assets identified in water planning processes, provide funding and undertake the required works to protect those assets.

During periods of water scarcity, NRM should focus on the protection of reserves and refuges and making sure that their regenerative capacity is protected.

Effective compliance regimes

Compliance and enforcement mechanisms are a key aspect of any regulatory system. To achieve agreed environmental outcomes, it is critical that the environmental water provided under water planning processes is delivered.

The vast majority of environmental water provisions are provided through the imposition of rules and constraints on other active water users. Effective compliance policy and processes to protect environmental water through these regulations is critical for achieving agreed environmental outcomes. Best practice includes:

- compliance processes (inspections and investigations, enforcement and reporting) that are targeted, accountable and consistent (within systems)
- penalties that are designed to support deterrence and proportionate to the level of harm posed to the environment
- compliance policy and processes that are risk-based. For example, in systems where there is high competition for water (such as systems that are overallocated and highly regulated), regular and systematic collection and collation of evidence on compliance is required
- clear, open and transparent reporting on instances of non-compliance.

SP E *Integrity* explores best practice in compliance and enforcement under the NWI.

Clearly identifying institutional responsibility for waterway management

The environmental condition of a waterway or wetland is the consequence of a range of management factors within both the catchment and the waterway itself. Therefore, effective waterway management requires the coordination of all waterway activities and will involve a range of people and organisations. It requires cooperative relationships between local communities, Traditional Owners, landowners, land managers, catchment groups, river operators, State and Territory government agencies, environmental water holders and scientists.

To be effective, shared governance models require significant effort in collaboration, coordination and the sharing of key information and data. When not managed well, shared responsibility governance models can lack structure, transparency and accountability, and ultimately key tasks to achieve good outcomes can be neglected or overlooked.

In the context of waterway management, a shared responsibility model can lack clarity over who is responsible when agreed outcomes cannot be met, such as during a prolonged period of water scarcity. For example, an outpouring of community frustration over poor environmental outcomes during the recent low-flow events in the Barwon–Darling exposed a gap in structure, transparency and accountability for waterway management in New South Wales.

The Review of the Water Sharing Plan for the Barwon–Darling reported:

The overwhelming majority of stakeholders feel that the Plan is not meeting its objectives, and that a lack of water and poor water quality is impacting environmental outcomes and affecting local residents and communities ...

Based on feedback from the [Natural Resources] Commission’s consultation, disparate stakeholder groups show widespread distrust and cynicism in government water planning and

management over a long time period. Indeed, there were numerous calls from community members, and more widely in media, for a Royal Commission and independent review body; “There needs to be one body in NSW to run water ... with ICAC type powers. It could even be federal. But it needs that level of oversight ... we need real action to be convinced”. (NRC (NSW) 2019, pp. 93 and 98)

This erosion of trust, transparency and accountability must be addressed to build the credibility of environmental management in the Barwon–Darling and more broadly.

Although no single agency can control all the factors affecting the condition of a waterway, to achieve agreed environmental outcomes all jurisdictions should have in place an institutional oversight responsibility for wetland and waterway management that provides an interface between the management of waterways and environmental water. Box 3 describes waterway management in Victoria, where the establishment of institutional responsibility for waterway and wetland management has generated benefits.

The type of agency responsible for waterway management may vary between jurisdictions and waterways, but the broad roles and functions of a waterway manager should include those listed below (in draft NWI renewal advice 8.3).

DRAFT NWI RENEWAL ADVICE 8.3: WATERWAY OVERSIGHT

Where not in place, State and Territory Governments should establish a formal institutional oversight responsibility for wetland and waterway management that provides an interface between the management of waterways and environmental water.

The roles and functions of a waterway manager should include:

- undertaking collaborative planning processes that result in clearly articulated environmental objectives, targets and priorities
- ongoing collaboration with Traditional Owners
- ongoing environmental risk assessment
- providing input to water planning processes on environmental priorities and impacts
- oversight of natural resource management actions to achieve agreed objectives
- working with the system manager to achieve agreed environmental outcomes
- facilitating on-ground delivery of environmental water management
- monitoring and reporting on environmental outcomes and risk management
- evaluation where environmental outcomes were not achieved
- providing opportunities for community participation, to facilitate change and awareness of waterway issues
- communicating policy changes to stakeholders.

Box 3 Case study: waterway managers in Victoria

In Victoria, there are ten catchment management regions and each has a catchment management authority to co-ordinate integrated management of land, water and biodiversity. Catchment management authorities also have specific responsibilities for waterway management (except in the Port Phillip and Westernport region where Melbourne Water has waterway management responsibilities). The nine catchment management authorities and Melbourne Water are referred to as 'waterway managers'.

A key function of waterway managers under the *Water Act 1989* (Vic) is to develop and deliver Regional Waterway Strategies (RWSs) and associated action plans. RWSs are planning documents for river, estuary and wetland management in each region that drive the implementation of the Victorian Waterway Management Strategy. RWSs are developed by waterway managers in collaboration with other regional agencies, authorities and boards involved in natural resource management, Traditional Owners, regional communities and other key stakeholders.

At the local and regional level, waterway managers are the primary link with local communities and regional stakeholders. Waterway managers work with their local communities to determine the environmental values of most importance to the community and additional benefits that can be met, such as helping to meet recreational needs.

RWSs outline regional goals for waterway management. The regional priority-setting process relies on information about values, threats and risks. High value waterways are identified, and from those, a subset of priority waterways are determined for the eight-year planning period. A strategic regional work program of management activities for priority waterways is included. The regional work program provides clear direction to guide investment in waterway management by the Victorian Government. RWSs also identify regional priorities for environmental water management over the eight-year planning period, together with the complementary management activities required at those sites. This information is used as a key input to environmental water planning arrangements.

Other functions of waterway managers under the *Water Act 1989* (Vic) include:

- developing and implementing work programs
- authorising works on waterways, acting as a referral body for planning applications, licences to take and use water and construct dams, for water use and other waterway health issues
- identifying regional priorities for environmental water management and facilitating the delivery of environmental water
- providing input to water allocation processes
- developing and co-ordinating regional floodplain management plans
- managing regional drainage in specified areas
- undertaking community participation and awareness programs.

Sources: DELWP (Vic) (2019b); DEPI (Vic) (2013).

Processes to adapt environmental objectives, when necessary, in a changing climate

Climate change is expected to lead to changes in water availability and reliability, and an increase in the frequency, severity and duration of droughts across much of Australia. This is likely to result in many of our waterways and wetlands changing character over the long-term. Environmental managers are already managing a changing climate through

planning restoration programs, for example in Ramsar sites such as Lake Albacutya and the Coorong.

Uncertainties associated with climate change compel the need for flexible, adaptable and risk-based environmental planning and management. In some systems, climate change may make the realisation of agreed environmental outcomes unachievable based on existing water provisions. The process of resetting the balance, outlined in *SP A Entitlements and planning*, reviews what may be possible in some systems.

However, in many water systems (particularly those in unregulated systems, with little water extraction or affected by rising sea levels), the scale of the predicted climate shifts means that some environmental objectives are unlikely to be met over the longer-term, even if environmental water provisions increase relative to consumptive use. In these systems, environmental managers will need to review environmental objectives, ultimately enabling those systems to adapt to a drier future.

To manage risk in a changing climate, environmental managers must establish clear processes for reviewing their progress on outcomes and determining if and when management objectives need to be revisited within planning review processes.

DRAFT NWI RENEWAL ADVICE 8.4: REVIEW PROCESSES FOR OUTCOMES

Clear processes should be established for reviewing progress on environmental outcomes, understanding their feasibility given climate induced changes in water availability and other factors (such as rising sea levels and increased temperatures), and determining if and when management objectives should be revisited within planning review processes.

2.2 Requirements in systems with additional held environmental water

As noted above, in a number of complex, highly developed and highly regulated systems, planned environmental flows are supplemented by held entitlements. This situation generally arises where environmental water has been recovered from the consumptive pool to improve the balance between water for consumptive and environmental use. In these systems, environmental water managers have been established to make decisions on where, how and when environmental water should be used and whether it should be traded or carried over (that is, stored for use in the following year). And, in the case of shared river systems (within the MDB), decision making also involves how environmental water managers should undertake actions in a coordinated way.

These more complex systems have further requirements, in addition to those outlined in the section 2.1, because of their complexity and their capacity to support the active management of held environmental water entitlements. They require dynamic planning for each parcel of

water, and day-to-day decision making because the timing of environmental water delivery can be as critical as the volume of water itself.

Active environmental management by environmental water holders involves making trade-offs between competing environmental needs at different locations and times. The decision-making task, and outcomes possible, will be strongly influenced by the scale of environmental water entitlements held, water plan outcomes sought, and the level of risk agreed in water plans. Where risk levels are higher, decisions made by environmental water holders will be more critical to achieving environmental outcomes.

And, because environmental water holders are provided with entitlements (worth billions of dollars), and have considerable discretion in how they use them, there is also an accountability obligation on environmental water holders to achieve the best outcomes that they can with the water resources that they steward. Environmental managers should use their best endeavours to achieve agreed (and, where possible, better) environmental outcomes in water plans by seeking out efficiencies from each allocation of environmental water. And, stakeholders have a right to clear information about how best-use decisions are made and the trade-offs involved.

To ensure accountability and build public confidence in the use of Australia's valuable environmental water, best-practice principles that support the effective and efficient use of held environmental water entitlements should be embedded in the NWI. The requirements for held environmental management set out in this section are focussed on achieving the best outcomes from environmental water under a renewed NWI.

Effective outcomes-based planning and priority-setting processes

The successful delivery of environmental water is a complex exercise and relies on robust planning mechanisms to deliver the best outcomes. A number of frameworks, plans and strategies, covering short and long-term time scales and local and regional spatial scales, guide the process.

Varying by jurisdiction, these documents broadly include long-term watering plans, long-term asset plans, annual watering plans, annual watering priorities and environmental watering strategies. They set out the:

- agreed ecological objectives and outcomes
- water regimes needed to achieve them under a range of climatic conditions
- principles for guiding the use of the relevant environmental entitlements to achieve them
- additional cultural and social benefits to be achieved, where compatible.

In systems with held environmental water, environmental water managers make active decisions on where, how and when environmental water should be used and whether it should be traded or carried over, guided by these planning mechanisms. The overarching

objective for environmental water managers is to make these decisions based on the best use for the environment over the long-term.

The actual water needs of environmental assets vary on a yearly basis, depending on antecedent conditions, watering history, environmental requirements and risk considerations. Therefore, the best mix of water use, trade and carryover will be different in each catchment and vary every year. Best use is influenced by a range of local factors and assessment criteria. For example, box 4 summarises decision making for Commonwealth environmental water holdings.

Box 4 Environmental watering — best-use decision making

As set out in the Commonwealth Environmental Water Office's (CEWO) *Water Management Plan (2020c)*, a range of local factors influence decisions on the use, trade and carryover of water including:

- environmental demands and opportunities at specific sites
- anticipated environmental demand in coming years
- climatic conditions across a range of scenarios and current dam storage levels
- physical and operational constraints to water delivery
- environmental and operational risks
- cost versus benefit assessment of each option, within and across catchments
- water account rules and carryover limits
- long-term yield of entitlements and appropriate levels of carryover, given uncertainty about future environmental needs
- water market conditions.

Watering assessments are undertaken against set criteria (and are also outlined in the CEWO's *Water Management Plan (2020c)*) including the:

- ecological value of the river, floodplain or wetland
- expected outcomes from watering
- potential risks of watering
- long-term sustainability and management of the site
- cost effectiveness and feasibility of watering.

Watering events vary in scale significantly — in terms of the target area, volume of water and whether they are a single or repeated event. Before any water is delivered, potential risks are considered, include the risk of flooding private property or 'double-booking' a channel for water delivery.

Local on-ground knowledge is important for detailing a specific watering action including the flow magnitude, timing, triggers for commencement, rates of rise and fall in the level of the water course and the area to be inundated. When a decision is made to proceed with a watering action, arrangements for implementation are made with delivery partners including river operators, who manage the delivery of the water and operational monitoring. Communication with stakeholders is crucial during water delivery as weather and flow conditions can change rapidly and may result in the need to adjust, suspend or even cancel the watering action.

Source: CEWO (2020c, p. 7).

Because environmental water needs are not consistent across years, and rainfall and water available under entitlements are also highly variable, environmental watering has evolved to strategic use of available allocations. In a dry year, environmental water managers are required to set priorities for the best use of limited environmental water, and so they need the information and management tools to undertake this task efficiently. Ideally, water planning would pre-empt and accommodate these needs.

At an operational level, in seasonal watering plans environmental water managers make risk-based decisions on watering various, specific environmental assets. During periods of water scarcity (in particular), this is likely to involve difficult environmental trade-offs between different:

- regions (deciding to commit water to a river or wetland in one region over a river or wetland in another region)
- river reaches or wetlands in one river system (deciding to commit water to one river reach or wetland over another in the same system)
- environmental flow elements in a particular river or wetland (for example, the creation of small summer flushes for water quality versus the maintenance of baseflows) (VEWH 2015, p. 3).

These trade-offs establish priorities from a tactical management sense, within agreed long-term water objectives and outcomes. As discussed in section 2.1, under the water planning process communities agree on the key assets and ecosystem functions that they would like to protect (guided by precursory scientific data and qualitative inputs). The water planning process establishes the long-term environmental objectives and outcomes to be sought from environmental water management. However, because environmental water holders make active tactical decisions on the use of the actual available water in a particular season, they use prioritisation criteria that can be applied on a real-time basis in response to actual climatic conditions. In doing this, they have the potential to achieve better outcomes than those agreed through long-term water planning processes. Indeed, to be accountable for the water resources that they steward, it is important that environmental water holders are well informed, nimble, and (where possible) seek out efficiencies and outcomes that are better than those agreed in water planning processes.

Environmental water holders have developed prioritisation criteria to guide the active management of held environmental water. These broad criteria are summarised in table 3 and can be equally applied at individual sites or at the broader landscape scale. Environmental prioritisation criteria for held environmental water should be embedded in the NWI to provide validity to current best practice and transparency to the community and other entitlement holders.

It is also important (given Australia's increasingly variable climate) that these prioritisation criteria are used to set objectives that take into account information about values, threats and risks under different seasonal climate conditions.

Table 3 Criteria for prioritising environmental watering^a

<i>Prioritisation criteria</i>	<i>Factors considered</i>
Extent and significance of environmental benefit	Size of the area being watered Expected ecological outcomes Expected scale of response Conservation status of the species or community that will benefit Expected contribution to regional environmental objectives
Likelihood of success	Evidence that the desired outcomes are likely to be achieved External threats that may affect getting the desired results
Longer-term benefits	Value added to previous watering undertaken at the site Longer-term environmental benefits expected Ability to sustain these values into the future
Urgency of watering needs	History of watering at the site Potential for irreversible damage if the watering does not occur Risks associated with not delivering the water
Feasibility of the action	Capacity of infrastructure to meet the delivery requirements System or operational constraints Flexibility in the timing of delivery Likelihood that planned management actions will mitigate external threats
Environmental or third-party risks	Adverse environmental outcomes that may arise from the event Third-party risks associated with the event Effectiveness of mitigation to manage third-party and environmental risks
Cost effectiveness of the watering action	Likely environmental benefit compared against costs to deliver and manage water and costs of interventions to manage external threats and risks
Efficiency of water use	Volume of water needed to achieve the desired outcome Volume and timing of return flows that may be used at downstream sites Alternative supply options such as use of consumptive water en route or augmenting natural flows Risks of spills from storages in the upcoming water year and any carryover water that may be available
Cultural, economic, social and Traditional Owner benefits	Traditional Owner values and aspirations Recreation, community events and activities Economic benefits

^a The table sets out the prioritisation processes of the Victorian Environmental Water Holder. Other jurisdictions with environmental water entitlements follow a similar approach, as described below.

Box 4 outlined the Commonwealth Environmental Water Holder's five criteria for assessing water use options: ecological value of the river, floodplain or wetland; expected outcomes from watering; potential risks of watering; long-term sustainability and management of the site; and cost effectiveness and feasibility of environmental watering.

The Murray–Darling Basin Authority's process to identify Murray–Darling Basin annual priorities follows five broad steps: identify environmental watering need (consideration of outcomes from previous watering and whether additional watering is required to consolidate outcomes, assessment of flow data against environmental watering requirements for significant sites, and consideration of ecological condition); identify the resource availability scenario and management outcomes; consider complementary outcomes and risks (such as the First Nations Environmental Water Guidance Project); consider state annual environmental watering priorities; and consult and collaborate.

The Living Murray (TLM) water is prioritised based on where the water will achieve the biggest environmental outcomes, the availability of water in the river and the Living Murray, seasonal outlook and on site condition. TLM water is generally not distributed evenly across sites each year, but delivered (in a 'rostered' way) to mimic natural flooding cycles. This involves alternating large-scale watering of different sites every three to five years, and smaller watering in between.

Sources: CEWO (2020c, p. 7); MDBA (2011, p. 75, 2019a, pp. 80–82); VEWH (2020a, p. 23).

The Australian Government described how, during the recent drought, objectives were aligned with conditions to achieve the best use from environmental water:

The CEWO's [Commonwealth Environmental Water Office's] planning was very effective in the recent drought, with unprecedented dry conditions experienced throughout the Basin ... Like other water users when it's dry, Commonwealth environmental water holdings receive less allocation. This means that during drought we reduce the footprint of our watering to achieve more modest objectives, focussed on protecting sites of highest priority, creating refuges for plants and animals to survive through the drought, improving water quality, minimising irreversible damage and providing for later recovery.

As an example, throughout the year Commonwealth environmental water maintained longitudinal connectivity between the River Murray and the Coorong, providing constant fish passage and contributing 100 per cent of flows through the barrages in 2019-20. Over 685 GL of Commonwealth environmental water flowed to the Coorong to provide critical estuarine habitat refuges in low flow, drought conditions. (DAWE, pers. comm., 4 September 2020)

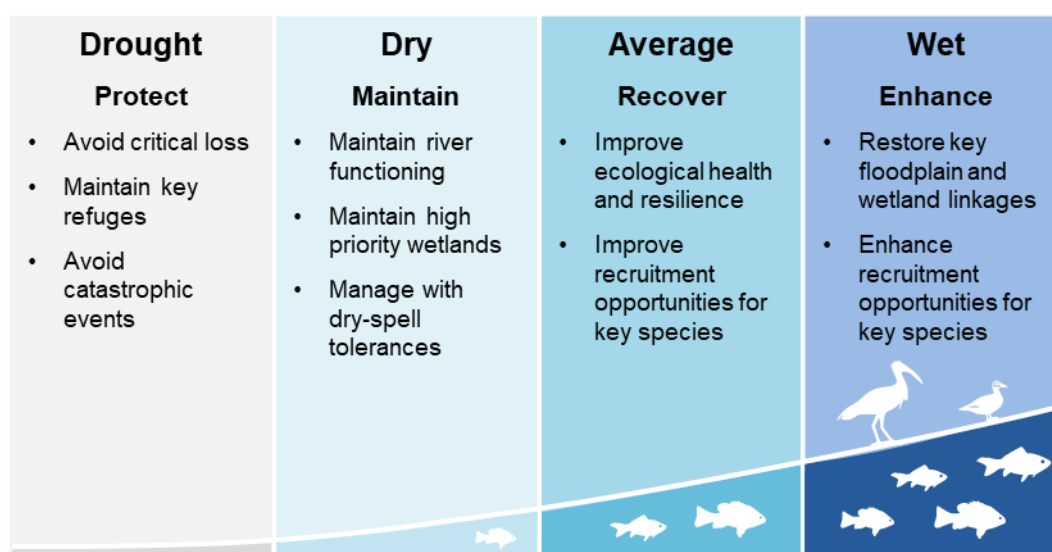
Similarly, the Victorian Government (sub. 108, p. 16) said:

Victoria continues to apply a seasonally adaptive approach to environmental water management that considers recent climate history, climate outlook and available environmental water. This approach was established during development of the Northern Region Sustainable Water Strategy 2009 as a flexible way to manage rivers and wetlands.

This has proved effective during the recent drought when environmental water has been targeted to the sites that need it most. For example, in West Gippsland earlier this year, the WGCMA [West Gippsland Catchment Management Authority] decided not to deliver the usual autumn fresh in three rivers to promote fish spawning, focusing instead on using available environmental water to maintain base flows and water quality.

Figure 4 illustrates environmental planning objectives for seasonal environmental watering under different climate conditions — drought, dry, average and wet climates. For example, in drought conditions, the general environmental watering objective is to protect at-risk environmental values and avoid critical loss. In wet conditions, the objective is to reconnect rivers to floodplains and wetlands and enhance recruitment of key species. Objectives for seasonal environmental watering under different climate scenarios should be embedded in a new NWI.

Figure 4 Environmental objectives under different planning scenarios



^a This figure sets out the prioritisation processes of the Victorian Environmental Water Holder (VEWH). The Murray–Darling Basin Authority (MDBA), under the *Basin-Wide Environmental Watering Strategy*, follows a similar climate scenario approach (described below).

- Very dry — avoid irretrievable loss of, or damage to, environmental assets.
- Dry — ensure environmental assets maintain their basic functions and resilience.
- Moderate — maintain or improve ecological health, condition and resilience of water-dependent ecosystems.
- Wet — improve ecological health, condition and resilience of water-dependent ecosystems.

Commonwealth environmental water planning is primarily driven by supply (how much water is available) and how this can be used to meet identified demands (what are the environment’s needs). The *Commonwealth Environmental Water Portfolio Management Framework* specifies four objectives (similar to the VEWH and MDBA approaches) but scenarios are based on different combinations of environmental water demand and supply (described below).

- Avoid damage to the environment — very low supply and very high or high demand; and low supply and very high demand.
- Protect and ensure capacity for recovery — very low supply and moderate or low demand, low supply and high or moderate demand, and moderate supply and very high or high demand.
- Maintain ecological health and resilience — very low supply and very low demand, low supply and low or very low demand; moderate supply and moderate, low or very low demand; high supply and low or very low demand, and very high supply and very low demand.
- Improve ecological health and resilience — high supply and very high, high or moderate demand, and very high supply and very high, high, moderate or low demand.

Sources: CEWO (2020c, p. 6); MDBA (2019a, p. 71); VEWH (2015).

DRAFT NWI RENEWAL ADVICE 8.5: EMBED OBJECTIVES AND PRIORITY SETTING FOR HELD ENVIRONMENTAL WATER

The overarching objective for environmental water managers managing held environmental water is to make decisions on where, how and when environmental water should be used (or whether it should be traded or carried over) based on the best use for the environment over the long-term.

Criteria for prioritising environmental watering should be embedded in a new National Water Initiative and include the:

- extent and significance of environmental benefit
- likelihood of success
- longer-term benefits
- urgency of watering needs
- feasibility of the action
- environmental or third-party risks
- cost effectiveness of the watering action
- efficiency of water use
- additional cultural, economic, social and Traditional Owner benefits.

Objectives for seasonal environmental watering under different climate scenarios should be embedded in a new National Water Initiative such as:

- avoid critical loss, maintain key refuges and avoid catastrophic loss during drought scenarios
- maintain river functioning and high priority wetlands and manage dry-spell tolerances during dry scenarios
- improve ecological health and resilience and recruitment opportunities for key species during average-climate scenarios
- restore key floodplain and wetland linkages and enhance recruitment opportunities for key species during wet scenarios.

Coordinated water delivery in the MDB

In MDB shared systems, providing water for the environment through the use of held entitlements requires collaboration and coordination by environmental water holders and government agencies at all levels, including on-ground waterway managers, delivery partners and community stakeholders more broadly. Since 2017, there has been increased commitment to improving the coordination of water delivery in the MDB to achieve better outcomes.

Improved cooperation between Basin governments in the delivery of water for the environment was demonstrated in mid-2018 when 32 gegalitres of water was delivered an unprecedented distance flowing over 2000 km from the northern tributaries of the Barwon-Darling River to the Menindee Lakes. As it flowed from storages in the north through Bourke and Wilcannia, this

water refreshed waterholes and provided connectivity for native fish. The NSW Government applied temporary water restrictions to protect the water from being pumped as it flowed down the rivers. This event was so successful that the second event of this kind, called the Northern Fish Flow Event, ran from April to June 2019 to support the health of the Dumaresq, Macintyre, Mehi and Barwon river systems. (Joint Basin Governments 2019, p. 15)

The mechanism to enable coordination in shared systems of the MDB is the *Basin-wide Environmental Watering Strategy* (MDBA 2019a). The Commission will examine the Strategy in its 2023 review of Basin Plan implementation.

Capacity to actively trade environmental water allocations, including between years

Environmental water holders have considerable discretion on whether to use, trade or carryover each parcel of water. With this management discretion, there is an accountability obligation for environmental water holders to make decisions based on the best use for the environment.

Carryover allows water entitlement holders to retain the unused portion of their water allocation from one year so that it can be used in subsequent years, and is available to consumptive water users and environmental water holders in most highly regulated systems. It allows all entitlement holders to flexibly manage their water availability between seasons to help meet discrepancies between water supply and demand in wet years versus dry years (VEWH 2018, p. 10). However, the use of carryover can be limited in some catchments by a lack of storage capacity, high rates of storage evaporation and a lack of connectivity, which prevents the use of carryover in other catchments. Trade in held environmental water can overcome some of these barriers.

All governments with held environmental water (Australian, New South Wales, Victorian and South Australian) are legally able to trade water allocations (PC 2017, p. 72).⁹ Environmental water holders trade water in two key ways:

- administrative water transfers, which enable environmental water to be moved across river systems and/or between environmental water holders for environmental purposes (with no financial considerations). These are the majority of trades undertaken by environmental water managers and are required to operationalise many environmental water decisions outlined in seasonal watering plans
- trading environmental water allocations with consumptive users (both selling and buying), where it is in line with their statutory objectives such as that it benefits the environment.

⁹ In South Australia, water entitlements held by the Minister exclusively for environmental purposes for the SA River Murray (for example, under the Living Murray program or as a result of environmental watering obligations under the original Adelaide Desalination agreement with the Commonwealth) are not traded. The Minister also holds a small volume of additional water entitlement which may be the subject of trading activity (South Australian Government, pers. comm., 18 September 2020).

Water markets can allow more efficient water use. Trade can provide opportunities for environmental water holders to manage low flows as well as to top-up medium flood events for the benefit of water-dependent ecosystems. Trade can help maximise environmental benefits by putting environmental water to better use in different locations or at a later time, to better match the hydrographs of environmental needs. It allows for increased flexibility and reduced risk by better aligning seasonal water resource variability with needs.

To maximise environmental outcomes, it is important that environmental water holders have the ability to actively trade water allocations and carry forward revenues. However, decisions to sell environmental water allocations can be contentious, particularly during periods of water scarcity and when significant public investment has been used to procure entitlements. For example, in 2018 when the New South Wales Government sold 15 GL of environmental water allocation to irrigators within the Gwydir, Macquarie, Lachlan, Murrumbidgee and Murray–Lower Darling valleys in response to dry conditions, questions were raised as to whether this was the best use of the allocations for the environment (PC 2018, p. 294).

Decisions to sell or buy environmental water allocations require a robust and transparent framework to facilitate optimal outcomes from the trade of environmental water, and ensure that these decisions are well understood by communities and other stakeholders. Under the NWI, parties agreed that water for the environment held as an access entitlement may be traded on the temporary market, ‘when not required to meet the environmental and other public benefit outcomes sought and provided such trading is not in conflict with those outcomes’.¹⁰

This limit (placed on trade) is intended to ensure that trading arrangements are consistent with the use of the water for environmental purposes, and are not primarily aimed at raising revenue. But, the salient concern is that the environmental water holders may fail to maximise environmental and community benefits by trading too little.

Although the CEWH manages a large quantity of water rights, to date it has only sold water on five occasions when it judged that the environment’s needs in the relevant catchments had been met — a requirement of Part 6 of the *Water Act 2007* (Cth). And the CEWH has (to date) not purchased any water allocations through the temporary market. However, as discussed below, in 2020 the Commonwealth Environmental Water Office (CEWO) implemented a market-like instrument (a ‘no-pump’ contract) in the Lower Balonne that served a similar role to the purchase of a water allocation. A grant was accepted by a landholder who agreed to forgo pumping of their water allocations during a flow event (*Assessment*).

It is desirable that over time, the CEWH and other environmental water holders fully exploit trade in allocations to maximise benefits for water-dependent ecosystems. Active decision making by environmental water holders on whether to use, trade or carryover held environmental water should demonstrate the best use of water to contribute to environmental outcomes as opportunities arise. In particular, best use for the environment, should take into account the potential for net environmental benefits over both the short and long-term.

¹⁰ NWI paragraph 35.

Revenue from trading should also be put to best use to achieve environmental outcomes. It should be held in a dedicated, ring-fenced account with the ability to carryover between years. The uses for this revenue should be clearly defined and transparent. Examples include:

- trading costs
- acquisition of entitlements
- acquisition of allocations, including buying allocations or entering into lease, option or similar arrangements
- making use of market-like instruments such as ‘no-pump’ arrangements (discussed in the next section)
- works and measures that enable best use of environmental water or extend environmental water outcomes
- research and development relevant to enabling more efficient use of environmental water or extending environmental outcomes and assisting with operations
- providing contingency funds to assist delivery of agreed environmental outcomes during periods of extreme water scarcity
- monitoring outcomes.

To ensure accountability, decision making by environmental water holders on best use should be open, transparent and publicly reported (for example, through annual trading and carryover strategies or statements).

DRAFT NWI RENEWAL ADVICE 8.6: TRANSPARENT TRADE STRATEGIES

Environmental water holders should have in place transparent and publicly reported trading and carryover strategies and reporting statements for entitlements and allocations that show the best use of water to contribute to environmental outcomes as opportunities arise.

Revenue from trading should be held in a dedicated, ring-fenced account with the ability to be carried over and devoted to activities that enable the best use of environmental water over time. And, use of this revenue should be publicly reported.

Innovative market approaches

Environmental water holders will require further development of market instruments, particularly in unregulated systems, coupled with the removal of some remaining trade barriers to be able to best use markets to support the achievement of environmental objectives.

In unregulated water systems, water sharing is particularly time-sensitive. Consumptive and environmental users rely on rainfall events to access allocations. In these systems, innovative market instruments have the potential to move water across time that would otherwise not

be possible through standard allocation trade. Innovative approaches to trading in unregulated systems include no-pump contracts, store and release arrangements, option mechanisms and conditional leases (BDAGroup and CSIRO 2017, p. 32).

Box 5 presents a case study on a no-pump contract, a market-like mechanism recently trialled by the CEWH as a pilot project to enhance flows to the Narran Lakes and improve outcomes. The New South Wales Government also reported that in 2015-16 it entered into a no-pump contract with a landholder to prevent water extraction from a key lagoon. This volume was compensated with a transfer of general security allocation (New South Wales Government, pers. comm., 11 November 2020).

Operational rules for these sorts of activities need to be fit for purpose to ensure that trade is efficient. For example, in Queensland under the *Water Supply (Safety and Reliability) Act 2008*, the use of waterways as a conduit is only allowed in exceptional circumstances. This prevents water stored privately being traded to a potential downstream buyer. For environmental water managers who may wish to store their allocations for opportunistic use, this restricts their potential to on-sell the water when not needed. Whether this barrier is still fit-for-purpose warrants review. For innovative market instruments to develop and be efficient, appropriate institutional pre-conditions need to be in place (SP B *Trading*).

Internationally, an innovative approach to leverage farmland as temporary wetlands was adopted during California's extreme drought (2011 to 2017). This involved nature conservation groups in California paying rice farmers to keep their fields flooded during the post-harvest months, to allow migratory birds to take refuge in these 'pop-up wetlands' (Weill 2018).

Inquiry participants expressed support for increased use of innovative mechanisms to manage environmental watering. For example, AgForce (sub. 24, pp. 6–7) said:

AgForce supports alternative approaches to the management and use of already held environmental water, such as the use of temporary water markets and mechanisms like 'no-pump' contracts to maximise the value of this water across a broader range of outcomes or shared benefits while not compromising environmental objectives (NWI paragraph 35(iii)). Any water efficiency expectations on consumptive water users should also be applied to managers of environmental water.

Similarly, Lifeblood Alliance (sub. 70, p. 20) commented:

There remains an opportunity to be innovative by using alternative approaches to managing water for the environment, such as greater and more innovative use of temporary water markets and market like mechanisms. For example, the Murray Darling Wetlands Working Group were able to use temporary trade of water to help fund complementary waterway/wetland management activities, and works and measures to enable the supply of environmental water.

Environmental water holders should work with system managers and consumptive water holders to pursue innovative market approaches, as opportunities arise. Innovative market approaches should be assessed relative to their contribution to achieving environmental

outcomes. Establishment and transaction costs should be estimated and the risks of implementing the arrangement for all parties should be evaluated (CEWO 2011, p. 18).

Box 5 Case study: Narran Lakes no-pump contracts

The internationally significant Narran Lakes is an important wetland in the northern Murray-Darling Basin. Endangered native waterbirds rely on the lakes to breed and survive. The Narran Lakes are also of immense cultural significance — a meeting place. When water flows, frogs emerge, birds breed, people arrive and ceremonies begin. The lakes system has been important for Aboriginal groups for thousands of years.

An unusually long period of low flows has resulted in ecological decline. In most circumstances, mid-sized flows in the Lower Balonne do not reach the Narran Lakes due to irrigation extractions. The protection of mid-sized flows by limiting extractions can enable some water to reach the lakes.

The Commonwealth Environmental Water Office (CEWO) implemented a market-like instrument in the Lower Balonne in early 2020. This involved offering grants to landholders who agreed to forgo pumping of their water allocations to leave water in the system for the environment.

The grant process was run through a community grant hub within a Commonwealth agency. The grants resulted in 9 GL being left in the Narran River, at a cost of \$2 million. This water contributed to the 90 GL of flow into the Narran Lakes system (measured at the Wilby Wilby gauge). The Commonwealth Environmental Water Holder has undertaken a review of the Narran Lakes event to inform future event management.

The CEWO chose to use this reimbursement grant process to enhance flows in the Narran Lakes because the allocation trade (termed seasonal water assignment) processes currently in place in Queensland could not provide the Commonwealth with sufficient allocation or be implemented in a timely manner. Future changes being considered by Queensland should enable such an acquisition to be completed by allocation trade in the future rather than by a grant process.

The grant process to reimburse irrigators who were prepared to forego the conditions on their licences provided the CEWO with the ability to secure the environmental outcome for the Narran Lakes without exposing it to costs greater than would be incurred through trading seasonal allocations.

Other market-based mechanisms will be considered by the CEWO in due course.

Sources: DAWE (pers. comm., 4 September 2020); DAWE (nd).

DRAFT NWI RENEWAL ADVICE 8.7: INNOVATIVE MARKET APPROACHES

Environmental water holders should work with system managers and consumptive entitlement holders to pursue innovative market approaches.

Capacity to vary the entitlement portfolio to match ecological requirements

The mix of different entitlement types held by environmental water holders determines the allocations available for use each year. As discussed above, short-term seasonal variations in the

demand for, and supply of, environmental water can be managed through allocation trading. However, over time, structural entitlement portfolio issues (such as a mismatch between entitlement reliability and environmental demand) can emerge that nimble seasonal allocation trading cannot address. This has implications for achieving agreed environmental outcomes.

Environmental water holders may require the flexibility to re-balance the portfolio of entitlements based on new knowledge of environmental watering requirements. This will only become more important as climate change compels environmental water holders to re-evaluate their approach to environmental management. To achieve the best environmental outcomes, environmental water holders may, from time to time, need to rebalance entitlement portfolios, and should be empowered to do so under very strict controls.

Environmental water entitlements are a major public asset and should not be sold at the cost of diminished environmental outcomes over time. The selling of environmental water entitlements should only occur against a long-term plan of portfolio requirements, under clear guidelines, with cost–benefit analysis, consideration of possible consequential adjustments to catchment sustainable diversion limits and environmental provisions in water plans, a formal approvals process such as ministerial approval and publicly reported trade activity. These processes would provide confidence that selling entitlements will provide net benefits for the environment. This cautious, risk-based approach would mean that entitlement transactions would be expected to be infrequent.

DRAFT NWI RENEWAL ADVICE 8.8: CAPACITY TO VARY ENTITLEMENT PORTFOLIO

Environmental water holders should be enabled to vary their entitlement portfolio over time to match ecological requirements in a changing climate.

Governments should develop clear guidelines on the criteria for selling environmental water entitlements including cost–benefit analysis, consideration of possible consequential adjustments to catchment sustainable diversion limits and environmental provisions in water plans, a formal approvals process and publicly reported trade activity.

Delivery of shared community benefits wherever they are compatible with achieving environmental outcomes

As discussed in section 1.5, environmental watering has benefits beyond individual wetlands and river reaches — it can provide other public benefits that contribute to cultural, social and economic outcomes.

Environmental watering contributes both directly and consequentially to other public benefit outcomes.

- For Aboriginal and Torres Strait Islander people, healthy rivers and wetlands are essential to spiritual, cultural and physical wellbeing. Where environmental and

cultural water outcomes intersect there are opportunities for environmental water holders to directly contribute to achieving cultural outcomes.

- Site-specific watering events can make a direct positive contribution to recreational opportunities such as recreational fishing and canoeing and rowing regattas.
- Environmental watering of rivers, lakes and wetlands provides consequential benefits via contributing to the strength of local economies and to the health and wellbeing of community members.

For example, the Murray–Darling Basin Authority (MDBA) reported that watering events are contributing both directly and indirectly to social and economic outcomes:

Residents in Victoria report that specific environmental watering activities have contributed to, “bumper recreational fishing catches, increased numbers of bird watchers, improved canoeing and rowing regatta conditions, influxes of campers and bush-walkers and a general improvement in the ‘greening’ of scenery encouraging picnickers and day-trippers.” There are also anecdotal reports from site managers and operators of tourism businesses that environmental flows have directly supported a recovery in visitor numbers to specific sites. (MDBA 2017, p. 5)

The NWI recognises the positive externalities of environmental watering under the agreement that environmental water managers should seek opportunities to achieve other public benefit outcomes.¹¹ The Commission’s view is that environmental water holders should contribute to those outcomes where doing so does not compromise environmental objectives. This limit is important because the pursuit of other public benefit outcomes may not always align with decisions on the best use of environmental water (including flow volume, timing of delivery and asset prioritisation) to achieve environmental outcomes. If instances arise where competing public benefit outcomes are thought to be of more value to the community than the environmental watering and associated outcomes that would be forgone, then this needs to be the subject of discussion, agreement and the rebalancing of consumptive allocations in water sharing review processes (SP A Entitlements and planning).

To maximise the benefits of environmental water, explicit consideration should be given to other public benefit outcomes, provided agreed environmental outcomes are not compromised.

Environmental water holders are increasingly planning watering events to deliver other public benefit outcomes, when they are compatible with achieving environmental outcomes. For example, in Victoria, in 2019 a requirement to consider recreational and Aboriginal cultural values during water planning and operations was introduced under the *Water Act 1989* (Vic) (DELWP (Vic) 2019a).

The Victorian Government commented:

When planning for and delivering environmental flows, the VEWH [Victorian Environmental Water Holder] and its program partners look for opportunities to achieve shared community

¹¹ Schedule B(i) defines ‘other public benefits’ as: ‘mitigating pollution, public health (eg. limiting noxious algal blooms), indigenous and cultural values, recreation, fisheries, tourism, navigation and amenity values’.

benefits in both the short and longer-terms, without compromising environmental outcomes. CMAs [Catchment Management Authorities] engage with Traditional Owners, key stakeholders and the local community to provide local knowledge, views and solutions to inform annual environmental watering priorities during the preparation of their seasonal watering proposals and throughout the year. These proposals form the basis of the VEWH's Seasonal Watering Plan, which sets the scope of potential environmental watering across Victoria for the water year. (Victorian Government, pers. comm., 6 October 2020)

A number of inquiry participants¹² also commented that the CEWO's has improved collaboration with First Nations people on environmental water decision making through the First Nations Environmental Water Guidance project. The collaborative project, funded by the MDBA and CEWO, helped to frame the way that First Nations, the MDBA, the CEWO and other environmental water holders do business together in setting annual priorities for the use of environmental water. The project was delivered by Murray Lower Darling Rivers Indigenous Nations and the Northern Basin Aboriginal Nations and involved the engagement of 32 Nations across the MDB (MLDRIN, sub. 105, p. 5).

But despite the positive steps in collaborative processes, MLDRIN (sub. 105, pp. 6–7) reported that there remains a need for improved engagement and transparency in environmental water prioritisation processes.

It is still unclear in many cases how First Nations' inputs are factored into complex decision-making and trade-offs regarding environmental water use. In most cases, the MDBA and water holders are required only to 'have regard to' First Nations values and uses. This weak and opaque terminology can result in confusion and cynicism, with First Nations disappointed that plans and strategies do not necessarily need to reflect their substantive inputs ...

There is still a strong need for the CEWO to develop a more transparent and structured engagement approach so that all Nations are informed of options to participate and influence planning. There are some promising examples of direct collaboration between Nations and the CEWO, including an environmental water delivery agreement with the Ngarrindjeri regional authority.

Environmental water holders have a responsibility to effectively collaborate and transparently communicate decision making on the delivery of shared benefits from environmental water. In particular, environmental water holders should improve engagement and transparency with Traditional Owners on cultural water decision making and outcomes in environmental water planning processes (SP D *Cultural access*). This includes clear and public reporting on where specific cultural benefits sought by environmental water holders have been achieved and where they were not. And this, in turn, should be fed back into planning as part of an adaptive management process.

A further priority for reform relates to the ability to achieve agreed shared benefits during climatic extremes and an increasingly drying climate. During periods of water scarcity, environmental water allocations are reduced, and other public benefit outcomes from environmental watering may be more difficult to achieve. This was the case in some systems

¹² For example: Northern Basin Aboriginal Nations (sub. 17, p. 2-3); Lifeblood Alliance (sub. 70, p. 23) MLDRIN (sub. 105, p. 6).

during the Millennium Drought when cultural, social and amenity values derived from water ecosystems declined and recreational and tourism-based industries suffered as visitor numbers dropped (MDBA 2017, p. 3). To plan for an increasingly drying climate environmental water holders should build upon their knowledge of the potential for environmental water to achieve public benefit outcomes under drying climate scenarios.

DRAFT NWI RENEWAL ADVICE 8.9: ACTIVELY PURSUE PUBLIC BENEFIT OUTCOMES

Environmental water holders should:

- give explicit consideration to other public benefit outcomes, including cultural and social outcomes, where they do not compromise environmental outcomes
- improve collaboration and communication with Traditional Owners on cultural water decision making and outcomes in environmental water planning processes
- report on any instances where specific cultural outcomes were unable to be delivered because they were incompatible with agreed environmental outcomes
- build on their knowledge of the potential for environmental water to achieve shared community benefits under drying climate scenarios.

Good governance, including the independence of environmental water holders and independent audit

The stakes in environmental water management are high. Governments hold entitlements worth billions of dollars — the Commonwealth’s holdings alone are valued at over \$3.3 billion (PC 2018, p. 273). Active management by environmental water holders involves making trade-offs between competing environmental needs at different locations and times. And, these decisions affect regional environments and communities, are of significant interest to other water users and involve substantial funds. As a result, best-practice governance is essential to ensure that environmental water is managed appropriately.

Managers require independence

The NWI recognises that environmental water managers must have ‘the necessary authority and resources’ in order to do their jobs well.¹³ This authority is likely to be best achieved through governance arrangements that provide independence to the entity responsible for managing the water, so that decision making is free from political interference.

In 2017 the Commission recommended that:

- where governments own significant environmental water that can be actively managed, they should ensure that decisions on the use of this water are made by independent bodies at arm’s length from government

¹³ NWI paragraph 78(ii).

-
- the Australian and New South Wales Governments should review governance arrangements to ensure that held environmental water and environmental contingency allowances are managed independently of government departments and political direction, and by statutory office holders with an appropriate range of expertise (PC 2017, p. 162).

Independence that allows environmental water holders to operate at arm's length from government promotes objectivity in decision making and community 'buy in' to environmental water programs.

During the recent drought, it was suggested that the independence of environmental managers (the CEWH and the New South Wales Office of Environmental Heritage) had been put to the test when significant political pressure was placed on the Australian and New South Wales Governments to provide or sell environmental water allocations to irrigators (O'Donnell and Horne 2018). It has also been argued that CEWH governance arrangements proved effective and robust (SMH 2018), signalling the CEWH's independence in decision making.¹⁴ In contrast, it is not clear whether the New South Wales Government's decision to sell 15 GL of environmental water allocation to irrigators within the Gwydir, Macquarie, Lachlan, Murrumbidgee and Murray–Lower Darling valleys in 2018 was the best use for the environment (PC 2018, p. 294).

To ensure accountability, any decision to trade environmental water should be based on an objective and transparent approach that takes into account the environmental condition of key assets and the best use of environmental water, free from political interference. The New South Wales Government should review current governance arrangements to ensure that held environmental water is managed independently of government departments and political direction.

Independent audit is a requirement under the NWI

Independent auditing is important for accountability and adaptive management. The NWI recognises the need for 'periodic independent audit ... of the achievement of environmental and other public benefit outcomes and the adequacy of the water provision and management arrangements in achieving those outcomes'.¹⁵

The National Water Commission (NWC) independently reviewed the arrangements in all jurisdictions for its *Australian Environmental Water Management* reports in 2010, 2012 and 2014. However, these biennial reviews ceased with the abolition of the NWC in 2015.

¹⁴ The *Water Act 2007 (Cth)* part 6, division 1 prevents the CEWH from disposing of water entitlements unless they are surplus to meeting environmental needs at the time. It also stipulates that the CEWH is not subject to the direction of the Department of Agriculture, Water and the Environment or the Australian Minister for Water when undertaking water trading.

¹⁵ NWI paragraph 79(i)(d).

-
- In November 2017, an independent panel (Byron 2017) undertook a *Review of the Commonwealth Environmental Water Holder's Operations and Business Processes*.
 - In 2018, the Victorian Public Sector Commission was commissioned by the Department of Land, Water and Planning Victoria to review the Victorian Environmental Water Holder's first seven years of operation (VEWH 2019, p. 11).

But, there is currently no consistent or regular basis for this activity.

When water functions were transferred from the NWC to the Productivity Commission, the Productivity Commission became responsible for reviewing the NWI and the Basin Plan. But, the audit of environmental water management was not explicitly transferred. The NWI and Basin Plan inquiries are not a substitute for in-depth consideration of environmental water management. Governments with environmental water entitlements should put independent auditing processes in place.

DRAFT NWI RENEWAL ADVICE 8.10: INDEPENDENT MANAGERS AND AUDITING

Where governments own significant held environmental water that can be actively managed they should ensure that decisions on the use of this water are made by independent bodies at arm's length from government.

Governments with held environmental water entitlements should provide for independent auditing, on a three-yearly basis, of the adequacy and use of environmental water entitlements to achieve the best outcomes.

Bringing it together — a visual summary of the active management of held environmental water

The active management of held environmental water is a complex, dynamic process, with multiple steps completed by a range of organisations acting in partnership with environmental water managers. The field of environmental water management has evolved rapidly since 2004 when the NWI was agreed and reform efforts were primarily focussed on the recovery of water for the environment. Today, best-use held environmental water management has evolved to follow a continuous, adaptive management cycle of: planning, active decision making; water delivery; and monitoring, evaluation and reporting. This cycle is summarised in figure 5.

Moving forward, it is important that current best-use practices in water planning are embedded in the NWI and that environmental water managers continue to evolve through experience and adapt to new knowledge (section 4).

Figure 5 The held environmental water active management cycle



Sources: adapted from CEWO (2020c); VEWH (2015).

3 Water system managers should use their best endeavours to achieve agreed outcomes

Section 2.1 presented the need for a waterways manager to provide oversight and work collaboratively with all parties to achieve agreed objectives and outcomes. An important aspect of this involves working collaboratively with water system managers. Water system managers are responsible for managing bulk water resources and operating bulk water infrastructure to meet stated objectives (SP E *Integrity*). Essentially, this involves

maximising the benefits of water use for entitlement holders, the environment and other cultural, economic and social uses (where possible). (The role of the system manager in water resource management is discussed in SP E *Integrity*.)

The decisions and actions of a water system manager can involve making trade-offs that affect water-dependent ecosystems and communities. Achieving agreed (and, where possible, better) environmental and other public benefit outcomes requires a flexible and innovative system manager who is open to experimentation as opportunities arise. This is mostly applicable in actively managed, held water systems where the timing of environmental watering can be crucial to achieving the best use of environmental water. However, even in a planned water system, stakeholders may benefit from a flexible system manager who, for example, is willing to review the timing of planned environmental flows.

In making decisions, a key consideration for the system manager is to ensure that deals are suitable for third parties by avoiding, managing or mitigating impacts to stakeholders, local communities and industries — that is, ensuring that there are no unacceptable third-party impacts.

It is in the interests of all entitlement holders and the community that all opportunities are taken to get the best environmental outcomes possible from the share of water for the environment. The expectation that water system managers should use their best endeavours (while protecting third-party interests) to facilitate the achievement of environmental and other public benefits should be included in the NWI. In practice, this could be achieved through a formal process such as inclusion in a ministerial statement of expectations for water system managers.

For transparency and accountability purposes, governments should report and evaluate system managers' efforts and commitment to facilitate the achievement of agreed environmental and other public benefit outcomes.

Finally, to implement adaptive management through continuous improvement, the system manager should reflect on successes and failures from experimentation among stakeholders and share knowledge to improve practices across systems.

DRAFT NWI RENEWAL ADVICE 8.11: THE SYSTEM MANAGER'S ROLE IN ENVIRONMENTAL MANAGEMENT

Water system managers should be obligated to use their best endeavours, while protecting third-party interests, to achieve agreed outcomes.

State and Territory Governments should report and evaluate system managers' efforts at facilitating the achievement of agreed environmental and other public benefit outcomes.

4 Effective monitoring, evaluation and reporting

Sections 2 and 3 discussed requirements that are crucial to achieve agreed (and, where possible, better) environmental outcomes, ensure accountability and build public confidence in the use of environmental water. Interconnected with these requirements is the need for adaptive management. Knowledge gained through monitoring and evaluation should be used to continuously improve management decisions.

Environmental water management is not set and forget — continual learning and adapting underpins sustainable management. Monitoring, evaluation and reporting as part of an adaptive management process (one that learns from past experience to improve future decisions) should lead to more efficient and effective water use over time. And these activities will only become more important given the uncertainties of a changing climate.

Monitoring, evaluation and reporting are key inputs to ensuring accountability and building public trust and credibility in the way water is managed. They allow informed judgements on the merits of government decisions to allocate water to the environment, whether through planning frameworks or entitlement acquisitions.

Under the NWI, the focus of environmental monitoring, evaluation and reporting is rightly on outcomes. Progress in environmental management cannot be measured by, or simply attributed to, the volume of environmental water allocated or used. It has to be evaluated on the basis of whether agreed environmental outcomes are being achieved.

Ecological complexity makes monitoring agreed environmental outcomes inherently difficult and costly. Therefore, monitoring, evaluation and reporting should be fit for purpose — that is, commensurate with the risk to, and value of, these outcomes to the community.

For example, Tasmania (which has not identified any overallocation) generally faces a low level of risk in meeting agreed environmental outcomes. It therefore has less need to monitor the outcomes of environmental water provision than jurisdictions facing water resource stress. In contrast, in higher risk areas (such as the WA Gngangara Mound) monitoring is critical to ensure these resources are being managed sustainably and adaptively.

However, even in systems without overallocation or resource scarcity, some monitoring of outcomes is necessary to ensure planning arrangements remain adaptive and sufficient to maintain the desired benefits over time.

In complex systems with held environmental water, adaptive management requires greater attention. Managers must make decisions about water use despite significant uncertainty concerning future water availability, ecological responses to water provision and changing on-ground conditions. This inevitably involves trial and error, so it is essential that past learnings are used effectively to inform future decisions. This will only become more important in the future as climate change compels governments to re-evaluate their approach to managing water resources.

In held environmental water systems, monitoring undertaken over different geographic scales and timeframes is required to ensure that the water is used as effectively as possible and to assess whether the costs are justified. Environmental water holders have a responsibility to monitor and evaluate effectively, and to transparently communicate their objectives, work undertaken, outcomes, and consistency with the watering priorities established in planning processes.

Of particular importance is evaluation and reporting on agreed outcomes that have not been achieved. Key areas of monitoring, evaluation and reporting in systems with held environmental water include: environmental water use; the outcomes of watering events; the achievement of ecological outcomes; and monitoring of environmental objectives (to determine if and when management objectives should be revised).

Monitoring of the size of environmental water holdings and use is undertaken through accounting registers — discussed in SP E *Integrity*. Monitoring, evaluation and reporting on the effectiveness of water use is essential for adaptive management and this is discussed in section 4.1.

4.1 Commitment to adaptive management

Adaptive management is widely recognised as a key overarching principle for effective water management, yet it is not reflected in the NWI and therefore warrants a greater focus in future reforms. The Commission is recommending that adaptive management be included as an overarching principle, under the NWI, across all key areas of water resource management and water service provision (*Report*: chapter 3).

Environmental management requires feedback loops to ensure that the knowledge gained through experience, monitoring, evaluation and research continuously improves management decisions. This particularly applies to held environmental water, which requires decision making in the face of uncertainty. Recent shocks are a reminder that experience, evaluation and the sharing of new knowledge is critical to adaptive management and achieving agreed outcomes.

Environmental holders have committed to and are increasingly recognising the value of adaptive management. For example, box 6 describes the adaptive management response to the 2019 fish deaths in the Darling River.

Box 6 Adaptive management case study, 2019 fish deaths

Three significant fish death events occurred in the Darling River near Menindee between December 2018 and January 2019. The events posed a serious ecological shock to the Lower Darling and reversed the positive ecological outcomes that had accrued from past environmental watering programs. The main native fish species impacted included Murray cod, silver perch, golden perch and bony herring, with mortality estimates ranging from of hundreds of thousands to over one million fish (Vertessy et al. 2019, p. 8).

An independent panel (Vertessy et al. 2019) was appointed to assess the causes and influencing factors of these deaths and provide recommendations for future management. Consequent priorities for reform are listed in the table below (MDBA sub. 23, p. 10). Foremost amongst these is the recognition of the importance and protection of low flows.

<i>Priorities for policy makers</i>	<i>Priorities for Basin water managers</i>
The protection of low flows	Emergency native fish response and early warning systems
Basin connectivity	Ongoing monitoring
Improving Menindee operations	Collaboration with key stakeholders
Provide joint plans for Northern Basin Toolkit Measures	Management of water for the environment
Increase investment in research and development	Climate change research

In response to the fish deaths, the Australian Government and Basin States have developed the *Native Fish Recovery Strategy* to guide future investment and achieve four key outcomes:

- recovery and persistence of native fish
- threats to native fish are identified and mitigated
- communities are actively involved in native fish recovery
- recovery actions are informed by best available knowledge (MDBA 2020c).

The Australian Government has also injected \$20 million into the *Murray–Darling Water and Environment Research Program* to strengthen scientific knowledge of the Murray–Darling Basin (MDBA 2020e).

And the MDBA (sub. 23, p. 10) has adapted and improved its management activities.

Significantly improved planning and management arrangements for the MDBA were put in place across the 2019-20 summer period to act as our early warning and emergency response system. Across this high-risk period, the MDBA implemented a planned process of sharing information with states to understand risk trajectories and pre-emptive management responses; reporting regularly to MDBA Executive; and triggering urgent advice to the Minister for Water as required. These processes were invaluable both in the context of the higher risk to native fish during summer under drought conditions and also as the bushfire season placed additional pressure on the quality of the Basin’s water resources. The MDBA notes the considerable efforts by the Basin states in managing native fish throughout this period, and the spirit of collaboration and information sharing committed to by all stakeholders.

In 2017, the Commission identified that further work on monitoring of environmental outcomes, reporting and auditing was required. In particular, the Commission reported that although there have been some positive developments, some jurisdictions should increase their focus on outcomes, and report more openly about instances where objectives are not achieved (PC 2017, pp. 166–167).

Since 2017, there has been an increased focus on the monitoring and reporting of environmental outcomes. For example, in Queensland, new water plans now include a measure to develop a Monitoring, Evaluation and Reporting Strategy which sets out evaluation questions, monitoring objectives and information to be collected over the life of the water plan. This informs and assists in the evaluation of the plan and whether its outcomes have been achieved (*Assessment*).

A number of inquiry participants noted improved efforts in monitoring, evaluation and reporting. The Australian Floodplain Association (AFA) (sub. 45, p. 8) commented:

The AFA was impressed with the monitoring and reporting to the community throughout the 2019 Northern Fish Flow event. We commend the Commonwealth Environmental Water Holder for ensuring timely and transparent reporting to interested stakeholders and communities. The AFA recommends that this ‘high-bar’ set a standard for future reporting.

But others stipulated that gaps in monitoring, evaluation and reporting remained in some systems. Lachlan Valley Water (LVW) (sub. 40, p. 4) stated:

LVW believes that the monitoring could be improved. We recommend that an important requirement of monitoring and evaluation programs should be that they must clearly identify the change in conditions as a result of climatic variation, and as far as possible they should distinguish between the additional environmental outcomes achieved as a result of the use of water entitlements held by Commonwealth and state governments, and the outcomes that have occurred as a result of planned environmental water that was already available due to state based water sharing plans.

And the Wentworth Group of Concerned Scientists (sub. 68, p. 2) reported:

The NWI should focus on transparency to improve decision-making, including systematic monitoring of ecosystem information and management ...

The body of knowledge about environmental watering has grown significantly in recent years, but increased effort on monitoring, evaluation and reporting would build on this and enable environmental water managers to improve management and ensure that water for the environment is used effectively and accountably (*Assessment*).

An ongoing commitment to adaptive management through monitoring, evaluation and reporting is key to achieving agreed outcomes. Governments should establish mechanisms to ensure adaptive management is implemented consistently and explicitly in practice. Jurisdictions should focus on outcomes, and publicly report on agreed outcomes that are not achieved, in addition to those that are, and the reasons why. In the context of a changing climate, progress on agreed outcomes and monitoring of objectives will become an increasingly important input into water planning processes.

Finally, managers of held environmental water should use the results of monitoring, evaluation and research to improve water use as part of an adaptive management cycle. To achieve this, adaptive management should be adequately resourced.

DRAFT NWI RENEWAL ADVICE 8.12: COMMITMENT TO ADAPTIVE MANAGEMENT

In planned environmental water systems, State and Territory Governments should:

- establish mechanisms to ensure that adaptive management is implemented consistently and explicitly in practice
- ensure adequate monitoring, evaluation and reporting efforts on agreed environmental outcomes, and report openly about instances where these outcomes are not achieved.

Environmental water holders should:

- use the results of monitoring, evaluation and research to improve water use as part of an adaptive management cycle and ensure that this is adequately resourced
- publicly report on environmental water use, the outcomes of watering events, the achievement of ecological outcomes, and monitoring of objectives.

References

- ABS (Australian Bureau of Statistics) 2016, State and Territory (STE) ASGS July 2016 Digital Boundaries in ESRI Shapefile Format, Cat. no. 1270.0.55.001, Canberra.
- Acreman, M. 2016, 'Environmental flows - basics for novices', *WIREs Water*, vol. 3, no. 5, pp. 622–628.
- , Jain, S., McCartney, M. and Overon, I. 2017, 'Drivers and Social Context', *Water for the Environment: From Policy and Science to Implementation and Management*, 1st edn, Elsevier.
- BDAGroup and CSIRO 2017, *A Comparative Assessment of Event-Based Mechanisms for Providing Water to the Narran Lakes*, Prepared for the Commonwealth Environmental Water Office, Canberra.
- Byron, N. 2017, *Review of the Commonwealth Environmental Water Holder's Operations and Business Processes*, Natural Capital Economics.
- CEWO (Commonwealth Environmental Water Office) 2011, *Commonwealth Environmental Water - Trading Arrangements*, Discussion Paper, Canberra.
- 2020a, *Environmental Water Holdings*, www.environment.gov.au/water/cewo/about/water-holdings (accessed 10 September 2020).
- 2020b, *Recent Highlights from the Flow-MER Program*, www.environment.gov.au/water/cewo/monitoring/highlights (accessed 17 September 2020).
- 2020c, *Water Management Plan 2020-21*, Canberra.
- Chen, Y., Colloff, M.J., Lukasiewicz, A. and Pittock, J. 2020, 'A trickle, not a flood: environmental watering in the Murray–Darling Basin, Australia', *Marine and Freshwater Research*, no. MF20172, p. A-S.
- DAWE (Department of Agriculture, Water and the Environment) nd, *Rebuilding waterbird habitat - Narran Lakes*, www.environment.gov.au/water/cewo/catchment/rebuilding-waterbird-habitat-narran-lakes (accessed 6 October 2020).
- DELWP (Vic) (Department of Environment, Land, Water and Planning (Vic)) 2019a, *Protecting Recreational and Aboriginal Water Values*, www.water.vic.gov.au/media-releases/2019/protecting-recreational-and-aboriginal-water-values (accessed 19 November 2020).
- 2019b, *Waterways and catchments*, www.water.vic.gov.au/waterways-and-catchments/rivers-estuaries-and-waterways/strategies-and-planning (accessed 31 August 2020).
- 2020a, *Monitoring Water for the Environment in Victoria VEFMAP Stage 6 Results 2016-2020*.
- 2020b, *Victorian Water Accounts - 2018-19*.
- DENR (NT) (Department of Environment and Natural Resources (NT)) 2020a, *Approved Extraction Licenses*, Water register.

-
- 2020b, Water Allocation Plan, <https://nrmaps.nt.gov.au/nrmaps.html> (accessed 8 October 2020).
- DEPI (Vic) (Department of Environment and Primary Industries (Vic)) 2013, An Overview of the Victorian Waterway Management Strategy, Melbourne.
- DEW (SA) (Department for Environment and Water (SA)) 2020, South Australian River Murray WRP Held Environmental Water Register (June 2020), www.environment.sa.gov.au/topics/river-murray/improving-river-health/environmental-water#:~:text=There%20is%20no%20held%20environmental,areas%20as%20of%20June%202020. (accessed 8 October 2020).
- DNRME (Qld) (Department of Natural Resources, Mines and Energy (Qld)) 2020, Water plan areas - Queensland, <http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={8DCF83BC-A683-4403-B8C9-F07DE7838640}#> (accessed 8 October 2020).
- Doyle, K., Baumgartner, L., Silva, L.G.M., Pearce, L. and Ning, N. 2020, 'Before and after: see how bushfire and rain turned the Macquarie perch's home to sludge', *The Conversation*, 13 July.
- DPIE (NSW) (Department of Planning, Industry and Environment (NSW)) 2019, Cumulative water for the environment holdings ('held') recovered to 30 June 2017 (megalitres), www.environment.nsw.gov.au/topics/water/water-for-the-environment/about-water-for-the-environment/current-water-holdings (accessed 8 October 2020).
- DPIPWE (Tas) (Department of Primary Industries, Parks, Water and Environment (Tas)) 2020, Water Management Plan Areas, <https://listdata.thelist.tas.gov.au/opendata/> (accessed 8 October 2020).
- DWER (WA) (Department of Water and Environmental Regulation (WA)) nd, Managing our waterways, www.water.wa.gov.au/water-topics/waterways/managing-our-waterways2 (accessed 3 August 2020).
- 2020, RIWI Act Proclaimed Areas, <https://atlases.water.wa.gov.au/idelve/dowdataext/download/default.html> (accessed 8 October 2020).
- Hart, P.B. and Butcher, D.R. 2018, Commonwealth Long-Term Intervention Monitoring Project: Stage 1 Mid-Term Review and Evaluation, Department of Agriculture, Water and the Environment.
- Hawke, T., Bino, G. and Kingsford, R.T. 2020, A National Assessment of the Conservation Status of the Platypus, Prepared for the Australian Conservation Foundation, WWF-Australia and Human Society, University of New South Wales.
- Hayter, Melinda 2020, 'Gayini Nimmie Caira wetlands "Kakadu of the South" awash with life thanks to winter watering', *ABC News*, 2 September.
- Joint Basin Governments 2019, Response to the Productivity Commission Inquiry Report: Murray-Darling Basin Plan: Five Year Assessment, Canberra.
- MDBA (Murray-Darling Basin Authority) 2011, *The Living Murray Story: One of Australia's Largest River Restoration Projects*, Canberra.

-
- 2017, Social and economic benefits from environmental watering, 50/17, Canberra.
- 2019a, Basin-wide Environmental Watering Strategy, second edition, Canberra.
- 2019b, First Nations People participation in environmental watering, 56/19, Canberra.
- 2020a, Annual Progress Report 2020: Sustainable Diversion Limit Adjustment Mechanism, 26/20, Canberra.
- 2020b, Progress on Water Recovery, www.mdba.gov.au/managing-water/environmental-water/progress-water-recovery (accessed 8 October 2018).
- 2020c, The Native Fish Recovery Strategy, www.mdba.gov.au/managing-water/drought-murray-darling-basin/native-fish-recovery-strategy (accessed 1 September 2020).
- 2020d, Transition Period Water Take Report 2018-19, Report on Cap Compliance and Transitional SDL Accounting, 38/20, Canberra.
- 2020e, Murray-Darling Water Environment Research Program, www.mdba.gov.au/discover-basin/science-research/murray-darling-water-environment-research-program (accessed 1 September 2020).
- NRC (NSW) (Natural Resources Commission (NSW)) 2019, Review of the Water Sharing Plan for the Barwon Darling Unregulated and Alluvial Water Sources 2012, Final Report, NSW Government, Sydney.
- O'Donnell, E. and Horne, A. 2018, 'Giving environmental water to drought-stricken farmers sounds straightforward, but it's a bad idea', *The Conversation*, 18 September.
- PC (Productivity Commission) 2017, National Water Reform, Report no. 87, Canberra.
- 2018, Murray-Darling Basin Plan: Five-year Assessment, Report no. 90, Canberra.
- SCEBWC (The Southern Connected Basin Environmental Water Committee) 2019, Southern Connected Basin Environmental Water Committee Annual Report 2018-19, www.mdba.gov.au/publications/mdba-reports/southern-connected-basin-environmental-water-committee-annual-reports (accessed 17 September 2020).
- Silva, L.G.M., Pearce, L., Mabon, S., Horta, A., Duffy, D., Kopf, S., Ning, N. and Baumgartner, L.J. 2018, Macca's in the Mannus, Macquarie Perch Refuge in the Upper Murray, Institute for Land, Water and Society Charles Sturt University.
- SMH (Hannam) 2018, 'Federal agency pushes back at Barnaby Joyce's environmental water grab', *Sydney Morning Herald*, 29 August.
- The Nature Conservancy 2018, Nimmie-Caira – a Giant Win for Nature, the Local Economy and Indigenous Reconnection to Country - Media Statement, www.industry.nsw.gov.au/__data/assets/pdf_file/0004/161770/The-Nature-Conservancy-Nimmie-Caira-media-statement.pdf (accessed 25 September 2020).
- Thurgate, N., Mynott, J., Smith, L. and Bond, N. 2019, Murray-Darling Basin Environmental Water Knowledge and Research Project, Synthesis Report, p. 41.

-
- Vertessy, R., Barma, D., Baumgartner, L., Mitrovic, S., Sheldon, F. and Bond, N. 2019, Independent Assessment of the 2018-19 Fish Deaths in the Lower Darling.
- VEWH (Victorian Environmental Water Holder) 2015, What does environmental watering involve?, www.vewh.vic.gov.au/__data/assets/pdf_file/0004/342535/4.2.04-FS04_What-does-environmental-watering-involve_SWP_FS.pdf (accessed 20 June 2020).
- 2018, Submission to the Inquiry into the Management and Use of Commonwealth Environmental Water, Submission no. 41, Melbourne.
- 2019, Annual Report 2018-19, Melbourne.
- 2020a, Seasonal Watering Plan 2020-21, Melbourne.
- 2020b, Where do environmental water entitlements exist in Victoria?, <https://vewh.vic.gov.au/watering-program/how-much-water-is-available> (accessed 8 October 2020).
- Walker, D.J. 2002, The Behaviour and Future of the River Murray Mouth, Adelaide University, Adelaide.
- Weill, A. 2018, One Way to Save Birds: Pay Farmers to Flood Their Land, www.kqed.org/science/1927677/how-pop-up-wetlands-helped-birds-through-californias-5-year-drought (accessed 25 November 2020).