



Environmental Water Delivery Mechanism Documentation and Assessment to Increase Transparency and Trust

Final report

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Summary

Recommendation 18 of the Australian government's *Water Market Reform: Final Roadmap Report* addressed the need for improved transparency around environmental water delivery. It recommended that:

The Basin Officials Committee – in consultation with the Commonwealth, Basin states and environmental water holders – should increase transparency about how held environmental water trade, transfer and delivery is managed and communicated. This should include communicating the volume of environmental and other water flows in the system at any time.

This recommendation was aimed at addressing misconceptions, improving public understanding of environmental water management, and increasing trust and confidence in river operations. In 2024, the Department of Climate Change, Energy the Environment and Water (DCCEEW) established a Commonwealth-led project with the Murray-Darling Basin Authority (MDBA) to address both Recommendation 18 and informing Basin Plan Review's assessments of HEW delivery and transparency. The scope of works for this project was developed in consultation with a wide range of stakeholders, including Basin states.

This report provides a summary of the following matters in relation to the delivery of Held Environmental Water (HEW):

- all current formal and informal environmental water delivery mechanisms
- any potential third party impacts of each mechanism and the mitigations strategies in place to address these risks
- areas where environmental water delivery mechanisms may benefit third parties.
- the channels used to communicate environmental water delivery mechanisms
- existing processes for the provision of environmental water delivery data

The report also assesses the adequacy of third party risk mitigations and identifies a number of opportunities to improve the communication of environmental water delivery mechanisms and delivery data.

Environmental water delivery mechanisms

Environmental water delivery using HEW in regulated water systems has a number of features which are markedly different to consumptive water delivery. In recognition of the different characteristics of environment water deliveries compared to traditional consumptive deliveries, a range of new delivery mechanisms have been developed to meet these needs.

In unregulated water systems, releases from storages are not possible for any form of entitlement water, including held environmental water (HEW), as there are no regulating structures to control flow. The key management choice available to water entitlement holders is to divert water (pump) if the flow trigger levels on their licence are met, or alternatively refrain from pumping. When unregulated water entitlements are acquired for HEW, the environmental water manager's option to benefit the environment involves refraining from extracting the water and leaving it instream to improve environmental outcomes. To achieve these outcomes, the water left instream must also be protected from extraction by downstream consumptive users.

The key environmental water delivery mechanisms currently in use are:

1. *Standard (trade and delivery) mechanisms:*

Environmental water is regularly diverted out of the river channel during periods of regulated river operation into an environmental feature (e.g. a wetland) in the same way that a consumptive diversion to supply an irrigated crop occurs (i.e. through a water meter or other standardised measurement structure).

Environmental Water Holders (EWHs) may also wish to move water allocations held in one system to a different system for future delivery to an environmental site. This is directly analogous to the situation faced by many consumptive water users, and EWHs meet this need using standard water trade processes, under the same rules as apply to all other water access rights holders.

2. *Prerequisite Policy Measures*

A key assumption made in developing the Basin Plan was that rivers would be managed to maximise environmental outcomes with the held environmental water available without impacting on the reliability of other water users. Two key policy measures were developed to enable the improved use of environmental water in regulated water systems. These measures are known as Prerequisite Policy Measures (PPMs) and states were required to implement arrangement that would enable:

- credit of environmental return flows for downstream environmental use; and
- the call of held environmental water from storage during unregulated flow events.

Each state and the MDBA developed and implemented PPMs in accordance with their respective state water legislation frameworks and within the provisions of the MDB Agreement in the case of the River Murray system. While the details of how the PPMs were given effect differ in each state, the fundamental mechanisms that were put in place for environmental water delivery are the same in each jurisdiction. There are two key mechanisms that give effect to the PPMs – directed releases from storages and return flow credits. PPMs are currently only available for use by environmental water managers in regulated systems within the southern connected Murray-Darling Basin (MDB).

3. *Active Management*

In unregulated river systems, there are no public storages from which held environmental water can be called. However, recovery of water licences can be used to designate or claim a proportion of river flows for environmental purposes, and a process to protect those flows is needed. Active management is a daily operational process that has been developed by WaterNSW to operate each day in all unregulated river reaches where water sharing and protection of water for environmental benefits is required. The process includes:

- an on-line portal for licence holders to place expressions of interest to take water,
- a decision support system to assess flows and losses in each river reach, forecast flows, and calculate how much water can be taken without impacting on HEW, and

- announced access to available water for each class of licence access that will ensure that HEW is protected.

4. *Qld unregulated systems*

The Lower Balonne is an unregulated river system where a significant volume of the water use in the Queensland portion of the Murray-Darling Basin occurs. In this river system, water access is subject to a system of flow windows and announced access periods to share water between licensed water users. The Commonwealth has recovered significant volumes of licensed entitlement in this area, and the use of flow windows and access announcements allows the water to be accounted against the Commonwealth's entitlements but left in the river without being taken by other licences.

Queensland have used the water allocation rules embedded in the water plans for the Condamine Balonne catchment (including hydrologic modelling) for the trade of water licences in the Lower Balonne to create a "virtual licence" at the NSW-Queensland border on each of the intersecting streams to account for the HEW. Following the water allocation dealing rules to establish the virtual entitlement ensures that the trade complies with key provisions in the water plan for the Environmental Flow Objectives, Water Allocation Security Objectives and there is no increase in take of water. The announced access arrangements apply to these virtual water entitlements for the purposes of accounting the volume of HEW passing the Queensland-NSW border. This provides a basis for protecting environmental flows arising from the Commonwealth's entitlements that is not in place in unregulated rivers more generally. It also provides a basis for recognising environmental flows into NSW that can be protected under Active Management.

Third party risks and mitigations

An important consideration in the development of environmental water delivery mechanisms is the avoidance of unacceptable impacts to third parties.

The key categories of third party risk that have the potential to arise from environmental water delivery are:

- Reliability risks – actions that reduce the overall water available to other entitlement holders as a result of environmental water deliveries.
- Environmental risks – adverse impacts to rivers and ecosystems resulting from environmental water delivery.
- Deliverability risks – impacts on the ability to deliver water from storages to other users. It is also noted that deliverability may largely be a dynamic risk, strongly influenced by overall demand for water and flows in the river system at the time of a delivery event.
- Operational risks - Risks like inundation of private land, reduced recreational access, or cultural site impacts may arise depending on how, when and where water is delivered.

Overall, there has been significant attention directed to identification and mitigation of potential third party risks associated with environmental water deliveries. This review found that all areas of significant risk had been identified, and the mitigations put in place under various environmental delivery mechanisms were all deemed to be effective and appropriate to the identified risks. Nevertheless, some opportunities to further improve the risk mitigations were identified.

Communication of e-water delivery mechanisms

The practice of environmental water management is still a relatively new discipline, with the first significant environmental entitlements that provided a measure of discretion around the timing and volume of their release having only been created at the start of the 21st century. It is expected that the ongoing development of new environmental water delivery mechanisms will continue.

This review found that information on existing environmental water delivery mechanisms is generally available in some form in all jurisdictions. However, it was noted that:

- The available information generally provides the what but not the why for environmental water delivery mechanisms. The published information usually describes the water delivery and accounting processes but may not speak to the intent or underlying objectives of the mechanisms.
- The current descriptions of delivery mechanisms are often incorporated into system operating rules, manuals or procedures. These documents have largely been written for specific purposes including guidance to river operators or for detailed assessment for compliance with Basin Plan requirements. They tend to be lengthy and have not been written with an interested general public audience in mind, so are not particularly user friendly.
- The information on environmental water delivery mechanisms is distributed across a range of websites, and is not generally easily accessible.
- Jurisdictions provide different levels of detail on environmental delivery mechanisms.

There is considerable scope for improvements in the communication of environmental water delivery mechanisms.

Provision of e-water delivery data

There is a strong interest from a wide range of stakeholders around understanding the timing, location and quantum (volume and flowrate) of environmental water deliveries. In addition to understanding where, when and how much environmental water is delivered, there is also interest in understanding the outcomes achieved through delivery of environmental water.

It was found that all jurisdictions provide information on environmental water deliveries at an annual scale. Available allocation and cumulative usage of HEW throughout the water year (separated from available consumptive pool data) is provided at a water system scale in NSW and Victoria. Provision of this data separately, rather than being lumped together with consumptive water as total water available, allows water market participants to more clearly identify the volumes of water available in the consumptive pool and provides insights into the potential supply of water that may be available for trade in the allocation market.

Environmental water holders and catchment management authorities generally report on the location and timing of watering events planned and/or in progress and completed and in many cases (but not all) indicate the volume of water planned to be delivered, or actually delivered in watering events across their jurisdictions.

Near real time environmental flow data refers to information on the component of flows in river systems that are for purposes of environmental water delivery. This is an area of significant interest to many stakeholders, and river operators advise that there are frequent enquiries from the public

seeking information on the drivers of river flows. There is particular interest in understanding what component of the total flow is due to environmental water delivery.

This is also the area where the community is least well served by available information. There is a significant amount of information available on total flows in river systems. Unfortunately, information on how much of the total flow is environmental water (or consumptive water) is not readily available. To be meaningful, near real time environmental flow data needs to be presented within the context of the total flow regime in the river system.

The other important finding is the disjointed, widely distributed nature of available environmental flow and usage data, which is scattered across a range of organisations and websites. This makes it difficult for interested stakeholders to access data, especially when looking at multiple valleys or across jurisdictions in relation to connected water systems. Some form of more centralised data provision or more seamless linking of data sources, coupled with development of near real time environmental flow data systems will offer significant improvement in transparency and support improved stakeholder confidence in environmental water management.

1. Introduction

In 2019, the Australian government directed the Australian Competition and Consumer Commission (ACCC) to undertake a wide-ranging review of Murray-Darling Basin water markets. The review was conducted over an 18 month period, and the final report and recommendations from the review were released in March 2021. In particular, the ACCC made recommendation 23, to implement clear and integrated mechanisms for delivery of environmental water, described in Box 1.

Box 1

ACCC Recommendation 23: Implement clear and integrated mechanisms for delivery of environmental water

Basin States, in collaboration with the MDBA and the Commonwealth and State environmental water holders, should better integrate environmental watering arrangements into trading arrangements and market design, including by:

ensuring that trading and delivery arrangements are not contingent on the intended use of the water, including by making available arrangements currently only open to environmental water holders to consumptive water users, where possible, and ensuring neither consumptive or environmental users are given preference over the other

- committing to explicitly assess and address likely impacts on water markets, landholders or the environment of any new trading or delivery arrangements developed in future
- clearly and consistently accounting for environmental trade and delivery across Basin States
- developing a transparent policy position on how and when environmental water holders, and consumptive users, should use trade mechanisms to move water, and clearly articulating how movements of water within and outside of the trading framework affect trade opportunities, particularly for interzone trade opportunities governed by restrictions.

This will contribute to developing arrangements and tools to deliver environmental water in ways that help improve transparency and confidence, and alleviate system congestion.

The Australian government subsequently initiated a process to develop a roadmap for implementing water market reforms, having regard to the ACCC report and recommendations. The *Water Market Reform: Final Roadmap Report* was released in October 2022. It contained 23 recommendations aimed at strengthening and improving the performance of Basin water markets.

Recommendation 18 of the Roadmap addressed the need for improved transparency around environmental water delivery. It recommended that:

The Basin Officials Committee – in consultation with the Commonwealth, Basin states and environmental water holders – should increase transparency about how held environmental water trade, transfer and delivery is managed and communicated. This should include communicating the volume of environmental and other water flows in the system at any time.

This recommendation was aimed at addressing misconceptions, improving public understanding of environmental water management, and increasing trust and confidence in river operations.

In 2024, the Department of Climate Change, Energy, the Environment and Water established a Commonwealth-led project with the MDBA to address both Recommendation 18 and informing Basin Plan Review's assessments of HEW delivery and transparency. The scope of works was developed in consultation with a wide range of stakeholders, including Basin states¹, EWC, TWG, CEWO, and river management subject matter experts. In 2025, the MDBA engaged DG Consulting in partnership with Paul Simpson Consulting, to prepare a report.

¹ Basin states are defined as New South Wales, Queensland, South Australia, Victoria and the Australian Capital territory

2. Project Methodology

The project methodology was designed around two key stages.

Stage 1 involved the development of a stocktake, which reviewed:

- all current formal and informal ² environmental water delivery mechanisms
- the mitigation of third-party risks associated with identified mechanisms, covering:
 - o third party impacts of each mechanism and the mitigations strategies in place, and
 - o areas where environmental water delivery mechanisms may benefit third parties.
- the channels used to communicate environmental water delivery mechanisms
- existing processes for the provision of environmental water delivery data, including identification of any current limitations or constraints on data provision that impact on transparency.

The Stage 1 stocktake aimed to provide a clear, concise picture of current arrangements. This information is set out Section 3 and Appendices 1 - 3 of this report.

Stage 2 built on the stocktake to provide findings and identify potential opportunities for improvements relating to:

- identification of any areas where third party risks are not currently fully mitigated or are insufficiently mitigated, and potential measures to mitigate any identified issues.
- opportunities for improved public communication on environmental water delivery mechanisms that could increase transparency, confidence, and trust.
- opportunities for potential improvements to the provision of environmental water delivery data aimed at also improving transparency, confidence, and trust.

This information is set out in Section 4 of this report.

Delivery Mechanisms in Scope: The project's focus was on exploring and documenting the primary delivery mechanisms used for Held Environmental Water (HEW) delivery in and from bulk water supply systems, including rivers and waterways. Delivery arrangements for Planned Environmental Water (PEW) and delivery of environmental water through irrigation supply networks and to private wetlands were out of scope for this review.

This review relied on information and advice generously provided by river operators and environmental water managers from Basin states and the MDBA via a guided interview and survey process, however the findings and opportunities for improvement were developed independently by the review team³.

² Informal delivery mechanisms refer to actions that are being trialled or are in use from time to time, but have not been included in formal approved operating procedures or documents

³ As part of their consulting roles or involvements with state water resource management agencies, the reviewers may have knowledge of or prior exposure to some water management matters that are addressed in the review. A reviewer with a potential conflict of interest in relation to an issue did not participate in development of findings on that issue.

3. Environmental water delivery mechanisms

Over time, the health of the Basin river systems has declined due to a range of factors. The primary aim of environmental water management is to protect and improve the environmental condition of these rivers and wetlands and ensure that they are sustainable systems that can continue to provide the wide range of benefits that Basin communities rely on.

Environmental water delivery using HEW in regulated water systems⁴ has a number of features which are markedly different to consumptive water delivery. Some of the major differences relevant to environment water deliveries include:

- Environmental water deliveries can involve very large volumes of water in a single delivery event.
- The duration of a delivery event can be significantly longer than for a typical consumptive delivery. Delivery of large volumes to a major wetland complex like Barmah-Millewa forest may require an event that extends for several weeks or even multiple months.
- Deliveries often occur at times when consumptive demand is low, including winter. Environmental water may also be delivered during or immediately after widespread rainfall events to supplement natural inflows to the river systems.
- There may be a number of different parties involved in a delivery event. Multiple Environmental Water Holders (EWHs) may partner and contribute environmental water volumes to support a major delivery event, especially where water is delivered to sites in different states along the River Murray system.
- While some environmental deliveries may involve diverting water out of the main river channel into a wetland, many delivery events involve releasing water into the river channel and allowing it to flow through the length of the river system in order to support in-stream environmental outcomes, including longitudinal connectivity, improving fish habitat and fish passage and maintaining bank vegetation (see Figure 1).
- Given the scale of the volumes involved, the geographic scope of large events, together with the potential for significant interaction with tributary inflows, large environmental water delivery events are all different, and there is no “standard” delivery event. Each large event requires careful planning and management by EWHs and river operators.

In recognition of the different characteristics of environment water deliveries compared to traditional consumptive deliveries, a range of new delivery mechanisms have been developed to meet these needs. While the delivery mechanisms for the environment may be different, this could also be viewed as the latest iteration of an underlying process of developing delivery arrangements that meet the needs of different water users which has been ongoing since the initial establishment of major water resource developments in the early 20th century.

In unregulated water systems⁵, releases from public storages are not possible for any form of entitlement water, including held environmental water (HEW), as there are no regulating structures to control flow. The key management choice available to water entitlement holders is to divert water (pump) if the flow trigger levels on their licence are met, or alternatively refrain from pumping. When unregulated water entitlements are acquired for HEW, the environmental water

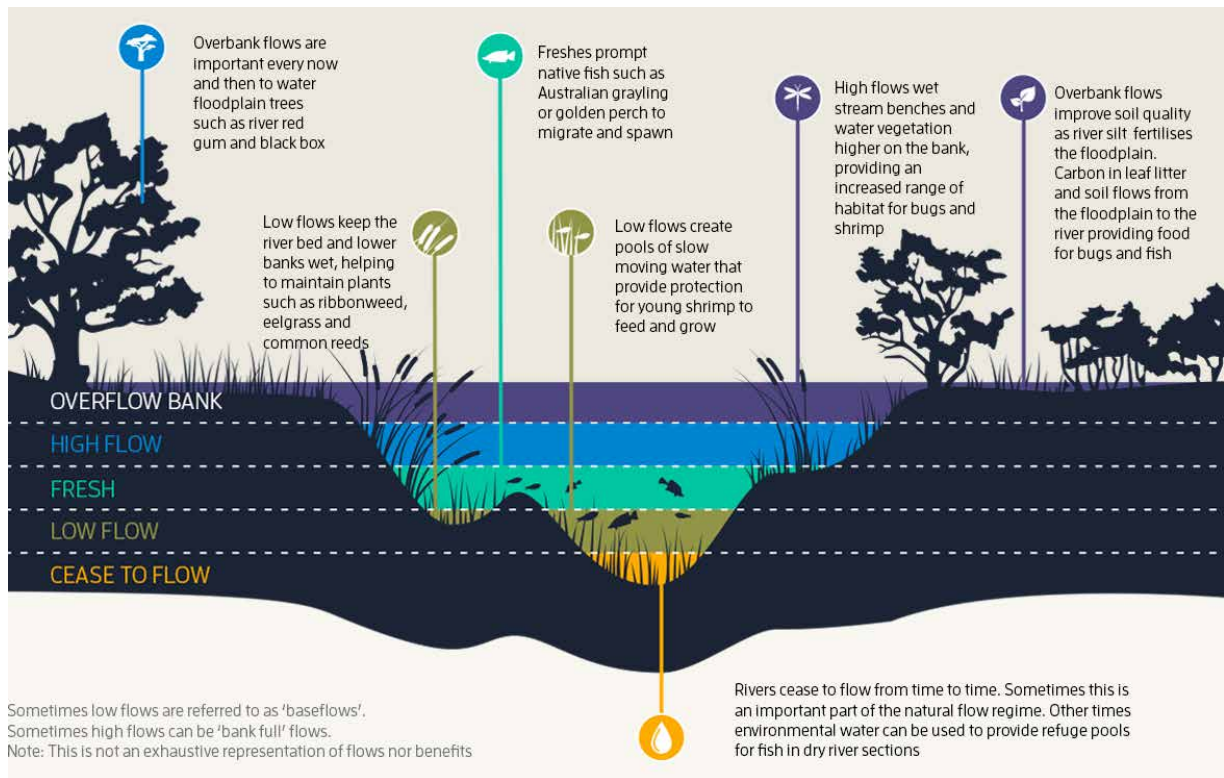
⁴ Regulated water systems are those systems where publicly owned storages are operated to provide for the water needs of downstream water access rights holders. These systems are also known as supplemented systems in Qld.

⁵ Unregulated systems have no publicly owned storages to regulate flows to meet the needs of downstream rural users. Water availability is governed by catchment inflows to the stream system (known as unsupplemented systems in Qld.)

manager’s option to benefit the environment involves refraining from extracting the water and leaving it instream to improve environmental outcomes. To achieve these outcomes, the water left instream must also be protected from extraction by downstream consumptive users.

Each of the Basin states have provided detailed information in relation to the environmental water delivery mechanisms they employ, and these are tabulated in Appendix 1. The key features of these delivery mechanisms used are described in summary in the following sections.

Figure 1: Benefits of different environmental flows in rivers



Source: VEWH website

3.1. Standard (trade and delivery) mechanisms

As noted above, some environmental deliveries in regulated systems can have many features that are quite different to consumptive deliveries. However, environmental water is regularly diverted out of the river channel during periods of regulated river operation into an environmental feature (e.g. a wetland) in the same way that a consumptive diversion to supply an irrigated crop occurs (i.e. through a water meter or other standardised measurement structure).

There are a range of different arrangements that may be encountered, including pumping from the river channel into the environmental site, or diversion by gravity through a regulating structure. In these situations, the delivery is generally managed using the same metering arrangements and water accounting processes as consumptive deliveries. In these situations, there are no additional risks of unintended third party impacts, as the same well developed and tested methods are applied as are widely used for consumptive deliveries across the basin.

EWHS may also wish to move water allocations held in one system to a different system for future delivery to an environmental site. This is directly analogous to the situation faced by many consumptive water users, and EWHS meet this need using standard water trade processes, under the same rules as apply to all other water access rights holders. Once the water has been traded into the destination system, the delivery can be planned and ordered for delivery in accordance with the established water management arrangements for that system.

Allocation trades are also frequently used to transfer water to the appropriate EWH for delivery to a particular site (i.e. where this involves diversion of water out of the river channel into an environmental site). The CEWH holds water entitlements in many systems across the Basin, however for delivery to environmental sites in a particular state, the CEWH allocations must be transferred into the allocation accounts of the relevant state based EWH for delivery⁶. State EWHS have the necessary legal powers for water deliveries, the required works and licences for delivery to environmental sites and have well developed relationships and delivery agreements with environmental site managers (e.g. National Parks services or crown land managers) that are necessary for deliveries to occur. These water trades are made in accordance with the standard water trading rules applying in each jurisdiction for trades within a trading zone and for intervalley trading. It is worth noting that Queensland and the ACT are exceptions in that they do not have environmental sites that water is diverted into, with environmental water instead remaining instream.

⁶ Note that in some NSW and Queensland valleys, where the water is to remain instream rather than being diverted into an environmental site, the release can be delivered directly from a CEWH allocation account, rather than needing to transfer the allocation to a state EWH.

3.2. PPMs

In developing the Basin Plan, modelling of the expected benefits associated with increased environmental water availability was based on a range of assumptions. A key assumption was that rivers would be managed to maximise environmental outcomes with the held environmental water available without impacting on the reliability of other water users. From 2010 onwards, this approach was explored and tested by the MDBA in collaboration with NSW, Victoria and South Australia through the multi-site environmental watering trials in the River Murray system.

As a result, the Sustainable Diversion Limits (SDLs) determined in the Basin Plan were developed on the basis that two key policy measures to enable the improved use of environmental water in regulated systems would be implemented by the Basin states. These unimplemented policy measures were identified in Section 7.15 of the Basin Plan. The unimplemented policy measures are now referred to as Prerequisite Policy Measures (PPMs). The measures set out in the Basin Plan are:

- i. credit environmental return flows for downstream environmental use (PPM 1); or
- ii. allow the call of held environmental water from storage during unregulated flow events (PPM 2);

The first PPM recognises that when water is delivered into many large environmental sites such as wetlands, a significant portion of the volume delivered returns to the river from the wetland or floodplain through a range of natural channels. PPM 1 enables this volume of water returning to the river to be assessed and then reused at additional environmental sites downstream, without affecting the volumes available in the river system for other users. The process of crediting return flows for downstream use can also be applied to in-stream environmental flows in a tributary system which can be assessed at the downstream end of the tributary system and credited for further downstream environmental use when it flows into the downstream river.

The second PPM achieves improved environmental outcomes from the available environmental water by enabling the strategic supplementation of natural inflow events (PPM 2) with releases from storages to deliver large environmental flow events using much less water than would be required to create the same flow regime solely from reservoir releases of environmental water.

PPMs are used in the connected regulated water systems of the southern Murray-Darling Basin. These arrangements significantly reduced the amount of water recovery required under the Basin Plan, and each of the relevant Basin states (i.e. NSW, South Australia and Victoria) was obliged to put these PPMs in place by 30 June 2019. The states all developed and implemented arrangements to give effect to the PPMs by the 2019 deadline. The MDBA River Management Division also developed and implemented a joint PPM plan for the shared River Murray system. In the event that the PPMs were not fully implemented by the deadline, the additional volume of water required to achieve the original level of environmental benefits assessed through modelling would have been deducted from any potential reduction in water recovery volumes achieved through the SDL Adjustment Measures projects.

Implementation of these PPMs by the relevant states and MDBA significantly reduced the volume of environmental water recovery required to achieve the environmental watering outcomes targeted under the Basin Plan.

Each state and the MDBA developed and implemented PPMs in accordance with their respective state water legislation frameworks and within the provisions of the MDB Agreement in the case of the River Murray system. While the details of how the PPMs were given effect differ in each state, the fundamental mechanisms that were put in place for environmental water delivery are the same

in each jurisdiction. There are two key mechanisms that give effect to the PPMs – directed releases from storages and return flow credits. PPMs are currently only available for use by environmental water managers.

3.2.1. Directed releases

Directed releases are one of the two key actions enabled under PPMs, and allow environmental water managers to order releases from specific storages, so that water can be added to any downstream inflows. In general, the requested release is not a specific flow rate, but the flow rate required to produce a target flow or hydrograph at a downstream location (in conjunction with downstream tributary inflows). This required flow rate is estimated by river operators each day.

The MDBA, NSW and Victoria use a similar process of assessing the volumes of directed releases, which is referred to as the with/without environmental release method. River operators first make an assessment of the releases that are required in order to meet all other water demands and the directed environmental releases. This is the with directed release operating plan and this is the volumes that are then released from the storage.

A second assessment is then made of the volumes that would be required to be released to meet all water demands excluding the volumes necessary to meet the specified hydrograph at the downstream location. This is the without directed release operating plan. The difference between the with and without release plans represents the actual volume of additional water released to meet environmental water needs, and this volume is debited from the EWH allocation account(s). Figure 2 provides a diagrammatic representation of the key elements of the directed release process.

The with and without environmental release scenarios are undertaken by the river operators using the software platforms that are normally used to make daily operational decisions. These are complex processes that require assumptions to be made and are not described in publicly available documentation. The MDBA, NSW and Victoria have documented the approach they take to key assumptions made in the “without environmental release” scenario in their internal documents⁷.

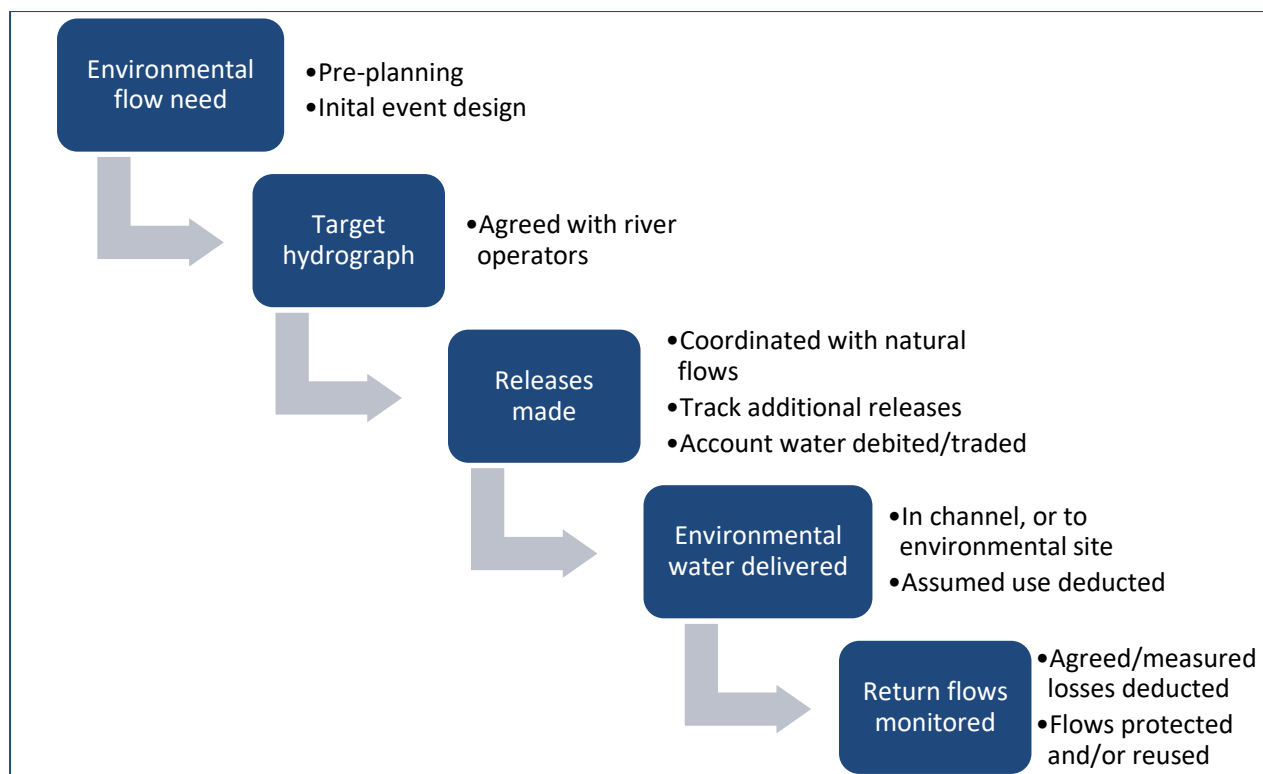
South Australia does not need to have provisions for directed releases, as there are no major public storages in the South Australian MDB. South Australia’s SA Water does operate the MDBA’s Lake Victoria storage, which is in NSW near the SA border. This storage is operated in accordance with the MDBA’s directions, with SA Water acting as a constructing authority under the Murray-Darling Basin Agreement. While directed releases can be made from Lake Victoria under limited circumstances, these arrangements form part of the River Murray PPMs and are covered by the arrangements set out in the MDBA’s *Objectives and outcomes for river operations in the River Murray System (O&O)* document⁸.

Directed releases from storages are also of limited relevance in the northern MDB, where there are fewer major regulated river systems, which discharge into downstream unregulated section of those same river systems or into the unregulated Barwon-Darling River system.

⁷ River Murray Environmental Watering Manual—Part A: Hume to SA Border

⁸ The O&O document sets out the agreed objectives and outcomes for operation of the River Murray system together with the arrangements approved to be used to deliver these outcomes
<https://www.mdba.gov.au/sites/default/files/publications/2024-objectives-and-outcomes-for-river-operations-river-murray-system.pdf>

Figure 2: Key elements of directed releases process under PPMs



3.2.2. Return flows

Return flows enable environmental water to be re-used at multiple locations, enabling the environmental outcomes targeted through the Basin Plan to be achieved with less water than would otherwise be the case.

The concepts underpinning return flows are relatively straightforward; however applying these concepts to real world situations can be quite complex in some situations. The key objective is to quantify the volumes of water that return to the river system following deliveries to an environmental site, or the volume of water that reaches a downstream location in a river. As noted above, the environmental site may be a wetland, or even the river channel itself.

In some cases, return flows may be able to be directly measured or estimated, for example where a defined waterway carries the return flows from the site back to the river and well developed flow measurement techniques can be applied. Examples of this situation include Hattah Lakes and, in certain flow ranges, the Gunbower and Koondrook-Pericoota forests, and Lowbidgee.

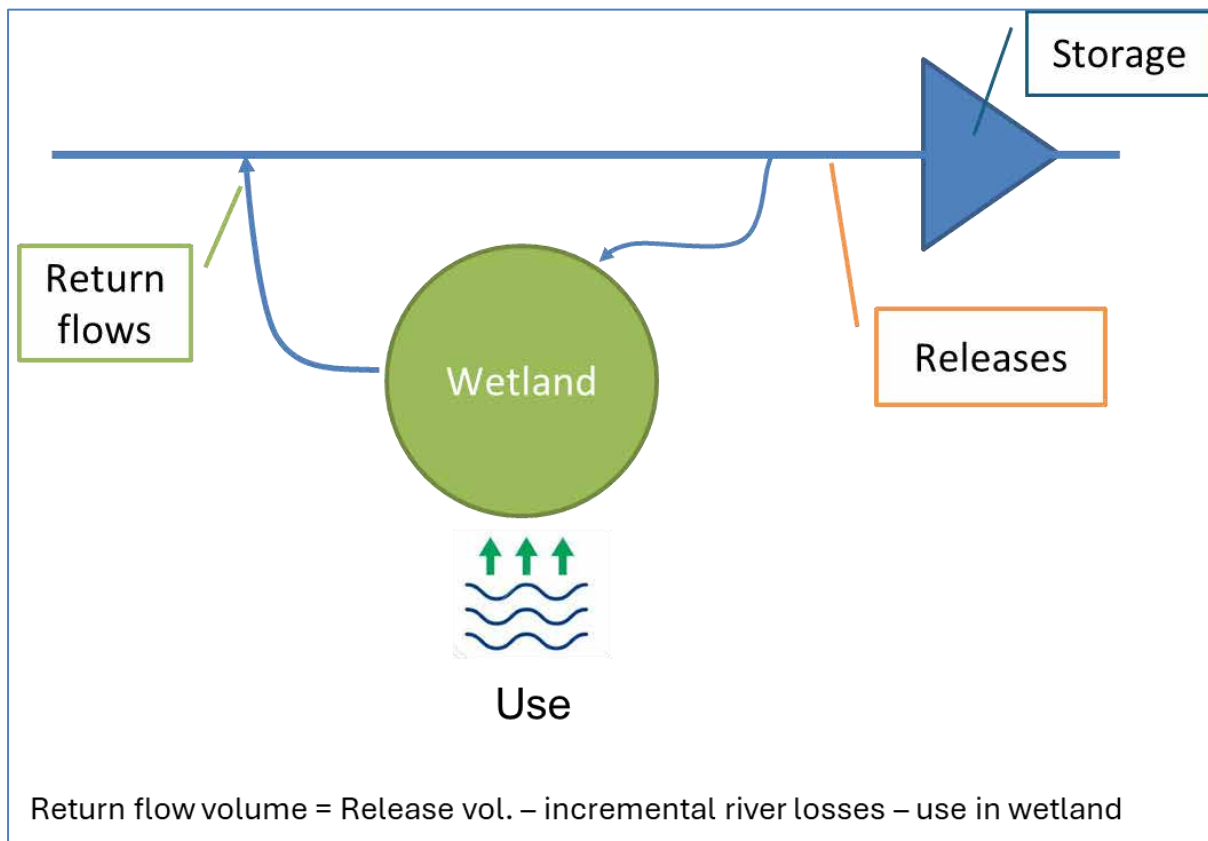
In other situations, this value is derived through assessment of releases to the site and use within the site. This process is shown conceptually in Figure 3.

Direct measurement of use in a large wetland complex where return flows occur is usually not feasible, so modelling is used to assess water use within the site. Use comprises evapotranspiration from the wetland, infiltration into the soil under the area watered and the volumes retained in the wetland water bodies at the end of the delivery event. The assessed use (also referred to as assumed use) is deducted from the volume delivered into the site to determine the return flow volume that comes back into the river and is available for use downstream.

At other sites where modelling is not warranted and highly accurate direct measurement is not possible, a range of techniques are applied using the best available data. These include daily spot flow measurements through regulating structures, monitoring of the change in wetland volume using capacity tables, stream gauging above and below the diversion point to the wetland etc. In these situations, care is generally taken to ensure that the estimate of use is conservative (i.e. the estimate is equal to or greater than the actual volume).

Where return flows are significant and raise river flow levels above normal operational flow ranges for regulated deliveries, river losses can be increased. All jurisdictions (i.e. NSW, SA, Vic & MDBA) have arrangements for estimating the incremental losses associated with the component of environmental flows that are above normal operating ranges and deducting this from the volume of return flows available for reuse downstream. The assessment of incremental losses associated with environmental flows can be relatively straight forward in simple situations, for example application of a simple percentage loss rate on the component of environmental flows above the regulated flow range. In other situations, the process can be more complex, requiring consideration of other inflows, passing flows, in-stream consumptive demands, system transfers and other pre-releases and system operations. Where return flows are within typical regulated flow ranges, they are largely excluded from reductions for losses, as losses are deemed to be covered by each system's collective loss allowance, as is the case for all consumptive deliveries.

Figure 3: Conceptual model of return flow assessment



3.2.3. Accounting treatment for PPMs

Accounting for PPMs involves a number of steps (see Figure 2).

- The volumes of directed releases are assessed and debited from EWH allocation accounts (see section 3.2.1).
- Environmental flows in transit in the river system are tracked, monitored and protected from re-regulation or extraction by system operators.
- Water volumes diverted into environmental sites are assessed:
 - Where the delivery is from normal regulated flow, the volume is debited from EWH allocation accounts.
 - Where the water diverted to a site is from a directed release which has already been debited from an account or an upstream return flow, the volume of water diverted is deducted from the volume of environmental water in transit.
- Water volumes returning to the river from environmental sites (or flowing into the River Murray from an environmental release in a tributary river) are assessed (see section 3.2.2), tracked, monitored and protected from re-regulation or extraction by system operators.
- Incremental increases in losses where environmental flows exceed normal regulated flow operational ranges are assessed and debited from the volumes of environment water in transit in the river and available for downstream use.

The systems used to track and monitor the volumes of directed releases and return flows moving through the river systems in NSW and Victoria all apply these same steps, however the specific processes used in each jurisdiction to recognise return flows and allow their re-use are different, reflecting the different legal and operational frameworks for water management in each state.

As these flows move through the River Murray system to the destination state, the MDBA is also responsible for tracking, monitoring and protecting return flows through water accounting arrangements at the bulk system level.

NSW return flows (including return flows from tributary streams) are managed under Bulk Entitlement Delivery arrangements. These flows are managed under the provisions of Clause 98 of the MDB Agreement, which enable NSW to direct the MDBA to release water from storages in the River Murray system, advise the appropriate debits to EWH accounts, and manage the return flows as required by Environmental Water Holders using the agreed accounting arrangements. Victorian return flows are also managed by the MDBA using the agreed accounting arrangements; however, they are tracked in a different manner. Return flows in transit are credited by Victoria to the Victorian Environmental Water Holder's allocation account and are traded for immediate delivery to the South Australia environmental water manager's account at the border⁹. This allows for the movement of water through the system to South Australia to be tracked through the Victorian Water register, providing a strong record trail.

Under both the NSW and Victorian processes, the agreed incremental losses are deducted from the return flow volumes to accurately reflect the environmental volumes flowing to SA. Deducting these incremental losses ensures that there is no impact on consumptive supplies to other users. These NSW and Victorian processes also ensure that the environmental volumes are separately identified

⁹ In South Australia, the SA Minister is the designated holder of environmental water.

at the SA border, and are provided in addition to SA's normal entitlement flows under the MDBA Agreement. Once these environmental flows are within SA, they are monitored and tracked using a specially designed environmental water accounting spreadsheet tool.

Where Victorian managed return flows in the River Murray system are to be delivered to a NSW site (and vice-versa) a trial process known as instream trade adjustments for return flows has been agreed by BOC¹⁰. This allows water in transit in the system to be traded for immediate delivery in the receiving state. This means that the transfer of water between NSW and Victoria can be tracked and accounted for using established processes for adjusting NSW and Victorian state shares to water to reflect interstate allocation trade.

3.3. Active Management

Active management is a daily operational process that has been developed by WaterNSW to operate each day in all unregulated river reaches where water sharing and protection of water for environmental benefits is required. The process includes:

- an on-line portal for licence holders to place expressions of interest to take water,
- a decision support system to assess flows and losses in each river reach, forecast flows, and calculate how much water can be taken without impacting on HEW, and
- announced access to available water for each class of licence access that will ensure that HEW is protected.

3.3.1. Operation of Active Management

NSW has published a policy for the implementation of active management¹¹ that sets out the key policy positions taken by the NSW government. The detailed arrangements for implementation of the policy are published in procedures manuals¹¹ for each of the unregulated river systems where active management is applied. The procedures manual for each valley sets out procedures for each stage of the process, and this forms the business rules for WaterNSW's systems and internal processes. The process is resource intensive, and has been implemented where larger volumes of held environmental water are to be protected instream, including the Barwon-Darling River system from Mungindi to Menindee, the Lower Macquarie River below the regulated river system to its confluence with the Barwon-Darling River system, and the Gingham Watercourse and Mallowa Creek in the lower Gwydir River system.

Licences in these unregulated river systems have commence to pump thresholds based on their class of access. Each day that HEW is flowing in a river reach, the system calculates the increase in the commence to pump thresholds that will protect HEW. Flows forecast to be available above the adjusted access threshold are then shared among licensed water users who have submitted an expression of interest to take water, and this publicly announced. The Commonwealth and NSW governments have recovered water licences in the Lower Macquarie and Barwon-Darling River systems, and these licences can nominate their share of available water to be protected from extraction, as can any other licence holders if they wish to do so. Flow shares that are nominated for

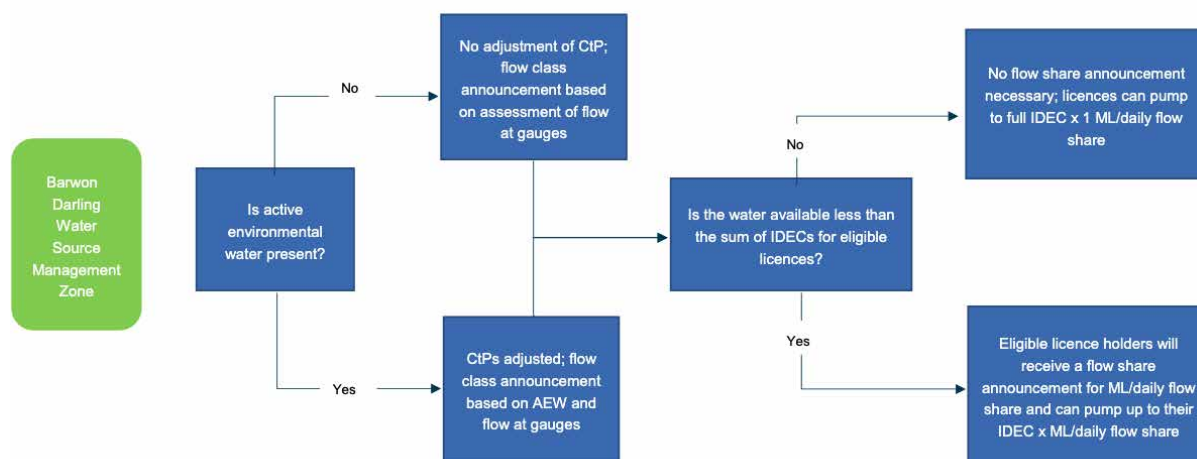
¹⁰ <https://www.mdba.gov.au/water-use/water-markets/interstate-water-trade/bulk-water-trade-adjustments-trials>

¹¹ <https://water.dpie.nsw.gov.au/our-work/projects-and-programs/environmental-water-management-in-nsw/what-we-are-working-on-now/active-management>

protection become part of the HEW that is then protected in downstream river reaches. The decision-making process is shown in Figure 4.

The policy and manuals include provisions to mitigate impacts to other water users, including reductions in the volumes of protected water as it flows downstream to allow for transmission losses. The NSW policy requires losses to be assigned proportionally based on the ratio of water to be protected at the start of the management zone relative to the total flows. If the water to be protected is flowing outside channels, WaterNSW may select an alternative approach to assigning losses. Assigning incremental losses was considered to be a more complex process in unregulated rivers where losses can vary significantly, and therefore not practical within the operational timeframe of a flow event. It is also noted that in unregulated systems HEW is not being added to the existing flows in stream and raising flows above “normal” levels, and the EWH is merely choosing not to pump water, as any other user may do from time to time. Application of proportional losses is considered a reasonable approach in these circumstances.

Figure 4: Barwon-Darling flow access decision making process



Source: Active Management Procedures Manual for the Barwon–Darling Unregulated Rivers Water Source, November 2020

Legend:

- AEW: Active Environmental Water is the environmental water recognised under Active Management
- IDEC: Individual Daily Extraction Component is the component of a water licence specifying a share of available resources. These components have been specified in some NSW unregulated water sources where daily access to flows needs to be shared, such as the Barwon-Darling River system.
- CtP: Commence to Pump is the flow threshold at which a class of water access licences can commence to take water.

3.3.2. Inflows from upstream catchments

HEW that is delivered from regulated tributary rivers to the Barwon-Darling River system is advised by each valley river operator¹² and is protected under Active Management (e.g. from Namoi, Gwydir and Border River systems). However, Active Management cannot be used to protect any flows from rules-based environmental water such as end of system flow targets and environmental water allowances established by water sharing plans. NSW implemented planned environmental water on

¹² The volumes of HEW delivered from upstream regulated rivers and upstream unregulated rivers with Active Management are published in the annual evaluation and review reports.

a valley-by-valley basis, with each valley establishing its own rules for sharing water between licensed water use and environmental purposes. Under this approach, the sharing arrangements are not carried from one water sharing plan area to another.

NSW has undertaken a review of the risks to HEW being diverted by licensed water users in the NSW portion of the intersecting streams (Moonie, Narran, Culgoa, and Warrego Rivers)¹³, which recommends that the risk of HEW being taken is very low and the implementation of resource-intensive Active Management in the NSW portion of the intersecting streams is not required. The review instead recommends that:

- a loss accounting arrangement for HEW arriving from Queensland is implemented to allow an appropriate volume of HEW reaching the Barwon-Darling to be managed under the current Active Management arrangements, and
- continue monitoring to assess the risks of HEW being taken.

The NSW Active Management annual evaluation and review report for 2023-24 (June 2025) indicates that:

- Following earlier agreement on a cross-border accounting method, a procedure was agreed in mid-2021 between Queensland, NSW and WaterNSW to protect Queensland HEW from the Border Rivers regulated system into the Barwon–Darling. The method included an electronic portal for recording volumes of HEW passing the Queensland-NSW border on a daily basis. This portal was developed and is maintained by NSW.
- A procedure to account for and protect QLD HEW reaching the Barwon–Darling from the Intersecting Streams is in development and will be finalised in 2024-25, with the aim of an implementation start date of 1 July 2025¹⁴, subject to agreement with WaterNSW.

Toorale is a large property at the confluence of the Warrego and Darling Rivers that was purchased by the NSW and Australian governments to protect the large wetland areas and cultural values on the property, and to recover the associated water access licences on the Warrego and Darling Rivers. The Darling River water licences are used to nominate water for protection under Active Management. The Warrego licences are used for controlled watering of the wetlands, and will be able to nominate water for protection when Active Management arrangements are extended to the Warrego River (as part of the intersecting streams).

¹³Intersecting Streams held environmental water extraction risk assessment (March 2025): https://water.dpie.nsw.gov.au/_data/assets/pdf_file/0011/628193/intersecting-streams-HEW-extraction-risk-assessment-V1.pdf

¹⁴ As at the time of writing, this procedure is yet to be implemented.

3.4. Qld unregulated systems

The Lower Balonne is an unregulated river system where a significant volume of the water use in the Queensland portion of the Murray-Darling Basin occurs. In this river system, water access is subject to a system of flow classes and announced access periods to share water between licensed water users.

This river system is managed based on flows passing Beardmore Dam at St George, which represents the point downstream of all major tributary rivers, and upstream of the major bifurcations of flows into four separate rivers that flow across the border and into NSW.

Downstream licences include references to one or more flow windows, and access to flows are announced based on the volume of water assessed to be entering the Lower Balonne system upstream of Beardmore Dam on a daily basis. The first 730 ML/day of inflow to the Lower Balonne system upstream of Beardmore Dam is either allowed to pass downstream for environmental, stock and domestic purposes or stored in air space in Beardmore Dam for later release.

The Commonwealth has recovered significant volumes of licensed entitlement in this area, and the use of flow windows and access announcements allows the water to be accounted against the Commonwealth's entitlements but left in the river without being taken by other licences. To facilitate accounting of the volumes of HEW that now reach the Queensland-NSW border, Queensland have used the water allocation dealing rules embedded in the Water Plans for the Condamine and Balonne catchments (including hydrologic modelling) for the trade of water licences from one location to another in the Lower Balonne, and have created a "virtual licence" on each of the intersecting streams to account for the HEW. Following the water allocation dealing rules to establish the virtual entitlement ensures that the trade complies with key provisions in the water plan for the Environmental flow Objectives, Water Allocation Security Objectives and there is no increase in take of water. The process uses an approved long-term hydrologic model run to determine the change in flows at the downstream location when the purchased licence is removed, which is then used to factor the virtual licence at the downstream location(s). The factored licence is then modelled to check that there are no changes to the reliability of other licences or the long-term average flows downstream (compared to the base case).

The announced access arrangements in the Lower Balonne apply to these virtual water entitlements for the purpose of accounting for the volume of HEW passing the Queensland-NSW border and are noted here as they provide a basis for protecting environmental flows arising from the Commonwealth's entitlements that is not in place in unregulated rivers more generally. They also provide a basis for recognising environmental flows into NSW that can be protected under Active Management, subject to appropriate recognition of transmission losses as they flow down to the Barwon-Darling River system.

3.5. Other issues

Environmental water management is a relatively new discipline. Unlike water management for consumptive use where techniques have been progressively developed and refined over more than a century in the southern MDB, environmental water management is still very much in the development stage.

It is to be expected that new mechanisms, or new applications of existing mechanisms will continue to be developed, trialled and incorporated into standard practices. For example, implementation of SDL Adjustment Measures projects and constraints relaxation projects will lead to major changes in delivery of environmental water.

It will continue to be important for environmental water managers and river operators to ensure that fit for purpose arrangements are put in place for managing and accounting for these new actions, and that there is transparency around new actions as they are Implemented.

One example of arrangements currently in the trial phase is the “north-south” trial to recognise additional inflows of environmental water arriving at Menindee Lakes during 2023-24, and allow that water to be managed for environmental outcomes in the Lower Darling and Murray River systems. Recognising the volume of additional inflows of environmental water arriving at Menindee Lakes is now possible as a result of the active management process implemented by NSW in the Barwon-Darling River system that flows into Menindee Lakes. This trial has been approved the Basin Officials Committee, but arrangements are not yet included in the O&O document.

4. Findings and opportunities for improvement

4.1. Third party risks and mitigations

An important consideration in the development of environmental water delivery mechanisms is the avoidance of unacceptable impacts to third parties. This section sets out the potential third party risks identified for the key environmental water delivery mechanisms, and considers the mitigations that have been put in place to address these risks.

The tables included in Appendix 1 also provide further detail on the risks and mitigations as identified by the jurisdictions for each mechanism, together the jurisdiction's assessment of the effectiveness of these mitigations provided via interviews, or from the jurisdictions' published annual reviews. An independent assessment of the effectiveness of mitigations by the review team is also provided in these tables in Appendix 1.

4.1.1. PPMs

Findings

In thinking about the third party risks associated with delivery of HEW in regulated water systems, it is helpful to consider both static and dynamic risks. Static risks are those risks that are generally always present, and their likelihood of occurrence is relatively constant over time, regardless of the specific conditions occurring in the water system. Dynamic risks, as the name suggests, are risks where the likelihood of the risk occurring and the consequences of the risks vary markedly depending on the circumstances at any particular time.

Table 1: Summary of potential types of third party risk relevant to environmental water delivery under PPMs

Risk Type	Description
Reliability risks	Environmental watering may affect how much water is available to other users (e.g. due to underestimating environmental use or higher system losses).
Deliverability risks	Environmental deliveries might compete with or delay delivery of water to other users, especially during peak demand periods or in constrained parts of the system.
Environmental risks	Poorly planned environmental flows could harm the environment in non-targeted areas (e.g. erosion, pest spread, water quality issues), reducing system benefits for all users.
Operational risks (dynamic)	Risks like inundation of private land, reduced recreational access, or cultural site impacts may arise depending on how, when and where water is delivered.

The primary focus for mitigation of potential static risks is through the design of the watering mechanism. Dynamic risks are more readily assessed and mitigated through the development of specific plans for environmental water delivery.

Table 2: Summary of key mitigations for potential third party risks

Mitigations	Description
Careful planning and approvals processes	Every environmental watering action is planned and reviewed by river operators, water holders, and local managers, using risk frameworks.
Assumed use and loss estimates	Conservative estimates are used to ensure environmental use is not underestimated.
Accounting for losses	Additional losses from environmental flows are debited to environmental water holders, not other users.
Volume limits on directed releases	In systems like the River Murray, upper limits on annual release volumes reduce risks to entitlement reliability.
PPMs vetted through Basin governance	All mechanisms were trialled, assessed, and approved by jurisdictions to ensure they meet Basin Plan requirements.
On-ground collaboration	Operational Advisory Groups monitor watering in real time and adjust actions to avoid or respond to emerging risks.
Transparent coordination	Processes like VEWH risk workshops bring together all relevant organisations (e.g. CEWH, MDBA, CMAs, Traditional Owners, land managers) to jointly assess and manage risks.
Review and updating arrangements	Existing mechanisms are reviewed and assessed as needed to ensure that risks are being appropriately managed

Static Risks

There are a number of static risks that have been identified as having potential to be associated with environmental water delivery. The three key categories are:

- Reliability risks – actions that reduce the overall water available to other entitlement holders as a result of environmental water deliveries.
- Environmental risks – adverse impacts to rivers and ecosystems resulting from environmental water delivery.
- Deliverability risks – impacts on the ability to deliver water from storages to other users. It is also noted that deliverability may largely be a dynamic risk, strongly influenced by overall demand for water and flows in the river system at the time of a delivery event.

These categories of risk are also relevant to other water management activities, including water trade and have been applied to developing mitigations for these issues.

The static risks around creating adverse environmental impacts through the release and delivery of environmental water are largely mitigated by the processes used to develop environmental watering proposals. These proposals for delivery events are generated by environmental managers including EWHs and catchment management agencies, and also include consultation with community based environmental interests and traditional owners in each jurisdiction. These processes are designed to ensure that potential adverse impacts on the environment are identified and mitigated as part of developing annual watering plans and delivery plans for specific events (see also discussion on dynamic risks).

Deliverability risk are largely addressed on an event by event basis; however, the other key arrangement that has been put in place to mitigate any potential deliverability risks is the transfer of water allocation between EWHs to provide sufficient water to undertake a planned delivery event are undertaken in accordance with the standard trading rules that apply to all water users. The Commonwealth Environmental Water Holder has also developed its “Good Neighbour” policy¹⁵, which aims to mitigate any impacts on water orders placed by other users.

The aspects of environmental water deliveries that have the potential to create risks to reliability of entitlements and water availability have been identified as:

- Inaccurate assessment of assumed use of environmental water at environmental sites. If the volumes of water use at an environmental site are underestimated, this has the potential to affect water availability to other users. The measures put in place to mitigate this risk include:
 - Assessment of assumed use is undertaken using the best available data, including direct measurement, real time monitoring and flow data, modelling, and analysis of historic data.
 - Where there is uncertainty in assessment of use, conservative estimates are used (i.e. the estimate of use is equal to or greater than the actual volume).
- Environmental deliveries may lead to higher system losses, which could lead to reduced water availability for other entitlement holders. The key mitigation is to debit the volume of incremental losses associated with flows above normal regulated operating ranges to EWHs, so that there are no adverse impacts on third parties. Similarly to the previous point, conservative estimates of incremental losses are adopted where there is uncertainty¹⁶.
- Some concerns have been raised that directed releases may impact on the ability to effectively utilise system inflows downstream of major storages, reducing overall water harvesting and entitlement reliability. In the River Murray systems, limits have been placed on the annual volumes of directed releases that can be made in a single water year. No similar limits have been considered necessary for tributary storages in NSW and Victoria. It is also noted that directed releases may also offer reliability benefits in some situations, such as early season releases.
- In the shared River Murray system storages, the storage capacity and inflows are shared between Victoria and NSW. If one state’s share of a storage is nearly full and further inflows occur, an internal spill of water into the other state’s share of the storage may occur, even when there is no physical spill of water from the storage. Changes in water users’ behaviour, including through interstate water trade can also change the relative state shares of water in storage. In the case of consumptive users, these changes in internal spill patterns happen

¹⁵ <https://www.dcceew.gov.au/sites/default/files/documents/portfolio-managment-plan-approach-planning-2019-20.pdf>

¹⁶ Incremental losses may also be referred to as assumed use, and in some situations may be a component of an overall assumed use assessment.

gradually as a result of numerous individual use or trade transactions. There was some concern that given the large volumes of some individual environmental watering deliveries, this may more rapidly influence the chances of internal spills occurring, resulting in changes to the expected levels of relative water availability between NSW and Victoria. The MDBA has put in place a number of mitigations to ensure that directed releases don't unacceptably increase the risk of internal spills between NSW and Victoria in shared storages.

The other mitigations against unacceptable third party reliability impacts are the procedures used to develop approve and apply PPMs and other new watering mechanisms.

- The mechanisms that form the PPMs were extensively trialled in the River Murray system and assessed for potential third party risks before being codified as ongoing environmental delivery mechanisms.
- Jurisdictions (and the MDBA River Management Division) developed detailed PPM implementation plans that were then assessed for compliance with Basin Plan provisions, including the requirement that SDL adjustment measures must not adversely affect reliability of water entitlements.
- The River Murray system PPMs were approved by the multi-jurisdictional Basin Officials Committee.
- Development of new watering actions are subject to review and assessment by river system operators and technical specialists in all jurisdictions. Watering actions that affect the shared River Murray system are also reviewed and scrutinised by the multi-jurisdictional Water Liaison Work Group, and approved by the Basin Official Committee (if required).
- Assessment of environmental water usage for watering actions is undertaken by river operators (i.e. not by EWHs).
- Existing mechanisms are reviewed and assessed as needed to ensure that risks are being appropriately managed.

Dynamic Risks

Environmental water delivery events can be complex actions, giving rise to a range of potential impacts. EWHs are all aware of the potential for adverse impacts and have put in place varying risk assessment and management processes. Risk issues considered by EWHs in the planning of annual watering actions and development of individual water delivery plans include:

- Water quality risks – hypoxic black water, salinity
- Deliverability issues and capacity constraints
- Erosion risks
- Inundation of private land
- Recreation and amenity impacts
- Public safety
- Cultural heritage impacts
- Navigation risks
- Adverse environmental impacts
- Pest plant and animal risk

The review panel considered the risk assessment process applied by the Victorian Environmental Water Holder (VEWH) to be an excellent example of good practice in this space. The VEWH convenes a series of risks workshops in each catchment region as annual watering proposals are being developed. These workshops include all the partners involved in environmental watering actions, waterway managers (Catchment Management Authorities), EWHs (VEWH, CEWH), river operators (GMW, MDBA), land managers (Parks Vic, DEECA) and traditional owner representatives. This

provides a range of perspectives to identify shared risks associated with potential watering actions and assigns lead responsibilities for the agreed mitigating actions. The risk assessments are conducted in accordance with the VEWH's environmental watering program risk management framework and the outcomes of the assessment are recorded in a risk register to guide watering actions across the year.

In addition to risk assessments and development of mitigation through the planning of watering actions, a network of Operational Advisory Groups (OAGs) have been established across the southern connected MDB. These OAGs bring together all the parties involved in environmental watering actions, including river operators, land managers and environmental water managers. OAGs meet frequently during major watering events to monitor progress, adjust the event to enhance environmental outcomes and adjust the delivery in response to any risks or issues identified through monitoring of the event as it progresses.

On some occasions, a movement of water with a source zone downstream of the Barmah Choke to above the Choke is necessary to complete an environmental watering action above and across the Barmah Narrows. Water for the zones upstream and downstream of the Choke is all delivered from Lake Hume. As the water is to be immediately delivered across and through the Barmah Narrows, it does not free up additional capacity for subsequent deliveries downstream through the Choke. At present, the criteria and processes that the states apply to assess what movements of environmental water upstream of Barmah for delivery downstream outside the trading rule are not as transparent and well codified as they could be.

Benefits

Table 3: Summary of key environmental water delivery benefits

Benefit	Description
Environmental protection and enhancement	Environmental deliveries enhance environmental values at delivery sites, support healthy waterways and help maintain biodiversity. They are also sometimes used to provide a more gradual recession of natural inflow events to reduce the risk of riverbank collapse.
Improved water entitlement reliability	Early-season environmental releases create airspace in storages, allowing more inflows to be captured, which can boost allocations.
Reduced delivery losses	Environmental flows through dry channels can reduce future losses when consumptive deliveries follow.
Water quality benefits	Environmental water can dilute poor quality water (e.g. blackwater), reduce salinity, and improve conditions in key river stretches and the Lower Lakes.
Amenity and recreation	Healthier rivers support tourism, recreation, and fishing.
Reduced water recovery pressure	Because PPMs enable environmental outcomes with less recovered water, there is less need to recover water from the consumptive pool.

As well as creating the potential for risks to third parties, environmental watering mechanisms can also provide a range of benefits to third parties. The primary benefits arising from environmental water delivery are protection and enhancement of environmental values at a range of environmental sites. Environmental deliveries support healthy waterways and help maintain biodiversity. In addition, environmental watering can provide benefits including:

- **Improved entitlement reliability.**

There are several processes that support this benefit. The release of significant volumes of environmental water, particularly early in the water year when releases for consumptive use are generally low, creates additional airspace in the storage. This provides the opportunity for subsequent inflows to be harvested to refill the storage (rather than spilling), leading to increased seasonal allocations and improved entitlement reliability.

In addition, the use of conservative assessments of assumed use and incremental losses associated with environmental water deliveries can provide a boost to general water availability to the extent that actual use or incremental losses are less than the estimated volumes debited to EWH allocation accounts. It is noted that environmental water managers would argue that in some cases the current arrangements are overly conservative and there may be a case for reviewing them in light of additional data collected during environmental watering actions.

- **Saving consumptive losses.**

In some situations (predominately in NSW) environmental deliveries are made via natural waterways that have dried out, prior to consumptive deliveries commencing later in the water year. This “wets” up the natural channel, saving water by reducing losses associated with subsequent consumptive deliveries, and also offers enhanced access to basic stock and domestic water supplies for land holders adjacent to these waterways.

- **Water quality benefits.**

Environmental water deliveries have been used to dilute and mitigate hypoxic black water events. In addition, careful planning of environmental water deliveries can reduce the build of large volumes of forest leaf litter, in turn reducing the occurrence and/or severity of hypoxic black water events.

Large volumes of environmental water flowing through the length of the River Murray system and down to the Lower Lakes and Coorong provides significant additional dilution flows which have contributed to positive improvements in river salinity levels.

- **Recreational and amenity benefits.**

Improved environmental conditions also provide greater opportunities for recreational activities including recreational fishing and eco-tourism.

- **Bank protection.**

Environmental water is at times delivered to help extend the recession of natural inflow events. This provides a more gradual reduction in river flow levels, which reduces the risks of bank collapse associated with rapid drops in river water levels.

- **Cultural benefits.**

Water for the environment can sustain healthy Country and help meet cultural objectives for Traditional Owners.

- **Reduced water recovery.**

As noted previously, a significant benefit arising from the adoption of the PPMs is the reduction in volumes of water recovery that are required to deliver the Basin Plan outcomes.

Opportunities for improvement

Overall, there has been significant attention directed to identification and mitigation of potential third party risks associated with environmental water deliveries. This review found that all areas of significant risk had been identified, and the mitigations put in place under the PPM arrangements were all deemed to be effective and appropriate to the identified risks. Nevertheless, there remain some opportunities to further improve the risk mitigations.

Jurisdictions should consider:

- **Review of assumed use and loss estimates:**
Many were based on limited data. Updated assessment may be warranted using current measurement and operational experience. This is particularly relevant for assumed use estimates for sites where accurate measurement or modelling was not possible or justified originally.
- **Update modelling:**
Modelling of environmental watering actions to assess risks (and benefits) such as reliability impacts from directed releases were undertaken some time ago. Improved assessments may be possible with improved models and representations of environmental watering.
- **Ensure new projects are included in PPM arrangements:**
Detailed PPM arrangements may need to be reviewed and extended as major new actions including SDL Adjustment Measures projects or constraints relaxation measures are moving towards implementation.

4.1.2. Active Management

Findings

The Active Management procedures recognise a number of risks in relation to protecting HEW and sharing water between licences in unregulated river systems. The primary risks relate to the uncertainty in the daily process of forecasting flows, and adjusting the volume of water protected using estimated losses based on a daily water balance method.

Table 4: Summary of potential types of third party risk relevant to environmental water delivery under Active Management

Risk Type	Description
Reliability risks	Over or under-estimating the volume of environmental water to be protected, or not appropriately applying losses to the protected flows can reduce water availability for water users or fail to, protect environmental flows. This includes water users in the river reaches where Active Management is applied, and also in downstream river systems.
Environmental risks	There are no significant risks identified from allowing naturally occurring flows to remain instream. Where flows have been released from storage in an upstream regulated river system, and are subsequently protected under active management, poorly planned flows could cause water quality impacts and result in fish deaths.
Operational risks (dynamic)	There are no significant risks identified from allowing naturally occurring flows to remain instream. Where flows have been released from storage in an upstream regulated river system, and are subsequently protected under active management, risks like inundation of private land, reduced recreational access, or cultural site impacts may arise depending on how, when and where water is delivered.

Calculation of losses

Losses in river reaches are usually estimated through a water balance process each day, as losses are not generally able to be measured directly. River operators employ this method as part of normal river operations, with the balancing term often referred to as the “unaccounted difference”. However, unaccounted differences represent a balancing term for all processes that cannot be directly measured for the calculation of a water balance in each river reach between two hydrographic flow gauging stations. This balancing term is the net result of both unmeasured movement of water into or out of the river reach, and any measurement error in the water balance terms that can be measured (e.g. river flows). Often, errors in flow gauges will result in opposite, compensating errors in loss calculation, as the one error may (for example) over-estimate losses in one river reach, but will lead to an under-estimation of losses in the next river reach.

The Active Management process intends that HEW arriving in a river reach from upstream will receive a share of losses but not of any inflows. When there are no ungauged inflows such as when conditions are dry, the unaccounted difference is likely to be a good estimate of losses. In wet periods, where the unaccounted difference can become a positive term (representing net inflows), the current procedure is to assume a zero unaccounted difference, so no loss is applied to the

environmental water. It is noted that the Active Management procedures require WaterNSW to publish its loss calculation methods, which is yet to occur. This is also a finding from the annual reviews of Active Management.

Rainfall and evaporation contribute to unaccounted differences, and are broadly known from the Bureau of Meteorology observational network. Evaporation is less spatially variable, and evaporation rates can generally be reasonably estimated from the observational network. Rainfall can be particularly spatially variable at times, and rainfall across residual catchments along the river (between flow gauges) can vary significantly from nearby observations. It is understood that the unaccounted differences being calculated for Active Management are not adjusted for rainfall and evaporation. For evaporation, this approach is consistent with estimating transmission losses. For rainfall directly on the river, this is not the case, however this term may not be material to the outcomes of AEW accounting.

The calculation of unaccounted differences is also affected by any mismatch between the physical routing of the flows along the river and the simplified routing assumptions usually used in the unaccounted difference calculation. However, these effects will reduce when the unaccounted difference is calculated over longer time frames compared to the flow travel time, or the results over multiple time steps are aggregated. Assessing transmission losses over periods of weeks will likely mean these errors are negligible.

Another element to improve calculation of losses and therefore reduce forecasting uncertainty is access to telemetered water use data, which would enable a more accurate assessment of losses each day. Telemetry and meters compliant with national standards have been installed along the Barwon-Darling River system, but implementation of the systems to enable that data to be processed for use in WaterNSW's Active Management systems has lagged behind the installation of the on-site meters and telemetry by a considerable period.

Underuse with respect to Expressions of Interest

Successive annual reviews of Active Management by NSW DCCEEW have indicated that actual water use has been consistently lower than the water announced as available based on expressions of interest (Eoi) in some river reaches. This behaviour by licensed water users is not considered a failing of the Active Management arrangements, although it has the potential effect of reducing water available to active users in that reach and increasing flows to the next river reach, and reducing the assessment of losses using the unaccounted differences method. WaterNSW and NSW DCCEEW have discussed this issue with water users, and encouraged water users to improve the accuracy of their Eois. WaterNSW has also modified its model to help address this issue. Overall, the proportion of the mismatch between announced access (based on forecasts) and the calculated access based on subsequently observed flows has fallen in the last year (2023-24) compared to previous years.

Notwithstanding the efforts to correct for this issue when undertaking flow forecasting, there remains an impact on the calculation of losses and the adjustment of water protected instream.

Mitigations

Forecasting of river flows, by its very nature, will involve uncertainty. The approach to Active Management has sought to mitigate risks in a number of ways, including:

- procedures that minimise the period of time over which flows are forecast (and associated announcements of water availability are made) in each river reach,
- a continuous process to track performance of forecast and observed flows, and making compensating adjustments where necessary to following forecasts and announcements of water availability, and

- an adaptive management approach combined with an annual review to ensure active management continuously improves and responds to information, insights, infrastructure, tools and systems.

Table 5: Summary of key mitigations for potential third party risks relating to Active Management

Mitigations	Description
Assessing river transmission losses	<p>The assessment of losses using a water balance approach (unaccounted differences) that excludes any gains has been shown to result in a conservative assessment of losses, particularly with regard to inflows into Menindee Lakes.</p> <p>Further work to improve the assessment of losses and the confidence in overall outcomes from Active Management have been identified by NSW. In particular, estimates of water use are also important to the assessment of losses. Telemetry has been installed for most of the significant water users, however, implementation of the systems to enable that data to be processed for use in WaterNSW's Active Management systems has lagged behind the installation of the on-site meters and telemetry by a considerable period.</p>
Review and updating arrangements	Existing mechanisms are reviewed and assessed annually to ensure that risks are being appropriately managed

Annual reporting of performance in forecasting versus actual flows indicates that the forecast volume of water available was slightly lower than the volume calculated using observed data after the event in all four years between 2020 and 2024, although this varied between river reaches. The annual reviews of Active Management implementation by NSW DCCEE have highlighted a number of issues relating to forecasting of flows, and the process of making recommendations and reviewing progress against these is reported each year.

From these analyses, forecasting uncertainty is resulting in a modest reduction in the environmental water accounted as arriving at Menindee Lakes (ignoring other forms of uncertainty). The effect of under-estimation of water available on the resulting volumes of water announced as available for all users (consumptive and environmental licence holders) is not clear. However, to the extent there is any effect on water take, it would have been to reduce water use, and increase the inflows to Menindee Lakes accounted to the shared resources.

Benefits

Table 6: Summary of key environmental water delivery benefits from Active Management

Benefit	Description
Protection of environmental flows	Protecting environmental water instream will enhance environmental values along the river systems, support healthy waterways and help maintain biodiversity.
Improved water sharing	Determining and announcing equitable shares in water access improves equity between water users in each river reach, compared with water access going to the first user(s) in each river reach.
Water quality benefits	Environmental water can dilute poor quality water (e.g. blackwater), reduce salinity, and improve conditions in key river stretches and the Lower Lakes.
Amenity and recreation	Healthier rivers support tourism, recreation, and fishing.

As well as creating the potential for risks to third parties, environmental watering mechanisms can also provide a range of benefits to third parties. The primary benefits arising from environmental water delivery are protection and enhancement of environmental values at a range of environmental sites. Environmental deliveries support healthy waterways and help maintain biodiversity. In addition, environmental watering can provide benefits including:

- Improved environmental outcomes.**
Protecting environmental water instream allows environmental benefits to be achieved across river systems, and improve connectivity between regulated and unregulated rivers in the northern Basin.
- Water quality benefits.**
Protecting environmental instream water will help improve water quality. More water flowing through the length of the Barwon-Darling River system and down to the southern Basin provides significant additional dilution flows which can contribute to positive improvements in water quality.
- Recreational and amenity benefits.**
Improved environmental conditions also provide greater opportunities for recreational activities including recreational fishing and eco-tourism.
- Cultural benefits.**
Water for the environment can sustain healthy Country and help meet cultural objectives for Traditional Owners.

Summary

The majority of the existing Active Management procedures are demonstrably conservative and, taken together with the documented conservative flow forecasting and associated announcements of water availability, mean that there is a low risk there will be any net impact to shared resources, and therefore any impact to water access for licensed water users in the Murray and Lower Darling River systems.

Whilst Active Management is a technically challenging undertaking that requires ongoing development to ensure that risks remain managed, the following points are worth noting:

- The adaptive management and annual review processes have provided significant improvements to procedures over the first four years of operation.
- Further work to improve the assessment of losses and the confidence in overall outcomes from Active Management have been identified by NSW. In particular, estimates of water use are also important to the assessment of losses. Telemetry has been installed for most of the significant water users, however, implementation of the systems to enable that data to be processed for use in WaterNSW's Active Management systems has lagged behind the installation of the on-site meters and telemetry by a considerable period.
- The modest overall risks associated with Active Management need to continue to be addressed and mitigated; however, the current arrangements are a significant improvement on the previous situation.

4.1.3. Qld unregulated systems

As noted in section 3.4, there are no water delivery mechanisms specific to environmental licences. Queensland uses the standard water management and trade mechanisms that are applied to consumptive licences to manage and protect environmental water instream. Consequently, there are no third party risks particularly arising from or related to environmental water management actions.

4.2. Communication of e-water delivery mechanisms

Findings

The practice of environmental water management is still a relatively new discipline, with the first significant environmental entitlements that provided a measure of discretion around the timing and volume of their release having only been created at the start of the 21st century.

Environmental water delivery practices have been developing and improving over time, as environmental water managers gained experience and developed new methods for delivery to environmental assets. The recovery of additional volumes of environmental water through programs associated with The Living Murray initiative and the Basin Plan have led to a significant expansion in the scope and scale of environmental water delivery activities.

It is expected that the ongoing development of new environmental water delivery mechanisms will continue. Drivers for development of new delivery mechanisms will include:

- Completion of Sustainable Diversion Limit Adjustment Measures (SDLAM) projects. A range of new environmental delivery sites will be able to be watered following the completion of works and measures under a range of SDLAM projects across NSW, South Australia and Victoria.
 - Constraints relaxation programs will offer new watering opportunities which are outside the range of current regulated flow limits.
 - The Enhanced Environmental Water Delivery SDLAM project is also expected to offer a range of new and novel watering actions to environmental water managers.
- Concerns around water quality and environmental conditions in Menindee Lakes and the Lower Darling River may also continue to lead to development of new operational rules and environmental water delivery actions.
- Expansion of active management arrangements to additional NSW systems, including to the Intersecting Streams will enable protection for environmental water inflows across the border from Queensland.

In many cases, the mechanisms required to enable environment deliveries to new locations will not be entirely new techniques, but rather will be applications and adaptations of existing mechanism to meet the specific needs of new locations or new waterways. Development of new PPM pathways for NSW systems is an example of this phenomenon.

A widely used technique for the development of new environmental water delivery mechanisms is the use of trials to test approaches and confirm the robustness of risk mitigation measures etc. prior to codifying the mechanism as part of standard operational procedures, which the reviewers consider to be a prudent approach.

In the context of this developing practice around environmental water delivery, transparency around the mechanisms being used is important. Access to suitable information on delivery mechanisms will support stakeholder understanding of and confidence that the mechanisms being used are fit for purpose and don't lead to unacceptable third party impacts. Environmental water managers and river operators were supportive of the need to provide information to build public confidence in these mechanisms.

This review found that information on existing environmental water delivery mechanisms is generally available in some form in all jurisdictions. The other important findings in relation to publication of information on environmental water delivery mechanisms are:

- The available information generally provides the what but not the why for environmental water delivery mechanisms. The published information usually describes the water delivery and accounting processes but may not speak to the intent or underlying objectives of the mechanisms. There is also limited information provided on how third party impacts have been considered in the design of the mechanism and what measures are incorporated in the mechanism to mitigate the risk of impacts.
- The current descriptions of delivery mechanisms are often incorporated into system operating rules, manuals or procedures. Examples include:
 - Procedures Manual for the NSW Murray & Lower Darling Regulated Rivers Prerequisite Policy Measures¹⁷
 - Objectives and outcomes for river operations in the River Murray System¹⁸
 - Overview of pre-requisite policy measures in Victoria¹⁹
 - Bulk and environmental entitlements under the Victorian *Water Act 1989*²⁰

These documents have largely been written for specific purposes including guidance to river operators or for detailed assessment for compliance with Basin Plan requirements. They tend to be lengthy and have not been written with an interested general public audience in mind, so are not particularly user friendly.

- The information on environmental water delivery mechanisms is distributed across a range of websites, and is not generally easily accessible. This was acknowledged by environmental water managers and river operators from a number of jurisdictions. Publications may be on resource manager/central policy agency websites, while the plans for use of environmental water are on environmental water holder websites. Interested stakeholders could be expected to be seeking information on environmental water delivery data, and there may be merit in also providing information on delivery mechanisms on the same websites (or easy to follow links to this information).
- Jurisdictions provide different levels of information. Some jurisdictions publish detailed descriptions of the mechanisms, including complex water accounting arrangements. Other jurisdictions opt to provide higher level descriptions of the key features of the mechanism and the broad principles and general approach underpinning the method, leaving specific details of the water accounting treatment (e.g. detailed loss estimation methodologies) and the basis for derivation of these arrangements to be covered in internal operations manuals and operating arrangements documents. There are differing perspectives on what is the most appropriate approach to publication of environmental watering mechanisms. It could be argued that full disclosure of all the details of the loss estimation methodologies offers full transparency, however the counter argument may be that publishing of detailed, complex information that is subject to review or

¹⁷ https://water.dpie.nsw.gov.au/__data/assets/pdf_file/0006/549519/NSW-PPM-Procedures-Manual-for-the-NSW-Murray-and-Lower-Darling-Dec-2022.pdf

¹⁸ <https://www.mdba.gov.au/sites/default/files/publications/2024-objectives-and-outcomes-for-river-operations-river-murray-system.pdf>

¹⁹ <https://www.mdba.gov.au/sites/default/files/publications/overview-of-ppms-in-victoria-updated-august-2019.pdf>

²⁰ <https://waterregister.vic.gov.au/water-entitlements/bulk-entitlements>

amendment as additional data is gathered may create confusion and could tend to obscure the key aspects of the mechanism.

It is considered unhelpful to be too prescriptive in this area; however, a consistent approach across jurisdictions would be desirable. At a minimum, all jurisdictions should (and do) make descriptions of the key features of the mechanism and the broad principles and general approach underpinning publicly available. There is no clearly compelling rationale for detailed procedures that implement these mechanisms to be generally publicly available. Nevertheless, there may be worthwhile transparency benefits associated with sharing these types of detailed arrangements with key stakeholders that are directly affected by the application of these procedures.

- As noted earlier, the development of new delivery mechanisms often involves the use of trials before mechanisms are codified in approved operating procedures or manuals. The current approach adopted by jurisdictions is to generally not publicise or publish information on such trials until they are finalised and the mechanism is approved for ongoing adoption. In order to support greater transparency, it is considered that information on environmental water delivery trials should be publicised in some form. This will provide useful context and should build greater confidence in mechanisms that are ultimately adopted for business as usual implementation.

Opportunities for improvement

Jurisdictions should:

- **Publish plain English information on environmental water delivery mechanisms:**
This information should set out:
 - an overview of the objectives of the mechanism,
 - the key features of the mechanism and general approach underpinning the method,
 - information on how third party impacts have been considered and what measures have been included in the design to mitigate these risks.
- **Publicise information on trials**
Where trials are being conducted that may lead to the adoption of new environmental water delivery mechanisms, information on these trials should be publicised in some form.
- **Aim to provide consistent, easy to access information:**
 - A broadly consistent approach to publications of this information across all jurisdictions, which could include providing it at the same location as environmental water delivery data. This would not prevent providing the information in multiple locations or linking from other websites if that was seen as beneficial.
 - A basin-wide summary of the delivery mechanisms available on a suitable “central” location, with links to appropriate websites for access to more detailed information. The MDBA website may be a potentially suitable central location for summary information and links, however that is a matter for discussion and resolution between the jurisdictions and the Authority.

4.3. Provision of e-water delivery data

Findings

There is a strong interest from a wide range of stakeholders around understanding the timing, location and quantum (volume and flowrate) of environmental water deliveries. In addition to understanding where, when and how much environmental water is delivered, there is also interest in understanding the outcomes achieved through delivery of environmental water.

Following review of the current arrangements for provision of environmental water delivery data (delivery data) it was found that overall, provision of environmental water delivery data is fragmented and inconsistent across the basin.

Environmental water usage data is provided on a mixture of websites and in a range of forms. There are three main categories of environmental water delivery data of interest, which are provided across jurisdictions.

1. Available water and water usage:

The volumes of allocation available to and used by the environment under held environmental water entitlements in regulated water systems is important data for a range of stakeholders. It enables stakeholders with an interest in environmental water management to better understand the scope for environmental watering actions etc.

Provision of this data separately, rather than being lumped together with consumptive water as total water available, allows water market participants to more clearly identify the volumes of water available in the consumptive pool and provides insights into the potential supply of water that may be available for trade in the allocation market.

This information is provided across all jurisdictions in a variety of forms:

- Environmental water holders or central water resource agencies in all jurisdictions publish annual reports setting out volumes of environmental water delivered etc. These reports appear some months after the completion of the water year, and are therefore of no value for stakeholders interested in understanding supply and demand issues in allocation markets. Similar information is also provided through state water accounts or overall water usage reporting in most jurisdictions.
- Available allocation and cumulative usage of HEW throughout the water year (separated from available consumptive pool data) is provided at a water system scale in NSW (WaterNSW website) and in Victoria (Victorian Water Register and Northern Victorian resource Manager websites). This type of information is near real time, after allowing for any delays in assessing environmental water use (see below for further discussion), and is important for water market participants. It is also noted that this information is, and needs to be, provided by organisations that have clear visibility of the volumes of water allocated and available in allocation accounts, and that also collect and manage usage data for retail water accounting.

2. Event based water delivery data:

Environmental water holders and catchment management authorities generally report on the location and timing of watering events planned and/or in progress and completed and in many cases (but not all) indicate the volume of water planned to be delivered, or actually

delivered in watering events across their jurisdictions. In some jurisdictions, this type of information may be provided on a quarterly basis.

The other opportunity to build awareness of environmental water delivery mechanism is to provide additional information on the different sources of environmental water that may contribute to the deliveries to environmental sites. Individual delivery events in major river systems can consist of releases of water from storages on the main stream, combined together with return flows from tributary watering actions, or return flows from upstream environmental sites. In addition, in shared systems environmental water for a single event may be provided by a range of environmental water holders acting in partnership. Providing this type of information on a quarterly or annual basis would help illustrate how environmental water is managed and how PPMs and protection of environmental water in unregulated systems operate to support more effective use of available environmental water.

3. *Near real time environmental flow data:*

Near real time environmental flow data²¹ refers to information on the component of flows in river systems that are for purposes of environmental water delivery.

This is an area of significant interest to many stakeholders, and river operators advise that there are frequent enquiries from the public seeking information on the drivers of river flows. There is particular interest in understanding what component of the total flow is due to environmental water delivery.

This is also the area where the community is least well served by available information. There is a significant amount of information available on total flows in river systems, and river operator organisations are actively improving the quality and accessibility of this total flow data. Unfortunately, information on how much of the total flow is environmental water (or consumptive water) is not readily available. To be meaningful, near real time environmental flow data needs to be presented within the context of the total flow regime in the river system.

Weekly reports from the MDBA often provide some narrative guidance on the volumes of environmental water in the River Murray system, and SA weekly flow reports identify total flows across the SA border and the environmental component of that flow, together with narrative coverage on environmental delivery events in progress.

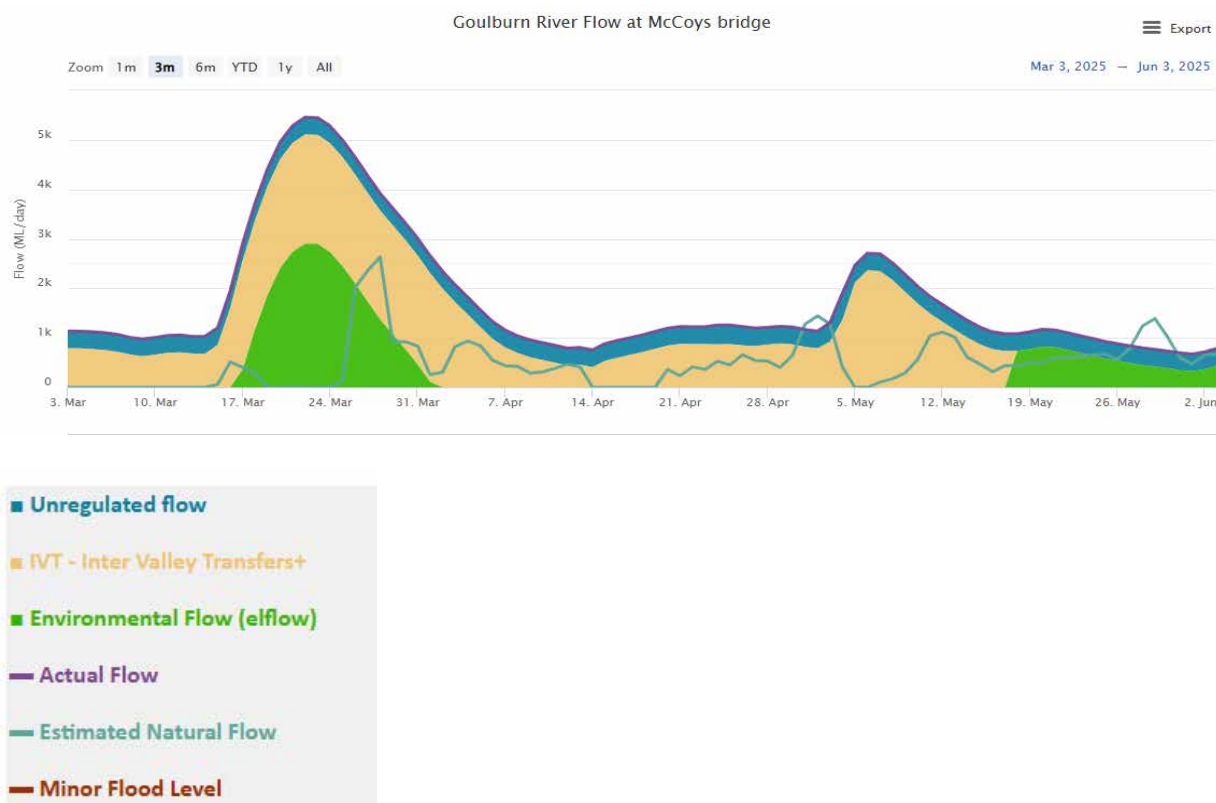
The standout exception is the work done by the Goulburn Broken CMA in Victoria to provide insights into flows in the Goulburn River. A near real time hydrograph showing the components of flow in the Goulburn at the most downstream flow gauge, McCoy's Bridge, provides detailed information on the flows over time. The data is updated weekly (see Figure 5).

The MDBA has also developed a proof-of-concept prototype of a web-based tool that will provide similar rich information in near real time across the River Murray system. This tool has the working title of Hydravision, and will be capable of drawing information from MDBA's operational data bases in an automated process that will provide frequent updates

²¹ Near real time environmental flow data refers to flow information that provides generally "current" indications of flow.

of data. It will also have the capacity to provide annotations and easily accessible supporting information to help with interpretation of the data presented.

Figure 5: Example of GB CMA Goulburn R flow information



Source: <https://services.hydrologic.com/GBCMA/McCoysBridge/detailed.html>

The key building block for effective reporting of environmental water deliveries is the provision of usage information from the relevant water system operators. In a number of areas, environmental water deliveries are made through metered supply points and regulating structures, in the same way that consumptive deliveries are made. Provision of this data in a timely manner is readily achievable. In contrast, determination of usage volumes for major delivery events, particularly those involving assessment of return flow volumes can take some time. This is due to the complex methods required to assess and confirm return flow, which in a number of major wetland/floodplain sites requires use of sophisticated hydrodynamic modelling.

Past delays in providing usage data have also been attributed to limited staffing resources combined with the bespoke measurement techniques involved. It was reported that this situation is improving, and the jurisdiction that was experiencing the most severe delays has now put in place dedicated environmental water accounting resources and service levels are improving.

Nevertheless, regardless of the resources dedicated to usage assessment, there are situations that will always require more time to determine environmental usage than acquiring a direct reading from a pump meter or irrigation outlet. This has been seen as a barrier to providing more timely environmental flow and usage data; however, it is questionable whether the high degree of accuracy needed for debiting usage accounts and calculating delivery charges is required for providing useful information to the broader public on environmental flows. It is suggested that operational estimates of environmental flows and usage could be provided in a timely manner and would be sufficiently accurate to provide interested stakeholders with good understanding of the relative volumes of environmental, consumptive and operational water moving through river systems at any given time.

The other important finding is the disjointed, widely distributed nature of available environmental flow and usage data, which is scattered across a range of organisations and websites. This makes it difficult for interested stakeholders to access data, especially when looking at multiple valleys or across jurisdictions in relation to connected water systems. Some form of more centralised data provision or more seamless linking of data sources, coupled with development of near real time environmental flow data systems will offer significant improvement in transparency and support improved stakeholder confidence in environmental water management. The need for this sort of near real time information on environmental flows, coupled with effective notification process for river side communities will increase significantly when constraints relaxation programs enable flows above current regulated flow limits.

While environmental water managers have recognised the importance of providing environmental flow and usage data and have been seeking to provide what information they can, river system operators are the custodians of all the primary data needed to provide this information. It would seem more efficient for these operators to take a lead role in providing near real time environmental flow data within the context of the total flow regime in the river system. River system operators are also best placed to provide the explanatory notes and other supporting information and disclaimers required to help build informed understanding of environmental flow behaviour. It is suggested that there may be a role for the MDBA in helping to facilitate provision of more centralised “one stop shop” for environmental water flow and delivery information, however that will be a matter for joint consideration between all parties.

Opportunities for improvement

Jurisdictions should:

- **Jointly work towards providing more consistent and centralised delivery information:**
Information should be centralised at a state level or at a wider regional or basin level on environmental water delivery and environmental flow and usage.
- **Provide data in an accessible manner:**
Ensure they are providing data on available environmental water allocations and progressive and annual usage in a manner that is readily accessible to water market participants. This information should also include data to clearly identify the extent of environmental water trades between environment water holders as a component of overall trade volumes.
- **Develop an overall information roadmap for each jurisdiction:**
This should be a roadmap which signposts where stakeholders can easily find information on:
 - Annual environmental watering plans
 - Short term environmental delivery plans
 - Delivery events currently in progress
 - Outcomes achieved through previous watering actions
- **Improve provision of near real time environmental flow data:**
Consider how best to improve provision of near real time environmental flow data within the context of the total flow regime in the river system.
- **Improve data coordination across systems and between states:**
Consider the opportunities for the MDBA to co-ordinate and facilitate overall data provision and access across basin to support their efforts to improve environmental water data transparency, particularly in and across connected water systems.

Appendix 1 – Detailed environmental water mechanisms

These tables provide detailed descriptions of the key environmental water mechanisms in each jurisdiction, based on information provided by each state and the MDBA. The standard text in the last column is the assessment of the effectiveness of risk mitigations provided by the relevant jurisdiction(s). The independent assessment of the effectiveness of the mitigations by the review team is provided as a traffic light colour code together with brief explanatory text in italics. Where advice was provided verbally during interviews, appropriate text has been used in the tables, and consistent wording has been used across jurisdictions where the same responses have been received.


Victoria

Victoria also provided the following preamble to information in the tables:

- Victoria has appropriate controls in place under the Victorian Water Act 1989 and relevant additional instruments and arrangements to manage third-party and local environmental risks associated with the movement of environmental water under all formal mechanisms (noting that Victoria does not have any informal mechanisms). For example:
 - Victorian framework allows explicit decision-making by resource / storage manager / SCA (State Constructing Authority) on all environmental watering actions – to issue a return flow credit or approve a directed release the resource / storage manager / SCA must first make an assessment that there will be no material impacts on other entitlement holders, which is determined based on current conditions and a robust process for measuring and accounting.
 - VEWH considers risks associated with e-water delivery in annual planning (seasonal watering plans) ensure appropriate mitigations are in place. This is done via annual VEWH-led risk assessment workshops (with e-watering program partners) held during the planning stage for seasonal watering proposals. Outcomes of the risk assessments are documented in a risk register. The VEWH, along with environmental watering program partners, follow the Victorian Environmental Watering Program Risk Management Framework.
 - All environmental watering actions are developed collaboratively using the best available information and are agreed between EWHs (CEWH, VEWH, TLM), River Operators (GMW, LMW, MDBA), Waterway Managers (local CMAs, GBCMA, NCCMA, Mallee CMA) and Land Managers (Parks VIC, First Nations, etc) via operational advisory and planning groups.
 - Specific arrangements for environmental watering movements and actions were established through extensive testing / trialling and, for actions that interact with Murray operations, were formalised through joint government agreement and Basin Officials Committee (BOC) approval (where relevant) – trialling and testing processes, risks and benefits associated with environmental water movements enabled joint governments to identify and mitigate third-party risks and agree to novel e-water actions.
- Accounting for environmental water in Victoria follows a consistent set of principles, including with and without e-water assessments, robust metering and measurement processes, use of real time measurement data (where possible), incremental loss accounting which considers other inflows, passing flows, in-stream consumptive demands, system transfers and other pre-releases and system operations – which are agreed as part of operating arrangements established under bulk and environmental entitlements.
- The general role for each agency in relation to risks due to environmental watering includes:
 - VEWH has primary responsibility for mitigating actions that relate to the demonstration of outcomes from environmental water delivery and portfolio management.
 - The relevant CMA has primary responsibility for mitigating actions relating to engaging with the community in relation to environmental watering, adequate planning and monitoring of environmental water delivery and incorporating learnings into improved environmental water management.

- GMW has primary responsibility for mitigating actions relating to system operations associated with the delivery of environmental water. GMW as storage manager may defer delivery of passing flows for dam safety and operational purposes. The storage manager has the authority to reject or cease delivery of an order immediately if it reasonably believes will create unacceptable risks to public safety or may expose the storage manager to liability for payments of claims for loss or damage to property.

Table 7: Victorian PPMs



ID No	Description	Methodology	Risks and benefits	Mitigations	Assessment of risks/mitigations
1	Directed release from Victorian storages Victorian storages (Eildon, Eppalock, Cairn Curran, Tullaroop, Nillahcootie)	Debiting of accounts: with/without environmental releases scenarios Debit accounting and assumed use calculations are described in the relevant appendices of the operating arrangements. ²² Order submitted to resource / storage manager, if approved release made from storage to meet primary d/s flow target – method described in operating arrangements developed between VEWH, relevant CMA and GMW for the Goulburn/Broken, Campaspe and Loddon systems. Accounting is communicated via weekly storage manager reports (incl daily flows), monthly Irrigation Planning Module (IPM) and VWR	All third-party risks assessed on implementation of the pre-requisite policy measures in NSW and Victoria ²³ . General risks / benefits specific to this type of action include: <ul style="list-style-type: none"> • Risks to deliverability of other demands due to e-water actions • Risks to reliability of all entitlements (e-water recovered from consumptive use now delivered from storage rather than from existing flows) • Risks to reliability of all entitlements from error in the assumed use method. 	Approved operating arrangements follow a consistent set of principles and that appropriately balance risk - including using real time measurement data ²⁴ where possible. Annual risk assessment follows the process described in the Victorian Environmental Watering Program Risk Management Framework (VEWH 2016a) and documented in the VEWH risk register. VEWH must consider risks associated with e-water delivery in annual planning (seasonal watering plans) (as described above).	Arrangements described for this mechanism are clear and codified – see provided operating arrangements, VEWH risk management framework, seasonal watering plans and relevant BE/EEs. Operating arrangements are agreed between relevant parties and the VEWH risk management process is implemented collaboratively each year and is consistent with ISO 31000:2018.  <i>Key risk identified and well mitigated</i>

²² “Operating arrangements for the environmental water holdings” document for each valley

²³ Overview of pre-requisite policy measures in Victoria (<https://www.mdba.gov.au/sites/default/files/publications/overview-of-ppms-in-victoria-updated-august-2019.pdf>)

²⁴ Described in the *Northern Victorian environmental metering program*

ID No	Description	Methodology	Risks and benefits	Mitigations	Assessment of risks/mitigations
		uploads, and annual reporting (VEWH, GMW and relevant CMA).	<ul style="list-style-type: none"> • Risks to local environment (through erosion and water quality) • Risks to private land inundation • Risks to environmental outcomes not being achieved • Benefit that directed releases (particularly earlier in the season) free up airspace for new inflows <p>Benefit of improved water quality, provision of ecosystem services, amenity, with further benefit to other users, e.g. food production.</p>		
2	<p>Return flow – From a tributary to the Murray</p> <p>Request by VEWH to reuse flows in the River Murray as a result of a directed release from a Victorian tributary storage</p>	<p>Resource / storage manager estimates volume arriving at the confluence of the relevant tributary and the River Murray – VEWH requests use of return flows at d/s locations / sites or recredit in storage (if the flow can be reregulated – only currently applicable for Waranga Basin) or trade to SA.</p> <p>Method described in operating arrangements developed between VEWH, relevant CMA and GMW for the Goulburn / Broken, Campaspe and Loddon systems, and described in the MDBA's River Murray Environmental Water Manual and</p>	<p>Risk / benefits as per mechanism Vic #1.</p> <p>Additional risks associated with return flows from Victorian tributaries to the Murray:</p> <ul style="list-style-type: none"> • Risk of over-estimating e-water available for return flows - potential impact to Murray resource / water available to allocate to other water users (for both VIC and NSW) • Risk of over-estimating e-water available for return flows –potential increase in delivery risks in the Murray 	<p>Assumed use / losses are also debited from flow in the Murray so that additional e-water in the system is not over-estimated – if flows are within channel a loss of 9% is applied to the SA border (noting that reuse of return flows does not incur this loss debit as additional loss to Murray sites is deemed negligible) however if flows are above channel an additional 30% loss is applied to the SA border.</p>	<p>As above, the mitigations are effective at managing all risks. Arrangements described for this mechanism are clear and codified – see MDBA's River Murray Environmental Water Manual and MDBA's O&Os.</p> <p>Methodology (including assumed use / loss) was developed by GMW based on historic loss data and supported by other joint</p>

ID No	Description	Methodology	Risks and benefits	Mitigations	Assessment of risks/mitigations
		<p>MDBA's Objectives and outcomes for river operations in the River Murray System.</p> <p>See above mechanism #1 for more information on return flow methodology for directed releases.</p>	<p>d/s of the Narrows (for both VIC and NSW) (i.e. meeting Tar Ru targets)</p>		<p>venture governments through WLWG.</p> <p> <i>Key risk identified and well mitigated</i></p>
3	<p>Return flow – From diversion site / wetland</p> <p>Request from VEWH to recognise return flows to the Murray from wetlands or diversion sites</p> <p>Applicable at nominated return flow sites for example Gunbower Forest, Hattah Lakes, Lindsay-Wallpolla, Mulcra etc.</p>	<p>As above for mechanism #2 except that EWHs request under the BE for return flows from the relevant sites to be recognised as part of the watering action.</p> <p>Specific methodology described in the MDBA's River Murray Environmental Water Manual and MDBA's Objectives and outcomes for river operations in the River Murray System.</p> <p>This includes gauged flow sites and the use of various models, including hydraulic models of floodplains.</p>	<p>Risk / benefits as per mechanisms Vic#2 and MDBA#2.</p>	<p>As above for mechanisms Vic#2 and MDBA #2.</p> <p>The arrangements set out in the operating arrangements documents agreed between the VEWH and GMW for each river system include environmental water accounting arrangements that ensure incremental losses are debited to EWH accounts.</p> <p>Additionally return flows are calculated based on modelling by the MDBA for Gunbower Forest as an example (note specific arrangements for Hattah are also codified in the MDBA's Environmental Water Manual).</p>	<p>As above, the mitigations are effective at managing all risks. Arrangements described for this mechanism are clear and codified – see MDBA's River Murray Environmental Water Manual and MDBA's O&Os.</p> <p>Methodology (including assumed use / loss for Gunbower and Hattah) was developed based on historic loss data and supported by other joint venture governments through WLWG.</p> <p> <i>Key risk identified and well mitigated</i></p>


NSW

Table 8: NSW PPMs

ID No	Description	Methodology	Risks and benefits	Mitigations	Assessment of risks/mitigations
1	Directed release from NSW storages (Blowering, Burrinjuck, Tombullen)	<p>Debiting of accounts: with/without environmental releases scenarios</p> <p>Environmental water manager (NSW DCCEEW-CPHR) places orders and liaises with river operator.</p> <p>River operator (Water NSW) approves orders and applies agreed PPM arrangements as documented in the PPM Manual & subject to annual evaluation & review reports²⁵.</p>	<p>All third-party risks assessed on implementation of the pre-requisite policy measures in NSW and Victoria²⁶.</p> <p>General risks / benefits specific to this type of action include:</p> <ul style="list-style-type: none"> • Risks to deliverability of other demands due to e-water actions • Risks to reliability of all entitlements (e-water recovered from consumptive use now delivered from storage rather than from existing flows) • Risks to reliability of all entitlements from error in the assumed use method. • Risks to local environment (through erosion and water quality) • Risks to private land inundation 	<p>Conservative procedures developed in Manual by technical working groups with key agency stakeholders as members.</p> <p>Approval process via PPM Working Group (senior officials) and also reviewed by WLWG for NSW Murray.</p> <p>Risk assessment undertaken by EWH on an event by event basis</p> <p>WNSW undertake a risk assessment for delivery events.</p> <p>WLWG also considers deliverability in Murray for major events.</p> <p>Technical working groups with key agency stakeholders as members are involved in developing mitigations, and reviewed by NSW PPM Working</p>	<p>The annual evaluation and review process for 2023/24 (released June 2025) made 6 recommendations, and an additional 8 recommendations that are partially complete or in progress have been carried forward from previous reviews.</p> <p>The evaluation framework uses criteria of consistency, efficiency and effectiveness were used to assess the implementation of PPMs during the 2023–24 water year, with all three criteria rated as ‘average’, based on mostly moderate performance indicator scores and neutral trends.</p>

²⁵ PPM Implementation Manuals and PPM Annual evaluation and reviews (<https://water.dpie.nsw.gov.au/our-work/projects-and-programs/environmental-water-management-in-nsw/what-we-are-working-on-now/pre-requisite-policy-measures>)

²⁶ Overview of pre-requisite policy measures in Victoria (<https://www.mdba.gov.au/sites/default/files/publications/overview-of-ppms-in-victoria-updated-august-2019.pdf>)


ID No	Description	Methodology	Risks and benefits	Mitigations	Assessment of risks/mitigations
			<ul style="list-style-type: none"> • Risks to environmental outcomes not being achieved • Benefit that directed releases (particularly earlier in the season) free up airspace for new inflows • Benefit of improved water quality, provision of ecosystem services, amenity, with further benefit to other users, e.g. food production. 	Group (senior officials) and also reviewed by WLWG for Murray.	The average result is largely attributed to Water Group prioritising the development of new accounting arrangements to enable the recognition of additional return flows. This has resulted in less resourcing to progress recommendations from the previous annual reviews, which would have contributed to higher performance scores under the evaluation framework.
2	Return flows (NSW)	<p>Return flows from directed releases are protected from supplementary access, and no losses applied within regulated flow range. No reuse of return flows as yet within the Murrumbidgee.</p> <p>Recognition of return flows from mid-Murrumbidgee wetlands (relaxed constraints releases) and Lowbidgee are under development.</p> <p>In the Murray and Lower Darling, accounting and tracking deliveries uses BED procedures and provisions under CI 98 of MDB Agreement.</p> <p>Trial of return flows from the NSW Active Management program in the northern basin is underway at Menindee Lakes</p>	Risk / benefits as per mechanism NSW #1.	<p>Assumed use / losses are also debited from Murrumbidgee return flows in the Murray so that additional environmental water in the system is not over-estimated. Additional loss based on conservative assessment of historical losses.</p> <p>Technical working groups with key agency stakeholders as members are involved in developing mitigations, and reviewed by NSW PPM Working Group (senior officials) and also reviewed by WLWG for Murray.</p>	<p> <i>AMBER Key risks well mitigated, however there may be some minor residual impacts in some seasons or under some conditions, suggest that the materiality of these risks is difficult to quantify, further monitoring is required however these are not material</i></p>

ID No	Description	Methodology	Risks and benefits	Mitigations	Assessment of risks/mitigations
3	Return flow – From diversion site / wetland	<p>Specific methodology described in the MDBA’s River Murray Environmental Water Manual and MDBA’s Objectives and outcomes for river operations in the River Murray System.</p> <p>This includes gauged flow sites and the use of various models, including hydraulic models of floodplains.</p> <p>There are procedures developed for the Great Darling Anabranh, Niemur River and Koondrook-Pericoota forest that are not yet included in public documentation.</p>	Risk / benefits as per mechanisms NSW#1 and MDBA#2.	<p>As above for mechanisms Vic #2 and Vic #3.</p> <p>Technical working groups with key agency stakeholders as members are involved in developing mitigations, and reviewed by NSW PPM Working Group (senior officials) and also reviewed by WLWG for Murray.</p>	


MDBA

(Note –information in this table is based on combined advice from MDBA and relevant Basin states)

Table 9: MDBA - Shared Murray PPMs


ID No	Description	Methodology	Risks and benefits	Mitigations	Assessment of risks/mitigations
1	<p>Directed release from shared storages (Murray / Menindee / Tar Ru)</p> <p>As above for mechanism #1 but for Murray, Menindee or Tar Ru (Lake Victoria)</p>	<p>Debiting of state bulk accounts: with/without environmental releases scenarios</p> <p>Releases limited to 700 GL in any water year unless risks are assessed as low by the WLWG. Arrangements are described in the MDBA's River Murray Environmental Water Manual and MDBA's Objectives and outcomes for river operations in the River Murray System.</p> <p>Directed releases made using equal proportions of NSW and Victorian state shares where possible.</p>	<p>Additional risks associated with directed release from shared storages:</p> <ul style="list-style-type: none"> When shared storage levels are high – risk if e-water release is unequal could increase risk of internal spill, potentially leading to spill from Victorian spillable accounts impacting availability in current season If e-water releases are unequal – risk that the state with the lower release incurs a disproportionate (50%) share of the loss When equal e-water releases must occur – e-water portfolio efficiency may be impacted and environmental outcomes not achieved <p>Note that releases from Menindee under the N-S connectivity trial might have unique risks that are still being considered as part of the trial.</p>	<p>As above for mechanism Vic #1 and NSW #1.</p> <p>Additionally steps taken to assess the risks of releasing e-water of an equal / unequal nature – including work being undertaken through EEWD.</p> <p>Additional mitigations described in the MDBA's River Murray Environmental Water Manual regarding reapportioning losses when releases are unequal.</p>	<p>As above, the mitigations are effective at managing all risks. Arrangements described for this mechanism are clear and codified in the MDBA's River Murray Environmental Water Manual and MDBA's O&Os</p> <p>Assumed use / loss accounting for e-water has been developed by the MDBA and assessed and agreed between joint governments – reviews of assumed use / loss have been conducted through modelling.</p> <p> <i>Key risks identified and well mitigated</i></p>

ID No	Description	Methodology	Risks and benefits	Mitigations	Assessment of risks/mitigations
2	<p>Return flow – From above to below the Barmah Millewa Forest (Barmah Choke)</p> <p>Request by VEWH to reuse flows in the lower Murray (d/s of the Barmah Millewa Forest) as a result of a directed release from Hume</p>	<p>Requests may be made by VEWH or NSW DCCEEW CPHR for the reuse of environmental water d/s of the Barmah Choke after a directed release from Hume are permitted.</p> <p>Where environmental flows have been made above channel capacity of the Barmah Choke, a reduction in the volume of water available for reuse is made based on assumed use through the Barmah Forest, as described in the MDBA’s River Murray Environmental Water Manual and MDBA’s Objectives and outcomes for river operations in the River Murray System:</p> <ul style="list-style-type: none"> • initial loss (50 GL) and • ongoing loss of 20% <p>Directed releases from Hume Dam that are within the channel capacity of the Barmah Choke may be reused without an assumed use.</p> <p>The volumes of shares of directed releases available for environmental reuse are tracked by the MDBA to ensure that they are not diverted for consumptive use or re-regulated in storages, and provides advice to each state.</p> <ul style="list-style-type: none"> • Victoria records its share of these volumes as trades for 	<p>In addition to risks & benefits for directed releases, there are additional risks & benefits associated with return flows from above to below the Barmah Narrows:</p> <ul style="list-style-type: none"> • Risk of over-estimating e-water available for return flows - potential impact to Murray resource / water available to allocate to other water users (for both VIC and NSW) • Risk of over-estimating e-water available for return flows - potential increase in delivery risks in the Murray d/s of the Narrows (for both VIC and NSW) (i.e. meeting Tar Ru targets) • Additional risks associated with moving e-water recovered in zone 6 (which would have previously been used in zone 6) to zone 7, by placing potential additional pressure to deliver water further downstream (likely timing dependent) • Risks to local environment (i.e. flooding the forest unseasonably or private land inundation) 	<p>The assumed use method has been developed based on modelling and analysis of observed data by the MDBA to address these risks, and has been approved by BOC.</p> <p>MDBA assesses the risk of the e-water movement to meeting Tar Ru targets / impacts to deliverability in the lower Murray.</p> <p>SCA (GMW) authorises recrediting of accounts for return flows according to MDBA advice.</p>	<p>The process of assessing the impact of recognising a return flow d/s of the Barmah Narrows in terms of deliverability in the lower Murray could be improved / transparency could be increased – the Barmah Choke trade rule is no net d/s trade and the assessment of the risk of an environmental water movement to shortfall / deliverability risks in the lower Murray is unclear – the assessment by the MDBA for movements across the Barmah Narrows should be codified (see feedback provided by Victoria in the review of Schedule D to the Agreement).</p> <p>From a resource perspective, the assumed use / loss arrangements agreed (as described above) are effective at managing risks and are codified in the MDBA’s River Murray Environmental Water</p>


ID No	Description	Methodology	Risks and benefits	Mitigations	Assessment of risks/mitigations
		<p>immediate use between designated trading zones as the water flows down the river.</p> <ul style="list-style-type: none"> NSW advises the MDBA to deliver its share of these volumes via a Bulk Entitlement Delivery notice under cl. 98 of the MDB Agreement. 	<ul style="list-style-type: none"> Benefit to watering the BM Forest and maximising use of e-water held above the BM Narrows 		<p>Manual and MDBA's O&Os.</p> <p>A movement of water from below the Barmah Narrows to above the Narrows is at times necessary to complete an e-water action across the Narrows (as the water is sourced from Hume regardless). MDBA currently receives advice from states about which movements of water contribute to the Barmah Choke Trade balance. However, further codification of actions and movements across the Narrows should be made.</p> <p> <i>Key risks identified and well mitigated. Transparency of process for assessing and communicating water movements that contribute to Barmah Choke trade balance could be improved.</i></p>

South Australia

Table 10: SA PPMs

ID No	Description	Methodology	Risks and benefits	Mitigations	Assessment of risks/mitigations
1	Return flows to South Australia	<p>Return flows are flows in excess of SA entitlement flow delivered to SA, that arrive at the SA Border as a result of environmental water delivery upstream. These flows consist of:</p> <ul style="list-style-type: none"> • Vic retail trade for immediate delivery - Credited to allocation account held by Minister • NSW BED delivery - Not added to a licence, so typically not diverted. Authorisation is available to allow pumping into wetlands, but generally not used <p>Losses are debited to environmental water moving through the system to the SA border. Within SA a water balance is maintained to track the movement of environmental water through each weir pool and deduct losses from the account.²⁷.</p>	<p>Risk that consumptive or environmental water holders are non-compliant and usage exceeds the volume available on the account.</p> <p>Local environmental risks such as salinity</p>	<p>Enforcement of usage limits on other users ensures return flows are not taken by non-environmental users.</p> <p>Environmental risks are managed through River Murray Action request.</p> <ul style="list-style-type: none"> • General information of intended action and ability for agencies/groups to identify risks/issues • EWH team address these risks before placing River Murray Action request <p>Consideration of environmental requirements within SA as part of annual planning.</p>	<p> <i>Key risks identified and well mitigated</i></p>

²⁷ Policy for Application of Losses to Environmental Water ([link](#))

ID No	Description	Methodology	Risks and benefits	Mitigations	Assessment of risks/mitigations
2	Return flows within South Australia from Weir pool manipulation & environmental sites	With and without modelling ²⁸ using Source, to identify site based losses (accounted as additional net environmental use) and return flows. <ul style="list-style-type: none"> Detail of weir pool manipulations published in operating plans 	Risk that consumptive or environmental water holders are non-compliant and usage exceeds the volume available on the account. Navigation and salinity risks also assessed	All environmental use is modelled to ensure net use is not exceeding available allocation at the SA River Murray scale Enforcement of usage limits on users ensures do not exceed water available on the accounts or (or authorisations for NSW) Environmental risks are managed through River Murray Action request ²⁹ . - General information of intended action and ability for agencies/groups to identify risks/issues - EWH team address these risks before placing River Murray Action request is approved	 <i>Key risks identified and well mitigated</i>

²⁸ Methodology to calculate water use losses for environmental water delivery in South Australia (link)

²⁹ A River Murray action request is required to be submitted by any person, or organisation, proposing to undertake an action that takes water from, or returns water to, the River Murray in South Australia. The purpose of the River Murray action request is to capture specific details of all actions being undertaken and enable the impacts of the action (or cumulative actions) to be considered, such as risks to water quality.


NSW Northern Basin

Table 11: NSW Northern Basin

ID No	Description	Methodology	Risks and benefits	Mitigations	Assessment of risks/mitigations
1	Active management – Barwon-Darling	Daily flow forecasting, expressions of interest, and announcements of water access to protect HEW flowing into and along the Barwon-Darling River system, as described in the procedures manual ³⁰	<p>The principal benefit is the protection of HEW in unregulated river systems.</p> <p>The principal residual risk arises from uncertainty in forecasting flows due to the inherent variability in natural river systems and limitations in measuring factors.</p>	<p>Daily forecasting and announcements of access allow for adjustments to address any mismatches arising from uncertainty in loss forecasts.</p> <p>Conservative loss assessments (positive unaccounted differences ignored),</p> <p>Telemetry on water users pumps to better quantify losses and improve flow forecasts (installed but data not yet accessible).</p> <p>Process of annual evaluation and review, and an adaptive management process to support continuous improvement.</p>	<p>(PS) The annual evaluation and review process has identified 49 issues (as at June 2025), of which 36 have been resolved or progressed.</p> <p>Key challenges;</p> <ul style="list-style-type: none"> ongoing lack of access to telemetry, underuse compared with EOIs, and uncertainty b/w losses and inflows (ungauged inflows) <p>Independent reviews have made recommendations for improvement, but have supported the methods as reasonable, and that reported results have not shown material impacts:</p>
2	Active management – Macquarie valley	Daily flow forecasting, expressions of interest, and announcements of water access to protect HEW flowing into and along the Lower (unregulated) Macquarie River below the regulated Macquarie River system, as described in the procedures manual ³²	<p>Uncertainty in forecasting flows can arise from uncertainty in estimating water use, river transmission losses, tributary inflows, errors in flow or use measurements, or flow routing effects.</p> <p>Uncertainty in accounting between losses and ungauged inflows leads to risks of over or under estimating HEW arriving at Menindee Lakes</p>		
3	Active Management – Gwydir Valley	Daily flow forecasting, expressions of interest, and announcements of	Not used since implementation - no HEW has required protection,		

³⁰ https://water.dpie.nsw.gov.au/__data/assets/pdf_file/0006/337290/active-management-procedures-manual-barwon-darling.pdf

³² https://water.dpie.nsw.gov.au/__data/assets/pdf_file/0019/337231/active-management-procedures-manual-for-the-macquarie-bogan-unregulated-rivers-water-source.pdf



ID No	Description	Methodology	Risks and benefits	Mitigations	Assessment of risks/mitigations
		water access to protect HEW flowing into and along the Gingham Watercourse and Mallowa Creek, as described in the procedures manual ³³	as either PEW is delivered, or HEW is delivered at rates that are protected by existing licence conditions.		<ul style="list-style-type: none"> • Review of implementation of Active Management (Greg Claydon) • (via MDBA³¹) Assurance review (Badu Consulting) • (via MDBA) Technical review (Fifteen50 Consulting) <p> <i>AMBER Key risks well mitigated, however there may be some minor residual impacts in some seasons or under some conditions, further monitoring is required.</i></p>

³³ https://water.dpie.nsw.gov.au/__data/assets/pdf_file/0005/337613/active-management-procedures-manual-gwydir.pdf

³¹ Review conducted to support the north-south trial to recognise HEW in Menindee Lakes

Queensland

Table 12: Recognition of Queensland HEW flowing into NSW

ID No	Description	Methodology	Risks and benefits	Mitigations	Assessment of risks/mitigations
1	QLD flows to NSW for Active Management	<p>Recognising additional flows into NSW that arise from HEW.</p> <p>Virtual entitlement established at the Qld and NSW Border across Condamine Balonne, Moonie, Nebine and Moonie catchments</p> <p>Border Rivers uses the water allocation dealing rules for accounting at the Mungindi</p>	Reduce HEW or downstream water availability	Modelling has been undertaken by QLD	<p>(QLD) Modelling reviewed by NSW</p> <p> Key risks identified and well mitigated</p>
2	Purchase of water previously taken under the authority of a water allocation	<p>Purchase of water in private storage for return to the river.</p> <p>Uses standard arrangements for harvesting</p> <p>Grant established with landowner to release water from private storages into river (i.e. for the purpose of supporting bird breeding at Narran Lakes)</p> <p>Water released from private storage into river for environmental outcomes</p> <p>Releases from storages need to comply with a standing code of practice³⁴</p>	Has only been used a couple of times		<p> Key risks identified and well mitigated</p>

³⁴ https://environment.des.qld.gov.au/_data/assets/pdf_file/0032/88754/pr-cp-stored-water-release.pdf

Appendix 2 – Environmental water mechanisms published information sources

Jurisdiction	Document &/or links to information on environmental watering mechanisms
NSW	NSW Procedures Manuals for Prerequisite Policy Measures Annual PPM evaluation and review reports https://water.dpie.nsw.gov.au/our-work/projects-and-programs/environmental-water-management-in-nsw/what-we-are-working-on-now/pre-requisite-policy-measures
	Active Management Procedures manuals Active management annual evaluation and review reports https://water.dpie.nsw.gov.au/our-work/projects-and-programs/environmental-water-management-in-nsw/what-we-are-working-on-now/active-management
	Toorale water management https://www.environment.nsw.gov.au/publications/toorale-water-management-infrastructure-operating-and-maintenance-plan
South Australia	DEW website: multiple pages on watering arrangements https://www.environment.sa.gov.au/topics/water-and-river-murray/basin-river-murray-lakes-and-the-coorong/water-for-the-environment/water-for-the-katarapko-floodplain
	Prerequisite Policy Measures Implementation in South Australia https://cdn.environment.sa.gov.au/environment/docs/overview_of_arrangements_and_mechanisms_used_to_implement_prerequisite_policy_measures_in_south_australia.pdf
	Policy and procedure for Application of Losses to Environmental Water Entitlements https://cdn.environment.sa.gov.au/environment/docs/1-Policy-for-Application-of-Losses-to-Env-Water-2023.pdf
	Policy for Environmental Water Return Flow https://cdn.environment.sa.gov.au/environment/docs/3-Policy-for-Env-Water-Return-Flow-2023.pdf
	Policy for the Use of Unregulated Flow in the River Murray in South Australia https://cdn.environment.sa.gov.au/environment/docs/5-Policy-for-the-Use-of-Unreg-Flow-in-the-RM-in-SA-2023.pdf
	Policy and procedure for Use of Entitlement and Allocation on the Minister's Reserve License and Account https://cdn.environment.sa.gov.au/environment/docs/7-Policy-for-the-Use-of-Ent-and-Alloc-on-the-Min-Res-Licence-2023.pdf
Victoria	Overview of pre-requisite policy measures in Victoria https://www.mdba.gov.au/sites/default/files/publications/overview-of-ppms-in-victoria-updated-august-2019.pdf
	Victorian Northern Region Sustainable Water Strategy 2009 https://www.water.vic.gov.au/our-programs/long-term-water-resource-assessments-and-strategies/sustainable-water-strategies/northern-region-sustainable-water-strategy
	Victorian Bulk and Environmental Entitlements https://waterregister.vic.gov.au/water-entitlements/bulk-entitlements

Jurisdiction	Document &/or links to information on environmental watering mechanisms
MDBA	<p data-bbox="453 255 887 284">Prerequisite policy measure documents</p> <p data-bbox="453 286 1362 349">https://www.mdba.gov.au/publications-and-data/publications/prerequisite-policy-measure-documents</p> <hr data-bbox="438 353 1382 358"/> <p data-bbox="453 371 1246 400">Objectives and outcomes for river operations in the River Murray system</p> <p data-bbox="453 403 1315 465">https://www.mdba.gov.au/publications-and-data/publications/objectives-and-outcomes-river-operations-river-murray-system</p>

Appendix 3 - Environmental water delivery published information sources

Jurisdiction	Links to information on environmental water delivery information
NSW	Annual environmental watering priorities: multiple pages covering each valley e.g. https://www.environment.nsw.gov.au/topics/water/water-for-the-environment/catchments/murrumbidgee/annual-environmental-water-priorities-2024-25
	PPM Annual evaluation and review reports: https://water.dpie.nsw.gov.au/our-work/projects-and-programs/environmental-water-management-in-nsw/what-we-are-working-on-now/pre-requisite-policy-measures
	Interactive mapping tool showing watering events and volumes delivered: https://www.environment.nsw.gov.au/topics/water/water-for-the-environment/catchments#/catchment/murray_lower_darling
	Environmental water use for year to date data: https://www.environment.nsw.gov.au/topics/water/water-for-the-environment/about/local-catchment-water-use
	Toorale weekly environmental water data and hydrographs: https://www.environment.nsw.gov.au/topics/water/water-for-the-environment/planning-and-reporting/toorale-water-infrastructure-project
	Daily data on volumes protected under Active Management for the Barwon-Darling: https://waterinsights.waternsw.com.au/16001-barwon-darling-unregulated-river/river-data#volumetric
Queensland	Annual water use reports: https://www.business.qld.gov.au/industries/mining-energy-water/water/catchments-planning/water-plan-areas/condamine-balonne https://www.business.qld.gov.au/industries/mining-energy-water/water/catchments-planning/water-plan-areas/border-rivers-moonie https://www.business.qld.gov.au/industries/mining-energy-water/water/catchments-planning/water-plan-areas/warrego-paroo-bullockine
	Flow event reports for the Lower Balonne: https://www.business.qld.gov.au/industries/mining-energy-water/water/catchments-planning/water-plan-areas/condamine-balonne
	Border Rivers Commission statistical reports https://www.brc.gov.au/publications
South Australia	SA River Murray annual environmental watering plans and priorities: https://www.environment.sa.gov.au/topics/water-and-river-murray/basin-river-murray-lakes-and-the-coorong/water-for-the-environment/planning
	River Murray Environmental Watering Reports https://www.environment.sa.gov.au/about-us/our-reports/annual-reports#Annual%20reports
	River Murray Flow reports

Jurisdiction	Links to information on environmental water delivery information
	<p>https://www.waterconnect.sa.gov.au/River-Murray/SitePages/River%20Murray%20Flow%20Reports.aspx</p> <p>River Murray Flow reports (weekly)</p> <p>https://www.waterconnect.sa.gov.au/River-Murray/SitePages/River%20Murray%20Flow%20Reports.aspx</p> <p>Barrage Flows:</p> <p>https://water.data.sa.gov.au/Data/Dashboard/66</p>
Victoria	<p>Seasonal watering plans</p> <p>https://www.vewh.vic.gov.au/annual-planning-and-reporting/seasonal-watering-plan</p> <p>Annual Reflections publications</p> <p>https://www.vewh.vic.gov.au/annual-planning-and-reporting/reflections</p> <p>Victorian Water Accounts</p> <p>https://accounts.water.vic.gov.au/</p> <p>“Live” Goulburn River hydrograph showing components of flow (updated weekly)</p> <p>https://services.hydrologic.com/GBCMA/McCoysBridge/detailed.html</p>
MDBA	<p>Monthly flows in the River Murray system – includes environmental water info.</p> <p>https://www.mdba.gov.au/news-and-events/newsroom?page=1</p> <p>River Murray weekly reports</p> <p>https://www.mdba.gov.au/publications-and-data/data-and-dashboards/river-murray-weekly-reports-0</p>
CEWH	<p>Annual water management plans: multiple pages covering each valley</p> <p>https://www.dcceew.gov.au/cewh/water-region</p> <p>Watering actions planned, in progress and completed, with estimated water use planned: multiple pages covering each valley</p> <p>https://www.dcceew.gov.au/cewh/water-region</p> <p>CEWH current detailed water holdings plus summary of historic water entitlement holdings</p> <p>https://www.dcceew.gov.au/cewh/manage-water/basin/water-holdings#commonwealth-environmental-water-holdings</p> <p>Environmental Watering Event Updates:</p> <p>https://www.dcceew.gov.au/cewh/manage-water/basin/water-holdings#commonwealth-environmental-water-holdings</p>