



Australian Government
Commonwealth Environmental Water Holder



Water Management Plan

2023-24

Chapter 4 – Gwydir Valley Water Plan



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Acknowledgement of Country

Our department recognises the First Peoples of this nation and their ongoing connection to culture and country. We acknowledge Aboriginal and Torres Strait Islander People as the Traditional Owners, Custodians and Lore Keepers of the world's oldest living culture and pay respects to their Elders past, and present.

Acknowledgement of First Nations people

The Commonwealth Environmental Water Holder (CEWH) and their staff acknowledge the First Nations communities of the Murray–Darling Basin and pay respect to their Elders past and present.

We acknowledge First Nations people as the Traditional Owners and custodians of the land, water and sky country across the Basin. We recognise the intrinsic connection of First Nations people to Country, and we value their enduring cultural, social, environmental, spiritual, and economic connection to the rivers, wetlands, and floodplains of the Basin.

Over millennia, First Nations people have shaped, managed, and cared for the land and waterways that sustain them. The CEWH values the relationships we currently have with First Nations people and is continuously building relationships to understand how we can empower and support First Nations people to care for Country. The CEWH will continue to work with First Nations people to identify ways to support cultural values alongside environmental outcomes with Commonwealth environmental water.

We value the ongoing contribution that First Nations people make to the planning and delivery of environmental water. We acknowledge this contribution is made largely through frameworks and processes that have not been determined, or endorsed, by First Nations people. More can be done to increase First Nations people's involvement and enable progress towards self-determination within and beyond the environmental watering program. We will continue to support and enable this where we can.

There are more than 40 First Nations in the Basin with many distinct cultures and practices.

Most of the Gwydir River system falls within the traditional lands of the Gomeroi / Kamilaroi people. The Gomeroi Nation extends from around Singleton in the Hunter Valley through to the Warrumbungles in the west, and through the Namoi and Gwydir valleys to just over the Queensland border. The eastern headwater around Guyra, Uralla and Tenterfield is the traditional lands of the Anaiwan people. The CEWH respectfully acknowledges these Nations, their Elders past and present, as the Traditional Custodians of the land on which this chapter is focussed.

We embrace the spirit of reconciliation, working towards equity and equality for First Nations people.

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1 Gwydir Valley Water Plan

An overview of the Gwydir Valley including the Traditional Owners, key environmental values and sites, environmental objectives and environmental water delivery partners is provided on the [CEWH website](#).

1.1 Recent conditions and seasonal outlook

1.1.1 Recent conditions and environmental water use

The 2019 calendar year was the driest recorded in the Gwydir since 1965. Above average rainfall then occurred between January and April 2020, resulting in flows moving through the full length of the river system. Very heavy rainfall resulted in localised inundation of wetland areas along the lower Gwydir, Gingham and Mallowa systems in February and March 2020.

The 2021–22 water year was overall a much wetter year with La Nina conditions continuing. The flood event in March 2021 was followed by several follow-up high flow events occurring in late 2021 due to further local rainfall contributing to tributary flow and controlled releases from Copeton Dam, which filled for the first time in 9 years in November 2021. This led to prolonged flows in the Gingham and Lower Gwydir systems with moderate flooding in November and December 2021 and continuous core wetland inundation and good river flows that continued through the remainder of the calendar year. There was also significant long-term connectivity with the Barwon River. Flows then reduced substantially in early 2022 with only low flows occurring throughout the system after a return to regulated conditions.

In addition to producing significant improvements in native vegetation condition and extent throughout the system, the flows in late 2021 led to a large colonial waterbird breeding event in parts of the core wetland areas. This was the first large-scale colonial nesting waterbird breeding event seen in the Gwydir system since 2011–12 (10 years). Environmental water was delivered to both the Lower Gwydir Wetlands (Commonwealth and NSW water) and Gingham Watercourse (NSW water) to support the breeding birds. These flows helped maintain sufficient water depth underneath the nesting sites and inundated key wetland foraging areas until the birds fledged.

Environmental water was also used to improve the condition and extent of native vegetation in the Mallowa Creek system, which also plays an important role in providing foraging habitat for the waterbird colonies and offspring.

Natural high flows were again a feature of the first half of the 2022–23 water year. Very wet conditions occurred during the second half of 2022. These natural flows continued to help the system recover from the previous drought. High water flows and water across floodplains during spring also triggered large-scale colonial-nesting waterbird breeding in the Gwydir Wetlands for the second year in a row (and for only the second time in 10 years).

While environmental water cannot create the large flows and flooding that triggers these breeding events, it provides a crucial role in supporting successful waterbird breeding. Commonwealth and NSW environmental water was delivered between mid-December 2022 through to late March 2023. This water helped to maintain steady low flows under nests to minimise the risk of abandonment, predation and disease. It also maintained feeding areas to

allow chicks to grow and successfully leave their nests. This was important, as waterbirds numbers have been declining significantly in recent decades. Supporting waterbirds in wet years can help numbers to rebuild and create resilience for when drier conditions return.

Commonwealth environmental water was delivered to the Mallowa Creek and Wetlands between January 2023 through to March 2023 to build on previous inflows which occurred in 2022. These flows helped provide feeding resources for waterbirds breeding in the Gwydir Wetlands as well as helping to build resilience ahead of the next dry period. Natural flows maintained river connectivity during the first half of 2022.

While natural flooding can provide multiple benefits to the environment including those noted above, it can also present challenges. For example, the end of a flood can increase the risk of water quality issues, especially when floods reach areas that are not often watered. In late summer 2023 rivers in the northern Basin started to dry back quickly, resulting in areas of poor water quality and localised fish deaths. Environmental water was delivered from both the Gwydir and Namoi catchments between late April to mid-May to help improve water quality, keep streams and rivers connected, and to support native fish to move along waterways. This water also kept rivers flowing into the cooler months when water quality risks are lower. These deliveries built on water already being protected in the Barwon–Darling through the activation of the Commonwealth’s unregulated licences. Flows from planned environmental water, originating from NSW’s water sharing plan (3 Tributaries arrangement), also contributed to flows. Other tributary flows also contributed at times.

Learn more about previous [Commonwealth environmental water use in the Gwydir catchment](#).

1.1.2 Seasonal outlook

The La Niña climate pattern that has been bringing wet weather ended in the Pacific Ocean in mid-March 2023, with climate indicators returning to neutral levels. Climate models suggest that neutral conditions are likely to persist through autumn, but there is a 70% chance that an El Niño event will form later in 2023 (BoM 2023a).

According to the Bureau of Meteorology outlook, the forecast across the Gwydir Valley is for well below average rainfall between June and September (BoM 2023b, c).

Maximum temperatures across the Gwydir Valley are forecast to be well above average between June and September (BoM 2023d, e).

This forecast indicates that dry conditions may again be returning to the Gwydir Valley.

1.1.3 Water availability

Commonwealth environmental water is managed in conjunction with other held and planned environmental water managed by NSW. Other flows such as tributary flows, consumptive water and other water orders may also support environmental demands in the Gwydir Valley and downstream along the Barwon–Darling.

In the Gwydir Valley, the Commonwealth holds ~4.5 GL of high security entitlements; ~89.5 GL of general security entitlements; and ~20.4 GL of supplementary entitlements. The delivery of supplementary water is dependent on access announcements being made by WaterNSW.

NSW also manages the 45 GL Environmental Contingency Allowance account (planned environmental water) in the Gwydir Valley and hold 1.2 GL of high security entitlements; 25.5 GL of general security entitlements; and 3 GL of supplementary water (event dependant).

As of 1 July 2023, Copeton Dam was at 92% full (WaterNSW 2023b).

Based on the expected available volume of environmental water held by the Commonwealth and NSW, as well as recent and forecast catchment conditions, it is expected that the overall resource availability will be high in 2023–24. The volume of Commonwealth environmental water carried over in the Gwydir Valley for use in 2023–24 is 134 GL.

Forecast allocation of regulated (surface water) Commonwealth environmental water in 2023–24 is provided in Table 2 of chapter 1 in the [Commonwealth Environmental Water Holder Water Management Plan 2023–24](#).

1.1.4 First Nations environmental watering objectives

The CEWH is committed to working with First Nations people to better understand cultural objectives. The CEWH will use environmental flows to contribute to these objectives where possible and where this is consistent with the CEWH’s statutory responsibility of protecting and restoring environmental assets in the Basin (see chapter 1 of the [Commonwealth Environmental Water Holder Water Management Plan 2023–24](#)).

The CEWH will continue to develop and implement a work program to work with First Nations people in the northern Basin. The work program will refine and build on the work already undertaken by the northern Local Engagement Officers through engagement with First Nations people as part of the NSW Gwydir Case Study (Table GV1). This work program will be implemented in collaboration with First Nations groups and will be integral in continuing to build relationships and capacity. It will also help ensure First Nations people actively participate in the planning and management of environmental flows. Key elements of the program include the following elements, with the first two already in place and the remaining underway:

- Engaging a cultural advisor in the Gwydir Valley through the CEWH’s Monitoring, Evaluation and Research Program
- First Nations representation on the Northern Basin Environmental Watering Group
- Working jointly with NSW through the Gwydir Reconnecting Watercourse Country Project and NSW Department of Planning and Environment - Environment Heritage Group (DPE-EHG) to establish an Aboriginal advisory group for Gwydir environmental watering and associated projects.
- Developing of a seasonal calendar in collaboration with the Gamilaraay/Gomerioi/Kamilaroi Nation.

Sharing the outcomes from environmental flows and getting out on Country with First Nations groups will be a key step in this process and will include a two-way knowledge exchange. This information exchange and collaboration will improve the outcomes achieved from providing environmental water, whilst also ensuring First Nations people and their values are part of environmental water decision-making and management processes.

Table GV1 First Nations environmental objectives for the Gwydir system

Category	Priority sites and indicator species
River flows and connectivity	Water is life and connects all things, and all things are interconnected; rivers and wetlands need water, need flows; need to care for Country in a physical and spiritual sense; need to look after country and to fulfil cultural obligations; need to look after own mob and for downstream mobs.
Native vegetation	Vegetation species that are resources growing in and along rivers and in wetlands and billabongs, and on floodplains – bush tucker, medicines, and cultural practices.
Native birds	Important local indicator species include Brolga, ducks, magpie geese.
Native animals	Look after native fish, both own importance and resource for community; look after the critters, everything needs water, make sure things can survive and live; need to look after critters, care for all as part of whole picture, and to look after totem species and significant species.
Connecting with Country	Sharing stories and knowledge are important to the Gomerioi people and the following assist in doing this: being able to go out on Country to reconnect and share knowledge about landscape and resources, about spiritual and creation stories, and educate the younger generations; connecting to and Caring for Country – opportunities to go out on Country, and obligations to care for Country. Important values include modified trees, burial sites, scar trees, stone artefacts and a midden site.
Other notable water-dependent sites	Gwydir Wetlands, including the Gingham and Lower Gwydir watercourses and wetlands and significant places in and along these wetlands including Gingham Waterhole, Bunnor Lagoon, Wandoona (Troy) Waterhole and Yinarr Holes. The Mallowa Creek and its wetlands, including Valetta swamps and wetlands. Moomin Creek sites. Mehi River sites (especially Top and Bottom Camps). Mid-section of the Gwydir River includes Gravesend, Elcombe, and Gum Flat. Other lagoons and billabongs including Tillaloo, Baroona Waterholes, the Glen Swamp; Poison Gate (Derra) Billabong; Whittaker’s Lagoon and Collymungle.

Source: Heritage Concepts (2009), Hudson Consulting and Woodlots & Wetlands (2009), NSW DECCW (2010) and NSW DPIE (2018). Identified through the Gwydir Case Study.

1.1.5 Environmental demands

The environmental water demands for assets in the Gwydir Valley in 2023 –24 are shown in Table GV2. The capacity to contribute to these environmental demands is contingent on water availability and conditions in the catchment throughout the year.

Table GV2 Environmental demands, watering priorities and outlook for coming year, Gwydir Valley, 2023–24

Environmental assets	Target values	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)	2023–24		Implications for future demand
		Flow/volume	Required frequency (maximum dry interval)		Environmental demand for water (all sources)	Potential Commonwealth environmental water (CEW) contribution	
<p>Gwydir Wetlands</p> <p>Areas of Ramsar listed wetlands. Nationally significant wetlands. Waterbird breeding and habitat. Habitat and breeding ground for frogs. Native fish habitat. Endangered ecological communities. Lagoons and wetlands which have important values for the Gomeri local Aboriginal community. Key sites include:</p> <ul style="list-style-type: none"> • Old Dromana Wetland • Bunnor Wetland • Gingham Waterhole • Yinarr Holes. 	<p>Core wetland inundation. Refuge habitat for native fish, waterbirds, frogs and other aquatic species. Maintenance and regeneration of wetlands. Ecosystem function.</p>	<p>Small wetland (WL) inundation</p> <p>WL1 (Protect Core Wetland):</p> <ul style="list-style-type: none"> • greater than 6 GL event over 3 to 6 months (Gwydir at Millewa) at any time. • greater than 15 GL event over 1 to 3 months (Gingham at Teralba) at any time. • greater than 15 GL event over 2 to 6 months (Gingham at Tillaloo) at any time. • greater than 3 GL event 1 to 4 months (Gingham at Gingham Bridge) at any time. <p>WL2 (Maintenance and Regeneration of Wetlands):</p> <ul style="list-style-type: none"> • greater than 36 GL over 3 to 6 months (Gwydir at Allambie) in September to March (but can occur at any time). • greater than 30 GL over 1 to 3 months (Gingham at Teralba). • greater than 30 GL over 2 to 6 months (Gingham at Tillaloo) in September to March (but can occur at any time). • greater than 15 GL over 1 to 4 months (this should have been 2 to 6 months) (at Gingham Bridge). 	<p>WL1: 9 to 10 in 10 years (max. interval: 1 year). WL2: 8 to 9 in 10 years (max. interval: 2 years).</p>	<p>With wetter conditions persisting, targets for small wetland inundation were met at all gauges between 2020–21 and 2022–23. Flow targets to protect core wetlands (WL1) have also been achieved in each year over the previous 7 years between 2013–14 and 2019–20 at the Millewa, Teralba and Tillaloo gauges. However, the required frequency of these flows is not being achieved at the Gingham Bridge gauge, having been met 7 in the past 10 years. Despite being met in the last three years, and during wetter conditions in 2016–17, flows needed for the maintenance and regeneration of wetlands (WL2) are also not being achieved for the required frequency. Across the gauges, these flows have been met between 4 and 6 years in the last 10. Small wetland flows are required in most years, and the frequency is not being achieved at all locations, particularly for wetland maintenance and regeneration. Therefore, these flows have been assessed as having a high demand for water in 2023–24. Supporting WL2 flows to the Gwydir at Allambie and the Gingham at Gingham Bridge may be of a particularly high priority (met 4 of the last 10 years).</p>	High	<p>A high priority for CEW under high water resource availability scenarios, subject to occurrence of unregulated flow event and water availability. A combination of entitlements may be used to respond to unregulated flow events, to protect (supplementary) and potentially restore (regulated) parts of a natural flow. Use of supplementary water to protect natural flow. Use will be assessed based on the likelihood of third part impacts.</p>	High
	<p>Maintenance and regeneration of floodplain vegetation (including Lignum). Waterbird habitat and potential breeding. Maintain native fish habitat. Ecosystem function.</p>	<p>Large wetland (WL) inundation</p> <p>WL3 (Regeneration of Floodplain Vegetation):</p> <ul style="list-style-type: none"> • greater than 45 GL over 3 to 6 months (Gwydir at Allambie) in Oct to Apr. • greater than 45 GL over 1 to 3 months) Gingham at Teralba. • greater than 40 GL over 2 to 6 months (Gingham at Tillaloo) in Oct to Apr. • greater than 20 GL over 1 to 4 months (at Gingham Bridge). <p>WL4 (Maintenance of Floodplain Vegetation):</p> <ul style="list-style-type: none"> • greater than 65 GL over 2 to 6 months (Gwydir at Allambie) in Aug to Feb (but can occur at any time). • greater than 60 GL over 2 to 6 months (Gingham at Tillaloo) in Aug to Feb (but can occur at any time). • greater than 30 GL over 1 to 4 months (Gingham at Gingham Bridge) in Aug to Feb (but can occur at any time). 	<p>WL3: 5 to 8 in 10 years (max. interval: 3 years). WL4: 3 to 5 in 10 years (max. interval: 5 years).</p>	<p>With wetter conditions persisting, targets for large wetland inundation have been met for the Gingham at Gingham Bridge and Teralba between 2020–21 and 2022–23. However, even during wetter years, the flows needed to regenerate and maintain floodplain vegetation across other locations have largely not been achieved. With the exception of the Gingham at the Gingham Bridge gauge and Tilaloo for WL4, the frequency of these large wetland flows has not been met across the last 10 years. The maximum intervals of 3 years for vegetation regeneration and 5 years for vegetation maintenance have also been exceeded at most locations. While conditions over the last 2 to 3 years have helped to improve the condition of floodplain vegetation, these flows are being achieved too infrequently over the longer term. Therefore, the demand for water in 2023–24 has been assessed as high, to support the recovery of floodplain vegetation and provide suitable habitat for future colonial waterbird breeding.</p>	High	<p>System constraints (identified as part of the package of adopted 'Northern Basin Toolkit measures') will need to be addressed before CEW can contribute to these demands.</p>	High

Environmental assets	Target values	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)	2023–24	Implications for future demand	
		Flow/volume	Required frequency (maximum dry interval)				
Mallowa Wetlands <ul style="list-style-type: none"> Waterbird breeding and habitat. Habitat and breeding ground for frogs. Endangered ecological communities. Lagoons and wetlands which have important values for the Gomeri local Aboriginal community. Key sites include Valetta swamps and surrounding wetlands. 	Core wetland inundation. Maintain wetland and riparian vegetation condition. Ecosystem function.	Small wetland (WL) inundation: WL1 (Protect Core Wetland): <ul style="list-style-type: none"> greater than 3 GL over 2 to 4 months at the Mallowa Regulator in Oct to Mar (but can occur at any time). WL2 (maintenance and regeneration of wetlands): <ul style="list-style-type: none"> greater than 8 GL over 2 to 4 months at the Mallowa Regulator in September to March (but can occur at any time). 	WL1: 9 to 10 in 10 years (max. interval: 1.5 years). WL2: 7 to 9 in 10 years (max. interval: 2 years).	Flow targets to protect, maintain and regenerate core areas of the Mallowa Wetlands have been achieved over the last 3 years between 2020–21 and 2022–23. During 2018–19, the delivery of environmental water (based on a proactive water delivery strategy) also met both wetland flow targets. However, dry conditions across several years during the past 10 years means that the frequency of flows to protect, maintain and regenerate core areas of the Mallowa Wetlands are not being achieved. Therefore, there is a high demand for water to provide small wetland flows to the Mallowa Wetlands in 2023–24, to support core wetland areas, and build on the benefits of flows over the last 3 years.	High	A high priority for CEW under high water resource availability scenarios, subject to occurrence of unregulated flow event and water availability. A combination of entitlements may be used to respond to unregulated flow events, to protect (supplementary) and potentially restore (regulated) parts of a natural flow. Use of supplementary water to protect natural flow. Use will be assessed based on the likelihood of third party impacts.	High
	Maintain native vegetation condition (including Lignum). Waterbird habitat and potential breeding. Native fish. Ecosystem function.	Large wetland (WL) inundation WL3 (Regeneration of Floodplain Vegetation): <ul style="list-style-type: none"> greater than 15 GL over 2 to 4 months at the Mallowa Regulator in Oct to Apr. WL4 (Maintenance of Floodplain Vegetation): <ul style="list-style-type: none"> greater than 22 GL over 2 to 6 months at the Mallowa Regulator in Aug to Feb (but can occur at any time). 	WL3: 5 to 7 years in 10 (max. interval: 3 years). WL4: 3 to 5 years in 10 (max. interval: 5 years).	Floodplain areas within the Mallowa system received large wetland flows in both 2021–22 and 2022–23 during wetter conditions. However, before 2021–22, flows to support the regeneration of floodplain vegetation had not been fully achieved since 2013–14. Flows to maintain floodplain vegetation had not been achieved between 2013–14 and 2020–21. Therefore, the required frequency of these flows has not been achieved in the Mallowa Wetlands, and the maximum interval between these flows had also been exceeded. There is a high to critical demand for water in 2023–24, to increase the frequency of these events and to support recovery of floodplain wetland vegetation in the Mallowa Wetlands.	High to Critical	Use of Commonwealth supplementary water to protect natural flows. This demand is difficult to deliver without relaxing constraints.	High
Carole Creek <ul style="list-style-type: none"> Waterbird habitat and refuge. Habitat and refuge for frogs. Native fish habitat, breeding, recruitment and refuge. Aquatic communities. 	Native fish dispersal and condition. Native fish spawning (in-channel specialists and generalists, e.g. Murray cod). Maintain native vegetation condition. Aquatic ecosystem function.	Small fresh (SF) SF1: Greater than 200 ML/d for at least 10 days on the Carole near Garah, in Oct to Apr (but can occur at any time) (native fish condition and dispersal). SF2: 200 to 900 ML/d for at least 14 days on the Carole near Garah, in September to April (spawning of in-channel specialists and generalists).	SF1: Annually (max. interval: 1 year). SF2: 5 to 10 in 10 years (max. interval: 2 years).	Small freshes in the Carole Creek have generally been achieved over the past three years, while conditions have been wetter between 2020–21 and 2022–23. Before this, dry conditions in 2018–19 and 2015–16 meant that flows were insufficient to meet either the SF1 or SF2 targets. Small freshes to support native fish spawning (SF2), which need a longer duration, were also not met in 2014–15 or 2019–20. While flow targets for SF2 have been met less often over the last 10 years, the minimum ideal frequency has been achieved. However, small freshes to support native fish condition and dispersal (SF1) are required annually and have not been achieved in 2 of the last 10 years. Therefore, the demand for water to provide small freshes in the Carole Creek in 2023–24 has been assessed as moderate to high, with the highest demand being for SF1.	Moderate to High	A secondary priority for CEW under high water resource availability scenarios. Use of supplementary water to protect natural flow may be considered. Use will be assessed based on the likelihood of third-party impacts.	Moderate to High

Environmental assets	Target values	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)	2023–24		Implications for future demand
		Flow/volume	Required frequency (maximum dry interval)		Environmental demand for water (all sources)	Potential Commonwealth environmental water (CEW) contribution	
		<p>Small fresh (SF3) SF3: Greater than 45 ML/d for at least 10 days on the Gil Gil at Galloway, in October to April (but can occur at any time) (native fish condition and dispersal).</p>	<p>Within 12 months of a flow greater than 750 ML/day on the Gil Gil at Galloway (end of system gauge) for at least 5 days. (max. interval: 4 years).</p>	<p>This flow target is closely aligned to the occurrence of large natural flows. The combination of a large natural flow greater than 750 ML/d followed by a small fresh within 12 months has occurred in the last 4 years since 2019–20. However, before that, these flows have not been adequately achieved across the past 10 years assessed. In some years the small fresh flow target was met, but there were not larger natural flows in the preceding 12 months. Provision of a small fresh to the Gil Gil in 2023–24 would capitalise on recent higher flows and would provide native fish additional opportunity to move between the Gwydir and Barwon river systems. Therefore, the demand for water in 2023–24 has been assessed as moderate.</p>	Moderate	Use of Commonwealth supplementary water to protect natural flow. Use will be assessed based on demands and the likelihood of third-party impacts.	Low to Moderate
		<p>Large fresh (LF) LF1: Greater than 900 ML/d for at least 5 days on the Carole near Garah, in Jul to Sept (but can occur at any time) (native fish condition and dispersal). LF2: Greater than 900 ML/d for at least 5 days on the Carole near Garah, in Oct to Apr.</p>	<p>LF1: 5–10 years in 10 (max. interval: 2 years). LF2: 3 to 5 years in 10 (max. interval: 4 years).</p>	<p>Flow targets for large freshes along Carole Creek require large unregulated flows. Large freshes have been achieved in the Carole Creek during wetter conditions between 2019–20 and 2022–23. Before this, these flows had not been met since 2013–14, and the maximum interval between these flows had not been achieved. However, with large freshes being achieved over the last 4 years and in 2013–14, the minimum required frequency of these flows is currently being achieved. Therefore, the demand for water in 2023–24 has been assessed as low.</p>	Low	A secondary priority for CEW under high water resource availability scenarios. Use of Commonwealth supplementary water to protect natural flows may be considered. Use will be assessed based on the demands and the likelihood of third-party impacts.	Moderate
<p>Mehi River</p> <ul style="list-style-type: none"> Waterbird habitat and refuge. Habitat and refuge for frogs. Native fish habitat, breeding, recruitment and refuge. Aquatic Communities. Reaches within the system contain important values for the Gomeri local Aboriginal community. 	<p>Native fish dispersal and condition. Native fish spawning (in-channel specialists and generalists, e.g. Murray cod). Maintain native vegetation condition. Aquatic ecosystem function.</p>	<p>Small fresh (SF) SF1: For at least 10 days in October to April (but can occur at any time) for native fish condition and dispersal</p> <ul style="list-style-type: none"> greater than 345 ML/d at Moree. greater than 100 ML/d d/s Gundare. <p>SF2: In Sept to Apr (spawning of in-channel specialists and generalists)</p> <ul style="list-style-type: none"> 345 to 2,800 ML/d at Moree for at least 14 days. 100 to 850 ML/d d/s Gundare for at least 14 days. 	<p>SF1: Annually (max. interval: 1 year). SF2: 5 to 10 in 10 years (max. interval: 2 years).</p>	<p>Small freshes to support native fish condition and dispersal (SF1) have been met on the Mehi River at Moree and Gundare in each year over the last 10 years. Targets for small fresh flows to support spawning of native fish in-channel specialists and generalists (SF2) have also been achieved in the Mehi at Moree in 9 of the past 10 years. Although these flows have been met less frequently at Gundare, the minimum required frequency of these flows has been achieved over the last 10 years assessed. Therefore, the demand for water to provide small freshes in the Mehi River in 2023–24 has been assessed as moderate to high.</p>	Moderate to High	A secondary priority for CEW under high water resource availability scenarios. Use of Commonwealth supplementary water to protect natural flow may be considered. Use will be assessed based on the demands and the likelihood of third-party impacts.	Moderate High
				<p>Small fresh (SF) SF3: Greater than 90 ML/d/Mehi near Collarenebri for at least 10 days in October to April (but can occur at any time) (native fish condition and dispersal).</p>	<p>Within 12 months of a flow greater than 800 ML/day near Collarenebri for at least 5 days. (max. interval: 4 years).</p>	<p>This flow target is closely aligned to the occurrence of large natural flows. The combination of a large natural flow followed by a small fresh occurred each year between 2019–20 and 2022–23 on the Mehi near Collarenebri. It also occurred during wetter conditions in 2016–17. A follow up flow in 2023–24 would capitalise on recent higher flows and provide an additional opportunity for native fish to move between the Mehi–Gwydir and Barwon rivers. Therefore, this demand has been assessed as moderate.</p>	Moderate
	<p>Native fish dispersal and condition. Native fish spawning (flow specialists, e.g. golden perch). Maintain native vegetation condition. Frog breeding. Aquatic ecosystem function.</p>	<p>Large fresh (LF) LF1: For at least 5 days in Jul–Sept (but can occur at any time) for native fish condition and dispersal.</p> <ul style="list-style-type: none"> greater than 850 ML/d d/s Gundare. <p>LF2: For at least 5 days in October to April for spawning of flow specialists.</p> <ul style="list-style-type: none"> greater than 850 ML/d d/s Gundare. 	<p>LF1: 5 to 10 in 10 years (max. interval: 2 years). LF2: 3 to 5 in 10 years (max. interval: 4 years).</p>	<p>Large freshes to support native fish condition and dispersal, and for spawning of flow specialists have been met at the desired frequency on the Mehi at Gundare over the last 10 years. Therefore, the demand for water in 2023–24 to provide large freshes in the Mehi River have been assessed as low.</p>	Low (at Gundare)	A secondary priority for CEW under high water resource availability scenarios. Use of Commonwealth supplementary water to protect natural flow may be considered. Use will be assessed based on the demand and likelihood of third-party impacts.	Moderate to High

Environmental assets	Target values	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)	2023–24		Implications for future demand
		Flow/volume	Required frequency (maximum dry interval)		Environmental demand for water (all sources)	Potential Commonwealth environmental water (CEW) contribution	
Gwydir River Downstream of Copeton Dam <ul style="list-style-type: none"> Native fish habitat, spawning and recruitment. In-stream aquatic ecosystems. Reaches within the system contain important values for the Gomeri local Aboriginal community. 	Maintain refuge habitat. Native fish survival. Aquatic ecosystem function.	Very low flow Greater than 30 ML/d for at least 200 days at Gravesend. May occur at any time.	Annually (max. interval: 1 year).	Very low flows have been achieved downstream of Copeton Dam each year across the past 10 years assessed. These flows are generally met by other water in the system, including environmental water delivered to meet other environmental demands. Very low flows are required in every year to maintain refuges and support native fish survival. Therefore, the demand for water in 2023–24 has been assessed as high.	High	Environmental water for other actions could contribute to these demands. Expected to be met by essential regulated supply, so a secondary priority for CEW. Potential use of CEW under very low water availability scenario, subject to environmental water being available for delivery.	High
	Native fish movement, condition and recruitment (in-channel specialists and generalists, e.g. Murray cod). Native vegetation. Aquatic ecosystem function.	Baseflow (BF) BF1: Greater than 440 ML/d for at least 160 days at Gravesend, at any time (native fish movement and condition). BF2: Greater than 440 ML/d at Gravesend for at least 100 days in Sept to Mar (recruitment of in-channel specialist and generalists).	BF1: Annually (max. interval: 1 year). BF2: 5 to 10 in 10 years (max. interval: 2 years).	Baseflows have been achieved in the Gwydir River downstream of Copeton Dam in the last two years, while conditions have been wetter. The required frequency for baseflows to support naïve fish movement and condition (BF1) are required annually and have not been met for the ideal frequency across the last 10 years. Also, the maximum interval between these flows has been exceeded on more than one occasion during that time. Therefore, the demand for water to meet baseflow requirements in 2023–23 has been assessed as high, particularly for BF1, which is needed every year.	High	Copeton Dam can regulate a high proportion of inflows from upstream systems. Demand unable to be met at desired frequency in extreme dry. Expected to be met by essential regulated supply, so a secondary priority for CEW. Potential use of CEW under very low water availability scenario, subject to environmental water being available for delivery.	Moderate to High
	Native fish dispersal and condition. Native fish spawning (in-channel specialists and generalists, e.g. Murray cod). Native vegetation. Aquatic ecosystem function.	Small fresh (SF) SF1: Greater than 990 ML/d at Gravesend for at least 10 days in Oct to Apr (but may occur at any time) (native fish condition and dispersal). SF2: 990 to 8,600 ML/d at Gravesend for at least 14 days in September to April (spawning of in-channel specialists and generalists).	SF1: Annually (max. interval: 1 year). SF2: 5 to 10 in 10 years (max. interval 2 years).	Flow targets for small freshes in the Gwydir River have been met in all years over the past 10 year, excluding in 2019–20 for small freshes for fish spawning (SF2). Small freshes are ideally met each year, particularly for native fish dispersal and condition. Therefore, the demand for water in 2023–24 to provide small freshes in the Gwydir River has been assessed as moderate to high.	Moderate to High	Natural events or environmental water from other actions could contribute to meeting these demands. If needed, CEW could be utilised.	Moderate to High




Table GV3 Contingency Watering Actions

Environmental assets	Target values	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)	2023–24	Implications for future demand	
		Flow/volume	Required frequency (maximum dry interval)				
Refuge pools along the Gwydir and upper Mehi Rivers as well Carole Creek <ul style="list-style-type: none"> Refuge habitat. Native fish. Water quality. 	Maintain critical drought refuge habitat. Native fish maintenance and survival.	Up to 14 GL. Triggers 0 ML/d on the Gwydir River at Yarraman. Mehi River 0 ML/d on the Mehi River at Moree. Carole Creek 0 ML/d on Carole Creek near Garah.	Cease to flow period should not exceed: <ul style="list-style-type: none"> 30 to 60 days (depending on conditions) on the Gwydir at Yarraman 40 to 80 days (depending on conditions) on the Mehi River at Moree 40 to 80 days (depending on conditions) on Carole Creek near Garah. 	Environmental water was delivered to protect critical aquatic and fish refuge habitat in the Gwydir, Carole and Mehi systems to help meet this demand between Oct 2019 and Jan 2020. Late winter and early spring 2021 received below average to very much below average rainfall leading to a number of river reaches across the lower Gwydir ceasing to flow. These were subsequently broken by significant natural flows through 2021–22 originating from regulated tributaries. This environmental demand is a moderate priority if conditions turn dry in 2023–24. The Northern Connectivity Event in Apr to May 2018 (Mehi and Carole), the Northern Fish Flow Apr to June 2019 (Mehi only), the Northern Waterhole Top up flows from January 2021 to February 2021 and Northern Refresh autumn 2023 (Carole only) contributed to meeting this demand in key reaches (mainly in the Mehi and Carole).	Moderate	Natural events or environmental water from other actions could contribute to meeting these demands. If needed, environmental water could be utilised. Using regulated CEW entitlements, respond to extended dry periods to protect critical refuge habitat.	Moderate
Gwydir, and Gingham, and Mallowa systems <ul style="list-style-type: none"> Bird breeding. 	Support waterbird breeding events.	5 to 15 GL	Respond to naturally triggered bird breeding, if required	Large-scale colonial waterbird breeding action was triggered in 2021–22 and again in 2022-23. This environmental demand is assessed as unlikely under current forecast. However, if breeding does occur in 2023-24 supporting completion would be critical, to help populations to continue to recover.	Critical (if breeding event occurs)	Using regulated CEW entitlements, respond to extended period of floodplain inundation to sustain bird breeding.	Critical (if breeding event occurs)
Barwon–Darling <ul style="list-style-type: none"> Connectivity events. 	Maintain water quality within acceptable limits. Native fish maintenance and survival. Native fish movement, condition, and recruitment.	5 to 25 GL	Respond to: <ul style="list-style-type: none"> declining water quality following extended dry periods declining condition of fish communities following prolonged drought conditions 	The Northern Connectivity Event in April to May 2018, the Northern Fish Flow in April to June 2019, the Northern Waterhole Top-up in January to February 2021 and the Northern Refresh in autumn 2023 contributed to meeting this requirement. Natural unregulated flows throughout 2021–22 kept the systems connected. This environmental demand is still assessed as moderate whilst conditions were wet in 2022, dry conditions emerged in early 2023 and are forecast to continue. Recent monitoring has shown that fish communities in the Gwydir and Barwon-Darling River systems are under stress, with many native species and endangered species in low abundance.	Moderate - High	Using regulated CEW entitlements, respond to declining water quality and to support recruited native fish populations to disperse along the Barwon–Darling and/or into tributary systems.	Moderate
Ballin Boora Riparian Areas <ul style="list-style-type: none"> In-channel and riparian habitat. Aquatic communities. 	Water bird habitat and refuge Habitat and breeding ground for frogs. Native fish habitat.	600 to 1,200 ML event delivered at 10 to 50 ML/d (via infrastructure) for 12 to 120 days	Frequency subject to further examination. Est. max. interval: 3 years.	Environmental flows were delivered for the first time to the Ballin Boora system during 2018–19. The Ballin Boora ran from local runoff following localised intense heavy rainfall several times in February to March 2020 (local landholder feedback as per Mallowa). Heavy local rainfall and flood flows along the Mehi River in March 2021, August to September 2021 and September to November 2022 helped to inundate large sections of the Ballin Bora system but has been dry since. This environmental demand is assessed as low moderate.	Low to Moderate	A moderate priority for CEW given lack of recent flows into the system prior to 2020.	Low to Moderate




Note: Data and information from NSW Department of Planning, Industry and Environment and WaterNSW Realtime data website (WaterNSW 2023a) has informed the watering history in this table. A) Four sites in the Lower Gwydir and Gingham are internationally recognised under the Ramsar Convention and other international agreements for migratory species and for their special habitat value for waterbirds. These are Old Dromana on the Lower Gwydir system as well as Goddard’s Lease, Windella and Crinolyn on the Gingham Watercourse. The primary ecological features of the wetlands include large areas of coolibah woodland, water couch and marsh club-rush. By maintaining this wetland vegetation, other critical components of the Ramsar site may be supported, including waterbird breeding and foraging habitat. B) The Gwydir Long-Term Water Plan (NSW DPIE 2022a) describes the environmental water requirements (EWRs) needed to achieve the specified ecological objectives. The EWR’s defined within the Gwydir Long Term Water Plan have been used to inform indicative environmental demands for key assets located within the Gwydir system. C) Volumes are net of any irrigation deliveries

Key

Potential watering in 2023–24

-  High priority for Commonwealth environmental watering (likely to receive water even under low water availability)
-  Secondary priority for Commonwealth environmental watering (watering to occur only if natural trigger is met, or under moderate – high water resource availability); or water demand likely to be met via other means
-  Low priority for Commonwealth environmental watering (under high – very high water resource availability); or unable to provide water because of constraints or insufficient water

Environmental demands (demand is considered at a generalised scale; there may be specific requirements that are more or less urgent within the flow regime)

-  High to critical demand for water (needed in that particular year or urgent in that particular year to manage risk of irretrievable loss or damage)
-  Moderate demand for water (water needed in that particular year, the next year, or both)
-  Low demand for water (water generally not needed in that particular year)

1.2 Water delivery in 2023–24

In most years, it is generally preferred to use environmental water to ‘piggyback’ on natural flow triggers in the Gwydir system. These flow events can trigger a highly significant ecological response which requires support through the targeted use of environmental water.

Where a responsive approach is insufficient to achieve a desired outcomes (either through sudden changes in conditions or other unforeseen impacts), a more proactive approach is applied. Proactive environmental watering involves the delivery of a larger volume of environmental water to support the continued health of the wetlands or to support other environmental outcomes such as building or supporting native fish populations. A proactive approach reflects the available water, constraints, and modifications to the system. As water availability will be high in 2023–24, it is likely that a combination of both reactive and proactive approaches will be applied if deliveries are needed.

Following discussions with the NSW Gwydir Environmental Water Advisory Group (EWAG) and the Northern Basin Environmental Watering Group (NBEWG) and consistent with the demands and objectives and subject to availability, environmental water in the Gwydir Valley in 2023–24 may be used to:

- Maintain the long-term condition of core wetland and riparian areas.
 - Should unregulated tributary flows enter the Gwydir River, NSW and Commonwealth environmental water may be used to further restore and maintain the condition of core wetland and riparian areas in the lower parts of the Gwydir system, including along the Lower Gwydir and Gingham watercourses, Mallowa Creek and wetlands, Mehi River and Carole–Gil Gil Creeks.
 - Four sites in the Lower Gwydir and Gingham are internationally recognised under the Ramsar Convention. These wetlands are Old Dromana on the Lower Gwydir, and Goddard’s Lease, Crinolyn and Windella on the Gingham Watercourse. This outcome would seek to support the values of the Ramsar site by maintaining condition of wetland communities, including water couch and marsh club-rush communities within the Old Dromana and Goddard’s Lease sites.
 - Commonwealth environmental water is likely to be provided to further restore and maintain the condition of core wetland and riparian areas along the Mallowa Creek and wetlands, building upon the outcomes achieved in 2021–22 and 2022–23.
 - Commonwealth environmental water may also be used in Ballin Boora Creek.
 - Third-party impacts will be considered before making any environmental water deliveries into wetlands or lower watercourse areas.
- Enhance inter-system connection between the Barwon and Gwydir (via Mehi River and Carole–Gil Gil systems) to allow native fish populations the opportunity to migrate into the Gwydir from the Barwon River and vice-versa.
 - Unregulated flows in 2021–22 led to large populations of native fish being recruited in the Barwon–Darling River and its tributaries. It is important to allow these fish the opportunity to migrate along the length of the Barwon itself and also into the tributary systems where they can disperse. This can be achieved through the creation of ‘attraction flows’. Connection flows between the Gwydir and the Barwon will be

- supported using environmental water at the times that the fish require it, if suitable natural events do not occur.
- Should unregulated tributary flows enter the Mehi River and Carole Creek, Commonwealth supplementary entitlements are likely to be used to enhance connection between the Barwon and Gwydir systems. Use will be assessed based on the environmental demands and the likelihood of third-party impacts.
 - Should very dry conditions return and rivers and creeks across the lower part of the system stop flowing, NSW and Commonwealth environmental water would be used to maintain the condition of drought refuges across the lower Gwydir system pools. Refuges along the Gwydir River between Tareelaro weir and Brageen Crossing as well as the Mehi River upstream of Combadello and Carole Creek upstream of the Garah gauge would be the focus of this activity.
- Enable growth, reproduction and small-scale recruitment for a diverse range of flora and fauna.
 - Flows to increase food and habitat resources to improve conditions for possible native fish breeding.
 - Flows to provide stable water levels and resources to assist native fish to successfully breed.
 - Support the survival and viability of threatened species and communities.
 - Support colonial bird breeding events that may occur.
 - Unregulated flows in 2021–22 and again in 2022–23 led to large-scale and significant bird breeding across the various Gwydir wetland systems. If wetter conditions occurred in 2023–24 (however, current BoM forecast is for dryer conditions), it is possible that another bird breeding event may also occur in 2023–24. As such, Commonwealth environmental water may be used to support this event at the locations and times needed if it is required.

As in previous years, the use of Commonwealth and NSW environmental water in the Gwydir Valley will be adaptively managed throughout 2023–24, in response to changing water resource availability and environmental conditions and demands.

1.3 Monitoring and lessons learned

1.3.1 Monitoring

Monitoring and evaluation are key elements of the CEWH’s response to the requirements of the Water Act and Basin Plan. They support improved decision-making through the application of adaptive management principles. Monitoring and evaluation are critical steps in the management of Commonwealth environmental water, supporting the efficient and effective use of Commonwealth environmental water within the planning framework and demonstrating the achievement of environmental objectives.

The Flow Monitoring, Evaluation and Research (FlowMER) Program (previously the Long-Term Intervention Monitoring Project 2014–2019) has sites in the Gwydir Valley. In particular, the program focuses on the Lower Gwydir and Gingham Watercourse wetlands, sections of the Mehi River, the Mallowa Creek and wetlands, and the Gwydir River downstream of Copeton Dam. The MER program is being implemented jointly with NSW DPE – EHG with support from NSW

National Parks and Wildlife Service for the monitoring of vegetation and waterbirds. The MER program aims to understand the environmental response to Commonwealth environmental watering over multiple years, to help inform future water management.

Learn more about [monitoring activities funded by the CEWH in the Gwydir Valley](#).

Monitoring information is also provided by NSW agencies, including NSW DPE – EHG (vegetation, waterbirds and frogs), NSW DPI – Fisheries (native fish), and WaterNSW (hydrology and flow delivery data).

1.3.2 Lessons learned

Outcomes from monitoring and lessons learned in previous years are a critical component for the effective and efficient use of Commonwealth environmental water. These learnings are incorporated into the way environmental water is planned and delivered (through decision making processes including advisory groups, water use plans and water use minutes). This includes influencing the targeted areas and species for environmental water; and the timing, magnitude and duration of environmental flows.

Key findings from water delivery and monitoring in the Gwydir Catchment are summarised in Table GV4.

Table GV4 Key lessons learned in the Gwydir Valley

Theme	Lessons learned
Native fish	<ul style="list-style-type: none"> The fish population in the Gwydir River system remains under stress, with many native species and endangered species in low abundance. This may reflect the carrying capacity of the system in its current state. While some species appear to be breeding and recruiting, others, especially some of the more iconic species such as golden perch, freshwater catfish and Murray cod, are not recruiting sufficiently to improve their populations. Flow events delivered earlier in the water year (winter to spring) improved water quality, stimulated fish to move through the system and encouraged the development of diverse invertebrate communities. Primary and secondary production during flows at this time of year are limited by colder water temperatures. Maintenance of connection flows to the Barwon River is important to allow fish the opportunity to disperse once they recruit, which has only been intermittent and often absent in recent times. The creation and maintenance of connectivity should be a continuously high priority for environmental water delivery. Along with providing environmental flows, other options such as habitat rehabilitation, restocking and removing fish barriers should be considered to improve fish community condition.
Vegetation	<ul style="list-style-type: none"> Delivery of environmental water, in combination with natural inflows, has been effective in improving the extent and condition of wetland vegetation. Water couch-spike rush meadows, Cumbungi and marsh club-rush tall sedgelands and wetland areas of coolibah woodlands have benefited from watering. These areas are key to maintaining the ecological character of Ramsar sites within the Gwydir.
Wetlands	<ul style="list-style-type: none"> Providing flows to wetlands in the Gwydir system promotes invertebrate production and supports waterbird populations and vegetation condition. While small frequent flows to the Gingham and lower Gwydir wetlands can occur both from protected portions of natural flows and small deliveries of environmental water, these small flows tend to only reach into the more eastern portions, and do not result in effective inundation of the central and western portions of wetlands in the Gingham and lower Gwydir. A larger volume event, be it by natural flooding or a larger delivered volume from dam accounts is required at least once every 3 years to preserve and conserve the water dependent assets over time. The Mallowa wetlands rely almost solely on environmental water deliveries for all inflows except for inflows that occur from the larger natural flooding events. The CEWH is currently

Theme	Lessons learned
	<p>undertaking a scoping study for a greater understanding of the Mallowa Creek and wetlands system to aid current and future watering activities.</p> <ul style="list-style-type: none"> While it is preferred to use natural flow triggers for a responsive use of environmental water to inundate the east, central and western portions of the wetlands in the western Gwydir catchment, it is important to ensure that the wetlands within valley receive water across their entire length at least once every 3 years. Where a responsive approach is insufficient to achieve inundation in the 3-year period, a proactive approach, involving the use of a larger delivered volume from dam accounts into the wetlands, is then undertaken to ensure the continued health of the wetlands. This proactive approach reflects the available water, constraints, and modifications of the system. Larger scale proactive environmental watering in 2014–15 and 2018–19 successfully contributed to the recovery of wetland vegetation in the Lower Gwydir and Gingham Watercourses. The Old Dromana and Goddard's Lease Ramsar sites, can be successfully inundated with a large-scale proactive watering action (60 GL with around 30 GL each to the Gingham and Lower Gwydir), helping to support areas of coolibah woodland, water couch, cumbungi and marsh club-rush.
Ramsar sites	<ul style="list-style-type: none"> Four sites within the wetlands are listed as a Wetland of International Importance under the Ramsar Convention: Old Dromana on the Lower Gwydir Watercourse, and Goddard's Lease, Crinolyn and Windella on the Gingham Watercourse. The inundation extent achieved by environmental water deliveries varies between the 4 Ramsar parcels. Environmental water deliveries during the 2018–19 water year effectively inundated the 2 upstream Ramsar parcels - Old Dromana and Goddard's Lease. However, environmental water deliveries did not spill into the wetland areas located on Crinolyn and Windella but continued past these sites and reached Morialta Road downstream. These deliveries have demonstrated that while the upstream Ramsar parcels can be watered relatively easily, the 2 downstream sites require higher flow rates and/or works to enable environmental water to flow out onto the wetlands at the Crinolyn and Windella parcels. This is in train through the Gwydir Reconnecting Watercourse Country Project.
Productivity	<ul style="list-style-type: none"> Flows delivered over the summer/autumn period tend to improve water quality and promote primary and secondary production. This supports animals further up the food chain such as fish, frogs, and waterbirds.
Connectivity	<ul style="list-style-type: none"> Connectivity between Gwydir and Barwon rivers can be achieved using environmental water, and is important for supporting native fish habitat, and allowing the movement of native fish between rivers for spawning, dispersal, and recruitment. The Northern Connectivity Event, Northern Fish Flow and Northern Waterhole Top-up delivered from the Gwydir via the Mehi River and/or Carole Creek systems into the Barwon–Darling system during the 2017–18 and 2018–19 and 2020–21 water years were critical actions. These events reconnected channel habitats and promoted fish movement among the channels of the lower Gwydir system via the Mehi and Carole and between the Gwydir and Barwon Darling systems. Protecting environmental water delivered in these events from extraction was essential for success. During the 2020–21 water year active management arrangements were implemented in the Barwon–Darling for the first time. These arrangements enabled held environmental water delivered from the Gwydir and Border Rivers systems (as part of the Northern Waterhole Top-up) to be protected from extraction as it flowed along the Barwon–Darling. In autumn 2023, the CEWH provided environmental water across northern Basin rivers (including in the Gwydir) through the Northern Refresh. The deliveries built on river flows from rainfall to keep rivers flowing into the cooler months when water quality risks lessen. Water Quality monitoring undertaken by the MER providers ahead of releases found that the Northern Refresh would dilute salt, nutrients, and algal biomass, and potentially increase dissolved oxygen concentrations, thereby improving key water quality variables before they become critical.
Other	<ul style="list-style-type: none"> The principal management strategies employed in the lower sections of the Gwydir system of multi-year wetting and drying and using multiple flow types to target a range of wetland and channel outcomes, is helping to sustain the ecology of the system. Persistence of healthy populations of freshwater mussels (particularly <i>Alathyria jacksoni</i>, which is endemic to the Murray–Darling Basin) is dependent on permanent river reaches and waterholes. The provision and protection of minimum baseflows is vital to their persistence, and for populations to recover from the significant losses experienced during the 2017 to 2020 drought (Sheldon et al 2020).

Theme	Lessons learned
	<ul style="list-style-type: none"> • Freshwater mussels are extremely vulnerable when rivers dry out during intense drought or periods of low flow. Floodplain mussels could survive for months under drying conditions in certain circumstances when temperatures were cooler. River mussels could only survive for weeks under the same conditions. Survival times decreased to just days for both species as temperatures increase (Wright et al 2022). • Recolonisation of freshwater mussels is dependent on the recovery and movement of native fish populations through the northern Basin. Therefore, the minimum flow requirements of native fish also need to be provided to support recovery of both fish and mussel populations (Wright et al. 2022). • Bankfull and overbank flows are required to maintain the condition of waterholes and adequate depth to support freshwater mussels (Sheldon et al. 2020).

Source: CEWO MER (2020) & Eco Logical (2019)

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