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MURRAY–DARLING BASIN AUTHORITY

Basin environmental watering outlook for 2017–18

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Acknowledgement of the Traditional Owners of the Murray–Darling Basin

The Murray–Darling Basin Authority acknowledges and pays respect to the Traditional Owners, and their Nations, of the Murray–Darling Basin, who have a deep cultural, social, environmental, spiritual and economic connection to their lands and waters. The MDBA understands the need for recognition of Traditional Owner knowledge and cultural values in natural resource management associated with the Basin.

The approach of Traditional Owners to caring for the natural landscape, including water, can be expressed in the words of the Northern Basin Aboriginal Nations Board:

> …As the First Nations peoples (Traditional Owners) we are the knowledge holders, connected to Country and with the cultural authority to share our knowledge. We offer perspectives to balance and challenge other voices and viewpoints. We aspire to owning and managing water to protect our totemic obligations, to carry out our way of life, and to teach our younger generations to maintain our connections and heritage through our law and customs. When Country is happy, our spirits are happy.

The use of terms 'Aboriginal' and 'Indigenous' reflects usage in different communities within the Murray–Darling Basin.

Cover image: Woolshed east regulator, Chowilla Floodplain, South Australia, October 2016. Image courtesy of Daniel Haines, SA Water.

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Introduction

Each water year the Murray–Darling Basin Authority (MDBA) prepares environmental watering priorities for the Murray–Darling Basin. The priorities guide environmental watering across the Basin to achieve Basin-scale outcomes for flows and connectivity, native vegetation, waterbirds, and native fish. Environmental watering to meet these Basin priorities will also support essential ecosystem processes needed to achieve these outcomes such as nutrient cycling and food production.

Understanding the prevailing and forecast environmental conditions helps us to characterise the Basin on a spectrum from very dry to very wet. Appropriate management outcomes are selected, using the existing guidelines and principles, and environmental watering prioritised to achieve these outcomes. We call this the resource availability scenario.

This Basin environmental watering outlook (outlook) summarises the prevailing and forecast environmental conditions (ecological, climatic and hydrological) as at February 2017. Indicators collected by the Bureau of Meteorology (BOM) (rainfall, runoff, soil moisture, storage volumes, the El Niño Southern Oscillation Index and the Indian Ocean Dipole) inform this assessment.

This outlook presents a snapshot of recent flows at some important river, wetland and floodplain sites, and the overall ecological condition of waterbirds, native vegetation and native fish, where information is available. The outlook also foreshadows some of the important environmental watering needs over coming years.

In June we will publish the Basin-wide environmental watering priorities. They guide the annual planning and prioritisation of environmental watering across the Basin, and are consistent with the Basin-wide environmental watering strategy. This year, for the first time, these will be rolling, multi-year priorities and will address all resource availability scenarios.

Improving Basin-wide environmental watering priorities

In previous years, the MDBA identified environmental watering priorities with an annual timeframe.

Experience is showing that a medium-term perspective would better assist water managers. So from June 2017, we will publish rolling multi-year watering priorities. The new approach is better suited to the multi-year watering regimes that are needed for long-term recovery towards the environmental outcomes in the Basin-wide environmental watering strategy.

Research is showing that some populations use geographically distant rivers and sites for different parts of their life cycle, so the way environmental water is managed needs to reflect this. The priorities that will be published in June 2017 will also focus more on identifying watering needs at a system scale to match these large-scale population dynamics.

Reinstating key ecological processes requires flows across local, regional and basin scales. These processes can require coordinated flows across different timescales from event to event, season to season and across years.

Rolling multi-year priorities will also provide more flexibility for environmental water managers to manage their portfolios to meet the Basin priorities. In future years priorities will provide earlier identification of system-wide ecological needs which will assist water holders and managers earlier in their planning.

Basin priorities also need to be responsive to opportunities under different resource availability scenarios that may arise. To support this, rolling multi-year priorities will also cover a complete suite of climatic possibilities.

Current condition of the Murray–Darling Basin

Higher than average rainfall in 2016 resulted in much higher river flows than in 2015 and widespread inundation of wetlands and floodplains. These natural events watered many parts of the Basin's ecosystems. Environmental water holders and managers augmented natural flows in selected instances to ensure important breeding and recruitment cycles were completed.

Lag phase: muted response

The Basin Plan is part of the response to the decline of the Basin's important rivers, floodplains and wetlands over many decades. The Basin Plan is not yet fully implemented, for example sustainable diversion limits will not be fully in place until mid-2019. It will take some time for the ecosystems of the Basin to respond, especially slower-growing species and those with long life cycles. During this lag phase a muted response is anticipated (as set out in the Basin-wide environmental watering strategy) with greater improvements in some areas than others. This is illustrated in Figure 1.

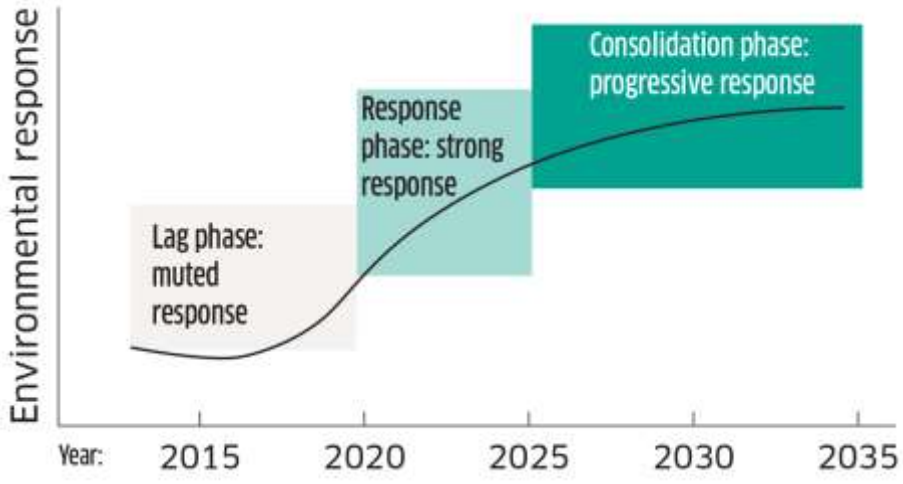

Figure 1: Illustrative environmental response to Basin Plan implementation

Although greatly improved by the 2016 flows, the condition of rivers and wetlands in the Basin is mixed. Many sites and species need follow-up watering to make the most of the 2016 flows and to boost their resilience for the dry periods that will inevitably return.

River flows and connectivity

There has been considerable variability in the Basin rainfall over the past decade. A long period of low rainfall persisted until widespread flooding in 2010 and 2011 heralded the end of the Millennium Drought. The near average annual rainfall recorded across much of the Basin in 2012 gave way to generally drier years in 2013 to 2015. Below average rainfall developed during 2013 in the northern Basin and persisted into 2014, leading to drought in parts of Queensland and northern New South Wales. Below average rainfall was more widespread in 2015. This was followed by a return to one of the strongest El Niño events on record combined with a positive Indian Ocean Dipole (associated with supressed rainfall over the Australian region), bringing warm and dry conditions into the early part of 2016.

Between May to September 2016, many parts of the Basin experienced wet conditions not recorded for 25 years. Consequently, total rainfall in 2016 was classified as above to very much above average across the southern Basin and average to above average in the north. For example, River Murray inflows were particularly high in 2016 – only about 12% of years since 1891 have higher inflows recorded. These wet conditions led to greatly improved connections between rivers and between rivers and floodplains, providing much-needed flows to water-dependent ecosystems.

The change from dry to very wet conditions in 2016 demonstrated how quickly above average rainfall can change the environmental watering opportunities. With catchments wet and water storages full, the resource availability scenario will not move back to dry as quickly. The coming year provides water managers with many opportunities to build upon natural recruitment and improvements to the condition of birds, fish and vegetation that resulted from wet conditions in 2016.

Condition of native vegetation

Heavy rainfall in 2016 led to many wetlands and floodplains across the Basin being inundated. These included the Gwydir Wetlands, the Macquarie Marshes, mid-Murrumbidgee wetlands, Booligal Wetlands and parts of the floodplains of the River Murray, Murrumbidgee, Lachlan and Goulburn. The inundation levels across some Basin floodplains were high enough to reach black box communities, which is expected to result in increased growth and improved tree condition. In general, riparian, wetland and floodplain vegetation communities across the Basin are responding well to the recent wet conditions and environmental water delivery. For example in the Murrumbidgee, environmental water was used to build on unregulated flows to improve the health of vegetation along the river, including the mid-Murrumbidgee wetlands.

However, many species have been in decline for decades and their recovery may require many years and successive watering. For example two species targeted by previous years' watering priorities have shown mixed responses:

- The extent of Moira grass in Barmah–Millewa Forest (and in pockets elsewhere along the Murray) declined significantly over the past few decades. In Barmah–Millewa Forest (where Moira grass is part of the ecological character description for the Barmah Forest Ramsar listing) about 180 hectares of Moira grass was recorded in early 2014, which is about 12% of the extent at the time of its Ramsar listing in 1982. Flooding and environmental water delivery in 2016 resulted in good growth and flowering.

- In the Coorong *Ruppia tuberosa* has not re-established population levels similar to those existing before the Millennium Drought. The ability of *Ruppia tuberosa* to re-establish is at risk because recent flow regimes have not supported flowering and seed setting in recent years.

Condition of waterbirds

Aerial waterbird surveys have been conducted over eastern Australia each year since 1983. The Eastern Australian Waterbird Survey conducted in October 2016 followed high rainfall across the Basin. Widespread flooding was observed throughout the Basin, particularly in the Macquarie Marshes, the lower Lachlan and Murrumbidgee catchments and the Coorong. Overbank flows occurred in much of the southern Basin and the Menindee Lakes were filling, watering productive floodplains (Porter et al. 2016).

Despite high flows, waterbird numbers dropped to the lowest on record since 2009, the peak of the Millennium Drought (Figure 2), noting that these counts are an index rather than absolute numbers. High counts of over 10,000 waterbirds in the lower Murrumbidgee and Lachlan catchments dominated survey totals during aerial waterbird surveys for the Basin (Porter et al. 2016). Widespread flooding created more places to feed and nest and waterbird populations were dispersed widely across eastern Australia. This dispersal may have contributed to low total waterbird abundance at sites in the Basin.

Annual migratory shorebird counts in the Coorong and Lower Lakes in 2016 showed decreased abundances (compared to 2015) for red-necked stints, the most common species in the Coorong, and curlew sandpipers. Sharp-tailed sandpiper and common greenshank numbers improved on the previous year. Shorebird numbers fluctuate year to year as these species rely on multiple international ‘staging’ sites during their annual migration. If one site is degraded it could affect counts in the Coorong, regardless of conditions there.

Although total waterbird counts were low, the number and diversity of birds observed breeding sharply increased in 2016. Local community groups, such as the Murrumbidgee Field Naturalists, noted especially high breeding numbers in Ramsar-listed sites such as Fivebough Swamp, as well as other important sites for waterbirds in the Basin including the Macquarie Marshes and Booligal Wetlands in the Lachlan. At these sites black swans, ducks and brolgas were observed with juveniles (O’Sullivan, 2017). The Commonwealth Environmental Water Holder’s long-term intervention monitoring recorded over 100,000 straw-necked ibis nests at Booligal Wetlands, with the colony exceeding 200,000 birds at its peak.

The lower Murrumbidgee supported large breeding colonies (totalling more than 20,000 nests) of straw-necked and white ibis. Environmental flows delivered to wetlands like these during dry years helped to prime these systems for a rapid productive response to natural flooding (Commonwealth Environmental Water Office, 2016).

Breeding during 2016 foreshadows greater opportunities to improve recruitment in coming years as fledglings mature. Environmental water can support this by maintaining habitats in good condition and by extending inundation periods, helping chicks to survive.

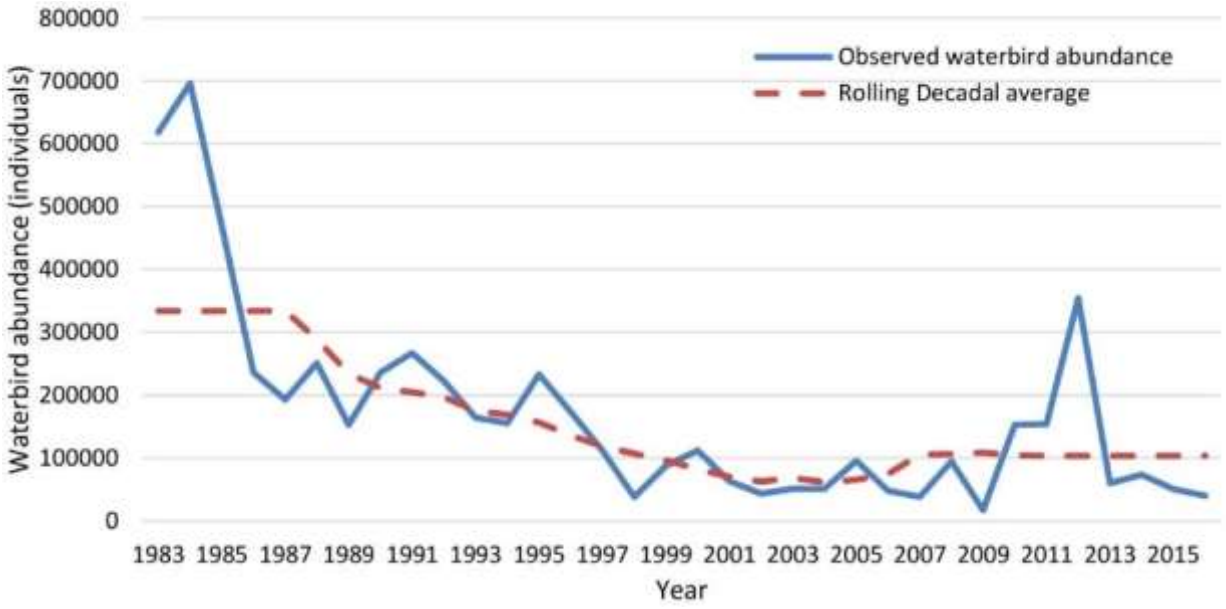

Figure 2: Waterbird abundance across the Murray–Darling Basin 1983–2016 (as estimated during aerial waterbird surveys) (Porter et al. 2016)

Condition of native fish

Basin-wide surveys, funded by the MDBA, are used to monitor long-term changes in the condition of native fish. A third survey was completed in May 2016 and initial analyses suggest that the recent condition of many native fish populations is stable, although still poor when compared to historical records.

Environmental flows are part of efforts to improve native fish populations. Environmental flows have benefitted golden perch and silver perch in major rivers, as well as Murray cod, trout cod and freshwater catfish, particularly within tributaries and anabranches. Environmental water has also helped small-bodied wetland fish, with some threatened species increasing in numbers. For further information, see Habitat makes fish happen, edition 39 of *RipRap* magazine.

Natural flooding in the northern and southern Basin in 2010 and 2011 provided a boost to many native fish species. In particular, golden perch breeding and the dispersal of young fish resulting from these floods now comprise up to 60% of the golden perch populations in parts of the southern Basin.

Wetter conditions in 2016–17 are likely to provide similar benefits to native fish. Flows in the Darling River, Murray River and major tributaries have resulted in large-scale breeding of Murray cod and golden perch, and dispersal of large numbers of juvenile silver perch in the southern Basin.

However, natural flooding also triggered hypoxic (blackwater) events in parts of the southern Basin as natural floods carried carbon-rich material (such as grasses, leaves, manure) from large areas of floodplain into the rivers. This caused oxygen levels in rivers to drop as the material decayed, harming and killing native fish and other species. These hypoxic events typically occur after long intervals between flooding, when excessive carbon loads build up on floodplains. In the past, regular flushing of material off the floodplain reduced this build up and consequent large scale hypoxic events.

The hypoxic events in 2016–17 affected native fish populations, particularly Murray cod, in the southern Basin. The impact on the total population is not yet known, but population recovery in affected regions is important in the medium term. Monitoring fishways along the River Murray showed that many fish moved to avoid the hypoxic water. Strategic use of environmental water during these events offered some mitigation by providing refuges in fresh, oxygenated water.

The resource availability scenario

After a dry start to 2016, wetter conditions emerged in late autumn and rainfall was above average to very much above average across much of the Basin (BOM 2017a). After Australia's ninth-driest April on record, the following month was the sixth-wettest May on record.

As a consequence, in the second half of 2016 rainfall, runoff and root zone soil moisture were generally above average to very much above average across much of the Basin. However, parts of the northern Basin, particularly in the north-east and around Bourke, were average to below average. Water storage levels are generally above average to well above average in regulated systems that experienced the wetter conditions.

The Bureau of Meteorology's seasonal forecast is for warmer and drier that average conditions for March to May 2017 (BOM 2017b). While the El Niño Southern Oscillation (ENSO) Index is likely to remain neutral over autumn, models suggest the chance of El Niño forming in 2017 has risen (BOM 2017d). The ENSO Outlook has now been raised to WATCH which means there is about a 50% chance of El Niño developing from July 2017 (BOM 2017c).

The Indian Ocean Dipole is currently in a neutral phase (typical at this time of year), however events often start forming in May–June. These can dampen or enhance the effect of El Niño depending on the sea surface temperature differences in the eastern and western Indian Ocean. The Bureau of Meteorology advises that model outlooks that span the southern autumn period tend to have lower accuracy than outlooks issued at other times of the year. This means that outlooks beyond May should be used with caution.

Taking all this into consideration, we are anticipating an overall wet resource availability for early 2017–18, noting that this may change as the year progresses and is trending towards moderate to dry in parts of the northern Basin. Rolling multi-year priorities will therefore describe system-scale ecological needs for each resource availability scenario. Anticipated resource availability scenarios will also be presented at a catchment scale.

Environmental watering opportunities in 2017–18 to support Basin-scale outcomes

The magnitude and extent of high flows experienced in 2016 last occurred in the early 1990s. This means that there is a one in 25 year opportunity to follow up these big flows with environmental watering that consolidates the benefits of these flood flows and builds the resilience of ecosystems ahead of the next, inevitable dry period. Relatively large volumes of environmental water in storages combined with ecosystems that are wetter than usual provides an ideal opportunity to strongly support the ecology of the Basin that has evolved to flourish in response to booms in water availability. A strategy of maximising watering following a wet year is

more likely to support diverse ecosystems over the medium to long term and encourage restoration of distribution, condition and abundance than a more conservative watering strategy that may overly dampen ecologically important fluctuations.

Current information suggests that in 2017–18 there will be many opportunities to build on the natural inundation in 2016. However, three opportunities currently stand out:

- Recent studies have strongly demonstrated the importance of large-scale golden perch breeding and nursery development of juveniles in Menindee Lakes to Basin-wide populations of this important species. Early monitoring suggests that there is a critical opportunity for flows to support the dispersal of large numbers of juveniles into the main rivers and tributaries to significantly boost golden perch populations Basin-wide.
- Trend analysis suggests that waterbird abundance is not recovering as expected. However, monitoring also suggests that following a flood and extensive breeding, waterbird abundance will spike 1 to 2 years later. So, supporting waterbirds, including any breeding is a critical opportunity over the next couple of years. This may include watering to support the first year birds that fledged following the 2016 floods, maintaining a suite of habitats for dispersed waterfowl breeding, and supporting the breeding of colonial nesting species, when opportunities arise.
- Experience gained undertaking environmental watering has demonstrated the importance of follow-up watering to ensure the initial gains are reinforced and vegetation resilience is improved for a longer period. The floodplain and wetland watering caused by widespread high flows in 2016 means that there will be many opportunities to reinforce the benefits arising from those flows to ensure the survival of the plants that germinated and build the resilience of older vegetation.

Some other important opportunities are discussed briefly below. These are not intended to be a comprehensive list and many opportunities will be identified over shorter timeframes and at catchment and site scales. Environmental water holders and river operators work together to identify the best ways to give effect to these opportunities on a case-by-case basis, often in real time. This can include coordinating flows across tributaries, undertaking multiple watering that uses the same water a number of times at different locations, manipulating weirs to raise and lower water levels, operating structures and timing releases to build on natural flows.

River flows and connectivity

Being at the end of the system, the Coorong, Lower Lakes and Murray Mouth complex is one part of the Basin that has been most affected by decades of reduced flows. Although flows in 2016 have benefitted this important Ramsar-listed area, it remains a priority for watering.

Restoring connectivity by increasing flows along the Murray River, and its tributaries, to the sea supports vital ecosystem functions including moving salt and sediment through the Murray Mouth and allowing native fish to move between marine, estuarine and freshwater environments. Without sufficient flows, salinity increases and connectivity between the ecosystems declines.

Improving conditions in the Coorong requires a long-term approach as many of the key species and ecological processes within the system require specific flow regimes over multiple years. So, the Coorong is likely to be an ongoing priority.

This opportunity builds on priorities from previous years and will, where possible, maintain hydrological connectivity between the freshwater, estuarine and marine environments in the Coorong, with a focus on improving habitat conditions to support the growth and maintenance of *Ruppia tuberosa* populations.

The Barwon–Darling River system is the only connection (both physical and ecological) between northern and southern Basin rivers. The Barwon–Darling supports high value ecological communities, contributes flows to the lower Murray and is a vital breeding and recruitment zone for native fish.

In order for the Barwon–Darling to deliver its key functions, it relies on the contribution of flows from upstream catchments and retention of those flows through to the lower Darling/Menindee Lakes system. Improved coordination of environmental water (including prioritising which tributaries release environmental water for particular goals), coordination with other river operations and augmenting natural events will improve ecological outcomes for the Barwon–Darling, and for the northern and southern rivers that it connects with.

Waterbirds

Surveys in 2016 recorded the lowest waterbird abundance for seven years. This low count may be the result of dispersal due to the availability of extensive waterbird habitat, or it may indicate a further depletion of waterbird populations. More positively, 2016 recorded an increase in breeding abundance and breeding species richness, which has been followed by significant recruitment in the first quarter of 2017.

Response in waterbird abundance generally occurs one to two years after flooding. For example, after the floods of 2010–11, abundance did not spike until 2012. This means that there is potential for 2017–18 to be an important year for the Basin's waterbird populations. Watering actions that support increased waterbird abundance in the short-term will be critical for reversing the long-term decline in waterbird numbers. A positive long-term trajectory in waterbird abundance will be needed to achieve the expected environmental outcomes for waterbirds in the Basin-wide environmental watering strategy.

In 2017–18 environmental watering should build on wet conditions to improve the health and resilience of the Basin's waterbird population. Promoting higher river–floodplain connectivity will maximise wetland habitat and promote the survival of first year birds, and facilitate further breeding across all waterbird functional feeding groups. This may be achieved by a variety of mechanisms, depending on location, timing and the particular target. These can include changing the height of weirs or releasing higher volumes that allow water to connect to wetlands through distributary channels that commence to flow before rivers are at bank full.

Within this context, and in anticipation of a wet resource availability scenario, the environmental flow management strategies for waterbirds are to:

- create a mosaic of wetland habitats (inundated vegetation, mudflats and islands) suitable for functional feeding groups (ducks, herbivores, large waders, fish-eating birds and shorebirds)
- support breeding where naturally triggered
- trigger and provide ongoing support for small to moderate-scale breeding across functional feeding groups.

Native fish

Population recovery for native fish depends on coordinating Basin-scale flow over the long term. To meet the needs of many fish species, river systems need to connect at certain times and in particular sequences, requiring coordination of flows that cross administrative boundaries and span multiple watering years.

Research in the southern Basin has shown that golden perch, silver perch, and two lamprey species have life cycle processes that can operate over many hundreds of kilometres. Some parts of the Basin are known recruitment zones for fish, with the offspring from the zones moving to populate other rivers (Figure 3).

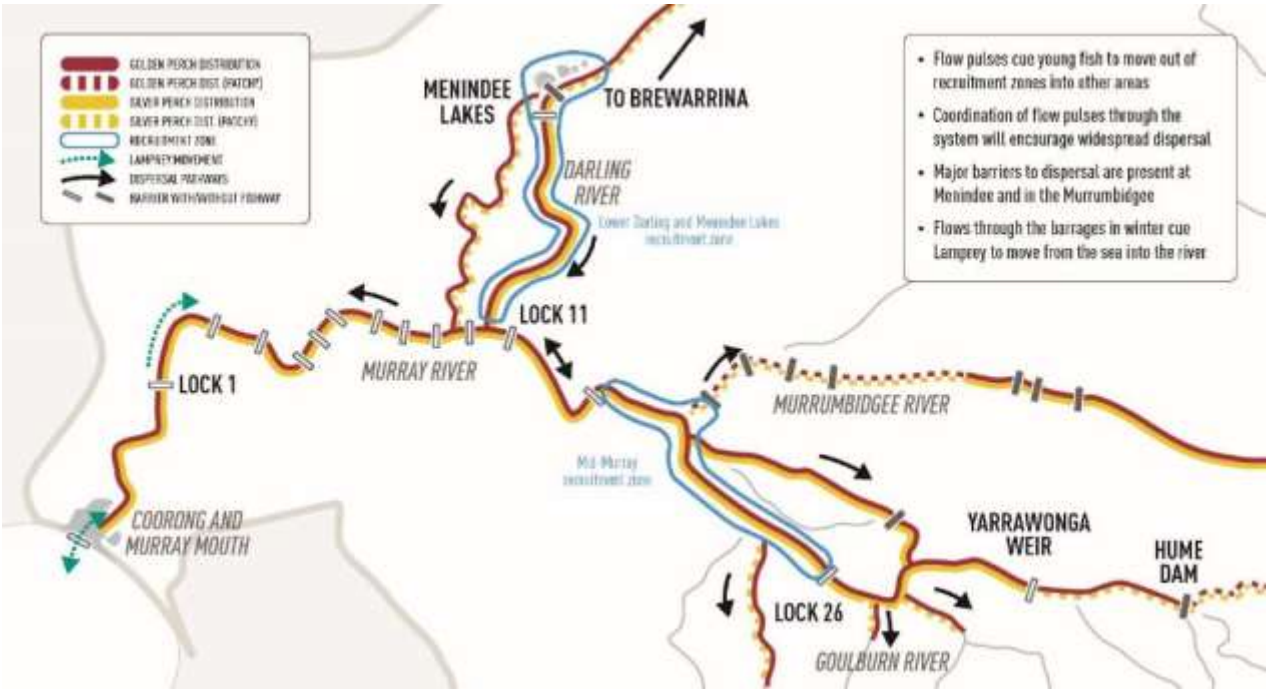

Figure 3: Golden perch and silver perch distribution in the southern Basin, and the system-scale movements and dispersal pathways that drive Basin-wide recovery

For golden perch, we now know that large recruitment events can result from interactions between the Barwon–Darling River, lower Darling River and River Murray with Menindee Lakes providing a particularly important role. The breeding events in this recruitment zone provide a significant boost to golden perch populations in southern connected Basin rivers in subsequent years.

Similarly, silver perch has a known recruitment zone in the mid-Murray region, driven by uninterrupted flowing sections that have a more natural flow pattern. However, despite almost annual recruitment of young fish, silver perch populations have not dispersed beyond the Murray region.

System-scale recovery of these species relies on flows that support breeding in these recruitment zones and dispersal of young fish into other river systems. Following natural flooding and environmental water delivery in 2016, there is an important opportunity to provide dispersal flows in the southern Basin in coming years by coordinating flows across catchments in response to natural cues.

A series of flow events released from upstream storages in spring, late summer and autumn over the next 12–24 months will disperse young Murray cod and encourage silver perch and golden perch to complete staged migrations and redistribute throughout the southern connected Basin. Flows through the system that reach the Murray Mouth in winter will support migrations of adult lamprey from the ocean into the River Murray, and flows through the Barwon–Darling River system can support juvenile dispersal upstream. Barwon–Darling River flows can also cue golden perch spawning and larval drift into the Menindee Lakes and lower Darling, starting the breeding cycle again.

There will also be opportunities in the coming years to support an expansion in the distribution of other species that have been affected by long-term changes in water management, as a result of the Millennium Drought or as a result of hypoxic water. Flows that lead to improved recruitment, food production and access to habitat (at the site or catchment scale) will be important, as will flows that encourage the movement of young fish from recruitment zones into new areas. Opportunities to prepare sites for reintroduction of threatened species using conservation stocking should also be taken.

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