Australian Government

Commonwealth Environmental Water Office

Commonwealth Environmental Water

Portfolio Management Plan

Lower Murray–Darling

2017–18

Front cover image credit: The Lower Darling River at Burtundy. Photo by Commonwealth Environmental Water Office.

Back cover image credit: Pelicans fly across the Lower Murray-Darling Region. Photo by Commonwealth Environmental Water Office.

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Commonwealth environmental water portfolio management planning

Commonwealth Environmental Water Holder

The Commonwealth Environmental Water Holder (CEWH) is a statutory position established under the *Water Act 2007* and is responsible for managing the Commonwealth's environmental water holdings. This water must be managed to protect and restore the rivers, wetlands and floodplains (and the native animals and plants they support) of the Murray–Darling Basin. Mr David Papps is the current CEWH. He is supported by staff of the Commonwealth Environmental Water Office (the Office). The Office employs six local engagement officers who live and work in regional centres across the Murray–Darling Basin.

Commonwealth environmental water

Commonwealth environmental water holdings are water entitlements that have been acquired by the Australian Government through investments in water-saving infrastructure and purchases on the water market. The holdings are a mix of entitlement types held across 19 catchments. The rules governing the entitlements vary across states and across catchments. Commonwealth environmental water entitlements are subject to the same fees, allocations, carryover and other rules as equivalent entitlements held by other water users.

There are broadly three options for managing Commonwealth environmental water:

- delivering water to a river or wetland to meet an identified environmental demand
- leaving water in storage and carrying it over for use in the next water year (referred to as 'carryover')
- trading water, that is, selling water and using the proceeds to buy water in another catchment or in a future year, or investing in complementary 'environmental activities'.

Purpose of the document

This document sets out the plans for managing the Commonwealth environmental water portfolio in the Lower Murray–Darling for 2017–18. Efficient and effective management of Commonwealth environmental water requires the utilisation of all portfolio management options. By taking a multi-year approach to planning, portfolio management tools such as use, carryover and trade can be managed for maximising environmental outcomes.

The portfolio management plans support transparent, coordinated and adaptive management of Commonwealth environmental water, consistent with the Basin-wide environmental watering strategy and having regard to the Basin annual environmental watering priorities.

To learn more about the planning approach see *Portfolio Management Planning: Approach to planning for the use, carryover and trade of Commonwealth environmental water* (available at: http://www.environment.gov.au/water/cewo/publications - under 'Planning approach'

Delivery partners

Commonwealth environmental water is managed in conjunction with and delivered by a range of partners. This portfolio management plan has been developed in consultation with our delivery partners, including South Australian Department of Environment, Water and Natural Resources (including Natural Resources Management Boards), NSW Office of Environment and Heritage, Victorian Environmental Water Holder, Victorian Catchment Management Authorities, NSW Department of Primary Industries – Fisheries, the Murray–Darling Basin Authority, the Murray–Darling Wetlands Working Group Ltd, Nature Foundation South Australia, Ngarrindjeri Regional Authority, Renmark Irrigation Trust, scientists engaged in monitoring the outcomes of Commonwealth environmental water use and various community groups and individuals.

Your input

The management of Commonwealth environmental water relies on considerable advice and assistance from local organisations, state governments and others. Individuals and groups within the Murray–Darling Basin community are encouraged to submit suggestions for the management of Commonwealth environmental water. Please contact the Office via: ewater@environment.gov.au.

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1. Environmental watering the Lower Murray–Darling

1.1. The Lower Murray–Darling Region

The Lower Murray–Darling Region consists of the River Murray downstream of Lock 15 at Euston to the Murray Mouth, the Darling River below Menindee Lakes and the Great Darling Anabranch. The lower River Murray contains several wetlands of ecological significance, including the internationally important Ramsar listed Coorong and Lakes Alexandrina and Albert, the Riverland (including the Chowilla floodplain), Banrock Station and Hattah Lakes.

Environmental water is sourced via managed releases from River Murray storages including Hume Reservoir, Menindee Lakes, Lake Victoria and River Murray tributaries. Natural cues (e.g. modelled natural flows) may be used to inform the use of environmental water in the lower River Murray, establishing a more natural flow regime and maximising the benefits of environmental water delivery. Environmental water delivery to specific sites within the lower River Murray occurs in two main ways. At low river flows, regulating structures or pumping can be used to manage the diversion of water into anabranches, creeks, wetlands and floodplains while in-channel pulses can provide benefits for native fish. At high river flows, environmental water is used to augment natural flow to influence the magnitude and duration of floodplain and wetland inundation.

Downstream of Lock 15 in the lower River Murray many wetlands, creeks and anabranches are permanently connected to the main river channel at normal weir pool levels, however, some sites are only connected through the operation of infrastructure or elevated river flows. The seasonally appropriate operation of river infrastructure, such as weirs, barrages and pumps, provides more natural patterns of inundation and drying sequences at these sites. Some wetland inundation can be achieved through weir pool manipulation, with a temporary raising of weir pools increasing the area of wetland inundation in low flow conditions whilst using much less water than the equivalent inundation from overbank flows. Water levels within the Lower Lakes and inflows into the Coorong are managed through the operation of barrages at Lake Alexandrina.

Environmental water delivery in the River Murray channel upstream of the South Australian border, including the operation of locks and storages, is managed by the Murray–Darling Basin Authority (River Murray Operations). In the lower Darling River, environmental water delivery is managed by either WaterNSW or the Murray–Darling Basin Authority (River Murray Operations) depending on who has operational control of Menindee Lakes at the time in accordance with the *Murray–Darling Basin Agreement*. Within South Australia, SA Water and the South Australian Department of Environment, Water and Natural Resources are the responsible agencies for environmental water delivery and management of locks and barrages. Delivery of Commonwealth environmental water is undertaken in collaboration with a number of delivery partners identified under 'Delivery Partners' above.

Environmental water is managed by a number of water holders in the Murray, including the CEWH, The Living Murray, the Victorian Environmental Water Holder, NSW Office of Environment and Heritage and the South Australian Department of Environment, Water and Natural Resources. Environmental water portfolios are coordinated to maximise the effectiveness of water delivery for achieving environmental outcomes. For example, the Southern Connected Basin Environmental Watering Committee was established by the Murray–Darling Basin Ministerial Council in October 2014 to coordinate the efficient and effective delivery of all environmental water in the southern-connected Basin.

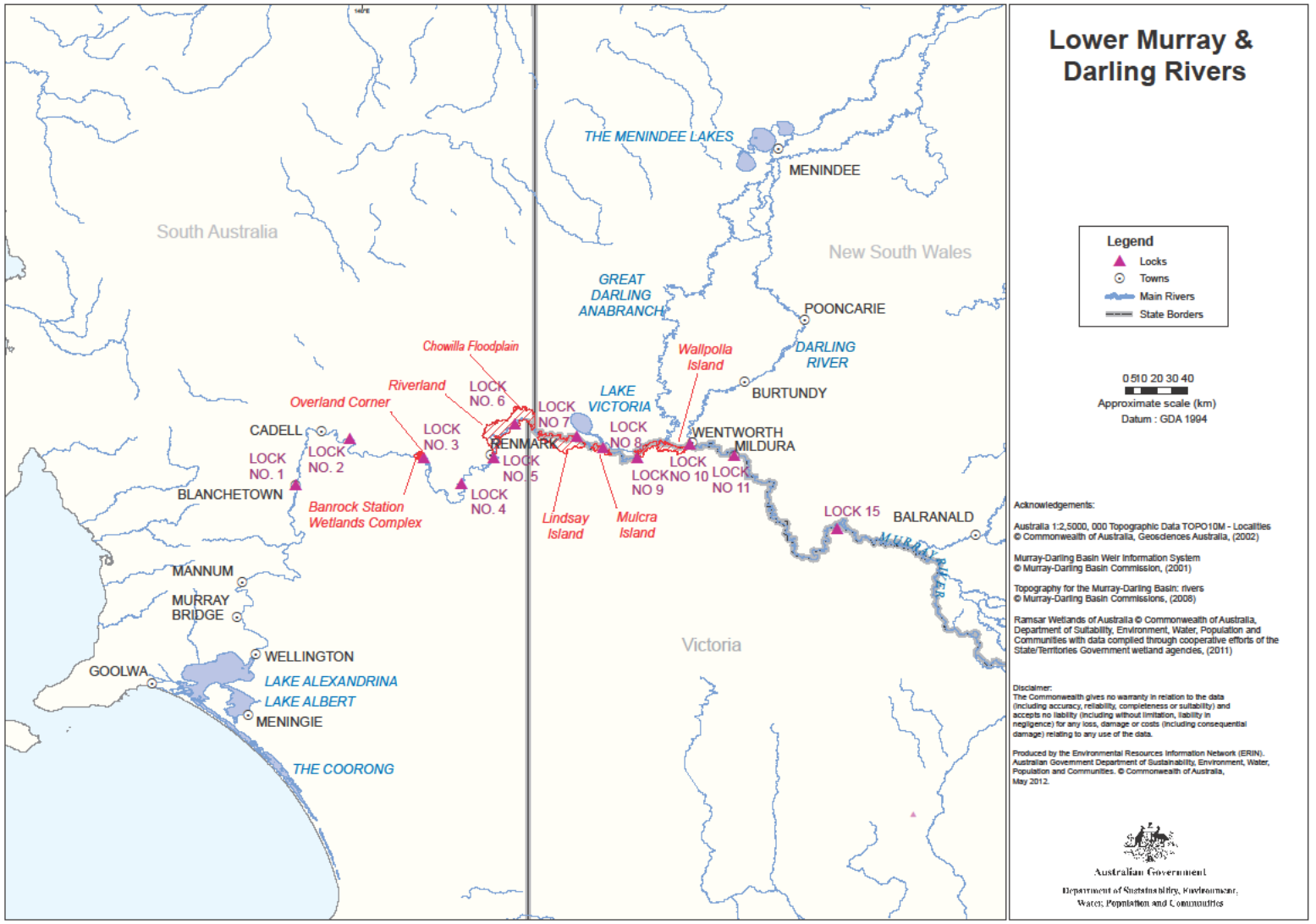

Figure 1: Map of the Lower Murray–Darling Region.

1.2. Environmental objectives in the Lower Murray–Darling Region

The long-term environmental objectives for the Murray–Darling Basin are described in the Basin Plan's environmental watering plan and the Basin-wide environmental watering strategy, which includes 'quantified environmental expected outcomes' at both a Basin-scale and for each catchment. The expected outcomes relevant for the Lower Murray–Darling are described in Attachment A.

The Victorian and South Australian state governments have also developed long-term watering plans for the Victorian (DELWP 2015) and South Australian River Murray (DEWNR 2015) regions. The plans identify the priority environmental assets and ecosystem functions in the catchment, the objectives and targets for these assets and functions, and their watering requirements. Once developed, the New South Wales Murray and Lower Darling plans will also provide key information on the long-term environmental water demands in the catchment.

The long term environmental watering plan for the South Australian River Murray water resource plan area is available at: http://www.environment.sa.gov.au/managing-natural-resources/river-murray/improving-river-health/environmental-water/environmental-water-planning

The long term environmental watering plan for the Victorian River Murray water resource plan area is available at: https://www.water.vic.gov.au/__data/assets/pdf_file/0023/53168/Victorian-Murray-LTWP_17-11-2015-FINAL.pdf. In addition to the long-term watering plans, the Office will continue to draw on existing documentation on environmental water demands developed by state governments, local natural resource management agencies and the Murray–Darling Basin Authority.

Based on these strategies and plans, and in response to best available knowledge drawing on the results of environmental watering monitoring programs, the objectives for environmental watering in the Lower Murray–Darling are summarised in Table 1 below. The objectives for water-dependent ecosystems will continue to be revised as part of the Commonwealth Environmental Water Office's commitment to adaptive management.

Table 1: Summary of objectives being targeted by environmental watering in the Lower Murray–Darling Region

BASIN-WIDE OUTCOMES (Matters in red link to the Basin-wide environmental watering strategy, MDBA 2014a)	OBJECTIVES FOR LOWER MURRAY–DARLING ASSETS						
	IN-CHANNEL ASSETS			END OF SYSTEM	OFF-CHANNEL ASSETS		
	River Murray from Euston to Lower Lakes	Lower Darling River	Great Darling Anabranch	Coorong, Lower Lakes and Murray Mouth	Hattah Lakes	Floodplain and wetlands from Euston to South Australian border	Floodplain and wetlands from South Australian border to Lower Lakes
VEGETATION	Maintain riparian and in-channel vegetation condition. Increase periods of growth for non-woody vegetation communities that closely fringe or occur within river channels.			Ensure survival and promote growth and recruitment of *Ruppia tuberosa* in the south lagoon of the Coorong. Maintain or improve the diversity, condition and extent of aquatic and littoral vegetation at the Lower Lakes.	Maintain the current extent of floodplain vegetation near river channels and on low-lying areas of the floodplain. Improve condition of black box, river red gum and lignum shrublands. Improve recruitment of trees within black box and river red gum communities.		
WATERBIRDS	Provide habitat and food sources to support waterbird survival and recruitment, and maintain condition and current species diversity.						
				Maintain habitat and food sources to support improvement in waterbird condition and populations within the Lower Lakes and Coorong lagoons (including curlew sandpiper, greenshank, red-necked stint and sharp-tailed sandpiper).	Complete seasonally appropriate colonial bird breeding events that are in danger of failing due to drying.		
FISH	Provide flows to support habitat and food sources and promote increased movement, recruitment and survival/condition of native fish.			Maintain or improve diversity, condition and population for fish populations (including estuarine-dependent and diadromous fish) through providing suitable habitat conditions within the Coorong lagoons and maintaining migration pathways that supports species recruitment and survival/condition. Provide flow cues to promote increased movement, recruitment and survival/condition of native fish.	Provide flow cues to promote increased movement, recruitment and survival/condition of native fish (particularly for floodplain specialists).		

<table>
<tr><th rowspan="3">BASIN-WIDE OUTCOMES
(Matters in red link to the Basin-wide environmental watering strategy, MDBA 2014a)</th><th colspan="6">OBJECTIVES FOR LOWER MURRAY–DARLING ASSETS</th></tr>
<tr><th colspan="3">IN-CHANNEL ASSETS</th><th>END OF SYSTEM</th><th colspan="2">OFF-CHANNEL ASSETS</th></tr>
<tr><th>River Murray from Euston to Lower Lakes</th><th>Lower Darling River</th><th>Great Darling Anabranch</th><th>Coorong, Lower Lakes and Murray Mouth</th><th>Hattah Lakes</th><th>Floodplain and wetlands from Euston to South Australian border</th><th>Floodplain and wetlands from South Australian border to Lower Lakes</th></tr>
<tr><td>INVERTEBRATES</td><td colspan="6">Provide habitat to support increased microinvertebrate and macroinvertebrate survival, diversity, abundance and condition.</td></tr>
<tr><td>OTHER VERTEBRATES</td><td colspan="6">Provide habitat to support survival, maintain condition and provide recruitment opportunities for frogs and turtles.</td></tr>
<tr><td rowspan="2">CONNECTIVITY</td><td colspan="3">Maintain baseflows and increase overall flows in the River Murray.
Maintain longitudinal connectivity along the Lower Darling and Murray rivers, including connectivity between the two systems in order to fulfil important environmental functions, such as nutrient and sediment transport, organism dispersal and water quality.
Maintain lateral connectivity through contributing to an increase in the frequency of freshes, bankfull and lowland floodplain flows.</td><td></td><td colspan="2">Maintain latitudinal connectivity (within constraints) to wetlands and floodplains, by contributing an increase in the frequency of lowland floodplain flows.</td></tr>
<tr><td colspan="4">Improve the connection of the River Murray to the Coorong and the sea, through supporting increased barrage flows and Murray mouth openness.</td><td colspan="2"></td></tr>
<tr><td>PROCESSES</td><td colspan="6">Increase primary productivity, nutrient and carbon cycling, biotic dispersal and movement.
Increase transport of organic matter, salt and nutrients downstream and out the Murray Mouth.</td></tr>
<tr><td>WATER QUALITY</td><td colspan="3">Maintain water quality and provide refuge habitat from adverse water quality events (e.g. blackwater).</td><td>Maintain salinity regimes below critical thresholds for key flora and fauna in the Lower Lakes and Coorong through supporting the export of salt through the Murray Mouth.</td><td colspan="2">Increase mobilisation and export of salt from the River Murray system.</td></tr>
<tr><td>RESILIENCE</td><td colspan="6">Maintain drought refuge habitat and maintenance/condition of native biota (e.g. fish and other aquatic fauna).</td></tr>
</table>

Information sourced from: MDBA (2014a); Department of the Environment (2011 and unpublished); MDBA (2012a-i); DELWP (2015), Department of Environment, Water and Natural Resources (2015).

1.3. Environmental flow requirements

Not all environmental demands can and will be met through the use of held environmental water. Some demands are met by regulated water deliveries for consumptive purposes and inter-valley transfers, while others are met by large unregulated/natural flows events or are beyond what can be delivered within operational constraints. Figure 2 shows the broad environmental demands that are in scope for Commonwealth environmental water. Importantly, these are broad, indicative demands and individual watering events may contribute to particular opportunities, such as using infrastructure to deliver water to individual wetlands that would otherwise not be possible due to constraints. Also, there may be opportunities for Basin State governments to remove or modify constraints, which will improve the efficiency and/or effectiveness of environmental watering. Further information on delivery constraints are described in Attachment B.

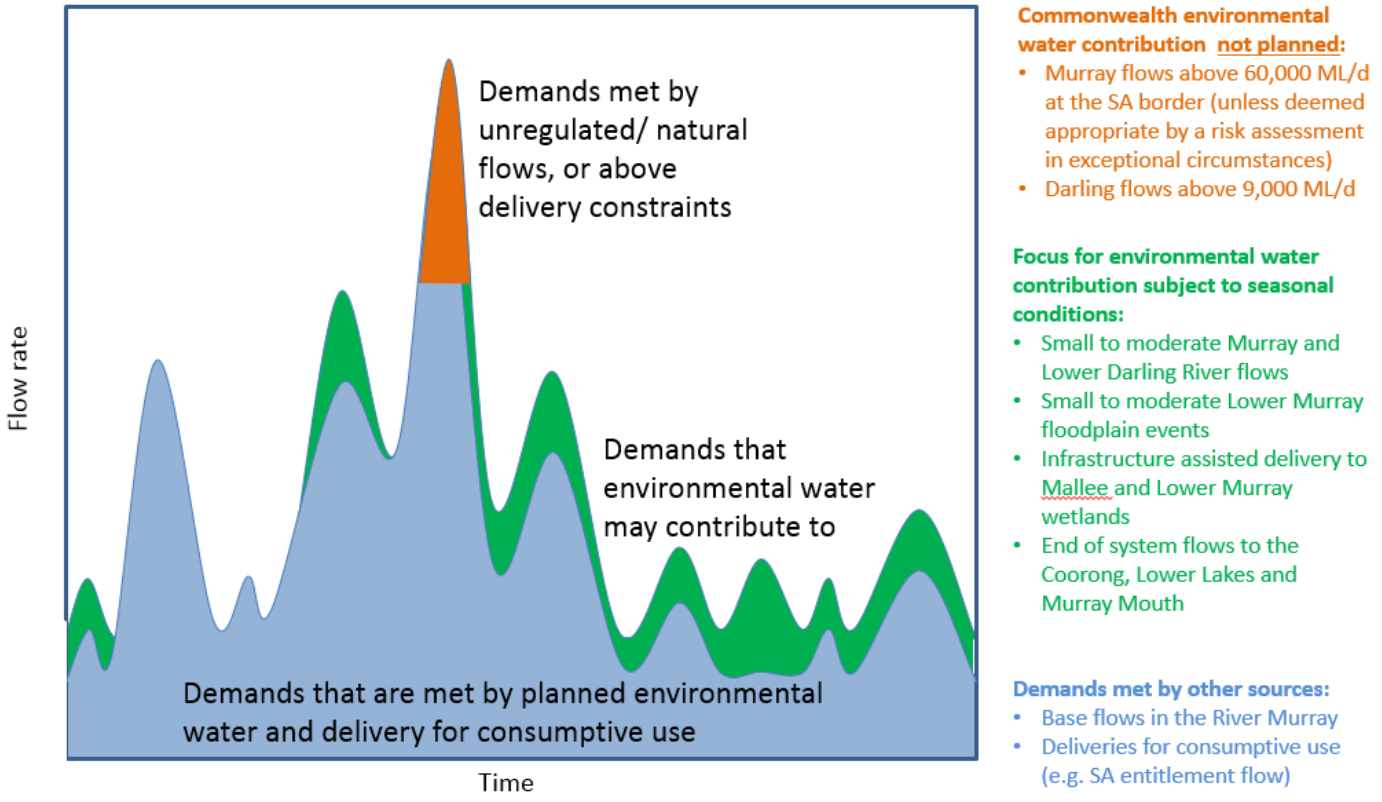

Figure 2: Scope of demands that environmental water may contribute to in the Lower Murray–Darling Region.

Based on the above objectives and delivery constraints, specific watering requirements (flow magnitude, duration, timing and frequency) have been identified as being in scope for Commonwealth environmental water. These water requirements are described in Table 3. As with the objectives, the environmental water requirements will continue to be reviewed and revised in response to new knowledge.

1.4. Monitoring and adaptive management

Operational monitoring is undertaken for all Commonwealth environmental watering actions and involves collecting on-ground data with regard to environmental water delivery such as volumes delivered, impact on the river systems hydrograph, area of inundation and river levels. It can also include observations of environmental outcomes.

The Long Term Intervention Monitoring (LTIM) Project is also being undertaken at the Lower Murray River region. It aims to understand the environmental response from Commonwealth environmental watering with respect to the targeted objectives.

Information on the monitoring activities is available at: http://www.environment.gov.au/water/cewo/catchment/lower-Murray–Darling/monitoring. Monitoring information is also provided by state governments and The Living Murray program.

Key findings and recommendations from the first two years (2014–2016) of the Lower Murray Long Term Intervention Monitoring Project (Ye et al, 2017; Ye et al, 2016) include:

- Environmental water use over successive years of lower flows has shown significant benefits for the system through the export of excess salt from the river, as well as through reducing the amount of salt imported into the Murray Mouth from the sea.

- Environmental water reduced salinity levels in the Lower Murray Channel, Lower Lakes, Coorong and Murray Mouth. It also transported nutrients through the river system, and in doing so may have provided 'food' for aquatic plants and animals. Commonwealth environmental water provided 100 per cent of flows over the barrages between September 2015 and June 2016 into the Coorong. This builds on Commonwealth environmental water use in 2014–15, which provided 100 per cent of flows over the barrages from November 2014 to June 2015.

- Using environmental water to raise weir pools in the Lower Murray provided improved connections between the floodplain and the river, which may have provided more fish food. In years of relatively low flow, changes in weir pool levels in conjunction with environmental water use can confer ecological benefits between the river and floodplain, such as nutrient exchange and wetting of fringing vegetation.

- Due to the low flows in 2015–16, there was little spawning and no recruitment of golden and silver perch in the Lower Murray. Compared to the previous year (2014–15), the number and different types of small-bodied fish remained high, however, there was an increase in number of exotic goldfish and common carp.

- For the second consecutive year, small Murray cod were found in the Lower Murray, indicating successful recruitment. The conditions which have supported this recruitment remain unclear.

- The timing of environmental flow delivery is important and should continue to align with ecological objectives and consider biological processes and life history requirements e.g. the reproductive season of flow-cued spawning fishes in spring and summer.

- Maintaining the integrity (the physical, chemical and biological aspects) of flow from upstream to the lower River Murray is critical to support system-scale processes and promote positive ecological outcomes.

In the lower Darling River, the Office invested in an extensive short-term intervention monitoring project in 2016–17 to monitor the ecological response to Commonwealth watering actions in both the lower Darling River and the Great Darling Anabranch. Results from this monitoring have not yet been analysed, however the environmental researchers undertaking the monitoring are working closely with the Office to assist environmental flow planning for this region for 2017–18.

The outcomes from these monitoring activities are used to inform portfolio management planning and adaptive management decision-making as outlined in Section 2.

2. Portfolio management in 2017–18

In planning for the management of Commonwealth environmental water, the Commonwealth Environmental Water Office aims to maximise the outcomes achieved from the available water. This includes consideration of the urgency of demands (based on targeted objectives and watering requirements, watering history and asset condition) and the available supply under different resource scenarios. Plans for water delivery, trade and carryover are then made in a multi-year context, with an assessment also undertaken of need for water in future years.

This planning process is outlined in full in Table 3 below and summarised in the sections below.

2.1. Antecedent and current catchment conditions and the demand for environmental water in 2017–18

The demand for environmental water is a reflection of the health of rivers, wetlands and floodplains, and the plants and animals they support. Ecological health is influenced by flows and conditions in the past—in some cases, this can date back many years, with parts of the environment still showing the effects of the millennium drought.

Lower Darling

Following the millennium drought, natural flows and environmental watering events from 2011 to 2013 led to a positive environmental response in the catchment, such as improvements in river red gum and black box vegetation in the Great Darling Anabranch. However, due to record-low inflows and very low water levels in the Menindee Lakes, the Lower Darling River channel received minimum flows in 2014–15 and ceased to flow during 2015–16. Similarly, the anabranch did not receive flows during 2014–15 or 2015–16. This led to detrimental impacts on water quality and native fish populations in the Lower Darling.

Significant flows down the Barwon-Darling and into the Menindee Lakes in 2016 provided an opportunity for environmental releases down both the Lower Darling River channel and the Great Darling Anabranch. In the Lower Darling River, environmental water supported Murray cod spawning with monitoring demonstrating extremely high abundances of drifting larvae in October 2016, together with the spawning and dispersal of other large-bodied native fish species such as golden perch and small-bodied species (pers comm. C. Sharpe November 2016). In the Great Darling Anabranch, environmental water releases contributed to positive responses in river red gum and black box vegetation fringing the anabranch, and enabled the successful dispersal of native fish down the anabranch and into the River Murray (pers comm. P. Brown May 2017).

Lower Darling River: There is a high demand for environmental water in 2017–18 to build upon outcomes in this reach from 2016–17, particularly in relation to native fish. Native fish population studies in past years have demonstrated the importance of the Darling River for providing source populations of golden perch and other species, which then disperse throughout other rivers of the southern-connected Basin (Ye et al, 2017; Zampatti et al, 2015). Protecting native fish in the Lower Darling, including providing opportunities for their dispersal, will be of high importance in 2017–18 to assist the recovery of native fish populations that were affected by hypoxic blackwater in the Murray, Goulburn and Murrumbidgee rivers in 2016–17.

Great Darling Anabranch: Following a significant environmental water release down the anabranch in 2016–17, there is only a low to moderate demand for environmental water in this system for the coming year. Monitoring results are still being analysed, however the flushing flows released down the anabranch in summer-autumn 2017 are believed to have generated a range of positive vegetation and water quality outcomes for this asset. These flows also enabled dispersal of a large number of native fish that would otherwise have been trapped in Lake Cawndilla. Further flows down the anabranch has the potential to build on these outcomes, in particular dispersal of native fish, however it is not as significant a priority for watering as the mainstem Lower Darling River.

River Murray

During the 2010 to 2012 period, natural flow events and environmental watering actions resulted in improvements in the condition of many wetlands in the Lower Murray–Darling and promoted ecological recovery following the millennium drought. Drier conditions from 2013 to early 2016 saw some floodplain and wetland sites entering into a natural drying phase. Flow-cued spawning fish species, such as golden and silver perch, spawned in the Mid Murray in 2015–16. However in the Lower Murray, negligible spawning has been detected in 2014–15 or 2015–16, likely due to insufficient flow triggers.

In the River Murray catchment, natural inundation of most wetlands occurred following a wet May–December 2016. This was of benefit to wetland and floodplain vegetation and waterbird populations, and watering in 2017–18 will look to consolidate these outcomes. However, the natural floods also caused a significant hypoxic blackwater event. Although environmental water was used to mitigate the impacts on native fish populations, the hypoxic blackwater still resulted in large-scale fish kills; particularly for older, large-bodied native fish species. While it will take some time to fully understand the effect of the hypoxic events in 2016–17 on fish populations, the impacts, particularly for Murray cod, may be significant. A positive result of the higher flows in 2016 is that there are early indications that flow dependent fish species have successfully spawned with evidence for subsequent recruitment (survival to juvenile life stages) in several parts of the southern-connected Basin.

River Murray Channel: There is a moderate-high demand for environmental water to contribute to greater variability and more natural seasonality of in-channel flows for a range of outcomes (including the recovery of native fish by providing habitat, food and opportunities for spawning and movement) and to connect the river with low-lying wetlands.

Hattah Lakes: Significant watering actions in 2013–14, 2014–15 and 2016–17 have resulted in a low demand for water for wetlands and river red gum at Hattah Lakes in 2017–18. There is a high urgency of demand for black box woodland. Restoration of black box woodland is a high priority for the site managers this year due to the poor condition of trees, with inundation to a height of 45 m Australian Height Datum (AHD) required to water these trees.

Floodplain and wetlands from Euston to South Australian border: These off-channel assets were watered naturally during the 2010–11, 2012 and 2016–17 high river flow events. Smaller-scale inundation occurred between 2012–13 and 2015–16 to complement natural high flow events, assisted by the use of regulating infrastructure or pumping. Across this reach there is generally a low demand for environmental water in the coming year. However, there is a moderate-high demand for environmental water in certain permanent wetlands, with a particular focus for environmental water use on wetlands that contain Murray hardyhead or other threatened species. In the semi-permanent wetlands, there is a moderate need to maintain aquatic vegetation, and to maintain and/or improve the condition of mature river red gum trees. There is a low demand for environmental water in the ephemeral wetlands as water has recently inundated many of these assets.

Floodplain and wetlands from South Australian border to Lower Lakes: Considerable parts of the South Australian Murray floodplain were watered naturally during the 2010–11, 2012 and 2016–17 river flow events. In-between inundation events, priority wetlands have received water via infrastructure to support on-going ecosystem recovery (e.g. use of infrastructure within the Chowilla floodplain and pumping to individual wetland sites). To maintain on-going recovery of vegetation communities and Murray hardyhead populations, there is generally a moderate-high demand for environmental water in these floodplain wetlands. There is a moderate demand for environmental water in the ephemeral wetlands as water has recently inundated many of these assets.

Coorong, Lower Lakes and Murray Mouth: Large volumes of environmental water in recent years have contributed to improved conditions in the Lower Lakes and parts of the Coorong. Unregulated flow conditions in 2016–17 resulted in large volumes of water in the Coorong, Lower Lakes and Murray Mouth region. The high natural flows and additional environmental flows during 2016–17 have resulted in improved water quality and water levels in the Coorong, with the system now in better condition (improved salinity and water levels) than previous years. However, the Coorong, and in particular the South Lagoon, is still showing limited recovery. The future survival of *Ruppia tuberosa* (a keystone aquatic vegetation species) in the Coorong is at risk due to a lack of a sufficient flow regime for flowering and seed set. Although *Ruppia* increased in coverage in 2016–17, the reproductive cycle appeared to be severely hampered by filamentous algae growth. In recent years, salinity levels in the southern lagoon have exceeded critical thresholds for seed viability contributing to the on-going decline of the seed bank.

Maintaining ongoing connectivity between freshwater and marine environments is crucial for supporting a diverse fish assemblage, and facilitating the movement and recruitment of species that rely on this connectivity. Improvement in spring estuarine conditions is also critical for supporting foraging habitat for migratory waterbirds that are characteristic of the Ramsar site. Maintaining continuous base flows through the barrages is required to avoid damage to the site and support salt export from the River Murray and Lower Lakes. Flows over the barrages during the warmer months (January to March) is required to maintain estuarine conditions in the North Lagoon.

Murray–Darling Basin-wide environmental watering strategy and 2017–18 annual priorities

In contributing to these demands, the Commonwealth Environmental Water Office will also be aiming to contribute to the expected outcomes in the Basin-wide environmental watering strategy (see Attachment A) and the following 2017–18 Basin annual environmental watering priorities relevant to the Lower Murray-Darling Region.

- Support Basin-scale population recovery of native fish by reinstating flows that promote key ecological processes across local, regional and system scales for the southern connected Basin
- Improve flow regimes and connectivity to maximise the ecological function of the Barwon-Darling river system for native fish
- Support viable populations of threatened native fish and maximise opportunities for range expansion and the establishment of new populations
- Improve the abundance and diversity of the Basin's waterbird population
- Improve connectivity between freshwater, estuarine and marine environments and improve habitat conditions in the Coorong by optimising and managing inflows through the Lower Lakes.
- Enable recruitment of trees and support growth of understorey species within river red gum, black box and coolibah communities on floodplains that received overbank flooding during 2016 by inundating the floodplains again

The Commonwealth Environmental Water Holder will not inundate private land without prior approval from land holders while contributing to the Basin annual environmental watering priorities.

2.2. Water availability in 2017–18

Forecasts of Commonwealth water allocations

The volume of Commonwealth environmental water likely to be carried over in the Murray and lower Darling catchments for use in 2017–18 is estimated to be 182.1 GL. Total carryover in the southern-connected Basin is estimated to be 300–310 GL.

Allocations against Commonwealth water entitlements in the Lower Murray- Darling are determined by state governments and will vary depending on inflows. The following forecasts in Table 2 are based on the best available information including State forecasts and historical inflow scenarios.

Table 2: Forecasts of Commonwealth water allocations (including carryover) in 2017–18 in the Lower Murray–Darling Region as at 31 May 2017.

Entitlement type	Forecasts of Commonwealth water allocations (including carryover) in 2017–18 (GL)[2]					
	Very dry ← → Very wet					
	95 percentile	90 percentile	75 percentile	50 percentile	25 percentile	10 percentile
NSW Murray (High/Conveyance /General security) (includes lower Darling)	68	179	211	409	409	408
Murray[3] (Victorian High/ low reliability)	309	410	410	411	385	346
Murray (South Australian High security)	152	152	152	152	152	152
Total – Murray (includes lower Darling)	**529**	**741**	**773**	**972**	**946**	**906**
Total – Southern-connected Basin[1]	**861**	**1273**	**1376**	**1614**	**1577**	**1526**

Notes:
1. The southern-connected Basin includes the Murrumbidgee, Murray, Lower Darling, Goulburn, Campaspe (excluding Coliban) and Loddon entitlements.
2. Forecasts for regulated catchments are given to the nearest whole gigalitre except where the entitlement held by the Commonwealth is below 1 GL.
3. Total forecast water available in the southern-connected Basin assumes that in Victoria 100 per cent of water held in spillable accounts becomes available under a median or dry scenario and 50 per cent or less becomes available under wetter scenarios. These figures do not include supplementary, unregulated or ground water accruals in the southern-connected Basin.

Information on allocations to Commonwealth environmental water holdings can be found at http://www.environment.gov.au/water/cewo/portfolio-mgt/holdings-catchment and is updated monthly.

Water resource availability scenarios

Commonwealth environmental water is not managed in isolation. When considering the available resource to meet environmental demands, it is necessary to also factor in the resources managed by other entities and available to contribute to environmental objectives. Relevant resources include portfolios held by NSW Office of Environment and Heritage, Victorian Environmental Water Holder, Department of Environment, Water and Natural Resources, The Living Murray program, the River Murray Increased Flows program, planned environmental water, natural and unregulated flows, conveyance water and consumptive water. Further detail on sources of environmental water in the Lower Murray- Darling Region is provided in Attachment C.

By combining the forecasts of water held by the Commonwealth with streamflow forecasts, as well as taking into account operational considerations, water resource availability scenarios can be developed ranging from very low to very high. Based on available information, moderate to very high resource availability scenarios are in scope for 2017–18. Even under dry conditions, the Commonwealth's environmental water holdings will be supported by approximately 300 GL of carryover from 2016–17 in the southern-connected Basin and high opening allocations. In the Lower Darling, resource availability will be dependent on inflows into Menindee Lakes.

2.3. Overall purpose of managing environmental water based on supply and demand

Environmental water needs (demand) and water availability (supply) both influence the overall purpose of Commonwealth environmental water management. Under different combinations, the management purpose can range from 'avoiding damage' to the environment to 'improving' ecological health. This in turn informs the mix of portfolio management options that are suitable for maximising outcomes.

Figure 3 shows how current demands and forecasted supply are considered together.

The overall 'purpose' for managing the Commonwealth's water portfolio in the Lower Murray- Darling Region for 2017–18 is to protect and/or improve the condition of most environmental assets, while seeking to avoid irreversible damage or decline to the Coorong and Lower Darling Region (where feasible).

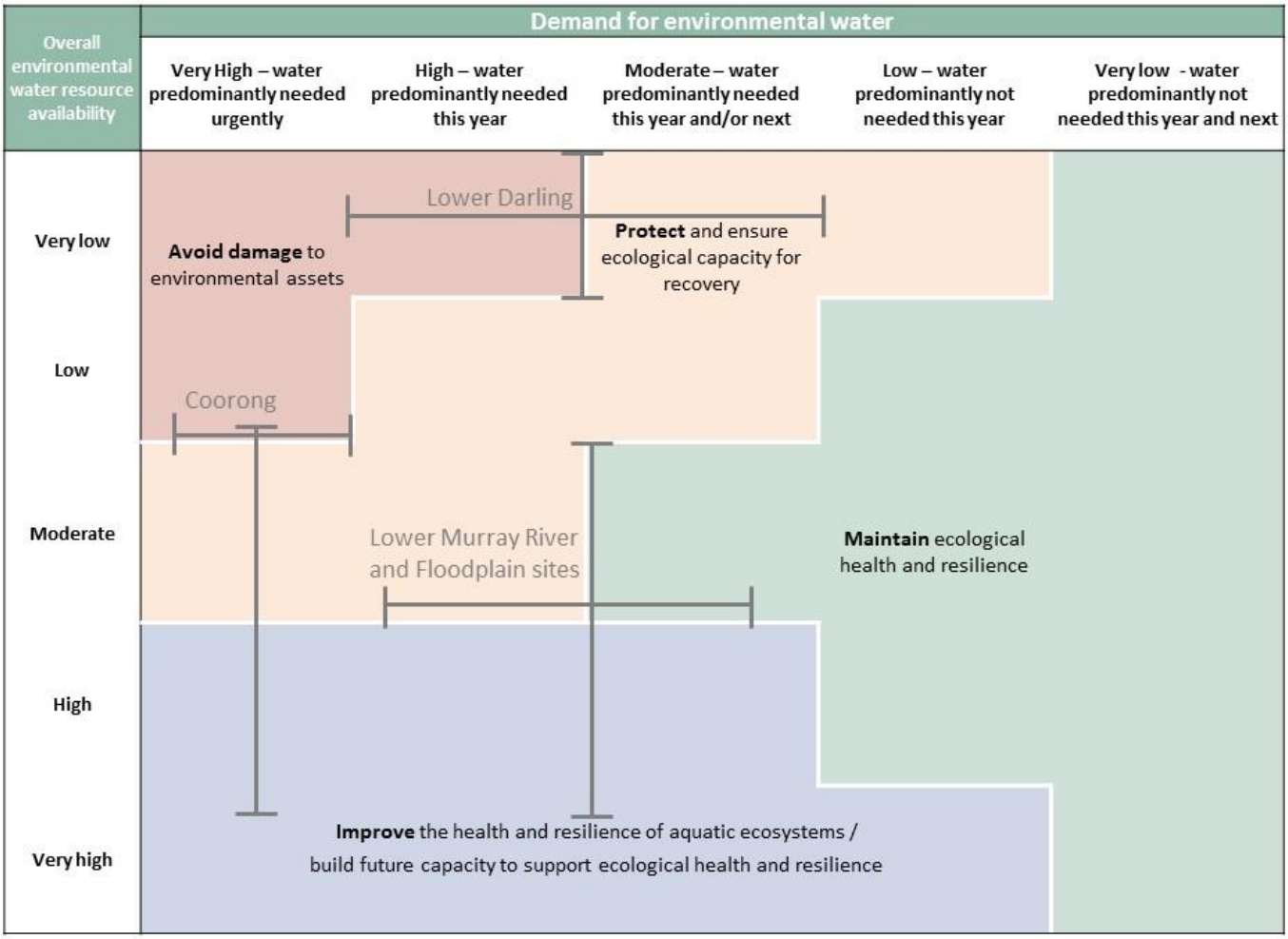

Figure 3: Determining a broad purpose for portfolio management in the Lower Murray–Darling Region for 2017–18. Note: grey lines represent potential range in demand and resource availability.

Further detail on how the overall purpose for portfolio management changes under different supply and demand scenarios is provided in *Portfolio Management Planning: Approach to planning for the use, carryover and trade of Commonwealth environmental water, 2017–18* (available at: http://www.environment.gov.au/water/cewo/publications).

2.4. Water Delivery in 2017–18

Consistent with the demands and purpose described above, the Office is considering supplying environmental water to the following watering actions for 2017–18 (see also Table 3 for supporting information regarding the basis for determining these watering intentions). Specific information on the operational arrangements are provided in Attachment B.

Lower Darling River and Great Darling Anabranch 2017–18 (See Attachment B, Table 4 options 1 and 2)

The ability for Commonwealth environmental water to be delivered to the Lower Darling River and the Great Darling Anabranch is likely to be dependent on inflows, and subsequent water resource conditions, into the Menindee Lakes in 2017–18. In the absence of additional inflows, environmental watering in the Lower Darling is likely to be reliant on other sources, such as The Living Murray program. Environmental water use will be prioritised to maintain sufficient baseflows in the Lower Darling River channel to provide habitat for native aquatic fauna, in particular large-bodied native fish species that are likely to have recruited in 2016–17. Opportunities to provide pulses targeting spawning and dispersal of native fish in the Lower Darling and the Great Darling Anabranch will be considered if water availability improves.

River Murray channel, including weir pool manipulation, fringing wetlands and floodplain sites 2017–18 (Table 4, options 3 to 10)

Environmental water is expected to be delivered as a River Murray 'whole of system' flow in 2017–18. Similar to the approach followed in 2015–16 and 2016–17, watering will be guided by natural hydrological triggers (rainfall and inflows) in order to reinstate a portion of the entire flow regime through the year. The 'whole of system' flows will be scalable so that the environmental watering is responsive to seasonal and operational conditions, the scale of hydrological cues and water availability. Environmental flows moving through the system will be able to be used for other activities that are considered seasonally appropriate, such as weir pool raising or refill following weir pool drawdown, or delivery to off-channel wetland sites. River Murray 'whole of system' flows are planned to be coordinated across the southern Basin, with watering actions occurring in the Edward-Wakool, Goulburn, Murrumbidgee and lower Darling catchments to target system-wide environmental benefits.

If conditions are dry and inflow triggers are small, environmental watering will be focused on in-stream watering, such as flow variability and connectivity with low-lying anabranches and wetlands for fish movement and condition, riparian and wetland floodplain vegetation. Larger floodplain events would be out of scope in dry conditions.

If conditions become moderate to wet, environmental water may be used for modest floodplain watering events (within constraints to avoid adverse third party impacts) for outcomes such as fish breeding and recruitment (or lateral movement from isolated wetland habitats, back to the River Murray channel), full reproductive cycles of important floodplain vegetation communities and completion of waterbird breeding events.

Where infrastructure or works (such as pumps) are available to support the watering of floodplain wetlands, decisions will be guided by the urgency of the demand and natural cues. For example, at sites with moderate demands, the contribution of Commonwealth environmental water will be informed by natural hydrological triggers—that is, if the site would have got water under natural conditions, water may be contributed to maintain the health of the site; if it is dry however, it is unlikely Commonwealth environmental water will be provided. Where wetlands have high demands (in terms of urgency), such as those still in a recovery phase or maintaining critical populations such as Murray hardyhead, Commonwealth environmental water may be provided in the absence of hydrological cues.

Coorong, Lower Lakes and Murray Mouth 2017–18 (Table 4, option 11)

Under dry conditions, Commonwealth environmental water will be required to maintain at least minimum flow through the barrages to the Coorong throughout the year. Over spring-summer, additional environmental water may be used to provide increased flows to the Coorong to improve water quality and water levels. Commonwealth environmental water delivered to the Lower Murray River for outcomes in the Coorong will also provide benefits to the Lower Lakes and Murray Mouth region. In autumn and winter, return flows from upstream actions will be used to provide constant flows through the barrages to support fish passageway for migration. Should natural high flow events occur, Commonwealth environmental water may be used to extend the duration of the event to maximise benefits to the Coorong. Where possible, flow regimes and flow integrity should be maintained from the source of delivery throughout the system for native fish and biota. Environmental water will be used to maximise the benefits of natural flows to protect and contribute to the capacity for the system to recover. Should conditions become drier over 2017–18, the contribution of environmental water to achieving the minimum flow requirements throughout the year will become more critical.

Stakeholder Feedback

The demands and watering actions have been developed based on input from and/or consultation with key delivery partners including: South Australian Department of Environment, Water and Natural Resources (including Natural Resource Management Boards), NSW Office of Environment and Heritage, Victorian Environmental Water Holder, Victorian Catchment Management Authorities, NSW Department of Primary Industries – Fisheries, WaterNSW, the Murray–Darling Basin Authority, the Murray–Darling Wetlands Working Group, Nature Foundation South Australia, Ngarrindjeri Regional Authority, Renmark Irrigation Trust, scientists engaged in monitoring the outcomes of Commonwealth environmental water use and various community groups and individuals. A range of comments were received with stakeholders supportive overall of the proposed approach. Feedback will be sought on an ongoing basis as planning transitions to implementation phase.

Feedback on the Lower Murray–Darling Plan focused on the environmental demand for environmental water in off-channel wetland sites. Although there has been two high flow events in the Lower Murray since the millennium drought, the feedback provided was that many wetlands, particularly in the Lower Murray in South Australia, require further watering to recover. Feedback also focused on the opportunity to build on the ecological outcomes from the high flow conditions in 2016–17, by using environmental water to support the recruitment of native fish, aquatic fauna and vegetation. This approach may be adopted at Hattah Lakes in Victoria, where high flows in 2016–17 have filled the lakes to the extent that additional water could be used to support surrounding black box woodland at higher elevations.

2.5. Trading water in 2017–18

The Water Act 2007 provides for the trade of Commonwealth environmental water allocations and entitlements and specifies the conditions under which sales may occur. To improve environmental outcomes must be the primary reason for trade of Commonwealth Environmental water. The Commonwealth Environmental Water Holder has no plans to trade entitlements in 2017-18.

As part of the portfolio management process, the Commonwealth Environmental Water Office regularly assesses environmental demand and supply throughout the year, considering factors such as environmental condition and demand, current and forecast climate conditions and water availability, carryover capacity and market conditions.

Where the need arises to adjust the availability of allocations in any valley in the southern-connected Basin for environmental use, the transfer of allocations from another southern connected catchment would be explored as the preferred and more efficient option to allocation purchase or sale. The transfer would be undertaken consistent with the rules identified in state water resource plans that apply to all water users. Possible third party impacts from portfolio transfers are considered when trade limits apply.

The trade zones within the Lower Murray-Darling planning area include trade zones 6, 7, 11, 12 and 14. In 2017-18, possible administrative transfers between environmental water accounts to enable environmental water delivery include:

- large (> 100 GL) **within or between** trade zones below the choke, due to the large size of environmental watering activities;
- small (~30 GL) **within** lower Murray trade zones for smaller environmental watering activities;
- moderate (~70 GL) ***into*** trade zone 7 from Victorian Rivers region, if required and allowable given possible trade limit;
- small to moderate (~50 GL) **through the Barmah choke** from trade zones 6 10A or 10B, if required and allowable given the Barmah Choke trade limit.

In the southern Basin, water allocation outlook statements are forecasting high allocations early in the season, and opportunities to sell allocation may arise in 2017–18. The issue of whether to sell will be considered once there is greater certainty regarding environmental use during the peak winter-spring demand period, most likely from October 2017 onwards. Should a decision be made to sell allocation, further information will be made available at: http://www.environment.gov.au/water/cewo/trade/current-trading-actions.

For more information on the rules and procedures governing the trade of Commonwealth environmental water, refer to the *Commonwealth environmental water Trading Framework* at: http://www.environment.gov.au/water/cewo/publications/water-trading-framework-dec2014.

2.6. Carrying over water for use in 2018–19

The volume of water carried over for use in 2018–19 will depend upon resource availability and demand throughout the year. A carryover volume of 300–310 GL in the southern-connected Basin is being targeted to meet early season water requirements and as a risk management strategy should low inflows result in low allocations. As documented in Table 3 below, potential demands early in 2018–19 that may require carryover to support include: baseflows in the Lower Darling River (pending water resource availability) and ongoing barrage releases into the Coorong.

Carryover volumes will be adjusted throughout the year as the season unfolds in response to both current and future demands and the water available to meet these demands. These decisions will be based upon best information available at the time.

Given the connected nature of southern Murray–Darling Basin catchments and the varying carryover, account and use limits, carryover is considered at a broader scale than just the Lower Murray–Darling. These decisions will be based upon best information available at the time. More information on how the Commonwealth makes decisions on carryover is here:
http://www.environment.gov.au/water/cewo/portfolio-mgt/carryover

2.7. Identifying Investment Opportunities

Changes to the *Water Act 2007* in 2016 have increased the flexibility for the CEWH to use the proceeds of water allocation sales to invest in environmental activities. Under these amendments environmental activities must improve environmental outcomes and be undertaken for the purpose of protecting and restoring environmental assets in the Basin.

The CEWH will publically release a Discussion Paper seeking feedback on what type of activities stakeholders would like the CEWH to consider when developing a framework for future investment in environmental activities.

It should be noted that proceeds of past water sales must be managed based on the legislation in place at that time, and are not available to be used for these activities.

Table 3a: Environmental demands, priority for watering in 2017–18 and outlook for coming years in the Lower Murray- Darling Region – **MODERATE WATER RESOURCE AVAILABILITY (HIGH ALLOCATION, LOW INFLOWS) IN 2017–18**

Environmental assets	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)			2017–18			Implications for future demands		
	Flow/volume	Required frequency (maximum dry interval)	2014–15 (drying)	2015–16 (dry)	2016–17 (wet)	Predominant urgency of environmental demand for water	Purpose under moderate resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2018–19 if watering occurred as planned in 2017–18	2019–20 Range of likely demand	Met in 2018–19 / Not met in 2018–19
Lower Darling River[1]	Elevated base flows above minimum releases through to River Murray for water quality and fish habitat requirements (400 ML/d @ Weir 32)	Continuous (if water limited, focus baseflows during spring-summer-autumn)				High	**Avoid damage**	It will only be feasible for the Commonwealth to contribute if there are sufficient water resources in Menindee Lakes. The Living Murray allocations may partially meet this demand.	High	High	High
	Small to moderate river pulse (up to 7,000 ML/day @ Weir 32 for 10 days in summer)	1-2 in 5 years (max interval unknown)				Moderate to high	**Protect**	Unlikely to be feasible under low-moderate resource availability as priority will be to maintain continuous baseflows in the Lower Darling River (see above).	High	Moderate	High
Great Darling Anabranch[1,2]	~1,100 ML/day from Menindee Lakes for ~60+ days	2 in 10 years (7 years)				Low to moderate	**Protect**		Low to moderate	Low	Moderate
River Murray from Euston to Lower Lakes, including pool level wetlands[3]	River flow of at least 10,000 ML/d @ SA Border for up to 60 days in spring/summer	9 in 10 years (2 years)				Moderate	**Maintain**	Likely Commonwealth environmental water contribution subject to seasonal cues	Moderate	Moderate	High
	River flow of 15,000-25,000 ML/day SA Border for up to 90 days in spring/summer	2 in 3 years (2 years)				High	**Protect**	Potential Commonwealth environmental water contribution subject to seasonal cues	High	Moderate	High
	River flow of 25,000-35,000 ML/day @ SA Border for up to 60 days in spring summer	1 in 2 years (3 years)				High	**Protect**	Unlikely under a Low-moderate resource availability scenario	High	High	Becoming critical
Hattah Lakes[4]	Small action targeting temporary wetlands (inundation to 42-43 m AHD in winter/spring) – up to 22 000 ML via infrastructure equivalent to natural event of 40,000-50,000 ML/day @ Euston for 26-60 days.	1 in 2-3 years (4 years)				Low	**Maintain**	Environmental water demands likely to be met by other environmental water holders.	Low	Low	Moderate
	Moderate action targeting wetlands and fringing river red gums (inundation to 43.5 m AHD for 90 days in winter/spring) – up to 40,000 ML via infrastructure equivalent to natural event of 85,000 ML/d @ Euston for 7-30 days.	1 in 3 years (7 years)				Low	**Maintain**	This action is likely to commence in the absence of natural cues. Commonwealth environmental water may contribute to this action with contributions from other environmental water holders also meeting demands.	Low	Low	Moderate
	Large event targeting wetland and river red gum/black box woodlands on floodplain (inundation to 45 m AHD for 90 days) – up to 120 000 ML via infrastructure equivalent to natural event of 150,000 ML/day @ Euston for 7 days anytime in the year.	1 in 8 years (12 years)				High	**Protect**	This action is likely to commence in the absence of natural cues. Commonwealth environmental water may contribute to this action with contributions from other environmental water holders also meeting demands.	Moderate	Low	Moderate

Environmental assets	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)			2017–18			Implications for future demands		
	Flow/volume	Required frequency (maximum dry interval)	2014–15 (drying)	2015–16 (dry)	2016–17 (wet)	Predominant urgency of environmental demand for water	Purpose under moderate resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2018–19 if watering occurred as planned in 2017–18	2019–20 Range of likely demand	Met in 2018–19 / Not met in 2018–19
Floodplain and wetlands from Euston to South Australian border[5]	30,000 ML/day @ Lock 8 for 30-60 days targeting low lying wetlands and anabranches, or priority areas via infrastructure	2 in 5 years (4 years)		Wetlands and anabranches		Low Met for large areas of floodplain in early 2011 floods and again with high flows in 2016–17	**Maintain**	Subject to seasonal cues	Low	Low	Met in 2018–19
										Moderate	Not met in 2018–19
	50,000-60,000 ML/day @ Lock 8 for 60-120 days targeting river red gum forest, lignum shrubland and associated wetlands, or priority areas via infrastructure	1 in 5 years (5 years)	Red gum and lignum received water in 2014-15			Low Met for large areas of floodplain in early 2011 floods and again with high flows in 2016–17	**Maintain**	Subject to seasonal cues, (unlikely under 'moderate' conditions)	Low	Low	Met in 2018–19
										Low	Not met in 2018–19
Floodplain and wetlands from South Australian border to Lower Lakes[6]	Infrastructure delivery to a priority areas of floodplain equivalent to 80,000 ML/day @ Lock 8 targeting river red gum and black box woodland and associated wetlands	1-2 in 10 years (8 years)				Moderate Met for large areas of floodplain in late 2016 high flows. However, some parts of the floodplain are still recovering from drought. Demands for some individual sites lower as managed water delivery has met their environmental water requirements.	**Maintain**	Overbank flows unlikely in a 'moderate' scenario. Commonwealth environmental water may be delivered to individual floodplain / wetland sites using infrastructure.	Moderate	Moderate	Met in 2018–19
										Moderate	Not met in 2018–19
	50,000-60,000 ML/day @ South Australian border for at least 30 days targeting river red gum forest, tea tree, lignum, river cooba and associated wetlands, or priority areas via infrastructure	1 in 2 years (5 years)	Individual wetland sites via pumping only				**Protect**		Moderate	Moderate	Met in 2018–19
										Moderate	Not met in 2018–19
	Infrastructure delivery to a priority area equivalent to 60,000-70,000 ML/day @ South Australian border targeting black box, cooba, lignum and chenopod and associated wetlands.	1 in 3 years (4 years)		Individual wetland sites via pumping only			**Protect**	Commonwealth environmental water may be delivered to individual floodplain / wetland sites using infrastructure, subject to natural cues.	Moderate	Low	Met in 2018–19
										Moderate	Not met in 2018–19
Coorong, Lower Lakes and Murray Mouth[7]	Minimum barrage flow of 650 GL/yr to maintain maximum salinity of 1000 µs cm^{-1} in Lake Alexandrina	1 in 1 year				High	**Protect**	Likely Commonwealth environmental water contribution	High	High	Met in 2018–19
										High	Not met in 2018–19
	Barrage flows of 2,000 GL/yr required to maintain maximum salinity of 1000 µs cm^{-1} in lake Alexandrina	Rolling three year average				High	**Protect**	Likely Commonwealth environmental water contribution	High	High	Met in 2018–19
										High	Not met in 2018–19
	Barrage flows of at least 2,500 GL over two years to avoid damage and protect habitat conditions within the Coorong	9 in 10 years (1 year)				High	**Protect**	Likely Commonwealth environmental water contribution	High	Moderate	Met in 2018–19
										High	Not met in 2018–19
	Barrage flows of 6,000 GL every three to five years to maintain and improve habitat conditions within the Coorong	1 in 3 years (5 years)				Moderate. While this has been met twice in the past 3 years, the South Lagoon, in particular, remains in poor condition.	**Maintain**	Commonwealth likely to contribute to support natural events, should they eventuate	Moderate	Moderate	Met in 2018–19
										High	Not met in 2018–19
	Barrage flows of 10,000 GL every seven to seventeen years to improve habitat conditions within the Coorong	1 in 7 years (17 years)				Moderate. While this has been met twice in the past 3 years, the South Lagoon, in particular, remains in poor condition.	**Maintain**	Commonwealth likely to contribute to support natural events, should they eventuate	Moderate	Moderate	Met in 2018–19
										High	Not met in 2018–19

Key - events in previous years

means demand was met by Commonwealth environmental water or any other source
means demand was partially met by Commonwealth environmental water or any other source (may be used to indicate infrastructure assisted delivery)
means water not provided (or not required)

Note that not all demands require water every year; drying phases are important for floodplains and temporary wetlands or streams

Key - potential watering in 2017-18

means a high priority for Commonwealth environmental watering (full or partial contribution, and subject to seasonal and operational considerations)
means a secondary priority for Commonwealth environmental watering, likely to be met via other means (other water holders, or natural flows)
means a low priority for Commonwealth environmental watering

Key - urgency of environmental demands

means critical demand i.e. urgent need for water in that particular year to manage risk of irretrievable loss or damage
means high demand for water i.e. needed in that particular year
means moderate demand for water i.e. water needed that particular year and/or next
means low demand for water i.e. water generally not needed that particular year
means very low demand for water i.e. water generally not needed that particular year or the following year

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

Carryover potential	A carryover target of 300–310 GL for the southern-connected Basin is being targeted to meet early season water requirements in 2018–19 (See Section 2.6)
Trade potential	Under a moderate resource availability scenario (high allocation, low inflows), it is likely that the transfer of allocations *into* the Lower Murray trade zones may be required for environmental needs in the Coorong. It is likely that insufficient water resources in Menindee Lakes will be a major constraint on achieving proposed actions in the Lower Darling. It is unlikely to be feasible for the Commonwealth to purchase or transfer allocations into the Lower Darling.
References	1. Sourced from MDBA (2012b); DPI Fisheries (pers.comm. 2016) 2. Sourced from Nias (2002) 3. Sourced from Wallace et al. (2014), Ecological Associates (2015), Ecological Associates (2010), DEWNR (2015) and MDBA (2012(j)) 4. Sourced from Mallee CMA (2017), MDBA (2012g), (2012j); Roberts and Marston (2011). 5. Sourced from MDBA (2012c): 40 000 ML/day for 45-60 days or 50 000 ML/day for 26-45 days. Total duration of natural flows can include multiple discreet flow pulses above 40-50 000 ML/day with a minimum duration of individual pulses of 7 days. 6. Sourced from MDBA (2014b), MDBA (2012h) and DEWNR (2015) 7. Sourced from MDBA (2012i) and DEWNR (2015)

Table 3b: Environmental demands, priority for watering in 2017–18 and outlook for coming years in the Lower Murray–Darling Region –**HIGH/VERY HIGH WATER RESOURCE AVAILABILITY (HIGH ALLOCATION, MOD/HIGH INFLOWS) in 2017–18**

Environmental assets	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)			2017–18			Implications for future demands		
	Flow/volume	Required frequency (maximum dry interval)	2014–15 (drying)	2015–16 (dry)	2016–17 (wet)	Predominant urgency of environmental demand for water	Purpose under low-moderate resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2018–19 if watering occurred as planned in 2017–18	2019-20 Range of likely demand	Met in 2018–19 / Not met in 2018–19
Lower Darling River[1]	Elevated base flows above minimum releases through to River Murray for water quality and fish habitat requirements (400 ML/d @ Weir 32)	Continuous (if water limited, focus baseflows during spring-summer-autumn)				High	**Improve**	Under a high resource availability scenario, it would be likely to be feasible for the Commonwealth to contribute if there are sufficient water resources in Menindee Lakes.	High	High High	
	Small to moderate river pulse (up to 7,000 ML/day @ Weir 32 for 10 days in summer)	1-2 in 5 years (max interval unknown)				Moderate to high	**Improve**	Under a high resource availability scenario, it would be likely to be feasible for the Commonwealth to contribute if there are sufficient water resources in Menindee Lakes.	Moderate to high	Moderate High	
Great Darling Anabranch[1,2]	~1,100 ML/day from Menindee Lakes for ~60+ days	2 in 10 years (7 years)				Low to moderate	**Improve**	Likely to be feasible under high resource availability, but second priority to the more critical demand identified above.	Low to moderate	Low Moderate	
River Murray from Euston to Lower Lakes, including pool level wetlands[3]	River flow of at least 10,000 ML/d @ SA Border for up to 60 days in spring/summer	9 in 10 years (2 years)				Moderate	**Improve**	Likely Commonwealth environmental water contribution subject to seasonal cues	Moderate	Moderate High	
	River flow of 15,000-25,000 ML/day SA Border for up to 90 days in spring/summer	2 in 3 years (2 years)				High	**Improve**	Likely Commonwealth environmental water contribution subject to seasonal cues	Moderate	Moderate High	
	River flow of 25,000-35,000 ML/day @ SA Border for up to 60 days in spring summer	1 in 2 years (3 years)				High	**Improve**	Likely Commonwealth environmental water contribution subject to seasonal cues	Moderate at sites still recovering from drought	Moderate High	

Environmental assets	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)			2017–18			Implications for future demands		
	Flow/volume	Required frequency (maximum dry interval)	2014–15 (drying)	2015–16 (dry)	2016–17 (wet)	Predominant urgency of environmental demand for water	Purpose under low-moderate resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2018–19 if watering occurred as planned in 2017–18	2019-20 Range of likely demand	Met in 2018–19 / Not met in 2018–19
Hattah Lakes[4]	Small action targeting temporary wetlands (inundation to 42-43 m AHD in winter/spring) – up to 22,000 ML via infrastructure equivalent to natural event of 40,000-50,000 ML/day @ Euston for 26-60 days.	1 in 2-3 years (4 years)				Low	**Improve**	Environmental water demands likely to be met by other environmental water holders.	Low	Low	Moderate
	Moderate action targeting wetlands and fringing river red gums (inundation to 43.5 m AHD for 90 days in winter/spring) – up to 40,000 ML via infrastructure equivalent to natural event of 85,000 ML/d @ Euston for 7-30 days.	1 in 3 years (7 years)				Low	**Improve**	Commonwealth environmental water only to contribute if natural cues present, which it is assumed are likely under a high resource availability. Environmental water demands may be met by other environmental water holders.	Low	Low	Moderate
	Large event targeting wetland and river red gum/black box woodlands on floodplain (inundation to 45 m AHD for 90 days) – up to 120 000 ML via infrastructure equivalent to natural event of 150,000 ML/day @ Euston for 7 days anytime in the year.	1 in 8 years (12 years)				High	**Improve**	Commonwealth environmental water only to contribute if natural cues present, which it is assumed are likely under a high resource availability. Environmental water demands may be met by other environmental water holders.	Moderate	Low	Moderate
Floodplain and wetlands from Euston to South Australian border[5]	30,000 ML/day @ Lock 8 for 30-60 days targeting low lying wetlands and anabranches, or priority areas via infrastructure	2 in 5 years (4 years)		Wetlands and anabranches		Low Met for large areas of floodplain in early 2011 floods and again with high flows in 2016–17	**Maintain**	Subject to seasonal cues	Low	Low	Moderate
	50,000-60,000 ML/day @ Lock 8 for 60-120 days targeting river red gum forest, lignum shrubland and associated wetlands, or priority areas via infrastructure	1 in 5 years (5 years)	Red gum and lignum received water in 2014-15			Low Met for large areas of floodplain in early 2011 floods and again with high flows in 2016–17	**Maintain**	Subject to seasonal cues, (unlikely under 'moderate' conditions)	Low	Low	Low
Floodplain and wetlands from South Australian border to Lower Lakes[6]	Infrastructure delivery to a priority areas of floodplain equivalent to 80,000 ML/day @ Lock 8 targeting river red gum and black box woodland and associated wetlands	1-2 in 10 years (8 years)				Met for large areas of floodplain in late 2016 high flows. However, some parts of the floodplain are still recovering from drought. Demands for some individual sites lower as managed water delivery has met their environmental water requirements.	**Improve**	Overbank flows likely in a 'high' or 'very high' resource availability.	Moderate	Moderate	Moderate
	50,000-60,000 ML/day @ South Australian border for at least 30 days targeting river red gum forest, tea tree, lignum, river cooba and associated wetlands, or priority areas via infrastructure	1 in 2 years (5 years)	Individual wetland sites via pumping only				**Improve**		Moderate	Moderate	Moderate
	Infrastructure delivery to a priority area equivalent to 60,000-70,000 ML/day @ South Australian border targeting black box, cooba, lignum and chenopod and associated wetlands.	1 in 3 years (4 years)		Individual wetland sites via pumping only			**Improve**	Subject to seasonal cues, possible under 'high' or 'very high' resource availability.	Moderate	Low	Moderate

Environmental assets	Indicative demand (for all sources of water in the system)		Watering history (from all sources of water)			2017–18			Implications for future demands		
	Flow/volume	Required frequency (maximum dry interval)	2014–15 (drying)	2015–16 (dry)	2016–17 (wet)	Predominant urgency of environmental demand for water	Purpose under low-moderate resource availability	Potential Commonwealth environmental water contribution?	Likely urgency of demand in 2018–19 if watering occurred as planned in 2017–18	2019-20 Range of likely demand	Met in 2018–19 / Not met in 2018–19
Coorong, Lower Lakes and Murray Mouth[7]	Minimum barrage flow of 650 GL/yr to maintain maximum salinity of 1000µs cm^{-1} in Lake Alexandrina	1 in 1 year				High	**Improve**	Likely Commonwealth environmental water contribution	High	High	
	Barrage flows of 2,000 GL/yr required to maintain maximum salinity of 1000 µs cm^{-1} in lake Alexandrina	Rolling three year average				High	**Improve**	Likely Commonwealth environmental water contribution	High	High	
	Barrage flows of at least 2,500 GL over two years to avoid damage and protect habitat conditions within the Coorong	9 in 10 years (1 year)				High	**Improve**	Likely Commonwealth environmental water contribution	High	Moderate / High	
	Barrage flows of 6,000 GL every three to five years to maintain and improve habitat conditions within the Coorong	1 in 3 years (5 years)				Moderate. While this has been met twice in the past 3 years, the South Lagoon, in particular, remains in poor condition.	**Improve**	Likely to contribute to support natural events, should they eventuate	Moderate	Moderate / High	
	Barrage flows of 10,000 GL every seven to seventeen years to improve habitat conditions within the Coorong	1 in 7 years (17 years)				Moderate. While this has been met twice in the past 3 years, the South Lagoon, in particular, remains in poor condition.	**Improve**	Likely to contribute to support natural events, should they eventuate	Moderate	Moderate / High	

Key - events in previous years

- means demand was met by Commonwealth environmental water or any other source
- means demand was partially met by Commonwealth environmental water or any other source (may be used to indicate infrastructure assisted delivery)
- means water not provided (or not required)

Note that not all demands require water every year; drying phases are important for floodplains and temporary wetlands or streams

Key - potential watering in 2017-18

- means a high priority for Commonwealth environmental watering (full or partial contribution, and subject to seasonal and operational considerations)
- means a secondary priority for Commonwealth environmental watering, likely to be met via other means (other water holders, or natural flows)
- means a low priority for Commonwealth environmental watering

Key - urgency of environmental demands

- means critical demand i.e. urgent need for water in that particular year to manage risk of irretrievable loss or damage
- means high demand for water i.e. needed in that particular year
- means moderate demand for water i.e. water needed that particular year and/or next
- means low demand for water i.e. water generally not needed that particular year
- means very low demand for water i.e. water generally not needed that particular year or the following year

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

Carryover potential	A carryover target of 300–310 GL for the southern-connected Basin is being targeted to meet early season water requirements in 2018-19 (See Section 2.6)
Trade potential	Under high and very high water resource availability scenarios, sufficient water resources in Menindee Lakes may enable the Commonwealth to consider transferring allocations into the Lower Darling for environmental use. The high allocation balance may also provide an opportunity to sell allocation (subject to an assessment that a reasonable level of supply or demand exists within the water market). The issue of whether to sell allocation will be considered once there is greater certainty regarding environmental water use during the winter-spring period, most likely from October 2017 onwards.
References	1. Sourced from MDBA (2012b); DPI Fisheries (pers.comm. 2016) 2. Sourced from Nias (2002) 3. Sourced from Wallace et al. (2014), Ecological Associates (2015), Ecological Associates (2010), DEWNR (2015) and MDBA (2012(j)) 4. Sourced from Mallee CMA (2017), MDBA (2012g), (2012j); Roberts and Marston (2011). 5. Sourced from MDBA (2012c): 40 000 ML/day for 45-60 days or 50 000 ML/day for 26-45 days. Total duration of natural flows can include multiple discreet flow pulses above 40-50 000 ML/day with a minimum duration of individual pulses of 7 days. 6. Sourced from MDBA (2014b), MDBA (2012h) and DEWNR (2015) 7. Sourced from MDBA (2012i) and DEWNR (2015)

3. Next steps

3.1. From planning to decision making

It is important to distinguish between planning and operational decision making. As shown in Figure 4, planning allows the Office to manage the environmental water portfolio in a holistic manner and is an exercise in developing a broad approach or intention, based on the key drivers (demand and supply).

Decision making throughout each year builds on the intention by considering in more detail the specific prevailing factors and additional factors such as costs, risks, and constraints to water delivery and market conditions.

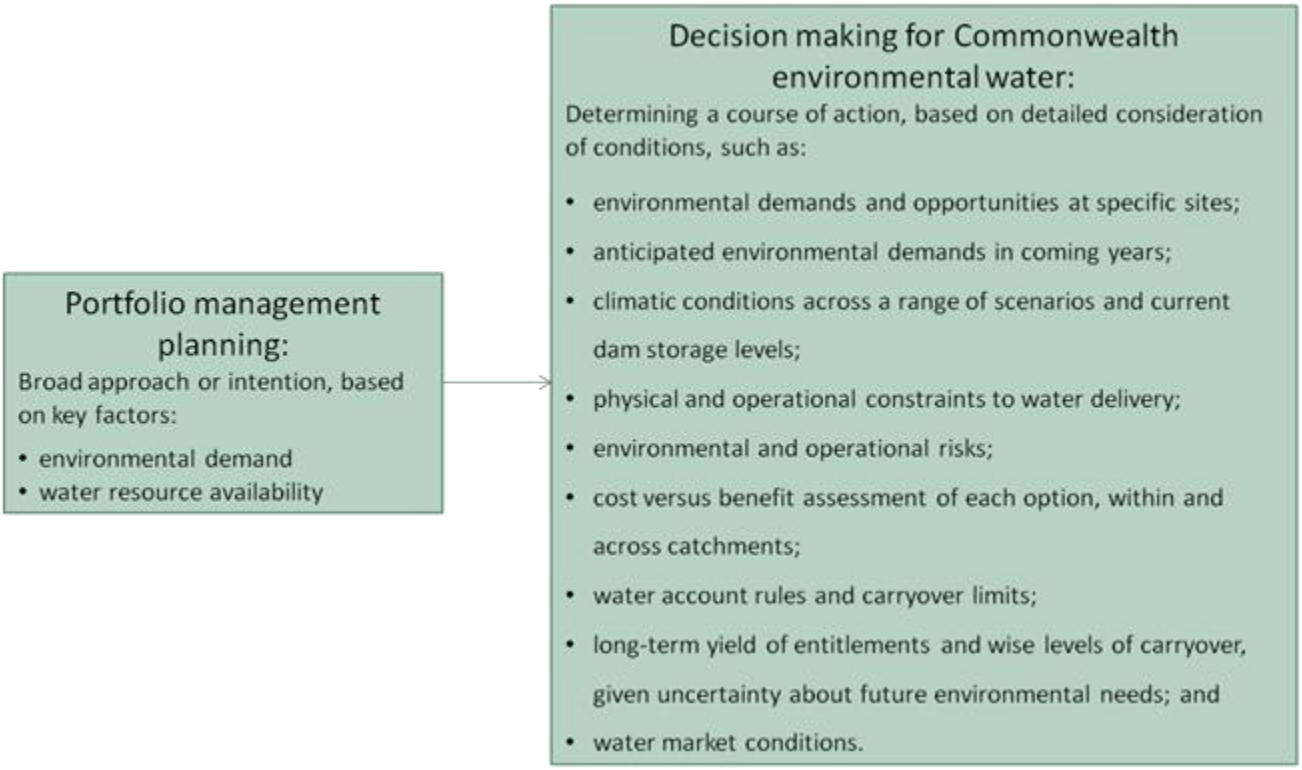

Figure 4: Planning and decision making for Commonwealth environmental water use

3.2. Further information

For further information on how the Office plans for water use, carryover and trade, please visit our web site: http://www.environment.gov.au/water/cewo or the sites below:

- Water use: www.environment.gov.au/topics/water/commonwealth-environmental-water-office/assessment-framework
- Carryover: http://www.environment.gov.au/topics/water/commonwealth-environmental-water-office/portfolio-management/carryover
- Trade: *Discussion Paper – Trade of Commonwealth Environmental Water* and *Commonwealth Environmental Water Trading Framework:* http://www.environment.gov.au/water/cewo/trade/trading-framework

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Attachment A – Expected outcomes from the Basin-wide environmental watering strategy

Expected outcomes from the Basin-wide Environmental Watering Strategy (MDBA 2014) that are relevant to the Lower Murray are described below.

RIVER FLOWS AND CONNECTIVITY

Baseflows are at least 60 per cent of the natural level.

A 30–60 per cent increase in the frequency of freshes, bankfull and lowland floodplain flows.

Contributing to a 30 per cent overall increase in flows in the River Murray.

A 30 to 40 per cent increase in flows to the Murray mouth.

Along with local management, improve the connection of the river to its estuary (the Coorong) and to the sea. The minimum outcomes expected are:

- the barrage flows are greater than 2 000 GL/year on a three-year rolling average basis for 95 per cent of the time, with a two year minimum of 600 GL at any time
- the water levels in the Lower Lakes are maintained above sea level (0 m AHD) and for 95 per cent of the time, above 0.4 metres AHD, as far as practicable, to allow for barrage releases
- salinity in the Coorong and Lower Lakes remains below critical thresholds for key flora and fauna including: salinity in Lake Alexandrina is lower than 1,000 EC 95 per cent of the time and less than 1 500 EC all the time; salinity in the Coorong's south lagoon is less than 100 grams per litre 95 per cent of the time
- the Murray mouth is open 90 per cent of the time to an average annual depth of one metre.

VEGETATION (Note: figures are for total Murray catchment)

Maintain the current extent of water-dependent vegetation near river channels and on low-lying areas of the floodplain.

Improve condition of black box, river red gum and lignum shrublands.

Improved recruitment of trees within black box and river red gum communities.

Increased periods of growth for non-woody vegetation communities that closely fringe or occur within the Murray.

A sustained and adequate population of *Ruppia tuberosa* in the south lagoon of the Coorong, including:

- by 2019, *R. tuberosa* to occur in at least 80 per cent of sites across at least a 50 km extent
- by 2029, the seed bank to be sufficient for the population to be resilient to major disturbances.

Vegetation extent

Region	Area (ha)			Shrublands	Non–woody water dependent vegetation
	River red gum	Black box	Coolibah		
Murray (assessment is for entire Murray catchment)	90,600*	41,700*	-	Lignum along the Murray River from the junction with the Wakool River to downstream of Lock 3, including Chowilla and Hattah Lakes	Closely fringing or occurring within the Murray *Ruppia tuberosa* in the Coorong
Lower Darling	10,300	38,600		Lignum swamps in the Lower Darling region	Closely fringing or occurring within the Darling River and Great Darling Anabranch

Black box condition

Region	Vegetation condition score		Percent of vegetation assessed (within the managed floodplain)
	0 –6	>6 –10	
Murray (assessment is for entire Murray catchment)	33 per cent	65 per cent	28 per cent
Lower Darling	72 per cent	28 per cent	85 per cent

River red gum condition

Region	Vegetation condition score					Percent of vegetation assessed (within the managed floodplain)
	0 – 2	>2 – 4	>4 – 6	>6 – 8	>8 – 10	
Murray (assessment is for entire Murray catchment)	2 per cent	1 per cent	10 per cent	51 per cent	35 per cent	51 per cent
Lower Darling	11 per cent	5 per cent	7 per cent	41 per cent	35 per cent	92 per cent

WATERBIRDS

Maintain current species diversity.

Increase Basin-wide abundance of waterbirds by 20–25 per cent by 2024.

A 30–40 per cent increase in nests and broods (Basin-wide) for other waterbirds.

Up to 50 per cent more breeding events (Basin-wide) for colonial nesting waterbird species.

By 2019, at a minimum, to maintain populations in the Coorong, Lakes Albert and Alexandrina of the following four key species: curlew sandpiper, greenshank, red-necked stint and sharp-tailed sandpiper, at levels recorded between 2000 and 2014.

Important Basin environmental assets for waterbirds in the Lower Murray

Environmental asset	Total abundance and diversity	Drought refuge	Colonial waterbird breeding	Shorebird abundance	In scope for C'th watering
Coorong, Lower Lakes and Murray Mouth	*		*	*	Yes
Pyap Lagoon		*			No
Noora evaporation Basin	*				No
Lindsay–Wallpolla–Chowilla	*				Yes
Hattah Lakes			*		Yes
Darling Anabranch	*				Yes
River Murray and Euston Lakes		*			Yes
Kerang Wetlands	*		*		Yes

FISH

No loss of native species.

Improved population structure of key species through regular recruitment, including:

- Short-lived species with distribution and abundance at pre-2007 levels and breeding success every 1–2 years
- Moderate to long-lived with a spread of age classes and annual recruitment in at least 80 per cent of years.

Increased movements of key species.

Expanded distribution of key species and populations.

For estuarine species – additional outcomes are:

- detection of all estuarine-dependent fish families throughout 2014–2024
- maintenance of annual population abundance (Catch Per Unit Effort – CPUE) of key estuarine prey species (sandy sprat and small-mouthed hardyhead) throughout the Coorong
- detection of a broad spatial distribution of black bream and greenback flounder; with adult black bream and all life stages of greenback flounder present across >50 per cent of the Coorong in eight out of 10 years
- detection in nine out of 10 years of bi-directional seasonal movements of diadromous species through the barrages and fishways between the Lower Lakes and Coorong
- increased rates of native fish passage in 2019–2024 compared to 2014–2019
- improved population structure of mulloway, including spawning aggregations at the Murray mouth in six out of 10 years and recruitment in at least five out of 10 years.

Specific outcomes for key species for the Lower Murray include:

Species	Specific outcomes	In-scope for C'th watering?
Diadromous species (Congolli, short-headed and pouched lamprey)	Upstream expansion facilitated through flows to operate fishways	Yes
Flathead galaxias (*Galaxias rostratus*)	Expand the core range in the wetlands of the River Murray	Yes
Freshwater catfish (*Tandanus tandanus*)	-	Yes
Golden Perch (*Macquaria ambigua*)	A 10–15 per cent increase of mature fish (of legal take size) in key populations	Yes
Murray cod (*Maccullochella peelii peelii*)	A 10–15 per cent increase of mature fish (of legal take size) in key populations	Yes
Murray hardyhead (*Craterocephalus fluviatilis*)	Expand the range of at least two current populations: Establish 3–4 additional populations, with at least two of these to be within the lower Murray conservation unit and a further population potentially within the Kerang Lakes region	Yes
Olive perchlet (*Ambassis agassizii*)	Olive perchlet are considered extinct in the southern Basin. Reintroduction using northern populations is the main option for recovery. Candidate sites may result from improved flow that reinstates suitable habitat in the River Murray	Restoration of flow to River Murray could support the future reintroduction of the species
Silver perch (*Bidyanus bidyanus*)	Improve core range in at additional locations, with candidate sites including lower Darling	Core range is within Mid-Murray region. Only in scope if additional populations are established
Southern purple-spotted gudgeon (*Mogurnda adspersa*)	Expand the range of current populations (including Jury Swamp)	Yes
Southern pygmy perch (*Nannoperca australis*)	Establish additional populations in the Lower Lakes	Only if additional populations are established
Trout cod (*Maccullochella macquariensis*)	For the connected population of the Murrumbidgee–Murray–Edwards, continue downstream expansion	Yes
Two-spined blackfish (*Gadopsis bispinosus*)	Establish additional populations (no specific locations identified)	Yes
Yarra pygmy perch (*Nannoperca obscura*)	Expand the range of current populations including the Lower Lakes/Coorong region	Yes

Important Basin environmental assets for native fish in the Lower Murray

Environmental asset	Key movement corridors	High Biodiversity	Site of other Significance	Key site of hydrodynamic diversity	Threatened species	Dry period / drought refuge	In-scope for C'th watering?
Coorong, Lower Lakes and Murray Mouth	*	*	*		*	*	Yes
Swamps on the lower Murray channel, between Wellington and Mannum (swamp geomorphic region		*			*		Yes
Kerang lakes					*	*	Yes
Katarapko anabranch	*			*			Yes
Pike anabranch	*			*			Yes
Lower River Murray main channel (from Darling junction downstream)	*	*	*		*	*	Yes
Murray main channel (from Hume dam to Darling junction)	*	*	*	*	*	*	Yes
Chowilla anabranch	*	*	*	*	*	*	Yes
Lindsay–Wallpolla–Mullaroo Creek	*	*	*	*	*	*	Yes
Lower Darling main channel	*	*	*	*	*	*	Yes
Darling anabranch			*			*	Yes
Hattah Lakes			*			*	Yes
Euston Lakes (including Washpen and Taila Creeks)					*		Yes

Attachment B – Library of watering actions

Operational considerations in the Lower Murray- Darling catchment

The delivery of environmental water in the Lower Murray–Darling is currently constrained by the following:

- Menindee Lakes are managed by New South Wales when storage levels fall below 480 GL. During this period stored water is used to supply essential stock and domestic water to local Menindee and Lower Darling River communities. Control over the Lakes reverts to Murray–Darling Basin Authority once storage levels increase to above 640 GL.

- Flows greater than 60 000 ML/day result in overbank inundation of floodplain throughout the lower River Murray, including the inundation of privately owned land and private infrastructure. The risk of impacting on public and private infrastructure through the use of environmental water requires further investigation prior to environmental water being used to target these higher flow rates. Flow rates of this magnitude may be considered in exceptional circumstances and subject to appropriate risk assessment.

- Operational and physical constraints in upstream catchment areas may potentially limit the delivery of environmental water in the lower River Murray. Environmental operations in the lower River Murray will need to remain flexible and complement the timing of upstream flows.

Further information about constraints in the Lower Murray–Darling Region is provided by the Murray–Darling Basin Authority, and can be found in the *Constraints Management Strategy 2013 to 2024* (MDBA 2013).

Operational considerations such as delivery methods, opportunities, physical constraints and risks will differ depending on inflows and are summarised in Table 4. Constraints as they relate to specific watering options are described in the standard operating considerations listed in section 3.6 below.

Potential watering actions under different levels of water resource availability

Under certain levels of water resource availability, watering actions may not be pursued for a variety of reasons, including that environmental demand may be met by unregulated flows and that constraints and/or risks may limit the ability to deliver environmental water. Table 4 identifies the range of potential watering actions in Lower Murray- Darling region and the levels of water resource availability that relate to these actions.

Table 4: Summary of potential watering actions for the Lower Murray-Darling

<table>
<tr><th rowspan="2">Broad Asset</th><th rowspan="2">Indicative demand</th><th colspan="5">Applicable level(s) of resource availability</th></tr>
<tr><th>Very Low</th><th>Low</th><th>Moderate</th><th>High</th><th>Very High</th></tr>
<tr><td>Lower Darling River</td><td>Small to moderate river flow (7,000 ML/day at Weir 32 for 10 days in summer)</td><td colspan="2"></td><td colspan="3">1. Lower Darling River flows: Contribute to base flows and freshes in the Lower Darling River.</td></tr>
<tr><td>Great Darling Anabranch</td><td>500 – 1,500 ML/day from Menindee Lakes for 30 – 60 days</td><td colspan="2"></td><td colspan="3">2. Great Darling Anabranch Flows: Contribute to a flow along the Anabranch, or extend the recession from a flood event and/or connect the Anabranch with main River channel and/or Lakes.</td></tr>
<tr><td>River Murray channel from Euston to Lower Lakes, including fringing wetlands</td><td>River flow of at least 10,000 ML/day at SA border for up to 60 days in spring/summer
River flow of 15,000-25,0000 ML/day @ SA border for up to 90 days in spring/summer
River flow of 25,000-35,0000 ML/day @ SA border for up to 60 days in spring/summer</td><td></td><td colspan="3">3. River Murray Channel Flows: Contribute to in-channel base flows and freshes, complemented by seasonally appropriate operation of river (weirs) and wetland infrastructure.</td><td></td></tr>
<tr><td rowspan="2">Hattah Lakes</td><td rowspan="2">Small action targeting temporary wetlands (inundation to 42-43 m AHD in winter/spring) - up to 15 000 ML via infrastructure, equivalent to natural event of 40-50 000 ML/day at Euston for 26-60 days
Large action targeting wetlands and river red gum/black box woodlands on floodplain (inundation to 45 m AHD for 90 days), up to120 000 ML via infrastructure - equivalent to natural event of 150 000 ML/day @ Euston for 7 days anytime in the year.</td><td colspan="5">4a. Infrastructure Delivery: Low-lying Wetlands: Contribute flows via pumping to inundate wetlands and waterways within the Hattah Lakes system.</td></tr>
<tr><td colspan="2"></td><td colspan="3">4b. Infrastructure Delivery: Contribute flows via pumping targeting black box woodland on higher level elevations.</td></tr>
</table>

<table>
<tr><th rowspan="2">Broad Asset</th><th rowspan="2">Indicative demand</th><th colspan="5">Applicable level(s) of resource availability</th></tr>
<tr><th>Very Low</th><th>Low</th><th>Moderate</th><th>High</th><th>Very High</th></tr>
<tr><td rowspan="3">Floodplain and wetlands from Euston to South Australian border</td><td rowspan="3">30,000 ML/day @ Lock 8 for 30-60 days targeting low lying wetlands and anabranches, or portion via infrastructure

50,000-60,000 ML/day @ Lock 8 for 60-120 days targeting river red gum forest, lignum shrubland and associated wetlands, or portion via infrastructure

Infrastructure delivery to a portion equivalent to 80,000 ML/d @ Lock 8 targeting river red gum and black box woodland and associated wetlands</td><td colspan="5">5 Delivery via Lindsay-Mulcra-Wallpolla Floodplain works: Contribute flows via works to inundate low lying wetlands and anabranches, river red gum forest and/or black box woodland.</td></tr>
<tr><td colspan="5">6. Infrastructure Delivery: Mallee Wetlands: Contribute flows via wetland regulators and/or pumping to inundate semi-permanent, temporary and ephemeral wetlands</td></tr>
<tr><td></td><td></td><td colspan="3">7. Contribution to Overbank Flows: Contribute to flows to reconnect river with river red gum forest and lignum shrubland, subject to appropriate trigger</td></tr>
<tr><td rowspan="3">Floodplain and wetlands from South Australian border to Lower Lakes</td><td rowspan="3">40 – 50 GL/day @ South Australian border for at least 30 days targeting river red gum forest, tea tree, lignum, river cooba and associated wetlands, or priority areas via infrastructure

50 -60 GL/day @ South Australian border for at least 30 days targeting river red gum forest, tea tree, lignum, river cooba and associated wetlands, or priority areas via infrastructure

Infrastructure delivery to a priority area equivalent to 60 – 70 GL/day @ South Australian border targeting black box, cooba, lignum and chenopod and associated wetlands</td><td></td><td colspan="3">8. Infrastructure Delivery: Chowilla Floodplain: Use Chowilla Floodplain infrastructure to deliver pulse flows to creeks and inundate parts of the floodplain</td><td></td></tr>
<tr><td colspan="5">9. Infrastructure Delivery: Lower Murray Wetlands: Contribute flows via wetland regulators, pumping and/or weir pool manipulation to inundate semi-permanent, temporary and ephemeral wetlands</td></tr>
<tr><td colspan="2">10a. Contribution to hydrodynamic diversity: Contribute to underwrite weirpools where lowering has been undertaken to increase diversity in hydrology, subject to appropriate trigger</td><td colspan="3">10b. Contribution to Overbank Flows: Contribute to flows to re-connect river with river red gum forest and lignum shrubland, subject to appropriate trigger</td></tr>
</table>

Broad Asset	Indicative demand	Applicable level(s) of resource availability				
		Very Low	Low	Moderate	High	Very High
Coorong Lower Lakes and Murray Mouth	Minimum barrage flow of 650 GL/yr Barrage flows of 2,000 GL/yr required to achieve salinity target in Lake Alexandrina Barrage flows of at least 2 500 GL over two years to avoid damage and protect habitat conditions within the Coorong Barrage flows of 6,000 GL every three years to maintain and improve habitat conditions within the Coorong.	*11a. Seasonal Lake Level Variation:* Between 0.40 m AHD and 0.80 m HD annually. *Fishway Flows*: Maintain minimum fishway flows *Differential Barrage releases*: To provide for connectivity between the Coorong, Lower Lakes and the Murray Mouth, improve Coorong water quality and maintain suitable estuarine conditions in the North lagoon and Murray Mouth				
	Barrage flows of 10 000 GL every seven years to improve habitat conditions within the Coorong			*11b. Seasonal Lake Level Variation*: Between 0.50 m AHD and 0.85 m AHD one in three years *Fishway Flows*: Maintain minimum fishway flows *Differential barrage releases*: To provide for seasonally appropriate water levels in the Coorong and connectivity between the Lower Lakes and the Murray Mouth		

Potential watering actions – standard operating arrangements

Table 4 identifies the range of potential watering actions in Lower Murray–Darling in the Murray–Darling Basin that give effect to the long-term demands and flow regime identified as being in scope for the contribution of Commonwealth environmental water in any given year. The standard considerations associated with these actions are set out below.

A note on approvals: watering actions in the Lower Murray–Darling would be implemented with local delivery partners, who will play a key role in engaging with the local community and third parties and implementing the event. As some actions may be constrained by other demands in the system, the Office will seek advice from river operators on the timing, magnitude and duration of a proposed event. As some actions occur on private land, they require input and/or consent of landholders, community groups and other agencies.

Watering action 1: Lower Darling River flows
Standard operational considerations

- Commonwealth environmental water may be provided to contribute to baseflows and freshes in the Lower Darling River or to contribute water to the recession of higher flow events in this system and in the River Murray. The contribution of environmental water to augment high River Murray flows will have regard to other operational releases, storage management and delivery arrangements.

- The magnitude, duration and timing of environmental releases will be dependent on available environmental water allocations within the water resource area and guided by natural flow cues upstream of the Menindee Lakes.

- When Menindee Lakes storage levels are low (<480 GL) resources within the lakes are managed by New South Wales for critical human needs. Under these conditions options for environmental watering are likely to be limited.

- Due to the low volume of entitlements held in the Lower Darling, Commonwealth environmental water held elsewhere in the southern-connected Basin needs to be transferred for this action to be feasible.

Watering action 2: Great Darling Anabranch flows

Standard operational considerations

- Commonwealth environmental water may be provided to contribute to baseflows and freshes in the Great Darling Anabranch, providing connectivity between the anabranch channel and the River Murray, and between the anabranch and its lakes.

- Planning the timing and magnitude of watering actions needs to consider risks associated with water quality and potential adverse environmental impacts. Delivery channel capacity limitations and potential third party impacts may limit flows to the anabranch channel.

- Operational considerations as for Action 1.

Typical extent: Anabranch channel from Lake Cawndilla (via Tandou Creek, Packer's Crossing Regulator and Redbank Creek) to the confluence with River Murray.

Watering action 3: River Murray channel flows

Standard operational considerations

- Environmental water will contribute to providing higher base flows and freshes to support in-stream aquatic communities, increase the export of salt and nutrients, contribute to hydrological connectivity with fringing wetlands and support habitat conditions within the Coorong and Lower Lakes.
- Benefits that can be achieved from environmental flows within the river channel can be enhanced through the seasonally appropriate operation of river, wetland and floodplain infrastructure. Complementary operations may include the manipulation of weir pools, wetland regulators and barrage operations.
- This action would typically source water from upstream storages and tributaries, subject to operational feasibility and opportunities to achieve multiple benefits using Commonwealth environmental water across the southern-connected Basin.

Watering actions 4: Infrastructure Delivery to Hattah Lakes

Standard operational considerations

- The pump station supplying water to the Hattah Lakes and Lake Kramen only operates when the River Murray water level is greater than 38.3 m AHD (above 5 000 ML/day at Euston). Any impending or ongoing pumping into the Hattah complex would need to be postponed or suspended if River Murray water levels fall below this limit.
- The recently commissioned environmental works (i.e. pumping infrastructure) can acheive a maximum inundation of 45 m AHD. Any inundation beyond this level would need to be via natural flooding.
- Return flows from Hattah Lakes to the River Murray can be faciliated via two regulators located on north and south Chalka Creeks. Adaptive management of return flows will be important to maintain acceptable water quality in Hattah Lakes and provide additional environmental benefit downstream.

Typical extent: Infrastructure allows for simulated natural watering actions of higher magntiude, requiring lower volumes of environmental flow contribution. Small scale temporary wetland inundation to 42-43 m AHD in winter/spring requiring up to 22 000 ML is possible via infrastructure, equivalent to a natural event of 40 000-50 000 ML/day at Euston for 26-60 days. Moderate inundation targeting wetlands and fringing river red gums with inundation to 43.5 m AHD for 90 days in winter/spring requiring up to 40 000 ML is possible via infrastructure, equivalent to a natural event of 85 000 ML/day at Euston for 30 days. Large-scale inundation targeting wetlands and river red gum/black box woodlands on the floodplain with inundation to 45 m AHD for 90 days, requiring up to120 000 ML is possible via infrastructure, equivalent to a natural event of 150 000 ML/day @ Euston for 7 days anytime in the year.

Watering action 5: Delivery via Lindsay-Mulcra-Wallpolla Floodplain works

Standard operational considerations

- In addition to large floods (via high River Murray flows influenced by upper Murray tributaries and flows in the Darling River), permanent infrastructure, weir pool manipulation and temporary pumping can facilitate delivery of environmental water to Lindsay, Mulcra and Wallpolla islands.
- Specific flow rates and weir pool levels in the River Murray are required to facilitate environmental watering to Lindsay, Mulcra and Wallpolla islands.
- Some floodplain wetland watering may occur in conjunction with weir pool manipulation to provide wetland inundation in conjunction with higher river water levels and to contribute to fast flowing fish habitat.

Typical extent: Lindsay Island - to provide flowing water habitat for fish spawning, winter/spring freshening flows to Lindsay River and Mullaroo Creek would be accomplished by targeting a raising of Lock 7 up to 500 mm above normal operating height during winter. *Wallpolla Island* - to promote wetland condition and aquatic plant diversity, spring inundation of Wallpolla Horseshoe and Finnigans Creek would be accomplished by targeting a raising of Lock 9 up to 500 mm above normal operating height and provision of inflows during September to October. *Mulcra Island* - to restore linkages between river and floodplain habitats, and support lignum communities, winter inundation of Mulcra Island would be accomplished by surcharging Lock 8 up to 800 mm above full supply level during July to August.

Watering actions 6 and 9: Infrastructure Delivery: Mallee Wetlands and Lower Murray Wetlands

Standard operational considerations

- Commonwealth environmental water is delivered to wetlands in the New South Wales and Victorian Mallee in partnership with the Mallee Catchment Management Authority, Victorian Environmental Water Holder, New South Wales Office of Environment and Heritage and Murray–Darling Wetlands Working Group. In South Australia, water is delivered via Natural Resources South Australian Murray–Darling Basin, the Nature Foundation South Australia and site managers such as Banrock Station, the Renmark Irrigation Trust and the Ngarrindjeri Regional Authority.
- Key operational considerations include the infrastructure required to deliver water, access arrangements, required approvals and delivery costs (i.e. cost effectiveness).
- Watering may be in conjunction with weir pool manipulation to provide wetland inundation in conjunction with higher river water levels and to contribute to fast flowing fish habitat.
- Drying cycles are a natural characteristic of floodplain wetlands along the River Murray. The watering of wetlands may be undertaken in relation to seasonal conditions.
- Saline water discharged from Mallee sites will need to be carefully monitored as per the water quality and salinity management plan (Basin Plan Chapter 9) and any potential adverse impacts on river water quality mitigated by coordination with adequate dilution flows in the River Murray (including possibly from other environmental watering actions). The Murray–Darling Basin Authority has salinity forecasting tools available to assist.
- Acid sulphate soils and potential groundwater influences are important considerations.

Typical extent: Individual wetland sites in the Mallee region and from the South Australian border to and adjoining the Lower Lakes.

Watering actions 7 and 10b: Contribution to Overbank Flows (within constraints)

Standard operational considerations

- Environmental water may contribute to channel flows to connect the River Murray with areas of floodplain from Euston through to Wellington (subject to flow constraints at Figure 3). Elevated natural flows are required for environmental water to piggy-back on and resource availability may be a limiting factor.
- Environmental water delivery may be constrained by other demands on the system, especially during periods of limited channel capacity, and the ability to release and coordinate releases from multiple storages.
- This option will be managed by river operators to avoid unacceptable impacts on land managers and other water users.

Typical extent: Low lying parts of the lower River Murray floodplain that can be inundated by managed flows and that do not create unacceptable third party impacts. Overbank flow actions are managed within the flow constraints identified in the opening paragraphs of Attachment B – Library of watering actions. Actions 4, 6, 7, 9 and 10 can use infrastructure to provide inundation of higher elevation areas on the floodplain that are not currently achieveable by overbank flows within current operational constraints.

***Watering action 8*: Infrastructure Delivery: Chowilla Floodplain**

Standard operational considerations

- Water can be delivered to a portion of the Chowilla Floodplain using infrastructure such as recently constructed regulators, fishways and upgraded weirs.
- The action needs to be managed in consideration of Action 3 in particular, to ensure there are adequate flows within the river channel to operate the infrasturcture and mitigate water quality issues as flows return from the floodplain to the river.
- Infrastructure needs to be operated in conjunction with Lock 6 weir pool raising.
- Adequate flows need to be maintained through the anabranch to maintain critical fish habitat values.
- Water qualtiy will need to be carefully monitored (as per action 7 above).

Typical extent: The infrastructure can be operated in a range of ways, including to vary water levels within anabranch and creeks, through to supporting the inundation of large areas of floodplain and high elevation wetlands.

Watering Action No 10a: Contribute to hydrodynamic diversity by lowering weir pools

Standard operational considerations:

- Commonwealth environmental water may be used to underwrite the lowering of weir pools to increase hydrodynamic diversity of the River Murray channel. Accounted use will only be required in the event that unregulated flows are not available to return the weir pool to the original or optimum level agreed to, prior to the commencement of the action.
- This option will be managed by river operators to avoid unacceptable impacts on land managers and other water users.

Typical extent: River Murray channel from Lock 6 to Lock 1 Weir Pools where the extent and impact of weir pool lowering has been tested and does not create unacceptable third party impacts. Weir pool lowering could be undertaken in conjunction with a raising to further diversify the environmental flow of the watering action. Weir pool lowering should be seasonably appropriate (very low – moderate) and undertaken where possible in conjunction with neighbouring weir pools.

Watering action 11: Seasonal lake level variation, differential barrage releases including fishway flows – Coorong, Lower Lakes and Murray Mouth

Standard operational considerations

- Commonwealth environmental water is delivered to the Lower Lakes for supporting outcomes within the lakes and the Coorong. The water levels of the Lower Lakes and barrage operations are managed complementarily for multiple environmental and socio-economic outcomes in the Coorong, Lower Lakes and Murray Mouth.
- The management of lake water levels throughout the year will be guided by seasonally appropriate water level ranges that are appropriate for lake vegetation outcomes, accommodating higher water levels in spring and lower water levels in summer-autumn. The effects of wind seiching can have a dramatic impact on water levels in the Lower Lakes including up to Lock 1. Minimum water levels of approximately 0.40 m AHD for managing acid sulphate soils in the Lower Murray Swamps will be maintained for pump access to support management of floodplains in the lower Murray swamps. Achieving this minimum water level for the Lower Murray Swamps may require targeting an average Lake Alexandrina water level of 0.50 m AHD.

- Flows into the Coorong are managed through the barrages situated on Lake Alexandrina. Barrage releases are managed to maintain minimum fishway flows, manage water quality and water levels within the Coorong, with reference to seasonally appropriate lake water levels.

- Commonwealth environmental water will provide continuous barrage flows to contribute to maintaining an open Murray Mouth which is especially important for exporting salt from the Basin in in lower flow years. It is also critical for maintaining tidal exchange between the Southern Ocean and the Coorong which helps maintain suitable habitat condition (water quality) within the Coorong Southern Lagoon.

- Specific target lake levels and barrage release rates will reflect seasonal conditions and be agreed by all parties as part of a short term operating plan for the Coorong, Lower Lakes and Murray Mouth.

Typical extent: Coorong North and South lagoons, Lakes Alexandrina and Albert, fringing floodplain wetlands, and the Murray Mouth.

Attachment C – Long-term water availability

Commonwealth environmental water holdings

The Commonwealth holds the following entitlements in the Lower Murray–Darling Region:

- Lower Darling High Security
- Lower Darling General Security
- Murray High Security (South Australia)

The full list of Commonwealth environmental water holdings can be found at: www.environment.gov.au/topics/water/commonwealth-environmental-water-office/about-commonwealth-environmental-water/how-much and is updated monthly.

Other sources of environmental water

Other potential sources of held environmental water that may be used to complement Commonwealth environmental water delivery in the Lower Murray- Darling include:

- Environment Entitlement – The Living Murray Program (Murray–Darling Basin Authority)
- South Australian Class 9 Wetlands – South Australian Department of Environment, Water and Natural Resources
- South Australian environmental water reserve – South Australian Department of Environment, Water and Natural Resources
- Bulk Entitlement – Victorian Environmental Water Holder
- New South Wales Adaptive environmental water entitlement – New South Wales Office of Environment and Heritage
- River Murray Increased Flows – New South Wales and Victorian Governments.

Planned environmental water

In addition to water entitlements held by environmental water holders, environmental demands may also be met via natural or unregulated flows and water provided for the environment under rules in state water plans (referred to as 'planned environmental water').

Rules for the use of planned environmental water in the lower Murray–Darling Region can be found in the *Water Sharing Plan for the New South Wales Murray and Lower Darling Regulated Rivers Water Sources 2003* (NSW) and the *Water Allocation Plan for the River Murray Prescribed Water Course 2002* (SA). Planned environmental water relevant to the lower Murray–Darling Region includes:

- Additional Dilution Flow
- New South Wales Lower Darling Environmental Contingency Allowance
- New South Wales Murray Regulated River Water Source Additional Environmental Allowance

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