2020-21 Annual Water for the Environment Priorities for the South Australian River Murray WRP

Government of South Australia
Department for Environment and Water

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Background

Priorities for the use of water for the environment in the River Murray are prepared annually for the South Australian River Murray Water Resource Plan area[1] (SA River Murray WRP) and the Coorong and Murray Mouth (DEW 2019). This recognises the intrinsic connection between the Coorong and the Lower Lakes and the need to manage the site as a whole as reflected in the River Murray Long Term Watering Plan (DEWNR 2015)[2]. The development of these annual priorities is in accordance with the principles and methods described in Part 6 of Chapter 8 of the Basin Plan and enables South Australia to meet its obligations under the Basin Plan (Chapter 8 – Environmental Watering Plan).

In accordance with the Basin Plan, this document identifies watering priorities for the priority environmental assets (PEAs) and priority ecosystem functions (PEFs) of the water resource plan area, and identifies the assumptions upon which the priorities are based. This includes the expected holdings and quantities of held and planned environmental water.

The annual priorities for the SA River Murray WRP area include proposed actions for the three priority environmental assets: the SA River Murray Channel; SA River Murray floodplain; and the Coorong, Lower Lakes and Murray Mouth. The annual priorities also include actions for the major environmental regulators (Chowilla, Pike and Katarapko), weir pool manipulations and wetland sites planned to be watered in 2020-21.

The actions proposed relate to a range of potential water resource availability scenarios provided by the Murray-Darling Basin Authority (MDBA).

Identification of priorities

The Long-Term Watering Plan for the SA River Murray WRP area (LTWP) identifies the PEAs and PEFs, as well as the ecological objectives, targets and environmental water requirements (EWRs) for each. It also demonstrates alignment between these and the expected environmental outcomes of the Basin Wide Environmental Watering Strategy (BWEWS) (Murray-Darling Basin Authority, 2014).

As in previous years, the proposed priority watering actions for 2020-21 have been identified using a scenario-based approach, for six water resource availability scenarios based on MDBA annual operating outlooks (AOO) including: 99% (extreme dry), 95% (very dry), 90% (dry), 75% (moderate), 50% (near average), and 25% (wet) (Figure 1). These percentages refer to the likelihood of exceeding different water resource availability based on the analysis of historical inflows, current storage volumes, and operational considerations for the upcoming year.

A volume of held environmental water (HEW) potentially available for delivery to South Australia in 2020-21 under each of the resource availability scenarios was assumed for planning purposes (see Table 1). The resource availability scenarios and assumed Held Environmental Water (HEW) availability were used to develop environmental watering proposals for each site/asset. The preparation of the proposed priorities for the South Australian River Murray has involved detailed planning and consultation. The priorities have been developed with input from water and land managers, river operators, scientists, community, and indigenous groups. Modelling is also undertaken for the suite of watering proposals prepared for each AOO to assess the potential alignment of actions and the influence on flows and water quality in the River Murray channel.

[1] This is defined as the River Murray prescribed watercourse and includes the surface water in the River Murray and floodplain from the South Australian border to and including Lake Alexandrina and Lake Albert. Portions of the Angas, Bremer and Finnis Rivers and Currency Creek that enter Lake Alexandrina are also included.

[2] The Coorong is considered by the Basin Plan to be part of the SA Murray Region WRP area, however it is addressed in the priorities for the SA River Murray WRP Area (i.e. this document) as the ecological outcomes of in the Coorong are primarily driven by surface water inputs from the River Murray. This is consistent with the approach taken in the LTWP.

Annual Priorities

Priority watering actions have been identified for the three PEAs defined in the South Australian River Murray LTWP. In addition, priority actions have been identified for a range of infrastructure operations (i.e. Chowilla, Pike, Katarapko, weir pool manipulation and wetland management) that significantly contribute to outcomes within the Priority Environmental Assets. A detailed summary of the watering actions proposed under each resource availability scenario is provided in Appendix 1. This summary of actions is the best representation at the time of planning, but other needs and opportunities may emerge consistent with the LTWP which may be undertaken if the opportunity arises.

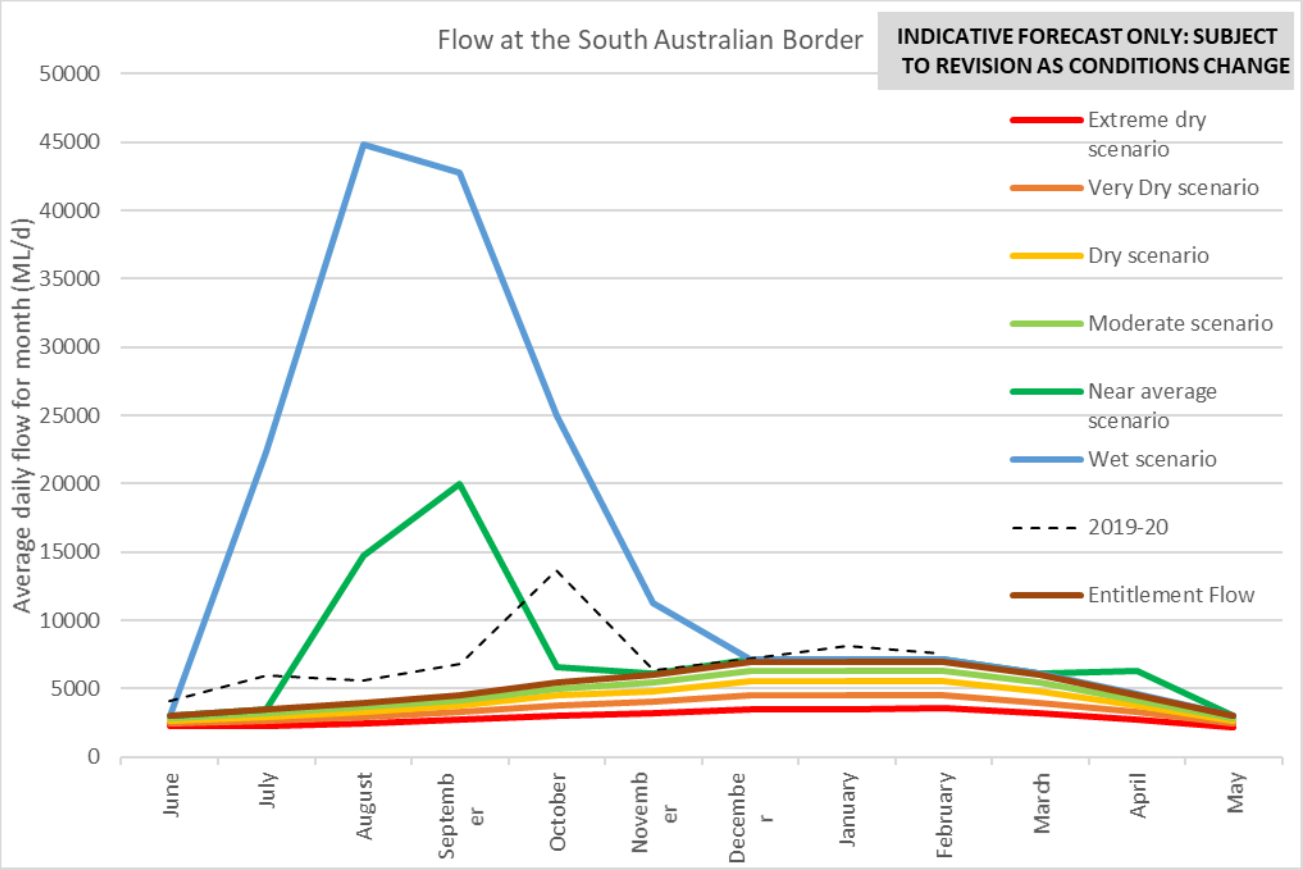

Figure 1. Annual Operating Outlooks used to inform environmental water planning for 2020-21

Four of the six AOOs (extreme dry – moderate) indicate SA will receive less than full Entitlement, representing the extended dry conditions that have been experienced across the Basin in recent years. The near average and wet scenarios include periods of unregulated flow in winter and spring. Enhanced water delivery in spring and/or summer is a priority for assets under all scenarios. This is consistent with the natural hydrology for the lower Murray and the period of peak biological activity in the river system.

In the extreme and very dry scenarios, environmental water demand is focussed on late spring and summer delivery. This will improve flows through the River Murray channel and deliver water to maintain lake levels and periods of flow to the Coorong. Delivery at this time will reduce the risk of harmful algal blooms developing, as blooms are typically associated with low velocities, high temperature and reduced mixing in the water column. It will also support the delivery of water to the Coorong while migratory waders are present. Water will also be provided to a number of wetlands to provide critical habitat.

In dry and moderate scenarios, priority actions include the potential operation of weir pools and/or floodplain regulators (in addition to maintaining spring – summer flow to the Lower Lakes and Coorong). Floodplain regulators including Pike and Katarapko will be operated under moderate conditions including operation of Lock 4. A number of wetlands, at Chowilla and various other locations will also be watered. Water will also be sought to provide sustained flow through the barrages into the Coorong and through the Murray Mouth throughout the remainder of the year.

Under average and wet conditions channel demands are slightly earlier (mid-late spring) and there is greater opportunity for ecological outcomes related to improved flow in the main channel such as improved productivity and native fish recruitment. Under wetter conditions, priority actions also include boosting flow to South Australia to promote inundation of floodplains and wetlands. This will also provide higher barrage flows throughout spring and into early summer to support outcomes in the CLLMM. In addition to boosting flow, weir pools may be raised at Weir 6, Weir 5 and Weir 4 in conjunction with the operation of Chowilla, Pike, and Katarapko regulators. Lock 2 may also be raised under a wet scenario. Pumping to support critical wetlands may also occur across the floodplain but is likely to be reduced due to natural inundation.

Across all conditions, a range of wetland watering actions are also proposed including drying and refilling a number of managed pool-connected wetlands and pumping priority temporary sites. Wetland watering actions will be undertaken by DEW and Landscape Board staff in conjunction with several non-government organisations (NGOs) including Nature Foundation of South Australia (NFSA), Renmark Irrigation Trust (RIT), Accolade Wines (Banrock Station), and the Australian Landscape Trust (ALT). Further detail on the range of priorities is provided in Appendix 1.

Assumptions

Held Environmental Water Availability

The work required to inform the identification of priorities was undertaken between February and April 2020. For the purposes of planning and prioritisation, an estimate of potential held environmental water (HEW) availability under each resource scenario was made based on environmental water delivery in recent years and advice from water holders (Table 1).

Table 1. Estimate of held environmental water available under each resource availability scenario

Scenario	CEW in SCB (excl. SA-held)	TLM/RMIF in SCB (excl. SA-held)	HEW (excl. SA-held)	SA-held CEW	SA-held TLM	TOTAL HEW (GL)
Extreme Dry (99%)	389	97	**486**	11	3	**500**
Very Dry (95%)	502	120	**622**	53	15	**690**
Dry (90%)	642	130	**772**	110	31	**913**
Moderate (75%)	1,050	246	**1,296**	162	45	**1,503**
Near Average (50%)	1,333	310	**1,643**	162	45	**1,850**
Wet (25%)	1,568	372	**1,940**	162	45	**2,147**

HEW is available from the Commonwealth Environmental Water Holder (CEWH), MDBA -The Living Murray (TLM), River Murray Increased Flows (RMIF), the Victorian Environmental Water Holder (VEWH), the South Australian Minister for Environment and Water and non-government organisations. HEW will be recorded on the Register of Held Environmental Water, as required under the Basin Plan.

Commonwealth Environmental Water

Total Commonwealth environmental water holdings within the Southern Connected Basin are approximately 2,130 GL (at 29 February 2020), with varying levels of security and a long-term average annual yield (LTAAY) of 1,584 GL[3]. Of this volume, approximately 162 GL of registered entitlement (144 GL LTAAY) is held in South Australia and forms part of South Australia's entitlement flow. Most of this holding is Class 3 and the availability of this water in 2020-21 will be in line with the River Murray Allocation Framework (South Australia Murray Darling Basin Natural Resources Management Board 2019).

[3] http://www.environment.gov.au/water/cewo/about/water-holdings viewed 29 February 2020

The Living Murray Environmental Water

TLM holdings are approximately 480 GL Long-Term Cap Equivalent (LTCE). The Minister for Environment and Water holds 45 GL of TLM water in South Australia, part of South Australia's Entitlement Flow (Class 3). The availability of this water in 2020-21 will be in line with the River Murray Allocation Framework (SAMDB NRMB 2019).

Victorian Environmental Water Holder

The Victorian Environmental Water Holder (VEWH) manages environmental water holdings in the Murray, Goulburn and Campaspe rivers. Under some circumstances, the VEWH may trade HEW to South Australia, generally as a result of return flows from upstream environmental watering actions. This water is protected from consumptive extraction within the River Murray in SA.

South Australian Minister for Environment and Water

In addition to TLM holdings, the South Australian Minister for Environment and Water holds approximately 45.2 GL of water access entitlements in South Australia that are committed to environmental purposes and form part of South Australia's Entitlement Flow.

Of this total volume, 37.6 GL is within the Wetlands Consumptive Pool (Class 9) described in the Water Allocation Plan for the River Murray Prescribed Watercourse (WAP) (SAMDB NRMB, 2019). This water is held on licence for managed pool-connected wetlands within the SA River Murray WRP area and is sourced from the dilution and loss component of South Australia's Entitlement. This volume does not affect water available for consumptive use. Approximately 1 GL of Class 3 water is committed to the management of Tolderol Wetland for environmental outcomes.

Approximately 6.5 GL has been committed for environmental use through the *Implementation Plan for Augmentation of the Adelaide Desalinisation Plant* and the location of its use is flexible (within the South Australian portion of the Murray-Darling Basin). This water is Class 3 and the availability of this water in 2020-21 will be in line with the River Murray Allocation Framework (SAMDB NRMB 2019).

Decisions on the use of environmental water held by the South Australian Minister for Environment and Water are made within DEW consistent with approved policies and procedures and in line with the annual priorities.

Non-Government organisations also hold small quantities of water including the Nature Foundation South Australia (NFSA) and Accolade Wines which holds 1.38 GL of Wetlands Consumptive Pool water (Class 9) for the management of the pool-connected areas of Banrock Station Wetland Complex.

Planned Environmental Water Availability

Planned Environmental Water (PEW) is defined under the SA River Murray WRP as any water that is committed or preserved for achieving environmental purposes or outcomes and that cannot be used for any other purpose unless required in emergency (in accordance with section 6 of the Water Act 2007 (Cwlth)). PEW is also identified through the 2019 River Murray WAP and includes the unallocated portion of annual South Australian entitlement flow, unregulated flows to South Australia, and the dilution and loss component of South Australia's entitlement flow.

The expected quantities of PEW for 2020-21 are incorporated into the Annual Operating Probabilities (AOP) provided by the MDBA in February 2020 (see Figure 1).

Co-operative Watering Arrangements

Between Water Resource Planning Areas

The Southern Connected Basin Environmental Watering Group (SCBEWC) and Water Liaison Working Group (WLWG) are inter-jurisdictional groups coordinated by the MDBA that contribute to the development of the multi-site watering events each year. Real-time Operational Advisory Groups hold regular teleconferences to ensure coordination and communication during events and rapid response to any issues that may arise. Membership of these groups includes holders of HEW and managers of PEW, managers of environmental assets and River operators.

South Australia has representatives on these cross-jurisdictional committees and is participating in the planning for large scale environmental watering events for 2020-21. As part of the annual planning process, a cross-jurisdictional River Murray channel watering event is planned to maximise all channel flows for the benefit of the main River channel biota, habitat and functions. This event is expected to enhance flow delivery to SA by coordinating upstream environmental water releases.

Within the River Murray Water Resource Planning area

For 2020-21, DEW has developed a multi-site watering proposal for the coordinated delivery of environmental water within the WRP area. The South Australian multi-site watering proposal seeks to align the site-specific watering actions that have been identified in this document, maximise the effectiveness of environmental water delivery and enhance ecological outcomes throughout the system. This multi-site approach is supported by South Australian policy which prevents return flows from environmental watering actions, such as the operation of the Chowilla regulator and weir pool raisings, from being re-allocated for consumptive use, ensuring this water will flow down the river and be delivered to the other downstream sites or the CLLMM for ecological benefit.

The SA multi-site watering action has been provided to the MDBA, water holders and relevant environmental managers via SCBEWC.

References

Department for Environment and Water (2019), *South Australian River Murray Water Resource Plan*, Government of South Australia, Adelaide

Department of Environment, Water and Natural Resources (DEWNR) 2015, *South Australian River Murray Region Long-Term Environmental Watering Plan*, Government of South Australia, Adelaide

Department of the Environment and Energy (2020), *Environmental water holdings*, viewed on 29 February 2020, Commonwealth Environmental Water Office, <www.environment.gov.au/water/cewo/portfolio-mgt/holdings-catchment>

Murray–Darling Basin Authority (MDBA) 2014, *Basin-Wide Environmental Watering Strategy*, Commonwealth of Australia, Canberra

South Australian Murray–Darling Basin Natural Resources Management Board (SAMDB NRMB) 2019, *Water Allocation Plan for the River Murray Prescribed Watercourse*, Government of South Australia, Adelaide

Appendix 1. Summary of environmental watering priorities proposed for 2020-21

Extreme Dry (99% AOO) and Very Dry (95% AOO) Scenario

Site	Action	Details	Objectives	Vol GL
CLLMM	99% - Extreme Dry: Increase base flows between November 2020 and April 2021	○ Maintain Lake Alexandrina water levels >0.4 m AHD ○ Deliver fishway flows to the Coorong during December 2020 and January 2021	○ Upstream movement of young-of-year diadromous fish during peak upstream movement period - December and January (targeting congolli & common galaxias) ○ Avoid triggering Lower Lakes Drought Emergency Framework at +0.4 m AHD and acid sulfate soil risks at 0 m AHD ○ Maintain at least some refuge habitat in Lower Lakes wetlands year-round for threatened fish and frogs	424
	95% - Very Dry: Increase base flows between November 2020 and April 2021	○ Maintain lake levels above +0.4 m AHD for the entire year ○ Allow fishways to be operated for the entire year (~170 ML/d)	○ Upstream movement of young-of-year diadromous fish during entire upstream migration period - October to February (targeting congolli & common galaxias) ○ Avoid triggering Lower Lakes Drought Emergency Framework at +0.4 m AHD and acid sulfate soil risks at 0 m AHD ○ Maintain at least some refuge habitat in Lower Lakes wetlands year-round for threatened fish and frogs ○ Provide a continuous trickle flow year-round to Coorong mudflats directly downstream of barrage fishways to maintain habitable sediment conditions for invertebrates	467
Channel and Floodplain	99% - Extreme Dry: boost flow at the SA border to 6,000 ML/day in December, January and February	○ Prevent persistent thermal stratification and conditions conducive to harmful algal blooms from occurring	○ Maintain a diurnally-mixed water column to ensure diverse phytoplankton and avoid negative water quality outcomes. ○ Restore and maintain resilient populations of foraging generalists	269.02 Return flows 263.6
	95% - Very Dry: boost flow at the SA border to 7,000 ML/day in December and January, and 6,500 ML/day in February (i.e. discharge equivalent to SA's normal entitlement)	○ Prevent persistent thermal stratification and conditions conducive to harmful algal blooms from occurring	○ Maintain a diurnally-mixed water column to ensure diverse phytoplankton and avoid negative water quality outcomes. ○ Restore and maintain resilient populations of foraging generalists	297.2 Return flows 291.3
Weir Manipulation	No weir pool manipulations proposed	N/A	N/A	N/A

Site	Action	Details	Objectives	Vol GL
Chowilla	Pump to priority wetlands. [4] Manage anabranch inflows via Pipeclay Creek and Slaney Creek weirs to optimise flow conditions for native fish through the anabranch.	Potential pumping to up to 8 priority wetland sites Adaptive management of inflows via weirs and associated fish passage to optimise fast flowing habitat for native fish.	○ Maintain viable river red gum, black box, river cooba and lignum populations ○ Improve the abundance and diversity of grass and herblands; flood dependant understorey vegetation; and submerged and emergent aquatic vegetation. ○ Maintain sustainable communities of the eight riparian frog species recorded at Chowilla and improve the distribution and abundance of the nationally listed Southern Bell Frog ○ Create conditions conducive to successful breeding of colonial waterbirds in a minimum of three temporary wetland sites at a frequency of not less than one in three years ○ Maintain or improve the diversity and abundance of key bird species ○ Re-establish habitat condition to sustain high value fauna communities ○ Establish groundwater and soil conditions conducive to improving vegetation condition *Extent of achievement of above objectives limited to watering sites receiving pumped delivery of water for the environment* ○ Maintain the extent and diversity of distribution of native fish	Up to 7 N/A
Pike	Manage base-flow conditions through anabranch		○ Maintain suitable flowing habitat for native fish	N/A
Katarapko	Maintain base-flow conditions through anabranch targeting optimal flow conditions for native fish		○ Maintain suitable flowing habitat for native fish	N/A
Wetlands	Delivery of water to up to 41 priority wetlands located along the River Murray from the border to the Lower Lakes		○ Support known populations of Murray hardyheads (nationally threatened), including providing conditions for breeding opportunities ○ Regent parrot (nationally threatened) populations supported ○ Providing breeding opportunities and refugia for Southern bell frogs (nationally threatened). ○ Prevent loss of long lived vegetation: black box, River red gums, lignum and River cooba ○ Provide refuge habitats for waterbirds	10.6
	Additional delivery of water to wetland sites by Non-Government Organisations		○ Provide habitat for fish, turtles, frogs and water dependent birds	3-4

[4] Delivery dependant on resourcing for pumping and bank reinstatement.

Site	Action	Details	Objectives	Vol GL
	including Renmark Irrigation Trust, Accolade, Nature Foundation SA and the Australian Landscapes Trust.		○ Support the maintenance of long lived vegetation including black box, River red gums, lignum and River cooba. ○ Support Regent parrot (nationally threatened) populations	

Dry (90% AOO) Scenario

Site	Action	Details	Objectives	Vol GL
CLLMM	Increase base flows between October and December 2020	○ Raise Lower Lake water levels in spring to >0.7 m AHD (leading to inundation of some fringing wetlands) ○ Allow fishways to be operated for the entire year (~170 ML/d)	○ Upstream movement of young-of-year diadromous fish during entire upstream migration period - October to February (targeting congolli & common galaxias) ○ Provide a continuous trickle flow year-round to Coorong mudflats directly downstream of barrage fishways to maintain habitable sediment conditions for invertebrates ○ Growth and recruitment of emergent and submergent aquatic vegetation in Lower Lakes wetlands from inundation of fringing wetlands ○ Habitat for threatened fish (Murray hardyhead, Southern pygmy perch) and frogs (southern bell frog)	316
	Increase base flows between January and April 2021	○ Allow fishways to be operated for the entire year (~170 ML/d) ○ Maintain lake levels >0.5 m AHD in autumn 2021	○ Continuous connectivity between the river and estuary ○ Continuous fish passage for diadromous fish ○ Fishways functional year-round ○ At least some threatened fish habitat in Lower Lakes remains inundated year-round	263
Channel and Floodplain	Boost flow at the SA border in November, December and February to discharge equivalent to SA's normal entitlement, and in January to 8,000 ML/day	○ Prevent persistent thermal stratification and conditions conducive to harmful algal blooms from occurring	○ Maintain a diurnally-mixed water column to ensure diverse phytoplankton and avoid negative water quality outcomes. ○ Restore and maintain resilient populations of foraging generalists	312.6 Return flows 306.3

Site	Action	Details	Objectives	Vol GL
Weir Pool Manipulation	Raise Weir Pool 4 to 13.5 mAHD (by up to 0.3 m above normal pool level).	○ Trigger flow will achieve a flow of ≥ 4,000ML/d downstream of the action for the duration of the action including during filling.	*Weir pool raising will contribute to achievement of the following objectives:* ○ Provide for the mobilisation of carbon, nutrients and propagules from the floodplain to the river ○ Establish and maintain groundwater and soil moisture conditions conducive to improving riparian vegetation. ○ Establish groundwater conditions conducive to maintaining diverse native vegetation ○ Promote bacterial rather than algal dominance of biofilms and improve food resource quality for consumers. ○ Maintain viable, functioning River Red Gum, black box, river cooba, and lignum populations within the Floodplain ○ Establish and maintain diverse water dependent vegetation within aquatic zones ○ Establish and maintain diverse native vegetation comprising native flood dependent and amphibious species within the shedding floodplain zones ○ Restore resilient populations of wetland/floodplain specialist native fish within aquatic zones during floodplain flow events ○ Provide habitat conducive to supporting diverse communities of riparian frogs ○ Provide refuge for the maintenance of adult populations of waterbirds	Fill volume 6.30 Losses 0.48 **Total 6.78** Return Flow 6.30 *additional passing flow 79.08*
Chowilla	Pump to priority wetlands. [5]	Potential pumping to up to 8 priority wetland sites *(final number and precise volumes contingent on resourcing for bank instatement and pumping costs)*	○ Maintain viable river red gum, black box, river cooba and lignum populations ○ Improve the abundance and diversity of grass and herblands; flood dependant understorey vegetation; and submerged and emergent aquatic vegetation. ○ Maintain sustainable communities of the eight riparian frog species recorded at Chowilla and improve the distribution and abundance of the nationally listed Southern Bell Frog ○ Create conditions conducive to successful breeding of colonial waterbirds in a minimum of three temporary wetland sites at a frequency of not less than one in three years	Up to 7

[5] Delivery dependant on resourcing for pumping and bank reinstatement.

Site	Action	Details	Objectives	Vol GL
	Manage anabranch inflows via Pipeclay Creek and Slaney Creek weirs to optimise flow conditions for native fish through the anabranch.	Adaptive management of inflows via weirs and associated fish passage to optimise fast flowing habitat for native fish – no additional water requirement.	○ Maintain or improve the diversity and abundance of key bird species ○ Re-establish habitat condition to sustain high value fauna communities ○ Establish groundwater and soil conditions conducive to improving vegetation condition *Extent of achievement of above objectives limited to watering sites receiving pumped delivery of water for the environment* ○ Maintain the extent and diversity of distribution of native fish	
Pike	Manage base-flow conditions through the anabranch		○ Maintain suitable flowing habitat for native fish	N/A
Katarapko	Maintain base-flow conditions through anabranch		○ Maintain suitable flowing habitat for native fish	N/A
Wetlands	Delivery of water to up to 41 priority wetlands located along the River Murray from the border to the Lower Lakes		○ Support known populations of Murray hardyheads (nationally threatened), including providing conditions for breeding opportunities. ○ Regent parrot (nationally threatened) populations supported ○ Providing breeding opportunities and refugia for Southern bell frogs (nationally threatened). ○ Prevent loss of long lived vegetation: black box, River red gums, lignum and River cooba ○ Provide refuge habitats for waterbirds	10.6
	Additional delivery of water to wetland sites by Non-Government Organisations including Renmark Irrigation Trust, Accolade, Nature Foundation SA and the Australian Landscapes Trust.		○ Provide habitat for fish, turtles, frogs and water dependent birds ○ Support the maintenance of long lived vegetation including black box, River red gums, lignum and River cooba. ○ Support Regent parrot (nationally threatened) populations	3-4

Moderate (75% AOP) Scenario

Site	Action	Details	Objectives	Vol GL
CLLMM	Increase base flows in July and August 2020	○ Winter flows of 1-2 GL/d prioritised through Goolwa and Mundoo barrages to the Murray estuary and ocean ○ Barrage bays opened adjacent to fishways to facilitate fish movement through fishways	○ Provide appropriate flow conditions to encourage winter upstream migration of adult lamprey (i.e. freshwater signal through Murray Mouth and to the ocean) to promote migration to upstream spawning sites ○ Allow winter downstream migration of adult female congolli, to promote recruitment in the Coorong	100
	Increase base flows September to December 2020	○ Raise Lower Lake water levels in spring to >0.8 m AHD (leading to inundation of most fringing wetlands) ○ Allow all fishways to be operated for the entire year (~170 ML/d) ○ Deliver up to 1000 ML/d in total to the Coorong (>70% of flows from Tauwitchere barrage) during this period	○ Upstream movement of YOY diadromous fish during entire upstream migration period (targeting congolli & common galaxias) ○ Provide a continuous trickle flow year-round to Coorong mudflats directly downstream of barrage fishways to maintain habitable sediment conditions for invertebrates ○ Provide freshwater flows during spring and early summer to the Coorong North Lagoon to support the Coorong food web (zooplankton, benthic invertebrates, small-bodied fish) ○ Growth and recruitment of emergent and submergent aquatic vegetation in Lower Lakes wetlands from inundation of fringing wetlands ○ Majority of breeding habitat inundated (i.e. higher elevation fringing Lower Lakes wetlands) for threatened fish (Murray hardyhead, Southern pygmy perch) and southern bell frog	450
	Increase base flows January to June 2021	○ Allow fishways to be operated for the entire year (~170 ML/d) ○ Allow 1-bay of attractant flow at Tauwitchere for the entire year ○ Maintain lake levels >0.5 m AHD in autumn 2021	○ Continuous connectivity between the river and estuary ○ Continuous fish passage for diadromous fish ○ Fishways functional year-round ○ At least some threatened fish habitat in Lower Lakes remains inundated year-round ○ Localized estuary (<50 g/L d/s of barrages and North Lagoon) for adult estuarine fish and macroinvertebrates	241
Channel and Floodplain	Boost flow at the SA border in November, December and February to discharge equivalent to SA's normal entitlement, and in January to 8,000	○ Prevent persistent thermal stratification and conditions conducive to harmful algal blooms from occurring	○ Maintain a diurnally-mixed water column to ensure diverse phytoplankton and avoid negative water quality outcomes. ○ Restore and maintain resilient populations of foraging generalists	312.6 Return flows 306.3

Site	Action	Details	Objectives	Vol GL
	ML/day			
Weir Pool Manipulation	Raise Weir 4 to 13.5 mAHD (0.3 m above normal pool level) This action will only be undertaken if the proposed Katarapko floodplain operation (incorporating WP4 raising) cannot occur. *Weir 4 raising in conjunction with a Katarapko regulator operation is incorporated into the Katarapko floodplain watering action below.*	Weir raising between August to November (depending on duration) Flows at Weir 5 of ≥ 5,400 ML/d required during filling phase. Targeting flows of ≥ 4,000ML/d downstream of Weir 4 for the duration of the action including during filling.	*Weir pool raising will contribute to achievement of the following objectives:* ○ Provide for the mobilisation of carbon, nutrients and propagules from the floodplain to the river ○ Maintain habitats and provide for dispersal of organic and inorganic material and organisms between river and wetlands. ○ Maintain water quality to support aquatic biota and normal biogeochemical processes. ○ Establish and maintain groundwater and soil moisture conditions conducive to improving riparian vegetation. ○ Establish groundwater conditions conducive to maintaining diverse native vegetation ○ Establish soil conditions conducive to maintaining diverse native vegetation ○ Promote bacterial rather than algal dominance of biofilms and improve food resource quality for consumers. ○ Maintain a viable, functioning River Red Gum, black box, river cooba, and lignum populations within the Floodplain ○ Establish and maintain diverse water dependent vegetation within aquatic zones ○ Establish and maintain diverse native vegetation comprising native flood dependent and amphibious species within the shedding floodplain zones ○ Restore resilient populations of wetland/floodplain specialist native fish within aquatic zones during floodplain flow events ○ Provide habitat conducive to supporting diverse communities of riparian frogs ○ Provide refuge for the maintenance of adult populations of waterbirds	Fill volume 6.30 Losses 0.34 **Total 6.64** Return flows 6.30 *Plus Additional passing TBC*

Site	Action	Details	Objectives	Vol GL
Chowilla	Pump to priority wetlands. [6] Manage inflows via Pipeclay Creek and Slaney Creek weirs to optimise outcomes for native fish through the anabranch.	Potential pumping to up to 8 priority wetland sites Adaptive management of inflows via weirs and associated fish passage to optimise fast flowing habitat for native fish – *no additional water requirement*.	○ Maintain viable river red gum, black box, river cooba and lignum populations ○ Improve the abundance and diversity of grass and herblands; flood dependant understorey vegetation; and submerged and emergent aquatic vegetation. ○ Maintain sustainable communities of the eight riparian frog species recorded at Chowilla and improve the distribution and abundance of the nationally listed Southern Bell Frog ○ Create conditions conducive to successful breeding of colonial waterbirds in a minimum of three temporary wetland sites at a frequency of not less than one in three years ○ Maintain or improve the diversity and abundance of key bird species ○ Re-establish habitat condition to sustain high value fauna communities ○ Establish groundwater and soil conditions conducive to improving vegetation condition *Extent of achievement of above objectives limited to watering sites receiving pumped delivery of water for the environment* ○ Maintain the extent and diversity of distribution of native fish	Up to 7
Pike	Operation of the Pike floodplain infrastructure to 15.0 mAHD to generate a low extent managed floodplain inundation.	○ Pike floodplain infrastructure operated to 15.0 mAHD ○ Lock 5 remains at Normal Pool Level (16.3 mAHD) for this operation ○ Instate a temporary rise in water level of ca. 0.45 m within the Pike anabranch system during a low flow period (Q is <20,000 ML/day).	○ Maintain viable river red gum, black box, river cooba and lignum populations ○ Establish and maintain a diverse plant community comprised of native flood dependent and/or amphibious species ○ Create conditions conducive to successful, small scale breeding events for waterbirds ○ Provide habitat conducive to supporting communities of native reptiles and mammals and woodland birds ○ Provide habitat conducive to supporting communities of riparian frogs ○ Provide diverse hydraulic conditions and complex habitat for	Filling - 2.94 Losses (evap and seepage) - 0.9 **Total - 3.83** Return flows – 2.8

[6] Delivery dependant on resourcing for pumping and bank reinstatement.

Site	Action	Details	Objectives	Vol GL
			flow dependent biota and processes ○ Implement a seasonal hydrograph that encompasses variation in discharge, velocity and water levels ○ Provide for the facilitation of carbon and nutrient movement from the floodplain to the creek and river to generate localised fluctuations in productivity. ○ Promote bacterial rather than algal dominance of biofilms ○ Establish groundwater and soil conditions conducive to maintaining a diverse native vegetation community ○ Restore and maintain resilient populations of foraging generalists (e.g. Australian smelt, bony herring, Murray rainbowfish, unspecked hardyhead)	*Additional Passing Flow 28.4*
Katarapko	Operate floodplain infrastructure to generate a low extent managed floodplain inundation	Katarapko floodplain infrastructure operated to raise water levels to 11.5 mAHD with weir 4 raised 0.3 m to 13.5 mAHD.	○ Maintain viable river red gum, black box, river cooba and lignum populations ○ Establish and maintain a diverse plant community comprised of native flood dependent and/or amphibious species ○ Provide habitat conducive to supporting communities of native reptiles and mammals and woodland birds ○ Provide habitat conducive to supporting communities of riparian frogs ○ Implement a seasonal hydrograph that encompasses variation in discharge, velocity and water levels ○ Provide for the facilitation of carbon and nutrient movement from the floodplain to the creek and river to generate localised fluctuations in productivity. ○ Promote bacterial rather than algal dominance of biofilms ○ Establish groundwater and soil conditions conducive to maintaining a diverse native vegetation community ○ Restore and maintain resilient populations of foraging generalists (e.g. Australian smelt, bony herring, Murray rainbowfish, unspecked hardyhead)	Filling - 7.3 Losses (evap and seepage) - 0.768 **Total - 8.1** Return flows – 7.3 *Additional Passing Flow: 26.4*
Wetlands	Delivery of water to up to 41 priority wetlands located along the River Murray from the border to the Lower Lakes		○ Support known populations of Murray hardyheads (nationally threatened), including providing conditions for breeding opportunities. ○ Regent parrot (nationally threatened) populations supported ○ Providing breeding opportunities and refugia for Southern bell frogs (nationally threatened). ○ Prevent loss of long lived vegetation: black box, River red	10.6

Site	Action	Details	Objectives	Vol GL
			○ gums, lignum and River cooba ○ Provide refuge habitats for waterbirds	
	Additional delivery of water to wetland sites by Non-Government Organisations including Renmark Irrigation Trust, Accolade, Nature Foundation SA and the Australian Landscapes Trust.		○ Provide habitat for fish, turtles, frogs and water dependent birds ○ Support the maintenance of long lived vegetation including black box, River red gums, lignum and River cooba. ○ Support Regent parrot (nationally threatened) populations	3-4

Near Average (50% AOP) Scenario

Site	Action	Details	Objectives	Vol GL
CLLMM	Increase base flows directly following a small spring unregulated flow event between October and December 2020	○ Maintain water levels in the Lower Lakes between 0.8 – 0.85 m AHD for this period ○ Allow 5-10 GL/d barrage releases split between Goolwa, Tauwitchere and Mundoo barrages ○ Maintain suitable 'salt wedge' conditions (gradient of 5-20 ppt) from October to January downstream of Goolwa and Mundoo barrages, and downstream of part of Tauwitchere barrage	○ Create optimal salt wedge conditions downstream of Goolwa, Mundoo and Tauwitchere barrages for black bream spawning and recruitment ○ North Lagoon freshening to support increased benthic invertebrate diversity and abundance ○ North Lagoon freshening to support migratory wader feeding ○ North Lagoon freshening to support nursery grounds for juvenile estuarine fish and feeding habitat for adult estuarine fish ○ All breeding habitat inundated (i.e. higher elevation fringing Lower Lakes wetlands) for a sufficient period to allow threatened fish (Murray hardyhead, southern pygmy perch) and frogs (southern bell frog) recruitment	710
	Increase base flow between January and June 2021	○ Maintain lake levels in autumn >0.55 m AHD ○ Maintain fishway releases for the entire year ○ Allow at least 1-bay each of attractant flow at Tauwitchere and Goolwa barrage for the entire year	○ Continuous connectivity between the river and estuary ○ Continuous fish passage for diadromous fish ○ Fishways functional year-round ○ Threatened fish habitat in Lower Lakes remains inundated year-round and reasonable likelihood that most new recruits from spring will survive ○ Salt export to the Murray Mouth and Lake Alexandrina salinity <1000 EC year-round ○ North Lagoon <45 ppt year-round for adult estuarine fish and macroinvertebrates	290

Channel and Floodplain	Extend duration of flow at the SA border of 15,000 – 20,000 ML/day into late October/early November	Target delivery of EWR-IC2 described in the SA River Murray LTWP to contribute to the following targets: ○ Increase availability of moderate-fast (0.18 – 0.25 m/s) velocity habitat	○ In near-bank areas of upper weir pools, freshen groundwater and maintain/improve adult river red gum tree condition ○ Support spawning and recruitment of golden perch and silver perch by creating conditions conducive to reproductive activity when temperature thresholds (20 degrees) are exceeded	550 Return flows 539
Weir Pool Manipulation	Weir raisings at Weir 2 and potentially also at one or more of Weirs 6, 5 and 4.	Raise Weir 2 by up to 52cm above normal pool level It is assumed that Weir 6, Weir 5 and Weir 4 will be raised in conjunction with a Chowilla, Pike, and Katarapko regulator operations, respectively. However if the floodplain regulator operations are NOT able to occur then the following weir raising actions may also be undertaken: - Raise Weir 6 by up to 59cm above normal pool to 19.84 mAHD - Raise Weir 5 by up to 50cm above normal pool level to 16.9 mAHD. - Raise Weir 4 by up to 60 cm above normal pool level to 13.8 mAHD Optimal timing August to November. *For August or later start if QSA > 15,000 ML/d in October weir pool water levels will be returned to full supply level earlier to avoid compromising River Murray Channel pulse outcomes.*	*Weir pool raising will contribute to achievement of the following objectives:* ○ Provide for the mobilisation of carbon, nutrients and propagules from the floodplain to the river ○ Maintain habitats and provide for dispersal of organic and inorganic material and organisms between river and wetlands. ○ Maintain water quality to support aquatic biota and normal biogeochemical processes. ○ Establish and maintain groundwater and soil moisture conditions conducive to improving riparian vegetation. ○ Establish groundwater conditions conducive to maintaining diverse native vegetation. ○ Establish soil conditions conducive to maintaining diverse native vegetation. ○ Promote bacterial rather than algal dominance of biofilms and improve food resource quality for consumers. ○ Maintain viable, functioning River Red Gum, black box, river cooba, and lignum populations within the Floodplain ○ Establish and maintain diverse water dependent vegetation within aquatic zones ○ Establish and maintain diverse native vegetation comprising native flood dependent and amphibious species within the shedding floodplain zones ○ Restore resilient populations of wetland/floodplain specialist native fish within aquatic zones during floodplain flow events	Fill volume for just Weir 2 - 6.07 With total losses 0.19 **Total 6.26** Fill volume for Weirs 2, 4, 5 & 6 - 35.54 With total losses 1.25 **Total 36.79** Return Flows - 35.54 *(if all 4 weirs raised)* - 6.07 *(if only Weir 2 raised)*

			○ Provide habitat conducive to supporting diverse communities of riparian frogs ○ Provide refuge for the maintenance of adult populations of waterbirds	
Chowilla	Operate Chowilla regulator to generate a medium to high floodplain inundation.	Chowilla regulator operated to 19.4 mAHD (3 m increase above normal pool) or higher (if scale and duration of passing River Murray flows are sufficient) and Weir 6 – operated up to 19.85mAHD (0.6 m above normal pool level) to generate floodplain and wetland inundation over more than 5,000 hectares.	○ Maintain viable river red gum, black box, river cooba and lignum populations ○ Improve the abundance and diversity of grass and herblands; flood dependant understorey vegetation; and submerged and emergent aquatic vegetation**.** ○ Maintain sustainable communities of the eight riparian frog species recorded at Chowilla and improve the distribution and abundance of the nationally listed Southern Bell Frog ○ Create conditions conducive to successful breeding of colonial waterbirds in a minimum of three temporary wetland sites at a frequency of not less than one in three years ○ Maintain or improve the diversity and abundance of key bird species ○ Re-establish habitat condition to sustain high value fauna communities ○ Establish groundwater and soil conditions conducive to improving vegetation condition ○ Maintain the extent and diversity of distribution of native fish ○ Provide processes for the mobilisation of carbon and nutrients from the floodplain to the river	Filling – 45.8 Losses – 17.3 **Total 63.1** Return Flows 35.5 *Addl passing QSA- 79.5GL*
Pike	Operation of floodplain infrastructure to generate a low extent managed floodplain inundation.	Operate floodplain regulators to 15.25 mAHD (raising water levels by 0.7m within the Pike anabranch) with Weir 5 also raised to 16.8 mAHD (increasing levels upstream	○ Maintain viable river red gum, black box, river cooba and lignum populations ○ Establish and maintain a diverse plant community comprised of native flood dependent and/or amphibious	Filling - 16.3 Losses (evap & seepage) - 4.5 ML **Total 20.74**

		of the weir by 0.5 m above normal pool level)	species o Create conditions conducive to successful, small scale breeding events for waterbirds o Provide habitat conducive to supporting communities of native reptiles and mammals and woodland birds o Provide habitat conducive to supporting communities of riparian frogs o Provide diverse hydraulic conditions and complex habitat for flow dependent biota and processes o Implement a seasonal hydrograph that encompasses variation in discharge, velocity and water levels o Provide for the facilitation of carbon and nutrient movement from the floodplain to the creek and river to generate localised fluctuations in productivity. o Promote bacterial rather than algal dominance of biofilms o Establish groundwater and soil conditions conducive to maintaining a diverse native vegetation community o Restore and maintain resilient populations of foraging generalists (e.g. Australian smelt, bony herring, Murray rainbowfish, unspecked hardyhead)	Return Flows 16.1 *Nil addl Passing Flow required under this scenario*
Katarapko	Operation of floodplain infrastructure to generate a low medium extent managed floodplain inundation.	Floodplain infrastructure operated to increase water levels to 12.8 – 12.9 mAHD (2.5-3.0 m above normal pool) within the Eckerts anabranch system and Weir 4 is raised 0.3 m above normal pool level (to a peak of 13.5 mAHD). Weir 4 raising <u>may</u> be increased a further 30 cm to 60 cm above	o Maintain viable river red gum, black box, river cooba and lignum populations o Establish and maintain a diverse plant community comprised of native flood dependent and/or amphibious species o Create conditions conducive to successful, small scale breeding events for waterbirds o Provide habitat conducive to supporting communities of native reptiles and mammals and woodland birds o Provide habitat conducive to supporting communities of	Filling - 10 Losses (evap & seepage) - 1.7 **Total 11.76** Return flows – 19.97 *Plus addl Passing Flow:*

		normal pool level to a peak of 13.8 mAHD [7]	riparian frogs ○ Provide diverse hydraulic conditions and complex habitat for flow dependent biota and processes ○ Implement a seasonal hydrograph that encompasses variation in discharge, velocity and water levels ○ Provide for the facilitation of carbon and nutrient movement from the floodplain to the creek and river to generate localised fluctuations in productivity. ○ Promote bacterial rather than algal dominance of biofilms ○ Establish groundwater and soil conditions conducive to maintaining a diverse native vegetation community ○ Restore and maintain resilient populations of foraging generalists (e.g. Australian smelt, bony herring, Murray rainbowfish, unspecked hardyhead)	*10.3* OR with Weir 4 raising increased to 0.6 m: Fill vol - 19.9 Losses (evap & seepage) - 2.35 **Total 22.25** Return flows – 19.9 *Plus addl Passing Flow:* *5.6*
Wetlands	Delivery of water to 37 priority wetlands located along the River Murray from the border to the Lower Lakes		The LTWP objectives of the channel asset, below 40,000 ML/day, that align with the wetland watering program include: ○ Establish and maintain a diverse native flood-dependent plant community in areas inundated by flows of 10,000–40,000 ML/day QSA ○ Establish and maintain a diverse macrophyte community in wetlands inundated by flows up to 40,000 ML/day QSA. ○ Establish and maintain groundwater and soil moisture conditions conducive to improving riparian vegetation. ○ Many of the priority wetlands within scope provide nature-based tourism experiences including camping, bird watching and recreation (Tolderol GR, Hogwash Bend CP, Katarapko NP, Morgan CP), contributing to local economies.	10.6
	Additional delivery of water to wetland sites by Non-Government		○ Provide habitat for fish, turtles, frogs and water dependent birds	3-4

[7] *This operation depends on capacity for increased raising of Lock 4 to 60 cm above normal pool level – depends on capacity to maintain appropriate head differential and confirmation by SA Water.*

	Organisations including Renmark Irrigation Trust, Accolade, Nature Foundation SA and the Australian Landscapes Trust.		○ Support the maintenance of long lived vegetation including black box, River red gums, lignum and River cooba. ○ Support Regent parrot (nationally threatened) populations	

Wet (25% AOP) Scenario

Site	Action	Details	Objectives	Vol GL
CLLMM	Deliver e-water from October 2020 to January 2021 (immediately after a moderate unregulated flow event in spring)	○ Maintain water levels in the Lower Lakes between 0.8 – 0.85 m AHD (or higher) for this period ○ Allow 10-20 GL/d barrage releases, prioritised from Tauwitchere barrage, between Oct-Dec	○ Maintain water levels in the Coorong South Lagoon >0.2 m AHD between October and December to support *Ruppia tuberosa* growth, flowering and seeding ○ Maintain salinity in the Coorong South Lagoon <60 ppt to promote *R. tuberosa* flowering and seeding ○ Maintain salinity in the Coorong South Lagoon <65 ppt to promote recruitment of other key Coorong food web biota (i.e. benthic invertebrates and small-mouthed hardyhead) ○ Surcharge water levels in the Lower Lakes to promote recruitment of high elevation emergent aquatic vegetation such as *Melaleuca halmaturorum*	1140
	Increase base flows between February and June 2021	○ Maintain lake levels in autumn >0.60 m AHD ○ Maintain fishway releases for the entire year ○ Allow at least 1-bay each of attractant flow at Tauwitchere and Goolwa barrage for the entire year	○ Continuous connectivity between the river and estuary ○ Continuous fish passage for diadromous fish ○ Fishways functional year-round ○ Threatened fish habitat in Lower Lakes remains inundated year-round and high likelihood that most new recruits from spring will survive ○ Salt export to the Murray Mouth and Lake Alexandrina salinity <1000 EC year-round ○ North Lagoon <45 ppt year-round for adult estuarine fish and macroinvertebrates ○ Higher flows through remainder of year maintain lower salinity in Coorong South Lagoon	315
Channel and Floodplain	Enhance unregulated flow to inundate low elevation areas of SA River Murray Floodplain Asset	Target EWR-FP1 described in the SA River Murray LTWP (Median discharge OSA 50,000 ML/d) to contribute to the following targets for the SA River Murray Floodplain PEA: ○ River red gum adult tree condition and population demographics in the target zone ○ Large Murray cod recruitment event	○ River red gum adult tree condition and population demographics in the target zone ○ Large Murray cod recruitment event ○ Support large-scale breeding by eight riparian frog species	217.6 Return flows 213.2

		○ Support large-scale breeding by eight riparian frog species		
	Extend duration of flow at the SA border of 20,000 – 30,000 ML/day into late October/early November	Target EWR-IC3 (Median discharge QSA 20,000 ML/day) to contribute to the following targets: ○ Abundant fast flowing habitat (>0.25 m/s) available ○ Improved soil water availability and reduced soil salinity ○ Growth of emergent aquatic plants in temporary wetlands inundated by high flows ○ Improved river red gum population demographics in inundated areas and areas adjacent due to lateral recharge of groundwater ○ Improved survival of Murray cod and catfish larvae	○ Abundant fast flowing habitat (>0.25 m/s) available ○ Improved soil water availability and reduced soil salinity ○ Growth of emergent aquatic plants in temporary wetlands inundated by high flows ○ Improved river red gum population demographics in inundated areas and areas adjacent due to lateral recharge of groundwater ○ Improved survival of Murray cod and catfish larvae	217.3 Return flows 213.0
Weir Pool Manipulation	Weir raisings at Weirs 2 and potentially also at one or both of Weirs 5 and 4 should the Pike and/or Katarapko floodplain operations not be able to proceed.	Raise Weir 2 by up to 52cm above normal pool level to 6.62 mAHD It is assumed that Weir 6, Weir 5 and Weir 4 will be raised in conjunction with a Chowilla, Pike, and Katarapko regulator operations, respectively. However if the new floodplain regulator operations at Pike and Katarapko are NOT able to occur then the following weir raising actions will also be undertaken: - Raise Weir 5 by up to 50cm above normal pool level to 16.9	*Weir pool raising will contribute to achievement of the following objectives:* ○ Provide for the mobilisation of carbon, nutrients and propagules from the floodplain to the river ○ Maintain habitats and provide for dispersal of organic and inorganic material and organisms between river and wetlands. ○ Maintain water quality to support aquatic biota and normal biogeochemical processes. ○ Establish and maintain groundwater and soil moisture conditions conducive to improving riparian vegetation. ○ Establish groundwater conditions conducive to maintaining diverse native vegetation ○ Establish soil conditions conducive to maintaining diverse native vegetation ○ Promote bacterial rather than algal dominance of biofilms and improve food resource quality for consumers.	Fill volume for just Weir 2 - 5.59 With total losses 0.37 **Total 5.96** Fill volume for Weirs 2, 4 & 5 - 31.29 With total losses 2.46 **Total 33.75**

		mAHD. - Raise Weir 4 by up to 60 cm above normal pool level to 13.8 mAHD	○ Maintain viable, functioning River Red Gum, black box, river cooba, and lignum populations within the Floodplain ○ Establish and maintain diverse water dependent vegetation within aquatic zones ○ Establish and maintain diverse native vegetation comprising native flood dependent and amphibious species within the shedding floodplain zones ○ Restore resilient populations of wetland/floodplain specialist native fish within aquatic zones during floodplain flow events ○ Provide habitat conducive to supporting diverse communities of riparian frogs ○ Provide refuge for the maintenance of adult populations of waterbirds	
Chowilla	Operate Chowilla regulator and weir 6 to generate a high to maximum extent floodplain inundation.	Chowilla regulator operated up to 19.85 mAHD (3.45 m increase above normal pool) and Weir 6 – operated up to 19.85mAHD (0.6 m above normal pool level) to generate floodplain and wetland inundation over approximately 7,000 hectares.	○ Maintain viable river red gum, black box, river cooba and lignum populations ○ Improve the abundance and diversity of grass and herblands; flood dependant understorey vegetation; and submerged and emergent aquatic vegetation**.** ○ Maintain sustainable communities of the eight riparian frog species recorded at Chowilla and improve the distribution and abundance of the nationally listed Southern Bell Frog ○ Create conditions conducive to successful breeding of colonial waterbirds in a minimum of three temporary wetland sites at a frequency of not less than one in three years ○ Maintain or improve the diversity and abundance of key bird species ○ Re-establish habitat condition to sustain high value fauna communities ○ Establish groundwater and soil conditions conducive to improving vegetation condition ○ Maintain the extent and diversity of distribution of native	Filling – 74.4 Losses (evap & seepage) – 25.5 **Total - 99.9** Return Flow 61.3 *Additional passing flow 30.2 GL (in late Sept- Oct)*

			fish ○ Instate connectivity to mid-elevation floodplain and all key wetlands ○ Provide processes for the mobilisation of carbon and nutrients from the floodplain to the river ○ Maintain the flow mosaic characteristic of the Chowilla Anabranch system ○ Establish a flow regime with distinct variability in components of the flood pulse	
Pike	Operation of Pike floodplain infrastructure to generate a low extent managed floodplain inundation.	Pike and Tanyaca regulators operated to 15.25 mAHD (0.7 m increase above normal pool) and Weir 5 – operated up to 16.8 mAHD (0.5 m above normal pool level)	○ Maintain viable river red gum, black box, river cooba and lignum populations ○ Establish and maintain a diverse plant community comprised of native flood dependent and/or amphibious species ○ Create conditions conducive to successful, small scale breeding events for waterbirds ○ Provide habitat conducive to supporting communities of native reptiles and mammals and woodland birds ○ Provide habitat conducive to supporting communities of riparian frogs ○ Provide diverse hydraulic conditions and complex habitat for flow dependent biota and processes ○ Implement a seasonal hydrograph that encompasses variation in discharge, velocity and water levels ○ Provide for the facilitation of carbon and nutrient movement from the floodplain to the creek and river to generate localised fluctuations in productivity. ○ Promote bacterial rather than algal dominance of biofilms ○ Establish groundwater and soil conditions conducive to maintaining a diverse native vegetation community ○ Restore and maintain resilient populations of foraging generalists (e.g. Australian smelt, bony herring, Murray rainbowfish, unspecked hardyhead)	Filling – 16.9 Losses (evap and seepage) - 4.4 **Total 21.3** Return Flow 16.7 *Nil additional passing flow under this scenario*
Katarapko	Operation of Katarapko floodplain infrastructure to generate a medium extent managed floodplain inundation.	Katarapko regulators operated to 12.9 mAHD (2.5-3 m increase in water levels within the Eckerts anabranch) and Weir 4 – raised up to 13.5 mAHD (0.3 m above normal pool level).	○ Maintain viable river red gum, black box, river cooba and lignum populations ○ Establish and maintain a diverse plant community comprised of native flood dependent and/or amphibious species ○ Create conditions conducive to successful, small scale breeding events for waterbirds	Fill vol – 7.6 Losses (evap and seepage) - 1.5 **Total - 9.1** *Nil additional*

			○ Provide habitat conducive to supporting communities of native reptiles and mammals and woodland birds ○ Provide habitat conducive to supporting communities of riparian frogs ○ Provide diverse hydraulic conditions and complex habitat for flow dependent biota and processes ○ Implement a seasonal hydrograph that encompasses variation in discharge, velocity and water levels ○ Provide for the facilitation of carbon and nutrient movement from the floodplain to the creek and river to generate localised fluctuations in productivity. ○ Promote bacterial rather than algal dominance of biofilms ○ Establish groundwater and soil conditions conducive to maintaining a diverse native vegetation community ○ Restore and maintain resilient populations of foraging generalists (e.g. Australian smelt, bony herring, Murray rainbowfish, unspecked hardyhead)	*passing flow required under this scenario*
Wetlands	Delivery of water to 17-26 priority wetlands located along the River Murray from the border to the Lower Lakes		○ Establish groundwater conditions conducive to maintaining diverse native vegetation across the Floodplain PEA ○ Establish soil conditions conducive to maintaining diverse native vegetation across the Floodplain PEA ○ Maintain a viable, functioning River Red Gum population within the Floodplain PEA ○ Maintain a viable, functioning Black Box population within the Floodplain PEA ○ Maintain a viable, functioning River Cooba population within the Floodplain PEA ○ Maintain a viable, functioning Lignum population within the Floodplain PEA ○ Establish and maintain diverse native vegetation comprising native flood dependent and amphibious species within the shedding floodplain zones across the Floodplain PEA ○ Provide habitat conducive to supporting diverse communities of riparian frogs within the Floodplain PEA ○ Create conditions conducive to successful, small scale breeding events for waterbirds across the Floodplain PEA ○ Provide refuge for the maintenance of adult populations of waterbirds across the Floodplain PEA	4 to 6

			○ Provide habitat conducive to supporting communities of native woodland birds, reptiles and mammals across the Floodplain PEA	
	Additional delivery of water to wetland sites by Non-Government Organisations including Renmark Irrigation Trust, Accolade, Nature Foundation SA and the Australian Landscapes Trust.		○ Provide habitat for fish, turtles, frogs and water dependent birds ○ Support the maintenance of long lived vegetation including black box, River red gums, lignum and River cooba. ○ Support Regent parrot (nationally threatened) populations	3-4