South Australia's River Murray Annual Operating Plan

2021-22

Government of South Australia
Department for Environment and Water

Foreword

The Department for Environment and Water (DEW) acknowledges and pays respect to the Traditional Owners and their Nations, of the Murray-Darling Basin, who have a deep cultural, social, environmental, spiritual and economic connection to their lands and waters.

During 2020-21, DEW undertook a major review of the format of *South Australia's River Murray Annual Operating Plan* (SA AOP), which has been prepared annually since 2011-12. This led to the development of a new guiding document for River Murray operational decisions in South Australia on an ongoing basis - the *Objectives and Outcomes for Operating the River Murray in South Australia (O&O)*. The new format of the SA AOP is now focussed on operations for the current water year.

The *SA AOP 2021-22* is the key document that guides transparent and coordinated River Murray operational decisions in South Australia during the 2021-22 water year, and describes how the desired outcomes are proposed to be delivered in alignment with the O&O. It identifies how the River Murray in South Australia may be operated under a number of potential water availability scenarios to balance the benefits to all water users, including water for the environment (WFTE).

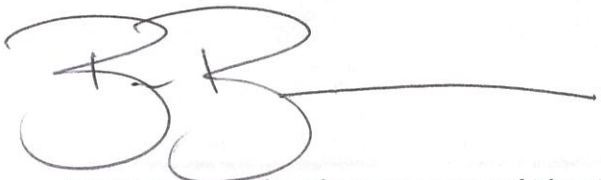
The SA AOP aims to achieve some of the specific objectives in the Basin Plan 2012 and objectives in the *2021-22 Water for the Environment Annual Plan for the South Australian River Murray* (WFTE Annual Plan) (Department for Environment and Water 2021), while meeting requirements in the *Australian Drinking Water Guidelines 6 2011 (updated December 2013)*.

The SA AOP draws on flow outlooks provided by the *River Murray System Annual Operating Outlook 2021-22* (AOO) prepared by the Murray-Darling Basin Authority (MDBA), with input from the Commonwealth, New South Wales, Victorian and South Australian governments through the Water Liaison Working Group.

A wide range of stakeholders have been engaged in the development of the SA AOP, including the MDBA and the River Murray Operations Working Group (RMOWG), which is a cross-agency group consisting of representatives with an interest in how the River Murray is managed and operated in South Australia. These include representatives from:

- Department for Environment and Water
- SA Water
- Primary Industries and Regions SA
- Environment Protection Authority
- Commonwealth Scientific and Industrial Research Organisation

I would like to thank all those who have been involved in the planning, management and operations of the River Murray in South Australia. Input was also gratefully received from the MDBA.



Ben Bruce, Executive Director, Water and River Murray
Department for Environment and Water
14 June 2022

Contents

List of Figures

List of Tables

1 Introduction

South Australia's Annual Operating Plan 2021-22 (SA AOP) identifies how the River Murray in South Australia may be operated for the current water year under a number of potential water availability scenarios (also referred to as inflow scenarios) to balance the benefits to all water users, including water for the environment (WFTE).

The SA AOP aligns with the *Objectives and Outcomes for Operating the River Murray in South Australia* (SA O&O) (Department for Environment and Water 2021), which aims to achieve some of the specific objectives in the Basin Plan 2012. The SA AOP has regard for the SA O&O under a range of climate and inflow scenarios and identifies the objectives and outcomes sought for the River Murray and its water users. Actions falling within normal operating parameters will be undertaken routinely. Where a proposed action falls outside normal operating parameters, additional approvals will be sought from the relevant authority. Some actions within normal operating parameters may also require approval.

The SA AOP also contributes to meeting objectives in the *Long-term environmental watering plan* (LTWP) (Department for Environment and Water 2020) for the area referred to in the *South Australian River Murray water resource plan* (Department for Environment and Water 2019). It also guides operations to help ensure that South Australia meets its obligations for the protection of WFTE.

The SA AOP is informed by the flow outlook scenarios contained in the *River Murray System Annual Operating Outlook* (AOO) prepared by the Murray Darling Basin Authority (MDBA) for the 2021-22 water year. It uses the six inflow scenarios being 'extreme dry', 'dry', 'moderate', 'near average', 'wet' and 'very wet' to inform water delivery operations in South Australia. It should be noted that a 'worst case' scenario has not been included in the set of scenarios chosen in the MDBA AOO 2021-22. Instead, a 'very wet' scenario has been included as this is likely to better represent the range of operational conditions that may eventuate in 2021-22. This includes the elevated potential for high flow and flood conditions to develop. However, if climatic drivers change substantially such that much drier conditions become more likely, the MDBA will review the scenarios in the outlook and refine as necessary. The MDBA will provide monthly water resource updates to the Basin Officials Committee (BOC) and the Water Liaison Working Group (WLWG) and undertake a midyear review. The SA AOP will be updated if necessary (for example, if there is a significant change in water resource conditions). If dry conditions cause the water level in the River Murray below Lock 1 to fall below 0.4 metres (m) Australian Height Datum (AHD), River Murray operations in South Australia will be consistent with the MDBA's Drought Emergency Framework for Lakes Alexandrina and Albert (June 2014) (DEF) to the extent that is practicably possible.

It is important to note that the actual conditions that occur during the 2021-22 water year may differ from the inflow scenarios described in the SA AOP, therefore river operations may vary from the projections in this document. This is in-part driven by the Murray Darling Basin's highly variable climate where one month can be wet followed by a month of dry. The actual pattern of environmental water delivery during the 2021-22 water year is also uncertain and variable, which may significantly change the distribution pattern provided in the scenarios. Nevertheless, the scenarios provide a useful indication of potential flow to South Australia during the 2021-22 water year. Ongoing decisions made during the year regarding river operations within South Australia will be consistent with the SA AOP and current operating policies and procedures as agreed under South Australia's Prerequisite Policy Measures (PPM) approved by the Murray-Darling Basin Authority.

For Entitlement Flow delivery, the worst case inflow scenario for water availability to South Australia was chosen to ensure that South Australia receives the maximum possible monthly volume of Entitlement Flow. This carries a small risk to flow delivered later in the water year if less than the dry inflows occur. If South Australia adopted the extreme dry inflow scenario for water delivery and the inflows improved, it would not be able to recover the reduced monthly Entitlement Flow for the months that had passed.

For water allocations, the extreme dry inflow scenario for water availability to South Australia was chosen to ensure (as much as possible) that water allocations do not decrease as the year progresses. Under the all inflow scenarios, South Australia will receive its full Entitlement Flow of 1 850 GL. As a result, the minimum opening water allocation is 100%, for River Murray water access entitlement holders.

The main focus of the SA AOP is to guide key processes to achieve the best outcome for the State (economic, environmental and social), deliver a portion of South Australia's deferred water for Critical Human Water Needs (CHWN) and private carryover if required, seek opportunities to defer additional water should the conditions improve and have regard for the Basin Plan targets and outcomes.

2 Resource conditions at commencement of 2021–22

2.1 Murray-Darling Basin inflows during 2020-21

In 2020-21, the River Murray System (southern Basin) and the Darling River (northern Basin) experienced varied rainfall depending on location within the basin. Large areas of northern NSW received above average to very much above average rainfall over 2020-21. The Lower Murray, including the length of the River Murray in SA, experienced below average rainfall across 2020-21. The Upper Murray at the headwaters of the Southern Connected Basin experienced average rainfall across the year.

Temperatures were above average across the Lower Murray and over some areas of the Upper Murray in 2020-21. The remainder of the Southern Connected Basin experienced average temperatures in 2020-21.

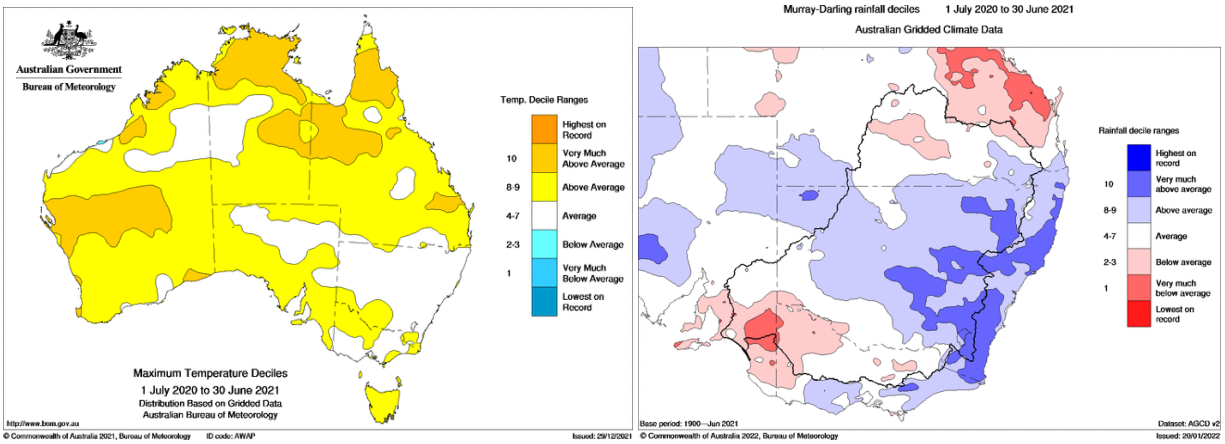


Figure 1. Maximum temperature across Australia and rainfall in Murray Darling Basin 1 July 2020- 20 June 2021

(Sources: http://www.bom.gov.au/jsp/awap/temp/index.jsp & http://www.bom.gov.au/climate/maps/rainfall/?variable=rainfall&map=totals&period=daily&region=nat&year=2022&month=02&day=07)

In 2020-21, River Murray System inflow (excluding Menindee, Snowy Mountains Scheme, Inter-valley Transfers and environmental water inflow) was approximately 5 142 GL (**Figure 2**). The River Murray System long-term annual average inflow is around 9 200 GL.

The inflow to the River Murray System during 2020-21 remained below the last 10 year average until October 2020 and then fluctuated for the remainder of the water year. During February 2021 inflows exceeded the long term average for the first time in the water year.

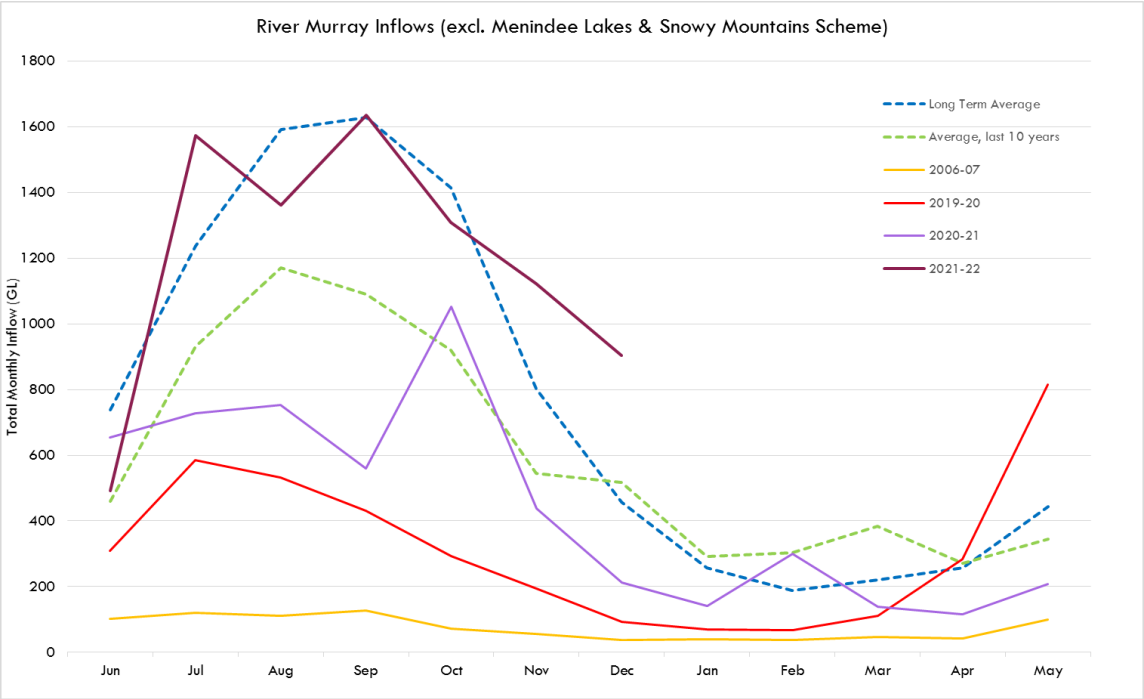


Figure 2. River Murray System Inflow (excluding inflow to Menindee and Snowy Scheme) recent years, long-term average and average over the last 10 years

In 2020-21, Menindee Lakes inflow was approximately 1 020 GL, comparatively in 2019-20 the inflow was approximately 530 GL. Menindee Lakes long-term annual average inflow is around 1 940 GL (**Figure 3).**

Following years of almost no inflow to Menindee Lakes, after some inflows during 2019-20, on 1 July 2020 the storage volume in Menindee Lakes was 479 GL (full capacity is 1 731 GL). Inflows between June 2020 and March 2021 remained moderate, then from April 2021 the inflows to the Lakes increased substantially. By the end of June 2021, the volume in storage was 1 088 GL.

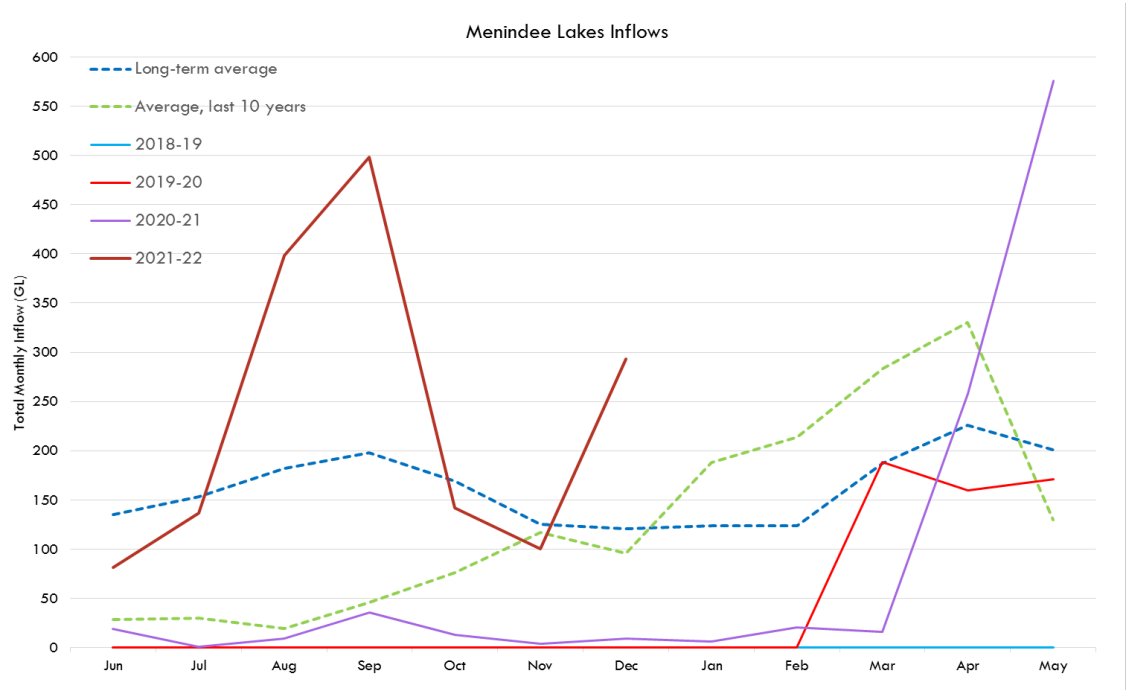


Figure 3. Inflows to Menindee Lakes in recent years, long-term average and average over last 10 year

2.2 MDB Storages at 1 July 2021

The water availability for the River Murray System and associated catchments (Murrumbidgee, Goulburn and Darling) at 1 July 2021 is identified in **Table 1**.

Table 1. Storage Volumes across MDB at 1 July 2021

	Total Capacity (GL)	Active capacity (GL)	Total water in storage (GL)	Percentage of total capacity %
River Murray Storage (MDBA Controlled)				
Dartmouth Reservoir	3 857	3 785	2 557	66%
Hume Reservoir	3 005	2 982	1 724	57%
Lake Victoria	677	577	376	56%
Menindee Lakes*	1 731	1 251	1 089	63%
* When Menindee Lakes volume falls below 480 GL the resource is controlled by NSW. **When the volume next exceeds 640 GL it reverts back to MDBA control. *** Menindee Lakes can be surcharged above 1,731 GL				
Murrumbidgee Storage (NSW Controlled)				
Burrinjuck Reservoir	1 026	1 023	993	97%
Blowering Reservoir	1 631	1 607	1 571	96%
Goulburn Storage (Victoria Controlled)				
Eildon Reservoir	3 334	3 234	1 947	58%

2.3 MDB Water Sharing Arrangements

As at 1 July 2021, the MDBA declared that the River Murray System will fall under under **Tier 1** conditions. This indicates that normal water sharing arrangements will be put in place. Tier 1 water sharing operates when enough water is available for CHWN (NSW 61 GL, Victoria 77 GL and South Australia 204 GL) and conveyance water (1 596 GL).

Under Tier 1, a *Conveyance Reserve* of 225 GL is required to be set aside by the MDBA to ensure that conveyance water can be met in the following year. The full *Conveyance Reserve* for 2021-22 has been set aside.

2.4 SA Water Resource Availability and Allocation

At the end of July 2021, the MDBA provided an assessment showing the projected minimum amount of water that could be delivered to South Australia in 2021-22 is 1 850 GL, which is the full SA Entitlement.

The opening allocation for SA River Murray irrigators in 2021-22 was 100 per cent.

2.5 SA Storage Right

On 1 July 2021, South Australia had a total of 386.6 GL of water deferred and stored, as shown in **Table 2**.

Table 2. Storage Right Volumes at 1 July 2021

	Lake Victoria (GL)	Hume (GL)	Dartmouth (GL)	Total (GL)
CHWN	9.5	40.0	236.3	285.8
Private Carryover	0.0	0.0	100.8	100.8
Total	9.5	40.0	337.1	386.6

2.6 Water Level and Salinity Conditions

During 2020-21, salinity remained well below Basin Plan target levels at Lock 6, Morgan and Murray Bridge. Salinity at Milang (at Lake Alexandrina) was near or briefly above Basin Plan target levels during July and August 2020. The range was between 618 EC and 930 EC at Lake Alexandrina.

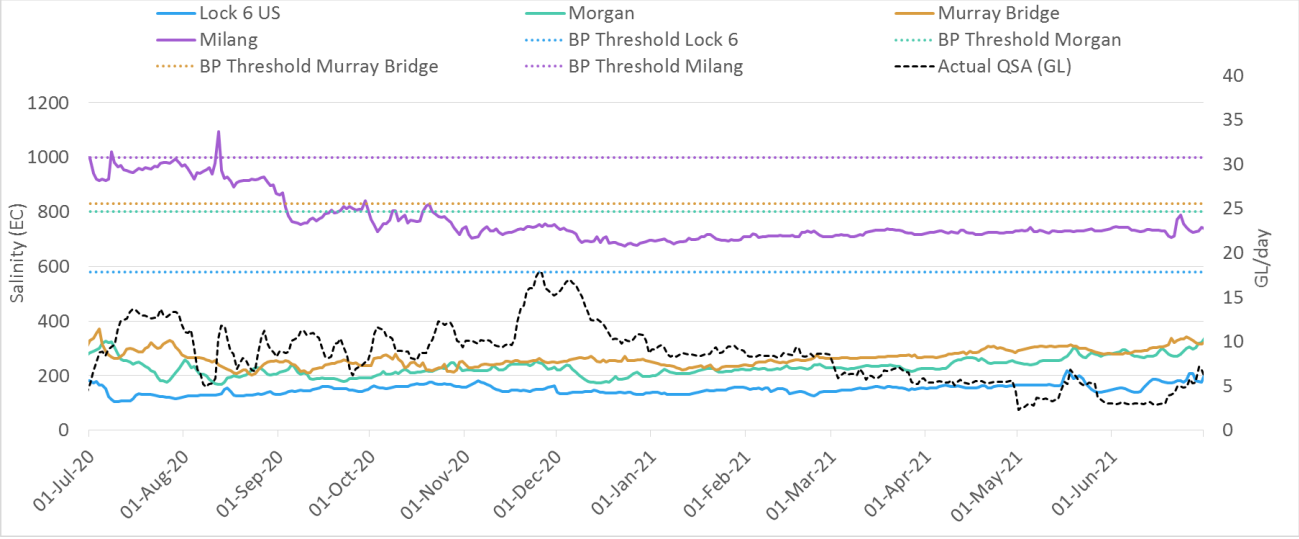


Figure 4. Salinity and water levels across Lock 6, Morgan, Murray Bridge and Milang from 1 July 2021 to 1 July 2021

During 2020-21 Lake Alexandrina water levels were in range of 0.55 m AHD to 0.89 m AHD.

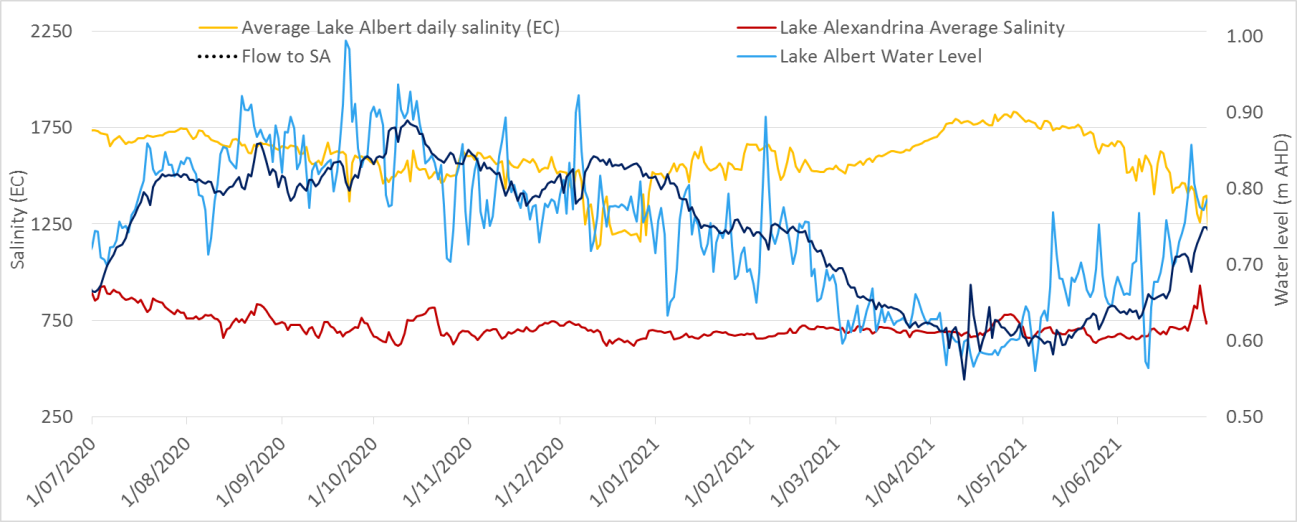


Figure 5. Lower Lakes average water and salinity levels from 1 July 2020 to 1 June 2021

Salinity levels in both the North and South lagoons of the Coorong exceeded target levels for periods during 2020-21 and were between 19 ppt and 54 ppt within the North Lagoon and 66 ppt and 122 ppt in the South Lagoon.

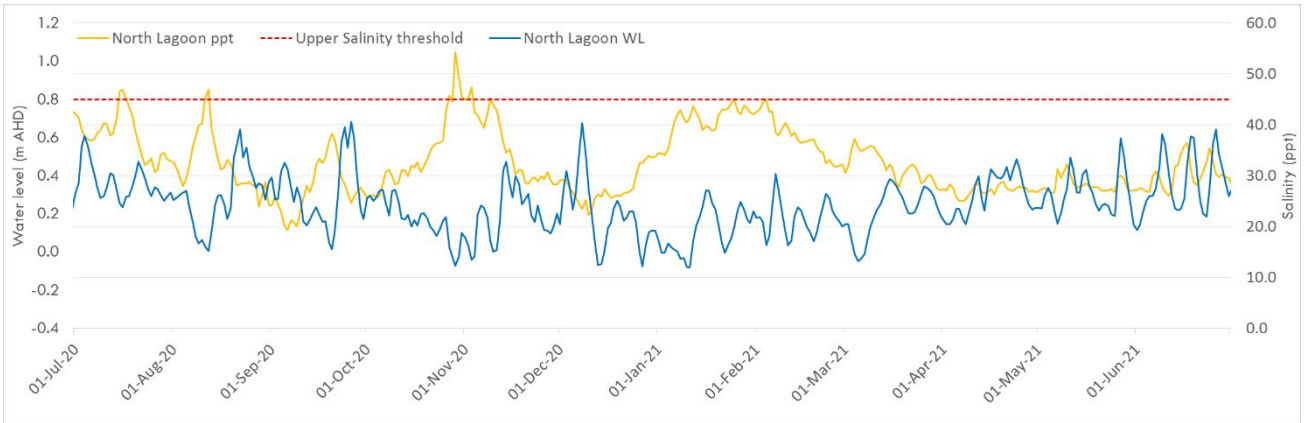


Figure 6. North Lagoon salinity levels from 1 July 2020 to 1 June 2021

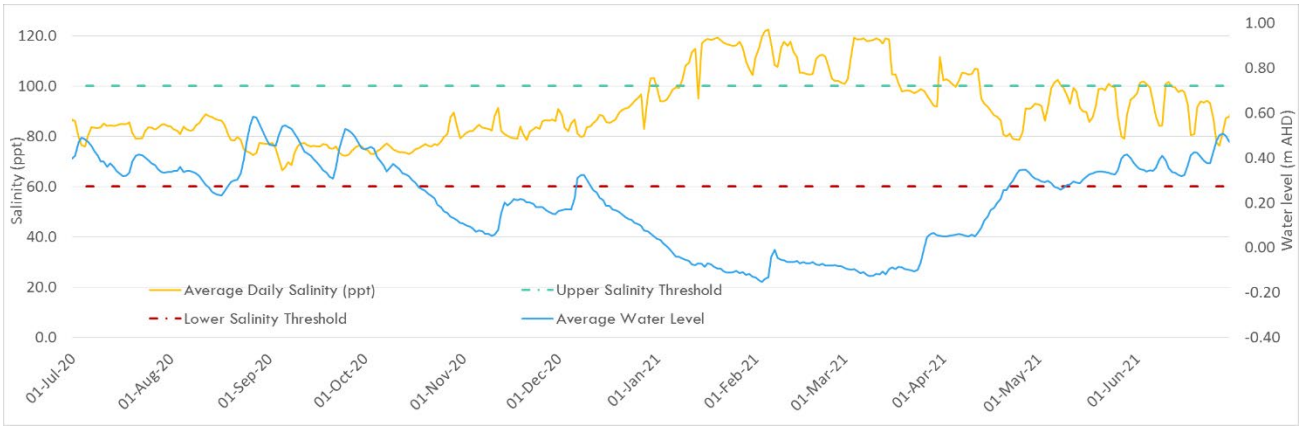


Figure 7. South Lagoon salinity levels from 1 July 2020 to 1 June 2021

3 Annual Outlook for 2021-22

3.1 Resource Conditions Summary for 2020-21

At the start of the 2020-21 water year, water resource conditions across the Murray-Darling Basin were drier than average, and inflows were well below the long term median. From June 2021, a shift occurred to wetter conditions with a corresponding increase in basin inflows. On 23 November 2021, the Bureau of Meteorology announced that a La Nina event had established in the tropical Pacific which caused above average spring rainfall in eastern Australia and continued over into summer 2021/2022.

3.2 Bureau of Meteorology Climate Outlook

In August 2021, the Bureau of Meteorology's three-month climate outlook indicated a high likelihood of exceeding median rainfall across the Murray-Darling Basin, with low to average likelihood of exceeding median maximum temperatures.

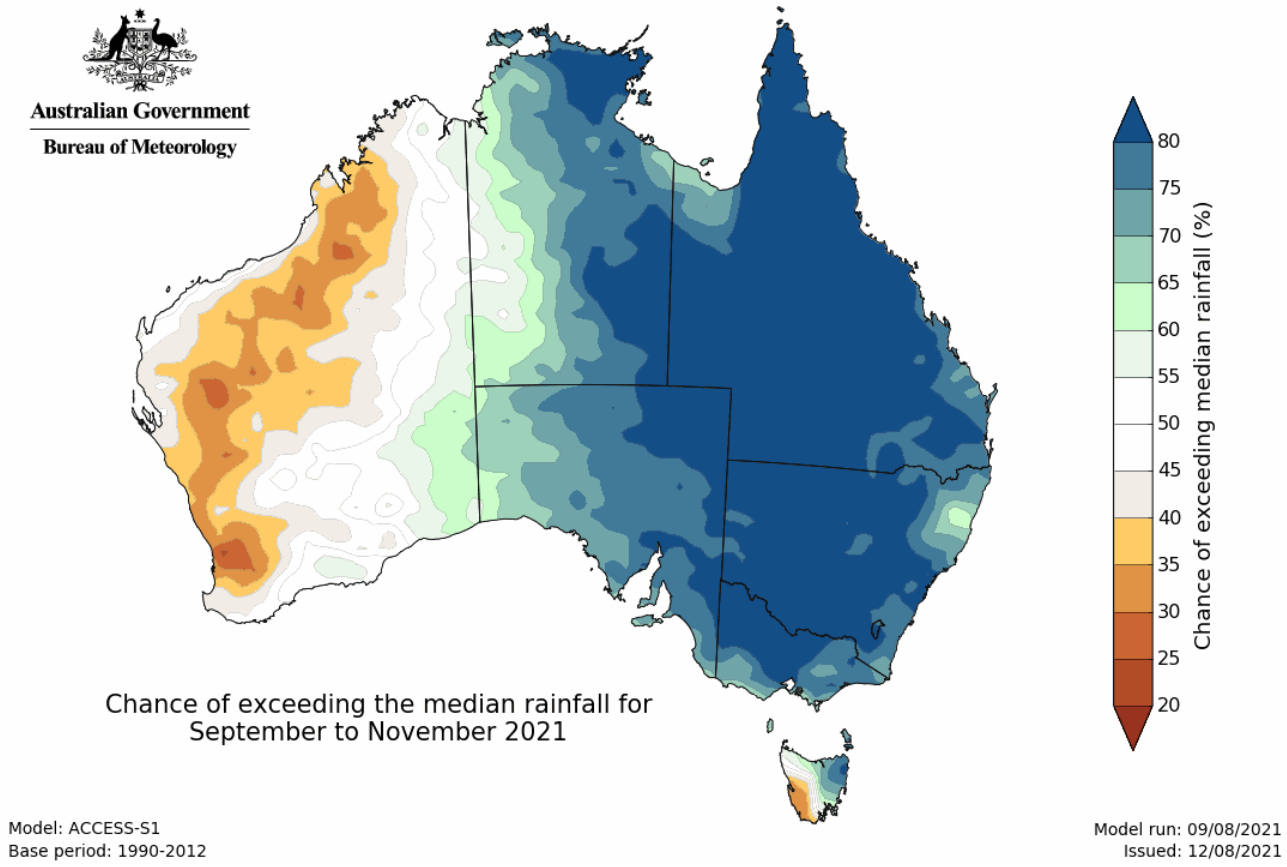


Figure 8. BOM Rainfall outlook from September to November 2021

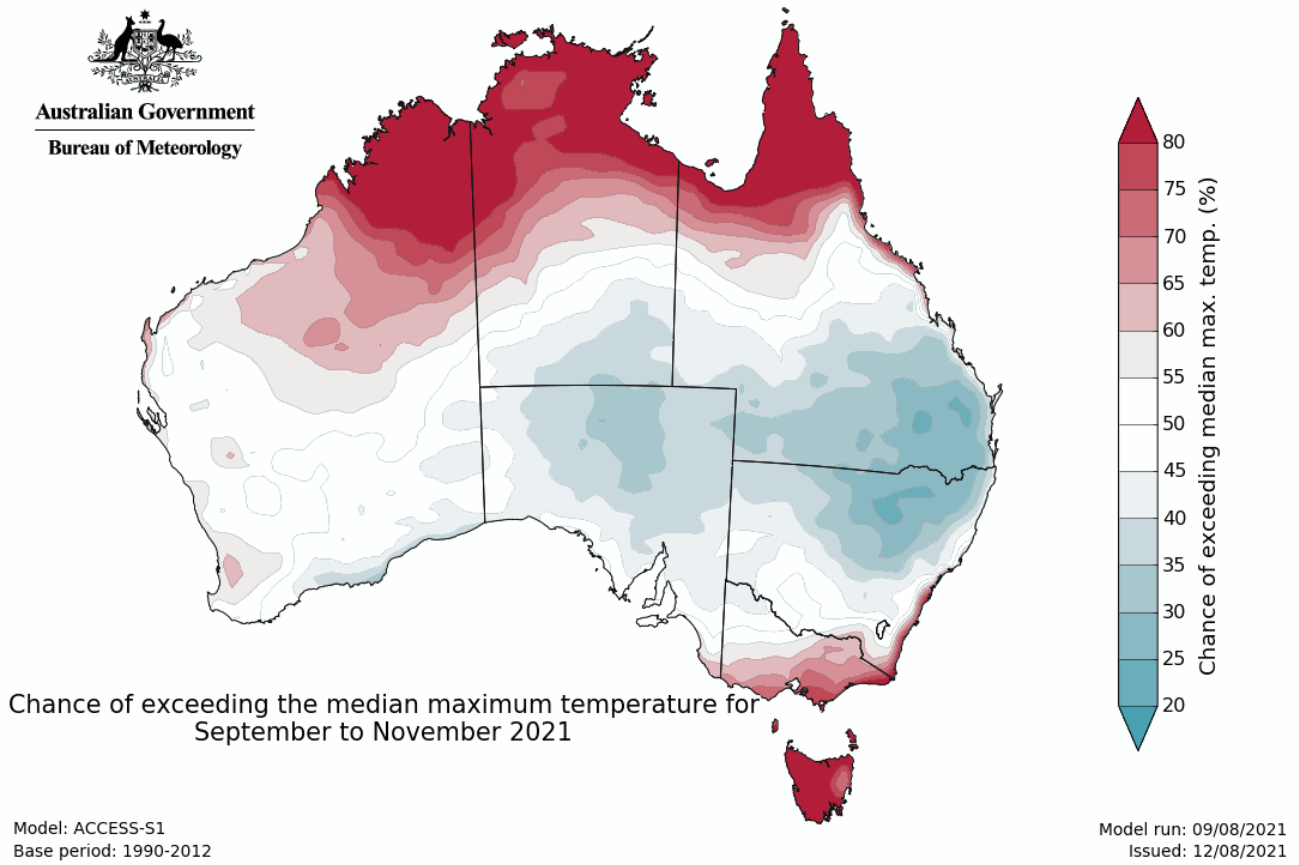


Figure 9. BOM Maximum temperature outlook from September to November 2021

3.3 MDBA Inflow Scenarios for 2021-22

The overall water availability for the River Murray System is determined by the MDBA at the start of each water year (1 June, which is different to South Australia's water year, which starts 1 July) and then at least monthly during the year.

It is not possible to accurately determine inflows to the River Murray System in advance, so the MDBA AOO defines six different inflow scenarios that cover the likely range of conditions that may be experienced during 2021-22. These scenarios are then used to guide general river operations and management actions that may be undertaken. River Murray System inflow scenarios are included in the SA AOP because they form the basis of the outlook for flow to South Australia.

At each assessment point throughout the water year, the volume of water available under the extreme dry and dry inflow scenarios will be progressively allocated to the States. The other scenarios are used to provide indicative quantities of water available to the States to assist in annual planning and management by water managers and customers, should those wetter scenarios eventuate.

The six 2021-22 River Murray System inflow scenarios exclude inflow from the Menindee Lakes, Snowy Scheme, inter-valley trade deliveries and WFTE deliveries from tributaries. The inflow scenarios are based on historic observed inflow, with adjustments to provide a reasonable transition from the observed June 2020 inflow, trending towards the inflow scenario. The June 2020 inflow was 650 GL and is around the 32% Annual Exceedance Probability (AEP*) (i.e. in the wettest 32% of Junes on record). The six scenarios are as follows (taken from MDBA AOO):

1. **Extreme dry** scenario assumes annual River Murray system inflows of 1,500 GL. This is higher than the lowest inflow on record (914 GL in 2006–07). In this scenario, inflows gradually recede from 47th percentile inflows in June 2021 to historic minimum inflows for the remainder of 2021–22.
2. **Dry** scenario assumes River Murray system inflows of about 3,500 GL (inflows recede from 47th percentile inflows in June 2021 to 90th percentile inflows for remainder of 2021–22). This volume is comparable to inflows in 2015–16.

3. **Moderate** scenario assumes River Murray system inflows of about 5,300 GL (inflows recede from 47th percentile inflows in June 2021 to 75th percentile inflows for remainder of 2021–22). This volume is comparable to inflows in 2020–21.
4. **Near average** scenario assumes River Murray system inflows of about 7,800 GL (inflows remain near 50th percentile inflows for remainder of 2021–22). This volume is comparable to inflows in 2012–13.
5. **Wet** scenario assumes River Murray system inflows of about 14,000 GL (inflows improve from 47th percentile inflows in June 2021 to 25th percentile inflows for remainder of 2021–22). This volume is comparable to inflows in 2011–12.
6. **Very wet** scenario assumes River Murray system inflows of about 21,600 GL (inflows improve from 47th percentile inflows in June 2021 to 10th percentile inflows for remainder of 2021–22). This volume is comparable to inflows in 2010–11.

*Annual Exceedance Probabilities (AEP):

- represent the percentage likelihood of a particular inflow, or greater inflow, occurring based on the historic record (i.e. percentage of years with a greater inflow)
- if the probability that an annual inflow will be exceeded in any one year based on historical records (i.e. 90% AEP is a dry year).

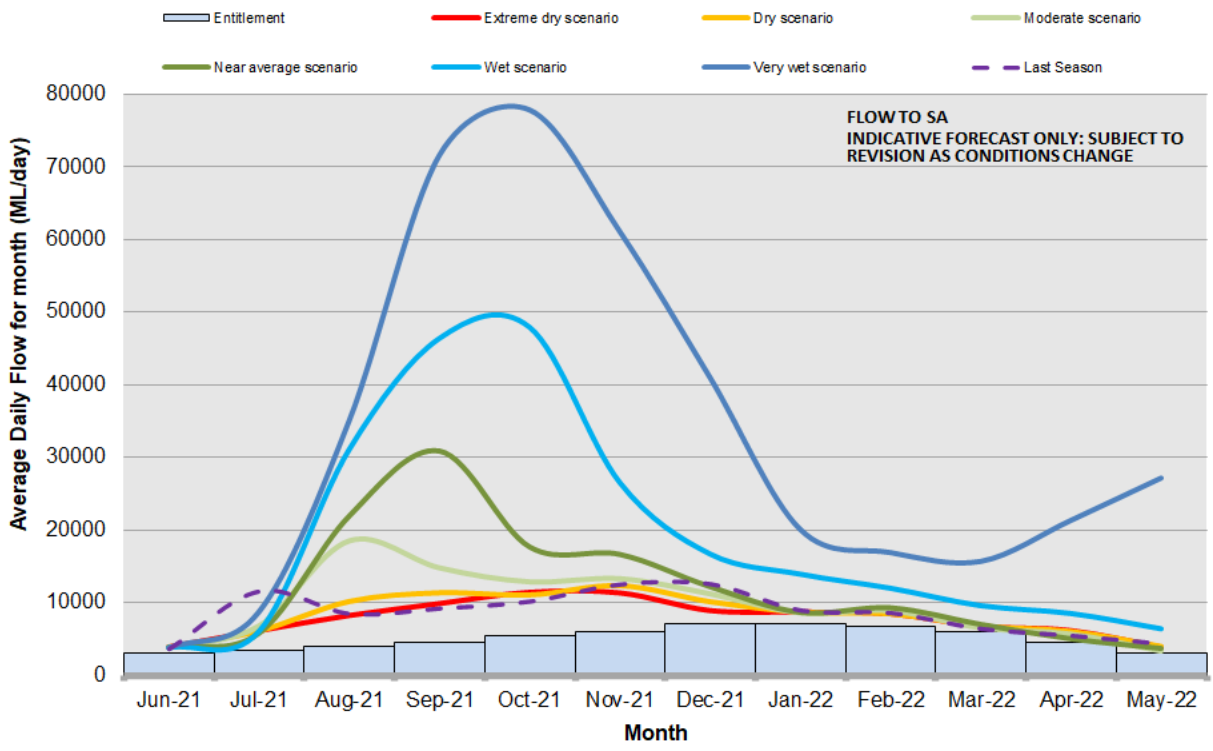


Figure 10. MDBA AOO Average Flow Forecast to SA from 1 July 2021 to 31 May 2022 (July 2021)

3.3.1 Entitlement Flow

The MDBA has advised that South Australia will receive its full Entitlement Flow of 1 850 GL in all scenarios. Accordingly, South Australian irrigators have access to 100% of their water allocation, with no access to private carryover.

3.3.2 Unregulated Flow

Any unregulated flow entering South Australia will be used in accordance with the principles outlined in the *Water Allocation Plan for the River Murray Prescribed Watercourse*. The 2021-22 Water for the Environment Annual Plan for the South Australian River Murray (Department for Environment and Water 2021) (WFTE Annual Plan) outlines potential environmental uses for unregulated flows in South Australia.

In the extreme dry inflow scenario, unregulated flow is not expected to occur.

In the dry and moderate inflow scenarios, modest volumes of unregulated flow may result through small inflow events from upstream.

In the near average, wet and very wet inflow scenarios, large upstream inflow events may result in prolonged unregulated flow. Under the wetter scenarios, there could be a significant flood along the River Murray in South Australia.

3.3.3 Additional Dilution Flow (ADF)

In 2021-22, ADF could be triggered in the early months of the water year under all scenarios however, it may be shorter in duration under the drier scenarios.

3.3.4 Shortfall

A 'system shortfall' occurs when the combined capacity of the system is unable to supply all downstream requirements over the full season. Based on the inflow scenarios for the 2021-22 water year, there is a very low risk of a system wide shortfall for 2021-22. This is due primarily to the significant stored water in the Menindee Lakes and the high Lake Victoria storage level heading into summer available to meet the lower system demands.

A 'delivery shortfall' occurs when actual water use is higher than it was forecast to be when river water is released from storages, weeks earlier, to meet the forecast needs for irrigation and WFTE. The availability of Menindee Lakes reduces required transfers from Hume, potentially lowering river levels along the Murray upstream of the Darling junction. Lower flows provide less buffer against short-term spikes in demand, elevating the risk of delivery shortfall. Avoiding a delivery shortfall will be a focus of operations over summer.

3.3.5 Salinity

Salinity in the River Murray System can become a problem if left unmanaged. The on-going management of measures taken over more than three decades are helping to keep river salinity under control. However, during droughts, salinity in the lower Murray below Lock 1 and in the Darling River can increase and begin to impact water supply for human consumption, industries, and the environment. The likelihood of a high salinity event is low if river flows remain high.

A summary salinity outlook for the six months (from date of publishing) using modelled salinity for each flow scenario indicates that salinity is predicted to remain below the Basin Plan Salinity Targets and River Murray thresholds (**Table 3**). The salinity outlook provides a range of likely river salinities over the outlook period. Usage of the results should focus on the difference between outlook scenarios. The model outputs should not be relied upon as absolute values but more so as an indication of the relative change between scenarios.

Table 3. August 2021 Salinity Outlook – Summary of maximum modelled salinity for each flow scenario compared to the Basin Plan salinity targets (paragraph (5)(c) of Section 9.14 of the Basin Plan (2012)

Site	BP Salinity Target (EC)	Maximum modelled salinity (EC)				Total No. days over BP Salinity Targets and RM threshold (for the 75% AEP scenario)[4]				
		90% AEP	75% AEP	50% AEP	25% AEP	580 EC	600 EC	800 EC	830 EC	1000 EC
River Murray at Lock 6	580	192	189	189	187	0				
River Murray at Morgan[5]	600 / 800	296	295	295	294		0	0		
River Murray at Murray Bridge	830	346	345	345	345				0	
Lake Alexandrina at Milang	1000	693	692	691	691					0

4 Operating considerations for 2021-22

4.1 Environmental Water Delivery

In 2021-22, water for the environment (WFTE) will be delivered to South Australia under all scenarios. Advice received from the MDBA in March 2021, was that South Australia is likely to receive between 230 GL in a very wet scenario and 790 GL in a near average scenario (**Figure 11**) (depending on the inflow scenario that eventuates) of WFTE during 2021-22.

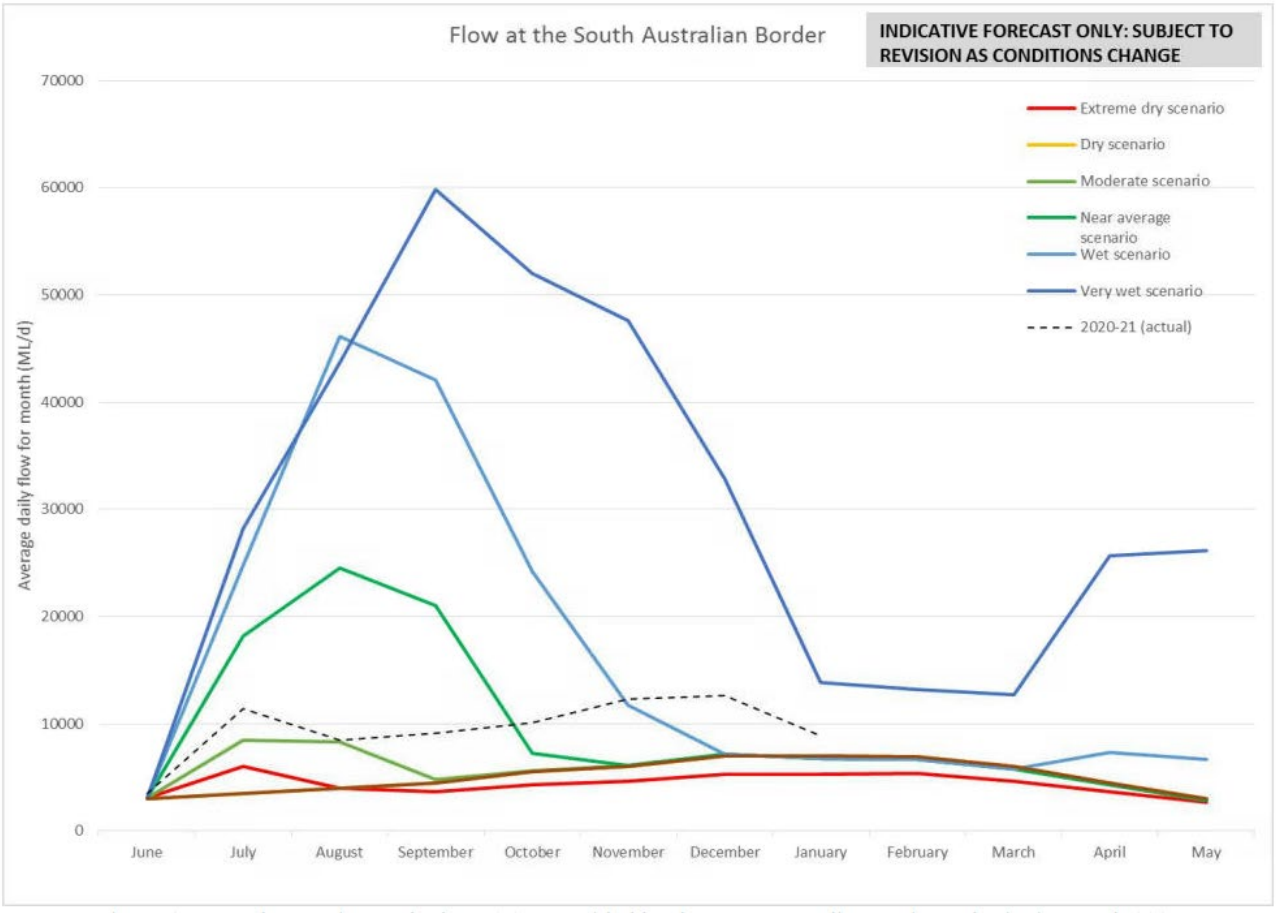


Figure 11. Annual operating outlooks provided by the MDBA in March 2021

River operations will facilitate where possible the delivery of WFTE to support actions identified in the *2021-22 Water for the Environment Annual Plan for the South Australian River Murray* (WFTE Annual Plan) (Department for Environment and Water), such as:

- the operation of regulators within floodplain anabranches, e.g. Chowilla, Pike and Katarapko floodplains
- weir pool manipulations, including raising and some lowering
- river channel and floodplain water via augmentation or unregulated flow or creation of in-channel flow events (e.g. spring pulses)
- pumping and water delivery via infrastructure into temporary wetlands
- wetting and drying of managed pool connected wetlands
- Lower Lakes, Coorong and Murray Mouth (LLCMM) management, including lake level variations, lake cycling, fishway operations and barrage releases.

The WFTE Annual Plan presents the priorities for delivery and use of WFTE under a range of water availability scenarios. This scenario-based approach is based on MDBA AOO and projected WFTE allocations and availability. The planning process includes the development of site based annual environmental watering proposals and a SA multi-site proposal describing the preferences for coordinated delivery of WFTE for all sites. WFTE delivered along the River Murray in SA is coordinated by DEW, with significant involvement from other government agencies, non-government organisations, scientific bodies and community stakeholders (**Table 4**).

Table 4. Environmental watering proposals submitted to the Murray Darling Basin Authority and/or the Commonwealth Environmental Water Office for 2021-22

Watering Proposal	Proponent
Lower Lakes, Coorong and Murray Mouth	SA Department for Environment and Water
SA River Murray Channel and Floodplain	SA Department for Environment and Water
Chowilla, Pike and Katarapko Floodplains	SA Department for Environment and Water
Weir Manipulation	SA Department for Environment and Water
Various wetlands along the River Murray and Lower Lakes	Murraylands and Riverland Landscape Board
Wetlands in the Renmark area	Renmark Irrigation Trust
Banrock Station wetlands	Accolade Wines
Calperum Station lakes and wetlands	Australian Landscape Trust
Various wetlands along the River Murray and Lower Lakes	Nature Foundation

DEW has developed a SA multi-site watering proposal for 2021-22, outlining the optimal delivery of WFTE within the SA River Murray system under a range of scenarios based on the MDBA AOO. Section 3.2 of the *WFTE Annual Plan* sets out the SA multi-site proposal and seeks to align the site-specific watering actions identified, minimise risks, maximise the effectiveness of environmental water delivery and enhance ecological outcomes throughout the system.

Adaptive management practices are undertaken, such as Integrated Operations (IO) to mitigate risks that may have adverse impacts to a third party. A number of tools have been developed to assist with the coordination of events, including the Integrated Operations Strategy (IOS), which supports the decision-making complexity associated with an increasing number of large scale watering opportunities and a hydrological modelling platform (Source Model). Both these tools assist in the development of the annual priorities within the WFTE Annual Plan and the development of the SA multi-site proposal.

The estimated volume of WFTE required to deliver the 2021-22 SA multi-site proposal ranges from approximately 953 GL in the dry scenario to 1 308 GL in the wet scenario (**Table 5**). The SA multi-site volumes represent the volume of WFTE required to be delivered to the South Australian border to support all proposed watering actions in the South Australian River Murray for that scenario. These volumes are in addition to WFTE on South Australian licences (approximately 250 GL), which is delivered as part of South Australia's Entitlement and therefore included in the base flow represented in the AOO. The SA multi-site volumes factor in return flows from site-based watering actions (e.g. Chowilla regulator operation) and their contribution to meeting other downstream demands. The volumes also factor in the contribution that the river channel water demand makes to the LLCMM water demands.

Table 5. Indicative volume of environmental water required per month to deliver the SA multi-site action. Options under each scenario represent alternative demand profiles and are not cumulative

Scenario		Indicative volume (GL) of e-water required per month												Total est.
AOP	Option	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	volume (GL)
Dry	LLCMM Option 1	66	44	70	220	309	101	51	41	32	31	41	40	**1,045**
Dry	LLCMM Option 2	66	44	70	220	309	101	20	41	32	31	10	10	**953**
Moderate	Chowilla Option D	44	78	125	225	309	151	51	40	41	30	40	40	**1,174**
Moderate	Chowilla Option E	44	20	105	229	309	151	51	40	41	30	40	40	**1,101**
Near Average	Option 1			282	400	198	151	50	40	40	30	40	40	**1,272**
Wet	Chowilla Option G		107	237	184	248	222	100	40	40	30	40	40	**1,290**
Wet	Chowilla Option H		115	248	184	248	222	100	40	40	30	40	40	**1,308**

Table 6. Proposed environmental watering actions for SA Priority Environmental Assets and weir pools

Proposed environmental watering actions 2020-21							
	Channel & FP	**Weir Pools**	**Chowilla**	**Pike**	**Katarapko**	**CLLMM**	**Wetlands**
Extreme dry (99%)	↑ QSA in Dec and Jan	No actions proposed	Deliver eWater to 12 wetlands; Manage inflows via Pipeclay & Slayney Cks	Maintain base flow conditions through anabranch	Maintain base flow conditions through anabranch	Small winter flow pulse for Lamprey; Spring & early summer flow to keep lakes >0.7 m AHD; Summer-autumn base flows to keep lakes >0.5 m AHD in autumn	
Dry (90%)	Spring pulse 20GL/day for 8 days (early Nov); <15 GL/day for 45 days (Oct-Nov); >10 GL/day Oct - Dec	As above	As above	↑ infrastructure to get water level of 15 m AHD	↑ infrastructure to get water level of 11.5 m AHD	Winter flow pulse; Spring/summer flows to keep lakes >0.75mAHD; Summer/autumn base flows to keep lakes >0.55m AHD	Deliver eWater to 40 priority wetlands
Moderate (75%)	As above	↑ L2 +0.55 m AHD ↑ L4 +0.3 m AHD# ↑ L5 +0.5 m AHD# ↑L6 +0.4 m AHD	↑ Chowilla Reg to get water level of 19.3 m AHD	↑ infrastructure to get water level of 15.4 m AHD	↑ infrastructure to get water level of 13 m AHD	Spring & summer flows to keep lakes >0.8mAHD; Summer/autumn base flows to keep lakes >0.55m AHD	As above
Near average (50%)	Enhance unreg flows to achieve 30 GL/day for 30 days and 20 GL/day for 31 days	↑ L2 +0.55 m AHD ↑ L4 +0.3 m AHD# ↑ L5 +0.5 m AHD# ↑L6 +0.42 m AHD	↑ Chowilla Reg to get water level of 19.6 m AHD	↑ infrastructure to get water level of 15.8 m AHD	As above	Spring & summer flows to keep lakes >0.8mAHD; Summer/autumn base flows to keep lakes >0.55 - 0.6m AHD	Deliver eWater to 29 priority wetlands
Wet (25%)	Enhance unreg flows to achieve 50 GL/day for 40 days; 30 GL/day in Oct for an additional 3 mths; 20 GL/day in Nov for an additional 5 mths	↑ L2 +0.55 then -0.1 m AHD ↑ L4 +0.3 m AHD# ↑ L5 +0.5 m AHD# ↑L6 +0.42 m AHD	↑ Chowilla Reg to get water level of 19.85 m AHD	As above	As above	Enhance unreg event to slow recession & make high barrage releases in summer; Summer/autumn base flows to keep lakes >0.6 m AHD in autumn	Deliver eWater to 7 priority wetlands

The 2021-22 SA River Murray multi-site watering proposal aims to meet watering objectives at individual sites, as well as provide additional landscape-scale outcomes. The SA multi-site proposal is underpinned by the objectives, targets and Environmental Watering Requirements (EWRs) in the *Long-term environmental watering plan* (LTWP) (Department for Environment and Water, 2020) and the expected outcomes in the *Basin-wide Environmental Watering Strategy* (Murray-Darling Basin Authority, 2019).

Unregulated flows are considered in the WFTE Annual Plan (*Appendix A. Summary of water for the environment actions proposed for 2021-22 under water resource availability scenarios)* as they are built into the AOO scenarios provided by the MDBA that form the basis of site-based planning.

4.2 Weir Pool Manipulations

The SA AOP and associated operational decisions will balance the impacts of weir pool manipulations within South Australia on irrigated agriculture, while acknowledging and exploring other opportunities to manage irrigation extractions within more flexible river management regimes.

Manipulation of weir pool water levels may be implemented for a number of reasons including:

- for environmental benefit including the wetting and drying of riparian areas and adjacent wetlands and floodplains;
- the need to supply downstream water requirements when there are very hot conditions and demands are high;
- to minimise evaporation rates;
- to temporarily store water rather than allow it to pass downstream;
- for construction and maintenance programs; and
- to provide variation in water levels to minimise bank erosion.

Potential weir pool manipulations that are being considered to be undertaken during 2021-22 to achieve environmental outcomes including detail of potential water levels, timing and duration can be seen in the table below (**Table 7**). It also identifies the required flow rate at the South Australian border before a decision would be made to commence the event.

Table 7. Potential Weir Pool Manipulations 2021-22

Weir Pool	Manipulation (m)	Level (m AHD)	Flow Trigger at SA border (GL/day)	Timing	Duration # (days)	Normal Pool Level (m AHD)	Normal Operating Range (m AHD)
Lock 1	No lowering or raising					3.20	3.10 - 3.40
Lock 2	Raise up to 0.55	6.65	>10	Aug - Nov 2021	114	6.10	5.90 - 6.40
Lock 3	No lowering or raising					9.80	9.77 - 10.02
Lock 4	Raise up to 0.30 Independently OR in conjunction with Katarapko Floodplain Operation	13.5	> 4 GL/day over Lock 4	July - Dec 2021	168	13.20	13.16 - 13.50
Lock 5	Raise up to 0.50 in conjunction with Pike Floodplain Operation	16.80	4 GL/day over Lock 5	July - Nov 2021	132	16.30	16.13 - 16.43
Lock 6	Raise up to 0.60. in conjunction with Chowilla Floodplain Operation	19.65	> 8.5 GL/day at the SA border at the peak of the operation	July – Sept 2021	90 to 115	19.25	19.17-19.50

Duration includes the time required to raise and lower the weir pool, which will be undertaken at a rate of approximately 0.02 to 0.05 m/day. The duration is not the time that the weir pool will be held at the maximum raised, or lowered, water level.

Under the extreme dry inflow scenario, WFTE demand is focussed on late spring and summer delivery. This will improve flows through the River Murray channel and deliver water to maintain Lower Lake water 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 maintenance of water levels in the Lower Lakes above 0.4 m AHD and the delivery of water to the Coorong. Water will also be provided to a number of wetlands to provide critical habitat.

Under the dry inflow scenario, 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 the operation of Weir 4. A number of wetlands (at Chowilla and various other locations) will also be watered. Water will also be provided to sustain barrage releases to the Coorong and through the Murray Mouth throughout the remainder of the year.

Under the moderate, near average, wet and very wet inflow scenarios, channel demands are likely to be provided in mid-late spring. This would provide a 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 larger barrage releases throughout spring and into early summer to support outcomes in the Lower Lakes, Coorong and Murray Mouth area. 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. Weir 2 may also be raised under a wet scenario. Pumping to support critical wetlands may also occur across the floodplain, however pumping 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 to priority temporary sites. Wetland watering actions will be undertaken by DEW and Landscape Board staff in conjunction with several non-government organisations including Nature Foundation of South Australia, Renmark Irrigation Trust, Accolade Wines (Banrock Station), and the Australian Landscape Trust.

The WFTE Annual Plan provides detailed actions and is provided here:
https://cdn.environment.sa.gov.au/environment/docs/sa-river-murray-environmental-water-plan-2021-22.pdf

4.3 Lower Lakes, Coorong and Murray Mouth

Barrage operations are guided by the *Barrage Operating Strategy* (BOS) (Department for Environment and Water 2019) and the *Barrage and Water Level Management Policy* (BWLMP) (Department for Environment and Water 2019). The BOS guides the operation of the barrages to achieve ecological outcomes for the Lower Lakes and Coorong. It includes management tools, rules and procedures for the operation of barrages under different operating conditions. The BOS also provides formal decision making processes for transparent and efficient management of barrage operations. The BOS outlines typical Lower Lakes, Coorong and Murray Mouth (LLCMM) barrage management actions considering water level and availability (*Table 1. Pp. 10 BOS*).

A summary of the proposed LLCMM actions for the 2021-22 water year, as submitted to SCBEWC in 2021, are shown below (**Table 8**).

Table 8. Proposed LLCMM actions for water year 2021-22

Water Availability Scenario	Watering action description	Delivery Details		
		Trigger flow (ML/d at a gauge or other trigger)	Vol (GL)	Optimal timing & alternate (if flexible) (months)
Extreme Dry – 99%	**Action A:** Small winter flow pulse for lamprey and congolli migration (Goolwa prioritised) **Action B:** Spring and early summer flows to maintain lake levels >0.7 m AHD (maintain lakes fish and frog habitat) and to maintain flows at all fishways (YOY congolli and common galaxias migration) **Action C:** Summer/ autumn base flows to maintain autumn lake levels >0.5 m AHD and to maintain flows at all fishways	QSA below entitlement	**Action A:** 30 GL **Action B:** 440 GL **Action C:** 190 GL **TOTAL additional QSA: 660 GL**	**Action A:** July 2021 **Action A:** Sep to Dec 2021 **Action B:** January to May 2022
Dry – 90%	**Action A:** Winter flow pulse for lamprey and congolli migration (Goolwa, Mundoo and Tauwitchere prioritised) **Action B:** Spring and early summer flows to maintain lake levels >0.75 m AHD (maintain lakes fish and frog habitat), maintain continuous flows at all fishways (YOY congolli and galaxias migration), and >500 ML/d attractant flow prioritised from Tauwitchere (North Lagoon ecology – estuarine fish, invertebrate and waterbird habitat) **Action C:** Summer/ autumn base flows to maintain autumn lake levels >0.55 m AHD and to maintain flows at all fishways		**Action A:** 100 GL **Action B:** 450 GL **Action C:** 230 GL **TOTAL additional QSA: 780 GL**	**Action A:** Jul-Aug 2021 (alt Jun-Jul) **Action B:** Sept – Dec 2021 (alt Oct –Jan) **Action C:** Jan-Jun 2022
Moderate – 75%	**Action A:** Spring and early summer flows to maintain lake levels >0.80 m AHD (enhance lakes fish and frog habitat), maintain continuous flows at all fishways (YOY congolli and galaxias migration), and >1000 ML/d attractant flow prioritised from Tauwitchere (North Lagoon ecology – estuarine fish, invertebrate and waterbird habitat) and Goolwa (black bream recruitment) (70:30 flow split Tauwitchere: Goolwa) **Action B:** Summer/ autumn base flows to maintain autumn lake levels >0.55 m AHD and to maintain flows at all fishways		**Action A:** 580 GL **Action B:** 240 GL **TOTAL additional QSA: 820 GL**	**Action A:** Sept-Dec 2021 (alt Oct-Jan) **Action B:** Jan-Jun 2022
Near Average – 50%	**Action A:** Spring and early summer flows to maintain lake levels >0.80 m AHD (enhance lakes fish and frog habitat), maintain continuous flows at all fishways (YOY congolli and galaxias migration), and >2000 ML/d attractant flow prioritised from Tauwitchere (North Lagoon ecology – estuarine fish, invertebrate and waterbird habitat) and Goolwa (black bream recruitment) (80:20 Tauwitchere: Goolwa) **Action B:** Summer/ autumn base flows to maintain autumn lake levels 0.55-0.60 m AHD, to maintain continuous fishway flows and provide pulsing opportunities from Tauwitchere		**Action A:** 710 GL **Action B:** 240 GL **TOTAL additional QSA: 950 GL**	**Action A:** Oct-Dec 2021 (alt Nov-Jan) **Action B:** Jan-Jun 2022
Wet – 25%	**Action A:** Flows on end of unreg event to slow recession and maintain higher barrage release volumes through summer – spring and summer outcomes for both North and South Coorong ecology **Action B:** Summer/ autumn base flows to maintain autumn lake levels >0.60 m AHD, to maintain continuous fishway flows with attractant flow and provide pulsing opportunities from Tauwitchere		**Action A:** 670 GL **Action B:** 240 GL **TOTAL additional QSA: 960 GL**	**Action A:** Oct-Dec 2021 (alt Nov –Jan) **Action B:** Jan-Jun 2022
Very Wet – 10%	**Action A:** Flows on end of unreg event to slow recession and maintain higher barrage release volumes through summer **Action B:** winter flow pulse for lamprey and congolli migration		**Action A:** 500 GL **Action B:** 120 GL **TOTAL additional QSA: 620 GL**	**Action A:** Nov 2021-Mar 2022 **Action B:** June 2022

To achieve a targeted objective(s), there may be multiple smaller-scale operational actions that can be undertaken. Many of these operational actions are outlined in the CEWO/DEW 2021-22 watering schedule, and in subsequent 3-month forward planning documents that DEW produce for the CEWO. Actions include:

- Seasonal lake level manipulation
- Rapid lake level manipulation for salinity export from Lake Albert (i.e. lake level cycle)
- Targeted seasonal barrage releases to achieve outcomes in either the Murray estuary (i.e. black bream recruitment downstream of Goolwa barrage) or the Coorong (i.e. high flows from Tauwitchere barrage to maintain water levels to support *Ruppia tuberosa* recruitment).
- Pulsing of releases from Tauwitchere barrage under certain wind, tide and swell conditions to reduce Coorong salinity levels
- Flow releases from Salt Creek to the Coorong South Lagoon, to provide fish migration between the Coorong and the South East drainage network, and for salinity reduction in the Coorong South Lagoon.

The WFTE Annual Plan provides detailed actions and is provided here:
https://cdn.environment.sa.gov.au/environment/docs/sa-river-murray-environmental-water-plan-2021-22.pdf

4.4 Water Quality

Operation of floodplain regulators may introduce water quality risks (salinity, low dissolved oxygen, algae) and are monitored as per event plans to ensure that measured interventions can be undertaken.

During summer blackwater events or summer algae outbreaks are more likely to occur in the SA River Murray. To mitigate those outbreaks originating from upstream of the SA border an option to utilise Lake Victoria is available to assist with diluting blackwater and bringing algae levels back within acceptable threshold limits. ADF together with Environmental watering during the warmer months, such as spring flows also assist in lowering water temperature, limiting stratification, increasing mixing and therefore reducing algae outbreaks.

Salinity levels are expected to remain below targets for Lock 6, Morgan and Murray Bridge, assisted by unregulated flow.

Irrigation extraction below Lock 1 requires the weir pool level to be maintained above +0.50 m AHD to generally retain access by irrigation pumping or diversion infrastructure although, at this level, water quality may deteriorate around the Lower Lakes.

Refer to the *Objectives and Outcomes for Operating the River Murray in South Australia* (Department for Environment and Water 2021) (*Section 8. Water Quality and Salinity*) for more detail on water quality targets and salinity obligations.

4.5 Deferral, Storage and Delivery of SA Storage Right

In accordance with the *South Australian River Murray Water Resource Plan* (Department for Environment and Water 2019), South Australia aims to have in storage up to an equivalent of 150 percent (306 GL) of its annual CHWN, in case it is required ahead of any year where the full Entitlement volume of 1,850 GL will not be available.

Any proposed changes to the delivery of monthly Entitlement Flow to South Australia, and the use of South Australia's Storage Right under Schedule G, will be identified through the Deferred Water Storage and Delivery Plan, which is updated on a monthly basis.

4.5.1 Deferral

If South Australia receives its full Entitlement Flow of 1 850 GL during 2021-22 up to 50 GL of Entitlement Flow will be considered for deferral for CHWN.

South Australia is not considering deferring a portion of its Entitlement Flow for private carryover in 2021-22 if conditions remain wet. The 101.4 GL stored for private carryover is considered sufficient to provide private carryover requirements for a few years, should it be required.

Deferral and storage of Entitlement Flow will only be undertaken if conducive to do so. It will be necessary to balance the needs of all water users. No deferral is assumed in the dry scenarios.

4.5.2 Delivery

With full SA Entitlement, it is not expected that South Australia will request delivery of any of its deferred water.

4.6 Shortfall Management

The MDBA in collaboration with the NSW, Victorian and South Australian governments (via the Water Liaison Working Group (WLWG)) will review operations of the River Murray system throughout the year. If at any stage a material risk of a shortfall is identified, the MDBA will refer the matter to WLWG, and if advised by WLWG will seek guidance from Basin Officials Committee to determine appropriate arrangements for managing shortfalls.

DEW is developing a policy for shortfall management which is anticipated to be completed in 2022.

5 Glossary of Terms Used

Additional Dilution Flow (ADF): is released to South Australia at a rate of 3 GL/day once storage volumes in Hume and Dartmouth and the Menindee Lakes Scheme exceed specified triggers. Delivery of ADF continues while the trigger levels are maintained.

Annual Exceedance Probabilities (AEP): represents the percentage likelihood of a flow, or greater flow, occurring based on the historic record

Conveyance Reserve: for a year, means water set aside by the MDBA to supply conveyance water for the following year, determined in accordance with clause 102 D of the *Murray-Darling Basin Agreement 2008*

Conveyance Water: is the volume required to physically deliver water to where it is needed for use such as CHWN.

Critical human water needs (CHWN): are the minimum amount of water required to meet core human consumption requirements in urban and rural areas; and those non-human consumption requirements that a failure to meet would cause prohibitively high social, economic or national security costs

Deferred water: South Australia requests the Murray-Darling Basin Authority to not deliver a portion of its Entitlement flow in any month and to store that water in the interstate storages (deferred water). South Australia can request this water to be delivered in a subsequent dry year

Entitlement Flow: minimum monthly River Murray flow to South Australia specified in clause 88 of the Murray-Darling Basin Agreement 2008

Environmental flow: any change to the flow regime that is intended to maintain and improve river health. It seeks to make better use of the water currently available in the system, as well as any new water made available, for the environment

Gigalitre (GL): 1 gigalitre is a thousand million (1 000 000 000) litres or 1 000 megalitres. 1 gigalitre would cover Adelaide oval to a depth of 50 metres (about a 15-storey building)

Integrated Operations (IO): a term used to describe the coordination of water delivery to SA with large scale environmental watering involving infrastructure operation, to manage the potential risks of adverse impacts and, where possible, achieve cumulative benefits across the SA River Murray.

MDBA Annual Operating Outlook: Murray-Darling Basin Authority's *River Murray System Annual Operating Outlook 2020-21*

Megalitre (ML): 1 megalitre is one million litres (about half an Olympic swimming pool)

Private carryover: means a volume of allocation made available in a year for use under an entitlement and not used in the year, but that may be made available to the holder of the entitlement for use in a subsequent dry year. (MDBA Agreement clause 2)

Salinity: concentration of salts in soil or water, usually sodium chloride

SA Storage Right: South Australia's limited right to defer a portion of its Entitlement Flow and store it in the Murray-Darling Basin storages for delivery in a future dry year

SA Operating Plan: South Australia's River Murray Annual Operating Plan 2018-19

The Agreement: the Murray-Darling Basin Agreement 2008 (Water Act 2007 (Cwlth))

Unregulated flow: flow to South Australia that cannot be captured (regulated) in Lake Victoria. Unregulated flow is preserved for the purpose of achieving environmental outcomes unless required in emergency circumstances

Water access entitlement holder: a natural person or body corporate that holds the right to a share of the consumptive pool for the River Murray Prescribed Watercourse
Weir pool: water that is held back by the presence of a weir

Wetland: land inundated with temporary or permanent water that is usually slow moving or stationary, shallow and either fresh, brackish or saline

6 Glossary of Acronyms Used

ADF	Additional Dilution Flow
AEP	Annual Exceedance Probabilities
AHD	Australian Height Datum
AOO	Annual Operating Outlook
BOC	Basin Officials Committee
BOM	Bureau of Meteorology
CHWN	Critical Human Water Needs
DEW	Department for Environment and Water
EC	Electrical Conductivity
FSL	Full Supply Level
GL	Gigalitres
m	metres
MDBA	Murray-Darling Basin Authority
NOR	Normal Operating Range
NPL	Normal Pool Level
ML	Megalitres
PIRSA	Primary Industries and Regions South Australia
PPT	Parts per Thousand
RMOWG	River Murray Operations Working Group
SA AOP	South Australia's River Murray Annual Operating Plan
SA Water	South Australian Water Corporation
WFTE	Water for the Environment
WLWG	Water Liaison Working Group

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