Australian Government

MURRAY–DARLING BASIN AUTHORITY

River Murray System Annual Operating Outlook 2022–23 water year (December 2022 update)

2022–23 water year

End December 2022 update

March 2023

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Acknowledgement of the Traditional Owners of the Murray–Darling Basin
The Murray−Darling Basin Authority pays respect to the Traditional Owners and their Nations of the Murray−Darling Basin. We acknowledge their deep cultural, social, environmental, spiritual and economic connection to their lands and waters.

The guidance and support received from the Murray Lower Darling Rivers Indigenous Nations and our many Traditional Owner friends and colleagues is very much valued and appreciated.

Aboriginal people should be aware that this publication may contain images, names or quotations of deceased persons.

Contents

1 Introduction

The 2022–23 River Murray System Annual Operating Outlook (AOO) published in August 2022 provided the context and descriptions of potential operations for the River Murray System under 'extreme dry' to 'very wet' conditions under a range of assumptions including system losses and demands.

In accordance with clause 10(3) of the *Objectives and Outcomes for River Operations in the River Murray System (The O&O)*, this AOO has been reviewed and assumptions refined where necessary. Scenarios in this updated outlook have been prepared by the Murray–Darling Basin Authority (MDBA) with input from the Australian Government and the states of New South Wales, Victoria, and South Australia through MDBA's Water Liaison Working Group (WLWG).

The O&O stipulates that an update to the AOO should occur following the end of October. However, due to extended and significant flooding across the Murray-Darling Basin in the latter half of 2022, the update to the AOO was delayed until the main River Murray flood peak passed downstream of the South Australian border.

Flooding is ongoing on the Darling River at Menindee, Pooncarie and Burtundy and on the River Murray in South Australia. Information on flood levels in the lower Darling is provided by the Bureau of Meteorology. WaterNSW continue to undertake flood operations at the Menindee Lakes. Information on the management of the Lakes and releases into the Lower Darling River is provided by WaterNSW and will not be displayed in this updated AOO. Information on flood warnings in South Australia is provided by the SA State Emergency Service.

This AOO will summarise the River Murray system conditions to the end of December 2022, then forecast conditions from January to May 2023 under the *Serially Correlated Minimum* inflow scenario ('extreme dry') and the 10th percentile inflow and demand scenario ('very wet'). These inflow scenarios will provide an envelope of the likely operating range for the remainder of the 2022–2023 water year.

This document is the *AOO End of December Update.* As this document is an update, much of the context and background on the modelling and scenario approach and governance framework contained in the original AOO (published in August 2022) is still relevant.

2 Wet June to December 2022

The water year to date has been dominated by increasingly wet conditions, particularly between August and November 2022, where the four-month rainfall decile was the highest on record for the majority of the southern Basin (Figure 1 and Figure 2). The Bureau of Meteorology (the Bureau) report that the La Niña, negative Indian Ocean Dipole, positive Southern Annular Mode and warmer than average waters around Australia all contributed to the wetter conditions observed across the Basin this winter/spring.

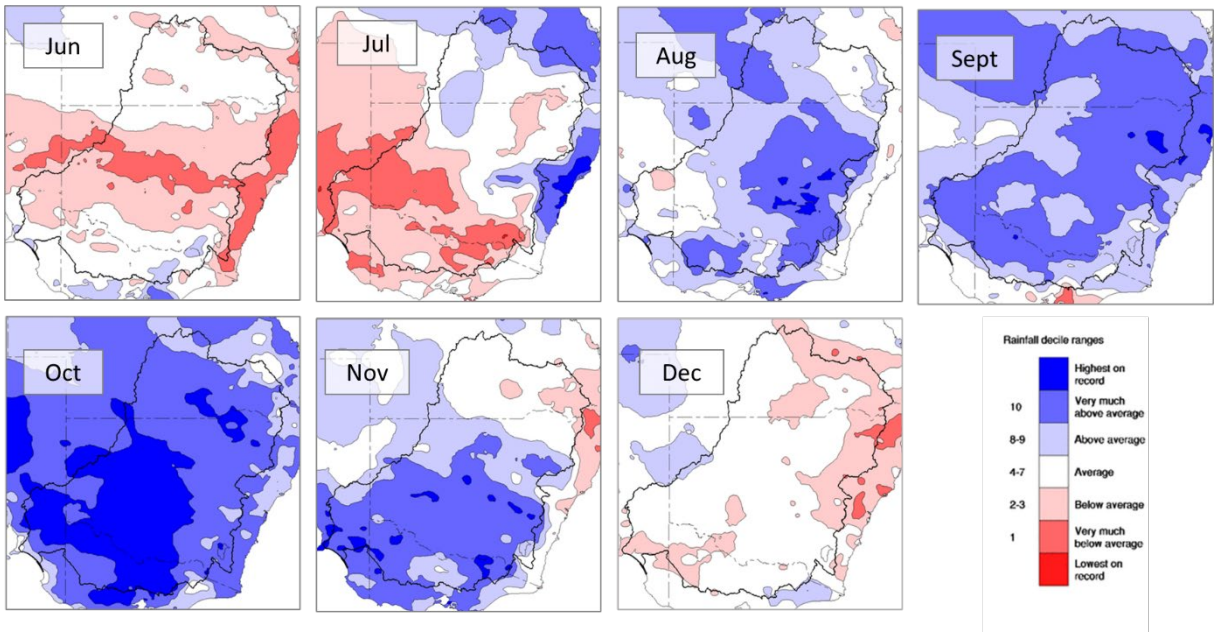

Figure 1 Monthly rainfall deciles in the Murray–Darling Basin for June to December 2022. (Source: adapted from Bureau of Meteorology).

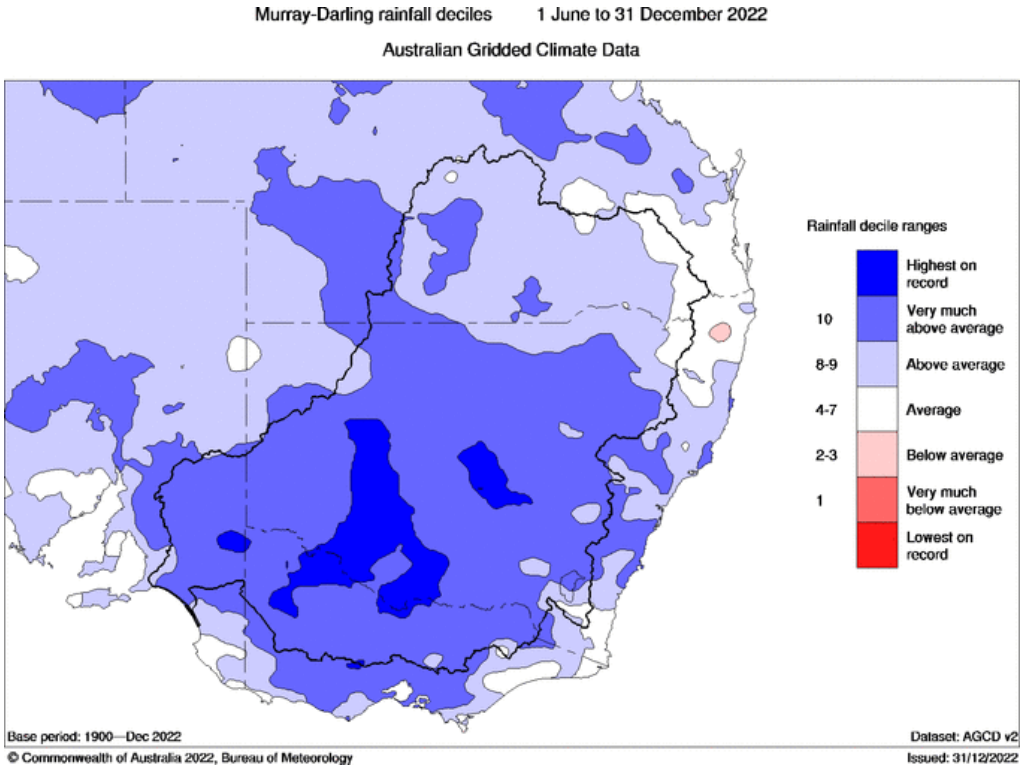

Figure 2 Four-month rainfall deciles for August to November 2022. (Source: Bureau of Meteorology)

The original AOO published in August 2022 noted that flooding across the River Murray system was a key risk for winter and spring 2022–23. River operations focused on management of airspace at major storages between June and December 2022. Major tributaries were also experiencing floods and airspace management at headwater storages. Major flood levels were exceeded across the River Murray system. By late December 2022, the major flood peak in the River Murray system had passed across the South Australian border, with the peak flow passing the Lower Lakes, Coorong and Murray Mouth in mid-January 2023.

Inflow to the River Murray system tracked from the 25% AEP (see note below Table 1) or 'wet' scenario in June 2022, to the highest inflows on record (in 127 years) in November and December (Table 1). Overall, between June and December 2022, River Murray system inflows were in the top 3% of years on record (Figure 3 and Figure 4).

Table 1 Monthly inflows (GL) and annual exceedance probabilities (AEP), June to December 2022.

Month	Dartmouth unregulated inflow	Hume unregulated inflow	River Murray system inflow*	Menindee Lakes inflow
June–Aug 2022	414 GL (24% AEP**)	1,227 GL (25% AEP)	4,046 GL (35% AEP)	2,145 GL (3% AEP)
September 2022	248 GL (11% AEP)	788 GL (10% AEP)	2,797 GL (14% AEP)	639 GL (7% AEP)
October 2022	257 GL (12% AEP)	960 GL (8% AEP)	5,136 GL (2% AEP)	832 GL (5% AEP)
November 2022	404 GL (0% AEP***)	1,429 GL (0% AEP)	5,523 GL (0% AEP)	842 GL (2% AEP)
December 2022	103 GL (8% AEP)	366 GL (4% AEP)	2,750 GL (0% AEP)	1,073 GL (1% AEP)
Total	**1,426 GL (3% AEP)**	**4,770 GL (3% AEP)**	**20,252 GL (3% AEP)**	**5,531 GL (2% AEP)**

*Excluding Snowy Hydro inflows, environmental inflows from tributaries, Darling River inflows and inter–valley trade (IVT).

** Annual exceedance probability (AEP) identifies the percentage of years over the period of record (127 years) that exceed the inflows recorded in the current period. I.e., inflows of 25% AEP indicates that 25% of years over the last 127 years recorded inflows were higher than inflows in the current period.

***AEP of 0% indicates the wettest year on record for that same period, i.e., November 2022 was the highest November inflow in 127 years of record.

Releases, for the purpose of managing airspace in **Dartmouth Reservoir** commenced in early August 2022. Inflows upstream of the storage increased such that flow over the Dartmouth spillway started in September and continued until mid-December 2022. Excluding minimum flow requirements, by the end of December, approximately 1,080 GL or nearly 30% of the total storage capacity was released from the storage via outlet valves and the spillway. The peak storage inflow reached around 40 GL/day in mid-November, with a peak downstream flow of nearly 22 GL/day at Colemans, and 32 GL/day at Tallandoon, which includes inflows from the Snowy Creek and other local tributaries. This flow resulted in moderate flooding on the Mitta Mitta River at Tallandoon.

At **Hume Dam**, airspace management releases started in May 2022 and continued into early January 2023. Through this period, around 6,450 GL was released to manage airspace (excluding minimum flow requirements and small releases of water for the environment in July and August 2022). This is over twice the storage capacity of Hume Dam. A number of significant upstream peaks were mitigated. The highest upstream inflow was near 150 GL/day and the highest release downstream reached 95 GL/day, both occurring during November which was the highest November inflow to Hume on record.

At Albury, the river remained above minor flood level from late September to the end of November 2022. During this period moderate flood level was exceeded for 20 days during November. The major flood level was exceeded at Albury for around 6 hours in mid-November, as a result of airspace release from Hume, inflow from the Kiewa River and local rain and runoff. A number of significant events were also managed through **Yarrawonga Weir**, with Ovens River inflows contributing to flood management releases. There is limited capacity to mitigate flood peaks through Yarrawonga Weir. The highest release rate was 178 GL for 8 hrs in mid-November.

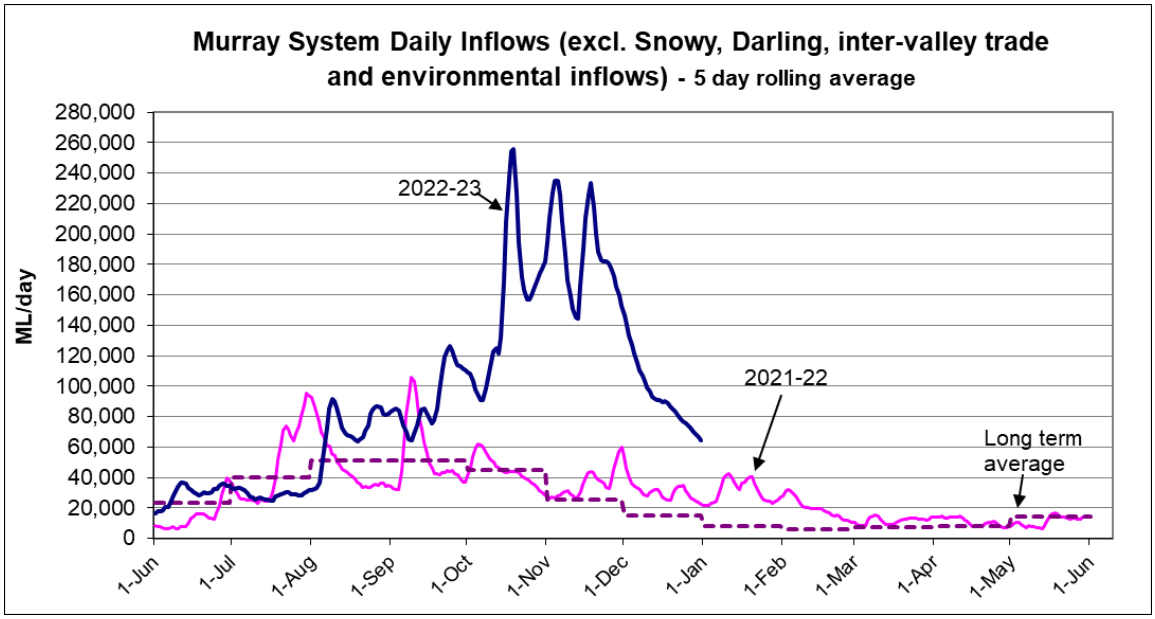

Figure 3 Murray system **daily** inflows (excluding Snowy Hydro, Darling River, inter-valley trade (IVT) and environmental inflows) for the 2022–23 water year to end December compared to long-term average inflows and the previous water year.

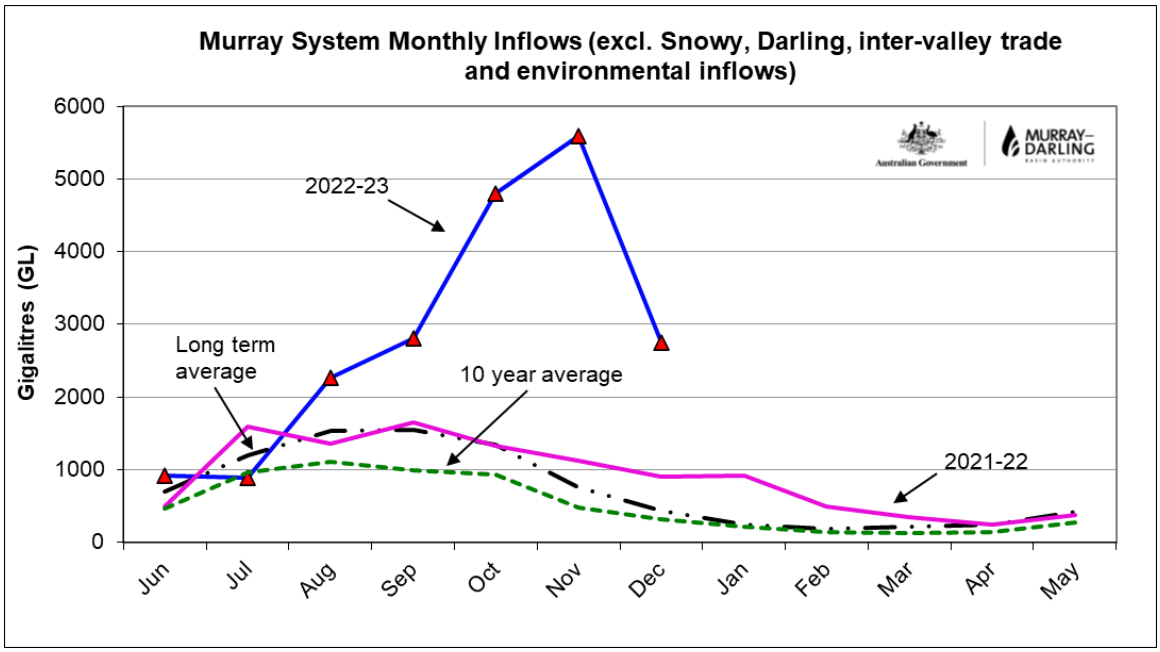

Figure 4 Murray system **monthly** inflows (excluding Snowy Hydro, Darling River, inter-valley trade (IVT) and environmental inflows) for the 2022–23 water year to end December compared to long-term average inflows and the previous water year.

Airspace management, or flood operations, at Dartmouth Reservoir and Hume Dam ceased in early January 2023 with inflows receding into summer. Despite regulated conditions returning at Dartmouth, Hume and Yarrawonga Weir, storages remain high for this time of year and there is a chance that further rainfall and inflows require releases to recommence to manage storage airspace.

WaterNSW is responsible for managing airspace and releases at the **Menindee Lakes**, including flows in the lower Darling River during floods. Inflows to the Menindee Lakes, for June to December 2022 were in the top 2% of the 127 years of records, with 5,537 GL reaching the Lakes (Table 1). Information regarding the management of the Menindee Lakes and flow in the lower Darling River will be provided by WaterNSW.

Significant inflows occurred in the **Goulburn and Murrumbidgee systems**. Total inflow from the Goulburn system was approximately 4,000 GL between June and December 2022 (excluding water for the environment delivered to the River Murray). The peak recorded inflow from the Goulburn River reached 83 GL/day at McCoy's Bridge gauge in mid-October following a significant rain event that resulted in widespread flooding in north-east Victoria. It is estimated that a similar volume bypassed the gauge and contributed to high flows in the River Murray. For more information see the Goulburn Murray Water summary of the October 2022 floods. Unregulated flows from the Goulburn system continued into January 2022 at low rates.

Airspace management of upper Murrumbidgee storages and significant rainfall across the Murrumbidgee catchment resulted in almost 5,000 GL flowing past Balranald Weir to the River Murray between June and December 2022. Murrumbidgee River inflows peaked at 53 GL/day in early December, before receding.

Significant flood peaks were observed across the River Murray system. River Murray weirs from Torrumbarry Weir to Lock 1 were removed during high flows. By December 2022, the Torrumbarry Weir had been reinstated, with other weirs to be reinstated as high flows recede below the required thresholds.

Unregulated flows continued across the River Murray system between June and December 2022. As of 1 January 2023, the reach between Hume Dam and Yarrawonga Weir returned to regulated conditions, with downstream reaches in the River Murray and Edward River likely to become regulated in early 2023 without significant rainfall. Unregulated conditions in the lower River Murray system are anticipated to continue well into 2023.

MDBA active storage as of 31 December 2022 was 8,740 GL (102% capacity) (Figure 5) which is above the maximum active storage at Full Supply Level (FSL) due to the surcharging at Menindee Lakes.

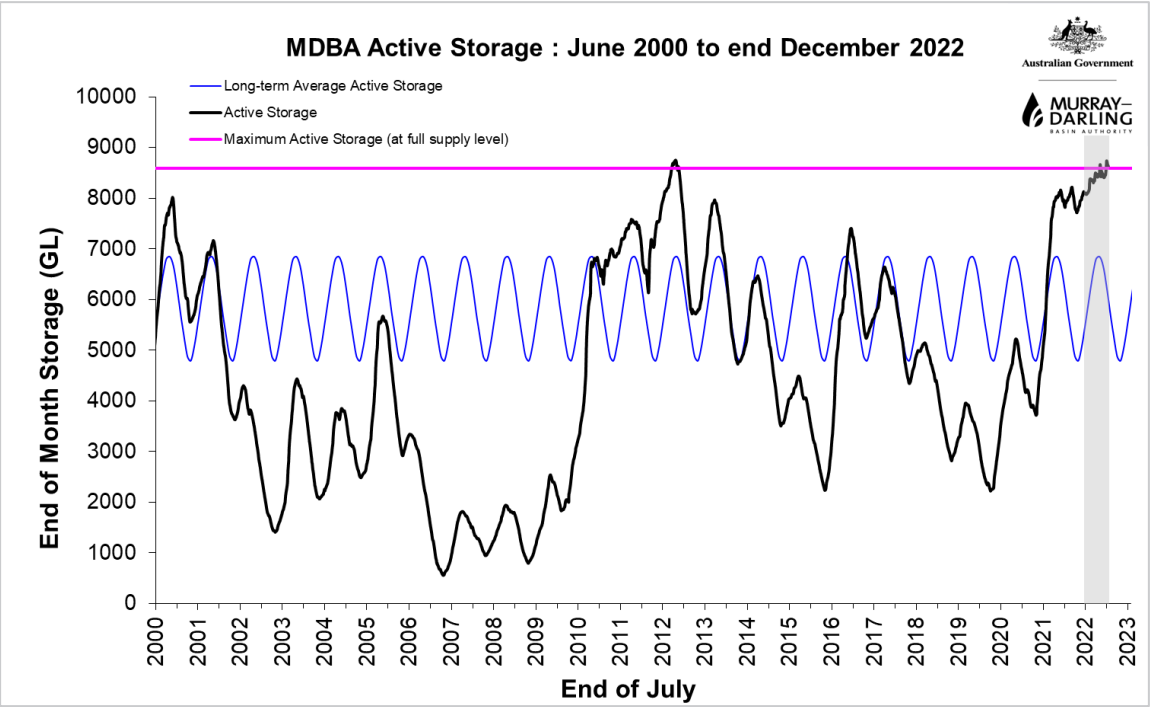

Figure 5 MDBA active storage for the period 1 June 2000 to 31 December 2022.

Water quality issues were identified as a key risk in the original AOO published in August 2022, particularly in combination with flooding areas not usually reached in normal regulated years. Low dissolved oxygen (DO) and blackwater were reported in the River Murray from late spring. A snapshot of threats to water quality in the Murray–Darling Basin are provided on the MDBA's website.

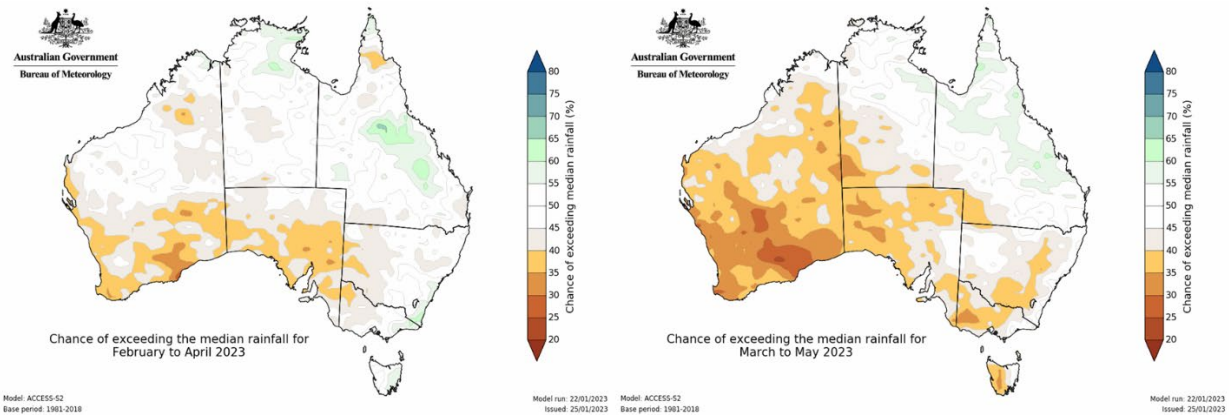

Figure 6 Outlook for wetter than average conditions for the Murray–Darling Basin from February to April 2023 (left) and March to May 2023 (right) (Source: Bureau of Meteorology).

The latest climate outlook issued by the Bureau on 25 January 2023 reports that average rainfall is likely across the Basin for the period February to April 2023, with a possible trend to drier conditions from March to May 2023 (Figure 6). This forecast reflects the outlook for several climate drivers, including a weakening La Niña and warm ocean temperatures around Australia.

3 Revised scenario assumptions

The original scenarios were based on a range of assumptions and the best information available at the time they were developed. Many of these assumptions have proved to be appropriate thus far through the water year; however, some have also required adjustment due to new circumstances arising. Some of the key assumptions, assumptions changes and behaviour to date are shown in Table 2.

Table 2: Key changes and updates to assumptions in the end December Annual Operating Outlook.

Assumption	Original value(s) across the Extreme Dry to Very Wet Scenarios	Updated value(s) across the Extreme Dry and Very Wet scenarios
Sharing rules at end May 2022	Tier 1	Tier 1
NSW consumptive annual use	960 – 1,860 GL	630 – 1,350 GL
Victorian consumptive annual use	860 – 1,490 GL	550 – 1,060 GL
NSW consumptive use to date*	–	320 GL
Victorian consumptive use to date*	–	298 GL
NSW Held Environmental Water usage to date**	–	113 GL
Victorian Held Environmental Water releases to date**	–	227 GL
Environmental water delivered to SA***	350 – 930 GL	400 – 560 GL
Environmental water delivered to SA to date***	–	366 GL
Conveyance upstream of SA	1,100 – 3,060 GL	2,000 – 3000 GL
Supply of Additional Dilution Flow to South Australia	580 – 1,100 GL	1,100 GL******
Goulburn IVT delivery	0 – 285 GL	0 – 40 GL
Murrumbidgee IVT delivery	0 – 200 GL	0 – 20 GL

* Irrigation use to date is provisional data that will change following hydrographic review.
** Includes Murray and tributary entitlement used upstream of SA *and* return flow to SA. *Does not* include BM EWA entitlement that does not have returns downstream of Barmah–Millewa Forest.
*** Return flow from water released from Hume Reservoir (including environmental RMIF) and tributary storages.
**** Additional Dilution Flow to South Australia will continue to end May 2023 in all scenarios.

Southern Basin system states reached full allocations at end December.

4 Scenario Graphs

Compared with the scenarios presented in the original AOO (published in August 2022), River Murray System inflows have tracked above the **Very Wet** (10% AEP) scenario, with flooding and extended unregulated flow conditions along the River Murray. As inflows increase above 10% AEP the volume of inflow becomes significantly greater. Therefore, when observed conditions are compared with those presented in the original AOO, the observed conditions at key sites deviate greatly above the 'very wet' scenario.

The first figure in each section below presents the same information as the original AOO with an additional line showing how river flows (as monthly averages) and storage levels (at the end of each month) have tracked against the original outlook.

The second figure shows the updated scenarios based on the end of December data and illustrates what the average daily river flow and storage levels may be under the serially correlated minimum 'extreme dry' (highest on record inflows in December recede to 99% AEP) and 'very wet' (10% AEP) scenarios over the remainder of the 2022–23 water year (January to May 2023).

The actual conditions that occur during the remainder of the 2022–23 water year will not follow a particular scenario. They are likely to lie within the envelope described by the scenarios in this updated AOO. If inflows are significantly wetter, observed conditions may be greater than the scenarios. The information presented in the figures below provides an indication of the potential range of river operations that may occur in the months ahead.

The storage figures show the *end of month* storage volume. Operational decisions that influence the end of month storage volume can change within months in response to conditions or management objectives. This is particularly the case during the period of flood operations when storage decisions changed in response to rainfall and inflows. Similarly, river flows are presented as the *average daily rate* across the month. Within each month, daily river flows will vary.

The potential for damage to infrastructure to occur during high flows is a risk to system operations. Damage may not be identified until flood levels recede and river conditions return to normal. It can take weeks to months for flood waters to fully recede and flood damaged structures to be properly assessed before remedial works can take place, if required. This AOO assumes that any remedial works following flood recession will not impact on the normal operation at storages, locks and weirs across the River Murray. Remedial works, if needed, may require different operating strategies to those presented in this AOO.

4.1 Dartmouth Dam

Releases to manage airspace (also referred to as 'pre-releases') started at Dartmouth Dam in August 2022, with releases initially targeting channel capacity on the Mitta Mitta River, measured at Tallandoon (3.4 m or ~10,000 ML/day). Rainfall and inflows increased upstream, and the storage surcharged in September with flow commencing over the Dartmouth spillway. Figure 7 and Figure 8 show that storage volume and releases tracked above the 'very wet' scenario throughout June to

December 2022. Flow over the spillway ceased in December as inflows receded. Airspace releases were then managed through the valves to manage Dartmouth Dam to 99% capacity.

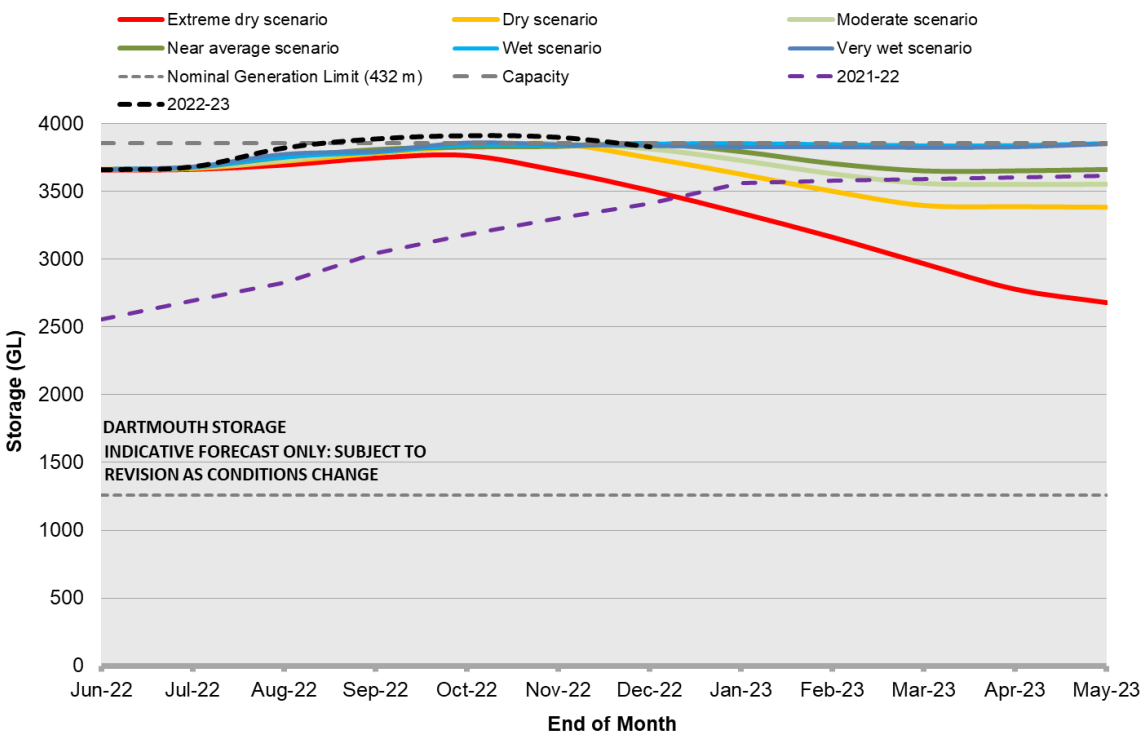

Figure 7 Original Dartmouth Dam storage outlook

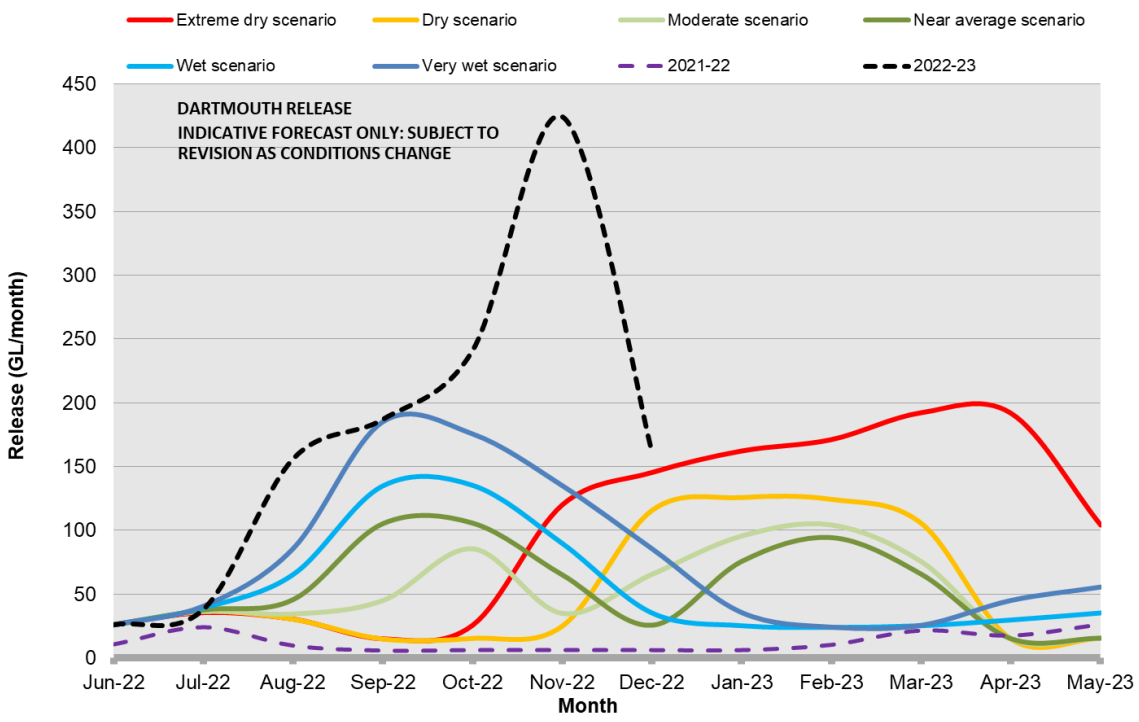

Figure 8 Original Dartmouth Reservoir release outlook.

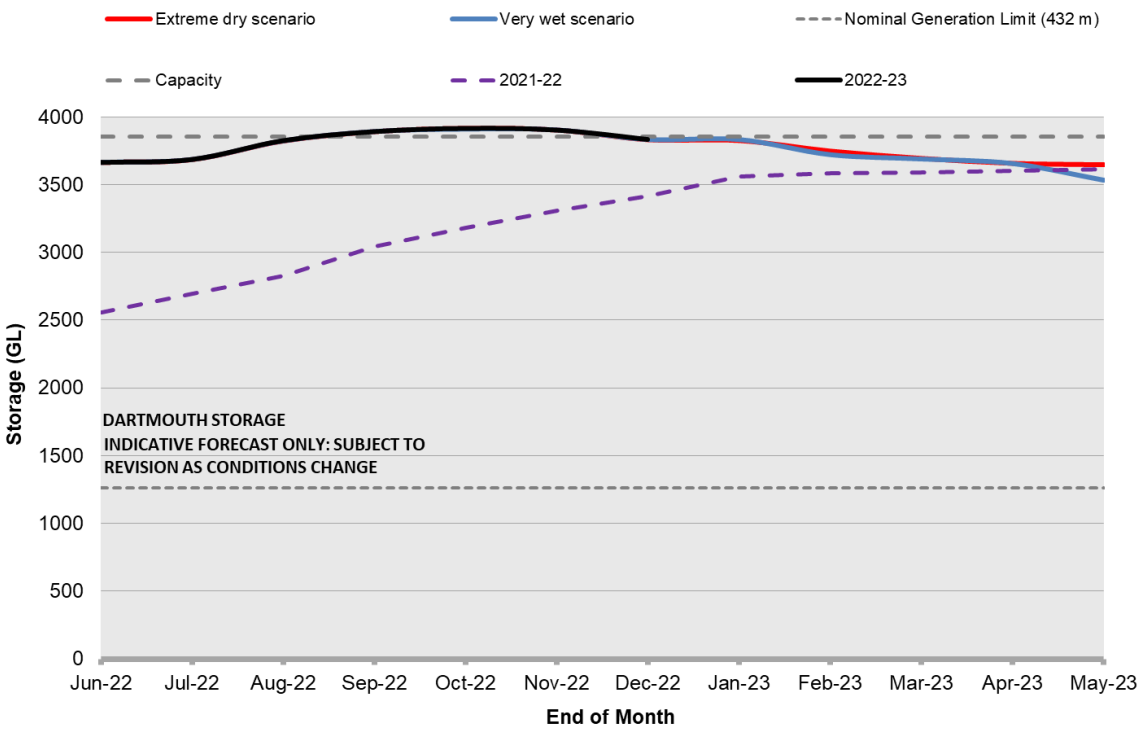

Figure 9 End December 2022 Dartmouth Dam storage outlook.

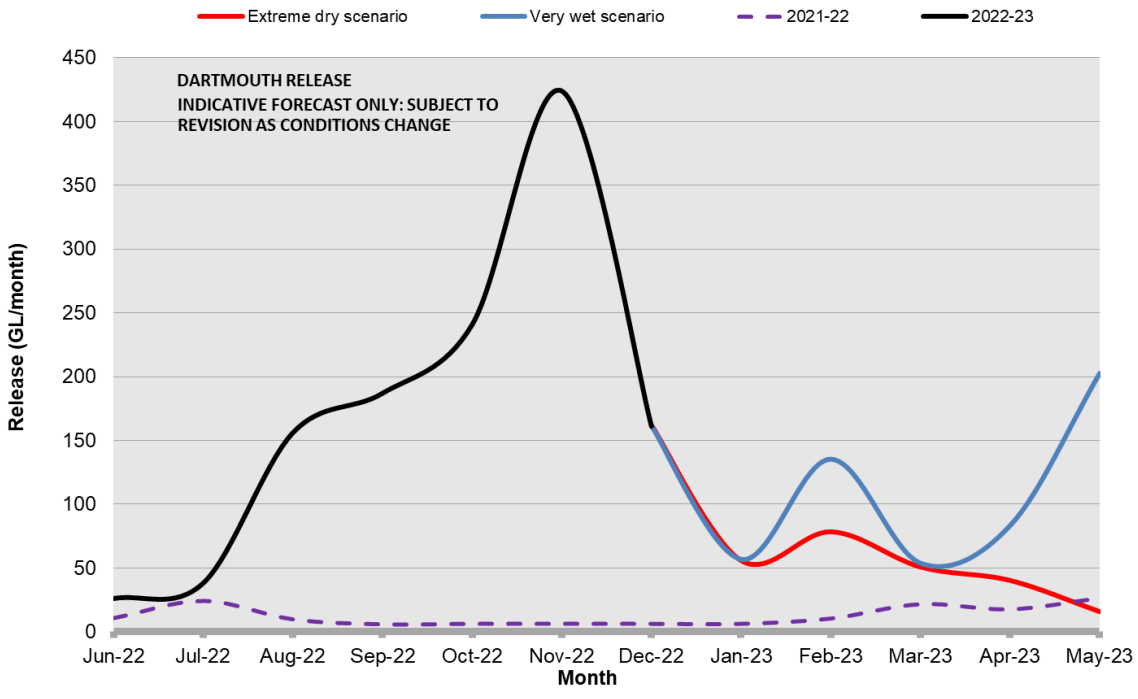

Figure 10 End December 2022 Dartmouth Dam release outlook

Dartmouth storage level is very high for this time of year and is expected to remain high at the end May 2023 in all scenarios (Figure 9). While the storage remains above 99% capacity AGL are permitted to release Above Target Water which they have during January 2023. In both the 'extreme

dry' and 'very wet' scenario, releases from Dartmouth Dam will increase in February 2023 as a pre-release or a harmony transfer to Hume Dam, depending on the relative storage levels and inflows to the dam (Figure 10). If inflows to Dartmouth Dam are wetter than the 10% AEP 'very wet' scenario, pre-releases may be required at higher volumes than presented in this AOO. Releases from Dartmouth Dam are managed, when possible, at variable rates to minimise downstream erosion.

4.2 Hume and Doctors Point

Airspace management at Hume Dam continued from May to December 2022 and the storage levels varied in response to airspace management decisions (Figure 11). During floods, airspace management decisions do not follow a precise and pre-determined strategy, rather they adapt to the actual and forecast conditions at that time. Likewise, the AOO only shows the *end of month* storage volume which does not capture the full picture of airspace management decision at Hume in 2022.

Figure 12 shows the release from Hume Dam as the average flow at Doctors Point which includes Kiewa River inflows. Hume releases exceeded the 'very wet' scenario from August onwards. November inflows to Hume and from the Kiewa River were highest on record, as such releases were significantly higher in that month. By December, inflows receded, and releases reduced back below Doctors Points channel capacity.

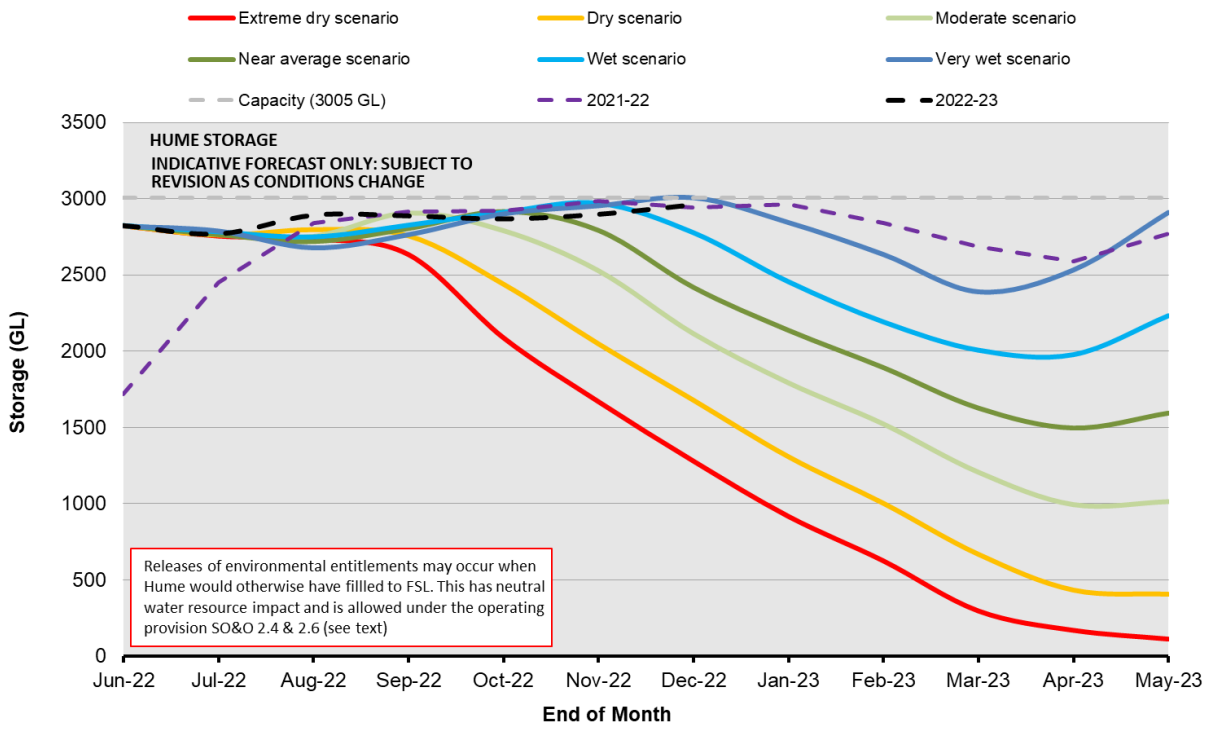

Figure 11 Original Hume Reservoir storage outlook

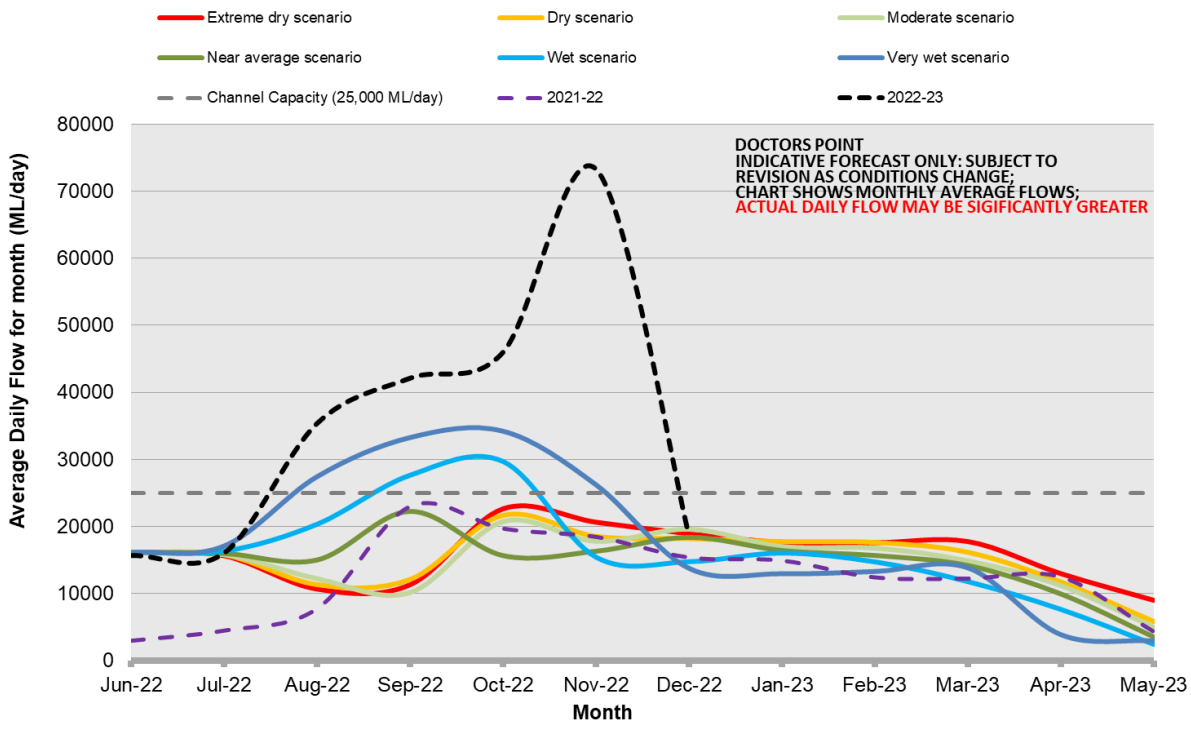

Figure 12 Original Hume Reservoir release outlook – average flow at Doctors Point

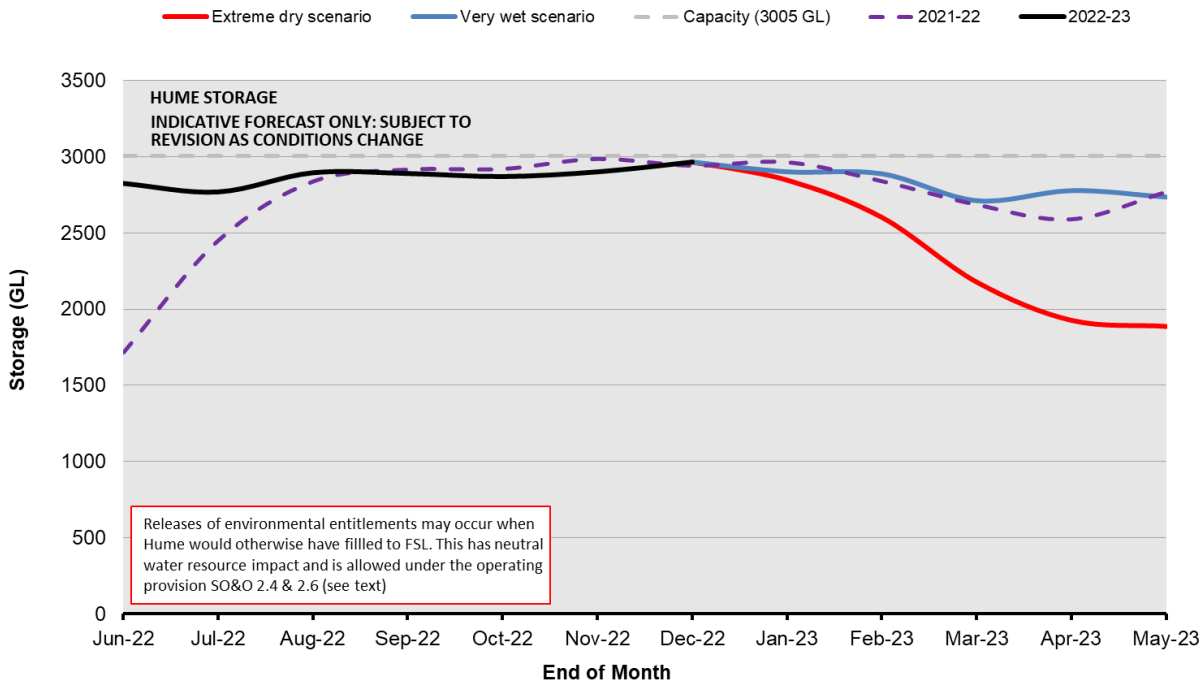

Figure 13 End December 2022 Hume Reservoir storage outlook

If inflows recede to those presented in the 'extreme dry' scenario (Figure 13), Hume Dam storage will reduce from January to May 2023, but remain above 60% capacity at the end of May 2023, supported by harmony transfers from Dartmouth Dam. In the 'very wet' scenario, Hume storage

remains high for the remainder of the water year and pre-releases are required in late autumn to actively manage storage levels into winter 2023–24.

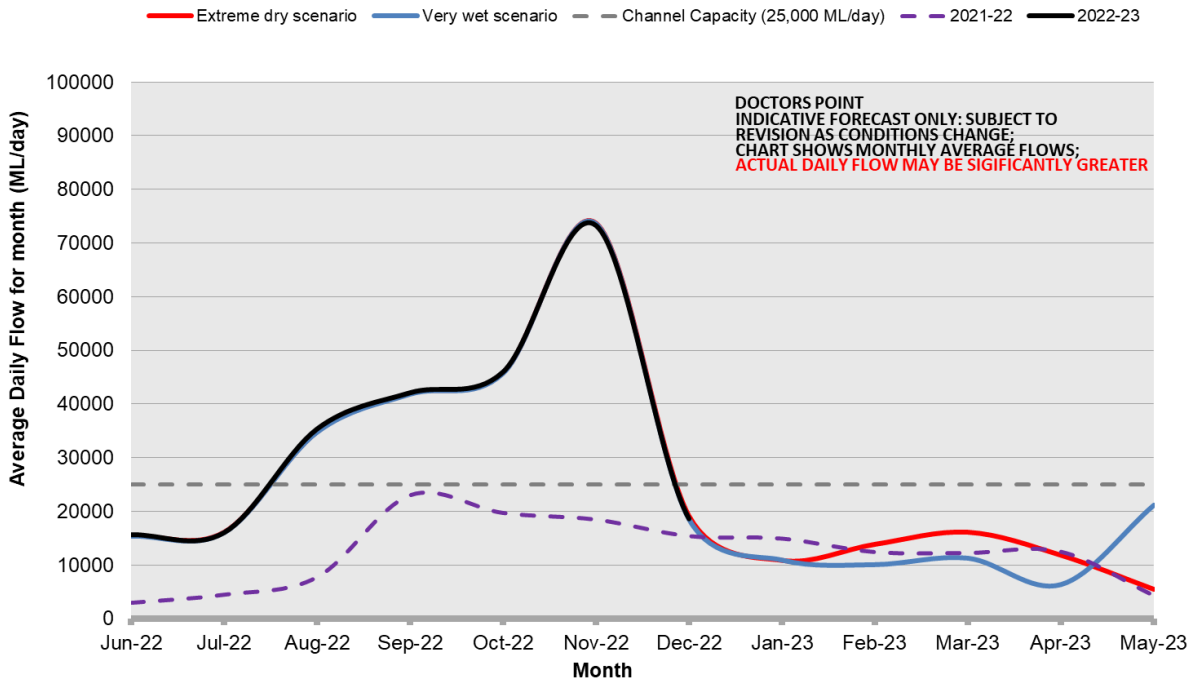

Figure 14 End December 2022 Hume Reservoir release outlook – average flow at Doctors Point

Airspace management releases from Hume Dam ended in January 2023, however, the storage level is very high for this time of year and further significant rainfall may recommence airspace releases. With no significant rainfall, Hume releases will continue to meet downstream water for the environment and consumptive demands during the peak demand period in both inflow scenarios (Figure 14). In the 'extreme dry' scenario releases from Hume Dam recede towards the end of May 2023. Hume pre-releases are required in late autumn to manage storage levels in the 'very wet' scenario, at rates below Doctors Point channel capacity.

4.3 Yarrawonga Weir

Figure 15 shows releases from Yarrawonga Weir increased above the 'very wet' scenario in August 2022. Significant releases were managed during November due to airspace management releases at Hume, highest on record inflows from Kiewa and Ovens rivers and localised rainfall. By December, Hume releases and tributary flows had reduced significantly with regulated river conditions returning at the Yarrawonga Weir in early January 2023 (Figure 16).

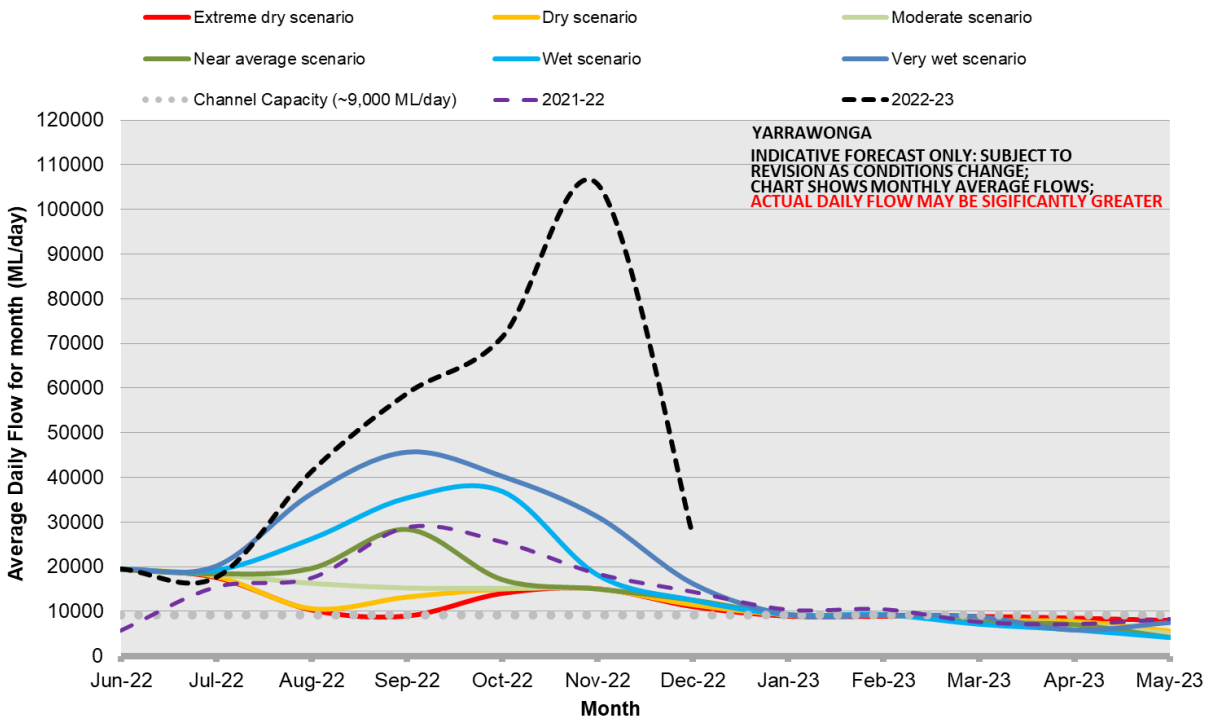

Figure 15 Original Yarrawonga Weir release outlook

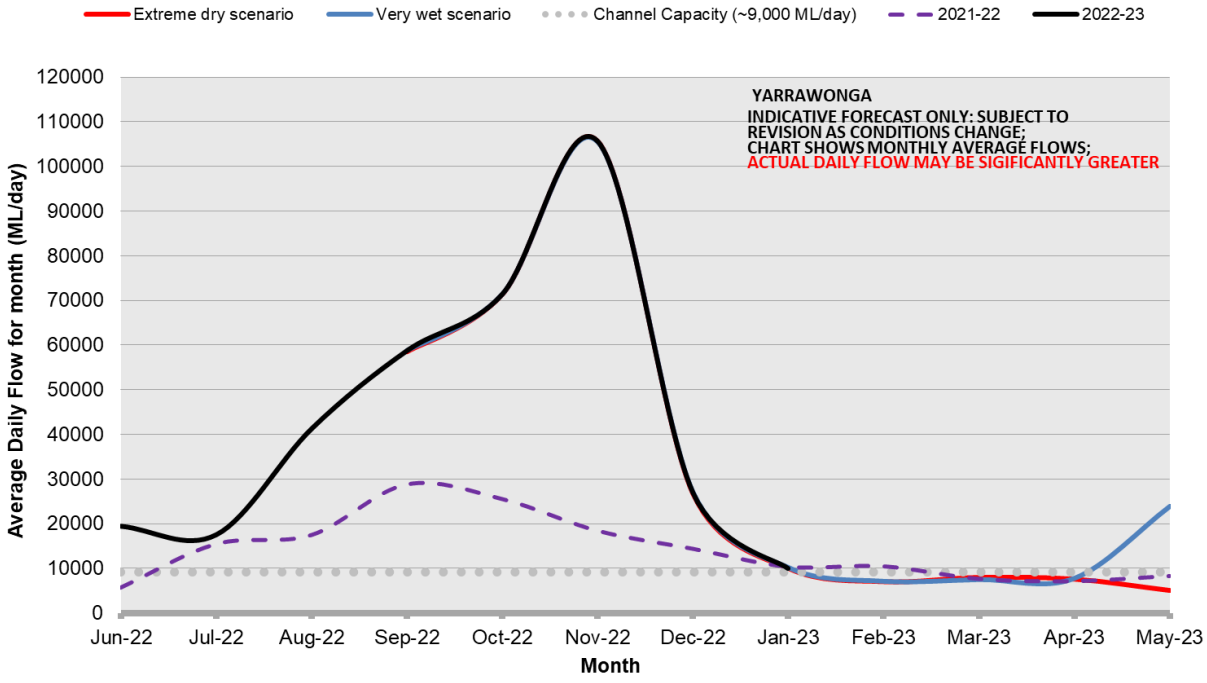

Figure 16 End December 2022 Yarrawonga Weir release outlook

As shown in Figure 16, in both scenarios, releases from Yarrawonga Weir aim to meet a water for the environment downstream target of around 9,000 ML/day until mid-February. This target is met by environmental entitlement releases from Hume Dam. Normal summer irrigation demands have been impacted by high rainfall and flooding with peak demands in the mid-Murray not anticipated until

autumn. In both scenarios, releases from Yarrawonga Weir meet autumn irrigation demand and minimum flow targets at rates below channel capacity. In the 'extreme dry' scenario, operational releases from Yarrawonga Weir reduce in May 2023 and water for the environment, released from Hume, supports an ecological baseflow of around 5,000 ML/day.

In the 'very wet' scenario, pre-releases from Hume Dam commence in late autumn and releases from Yarrawonga Weir increase above downstream channel capacity rates. If this scenario occurs, Barmah–Millewa Forest regulators will be opened to accommodate the higher release.

4.4 Euston

Euston flow is a combination of Hume Dam releases and tributary flows, predominately from the Goulburn and Murrumbidgee rivers. Like the upper Murray catchment, the Goulburn and Murrumbidgee catchments had significant and prolonged flooding during winter/spring 2022. Unregulated flow from these tributaries ultimately flows into the River Murray upstream of Euston. The combined flows increase river levels in the River Murray and spread out onto floodplains and into anabranches, like the Edward–Wakool system. This process increases the travel time of upstream flood peaks moving through the river system.

Flow at Euston tracked along the 'near average' scenario between June and September 2022 (Figure 17). As upstream peaks built and gradually travelled downstream the flow at Euston increased to and exceed the 'very wet' scenario between October to December 2022. The river peaked at Euston in mid-December at major flood level.

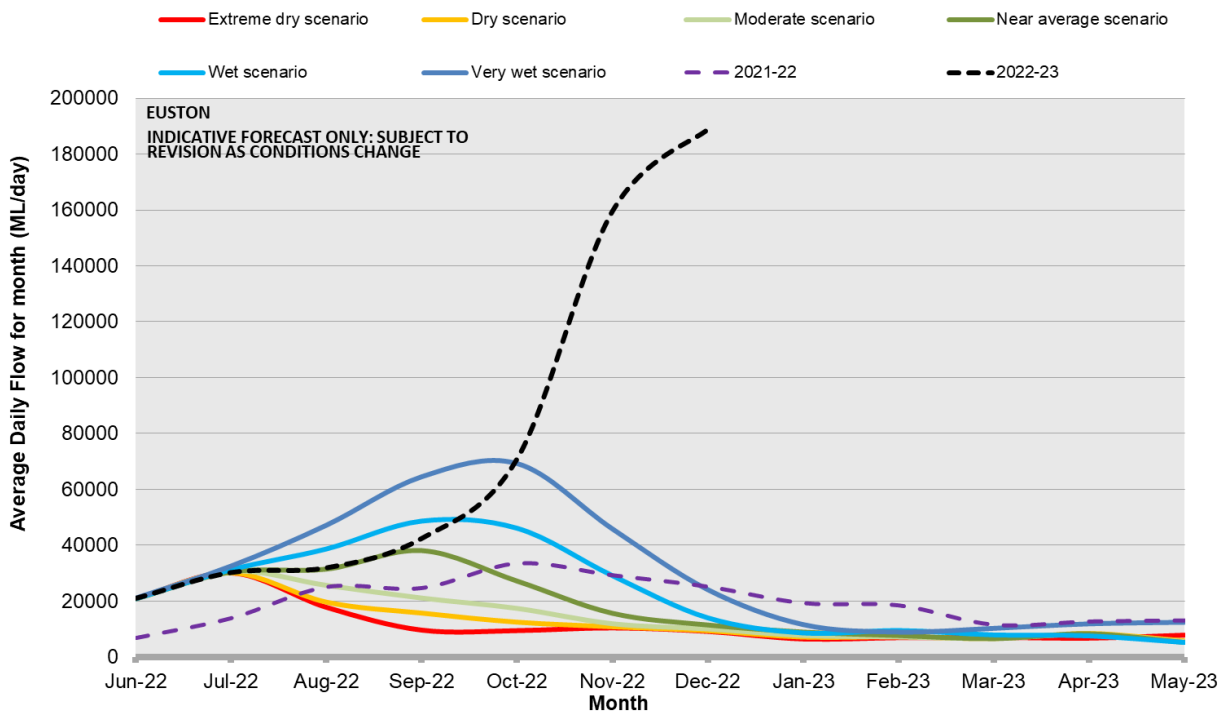

Figure 17 Original Euston Weir flow outlook

Euston flow will continue to recede in early 2023 (Figure 18).

In the ‘extreme dry’ scenario, Euston flow recedes to low rates by autumn. This scenario assumes that releases from the Menindee Lakes are sufficient to meet demands downstream of Wentworth. Small rates of Goulburn and Murrumbidgee IVT are released to assist in meeting end of season demands and the 350 GL end of May storage target in Lake Victoria, conserving resource in Hume Dam. In the ‘very wet’ scenario, Euston flow will recede over summer, yet upstream inflows continue and maintain unregulated flow conditions throughout 2022–23.

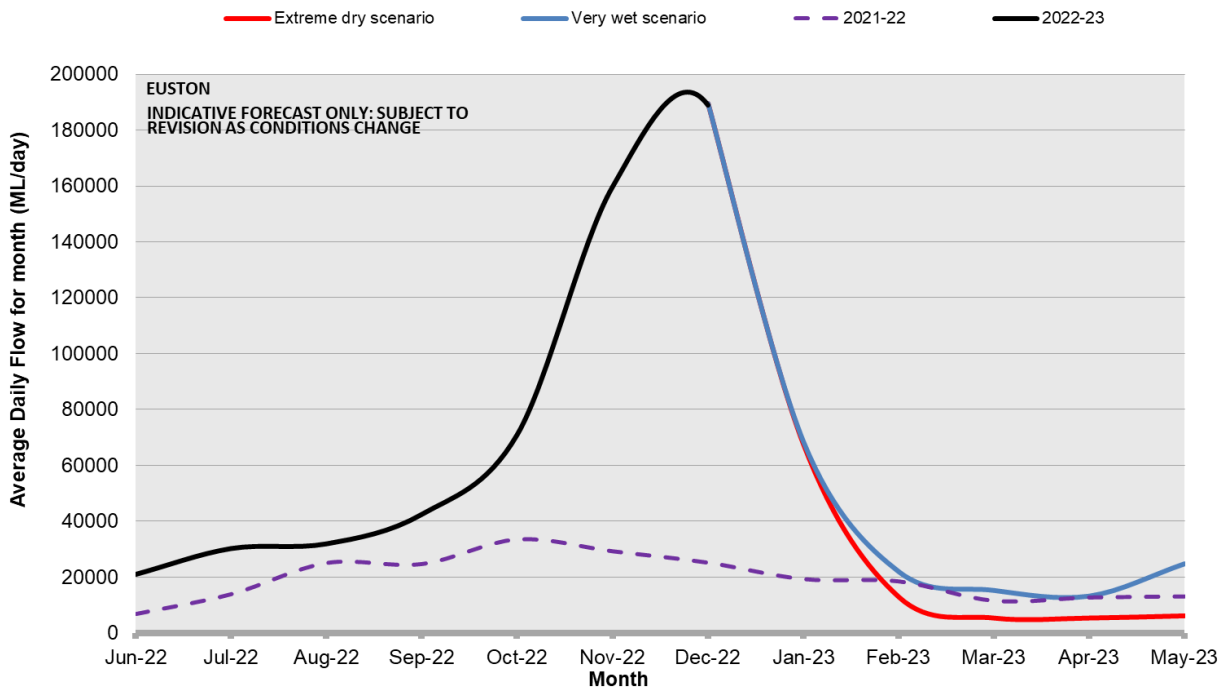

Figure 18 End December 2022 Euston Weir flow outlook

4.5 Menindee Lakes

Significant inflows into the Menindee Lakes have continued throughout June and December 2022 due to ongoing rainfall events across the Barwon–Darling catchment. The Barwon–Darling flood peak reached the Menindee Lakes in late December 2022, with major flooding along the Darling River at Menindee.

WaterNSW operate the Menindee Lakes during floods. As such, Menindee Lakes storage and releases have been managed by WaterNSW throughout June to December 2022 and they will continue to operate the lakes while flooding continues into 2023. Therefore, the storage and release scenarios for Menindee Lakes will not be presented in this updated AOO. Rather, WaterNSW’s latest Menindee Lakes releases have been factored into this AOO update with assumptions on a realistic trend to historical ‘extreme dry’ and ‘very wet’ inflows.

Refer to WaterNSW Lower Darling operational updates for information and updated on airspace management releases from Menindee Lakes and the Bureau NSW Warnings Summary for latest flood warnings along the Darling River.

Regulated releases from Menindee Lakes to help meet River Murray system demands were identified in the original AOO published in August 2022. Although not presented in this updated outlook, if flood operations end at the Menindee Lakes and the River Murray system is fully regulated, the MDBA may call on low rates of release from Menindee Lakes. These releases would aim to meet downstream requirements, including additional dilution flow to South Australia (Section 4.7) and harmony operations with Lake Victoria (Section 4.6) as outlined in the Objectives and Outcomes and in Section 5.2.

4.6 Lake Victoria

The lower River Murray system has remained unregulated since July 2021 and the overall management of Lake Victoria continues to follow the Lake Victoria Operating strategy (LVOS).

Between June and December 2022, Lake Victoria storage operations varied in response to changing river conditions and operational objectives (Figure 19). In July, Environmental Water Holders ordered a directed release of up to 100 GL from Lake Victoria during unregulated conditions (Objectives and Outcomes SO&O 9.4). The directed release from Lake Victoria assisted in meeting environmental flow targets across the South Australian border in winter and early spring. As flows to South Australia increased in October 2022, the operational strategy at Lake Victoria was adjusted to maintain airspace for flood peak mitigation. However, as the River Murray flood peak approached the lower River Murray in December 2022, water inundated the floodplain surrounding Lake Victoria and resulted in several levee breaches along the Frenchman's Creek, impacting the operability of the Lake Victoria inlet structure. As a result, Lake Victoria storage was not available to assist in mitigating the flood peak across the South Australian border in late December 2022.

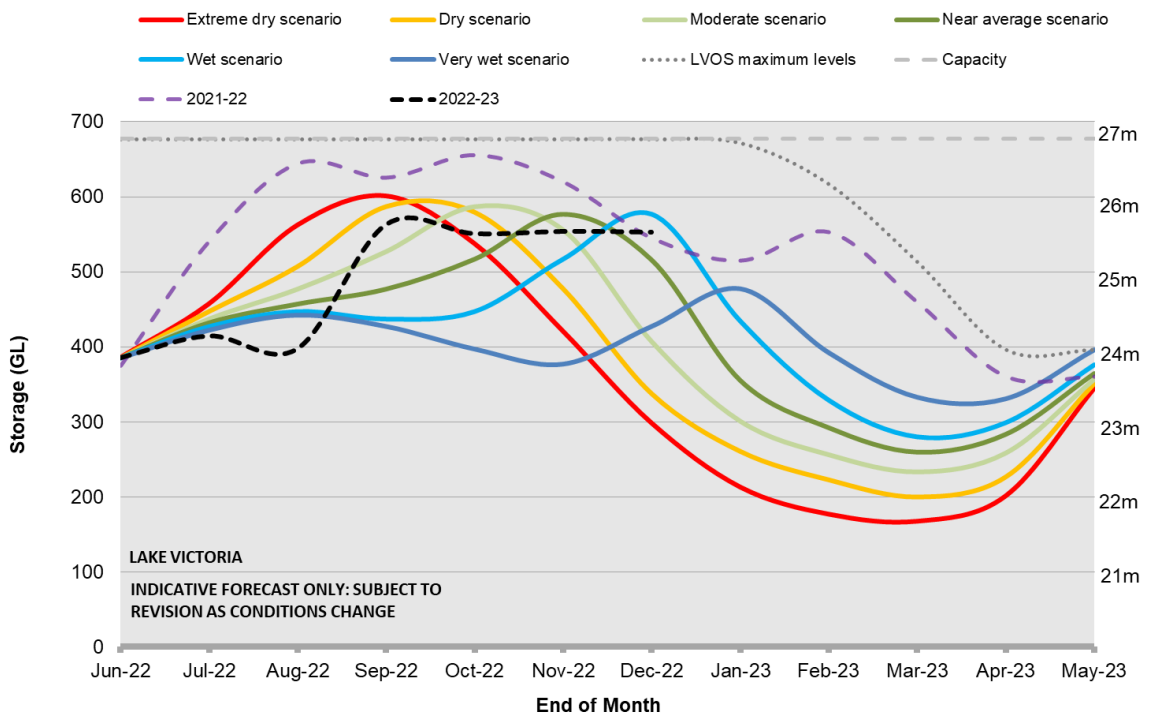

Figure 19 Original Lake Victoria storage outlook

As flood waters recede during January and February 2023, remedial work to the Frenchman's Creek levees and Lake Victoria inlet structure will occur. This is not anticipated to impact on the operation of Lake Victoria assumed in this AOO.

As flow across the South Australian border recedes to lower levels, Lake Victoria storage will be managed to utilise the directed release while the lower River Murray remains unregulated. In the 'extreme dry' scenario, Lake Victoria will be 100 GL below the LVOS maximum level when unregulated flows cease in the lower Murray (Figure 20). Then the storage will be managed to support demands to the lower River Murray system and reach the end of May 350 GL storage target.

In the 'very wet' scenario, unregulated flow conditions continue in the lower River Murray and the storage will be managed to the 350 GL storage target at the end of May 2023. Environmental Water Holders will be debited the directed release volume up to the LVOS maximum level at end May 2023.

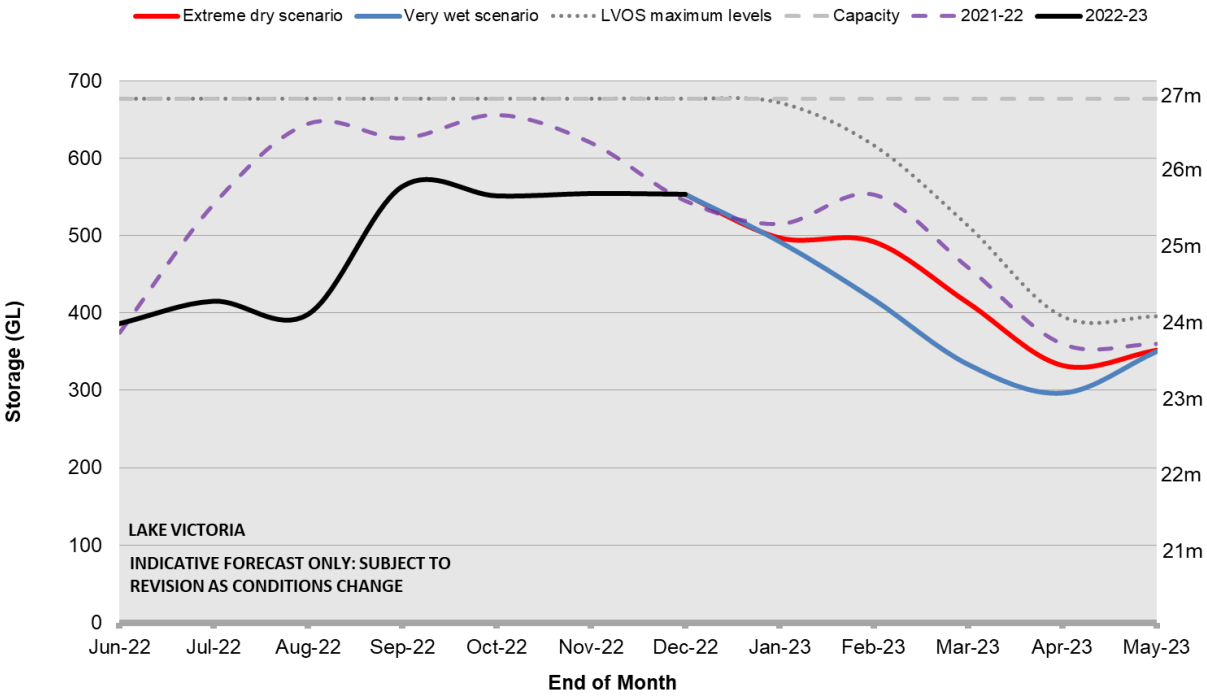

Figure 20 End December 2022 Lake Victoria storage outlook

Harmony operations between Menindee Lakes and Lake Victoria (Objectives and outcomes (SO&O 12.2)) have been triggered but are not currently being considered with ongoing unregulated river conditions in the lower River Murray. If upstream inflows recede to those assumed in the 'extreme dry' scenario, including at Menindee Lakes, the lower River Murray may return to regulated river conditions as early as April 2023. In this scenario, the MDBA would call on releases from the Menindee Lakes for harmony operations at Lake Victoria as required. The harmony rules aim to complement additional dilution flows to South Australia (described in Section 4.7 below).

4.7 South Australia

Flow across the South Australian border has been unregulated since July 2021.

Flow to South Australia tracked between the 'near average' and 'wet' scenario between June and October 2022 (Figure 21). By November 2022, flow was near the 'very wet' scenario. The upstream flood peak at Euston combined with the inflow from the lower Darling River peaked at the South Australia border at the end of December 2022 with significant flooding in the lower River Murray system and vastly exceeding the 'very wet' scenario.

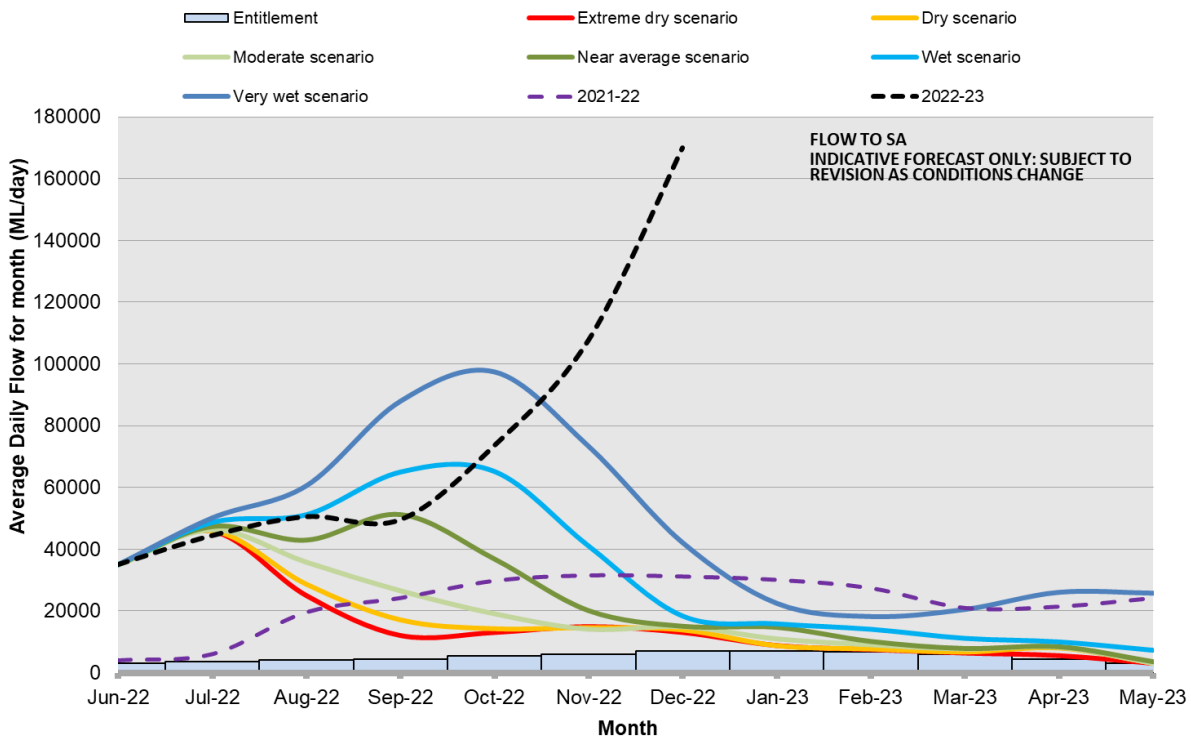

Figure 21 Original flow to South Australia outlook

Flow to South Australia will recede throughout summer in both scenarios (Figure 22). In the 'extreme dry' scenario, all upstream catchments recede to regulated conditions and flow to South Australia becomes regulated in April 2023. Given the Menindee Lakes storage is full, additional dilution flow (ADF) is triggered in all scenarios to the end of May 2023, increasing the Entitlement flow to South Australia by 3,000 ML/day (Objectives and outcomes (SO&O 12.3)). ADF will continue until such time that the combined Hume and Dartmouth storage volume reduces below 2,000 GL or the Menindee Lakes storage volume reduces below the monthly storage trigger (SO&O 12.3).

In the 'very wet' scenario, inflows from upstream catchments continue and the flow to South Australia remains unregulated throughout the 2022-23 water year.

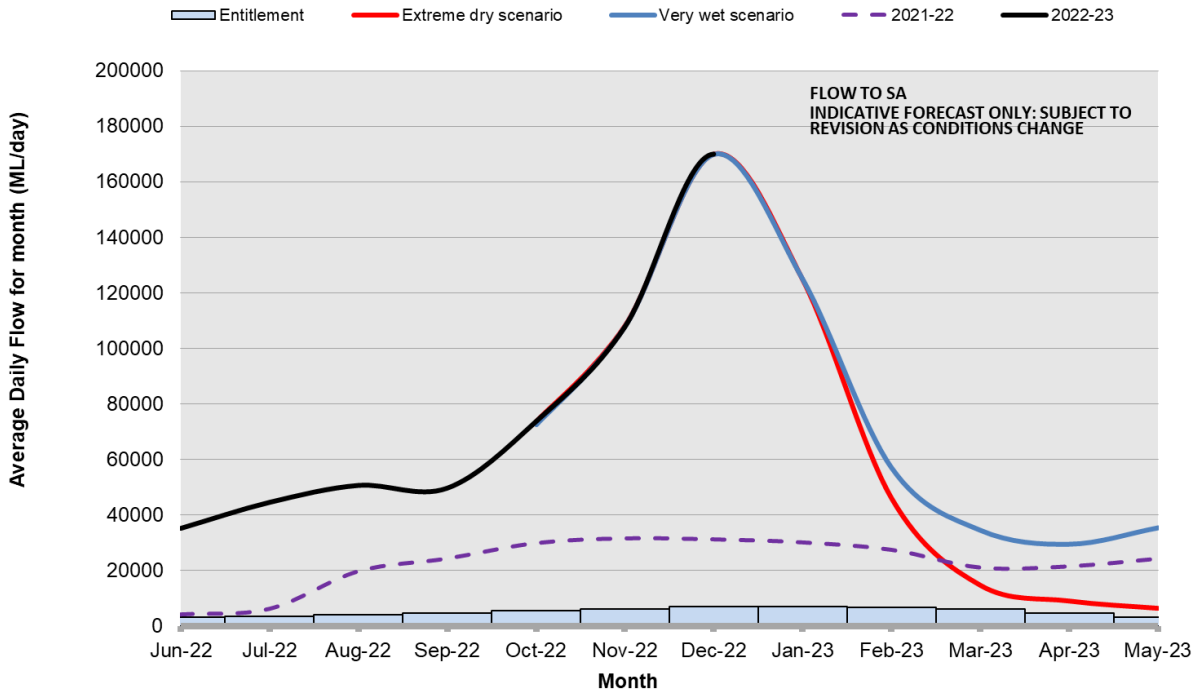

Figure 22 End December 2022 flow to South Australia outlook

In both scenarios, water from the environment, returned from actions in the River Murray and tributaries upstream, travel through the River Murray channel and are delivered to South Australia.

5 Operational challenges for the remainder of 2022–23

As described in the previous sections, River Murray system and Menindee Lakes inflows, have been in the top 3% of years on record for the June to December period. Both systems have tracked well above the 'very wet' inflow conditions presented in the original AOO. Significant flooding has occurred across the Murray–Darling Basin. On the River Murray the flood peak had passed into South Australia by end December 2022, yet major flooding was still occurring on the lower Darling River with the peak near Menindee township.

In the original AOO, flooding in the River Murray system was identified as an increased risk for the 2022–23 water year. Water quality issues were also highlighted as a likely risk resulting from significant flooding, with low Dissolved Oxygen and Blackwater occurring across the River Murray system as water temperatures increased in late spring.

River Murray System operational challenges remain similar to those presented in the AOO published in August 2022 with additional detail provided in the sections below.

5.1 Flooding in the River Murray System

Given the River Murray system storages are very high for this time of year, and while inflows generally recede to lower levels in summer and autumn flooding in the River Murray system remains a risk. The risk of flooding is continuing in the lower Darling River, at Menindee Lakes and into the lower River Murray as the main flood peaks pass downstream. WaterNSW will continue to manage the flood operations at the Menindee Lakes. Additional high releases from the Menindee Lakes would potentially contribute to persistent high flows along the River Murray downstream of Wentworth and into South Australia, as presented in the 'very wet' scenario in Section 4.7.

5.2 Approach to operating Menindee Lakes

The MDBA has not called on releases from the Menindee Lakes storage during 2022 due to system wide unregulated flows. The MDBA does not anticipate calling on releases from the Menindee Lakes to meet River Murray system demands unless inflows from storages and tributaries recede back to fully regulated river conditions. This is possible in the 'extreme dry' scenario, where inflows recede from 3% AEP in December 2022 to serially correlated minimum inflows. January 2023 inflows are currently tracking to 10% AEP, which demonstrates that the 'extreme dry' scenario, while possible, is increasingly unlikely to occur.

The MDBA's obligation to call on water from the Menindee Lakes is defined in the Murray–Darling Basin Agreement (the Agreement) of the Water Act 2007, and the 'Objectives and Outcomes for River Operations in the River Murray System' (O&O). The O&O defines the operating rules, as agreed by the state governments, for how the MDBA operates the River Murray System. The MDBA will continuously revise forecasts and operational plans to determine the volume, timing and location of water released from Menindee Lakes to support the Murray system. This process will be on-going and undertaken in consultation with the WLWG.

5.3 Delivery Risks

Given the ongoing unregulated flows across the River Murray and lower Darling River systems, there has been no delivery or system shortfall risks in 2022. Despite states water resource reaching full allocations by the end of 2022, normal summer irrigation demands have been impacted by high rainfall and flooding. As a result, system demands have been lower than previous years for this time. If dry conditions prevail, crop demands are anticipated to be high in autumn. Conversely, if rainfall occurs over irrigation areas crop demands may be less.

In operating the River Murray system, MDBA assesses shortfall risks and, when required, mitigates the risks by implementing appropriate actions to increase the chances that demands will be supplied. The MDBA will report on emerging system and delivery shortfall risks in 2022–23 in the River Murray weekly reports. See the MDBA website for more information on shortfall management.

The 'extreme dry' scenario assumes high crop demands are able to be met with the availability of water from Hume, IVTs and Menindee Lakes. Therefore, there is a low risk of a system shortfall occurring this water year. As highlighted in the original AOO, with Menindee Lakes available to help

meet River Murray System demands, the mid-Murray will be operated efficiently to maximise water stored in Hume Dam. As a result, there may be less water in transit to buffer against short term spikes in high demand, elevating the risk of a delivery shortfall.

The Barmah Choke capacity constraint is not anticipated to be an issue in 2022–23. Section 4.3 shows even in the 'extreme dry' scenario where high demands are assumed across the remainder of the water year, releases downstream of Yarrawonga Weir remain below channel capacity.

The Victorian Government implemented new long-term Goulburn to Murray trade and operating rules for 2022–23. The operating rule limits the daily flow rate of Goulburn Valley IVT between November and June to reduce environmental impacts. The updated AOO scenarios show that there continues to be a low risk of the Goulburn IVT operating rule contributing to capacity issues in 2022-23.

5.4 Water quality risks

Poor water quality, including low DO and blackwater resulted from the significant flooding in 2022. In December 2022, anoxic conditions were reported and managed in Lake Hume. Despite the floods receding water quality threats continue. Water quality alerts for sites are also available at Water quality | Murray-Darling Basin Authority.

Office locations – *First Nations Country*
Adelaide – *Kaurna Country*
Canberra – *Ngunnawal Country*
Goondiwindi – *Bigambul Country*
Griffith – *Wiradjuri Country*
Mildura – *Latji Latji Country*
Murray Bridge – *Ngarrindjeri Country*
Toowoomba – *Jarowair and Wakka Wakka Country*
Wodonga – *Dhudhuroa Country*

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