

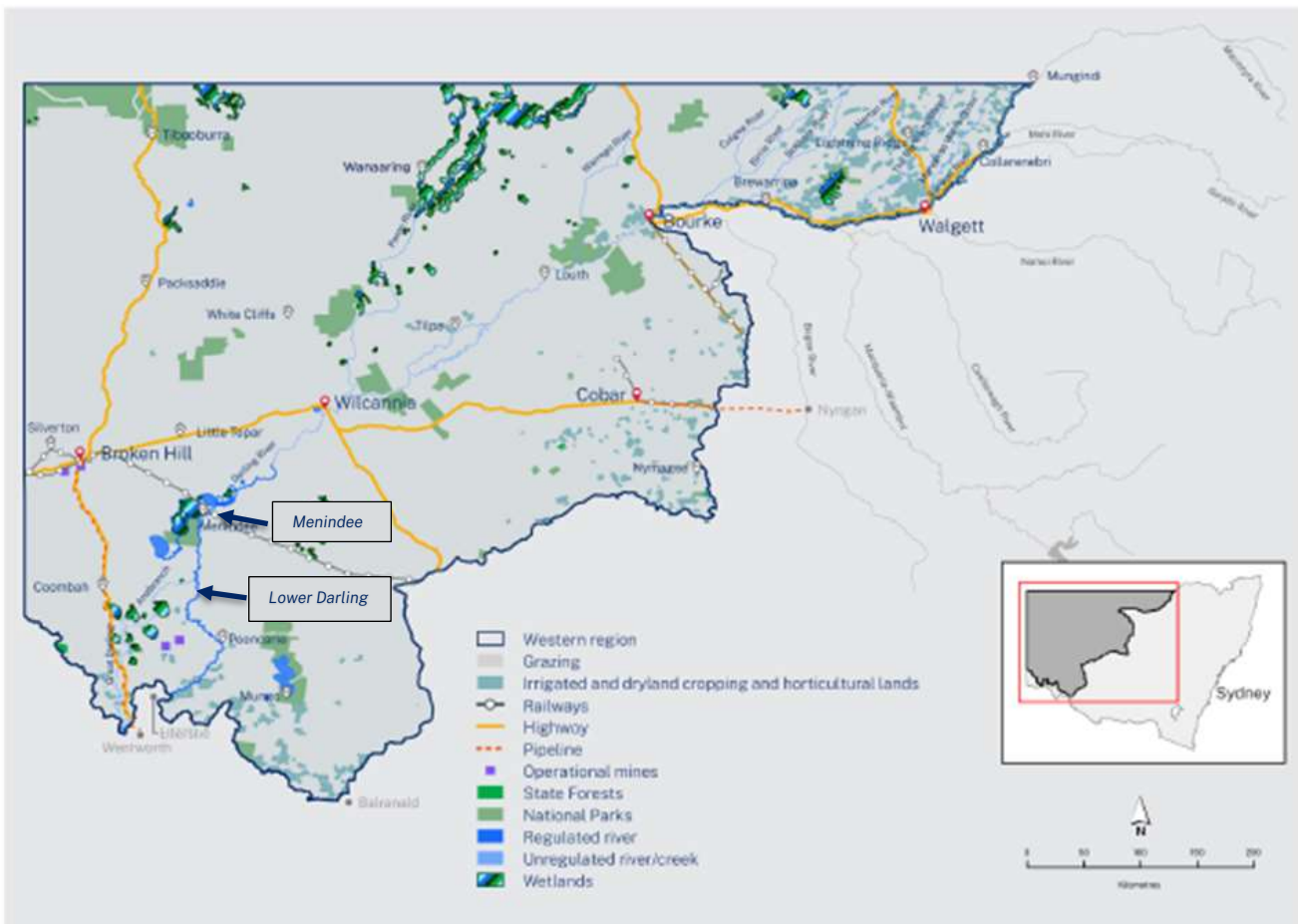
Water Allocation in the Regulated Lower Darling River

To complement the suite of water allocation guides for regulated river systems, this document covers the Lower Darling river system.

The Menindee Lakes System (MLS) forms the headwater storage for the regulated Lower Darling River. As with all regulated systems, the headwater storage is used to maximise water capture for subsequent controlled release to meet downstream commitments and demands. In wet periods the headwater storage is also used to mitigate the downstream flood risks to people and property.

In NSW, the statutory instrument governing the water sharing and allocation of water is the water sharing plan; in this instance the *Water Sharing Plan for the New South Wales Murray and Lower Darling Regulated Rivers Water Sources 2016* (hereafter, the Plan).

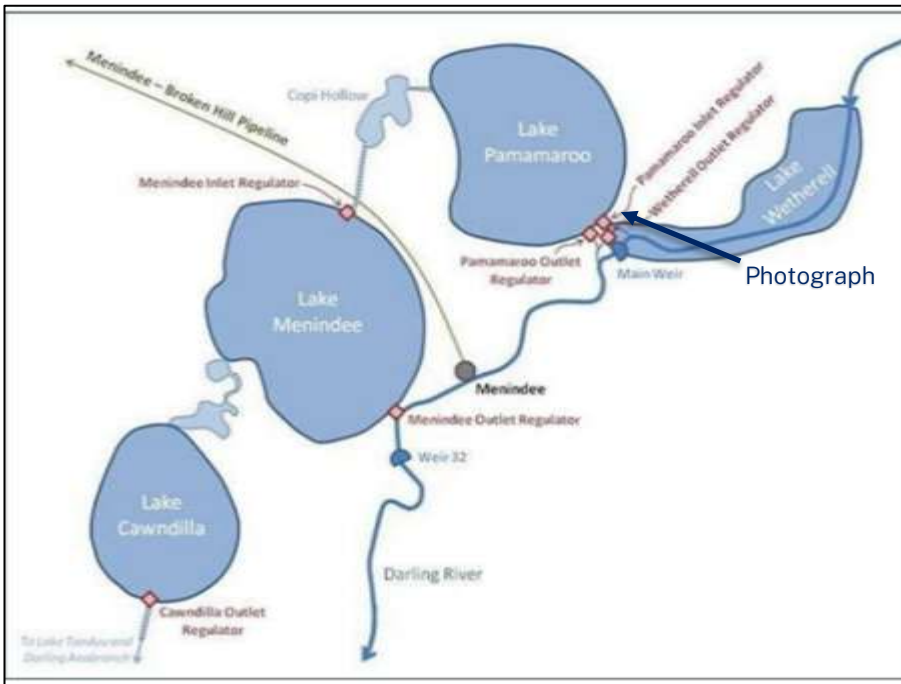
Menindee Location in Regional Western NSW



The Menindee Lakes System

The Menindee Lakes System (MLS) is a storage scheme constructed on the Darling River in the 1960's, about 250km north of Wentworth (on the Murray River) and 100km south-east of Broken Hill NSW. There are four main lakes in the system: Wetherell, Pamamaroo, Menindee and Cawndilla, as well as many smaller lakes.

Figure 1: The Menindee Lakes System



In 1963, the water held in the lakes above the needs of NSW was made available to the River Murray Commission for sharing between NSW, Victoria, and South Australia. This formed the basis for current sharing under the Murray Darling Basin Agreement, which allows water to be called by the Murray Darling Basin Authority for use in the Murray when levels are above 480 gegalitres (GL) when falling and above 640GL when rising.



Main Weir (bottom left) – the start of the Lower Darling River.

Lake Pamamaroo inlet regulator (top right), looking north-west across a near full Lake Pamamaroo (top) – 17 February 2010.

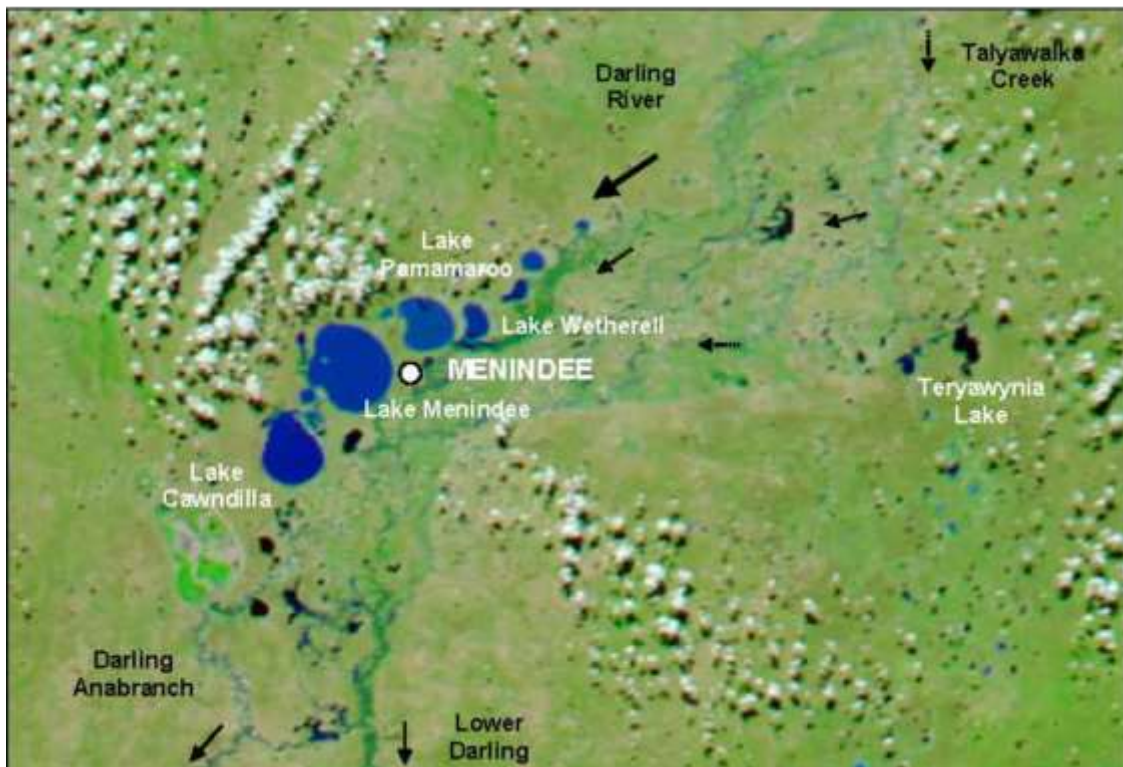
Prior to construction, the lakes comprised a series of natural depressions in an arid and fragile landscape that filled during floods. As flood flows receded, the lakes would naturally drain with much of the water returning to the Darling River. Lower sections of lakes and channels would reduce to isolated water holes until they were either consumed by seepage and evaporation or replenished by new inflows.

The Barwon-Darling system at Menindee township has a catchment area of 574,200km², extending from southern Queensland and west of the Great Dividing Range. Upstream of Menindee, the Darling River is unregulated, meaning there is no headwater storage from which to call flows when needed. Rather, the flows passing Wilcannia and reaching the MLS are uncontrolled; the result of rainfall and runoff and will naturally cease under prolonged dry conditions.

The climate in far western NSW comprises low rainfall and high summer temperatures. The lakes are expansive and relatively shallow with large areas of wetted perimeter (seepage) and a vast surface area (evaporation) relative to the storage volume, rendering them quite inefficient storages. The maximum surface area of the MLS is some 457km² when full and the average net evaporation about 1.6 meters, meaning evaporative losses can reach up to 730,000 megalitres (ML) per year. The lakes will readily deplete unless replenished with regular inflows from the upper catchment.

The image below shows the green landscape following rainfall and the break in the Millennium Drought. The blue is water accumulating in the MLS in 2011. The commencement of cropping (light green) in the dry bed of Lake Tandou, south-west of Lake Cawndilla, can also be seen.

Figure 2: 18 April 2011 - Image: MODIS Australia6 Subset – Terra 250m Bands 7-2-1 Image for 2011/108, Source: NASA/GSFC, MODIS Rapid Response 2011.



Historically the MLS provided water supply security for Broken Hill with a population of about 20,000 people, along with smaller towns and villages. Increasingly stringent water savings measures would be introduced as the forecast supply fell below 18 months. However, a pipeline from Wentworth on the Murray was constructed in 2018 to secure Broken Hill's water supply.

The MLS has a relatively small entitlement base. Historically the resource has been managed to meet the needs in the Murray, while also supporting the significant environmental and cultural values of local area. In terms of volume, the allocation of water to entitlement holders is small, around 5% of system capacity, therefore; a sophisticated assessment to underpin allocations is not warranted. General security allocations are mostly full or else zero and rarely in between (Table 1).

Table 1: Historical allocations in the Lower Darling

Water Year	Announced Allocation (% of Entitlement)				Notes
	High Security*		General Security		
	1 July	30 June	1 July	30 June	
2004/05	100%	100%	30%	100%	
2005/06	100%	100%	50%	100%	
2006/07	100%	100%	0%	Some licence-specific alloc'ns	WSP Suspended Millennium Drought
2007/08	Some licence-specific alloc'ns	Some licence-specific alloc'ns	0%	Some licence-specific alloc'ns	WSP Suspended Millennium Drought
2008/09	100%	100%	0%	50%	WSP Suspended Millennium Drought
2009/10	100%	100%	0%	100%	
2010/11	100%	100%	100%	100%	
2011/12	100%	100%	100%	100%	
2012/13	100%	100%	100%	100%	
2013/14	100%	100%	100%	100%	
2014/15	100%	100%	100%	100%	
2015/16	20%	80%	0%	0%	Severe depletion
2016/17	20%	100%	0%	100%	System recovery
2017/18	100%	100%	100%	100%	
2018/19	100%	100%	0%	0%	Severe depletion

Water Year	Announced Allocation (% of Entitlement)				Notes
	High Security*		General Security		
	1 July	30 June	1 July	30 June	
2019/20	30%	100%	0%	30%	
2020/21	100%	100%	30%	100%	System recovery
2021/22	100%	100%	100%	100%	
2022/23	100%	100%	100%	100%	

*Note: High Security allocations are not a higher percentage than those for towns, domestic and stock entitlements.

Dead storage and isolated water

Dead storage is the volume remaining in a lakebed that cannot flow downstream by gravity. As lake levels recede, the driving head reduces and outflows through regulators reduce to a trickle, leaving behind a dead storage volume. Approximate* volumes of dead storage in the lakes are as follows:

Wetherell	12,000 ML
Pamamaroo	10,000 ML
Menindee	50,000 ML
Cawndilla	50,000 ML

*These volumes are estimates only and could be unreliable. The lakes have not been surveyed since the early 2000's and there have been a number of significant inflow events since then, which may have eroded and deposited material and changed their bathymetry.

Lakes Menindee and Cawndilla are separated by a natural waterway at Morton Boulka. When Lake Menindee rises beyond 56.2m Australian Height Datum (AHD), its water begins spilling naturally into Lake Cawndilla. Continued inflow to Lake Menindee means that Lake Cawndilla will continue to rise until the two lakes are joined by the same water level. A regulator has been proposed for construction between the two lakes to control the inflow to Lake Cawndilla and to operate the lakes independently, but to date, this has not proceeded. An inlet regulator to Lake Menindee, downstream of Copi Hollow, can be closed to prevent water entering this lower part of the MLS.

The outlet regulator from Lake Menindee sends water to the Lower Darling, whereas the outlet regulator from Lake Cawndilla sends water to Tandou Creek, Redbank Creek and on to the Great Darling Anabranh. This water from Cawndilla cannot be readily diverted to the Lower Darling.

As water is released from Lake Menindee to the Lower Darling, and the shared water level falls below 56.2 m AHD, the water bodies separate and 232,000 ML remains in Lake Cawndilla. This water becomes isolated from the Lower Darling and can only be released to the Anabranh.

Therefore, unless this Cawndilla water can be debited from a water licence, for example for environmental water delivery to the Anabranh, or be used to meet obligations in the Murray by being called by MDBA, the water is stranded and contributes to the dead storage total.

WaterNSW operators manage the releases from the MLS as the 480,000 ML ‘drought reserve’ trigger is approached to minimise the volume of dead and stranded water, and maximise the remaining active volume, particularly in the upper lakes, to supply towns and local water needs for as long as possible. Despite the small demand from high priority water users, the relatively large ‘drought reserve’ is needed to deal with the large volumes of dead and stranded water, system losses and minimum releases to maintain connectivity with the Murray for at least 18-24 months.

Rights and entitlements held in the regulated Lower Darling Water Source

Basic Landholder Rights (BLR) are provided in the water sharing plan at Clauses 18 and 19.

BLR in the Lower Darling water source is estimated to total 445 ML/year.

Table 2: Entitlements on issue in the Lower Darling

Licence Category	Shares	Volume (ML)*
Local Water Utility	422 ⁽¹⁾	422
Regulated River (High Security)	7,771	7,771
Domestic and Stock [Stock]	612	612
Domestic and Stock [Domestic]	418	418
Domestic and Stock	311	311
Sub-Total	9,534	9,534⁽²⁾
Regulated River (General Security)	79,507	79,507 ⁽³⁾
Total	89,041	89,041
Supplementary Access	250,000	250,000 ⁽⁴⁾

* Assumes a full allocation of 1 ML per unit share

Notes

1. Some values differ from those in the Plan due to dealings over time and pipeline construction to the Murray.
2. High priority licence categories are assigned a total 9,534 megalitres (ML) per year.
3. General security licences receive allocation once high priority licences are fully allocated.
4. A full allocation is made each year to supplementary access licences however this water does not form part of the regulated resource but rather is supplied from unregulated flows.

Allocations

Available Water Determinations, or allocations, are provided for in Clauses 43 to 49 of the Plan.

All high priority entitlements (local water utility, stock, domestic and high security) are expected to receive a full 100% (1ML/share) allocation on 1 July each year in all, but the most severe droughts.

If less than a full allocation is provided, the allocation shall be increased as soon as resource availability permits and before allocation to general security entitlements commences.

Clause 48(6) indicates that an allocation of up to 1 ML/share can be made to general security entitlements in the Lower Darling water source if water availability permits.

Similarly, Clause 49 indicates that supplementary access licence holders can expect to be allocated a maximum 1ML/share at the start of each water year, regardless of regulated water availability, because this commitment is supplied only from unregulated flows.

Minimum recommended release requirements

Minimum recommended release requirements for flows in the Lower Darling to reduce the risk of blue green algae and to maintain connectivity with the Murray are given in Appendix 3 of the Plan.

The flows are measured at Weir 32 and are summarised in Table 3 below.

Table 3: Minimum recommended flows in the Lower Darling River

Months	Minimum Flow (ML/day)*
Jan - Mar	350
April	300
May - Oct	200
Nov - Dec	300

* Total annual volume commitment 95,600 ML

Additional Dilution Flow to South Australia

Under the Murray Darling Basin Agreement, and in accordance with Appendix 3 of the Plan, an additional release is required by upstream states to provide extra water at the South Australian border when there are good supplies in storages. The increased flow of 3,000 ML/d is met equally by NSW and Victoria, when the storage volume in Hume plus Dartmouth dams exceeds 2,000,000 ML **and** the MLS storage exceeds the trigger levels in Table 4 below. This additional flow to South Australia is normally met from Lower Darling resources.

Table 4: Additional Dilution Flow (ADF) Trigger Volumes in Menindee

Months	Trigger Volume in Menindee (ML)*
Jun – Jul	1,650,000
August	1,500,000
Sept – May	1,300,000

* There is no ADF if stored water in Hume plus Dartmouth Dams is less than 2,000,000 ML.

Obligations to the Murray

Under the Murray Darling Basin Agreement, the MLS is designed to form part of the shared Murray resource in all, but very dry conditions. Specifically, it is always deemed shared Murray resource other than when MLS falls below 480,000 ML until it next rises above 640,000 ML. This 480/640 rules identifies when Menindee resources are to be shared equally between NSW and Victoria to meet our respective commitments to South Australia, and when the Menindee resource is for NSW to manage for local Lower Darling needs alone. The Murray Darling Basin Authority’s Murray resource assessment assumes a ‘dead storage’ of 480,000 ML for the MLS, effectively setting aside this ‘drought reserve’ for NSW to use entirely to meet local Lower Darling needs as conditions dry.

Under these arrangements, the Murray Darling Basin Authority can call shared resources from Menindee on behalf of states to optimise river Murray operations and maximise Murray resources. Given that the MLS is an inefficient storage, due to its physical setting in a relatively flat, dry landscape, its water tends to be called first to meet downstream demands in the Murray and South Australia. The Menindee Lakes have historically been drawn down heavily under drying conditions and, if inflows are insufficient, the 480,000 ML NSW drought reserve can soon be reached.

Account limits and carryover

The maximum volume¹ of water allocation that may be credited to regulated river access licences in any water year from available water determinations in the Lower Darling Water Source, excluding general security licenses, is 1 ML/share, that is, 100% of entitlement. The accounts of these licence categories cannot carryover water from one year to the next, rather they forfeit any remaining account balance at the end of each water-year.

The maximum volume² of water allocation that may be credited to regulated river (general security) access licenses in the Lower Darling Water Source from available water determinations during a water year is equal to the greater of:

- (a) 0.5 ML multiplied by the number of unit shares specified in the access licence share component,
- or

¹ the Plan Clauses 44 to 47

² The Plan Clause 48

(b) 1 ML multiplied by the number of unit shares specified in the access licence share component minus the volume of water allocations carried over from the previous water year.

This allows those with on-farm storage to carryover greater than the 0.50 ML/share (50% of entitlement) in their accounts, depending on the capacity (airspace) to hold water in on-site storage.

Prior to this provision, general security water users were expected to call their water from MLS and physically store it on-site, so that their accounts could be debited and avoid forfeitures. However, it was more efficient to physically store the water in the Menindee system than on-farm, therefore; this rule was introduced to allow those who had capacity to store water on-farm (airspace) to physically carry that water over in the Menindee system and not have their accounts forfeit water.

Those without on-farm storage can receive up to 1 ML/share (100% of entitlement) in credits each water year (excluding temporary trades), comprising up to 50% carryover, plus allocation.

Resource assessment

Lower Darling Resource Distribution (1 July 2022 to 30 June 2023) (ML)

Resources

Menindee System storage volume (as at 01/07/2022) 1,731,000¹

Minimum Menindee system inflows (01/07/22 to 30/06/23) 0²

Total available resource 1,731,000

Less

Commitments

Basic Land Holder Rights 445³

Domestic and Stock (100%) 1,341

Local Water Utility (100%) 422

High Security (HS) account balance (100%) 7,771

Essential supplies reserve for year 2 (2023/24) 105,134⁴

General Security (GS) account balance (100%) 79,507

Total Commitments 194,620

Less

Operations

Minimum release requirements 95,600⁵

Annual Dilution Flow (ADF) 547,500⁶

Losses (evaporation, transmission, operation) 450,000⁷

Total Operations 1,094,150

Equals

Surplus (or deficit) 442,230⁸

Notes:

(1) Full supply level of the Menindee Lakes system is 1,731,000 ML. Higher volumes comprise temporary surcharge that, to be conservative, is not included as regulated resource. (On 1 July 2022 the system held 1,900,000 ML).

(2) The minimum inflow sequence from 1 July 2022 to 30 June 2023 is conservatively assumed zero. Under (current) surcharge conditions, inflows are effectively spilling. Under a dry scenario, minimum inflows are assumed zero as historically, long periods of zero flows have been observed upstream of Menindee.

(3) Basic Landholder Rights estimated at Clause 18 of the Plan.

(4) Essential supplies reserve comprises minimum releases (95,600 ML) plus high priority entitlements (9,534 ML).

(5) Minimum release requirements given in Appendix 3 of the Plan.

(6) This conservatively assumes the maximum 365 days of NSW share of ADF at 1,500 ML / day in 2022/23. This is a temporary commitment that lapses when Menindee system falls below the trigger level (Table 4).

(7) Opening loss budget for 12 months (2022/23) includes evaporation, seepage, and transmission losses. It is historically highly variable depending on storage surface area and wetted perimeter, and climatic conditions. Given the wet conditions and outlook a reduced value of 450,000 ML has been used. However, a full system under dry, windy conditions can lose up to 730,000 ML over 12 months, but losses are reduced when the storage depletes and/or conditions are mild. (Average annual evaporation of around 1,800mm³ less average annual rainfall of 200mm⁴, on a maximum surface area of 247km² results in annual evaporation loss of up to 730,000 ML).

(8) This value is the result of Resources minus Commitments minus Operations. A surplus means maximum allocations can be made from the resources available with remaining water available to underpin future annual allocations.

Observations and comments on the resource assessment and announced allocations

The high priority commitments in the Lower Darling regulated system are small, just 9,534 ML.

A full general security allocation is 79,507 ML (or about 40,000 ML at 50% allocation)

Running the river at recommended minimums requires at least 96,650 ML per year.

There is a large range and variability in losses across years, depending mostly on weather conditions and the volume (surface area) of water in storage. This value can be anything from 100,000 ML to 700,000 ML per year. While best (conservative) estimates are made for conditions in the year ahead, they are uncertain and this removes any sensitivity from setting a budget and allocating water on 1 July for the 12 months to 30 June. A sophisticated allocation calculation is not warranted, given the uncertainty in the available resource from the start to the end of the year.

For example, if the system is holding more than 600,000 ML on 1 July, it is likely safe to allocate fully (100%) to all high priority and general security entitlements for the year ahead.

If the system is holding less than 300,000 ML on 1 July, it is likely that zero allocation can be made to general security entitlements for the year ahead. Under these conditions the resource is dedicated

³ Bureau Meteorology Average Annual Evaporation: www.bom.gov.au/climate/map/evaporation/evap_ann.shtml

⁴ Bureau Meteorology Average Annual Rainfall: enviro-friendly.com/information/average-rainfall/

to supplying critical needs with contingency measures probably being deployed to extend supplies for as long as possible.

Three times in the past 19 years, the 1 July allocation has not been 0% or 100% of entitlement. On each occasion it was 30% or 50%, based on the outlook of a depleting resource, while full allocation was available to all higher priority entitlements.

For example, on 1 July 2020 the Menindee system had fallen to 480,000 ML or some 28% full. Based on full high priority entitlements, account balances and likely deliveries, it was estimated that an opening allocation of 24 GL to general security water users, some 30% of their entitlement, was an appropriate balance between likely future improvements from a forecast wet (La Nina) summer and the manageable risk of potentially no further significant inflow, noting that allocations can be incremented, but not reduced. In hindsight, the system was holding around 390,000 ML in December 2020, but wet conditions did eventuate and allocations increased to 100% of entitlement in April 2021.

As indicated above, inflows aside, in the Lower Darling more so than other system, it is river operations and the physical release of water in response to calls to meet downstream demands that primarily affects supply longevity, including through severe water shortages, not the allocations. In a worst case scenario, access to water already allocated to licences can be temporarily restricted (S324 of the *Water Management Act 2000*), effectively borrowing water from some water users to extend critical supplies to others, showing again that it is resource management actions, not Lower Darling allocations, that primarily impact MLS resource sustainability.