RIVER LAKES COORONG ACTION GROUP

Discussion Paper No.4:
HOW SOUTH AUSTRALIA MANAGES RIVER MURRAY WATER

(Prepared by: River Lakes & Coorong Action Group)

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EXECUTIVE SUMMARY

Without River Murray water, South Australia (SA) would not exist and relies almost totally on inflows from upstream of SA. However the River is managed upstream, SA bears the consequences.

Flows entering the Murray–Darling Basin (MDB) are highly variable, with occasional floods and prolonged droughts. Storage structures across the Basin total ~23,162 GL in capacity—providing roughly 2.0 years of average storage needs. However, because median annual inflows are substantially lower than mean averages, full storage recovery relies heavily on episodic, high-volume flood events.

The impact of over extraction from the Murray-Darling Basin became obvious during the drought of 1996-2010 when the Commonwealth Water Act, 2007 (Water Act) was introduced along with the Murray Darling Basin Plan (MDBP) to provide the framework for securing a healthy and sustainable working river for the future of all that rely on it, including the environment.

Basin water is managed via strict legal caps, Sustainable Diversion Limits (SDLs), to protect Priority Environmental Assets (PEAs) under an Environmentally Sustainable Level of Take (ESLT). Held Environmental Water (HEW) has been acquired from the consumptive pool of SDLs and environmental flows play a vital role in sustaining the Basin's environment including the Lower Lakes, and the Murray Mouth especially during dry conditions.

Water sharing between the states was first agreed in 1914 and is now incorporated in the MDBP. Under this arrangement SA is entitled to 1,850 GL/y, under normal conditions which is supplied equally from NSW and Victoria. This is approximately 6% of the total consumptive entitlements in the MD Basin.

SA prioritises its total annual intake by law into a hierarchy of: **Priority 1 (696 GL/y),** Non-negotiable Dilution and Loss Allowance to counter toxic salinity and run the physical river; **Priority 2 (204 GL/y),** Critical Human Water Needs (CHWN) to secure domestic drinking water for 90% of the state population; **Priority 3 (~950 GL/year),** Consumptive water allocations (irrigation, industrial, homestead) and environmental water shares.

State allocations fluctuate annually depending on storage levels and climate outlooks. Held Environmental Water (HEW) and environmental return flows play a vital role in sustaining downstream ecology including the Lower Lakes, and the Murray Mouth (CLLMM) region during dry conditions.

During recent dry cycles (e.g. 2018-2020 and 2024–2026), Held Environmental Water (HEW) and environmental return flows from upstream actions constituted the *only* water flowing through the lower barrages. Without this water, lower lakes would have fallen below the critical 0.4 m AHD threshold and may have even fallen below 0.0 m AHD, causing catastrophic soil acidification.

While removing barrages would cut the 800–1,000 GL/year evaporation loss from Lakes Alexandrina and Albert, the incoming flow is mostly upstream environmental return water. Avoiding it would only allow more returned environmental water to flow into the ocean without saving any SDL water.

Removing the barrages would also expand the tidal prism from ~1,420 ML to 16,000 ML, dropping the outcoming-to-ingoing tide ratio from 5.7 down to 1.5. This would cause incoming ocean tides to trap massive volumes of sand inside the mouth, accelerating its complete closure.

The entire CLLMM region is a Ramsar Wetland of International significance. Allowing the freshwater ecosystem to collapse would directly violates Australia's international conservation obligations.

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1. MURRAY-DARLING RIVER FLOWS

The River Murray is vitally important for social, economic, cultural and ecological purposes to all South Australians. Without River Murray water, South Australia (SA) would not exist.

The River Murray in South Australia sits at the end of the Murray-Darling Basin system and is the state's largest reliable surface water resource. The River Murray is essential to supporting internationally significant ecosystems, nationally important economies, culture, and way of life. South Australia has entitlements for around 6 percent of the Basin's extracted surface water resources.

The River Murray is heavily utilised by other states before reaching South Australia and water sharing arrangements and inter-jurisdictional agreements largely dictate the volume and pattern of River Murray flow to South Australia. This means there are constraints on how South Australia manages its take and use of water from the River Murray.

During the drought that occurred between 2001 and 2010, over-allocation and resultant low flows had significant negative impacts on the River Murray in South Australia, with parts of the system on the brink of collapse. The Commonwealth Water Act, 2007 (the Water Act) provides the framework for the Basin Plan and is a step towards securing a healthy and sustainable working river for the future of all that rely on it, including the environment.

The Murray River Waters Agreement has been in place since 1914 and is now part of the Murray-Darling Basin Agreement 2008 (the Agreement) which is incorporated in Water Act and sets out the arrangements for sharing the waters between the Basin States.

The Water Act, 2007 introduces the Basin Plan - a mechanism for a coordinated approach to the management of water resources within the Murray-Darling Basin. The Basin Plan aims to build upon existing approaches for managing the River Murray system, and recognises that a balance between the environment, economies and communities is important to provide for a healthy working river.

The water available each year to South Australia is determined by the Murray-Darling Basin Authority (MDBA) in accordance with the Agreement. South Australia then manages the water it receives with consideration of the Agreement and the Basin Plan.

There are two main catchments for the River Murray; the Northern Basin and the Southern Basin as shown in **Figure 1.**

Figure 1 – The Murray-Darling Northern and Southern Basins

Flows in both basins of the River Murray are highly variable, as shown in **Figure 2.**

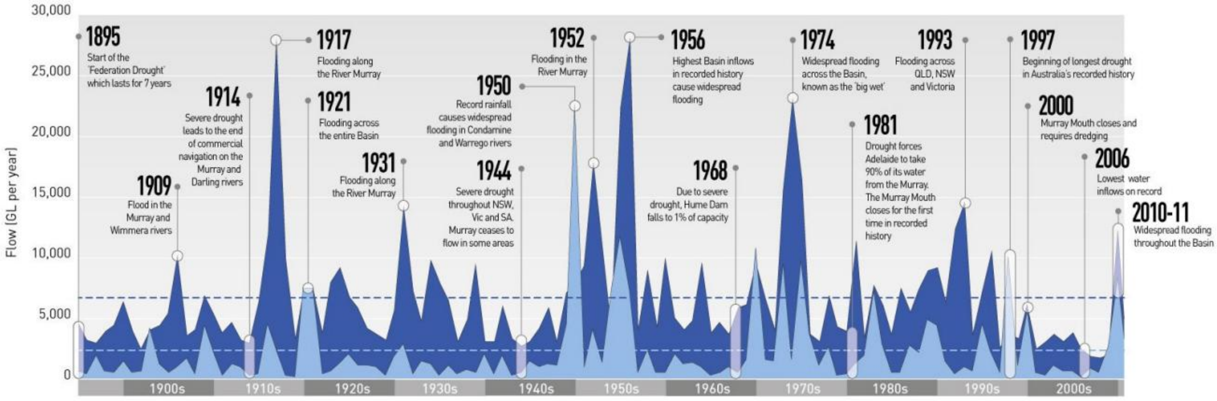


Figure 2. Historical river flows in the Murray-Darling Basin from 1895 to 2011 with major events highlighted. Annual flows are shown for the Southern Basin on the Murray River at Euston (dark blue) and for the Northern Basin on the Darling River at Burke (light blue), with averages shown as dotted lines. Source: MDBA, 2017.[11]

Flows in the Southern Basin have been highly modified with many dams, weirs and other regulators constructed enabling a high degree of regulation of flows to irrigators and other water users in this basin. Flows in the Northern Basin are far less regulated due mainly to the scarcity of suitable dam sites in the flat terrain of this basin. Hence, the Northern Basin irrigators and other water users extract water from the rivers when natural flows are available. Some of these users extract the river water by pumping it into large private dams or intercept flows for storage in a process called floodplain harvesting.

There are 91 public storage structures in the MD Basin with major dams being constructed in phases throughout the 20th century. The two largest and most critical structures were built between 1919 and 1936 (Hume Dam) and 1973 and 1979 (Dartmouth Dam).

In addition to the many storage structures constructed in the MD Basin, there are also many other modifications and engineering structures that have occurred since European settlement.

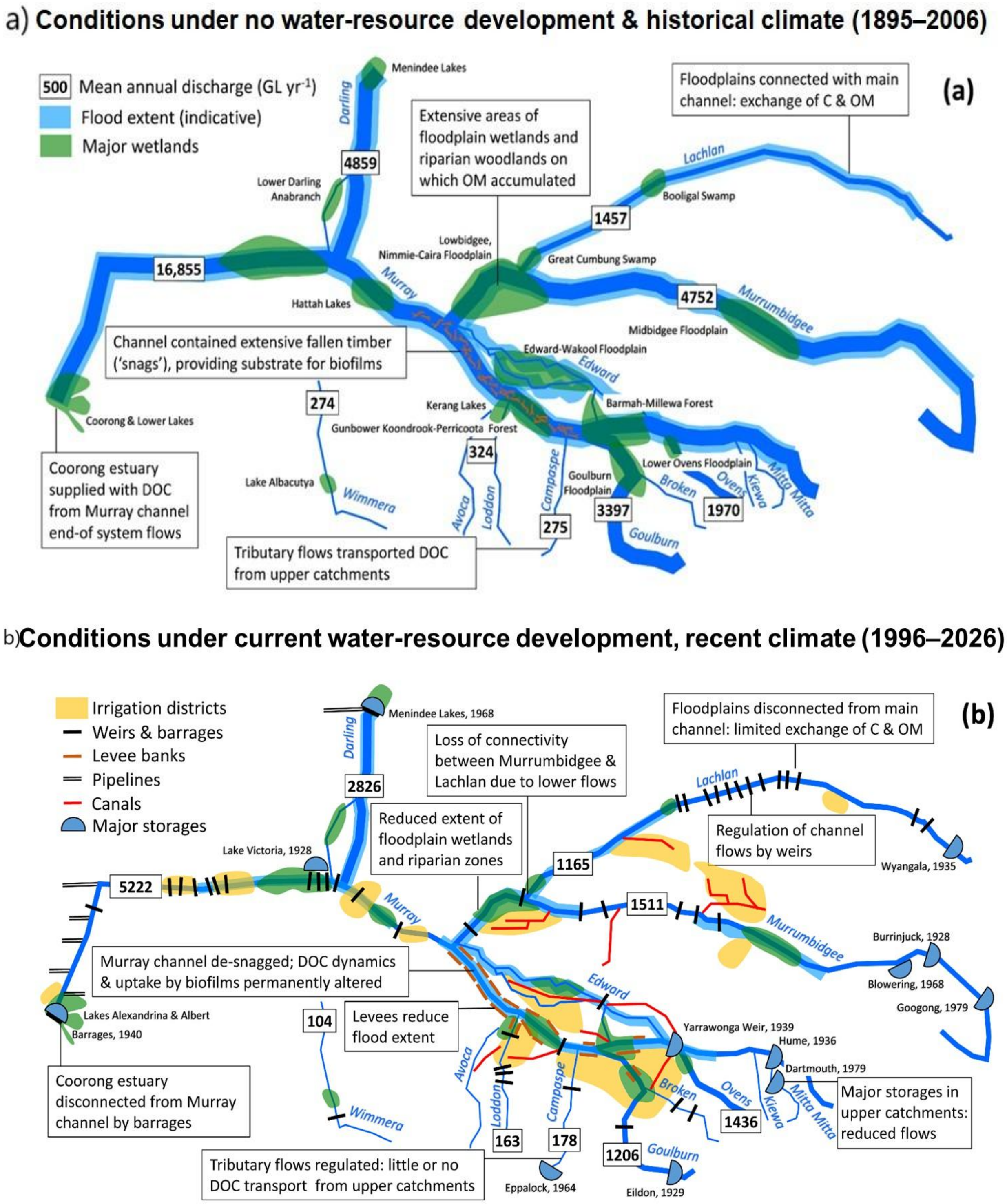
The Murray and Darling Rivers were both used extensively for navigation and trade in the early years of settlement. This led to the removal of natural rock reefs and de-snagging the river channels and clearing of trees along the riverbank for firewood to power the steamboats.

Other engineering structures include weirs, locks, regulators and barrages. Construction on Lock 1 at Blanchetown, South Australia, began in June 1915 and was officially completed in 1922. A total of 13 locks with weirs were built sequentially along the river throughout the 1920s and 1930s. The Yarrawonga Weir in Victoria was the last of the major regulation barriers completed, wrapping up the infrastructure suite in 1939.

The five tidal barrages near the Murray Mouth (Goolwa, Boundary Creek, Mundoo, Ewe Island, and Tauwitchere) were designed to prevent saltwater ingress into Lakes Alexandrina and Albert. Construction commenced in 1935 and was fully finalized in 1940.

Regulation of rivers not only changes the flow rates and timing of flows downstream but also changes physical and chemical properties of the water. Changes in physical properties due to flow regulation which have a significant effect on the environment include flow velocity, water temperature, dissolved oxygen and turbidity, while changes to chemical properties having an impact on the environment include dissolved organic carbon (DOC), organic matter (OM) including organic nutrient critical in natural ecosystems.

Average flows in the major rivers prior to development compared to flows after development of flow regulating structures are shown in **Figure 3**.



Baldwin, D. et al. (2016) Restoring dissolved organic carbon subsidies from floodplains to lowland river food webs: a role for environmental flows? *Marine and Freshwater Research* 67, 1387–1399. http://dx.doi.org/10.1071/MF15382

Figure. 3. - Changes in Average Annual River Flows (inflows minus diversions) and carbon dynamics of rivers, floodplains and wetlands of the southern Murray–Darling Basin under
(a) no water-resource development and historical climate (1985–2006) and
(b) current water-resource development, recent climate (1997–2006).
Flow data from CSIRO, (2008).
DOC, dissolved organic carbon;
OM, organic matter.

2. HOW MURRAY-DARLING BASIN WATER IS SHARED

Water in the MD Basin is not split into static, fixed volumes because the total volume changes every year based on rainfall and inflows. Instead, the legal rules set structural percentage splits for shared water systems, paired with strict historical limits on how much total volume each state is allowed to divert.

Water in the Southern Connected MD Basin is shared between New South Wales, Victoria and South Australia (see **Figure 4**.). Queensland extracts water from the Northern Basin (Darling/Barwon River System) based on regulations dependent mainly on river heights.

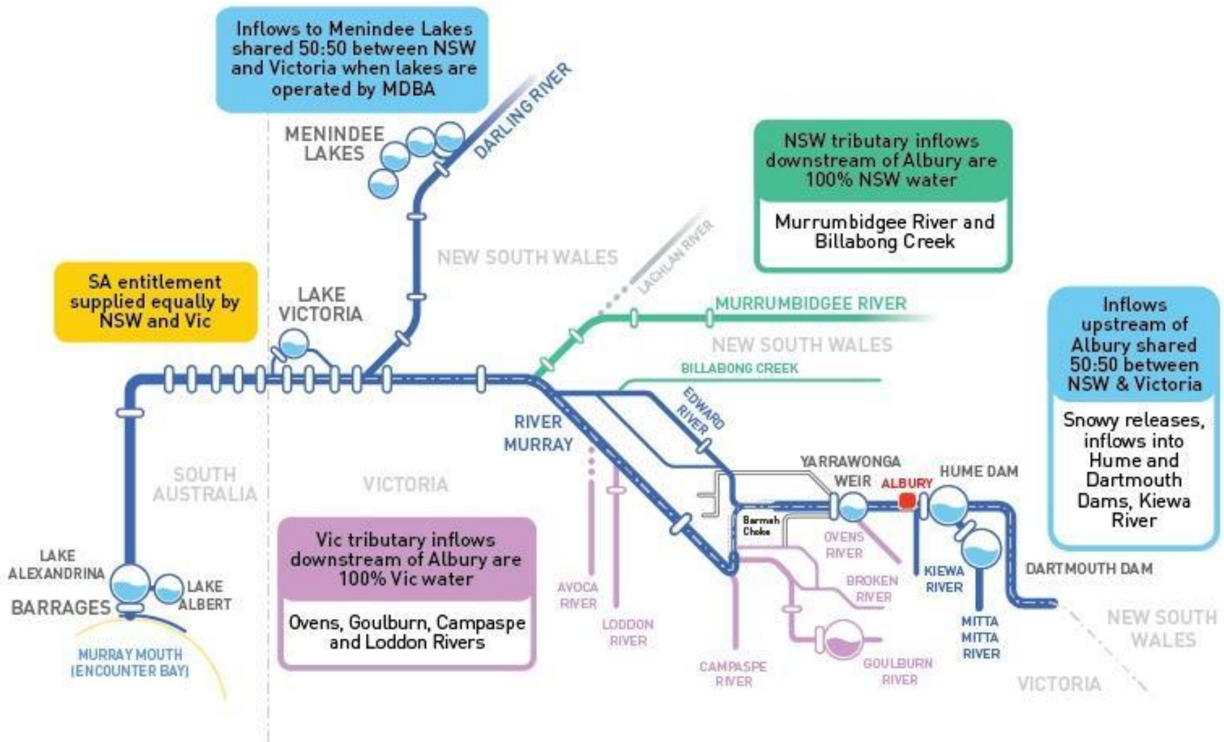


Figure. 4 – A Schematic of the Southern Connected MDB (Source MDBA)

The River Murray runs along the border of New South Wales and Victoria and then into South Australia. All three states rely on a certain amount of water from the river. The rules for sharing this water are outlined in the Murray–Darling Basin Agreement, 1989 (amended in 1992) which replaced the original River Murray Water Agreement, 1914 and are now incorporated as Schedule 1 of the Commonwealth Water Act, 2007.

The Murray Darling Basin Authority (MDBA) is legally responsible for sharing water according to this agreement. It acts as an independent body to make sure each state gets the water it is entitled to from the major River Murray storages (the Hume and Dartmouth Dams and Lake Victoria), and in some instances, water from the Menindee Lakes.

Water is not simply divided into 3 even parts. Victoria and New South Wales each receive:

- 50% of water flowing into the Hume Dam
- 50% of water flowing in the Kiewa River
- 50% of water flowing into the Dartmouth Dam
- 50% of water in the Menindee Lakes when they contain more than 640 gigalitres (GL) of water, at which point the MDBA has access to the lakes. When the amount of water falls below 480 gigalitres, only NSW receives water from them until they next reach 640 gigalitres.

Not all the water in the River Murray system is shared between the three states. Water flows into the Murray from tributaries in both New South Wales (NSW) and Victoria. Water flowing into the Murray from rivers downstream of Albury, such as the Murrumbidgee and the Goulburn, is owned by the state the water flows through. (See **Figure 4**.)

South Australia (SA) receives a maximum volume of 1,850 GL which it can rely on in most years, except when there has been very low rainfall (Tier 2 or Tier 3 drought operating rules). Victoria and New South Wales each provide half of South Australia's share from the water they have available.

The share of this Murray River water that each State has received under the current water sharing agreement is approximately:

- NSW – 53%
- Victoria – 36%
- South Australia – 11%

In addition to the shared flows from the River Murray, NSW and Victoria also have control of the water flowing from the tributaries downstream of Hume Dam. On average, Victorian tributaries deliver an additional 3,300 GL/y and the NSW tributaries deliver an extra 1,550 GL/y. Flows from tributaries in SA are considered insignificant and are not included in any water sharing arrangement.

Unregulated flow in the River Murray Prescribed Watercourse, which covers the main channel of the river from the Victorian border down to the sea, is classified as 'Planned Environmental Water'. This is water that is preserved for environmental outcomes and cannot be used for any other purpose.

3. ENTITLEMENTS v ALLOCATIONS

In the River Murray system, the MDBA calculates how much water belongs to New South Wales, Victoria and South Australia before the states determine water availability for allocations. Basin state governments allocate water within each water catchment, depending on how much water is available. The MDBA is not involved in deciding on the amount of water to allocate to entitlement holders.

In accordance with the Water Act, 2007, Sustainable Diversion Limits (SDL) are set for each of the 29 surface water catchments within the MD Basin to ensure that they meet the Environmentally Sustainable Level of Take (ESLT) which is needed to maintain a moderately healthy river environment of 33 Priority Environmental Assets (PEA's) which have been identified by the Act.

State Jurisdiction	**SDL - Legal Cap on Consumptive Water**	**%**	**Cap Context**
New South Wales	~6,100 GL/year	54%	Largest agricultural footprint and network of rivers.
Victoria	~3,000 GL/year	27%	High density of dairy and fruit irrigation systems.
Queensland	~1,500 GL/year	13%	High variability, mainly cotton.
South Australia	~630 GL/year	5.6%	Cap excludes the water required to run the river and prevent salinity.
ACT	~50 GL/year	0.4%	Mainly urban uses e.g. drinking water, lawns, etc.

There are three types of water that is accounted for in this system:

- River Water – water which stays in the river or is lost by evaporation or seepage.
- Consumptive Water – water extracted from the MD Basin,
- Held Environmental Water – water used to maintain the MD Basin's environment,

Each state government has agencies which are responsible for working out how much water is available and for getting it to where it needs to go. Some State agencies are State-owned, while others are statutory corporations which have been nominated by the State. There are different arrangements for different States, but in some instances one State agency is responsible for allocating water, while a separate agency is responsible for ensuring that water is delivered where it needs to go. In South Australia, the Department of Environment and Water is responsible for water allocations and managing flows.

Basin States are required to develop a Water Resource Plan which comply with the SDL set for that catchment for each of the 29 catchments in accordance with the Water Act and MDB Plan. Each catchment is governed by its own strict extraction rules to balance requirements between towns, farms and the regional ecology, and must be endorsed by the MDBA.

South Australia's Landscape South Australia Act, 2019 also requires Water Allocation Plans to be prepared for each of SA's prescribed catchments. These set the rules for managing, sharing, and using water from the prescribed water resource and mandates regular monitoring requirements to track water volume, water levels, and salinity risks.

The amount of water available to be allocated changes from year to year and depends on storage levels and weather conditions prevailing at the time. Also, water availability is not the same across the Basin. Water allocations are calculated individually for each catchment according to availability. **Figure 5** shows the historic annual surface water take.

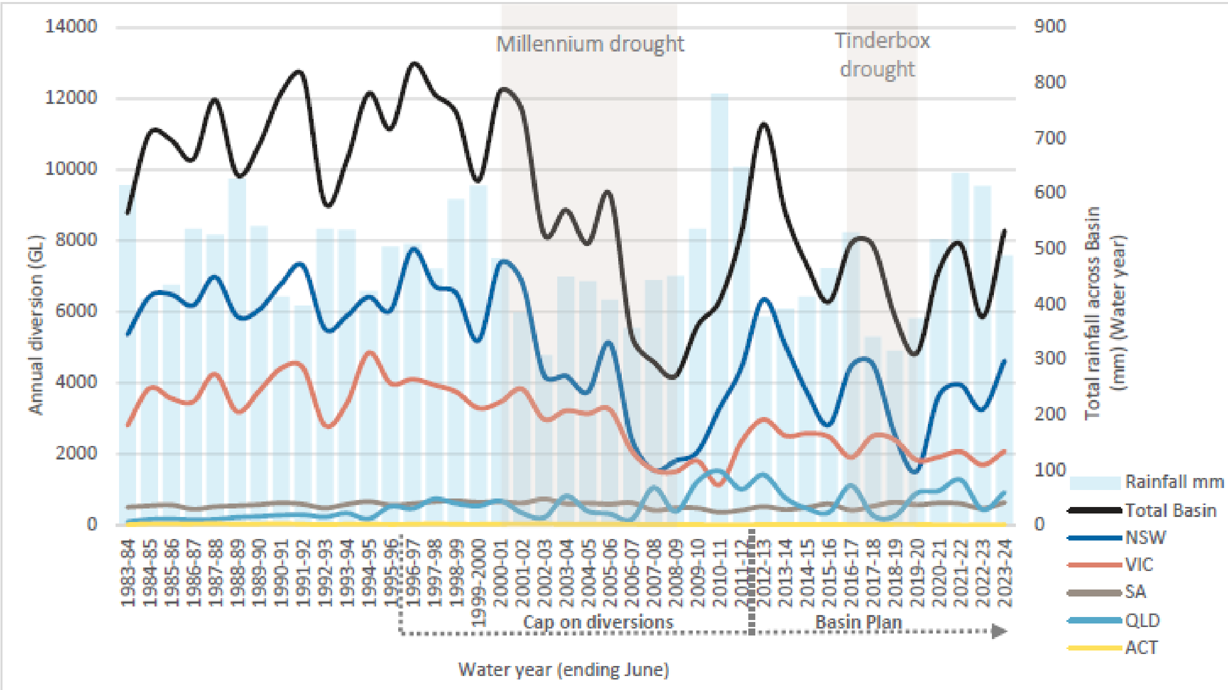


Figure.5 – Historical Surface Water Annual Actual Take. (MDBA, 2025)

River Murray water is allocated differently in each State because each has its own management approach, unique water products, unique industries and different rules and regulations about when and how water is allocated. However, Basin States must comply with the rules and limits in the MD Basin Plan, 2012.

When water is allocated to an irrigator by their state authority, it is up to the individual to determine how they use their water. Irrigators can choose to:

- Use their water on their farm,
- Trade all or some of their allocated water to another water user,
- Buy allocated water from another user to supplement their needs,
- Save water for the next irrigation year, which is called "carry over" (some entitlement licenses limit how much water can be carried over,
- Leave their water un-used, which means it stays in the storage for re-allocation the following year. There are rules to ensure carry overs do not unfairly affect other States.

At the time of its commencement in 2012, too much water was being extracted and the Basin Plan required a reduction in long-term average consumptive surface water diversions (as they were understood at the time) to achieve the Basin-wide SDL estimate of 10,873 GL/y (now estimated at 11,850 GL/y). This required a reduction in the long-term average diversions of 2,750 GL/y, which was in addition to water entitlements that had been recovered for environmental use prior to 30 June 2009. This is known as the surface water **Bridging the Gap** target and is the amount of water to be recovered as part of the Basin Plan. The water acquired was to be made available, to achieve the environmental objectives of the Basin Plan.

Prior to the Basin Plan, water for the environment had been recovered through programs such as The Living Murray (488 GL/y), Water for Rivers (250 GL/y) and various State programs (191 Gl/y). The water recovery commitments in the period 2004–09 were taken into account when determining the BDLs and SDLs for each SDL resource unit area.

The surface water recovery target builds upon these historical efforts to improve environmental outcomes. Basin Plan amendments in 2018 impacted both the SDL and the surface water recovery target. Together, the SDL adjustment mechanism (SDLAM) and the Northern Basin Review reduced the Basin-scale surface water recovery target from 2,750 GL/y to 2,075 GL/y. The Basin Plan also allows for the recovery of 450 GL/y of water rights for enhanced environmental outcomes. This is in addition to the 2,750 GL/y, bringing the Basin Plan total water recovery target to 3,200GL/y (see **Figure 6).**

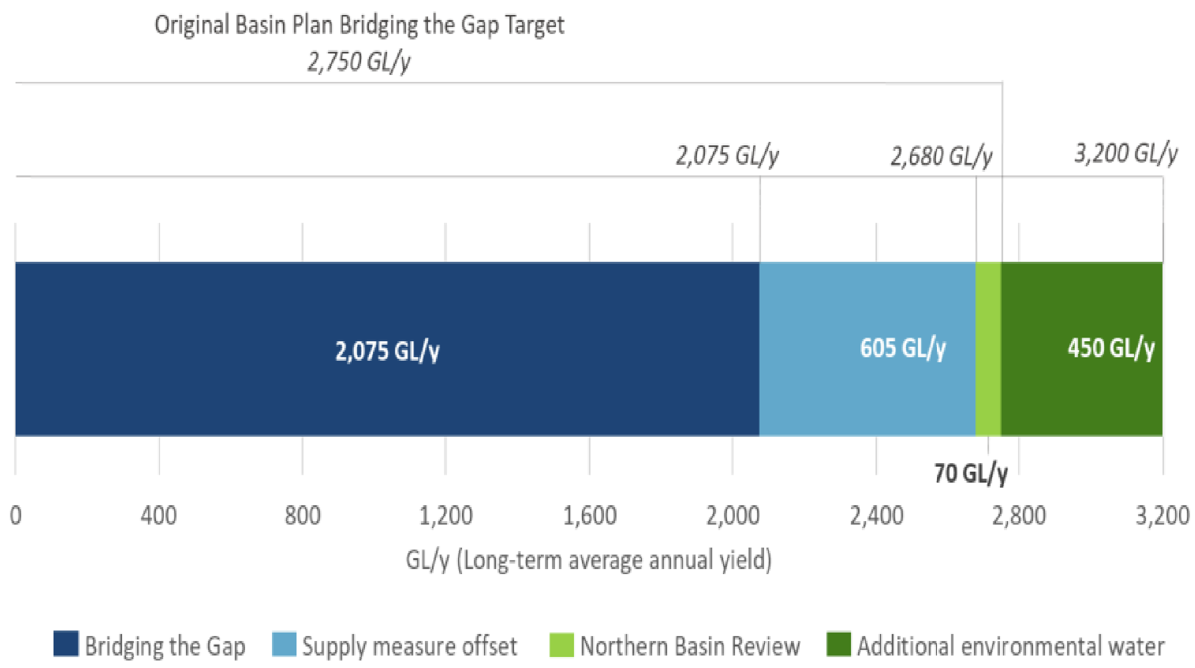


Figure 6 - Basin-wide surface water recovery and SDLAM targets. (MDBA, 2025)

Held Environmental Water (HEW) has been acquired progressively since 2008 from the consumptive pool of water entitlements as shown in **Figure 7**.

The Commonwealth Environmental Water Holder (CEWH) holds approximately 163 GL of South Australian water access entitlements (as at 26 June 2026). This is legally incorporated into South Australia's standard 1,850 GL/year annual Entitlement Flow.

For reporting of HEW entitlements, both the water entitlement volume and a long-term annual average yield (LTAAY) volume are considered. The LTAAY volume is derived using long-term diversion limit equivalent factors (also known as ‘Cap factors’).

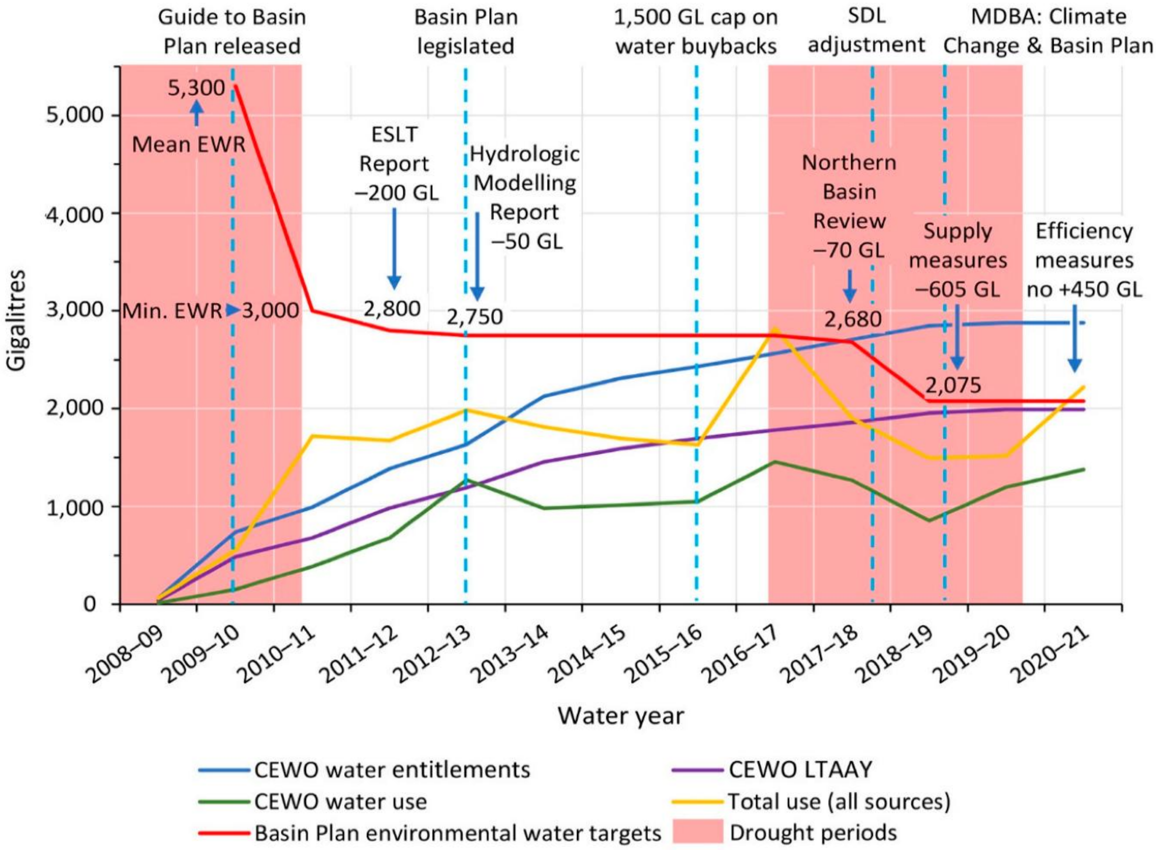


Figure. 7 - Recovery and use of water for the environment in the Murray–Darling Basin and adjustments to targets for environmental water requirements (EWR) in terms of long-term average annual yield (LTAAY) of Commonwealth Environmental Water Office (CEWO) water entitlements. (ref: Colloff & Pittock, 2022)

LTAAY enable differing entitlements across the Basin to be converted into a common currency to allow for direct comparison between products with differing reliability and expected usage under the rules of the relevant water sharing arrangements.

Under the Basin Plan, CEWH is required to manage and deliver water in accordance with the Basin-wide Environmental Watering Strategy (MDBA, 2025). The development of long-term watering plans by Basin States also informs the planning and use of environmental water.

The Inspector-General of Water Compliance (IGWC) was established in 2021 and is tasked with providing strict, independent oversight over how both state and federal government bodies manage water (https://www.igwc.gov.au/what-we-do/reviews-and-reports).

The total storage capacity of the 56 major storages (excluding weirs not considered as storages) within the Murray–Darling Basin region is 23,162 GL (Bureau of Meteorology) and an annual sustainable diversion limit of approximately 11,850 GL/y (as currently adjusted). Hence there is approximately 2.0 years of storage of average water needs.

The average inflow to the MD Basin, with full implementation of the Basin Plan, is estimated to be 13,001 GL/y (MDBA Report No. 23/26) which is more than the average amount released from storage of 11,850 GL/y. In addition, there are losses from storages due to evaporation and seepage which makes the basic system equation nearly balance:

$$Change\ in\ (Storage\ Volume) = Inflow - (Outflow + Losses)$$

However, this is deceptive as the median annual inflow (the median value has the same number of annual flows greater, as the number of annual flows less than the median value) is much smaller (approximately half) that of the average annual flow (sum of all annual flows divided by the number of values summed) due to the occasional very high flood peaks which significantly inflate the average annual flow and hence the total storage volume is likely to drop for several concurrent years before being refilled by an infrequent flood event.

During wet years, inflows may overflow storages and flow through the Basin as unregulated flows. Thes may be used for extraction depending on rules and regulations in each catchment.

During extreme drought events lasting several years, actual State allocations can plummet to a fraction of their entitlement (see **Figure 5**), while wet years allow states to fully utilize their entitlements or carry over unused water to the following irrigation cycle. Not all allocations are fully used or carried over but stay in storage and are available for re-allocation the following year as shown in **Figure 8**.

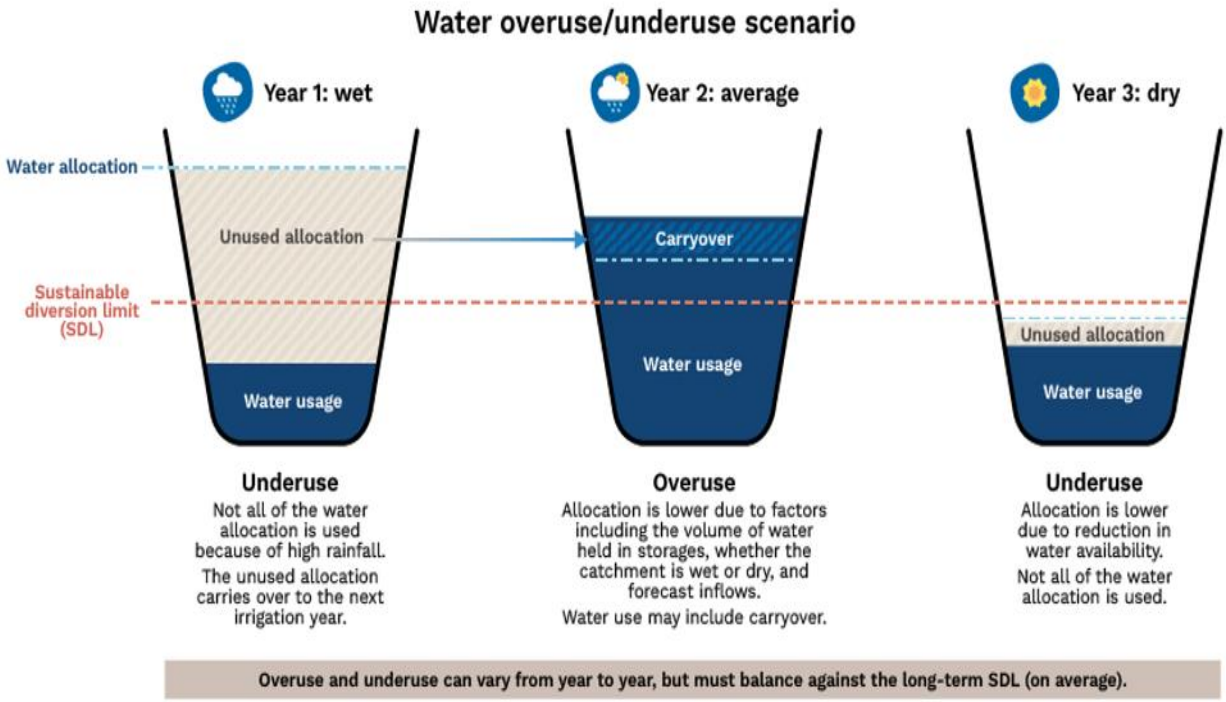


Figure. 8 – Change in Storage Volumes from Year to Year.

Hence, basin storage volumes are not regularly fully restored each year. Only during major floods such as in 2022/23, do all the storage structures fill to full storage and unregulated flows may over top storage structures and flow downstream and out the Murray Mouth to the sea. This can be seen from the historic total basin storage volume from year to year as shown in **Figure 9.**.

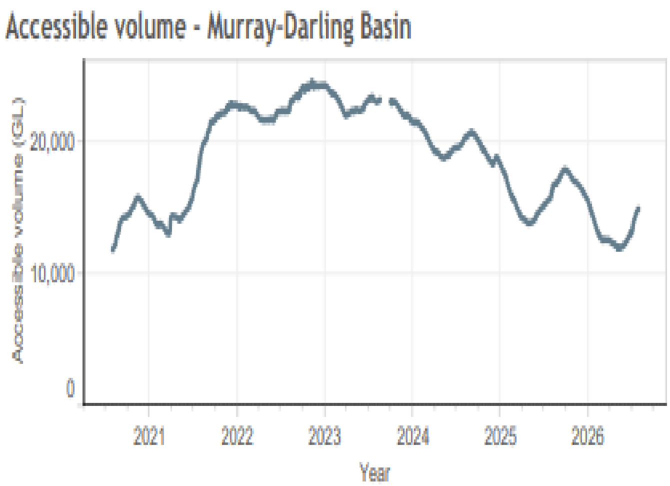


Figure. 9 – Total MD Basin Available Storage Volume over Time (BOM)

Due to the Millennium Drought, an important element of SA's water security framework, the SA Storage Right, was incorporated into the MD Basin Agreement in 2012. SA aims to have 150% of its Critical Human Needs Water (CHWN) i.e. 306 GL held in storage.

4. REGULATION AND REQUIREMENTS OF SA WATER ALLOCATIONS

Regulations and requirements that must be satisfied when managing the water that flows across the border into SA include:

(1) Minimum Dilution & Conveyance Rules

Before any water can be extracted for consumptive allocations in SA (irrigation, industry, domestic use), the Basin Plan and the Murray–Darling Basin Agreement legally enforce a non-negotiable **696 GL/year Dilution and Loss Allowance**. The Basin Plan contains an explicit Salt Export Objective to flush an average of **2.0 million tonnes of salt per year** out through the Murray Mouth.

(2) Salinity Targets for Flow Management

Chapter 9 of the Basin Plan sets **operational salinity targets** at key River Murray monitoring locations. River operators and environmental water holders must manage flows so that salinity levels stay below these specific electrical conductivity (EC) or concentration thresholds for at least **95% of the time** over a 5-year rolling period:

Lock 6 (SA Border)	< **580 EC** (~350 mg/L)
Morgan	< **800 EC** (~500 mg/L)
Murray Bridge	< **830 EC** (~520 mg/L)
Milang (Lake Alexandrina)	< **1,000 EC** (~600 mg/L)

(3) Coorong, Lower Lakes and Murray Mouth (CLLMM) Hydrological Requirements

The Basin Plan sets specific environmental water requirements (EWRs) and operational constraints for the Coorong, Lower Lakes, and Murray Mouth (CLLMM) Ramsar wetland complex as follows:

- Lake Alexandrina & Lake Albert Water Levels:
    - Operating guidelines generally require water levels in Lake Alexandrina to be managed above **0.4 metres AHD** (Australian Height Datum) to protect against soil acidification (acid sulfate soils) and maintain structural bank stability.
    - Seasonal target operating bands fluctuate between **0.5 m to 0.85 m AHD** to mimic seasonal water level variations, support fringing vegetation, and enable connectivity between the lakes.
- Barrage Operations & Murray Mouth Openness:
    - Barrage gates (e.g., Goolwa, Tauwitchere) must be operated dynamically to maintain end-of-system environmental flows, prevent seawater ingress during high tides, and flush sediment to keep Murray Mouth open without continuous dredging if possible.
- Coorong Salinity Thresholds:
    - While Coorong salinities fluctuate, environmental water schedules under the Basin Plan aim to keep the South Lagoon below 100 g/L (ppt) to preserve hyper-saline habitat suitable for key species like Ruppia tuberosa, small-mouthed hardyhead fish, and migratory shorebirds.

5. HOW SA WATER IS MANAGED

Each year South Australia receives Entitlement of up to 1,850 GL (the Entitlement), plus other ‘required flow’ including unregulated flows, water traded to South Australia (including environmental water deliveries) and other dilution flows as determined by the Agreement such as Additional Dilution Flow (3 GL/day when storage triggers are met in the Menindee Lakes and Hume and Dartmouth Reservoirs) and Lindsay River Dilution Flow (~65 GL/year).

The water share (1,850 GL/y) that SA receives is legally prioritised in the following order:

- **Priority 1:** 696 GL/y (58 GL/mth) – Dilution and Loss (Conveyancing and Salinity),
  - Required to purely run the River from SA Border to Wellington and combat toxic salinity levels.
- **Priority 2**: 204 GL/y – Critical Human Needs Water,
  - Secure essential drinking and domestic supplies to 90% of SA's population (Note in dry years, urban extractions are reduced by use of Adelaide's Desalination Plant to preserve irrigators' water shares)
- **Priority 3**: 950 GL/y – Consumptive Water Entitlements (Classes 1, 2, 3, & 5), subject to Cap of 630 GL/y plus Environmental Water (Class 8).
  - Class 1 – Domestic/Homestead water
  - Class 2 – Livestock
  - Class 3 – High security or Low Security irrigation water
  - Class 5 – Industrial and commercial
  - Class 8 – Environmental water for wetland and floodplain health

In dry conditions when SA receives less than 1,850 GL/y, water is distributed strictly in accordance with priority hierarchy, protecting domestic supplies and dilution flows before consumptive extractions are permitted.

The River Murray in SA is recognised to have two irrigation regions – the Riverland and the River Murray below lock 1 (see **Figure 10**). The Riverland region has a high dependence on irrigation, with wineries, packing sheds and food processing being reliant on a consistent supply of irrigated crops. The Riverland is a large wine producing region and is also well known for the production of citrus, stone fruit, almonds and vegetables.

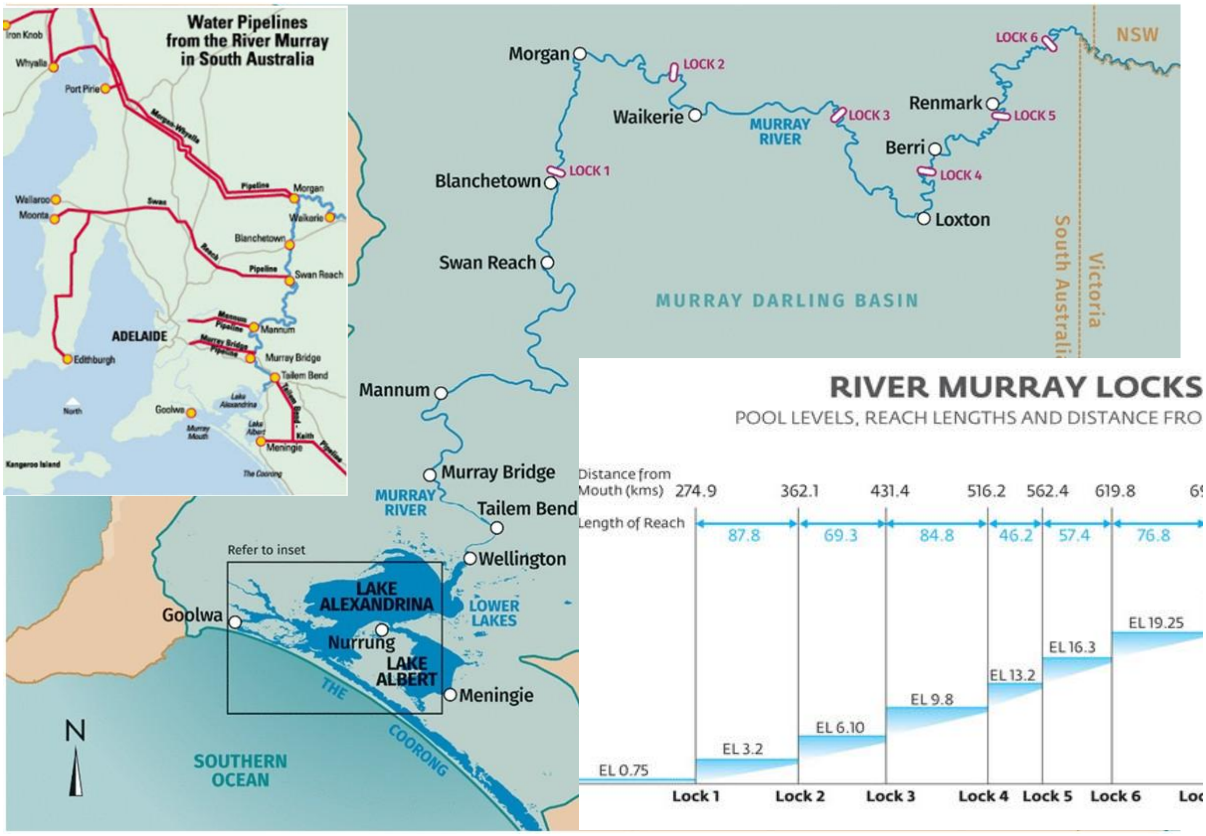


Figure 10 – Map of River Murray in SA with Details of Water Supply Pipelines and Lock details.

SA farmers in the Riverland, in particular, are very dependent on irrigations water as dry land farming is not an option due to the low rainfall in this area.

The main industries in the River Murray below Lock 1 region are agriculture (both irrigated and dryland), retail trade and manufacturing. Boating, fishing and tourism industries are also important around Lake Alexandrina and Lake Albert. The dairy sector in the Lower Murray Swamps and Lake Alexandrina and Lake Albert region has declined in recent years, with dryland farming and viticulture now dominating.

In addition to SA water entitlements, Held Environmental Water (HEW) may supplement flows into SA. These HEW flows are managed by the Southern Connected Basin Environmental Watering Committee (SCBEWC) who prepare an annual plan for how water for the environment will be managed. The SCBEWC is made up of representatives from NSW, Victoria, SA and the Commonwealth.

In 1969, SA was the first state to impose a cap on extractions from the River Murray. Other States did not follow until 1998 when The Murray-Darling Ministerial Council proposed a cap on further licensing of extractions. However, SDL's were not legally enforceable until 2019.

Following the imposition of the cap on extractions in SA in 1969, SA irrigators invested heavily in irrigation efficiency measures to achieve higher production with less water usage without any Commonwealth Government financial assistance.

Under the water allocation plan (WAP) for the South Australian River Murray, which was developed in partnership with irrigators and other stakeholders, allocations are determined using a deliberately conservative approach to minimise the risk of allocations going backwards over a water year.

Water account balances changes as water is used from the river and these changes are recorded in the SA Government's "mywater portal". The account balance is updated with meter readings and approved water trades. For example, water accounts can be credited with allocations from various sources, such as:

- annual allocations under a water access entitlement share
- transfers of water allocation
- carryover allocations.

The make-up of total flows at the SA border including environmental flows and unregulated flows in recent years is shown in **Figure. 11**, while flows in 2025/6 are shown in **Figure. 12**.

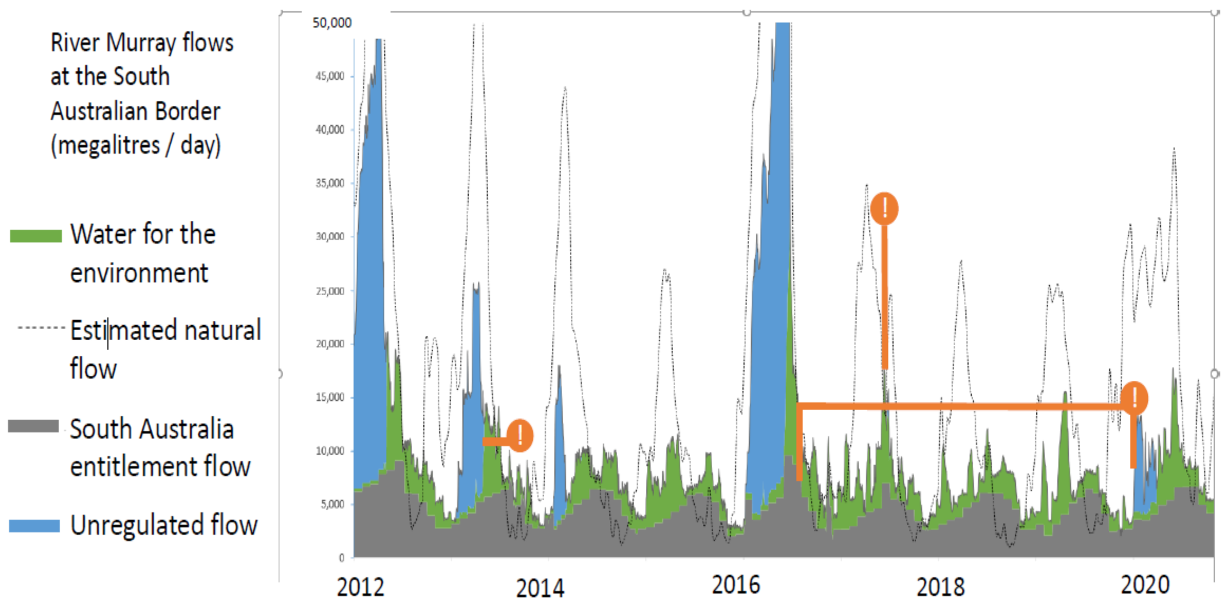


Figure. 11 – Contribution of Environmental Water at the SA Border (MDBA)

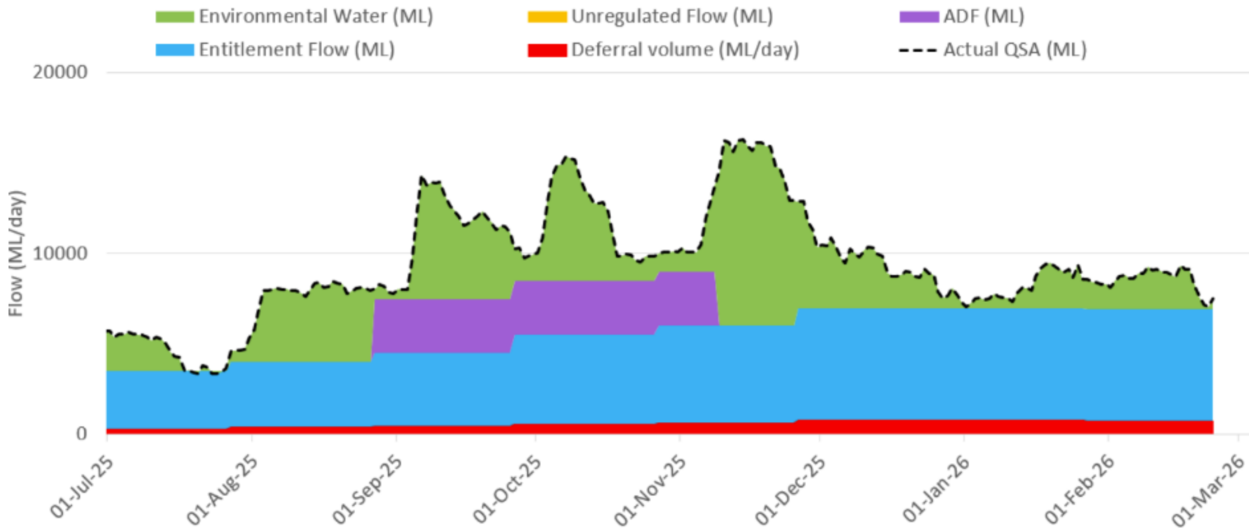


Figure. 12 – Contribution of Flow Types in 2025/26 (DEW)

In 2024-25, ~1,287 GL of environmental water, including ~976 GL of CEWO, was delivered to the South Australian border, largely as return flows from upstream watering actions. A total of 60 CEWO actions were undertaken, nine of which targeted outcomes in the Lower Murray River (LMR) main channel and CLLMM. Four of these, accounting for ~959 GL (98% of total CEWO use), were the delivery of baseflows and small freshes for a range of objectives including native fish, vegetation, waterbirds, hydrology/connectivity, processes, resilience and water quality.

Flow management objectives in the Lower Murray region are provided below, based on current understanding of flow-related ecology in the LMR:

- Environmental water can help reinstate key features of the natural hydrograph to support hydrodynamic and ecosystem restoration e.g. spring–early summer flow pulses of 15,000–19,000 ML/d are needed to substantially restore riverine characteristics in the LMR and achieve greater ecological outcomes (e.g. significant recruitment of golden perch
- Under regulated conditions, achieving and sustaining flows >20,000 ML/d in the LMR is challenging with existing volumes of water for the environment and delivery constraints. The coordination of flow deliveries across the southern MDB, that is responsive and flexible to rain events, is likely required to achieve this aim.
- Environmental flows are pivotal in maintaining Lower Lakes water levels, barrage flows and end of-system connectivity in the MDB, particularly during low flow periods. This is critical to support species' life history processes and for a functioning river ecosystem.

6. WATER DISCHARGED AT THE BARRAGES

Lakes Alexandrina and Albert act as a gatekeeper and if the River's inflow into the lakes drops below 1,000 GL/y, evaporation may exceed inflow. When this happens, the water level in the lakes drops below sea level and the barrage gates must stay tightly shut to prevent seawater from moving inland, and the Coorong estuary begins to starve of fresh water.

To comply with the Salt Export Objective, the minimum annual flow requirement to be discharged through the barrages is no less than 650 GL/y in a single year and a 3-year rolling average barrage flow of 2,000 GL/y i.e. 6,000 GL in total over 3 years. Flows discharged through the barrages in recent years is shown in **Figure. 13**.

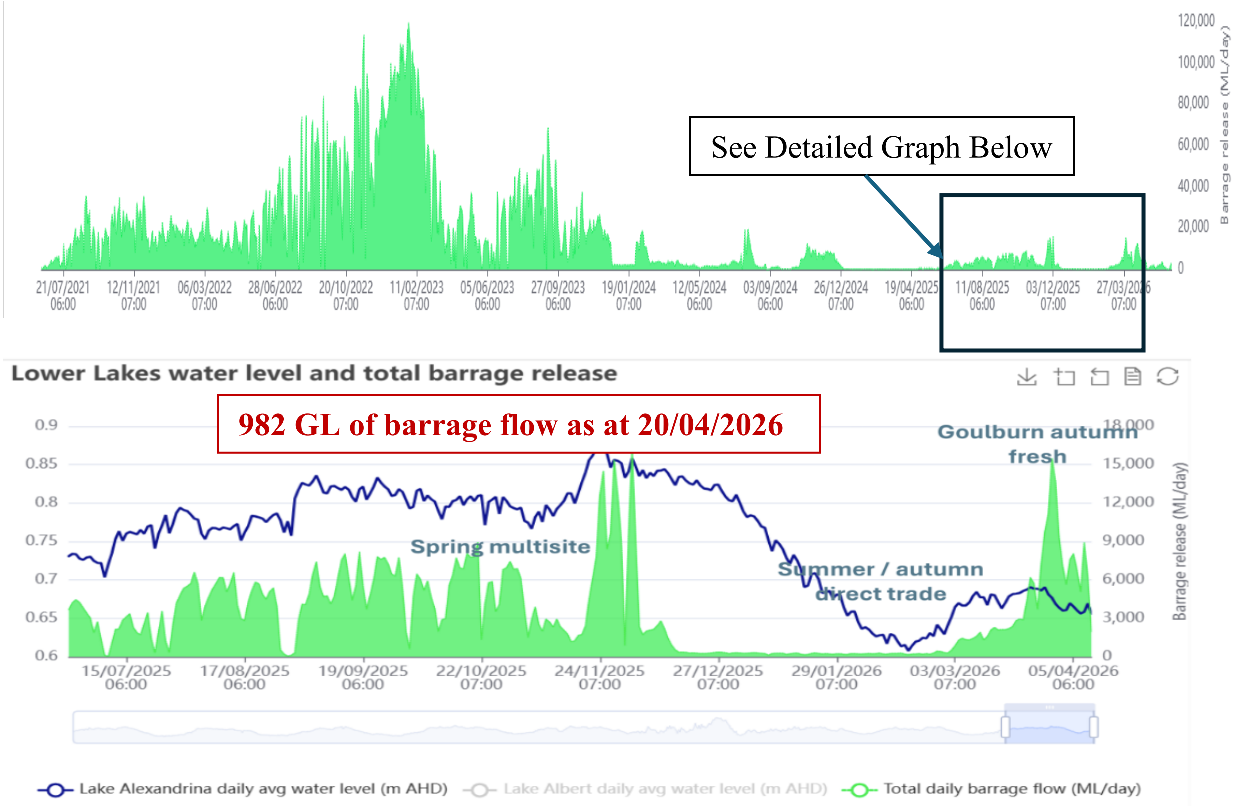


Figure 13 – Flow Discharged through the Barrages in recent year, include detailed view of 2025/26

As can be seen in **Figure 14**, comparing flow at the SA Border and that flowing through the barrages in 2024, the only water flowing through the barrages in recent dry years (2024 to 2026) has been environmental water. If this was not available, water levels in Lakes Alexandrina and Albert would have again fallen to critical levels (<0.4m AHD) as in the Millenium Drought.

Between 2014 and 2021, water level in the Lakes would have fallen below 0.4m AHD in 4 of the 7 years without environmental flows. While 100% of the flows through the barrages to the Coorong in 3 of the past 10 years has been all environmental water and this has exceeded 650 GL/y in 8 out of the 10 years which is critical for flushing salt from the Basin. (CEWH, 2026)

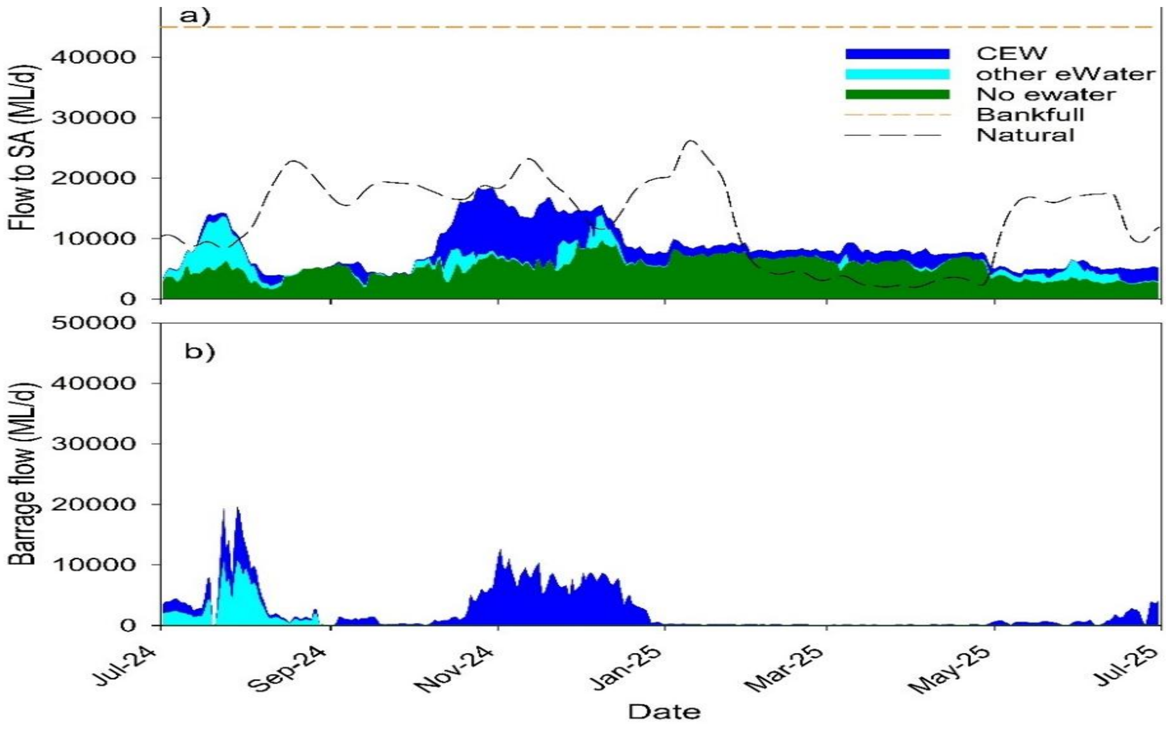


Figure 14 – Total Flows at SA Border and through Barrages in 2024/25

As can be seen in **Figure 15**, after wet years in 2022 and 2023, the salinity of Lake Alexandrina was very low (approx. 400 EC), however 2024 to 2026 were dry years and the salinity of Lake Alexandrina increased back to its maximum target value of 1,000 EC.

Figure. 15 – Salinity levels in Lake Alexandrina (Recorded at Milang) (DEW)

Considerations for management of barrage flows include:

Ecological Objectives:

- Promote successful migration and recruitment of diadromous fish species in the Lower Lakes and Coorong
- Maintain or improve aquatic and littoral vegetation in the Lower Lakes
- Maximise fish passage connectivity between the Lower Lakes and Coorong
- Support aquatic habitat by establishing and maintaining variable salinity regimes in the Murray Mouth Estuary and North and South Lagoons.
- Maintain or improve waterbird populations in the Lower Lakes, Coorong and Murray Mouth
- Restore resilient populations of black bream and greenback flounder in the Coorong
- Maintain or improve mudflat invertebrate communities
- Maintain or improve Ruppia tuberosa colonisation and reproduction

Lakes water levels:

- With water levels lower than 0.5 m AHD, irrigators downstream of Mannum have issues accessing water.
- Holding water levels up high (>0.85 m AHD) for too long can contribute to lakeshore erosion.
- At the end the water year (30 June), water levels should be at or above 0.65 m AHD to start the next water year in a strong position.
- "Only consider a lake level cycle to flush salt from Lake Albert if conditions are wet and there's plenty of water"
- The seasonal pattern of raising and lowering lake levels helps to improve aquatic vegetation condition.
- Lake levels <0.5 m AHD are detrimental to southern pygmy perch populations, with >0.6 m AHD preferred.
- Surcharging Lower Lakes water levels in spring and early summer supports frog and fish breeding.

Barrage Operations:

- Keeping the 11 barrage fishways operating year-round (~270 ML/d), even in dry times, is of the highest priority.
- Flow in spring-early summer is prioritised to support Coorong waterbirds, fish, plants & invertebrates.
- If conditions are dry, 'pulsing' releases from Tauwitchere in line with suitable storm / wind / tide conditions helps push freshwater into the South Lagoon.
- Flows from Tauwitchere in March and April are important for Coorong salinity during the annual increase in oceanic water levels and reconnection of the north and south lagoons.
- Opening barrage bays adjacent to fishways in winter allows adult congolli and galaxias to move downstream to spawn.
- Flows of 600–5000 ML/d in December – February, particularly from Goolwa barrage, support black bream recruitment.

First Nations Considerations:

- Maintaining connectivity of flow between Murrundi (River Murray), Lake Alexandrina, Kurilpang (Lake Albert), the Kurrangk (Coorong) estuary and the Murray Mouth (Meeting of the Waters) site is very important to Ngarrindjeri. The place where the fresh and salt waters mix is a place of creation for Ngarrindjeri Ngatjis (ancestor).
- Ngarrindjeri understand that the Kurrangk particularly the South Lagoon is suffering with a reduction in flow and a build-up of salinity and nutrients which is affecting Ngatjis and Ruwi (river). Priority should be given to address this and tailor barrage releases to maximise flow down to the Kurrangk South Lagoon.
- Waterbirds such as Kungari (black swan) and Nori (pelican) are important Ngatjis, and their abundance is an indicator of a healthy Ruwi. Kungari eggs are a food source for Ngarrindjeri and collection of these is a significant part of cultural practice. Ngarrindjeri recognise the importance of protecting all waterbirds through maintaining flow through Murrundi.
- Pondi (Murray cod) is key to the Ngarrindjeri creation story of Ngurunderi (creator) who created all fish, the waterways and islands. The Ngarrindjeri community have an aspiration to return Pondi back to the Lower Murray.
- A healthy population of Thukabi (turtles) and Korbili (frogs) are required for Ngarrindjeri to continue cultural practices. With increased water availability, it would be good to support the re-introduction of the freshwater Murray crayfish so they could return to Ngarrindjeri Ruwe.

7. FLOWS TO THE COORONG

(1) Source of Freshwater to the Coorong

Because the main source of freshwater to the Coorong is from the River Murray, freshwater must pass through the Northern Lagoon to the Southern Lagoon and hence there is a higher salinity in the Southern Lagoon than the Northern Lagoon (see **Figures 16 and 17**). This salinity gradient has always existed based on past records and First Nations knowledge. This strongly suggests that the River Murray has always been the main source of freshwater to both the Northern and Southern Lagoons of the Coorong.

Historically, surface water in South Australia's Southeast naturally pooled east of parallel dune ranges, forming broad wetlands that slowly overflowed via north-directed, south-to-north flow paths toward the Coorong. Artificial cross-catchment drainage (beginning in 1863) modified these paths and now discharge an annual average of 110 GL/y to the ocean (South East Water Conservation and Drainage Board, 2019). This would be a maximum that may have historically flowed to the Coorong, given the amount of evapotranspiration that would have occurred in this vast wetland area.

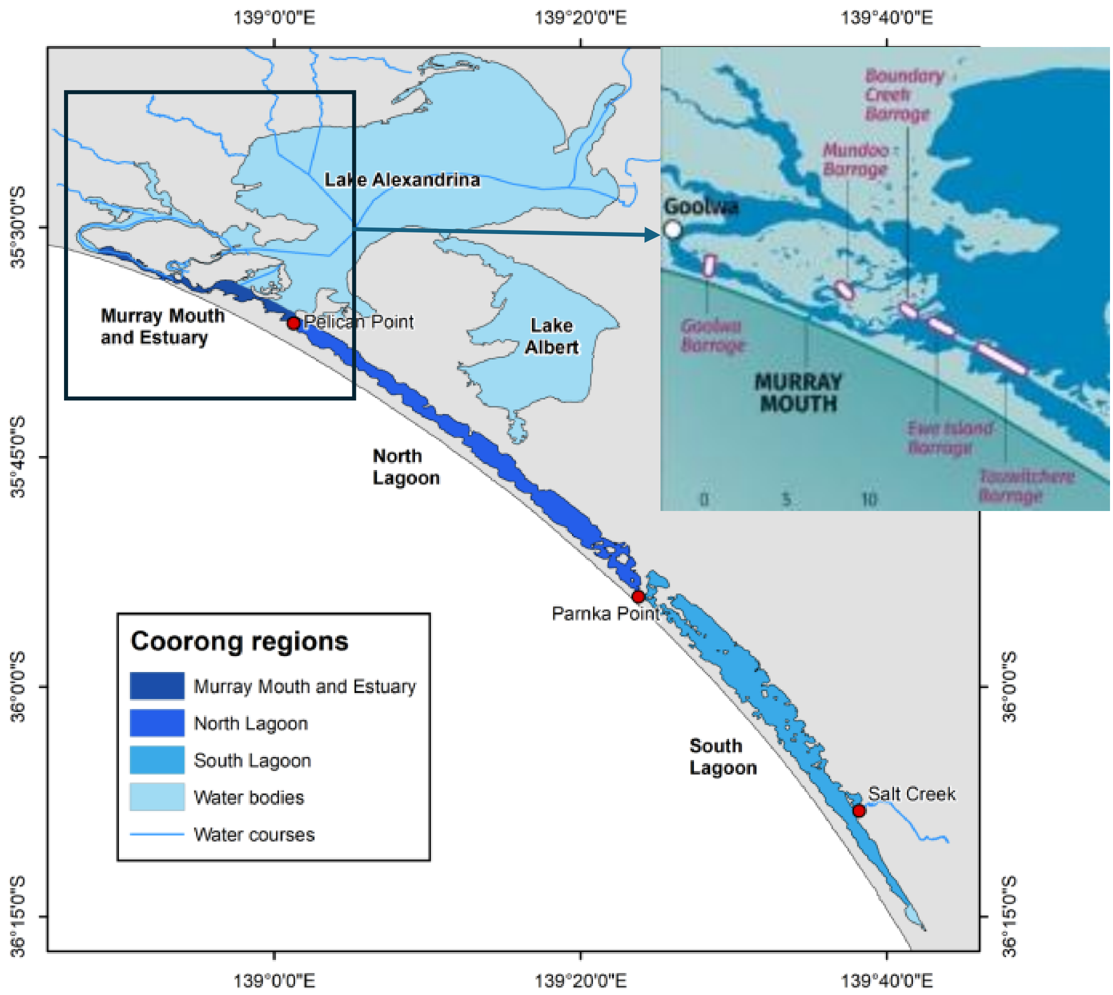


Figure 16 – The Main Features of the Coorong, Lower Lakes and Murray Mouth (CLLMM)

Hence, the Coorong may have received an average flow of up to 110 GL/y from the SE wetland area prior to drainage works, but this is insignificant compared to over 15,000 GL/y of freshwater that was supplied from the River Murray or even the current 4,800 GL/y average annual flow to the Coorong from the Murray River. There is currently an annual average of 14 GL/y of freshwater flowing into the SE end of the Coorong at Salt Creek.

However, it should be noted that these flows to the Coorong are highly variable and the average annual flows can be misleading due to the occasional very high wet weather flows. The current long term annual average flow to the Coorong from the Murray River is 4,800 GL/y but the median flow since the Basin Plan was introduced in 2012 is only 1,700 GL/y and for the 12 years prior to that the median was 600 GL/y. The median flows from the SE wetlands are also distributed similarly with median flows much less than the average flow.

The water quality of the inflows from the SE Wetlands at Salt Creek in the form or organic nutrients and minerals (particularly alkalinity) is important for the health of the Southern Lagoon (Goyder Institute, https://goyderinstitute.org/project/understanding-coorong-nutrient-dynamics/). However, there are many competing beneficial uses for the water from the SE Wetlands including the important ecological wetlands before reaching the Coorong.

Increased eutrophication of estuarine systems is linked to a lack of flushing as well as external nutrient sources, and warming temperatures due to climate change (Mosely, et al, 2022). The fate of water from the SE Wetlands, as well as how this drives export of dissolved and suspended material from the Southern to Northern Lagoon, is unknown at present. This is a critical question that needs answering to manage SE Weland flows in order to influence nutrient levels and cycles, as well as salinity and water levels.

As can be seen in **Figure 15**, salinity in both the Northern and Southern Lagoons drops significantly when there are high volumes of freshwater from the Murray River flowing through the barrages, such as during the floods of 2022/23. These low salinity concentrations persist for several years following a flood event.

Figure. 17 – Salinity in Coorong Northern and Southern Lagoons since 2017 (CET, 2026)

It has been demonstrated (Glen Hill, 2026) how freshwater releases through the barrages can be most effective in lowering the salinity in the Southern Lagoon if these releases are through Tauwitchere Barrage when water levels in the Southern Lagoon are low (due to tides, winds, evaporation or a combination of these) and strong winds start to blow from the northwest.

As discussed in Sect. 6 above, in most years the water that passes through the barrages to the Coorong is mainly returned Environmental Water that has already served its environmental purpose upstream and has continued to provide benefits all the way downstream from its original target and continues to provide benefits to the Basin by flushing salinity out of the Basin, assisting in keeping the mouth of the Murray River open, as well as providing essential contribution to the Coorong environment including many threatened fish and bird species.

Hence, increasing freshwater flows from the SE Wetlands may assist in a small reduction in the salinity and improved water quality of the Southern Lagoon but this will not obviate the need for the current flows over the barrages.

(2) Consequences of Removing the Barrages

The MDBA commissioned a thorough review in 2020 (MDBA, 2020), of the historical condition of the CLLMM region. This review considering all available information and concluded that there has been "a decline in marine influence over the last 8 ka. (8,000yrs)" and the "temporal trend is one of declining salinity, particularly during the last *ca* 2 ka (2,000 yrs)" and "the weight of evidence points to the Lower Lakes being largely fresh prior to European settlement, with moderate tidal influence and incursion of seawater …during periods of low river inflows".

Whether the CLLMM region's salinity was super-saline (saltier than seawater), marine (seawater), freshwater or estuarine (somewhere between seawater and freshwater) prior to European settlement is not considered relevant, as seen in **Figure 3**, the whole MD Basin is totally changed in both volumes and nature of flows and re-engineering the whole Basin is beyond the scope of this study or the financial resources of any government. However, it is undeniable that the CLLMM region has become more prone to saltwater intrusion as River flows have significantly diminished due to upstream extraction.

Removing the barrages now would allow salt water to enter the lakes and River system, possibly up to Lock 1 at Blanchetown unless River flows reaching the CLLMM region were substantially increased as the pool level is effectively the same between Lock 1 and the barrages**.** This saltwater intrusion would cause a major disruption to SA's domestic water supply (see **Figure 10)**.

Removing the barrages would reduce the amount of evaporation of freshwater that currently occurs from Lakes Alexandrina and Albert which is estimated to be 800 to 1,000 GL/y. However, most of the freshwater flow reaching the barrages is Returned Environmental Water (see **Figure 11**) which is estimated at 1,477 GL/y (MDBA 2011, 2012).

This Returned Environmental Water has already served its original targeted environmental purpose further upstream but has continued to provide benefits all the way down river to the Murray Mouth. So any savings in evaporation will result in more Environmental Water reaching the Coorong and Murray Mouth but there would be no savings in SDL that may be made available for consumptive purposes.

Also, removing the barrages would have no effect on the need to have an average of 696 GL/y delivered to the SA border to flush the Basin of salt as is currently required.

Removing the barrages would also increase the tidal prism from an estimated 1,420 ML (range of 643 to 2,200 ML) to 16,000 ML (Thom, et. al, 2019) but the freshwater flow would increase by 1,400 ML (i.e. 1,000 GL/y / 365d/2 tides/d) from 6,600 ML. Hence the ratio of outcoming tide to ingoing tide would reduce from 5.7 to 1.5 (i.e. freshwater component would be insignificant with almost the same amount of water going out as coming in on each tide.

This would cause the Murray Mouth to be more prone to closing, as more sand comes in with the tide than goes out on an ebb tide due to turbulent wave action stirring up sand in the ocean which is brought in with the incoming tide (Thom, et al, 2019, & Chiew, et al, 2020).

The sudden removal of the barrages would also have major environmental impact, too numerous to document, as the freshwater ecosystems would collapse. This would be in violation of our international obligations as the whole Coorong, Lower Lakes and Murray Mouth (CLLMM) region is a Ramsar Wetland of International Significance which as a nation we are bound to maintain in its current condition.

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