

# Objectives and Outcomes for Operating the River Murray in South Australia



**Government  
of South Australia**

Department for  
Environment and Water



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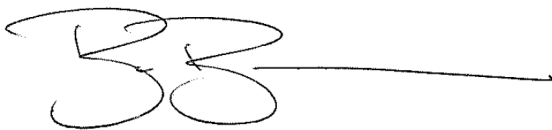
# Foreword

*Objectives and Outcomes for Operating the River Murray in South Australia* (O&O) is the key document that guides transparent and coordinated River Murray operational decisions in South Australia on an ongoing basis. This is a new document, drawn from content previously contained in Annual Operating Plans, to describe how a range of desired outcomes— economic, social and environmental – are achieved in an operational context in the long term.

The O&O aims to achieve some of the specific objectives in the *Basin Plan* and objectives in the *Long-term environmental watering plan for the South Australian River Murray water resource plan area*, while meeting requirements in the *Australian Drinking Water Guidelines 2011*. The O&O also guides operations to help ensure that South Australia meets its obligations for the protection of water for the environment.

A wide range of stakeholders have been engaged in the development of the O&O and previous Annual Operating Plans which it has evolved from. In particular, the River Murray Operations Working Group, which is a cross-agency group consisting of representatives with an interest in how the River Murray is managed and operated in South Australia.

I would like to thank all of those who have been involved in the planning, management and operations of the River Murray in South Australia.

A handwritten signature in black ink, consisting of stylized, overlapping loops and a long horizontal stroke extending to the right.

**Ben Bruce, Executive Director Water and River Murray**  
Department for Environment and Water

14 July 2021

# 1. Introduction

In South Australia, the Department for Environment and Water (DEW) regulates access to water resources, manages protection of water catchments and native vegetation and is the state body responsible for the River Murray as part of arrangements for managing the Murray-Darling Basin.

The *Objectives and Outcomes for Operating the River Murray in South Australia* (O&O) describes how the Department for Environment and Water, in partnership with other organisations and the community, will manage the River Murray in South Australia from an operational perspective to achieve optimal benefits for all water users, including the environment. In particular, DEW works in close collaboration with the South Australian Water Corporation (SA Water) who is responsible for managing structures along the River Murray on behalf of the Murray-Darling Basin Authority (MDBA) (from Lock 9 in Cullulleraine, Victoria, to the Goolwa Barrages, including the Lake Victoria storage in New South Wales) and is also the major potable water supplier for South Australia.

The O&O outlines the considerations that affect River Murray operational decisions within South Australia. The O&O has been developed with regard to the objectives of the Murray-Darling Basin Plan (Basin Plan) and contributes to the achievement of Basin Plan objectives in South Australia and assists in meeting the South Australian Government's obligations under the Basin Plan.

In addition to the O&O, management of the River Murray in South Australia is guided by a number of acts, regulations, strategies, plans, policies and procedures. More information on these can be found at <https://www.environment.sa.gov.au/topics/river-murray>.

## 2. General Objectives and Outcomes

The general objectives and outcomes for the operation of the River Murray in South Australia are to:

- integrate and optimise the delivery and management of water to and within, South Australia to achieve the best possible economic, social and ecological outcomes
- accommodate the needs of all water users within system constraints to the extent that is practicably possible;
- provide for operational arrangements to underpin the security of water supply and quality for all consumptive uses for current and future years;
- provide for the preferred water delivery requirements under a range of inflow and water availability scenarios; and
- ensure that South Australia's operational requirements are fulfilled under the:
  - *Water Act 2007 - Schedule 1 Murray-Darling Basin Agreement 2008 (Cwlth) (the Agreement);*
  - *Water Act 2007 - Basin Plan 2012 (Basin Plan) – in particular Chapters 5, 8, 9 10 and 11;*
    - South Australia's Water Resource Plans
    - South Australia's *Water Allocation Plan for the River Murray Prescribed Watercourse*
  - MDBA Annual Operating Outlook; and
  - Basin Officials Committee (BOC) *Objectives and Outcomes for River Operations in the River Murray System*; and

In meeting the above, operations will have regard for:

- [Long-term environmental watering plan for the South Australian River Murray water resource plan area](#)
- [Drought Emergency Framework for Lakes Alexandrina and Albert;](#)
- [South Australia's Annual Water for the Environment Plan and Priorities for the South Australian River Murray;](#)
- [Barrage and Water Level Management Policy;](#)
- [Barrage Operating Strategy;](#) and
- any other relevant policy.

Key risks associated with not meeting the objectives include:

- inability to address the impacts of identified risks to the condition, or continued availability, of Basin water resources;
- continuing deterioration of environmental condition of nationally and internationally important ecosystems through inadequate environmental watering and lack of variability in flow and water level;
- increasing frequency of adverse events affecting water quality or availability with serious impacts on all extractive water users and local communities;
- failure to meet international environmental obligations; and
- inability of the South Australian Government to effectively implement the Basin Plan and other Basin initiatives.

### 3. Governance, Review and Implementation

The O&O is produced by the Water Delivery Group in the Water Infrastructure and Operations Branch of DEW. It is reviewed annually by the River Murray Operations Working Group (RMOWG), which has membership from DEW, SA Water, Landscape SA – Murraylands and Riverland, the Department of Primary Industries and Regions (PIRSA), Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Environment Protection Authority (EPA).

Together with the MDBA's Annual Operating Outlook, the O&O guides the preparation of South Australia's *Annual Operating Plan for the South Australian River Murray*.

Under regulated conditions, River Murray flow within South Australia is adaptively managed in accordance with established operating policies, rules, procedures, prior practice and in accordance with the Agreement and the Basin Plan. Generally, the integrated and adaptive management approach seeks to achieve improvements in the South Australian River Murray channel, floodplain, wetlands, Lower Lakes, Coorong and Murray Mouth while managing (minimising) adverse impacts on third parties.

Day to day operational issues and changes that are in accordance with established operating rules are made between DEW and SA Water. Input from other agencies, RMOWG, the MDBA and expert, community and indigenous groups is sought where necessary.

Objectives and risks associated with specific events or operations (eg weir pool raising, lowering, filling a wetland) are detailed in the individual event implementation plans.

Actions to be undertaken that may have associated third party risks, or are outside of an agreed operating plan, require a River Murray Action Request. This is to enable DEW to have a complete picture of all actions proposed to be undertaken and to determine the combined impacts of all actions.

All River Murray Action Requests are forwarded to the RMOWG for consideration.

Consideration is required by the RMOWG (and other groups as necessary) for proposals that may result in:

- changes to weir pool levels outside their normal operating range (refer to **Table 4 Weir Pool Levels – Normal Operating Range**);
- negative impacts on the distribution of South Australia's Entitlement Flow;
- negative impacts to water quality;
- negative impacts to the environment; and
- delivery of environmental water that may trigger other events, such as the opening of disposal basins, which may have a negative impact on water quality and other downstream water users etc.

Where changes to river conditions require a change to established operating rules, a written proposal must be forwarded to the RMOWG for consideration and a recommendation through the Director, Water Infrastructure and Operations to the Executive Director, Water and River Murray (DEW) for consideration and determination as the appropriate delegate.

The MDBA will be involved in this process if there is the potential for an impact on the joint venture owned assets and SA Water will be advised in writing of any material change to river operations (ie alteration of flow timing or magnitude by more than 10%).

Effective communication and information programs are critical to ensure that water users, landholders and other stakeholders are provided with comprehensive and timely information necessary to manage the potential impacts of changed river operations.



## 4. Specific Objectives and Outcomes

The operating objectives and key outcomes sought (in no particular order) are to:

1. Optimise (where practicably possible) water accessibility for all users;
  - 1.1. provide the appropriate quantity of water to all users (see also Section 5); and
  - 1.2. align delivery of consumptive water for all users with anticipated timing of demands (see also Section 6).
2. Manage water quality, including salinity levels, for environmental, social, cultural and economic activity in the South Australian portion of the River Murray;
3. In accordance with Chapter 9 of the Basin Plan, ensure that water quality and salinity targets are taken into consideration when making flow management decision and appropriate management actions are taken when water quality parameters are likely to exceed the target limits (see also Section 8).
4. In accordance with s. 8.06 (3)(c) and (d) of the Basin Plan to ensure the Murray Mouth remains open at frequencies, for durations and with passing flows, sufficient to;
  - 4.1. enable the conveyance of salt, nutrients and sediment from the Murray-Darling Basin to the ocean; and
  - 4.2. ensure that tidal exchanges maintain the Coorong's water quality (in particular salinity levels) within the tolerance of the Coorong ecosystem's resilience.
5. Manage water levels in the Lower Lakes in accordance with s. 8.06 (3)(e) of the Basin Plan, to ensure sufficient discharge to the Coorong and Murray Mouth, help prevent riverbank collapse and acidification of wetlands below Lock 1 and to avoid acidification and allow connection between Lakes Alexandrina and Albert, by:
  - 5.1. maintaining water levels above 0.4 m AHD for 95% of the time, as far as practicable; and
  - 5.2. maintaining water levels above 0.0 m AHD all of the time.
6. Maintain, as much as possible, a flow of at least 2 GL/day at the Murray Mouth to minimise the rate of sand ingress in the Murray Mouth (see also Section 12)
7. Maintain seasonal variability in Lower Lakes water levels, between 0.5 m AHD and 0.85 m AHD, as identified in the Barrage and Water Level Management Policy 2019. The upper water level of 0.85 m AHD may be breached for short periods to accommodate an action or operation that would deliver positive outcomes for the area, such as exporting salt or diluting salinity, during unregulated flow events, or when conditions limit the release of water from the barrages (see also Section 12);
8. Actively seek opportunities to manage Lake Albert salinity levels below 1 500 electrical conductivity (EC). This will be reliant on unregulated flow or large volumes of environmental water being made available;
9. Actively seek opportunities to manage Coorong South Lagoon salinity levels to below 100 parts per thousand (ppt);
10. Implement clause 91 of the Agreement - South Australia's Storage Right;
  - 10.1. maximise opportunities to defer, store and deliver water; and
  - 10.2. minimise the risk to critical human water needs (CHWN).
  - 10.3. balance any demands for delivery of water during the current water year with potential benefits from deferring an appropriate portion of South Australia's Entitlement Flow for use in future dry years and deliver the appropriate portion of deferred and stored water in dry years (see also Section 7);
11. Have regard for the Annual Water for the Environment Plan and Priorities for the South Australian River Murray:
  - 11.1. coordinate the operational planning and delivery of environmental water to South Australia to maximise the potential environmental outcomes throughout the South Australian portion of the River Murray;
  - 11.2. maximise environmental outcomes through the operation of infrastructure (including weir pool manipulations and barrage operations) (see also Section 9);
  - 11.3. optimise the use of unregulated flow for environmental and water quality purposes; and
  - 11.4. facilitate the delivery of enhanced environmental flows

12. Manage operations to accommodate conditions when flows are outside of the expected flow range (i.e. flood or drought) (see also Section 10):
  - 12.1. contribute to the implementation of the MDBA's Drought Emergency Framework for Lakes Alexandrina and Albert should the water level in Lakes Alexandrina and Albert be predicted to fall below 0.4 m AHD;
  - 12.2. coordinate with the State Emergency Service (SES) in advance of and during, flow conditions that could cause flooding
13. Manage the rate of declining water levels within the River Murray Channel, where operationally possible, to minimise riverbank collapse, slumping and potential ecological impacts (see also Section 13);
14. Account for environmental water use within the River Murray channel, floodplain, Lower Lakes and through the barrages, in accordance with Prerequisite Policy Measures (see also Section 14)
15. Consider the potentially competing needs of floodplain works and flow delivery;
16. Effectively communicate and consult with stakeholders with regard to river operations;
17. When possible, actively manage the risk of acid drainage water below Lock 1 from the Lower Murray Reclaimed Irrigation Area (LMRIA) by providing sufficient dilution flow over Lock 1. A dilution flow rate at Lock 1 of 2.5 GL/day is required to manage this critical risk over an extended period of time. In particular, this is important during the irrigation season (September to April) when pumping to the main channel is highest (see also Section 11);
18. When possible, actively manage navigation issues between Lock 4 and Lock 3 by maintaining the flow rate at Lock 4 at, or above, 3 GL/day;
19. Where practicable, adaptively manage flows and water levels to facilitate construction, maintenance and improvement works undertaken for environmental water delivery projects and maintenance projects.

## 5. Water Delivery to South Australia

The flow to South Australia is managed in close cooperation between DEW, MDBA and SA Water. When environmental water is being delivered to South Australia, additional stakeholders such as the Commonwealth Environmental Water Office (CEWO) will be engaged as key participants as to how this water is delivered and managed.

Flow to South Australia can be made up from a combination of:

- Entitlement Flow;
- Water for the environment;
- Unregulated flow;
- Trade adjustments;
- Additional Dilution Flow;
- Delivery of deferred water for CHWN and private carryover; and
- Lindsay River dilution flow.

South Australia's annual Entitlement Flow provision is governed by the Agreement and determined by the MDBA based on water availability and the water sharing rules. The MDBA assesses the water resources and determines the overall water availability at 1 June, then at fortnightly or monthly intervals during the year. The Basin states are advised of their available share of the water resource. Each Basin state is then responsible for managing and allocating the resource it has available.

The instrument in South Australia that determines how water is allocated to different uses is the [Water Allocation Plan for the River Murray Prescribed Watercourse](#) (Water Allocation Plan).

The Water Allocation Plan sets out the objectives and principles that apply to the consumptive pools, water access entitlements and water allocations (section 5.1). Additional objectives apply when South Australia receives less than full Entitlement.

### Entitlement Flow

South Australia's full Entitlement Flow is 1 850 GL/year (**Table 1**), which is comprised of the following:

1. Dilution and Loss Entitlement of 696 GL/year, which is provided at a rate of 58 GL/month. Dilution and Loss Entitlement includes conveyance water. Conveyance water is a volume of water that is set aside for losses along the River Murray in South Australia upstream of Wellington due to evaporation and seepage along the river. It is assumed that about 50% of the 696 GL is used by the environment (such as by evaporation and seepage) between the border and Wellington and the other 50% flows through to the Lower Lakes. The proportion will vary depending on a range of factors including current climate.
2. Non-dilution (consumptive) Entitlement of 1 154 GL/year, with monthly totals identified in the Agreement.

South Australia is not guaranteed to receive its full Entitlement Flow in very dry years. In very dry years, the MDBA considers the water resource conditions, climate conditions, storages and predicted water use across the Murray-Darling Basin and shares the resource according to the Agreement. In very dry years where the MDBA notifies South Australia of its reduced Entitlement Flow, South Australia will notify the MDBA of its preferred reduced monthly delivery pattern using a clause 128 variation to the flow.

**Table 1 Delivery Pattern for full Entitlement Flow of 1 850 GL/year**

Month	Dilution and Loss (GL/Month)	Consumptive (GL/Month)	Total Entitlement (GL/Month)	Entitlement Flow Rate (GL/day)
Jun	58	32.0	90.0	3.0
Jul	58	50.5	108.5	3.5
Aug	58	66.0	124.0	4.0
Sep	58	77.0	135.0	4.5
Oct	58	112.5	170.5	5.5
Nov	58	122.0	180.0	6.0
Dec	58	159.0	217.0	7.0
Jan	58	159.0	217.0	7.0
Feb	58	136.0	194.0	6.69
Mar	58	128.0	186.0	6.0
Apr	58	77.0	135.0	4.5
May	58	35.0	93.0	3.0
<b>Total</b>	<b>696</b>	<b>1 154.0</b>	<b>1 850.0</b>	

Note: The MDBA water year starts on 1 June, which is different to South Australia's water year, which starts 1 July.

South Australia's Entitlement Flow is:

- adjusted for late season trade (April to June)  
Late season trade is a trade that occurs in April, May or June. The cumulative trade may be traded in to, or out of, South Australia. The volume of trade in to South Australia is added to South Australia's Entitlement Flow in the following year. The volume traded out is subtracted from South Australia's Entitlement Flow in the following year. This volume is adjusted to the monthly Entitlement Flow from September to April in the following year.
- adjusted for trade in to, or out of, South Australia during the year (trades made during July to March);
- increased by the volume of water delivered to South Australia from the Storage Right; and
- decreased by the volume that South Australia defers (and stores in the Storage Right) during the year.

Any proposed changes to the delivery of monthly Entitlement Flow to South Australia using South Australia's Storage Right under Schedule G (deferral or delivery of stored water) will be identified through monthly Deferred Water Storage and Delivery Plans.

## Water for the environment

The delivery and use of water for the environment within South Australia is guided by the long-term environmental watering plan, the state's annual environmental watering priorities and the annual *Water for the Environment Plan for the South Australian River Murray* (Annual Environmental Plan). The long-term plan is the primary document in which South Australia identifies the environmental water requirements and ecological objectives for priority environmental assets and functions. The annual plan identifies proposed watering sites and events under a range of climatic conditions for the year ahead.

The development of environmental watering priorities is a requirement under the Basin Plan. The priorities are submitted to the MDBA by 31 May of each year. The *Annual Environmental Plan* is then prepared which is a consolidation of the approved watering priorities and expected ecological outcomes. It also describes, preliminary outcomes of the previous year, the water resource availability outlook and the total environmental water delivery requirements for the South Australian River Murray for the coming year. The *Annual Environmental Plan* is a partner document to the *SA Annual Operating Plan*.

Once the water year commences, water for the environment is delivered, through trades, releases from storages and unregulated flow and delivered to sites using infrastructure (eg. regulators, weirs, pumps) and/or delivery through the

River Murray channel through to the Murray Mouth and Coorong. At the end of the water year, a range of reporting requirements are met including the production of an Annual Report, which includes a summary of the water delivered to the environment and the outcomes observed.

## 6. Water for Consumptive Purposes

The Murray-Darling Basin jurisdictions have agreed that delivery of water for CHWN will be the highest priority. The River Murray is operated to guarantee suitable water quality for CHWN and, where possible, connectivity with the majority of infrastructure off-takes. South Australia's volume of CHWN is described in the Water Allocation Plan.

DEW is responsible for overseeing the delivery of water to meet consumptive demands for non-environmental purposes. These consumptive demands include providing water for:

- SA Water supply to Metropolitan Adelaide and Country Towns;
- Irrigation extractions;
- Stock and Domestic;
- Recreational; and
- Industrial and mining activities.

Management of River Murray water to meet these consumptive demands can require active day-to-day operational management decisions, particularly when low flow conditions are being experienced. River Murray operational considerations include:

- flow rates, volumes and timing of flow at critical locations;
- salinity targets;
- timing of operations; and
- minimum flow rates and weir pool levels for operation of wetland regulators and drainage basin infrastructure.

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

Operational decisions will consider the impacts of weir pool manipulations within South Australia on irrigated agriculture, while acknowledging and exploring other opportunities to manage irrigation extractions within more flexible river management regimes.

## 7. Deferred Water Storage and Delivery

Deferring a portion of South Australia's Entitlement Flow for use in future dry years has been made possible by the *Schedule to Account for South Australia's Storage Right* (Schedule G) of the Agreement, Schedule 1 of the *Water Act 2007* (Cwlth). Schedule G defines the rules for giving effect to and accounting for, South Australia's right to defer, store, manage and subsequently deliver Entitlement Flow for CHWN and private carryover (including water for the environment) under clause 91 of the Agreement. The principle requirements of Schedule G are as follows:

- South Australian deferred water should cause no effect on the water availability of Victoria or NSW (the Upper States), or in the case of water stored for private carryover, their storage access;
- if South Australia's deferred water spills from storage, it should be, where possible, re-regulated for subsequent use by South Australia;
- water stored for private carryover spills before water for CHWN; and
- water stored by South Australia will be subject to incremental net evaporation losses only.

Based on the above, access to storage capacity is limited to the unused capacity of the major upstream storages (Lake Victoria, Menindee Lakes, Hume and Dartmouth Reservoirs). South Australia has no preferential access to storage capacity. For practical and water accounting purposes, South Australian deferred water floats on top of water held by New South Wales and Victoria (including environmental entitlements owned by those States, MDBA and Commonwealth Environmental Water Holder). It is therefore first to spill or to be pre-released, if required for flood mitigation purposes.

Schedule G provides South Australia with additional flexibility to manage the timing and delivery of Entitlement Flow for CHWN and private carryover.

Use of the Storage Right requires a Deferred Water Storage and Delivery Plan to be provided to the MDBA, New South Wales and Victoria on the first day of each month. The Deferred Water Storage and Delivery Plan is the mechanism by which South Australia can defer, store and deliver deferred Entitlement Flow (for CHWN and private carryover). It is a rolling (at least) 12 month plan that is prepared and revised each month in consultation with the MDBA and must consider a range of water availability scenarios.

Specifically, for each month, the Deferred Water Storage and Delivery Plan:

- details when Entitlement Flow is to be deferred and the proportions to be deferred as CHWN and private carryover;
- details where the deferred water should be stored, with regard for the unused capacity of the major storages;
- details how much deferred water should be delivered and from which storages;
- nominates any preferred downstream transfers or volumes to be substituted upstream; and
- does not provide for deferred water to be delivered in the same month that water became deferred.

Deferral and storage of Entitlement Flow is only undertaken when conducive to do so. It is necessary to balance the needs of all water users and the environment, particularly that of the Coorong, Lower Lakes and Murray Mouth. Planning for deferral, storage and delivery considers how deferral decisions may impact on planned environmental outcomes from environmental water delivery. Consultation is undertaken with the CEWO regarding any potential variations to water levels in the Lower Lakes or barrage outflows.

In dry years, when water allocations are restricted, deferred water may be delivered to top-up any short fall in CHWN and to provide for private carryover.

Volumes stored are adjusted for net evaporation losses and spills until delivered to South Australia.

## 8. Water Quality and Salinity

Water quality and salinity objectives and targets included in Chapter 9 of the Basin Plan, *Water Quality and Salinity Management Plan*, are taken into consideration when making operational decisions for the River Murray in South Australia. This includes the objective of providing water of suitable quality for the environment, CHWN and irrigation purposes.

The *Water Quality and Salinity Management Plan* is aimed at maintaining appropriate water quality and salinity for environmental, social, cultural and economic activity in the Murray-Darling Basin.

Included below are Basin Plan and South Australian Department for Health and Wellbeing (DHW) water quality and salinity targets and objectives that need to be considered when making flow management decisions. If it is anticipated that water quality parameters are likely to exceed the target limits (as defined in **Table 2** and **Table 3**), management actions to improve water quality will be considered.

### Targets for Managing Water Flows (Basin Plan – 9.14)

The *Water Quality and Salinity Management Plan* requires the MDBA, Murray-Darling Basin Ministerial Council, BOC, CEWO and the Basin States to have regard to the water quality targets included in **Table 2** when making policies or decisions relevant to flow management.

The MDBA [Guideline: 'having regard' to Water Quality Targets for Managing Water Flows](#) provides additional guidance on having regard to water quality targets for managing water flows in the Murray-Darling Basin.

Prior to undertaking actions under an operating plan that may affect water quality, river managers and environmental water managers will give consideration to the guideline to assist in their decision making.

The following are to be considered:

- The decision is consistent with relevant operational and environmental watering plans and policies including:
  - South Australian Annual Environmental Watering Priorities;
  - MDBA's River Murray System Annual Operating Outlook; and
  - BOC Objectives and Outcomes for River Operations in the River Murray System.
- The risk that a flow decision may result in either salinity, dissolved oxygen or cyanobacteria exceeding target values, after considering:
  - potential water quality impacts from the water flow decision<sup>1</sup>;
  - current in-stream conditions (including upstream of the South Australian border);
  - forecast flow conditions; and
  - available mitigation strategies.
- The need to undertake monitoring and evaluation of the implementation of the flow management decision to assess actual changes to relevant water quality parameters (before and after using existing or event based monitoring) and to determine long-term trends.
- The need to complete relevant notification requirements. This may include:
  - River Murray Action Request form to DEW, Water Delivery Group; and
  - community notification through appropriate channels when required.
- The need to put in place appropriate reporting arrangements, including:
  - documentation of decision making process and how targets for managing water flows (9.14) were considered; and
  - processes to allow provision of monitoring information and documentation on how targets were considered to the DEW Basin Plan reporting coordinator.

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<sup>1</sup> If likelihood of the impact is high, further detailed assessment may be required



**Table 2 Basin Plan Targets for Managing Water Flows (9.14 (5))**

Location	Value	Timeframe
Lock 6	Less than 580 EC *	95% of the time
Morgan	Less than 800 EC *	95% of the time
Murray Bridge	Less than 830 EC *	95% of the time
Lower Lakes at Milang	Less than 1 000 EC *	95% of the time
All	Maintain dissolved oxygen at a target value of at least 50% saturation #	100% of the time
	<p>Fresh recreational water bodies should <b>not</b> contain:</p> <p>≥10 µg/L total microcystins; ≥50 000 cells/mL toxic <i>Microcystis aeruginosa</i>; or biovolume equivalent of ≥4 mm<sup>3</sup>/L for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume; or</p> <p>≥10 mm<sup>3</sup>/L for total biovolume of all cyanobacterial material where known toxins are not present; or</p> <p>cyanobacterial scums consistently present.</p>	100% of the time

# Saturation of dissolved oxygen is based on standard assumptions of pressure at one atmosphere and water temperature at 25°C. At these assumptions 50% oxygen saturation is equivalent to approximately 4.13 mg/L.

\* Target values can be expressed as milligrams per litre (mg/L) by multiplying the EC values by 0.6.

Dissolved oxygen is an important parameter for determining overall water quality. Low dissolved oxygen levels reflect high levels of biological activity and can create anaerobic conditions. Anaerobic conditions contribute to the release of nutrients and heavy metals in sediments into the water body.

## Objectives for Raw Water for Treatment for Human Consumption (Basin Plan - 9.05)

The Basin Plan outlines objectives for raw water for treatment for human consumption in section 9.05, Chapter 9. South Australia has developed a set of CHWN water quality targets for raw water for treatment for human consumption to assist in the achievement of the Basin Plan objective. The targets are defined in **Table 3**. Exceeding targets in **Table 3** may trigger mandatory public notification protocols, refer to the *DHW Water/Wastewater Incident Notification and Communication Protocol 2019* (the Protocol).

The Protocol has been adapted from the *Australian Drinking Water Guidelines 2011* (ADWG) and also meets the *Safe Drinking Water Act 2011* requirements for an approved incident identification and notification protocol. The ADWG is also a key consideration for the Basin Plan – section 5.04, 9.14, 11.02, 11.05 and 11.16.

The Protocol classifies water quality incidents into three categories:

1. **Priority Type 1 Incidents** - likely to require immediate interagency meetings to consider responses and issue public advice. Priority Type 1 incidents are to be reported immediately by direct voice contact to the Water Incident Coordinator and are reportable to the Minister for Health and Wellbeing and the Minister for Environment and Water.
2. **Type 1 Incidents** are either:
  - **Health** – an incident that without appropriate intervention could cause serious risk to human health; or
  - **Environmental** – an incident that without appropriate intervention could cause, or threaten to cause, serious or material environmental harm.

Type 1 incidents require immediate notification to defined agencies (DHW and Environment Protection Authority (EPA)) and will always be reported to the Water Incident Coordinator and concerned Ministers or delegates. Notification to the Water Incident Coordinator and identified agencies will be immediately by telephone and within 24 hours by email or hard copy.

3. **Type 2 Incidents** are either:

- **Health** – an incident that without appropriate intervention represents a low risk to human health; or
- **Environmental** – incidents that without appropriate intervention could cause environmental harm but are not of a high impact or on a wide-scale.

In the absence of appropriate intervention and remediation, Type 2 incidents have the potential to escalate to Type 1 or Priority Type 1 Incidents. Type 2 incidents require notification within 24 hours to defined agencies (DWH and EPA) but are not required to be routinely reported to the Water Incident Coordinator and concerned Ministers.

**Table 3 Water Quality Targets for Raw Water for Treatment for Human Consumption**

Purpose	Location	Parameter	Target		
Raw water for treatment for human consumption	Water Treatment Plant Inlets	Salinity	Less than 500 mg/L for 95% of the time		
		Dissolved Oxygen	Greater than 5mg/L		
		Dissolved Organic Carbon	Less than 10 mg/L		
		Alkalinity	Greater than 40 mg/L		
		Turbidity	Less than 100 NTU		
		Soluble Manganese (Mn)	Less than 0.1 mg/L		
		Combine soluble MIB/Geosmin	Less than 10 ng/L		
			<b>Priority Type 1 ☼</b>	<b>Type 1 ☼</b>	<b>Type 2 *</b>
		Microcystin <i>Microcystis aeruginosa</i> <i>Microcystis flos-aquae</i>	≥ 13µg/L toxin ☼ ≥ 65 000 cells/mL	≥ 1.3µg/L toxin ☼ ≥ 6 500 cells/mL	N/A
		Nodularin <i>Nodularia spumigena</i>	≥ 13µg/L toxin ☼ ≥ 400 000 cells/mL	≥ 1.3µg/L toxin ☼ ≥ 40 000 cells/mL	N/A
		Saxitoxin(s) <i>Dolichospermum circinale</i> ( <i>Anabaena circinalis</i> )	≥ 3µg/L toxin ☼ ≥ 20 000 cells/mL	≥ 1µg/L toxin ☼ ≥ 2 000 cells/mL	N/A
		Cylindrospermopsin(s) <i>Cylindrospermopsis raciborskii</i> <i>Chrysosporum ovalisporum</i>	≥ 10µg/L toxin ☼# ≥ 150 000 cells/mL	≥ 1µg/L toxin ☼# ≥ 15 000 cells/mL	N/A
		Health-related organic or inorganic chemicals		Any exceedance of health values prescribed in the ADWG	Detection equivalent to ≥ 10% of the health values prescribed in the ADWG

☼ Priority Type 1 and Type 1 are DHW notifiable threshold limits. Incidents are triggered immediately and are reportable to the Minister for Health and Aging and the Minister for Environment and Water.

\* Type 2 incidents are to be notified to the EPA and DHW within 24 hours.

☼ This is a product of cyanobacteria. In the absence of toxicity data refer to the cell count (cells/mL).

# Prior to triggering an incident for health related chemicals, individual results are rounded to the same number of significant figures as the guideline value in the ADWG eg for Microcystin toxin results in the range 13.1-13.4 µg/L are rounded to 13 µg/L (not Priority Type 1) and 13.5-13.9 µg/L are rounded to 14 µg/L (Priority Type 1).

To oversee the management of the risks associated with heavy metals discharged from LMRIA acid drainage water, an interagency working group has been established between DEW, SA Water, EPA and DHW. The group meets as required. Flow management is the primary tool used to manage the risks around mobilising heavy metals in the River Murray downstream of LMRIA drainage outlets, where SA Water treatment plant intakes are located.

## **Water Quality Targets for Water Resource Plans (Basin Plan- 9.16 to 9.18)**

The *Water Quality and Salinity Management Plan* (contained within the Basin Plan) identifies water quality targets for irrigation water, water used for recreational water and fresh water-dependent ecosystems, that must be included in water resource plans by Basin States.

The water quality target for irrigation water set out in Basin Plan section 9.17 (3) is that salinity is maintained below 833 EC for 95% of the time over each 10 year period ending at the end of a water accounting period at sites in the Murray-Darling Basin where water is extracted by an irrigation infrastructure operator for the purposes of irrigation.

## **Salt Load Objective (Basin Plan- 9.09)**

The Basin Plan salt export objective is to ensure adequate flushing of salt from the River Murray System into the Southern Ocean. The objective is expected to be achieved by the discharge of a minimum of 2 million tonnes of salt from the River Murray System into the Southern Ocean each water accounting period (MDBA responsibility).

The MDBA must assess the export of salt annually by comparing the estimated number of tonnes of salt per year averaged over the preceding 3 years against the indicative figure of 2 million tonnes of salt per year.

## 9. Weir Pool Manipulations

Weir pool manipulations (raising or lowering water levels in a weir pool) are now an important feature of routine river operations. Weir pool manipulations may be implemented for a number of reasons including:

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

Weir pool water levels are generally operated within a normal operating range, (see **Table 4**). Weir pool manipulations that raise or lower water levels outside the normal operating range require written instruction from the Minister (or the Minister's delegate) to instruct SA Water to raise or lower the water level outside the current normal operating range. Decisions regarding operations within the normal operating range are undertaken by the DEW Water Delivery Group and SA Water River Murray Operations Unit (RMOU).

In the event that weir pool water levels need to be raised or lowered outside their normal operating range, the public will be notified through the MDBA River Murray Weekly Report, South Australia's River Murray Flow Report, media releases and radio announcements.

**Table 4 Weir Pool Water Levels - Normal Operating Range**

Weir	Normal Pool Level (NPL) (m AHD)	Normal Operating Range (m AHD)	SA Water's current minimum allowable level (m AHD)	SA Water's current maximum allowable level (m AHD)
Lock 6 - Murtho	19.25	19.17 - 19.50	19.17	≈ 19.67
Lock 5 - Renmark	16.30	16.13 - 16.43	16.03	16.80
Lock 4 - Bookpurnong	13.20	13.16 - 13.50	13.16	13.50
Lock 3 - Overland Corner	9.80	9.77 - 10.02	9.77	10.02
Lock 2 - Waikerie	6.10	5.90 - 6.40	5.90	6.65
Lock 1 - Blanchetown	3.20	3.10 - 3.40	3.10	# 3.40

≈ Lock 6 raising above 19.67 m AHD is dependent on conditions and observations at the time

# Lock 1 raising is currently limited to 3.40 m AHD, as this is the maximum height the structure has been tested since remedial works were completed

Natural variation in river levels has been greatly reduced since the construction of lock and weirs. Reinstatement of variability is important in improving river health. Raising water levels helps to improve connection between the River Murray and the floodplain fringe, support recruitment and growth of river red gums, lignum and understorey vegetation and temporary inundation of ephemeral wetlands. Weir pool lowering provides benefits to carbon and nutrient cycling, fish habitat – particularly improved hydraulic habitat, biofilm nutritional value and littoral vegetation abundance and diversity. A weir manipulation operations plan, including greater variability, is being developed that will inform future weir pool operations.

Under high flow or flood events many structures may be inundated or removed and, in such circumstances, the ability to undertake weir pool manipulations would be limited. Weir pool manipulations and associated environmental watering activities will consider downstream impacts to CHWN water quality targets through visual observation, on-site monitoring, water quality sampling where appropriate and communication to SA Water around changing risks.

# 10. Operations When Flow Conditions Are Outside Manageable Flow Range

As flow to South Australia increases above 60 GL/day (typically), river operators have progressively less ability to influence or mitigate flow through the operation of river infrastructure (upstream and within South Australia). This is due to the removal of structures such as weirs. In the case of high flow, or flood events, the River Murray will break-out of the channel onto the floodplain, fill backwaters and wetlands and flow unimpeded down to the Murray Mouth.

Should high flow or flooding occur, considerations would include, but not be limited to, the appropriate flow and weir pool manipulation to minimise the implications of salinity spikes from the movement of groundwater derived salt and salt stored in floodplain soils (from the recession of event) into the river channel and the risk of blackwater events.

Should extremely dry conditions occur, it may be necessary to make changes to river operations to conserve water for summer months or for other purposes such as CHWN. This may result in the minor lowering of some weir pools between the border and the barrages, which may impact on some water users. The barrages are likely to be closed to manage Lower Lakes' water levels. Under the most extreme cases the fishways (at the barrages) may also be closed. This is not ideal for fish migration but may be a necessary measure to manage declining water levels from Lock 1 to the Lower Lakes.

If dry conditions cause the predicted water level in the River Murray below Lock 1 to fall below 0.4 m AHD, River Murray operations in South Australia will be consistent with the MDBA's *Drought Emergency Framework for Lakes Alexandrina and Albert* (June 2014).

Information concerning any changes to river operations that may affect water users will be provided to the community in advance to minimise potential impacts due to access and water quality.

## Management of River Murray High Flow and Flood Events

To improve the health and resilience of the River Murray floodplain, to the extent that is practicably possible, the Government of South Australia is committed to increasing the frequency and duration of flows at the border through changed river operations upstream of South Australia and the use of water for the environment. This was central to South Australia's negotiations for the Basin Plan to achieve greater floodplain inundation frequencies, including through implementation of the [Constraints Management Strategy](#).

With a River Murray flow rate at the border of:

- approximately 35 GL/day, some access roads and infrastructure in low-lying areas at South Punyelroo become inundated; and
- approximately 60 GL/day, the low lying shack areas located on the floodplain below Cadell begin to be at risk of inundation.

These flow rates are important for floodplain health and resilience.

If the MDBA forecasts a flow of greater than 60 GL/day at the South Australian border, the Government of South Australia is usually able to provide shack owners and other potentially affected parties with four to six weeks of advance warning to take the necessary precautions.

The South Australian State Emergency Services (SES) is the control agency for flood under the State Emergency Management Plan and is responsible for the delivery of flood warnings and messaging for the River Murray in South Australia.

DEW is the Hazard Leader for Flood and provides advice to the SES on flow conditions for the River Murray in South Australia to assist in the development of public warnings by the SES.

DEW also issues a weekly River Murray Flow Report, which contains detailed information on river operations and flow conditions in South Australia. The River Murray Flow Report will include a section on High Flow Advice when applicable as shown in **Tables 5 and 6**.

A set of triggers and guidelines for River Murray flood warnings are identified in **Tables 5, 6 and 7**.

**Table 5 Flood level descriptions adopted for the River Murray in South Australia**

Flow at SA Border GL/day	SA River Murray	Shack Areas only downstream of Cadell (Excluding River Murray towns)
200 or more	Major Flood	Major Flood
130 to 200	Moderate Flood	Moderate Flood
100 to 130	Minor Flood	Minor Flood
60 to 100	High Flow	Minor Flood
40 to 60	High Flow	
40 or below	Normal Flow Range, no warnings	

#### Flow Ranges

##### <40 GL/day

Flows below 40 GL/day at the SA border do not trigger the requirement to issue any warnings, although some access roads and infrastructure in some low-lying areas at South Punyelroo become inundated.

##### 40 – 60 GL/day

For flows of 40 – 60 GL/day at the SA border, there are no significant consequences regarding inundation of shacks in the low lying areas. At 60 GL/day there are expected to be less than ten (in 2016, there were four) shacks where the water starts to reach the foundations and some access roads and local council infrastructure are affected. Flows within this range are not generally considered to cause any significant inundation of property or infrastructure.

##### 60 – 100 GL/day

For flows of 60 – 100 GL/day, inundation will begin to affect some shack areas and infrastructure. If management of flows is possible, consideration will be given to augmenting high flows consistent with the Basin Plan and *Constraints Management Strategy*.

##### > 100 GL/day

Flows greater than 100 GL/day will cause minor to major flooding for the entire River Murray in South Australia.

**Table 6 Communication product corresponding to flow at the SA Border**

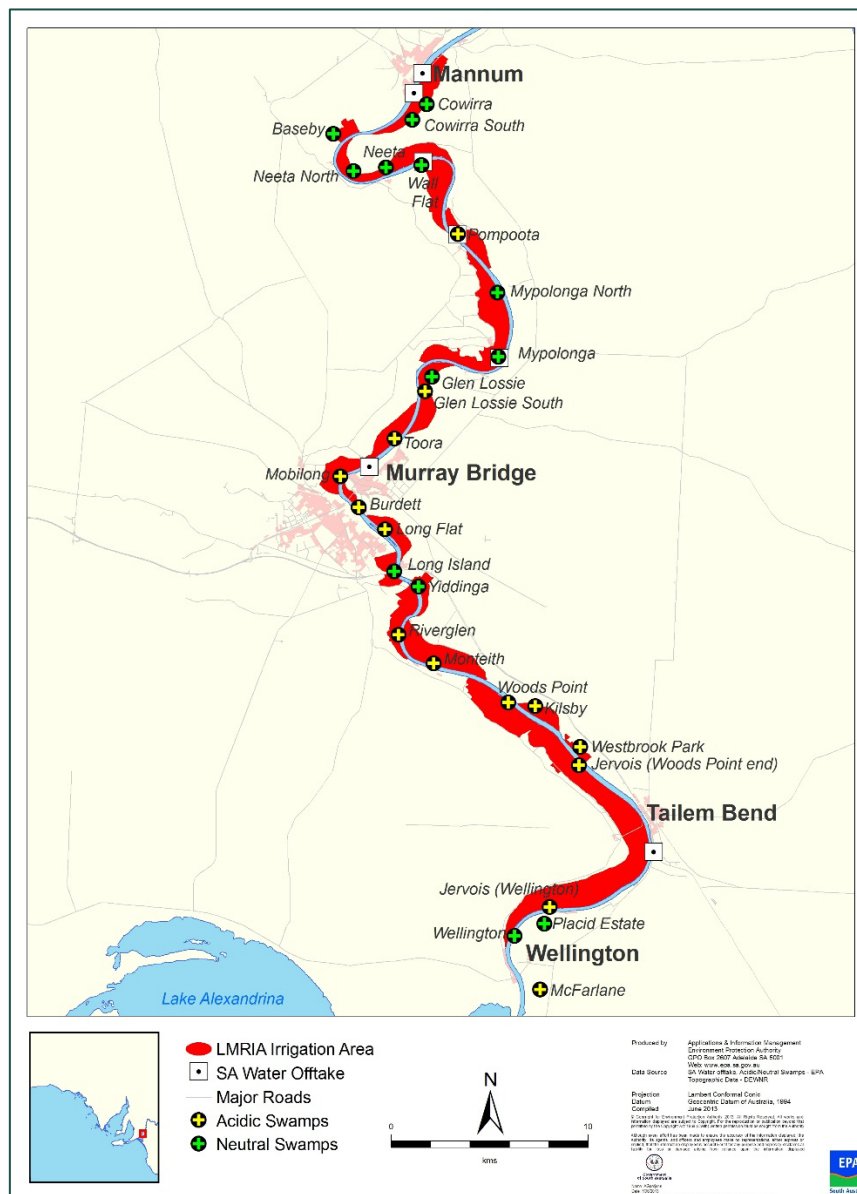
Flow at Border GL/day	SA River Murray	Shack Areas only downstream of Cadell (Excluding River Murray towns)
200 or more	Flood Emergency Warning - River Murray	Flood Emergency Warning - River Murray
130 to 200	Flood Watch and Act - River Murray	Flood Watch and Act - River Murray
100 to 130	Flood Advice - River Murray	Flood Advice - River Murray
60 to 100	High Flow Advice - River Murray (section in River Murray Flow Report)	Flood Advice - Shack Areas
40 to 60	High Flow Advice - River Murray (section in River Murray Flow Report)	

**Table 7 Timing for issuing public warnings**

<b>Predicted flow GL/day</b>	<b>0-1 week from border</b>	<b>1-2 weeks from border</b>	<b>2-3 weeks from border</b>	<b>3-4 weeks from border</b>	<b>4 weeks from border or more</b>
40 or >	High Flow Advice (section in RM Flow Report)	High Flow Advice (section in RM Flow Report)	High Flow Advice (section in RM Flow Report)	None	None
60 or >	Flood Advice - Shack Area High Flow Advice - River Murray (section in RM Flow Report)	Flood Advice - Shack Area High Flow Advice - River Murray (section in RM Flow Report)	Flood Advice - Shack Area High Flow Advice - River Murray (section in RM Flow Report)	None	None
100 or >	Flood Advice - River Murray	Flood Advice - River Murray	Flood Advice - River Murray	Message - Flood Advice expected in future	Message - Flood Advice expected in future
130 or >	Flood Watch and Act - River Murray	Flood Watch and Act - River Murray	Flood Watch and Act - River Murray	Flood Watch and Act - River Murray	Message - Flood Watch and Act expected in future
200 or >	Flood Emergency Warning – River Murray	Flood Emergency Warning – River Murray	Flood Emergency Warning – River Murray	Flood Emergency Warning – River Murray	Flood Emergency Warning – River Murray

# 11. Acid Drainage Water

In February 2011, scientists discovered the presence of acid water in 14 salt drains across 13 of the 27 LMRIA irrigation areas (**Figure 1**).



**Figure 1 LMRIA irrigation area** (courtesy of EPA)

Based on scientific investigations, a critical minimum mixing and dilution flow of 2.5 GL/day at Lock 1 has been recommended to manage the higher risk regional impacts of acid drainage water and soluble metal releases into the River Murray. In particular, this minimum flow is most critical during the irrigation season (usually September to April) when discharging water back into the River Murray channel is at its highest.

A risk assessment undertaken in 2017 identified that several LMRIA drains remained acidic and metal concentrations remained high (not recovered from the Millennium drought) and that discharge plumes are highly likely to increase in size under low flow rate conditions.



During very dry years, it may be difficult to maintain flow over Lock 1 above the target flow rate of 2.5 GL/day for reasonable periods of time. Since the Millennium drought, the flow rate at Lock 1 has been maintained above 2.5 GL/day, with the exception of a few weeks. There were no prevalent water quality issues in the River Murray channel when the flow rate was less than 2.5 GL/day for these short periods. It should be noted that problems were observed during extended periods of sustained low flow during the Millennium drought.

# 12. Operation of the Lower Lakes, Barrages and Murray Mouth

Operations at the Lower Lakes, Barrages and Murray Mouth is guided by the Barrage and Water Level Management Policy, the Barrage Operating Strategy and short- and long-term environmental watering plans for the Coorong, Lower Lakes and Murray Mouth Ramsar site.

## Flow at the Murray Mouth

A volume of:

- at least 2 GL/day is required to minimise the rate of sand ingress inside the Murray Mouth;
- approximately 20 GL/day can be sufficient to prevent sand ingress inside the Murray Mouth; and
- at least approximately 75 GL/day for around two months is required to substantially scour and remove sand that has already been deposited based on recent flow events. This generally requires an extended duration of unregulated flow (eg as occurred in 2011).

During periods of low or no barrage releases, tidal currents are the primary factor controlling the morphology of the Murray Mouth. The overall potential for tide-driven sediment infill of the Murray Mouth is greatest when barrage releases cannot be maintained above 2 GL/day between May and November, due to the increased frequency of storm events.

# 13. Riverbank Collapse and Bank Slumping

Slumping and collapse of river banks is a natural river process associated with river movement. Nonetheless, the risk of slumping and collapse of river banks along the length of the South Australian River Murray is increased by persistent low water levels and the rate and magnitude of drawdown (reduction in water level).

Downstream of Lock 1 (the river reach which has the highest risk of persistent low water levels), this physical process is frequently referred to as 'riverbank collapse'.

A prolonged decrease in pool level during 2008-10 of up to 1.8 metres below Normal Pool Level resulted in widespread riverbank collapse events downstream of Lock 1. During this period the resisting forces that the water was applying against the banks decreased, resulting in areas of riverbank collapsing into the river. In some cases, property, infrastructure (roads, buildings and pump stations), vehicles, boats and trees collapsed into the river or suffered damage.

Slumping was also observed in 2011 near Morgan as the water level decreased by approximately 1.0 metre over the course of one month.

Natural flow events in the River Murray frequently have a quick recession, ie a rapid decrease in flow rate and water level.

## Triggers and Actions

Based on engineering advice, the pool level below Lock 1 is maintained within its normal operating range as much as possible (above +0.4 m AHD) to minimise the risk of riverbank collapse. Maintaining the pool level above this level is also necessary to maintain access to water for consumptive use.

Engineering advice is that a drawdown in River Murray water levels by 1.0 metre within 28 days can also increase the risk of riverbank collapse or slumping. Maximum rates of rise and fall to support ecological outcomes are also specified in the *Long-term environmental watering plan for the South Australian River Murray water resource plan area*.

Where operationally feasible, river operations will strive to manage the rate of recession to reduce the risk of slumping. This may be achieved by adopting a slowed rate of lowering of weir pool and regulator levels following raising, managing the rate and timing of water releases from Lake Victoria, or complementary delivery of environmental water. In many cases, particularly during periods of unregulated flow, there may be no operational strategy available which is effective at slowing the rate of recession.

The following triggers and actions (**Table 8**) should be considered by DEW to reduce the possibility of injury or fatality as a result of riverbank collapse below Lock 1.

Planning for, responding to and recovering from, riverbank collapse incidents is the responsibility of the local government authorities in the Murray and Mallee Emergency Management Zone.

**Table 8 Riverbank Collapse Triggers and Actions**

Riverbank Collapse Triggers	Actions
If River Murray water levels reach +0.25 m AHD on a downward trend	Advise the Murray and Mallee Zone Emergency Management Committee (ZEMC) of the increased risk of riverbank collapse downstream of Lock 1, as water levels are +0.25 m AHD and on downward trend. Advise the Murray and Mallee ZEMC to request the public (people living in the area or using the river) to report cracking along riverbanks. Advise the relevant councils to consider resuming monitoring at Caloote, East Front Road, Walker Flat and Woodlane Reserve.
If River Murray water levels drop 1.0 m within 28 days	Advise the Murray and Mallee ZEMC of the increase risk of riverbank collapse due to rapid drawdown. Advise the Murray and Mallee ZEMC to request the public (people living in the area or using the river) to report cracking along riverbanks (if not already happening).



Long Island Marina 2009

# 14. Environmental Water Accounting

In accordance with the Prerequisite Policy Measures (PPMs) agreed to by the Basin States (of which South Australia is a part), environmental water must be protected from consumptive extraction throughout the Murray-Darling Basin. For South Australia, environmental water accounting is undertaken to provide transparency in management of all environmental water delivered to the State and to provide assurance that the water has not been made available for other consumptive purposes. Return flows, such as that occurs when an inundated floodplain is returned to normal pool level, are also accounted for, such that environmental water may be used more than once during its passage from the SA border to the barrages.

The Water Delivery Group maintains the South Australian River Murray Environmental Water Accounting spreadsheet which is updated on a monthly basis to track the delivery and usage of environmental water throughout the South Australian River Murray.

# 15. Glossary of Terms Used

**Agreement (or the Agreement):** *Murray Darling Basin Agreement 2008* (Cwlth), which is Schedule 1 of the *Water Act 2012* (Cwlth)

**Annual Environmental Plan:** Water for the Environment Plan for South Australian River Murray (year)

**Basin Plan:** sets the amount of water that can be taken from the Basin each year, while leaving enough for rivers, lakes and wetlands and the plants and animals that depend on them. The Basin Plan was developed to manage the Basin as a whole connected system. The aim of the Murray–Darling Basin Plan is to bring the Basin back to a healthier and sustainable level, while continuing to support farming and other industries for the benefit of the Australian community.

**Basin Officials Committee (BOC):** BOC membership comprises of one official from each of the Commonwealth Government and Basin states (New South Wales, Victoria, South Australia, Queensland and the ACT). The Murray-Darling Basin Authority's Chair and Chief Executive are permitted to attend and participate in any Committee meeting but are not entitled to vote on meeting decisions. BOC is responsible for providing advice to the Ministerial Council and implementing policy and decisions of the Ministerial Council on matters such as state water shares and the funding and delivery of natural resource management programs.

**Blackwater:** as organic matter decays, oxygen in the water is consumed, which results in low dissolved oxygen and the water turning black

**Conveyance Water:** is the volume of water required to ensure that critical human water needs is able to be delivered to where it is needed without evaporating or seeping into the riverbed.

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

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

**Cyanobacteria:** also known as blue-green algae. Of particular interest are those species producing health impacting cyanotoxins such as Microcystin, Nodularin, Saxitoxin and Cylindrospermopsin.

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

**Dilution and Loss:** in the South Australian part of the River Murray is 696 GL. This volume provides for evaporation losses and seepage into the river bed. It also assists in diluting salinity levels.

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

**Entitlement Holder:** a natural person or body corporate that holds the right to a share of the consumptive pool for the River Murray Prescribed Watercourse.

**Water demands:** a volume of water that is required to meet water use, including irrigation, environment and water supply.

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

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

**MDBA Annual Operating Outlook:** Murray-Darling Basin Authority's *River Murray System Annual Operating Outlook*. Each year the MDBA releases an annual operating outlook. It explains how the MDBA may operate the River Murray system across a range of possible climatic and rainfall scenarios.

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

**Nephelometric Turbidity Unit (NTU):** is used to describe turbidity. Nephelometric refers to the way how much light is scattered by suspended particles in the water – the greater scattering, the higher turbidity, the lower water clarity.

**Parts per Thousand:** a unit used to measure high salinity levels. In this report, it is used to measure salinity in the Coorong. This differs to the unit used to measure much lower salinity levels, where EC is the unit measure along the River Murray and in the Lower Lakes.

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

**River Murray Action Request:** a request to undertake a proposed action on the River Murray (including wetlands and floodplain) in South Australia. Examples of actions include raising or lowering weir pools, pumping water to a wetland or drainage basin, opening an environmental water regulator, flushing water through backwaters, returning water to the River Murray channel.

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

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

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

**Weir pool:** water that is held back by the presence of a weir.

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

# 16. Glossary of Acronyms Used

AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
BOC	Basin Officials Committee
CEWH	Commonwealth Environmental Water Holder
CEWO	Commonwealth Environmental Water Office
CHWN	Critical Human Water Needs
DEW	Department for Environment and Water, South Australia
DHW	Department for Health and Wellbeing
EC	Electrical Conductivity
EPA	Environment Protection Authority, South Australia
FSL	Full Supply Level
GL	Gigalitre
LMRIA	Lower Murray Reclaimed Irrigation Area
NTU	Nephelometric Turbidity Unit
m	metres
MDBA	Murray-Darling Basin Authority
NOR	Normal Operating Range
NPL	Normal Pool Level
mg/L	milligrams per litre = 0.001 grams per litre (parts per million)
ML	Megalitre
ng/L	nanograms per litre = 0.000000001 grams per litre (parts per trillion)
PIRSA	Primary Industries and Regions South Australia
ppt	Parts per thousand = 1 gram per litre
RMOWG	River Murray Operations Working Group
µg/L	micrograms per litre = 0.000001 grams per litre (parts per billion)
ZEMC	Zone Emergency Management Committee



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