

Report on Managing Water Quality and Salinity – Murray-Darling Basin Authority

The Murray-Darling Basin's annual report on the implementation of the water quality and salinity management plan (Schedule 12, Item 14)

Reporting context

The water quality and salinity management plan provides a Basin-wide framework of water quality objectives and targets for Basin water resources. The water quality and salinity management plan is set out in Chapter 9 of the Basin Plan and includes a list of the key causes of water quality degradation, water quality objectives for Basin water resources and water quality targets for long-term planning

The purpose of this report is to monitor the extent to which the water quality and salinity management plan has been implemented. This report is a requirement of Chapter 13 of the Basin Plan and relates to Item 14 of Schedule 12.

Indicators for measuring success

Implementation of the water quality and salinity management plan is evaluated using the following five indicators:

- Recorded salinity at reporting sites is consistent with the salinity targets (**Indicator 14.1**)
- Adequacy of the flushing of salt from the River Murray System to the Southern Ocean (salt export) (**indicator 14.2**)
- Governments are having regard to water quality and salinity targets when managing water flows (**indicator 14.3**)
- Governments are having regard to water quality targets when making decisions about using environmental water (**indicator 14.4**)
- Measures governments take to achieve end-of-valley salinity targets (**indicator 14.5**)

Indicator 14.1: Salinity at reporting sites is consistent with the salinity targets in s9.14(5)

14.1.1. Proportion of days where measured salinity met the target EC at select reporting sites

Response				
Salinity targets are based on a five-year rolling average to account for fluctuations that can occur as a result of changes in hydrologic and climatic conditions in the Basin, such as drought. The salinity levels at the five salinity reporting sites set out in s9.14(5) of the Basin Plan have been monitored over the five-year reporting period (2009 – 2014). The targets are deemed to have been met if the salinity levels have been below the target value for 95% of the time during the five-year period.				
The table below shows that the salinity targets at reporting sites were met except at the Lower Lakes at Milang, where recorded salinity was affected by drought in 2009-10, the start of the five-year reporting period. Salinity at Milang increased markedly at that time due to the low inflows and high rates of evaporation. Lake Alexandrina water level returned to normal around October 2010, resulting in decreased salinity at Milang. Over 2013-14, salinity levels at Milang were about 757 EC 95% of the time, and did not exceed the target at any time.				
Item	Reporting site	Target EC value (µS/cm)	Non-exceedance salinity at 95% of the time (µS/cm)*	% of days above target value
1	River Murray at Murray Bridge	830	692	0
2	River Murray at Morgan	800	584	0
3	River Murray at Lock 6	580	352	0
4	Darling River downstream of Menindee Lakes at Burtundy	830	611	0.2
5	Lower Lakes at Milang	1,000	4,786	30
*This means that for 95% of the 5-year reporting period salinity was at this level or below. Note: Salinity levels compiled from best available data (daily mean values derived from continuously logged data).				

Indicator 14.2: Adequacy of flushing to provide salt export (s9.09)

14.2.1: Estimated Salt Export (Tonnes) from the River Murray System to the Southern Ocean

Response
This indicator is about the estimated volume of salt exported from the River Murray System to the Southern Ocean.
Provisional estimates indicate salt export was 1.5 million tonnes a year, annualised over the period 2011-2014.

14.2.2. Flushing Adequacy

Response

The salt export objective in the Basin Plan is to flush enough salt from the River Murray System into the Southern Ocean to keep the river healthy. The Basin Plan estimates that an average of 2 million tonnes of salt should be discharged each year to meet this objective.

A provisional estimate indicates that the annualised rate of salt export over the three-year period (2011– 2014) was 1.5 million tonnes. This is less than the Basin Plan indicative figure of two million tonnes.

A range of factors can influence how much salt is exported each year. During extended droughts and periods of below average inflows into the River Murray System, the flows are not adequate to flush 2 million tonnes of salt while maintaining the salt concentration (or salinity of the river water) at acceptable levels.

Although salt export this year was assessed as less than 2 million tonnes, the maintenance of flows over the barrages into the Coorong, and low salinity levels in the lower Murray system, indicate that adequate flushing of salt through the system may have been achieved.

Indicator 14.3: Managing water flows with regard to water quality targets (s9.14)

14.3.1. What procedures and tools were in place to enable water quality (dissolved oxygen, recreational water quality and salinity) to be met

Response

A range of procedures and tools were in place which helped ensure MDBA had regard to the Basin Plan water quality targets in s9.14 when managing water flows. These include:

- The Basin Officials Committee has Objectives and Outcomes for River Operations in the River Murray System that help meet the requirements of s9.14
- Water quality requirements are covered in the general objectives and outcomes for 'People and Communities' and 'Environment'. For example a specific outcome under 'People and Communities' is: *Events that may adversely affect the quality of water available for urban, irrigation, industrial, environmental, recreational or stock and domestic use are mitigated*
- Specific Objectives and Outcomes related to water quality, include:
 - minimum flow requirements
 - Improving Water Quality at Lake Victoria
 - Operation of the Lower Lakes Barrages
 - Variability in flow patterns and levels
 - Lindsay River Allowance
- River operations occur in close consultation with the Southern Basin States and Australian Government through the Water Liaison Working Group (WLWG). Potential water quality matters are raised as early as possible with the WLWG. Any issues are referred to the Basin Officials Committee on the advice of the WLWG
- Potential water quality risks are considered when preparing the River Murray System Annual Operating Plan and throughout the water year as the operating plan is updated.
- All available, relevant water quality data has been incorporated into operations spreadsheets, providing MDBA Duty Officers better access to daily data to support decision making
- Contributing to the monitoring of DO levels along the Murray at key locations
- Identifying an additional 17 sites where telemetered DO data is being collected and adding these to operational spreadsheets. This expanded data set improves the ability to have regard to the DO targets when managing water flows
- Converting the DO data (mg/L) into percentage saturation and coding the operational spreadsheets to alert river operators when data may be trending toward target levels
- Contributing to the monitoring of Blue Green Algae (BGA) levels along the Murray at key locations
- Participating in Murray and Sunraysia Regional Algal Coordinating Committee meetings
- Working on an onscreen blue-green algae status mapping product to assist MDBA river operators. The map brings together the algal reporting from the states (algal data and alerts published by NSW Regional Algal Coordinating Committees, Goulburn-Murray Water and South Australia)

MDBA publishes [information on its website](#) about river levels, flows and water quality, including the River Operations Weekly Report and a weekly flow and salinity forecast.

14.3.2. Statement of how procedures and tools were used to meet water quality targets

Response

The Authority had regard to the requirements of s9.14(1) by:

- Implementing the specific objectives and outcomes for minimum flows.
- Operating Lake Victoria to improve the salinity levels of the flow to South Australia as specified in the Specific Objective and Outcome 9.5 Improving Water Quality at Lake Victoria. No significant water quality issues were observed at the Lake or downstream of Rufus River.
- Operating the Menindee Lakes in accordance with Specific Objective and Outcome 10.4 Distribution of water stored within the Menindee Lakes Storage. MDBA worked closely with the NSW Office of Water to balance the conservation of water and management of water quality issues when making releases from the Lakes
- Adhering to Specific Objective and Outcome 11.1 Operation of the Lower Lakes Barrages, for example working with South Australia to vary the level in Lake Alexandrina and Lake Albert when there were sufficient inflows and appropriate seasonal conditions, with the aim of improving salinity levels in Lake Albert. This appears to have been successful as salinity levels continue to trend downwards.
- Adhering to Specific Objective and Outcome 12.8 Variability in flow patterns and levels, for example when making bulk water transfers from Dartmouth Dam to Hume Dam and from the Menindee Lakes Storage to Lake Victoria
- Following Specific Objective and Outcome 12.10 Lindsay River Allowance
- Reviewing real-time DO information (Dissolved Oxygen Circulars) provided by the NSW Office of Water. This helps to provide 'early warning' of potential low DO levels.
- Considering information gained about the extent and distribution of algal blooms, through participating in jurisdictional algal co-ordinating committee meetings and algal reporting from the states, when making flow management decisions in the River Murray System.
- Case-by-case management of actions with the potential for water quality issues, as shown by the following examples
 - Providing an additional release of water from Lake Mulwala to maintain a flushing flow and mitigate the potential for salinity incursion from groundwater during the Mildura Weir drawdown for essential maintenance works. Potential risks were regularly discussed with the WLWG
 - Considering downstream water quality impacts during the flushing of the highly saline Psyche Bend Lagoon
 - Considering salinity implications in implementing a request from the Commonwealth Environmental Water Holder to allow a flow through locks 7 to 9, rather than the standard process of diverting through Lake Victoria
 - Trialling the increase of the minimum release from the Menindee Lakes Storage from 200 ML/d up to 300 ML/d in response to local concerns, including potential water quality issues
 - On 6 February 2014, a toxic algal bloom in Lakes Wetherell, Tandure and Menindee in the Menindee Lakes System was reported to the Authority by the Sunraysia Regional Algal Coordinating Committee with a red alert issued for BGA in Lake Menindee. At the time, a small release was being made from Lake Menindee to meet the flow target at Weir 32. The Authority, in co-operation with the NSW Office of Water and NSW State Water, recommended closing the Menindee outlet and delivering the full required flow at Weir 32 from Lake Pamamaroo (where water quality was significantly better). This action was undertaken to minimise the risk of releasing poor quality water from the Menindee Lakes into the lower Darling River

14.3.3. Case study

Response

The consideration of water quality, especially DO in the design and commissioning of environmental works at Hattah Lakes, provides a good example of how river operators and The Living Murray had regard for the requirements of s9.14(1) and (4).

- A number of features were incorporated into the design of the works to improve water quality outcomes. Water can be released back to the River Murray from two regulators, Messengers and Oateys. Both regulators have an 'overshot' mode to help oxygenate the water Messengers regulator is close to the inflow pumps and contains the most recently pumped water – hence it will usually be quite good DO. Oateys Regulator is at an end point; stagnant water accumulates and DO drops. Oateys is located about 15 km from the river, as such most of the initial water releases soak into the channel and do not reach the river. Secondly, the water will naturally reoxygenate as it flows through the 15 km of complex channel to the river
- Identifying broad water quality risks in the Hattah Lakes Operations Plan prepared by the icon site manager Mallee Catchment Management

Response

- Authority and approved by the Victorian Steering Committee and the MDBA Environmental Watering Group (EWG).
- Including water quality risks in the water bid put forward by the TLM icon site manager for that year
 - Putting in place risk mitigation measures, such as installing additional DO monitoring sites and having a locally-based Operational Advisory Group to communicate with the Authority river operators on what is happening on-ground
 - The Hattah Operational Advisory Group (HOG) is chaired by the icon site manager – Mallee Catchment Management Authority and includes the Land Manager - Parks Victoria, Victoria Department Environment and Primary Industries, Goulburn-Murray Water, Lower Murray Water (LMW), Commonwealth Environmental Water Holder, Victoria Environmental Water Holder, MDBA Operations and the MDBA Environmental Delivery and Planning
 - During operations, the Operational Advisory Group meets weekly via teleconference to discuss and solve any arising issues
 - The icon site manager collects water quality data and provides it to the MDBA. This is one area that needs to be improved. The manual collection of the data means that there can be delays in the timely provision of the data to MDBA operators
 - Once the data is provided to the MDBA, operators are able to identify any issues to discuss with the HAG. This is done manually. Ideally an automated system will be developed so that operations spreadsheets contain conditional formatting that alerts the operators of potential issues
 - If an operator has concerns about the DO data received, they will:
 - confirm with the icon site manager the integrity of the water quality data to determine if this is a true indication of DO
 - discuss with the HOG the best way to manage the low DO, based on the current situation. Consideration will be given to such things as; when is the water scheduled to be released back to the Murray? Will there be enough dilution flows in the Murray to counteract the low DO water being released from Hattah? Can water be held and released later?
 - At the end of the first watering of the Hattah Lakes, when water was scheduled to be returned to the River Murray, DO was low at Oateys Regulator but not of any concern at Messengers Regulator. The HAG agreed to release water from Messengers but not Oateys
 - DO levels at Oateys remained low during the second watering, but naturally increased to levels above 50% saturation. Messengers was also well above 50% DO saturation. As such, both regulators were used to release water back to the River Murray with no DO impacts
 - Post-watering results indicate that by releasing water from the regulators in overshot mode, substantial improvements were made in DO levels; at Oateys this lifted them from 5 to 6 parts per million (PPM) (acceptable) to 8 to 10 PPM (supports growth of fish).
 - Lessons from the first Hattah waterings will be incorporated into updated MDBA Environmental Guidelines and, if appropriate, also in new or amended specific objectives and outcomes.

Indicator 14.4: How were water quality targets taken into account when making decisions about using environmental water

14.4.1. Statement that procedures and tools were in place

Response

Operating plans for environmental works

In collaboration with TLM partner governments and icon site management authorities, operating plans have been developed to guide the use of the environmental works at Gunbower–Koondrook–Perricoota Forest, Hattah Lakes and the Chowilla Floodplains–Lindsay–Wallpolla Islands icon sites. These operating plans assist TLM to effectively and efficiently deliver environmental water as well as manage risks (including water quality risks) related to their operation.

Modelling

Operational models have been developed to inform watering activities at the icon sites with environmental works. These models simulate the operation of the works to produce information about areas of inundation, water usage, impacts on downstream flows and water quality.

A blackwater model of the River Murray and Edward–Wakool rivers was developed with the Murray–Darling Freshwater Research Centre. This model can predict downstream DO levels during watering activities, assisting water managers and river operators manage low DO (blackwater) during environmental water delivery. The model provides an assessment of the predicted DO levels from the inundation of major floodplains of Barmah, Millewa, Gunbower and Koondrook–Perricoota forests.

Response

Operational salinity risk management framework

In coordination with TLM partner governments, a salinity risk management framework was developed to use when delivering TLM environmental water to high salinity risk sites. The framework allows salinity risks and mitigation and/or monitoring measures to be identified. Selected measures will depend on a range of factors at the time of delivery. Some important measures include hydrograph manipulation, improved coordination of water deliveries and dilution flows.

Watering proposals

The TLM Annual Watering Plan outlines the framework for planning and delivering TLM water. It notes that TLM must have regard to Basin Plan water quality targets and embeds this into the planning and delivery processes. Using the tools outlined above, icon site managers are asked to assess the risk of proposed watering actions and provide appropriate mitigation strategies when they develop watering proposals for their icon sites. These watering proposals are reviewed by state agencies and then by the inter-jurisdictional Environmental Watering Group (EWG), which prioritises using criteria that includes the risks associated with the watering action.

Monitoring

Monitoring of water quality issues is primarily undertaken using data obtained by River Management Division water monitoring stations. The data is extracted to inform environmental water planning or delivery activities.

Other sources of data are available from state-based staff who record water quality data from spot readings during watering actions at icon sites.

During the real-time management of TLM watering events this information is reviewed by Operational Advisory Groups (OAGs) that provide advice including how to manage any water quality issues that may emerge. OAGs include representatives from state agencies, state water authorities, river operators, icon site managers and environmental water holders.

14.4.2. Statement of how procedures and tools were used

Response

Operating plans for environmental works

The Hattah Lakes Interim Operating Plan was used to underpin the two commissioning operations that occurred at Hattah Lakes in 2013-14 and into 2014-15. Chapter 11 of this plan summarises knowledge about water quality risks (BGA, DO and salinity) as well as potential mitigation measures.

That knowledge was used to inform the watering proposals as well as undertake specific actions to respond to emerging water quality issues during the event. For more information see the case study provided in section 14.4.3 below.

Modelling

When planning for the delivery of environmental water to an icon site, TLM uses a number of modelled scenarios to make the best use of the water and minimise any risks such as poor water quality.

The TLM models allow the simulation of flow events through an icon site, providing information on what response is likely. They allow management scenarios to be tested, such as different inflow volumes, holding times and release patterns. The models also provide information on potential risks, including poor water quality (low DO or high salinity levels), and can be used to assess appropriate mitigation strategies.

The monitoring data collected from watering events is recalibrated with the models to improve their accuracy and future environmental watering.

Operational salinity risk management framework

The operational salinity risk management framework was not used in 2013-14 as the only TLM site where salinity is considered a significant risk is the Chowilla Floodplain when works are operated; works at that site were not operated until September 2014.

Watering proposals

The watering proposals considered risks, including salinity and blackwater, and provided mitigation strategies where appropriate. For example, water quality was monitored during the watering action at Barmah and OAGs assessed the readings weekly during the event to ensure this risk was managed.

Monitoring

Data taken from telemetered monitoring stations or spot readings were used to inform the operations undertaken at Hattah Lakes. DO data was used to manage outflows from the site to avoid any problems in the River Murray. For more information see the case study provided in section 14.4.3 below.

14.4.3. Case study

Response

The consideration of water quality, especially DO in the design and commissioning of the environmental works at Hattah Lakes provides a good example of how river operators and The Living Murray had regard for the requirements of s9.14(1) and (4).

- A number of features were incorporated into the design of the works to improve water quality outcomes. Water can be released back to the River Murray from two regulators, Messengers and Oateys. Both regulators have an 'overshot' mode to help oxygenate the water. Messengers regulator is close to the inflow pumps and contains the most recently pumped water – hence DO readings will usually be quite good. Oateys Regulator is at an end point; stagnant water accumulates and DO drops. Oateys is located about 15 km from the river, as such most of the initial water releases soaks into the channel and does not reach the river. Secondly, the water will naturally re-oxygenate as it flows through the 15 km of complex channel to the river
- The Hattah Lakes Interim Operating Plan identifies broad water quality risks and potential mitigation activities, while water quality risks associated with a particular event are identified in the watering proposal put forward by the icon site manager for that year
- A number of risk mitigation measures were put in place, such as installing additional DO monitoring sites and having a locally-based Operational Advisory Group to communicate with the MDBA river operators on what is happening on the ground
- The Hattah Operational Advisory Group (HOG) is chaired by the icon site manager – Mallee Catchment Management Authority - and includes Parks Victoria (the land manager), Victoria Department of Environment and Primary Industries, Goulburn-Murray Water, Lower Murray Water (LMW), Commonwealth Environmental Water Holder, Victoria Environmental Water Holder, MDBA Operations and the MDBA Environmental Delivery and Planning
- During operations, the Operational Advisory Group (OAG) meets weekly via teleconference to discuss and resolve any issues concerning Murray system scale issues.
- The icon site manager collects water quality data and provides it to the MDBA. Manual collection of the data means that there can be delays in the timely provision of the data to the MDBA operators. The icon site manager has the ability to notify the HOG or MDBA operators of any issues of concern
- MDBA operators and TLM staff are able to consider the data and identify any issues to discuss with the OAG or HOG. This is done manually, ideally an automated system will be developed so that operations spreadsheets contain conditional formatting that alerts the operators of potential issues in the future
- At the end of the first watering of the Hattah Lakes, when water was scheduled to be returned to the River Murray, DO was low at Oateys Regulator but not of any concern at Messengers Regulator. The OAG agreed to release water from Messengers but not Oateys
- DO levels at Oateys remained low during the second watering, but naturally increased to levels above 50% saturation. Messengers was also well above 50% DO saturation. As such, both regulators were used to release water back to the River Murray with no DO impacts
- Post-watering results indicate that by releasing water from the regulators in overshoot (provides aeration) mode, substantial improvements were made in DO levels – at Oateys this lifted them from 5 to 6 PPM (acceptable) to 8 to 10 PPM (supports growth of fish)
- Lessons from the first Hattah waterings will be incorporated into the Hattah Lakes Interim Operating Plan and MDBA's Environmental Guidelines and if appropriate in new or amended specific objectives and outcomes.

Indicator 14.5: Implementation of measures to achieve end-of-valley salinity targets

14.5.1. Types of measures implemented

Response

The Authority reports on this indicator on behalf of Basin governments, about the types of measures Basin governments used in progressing towards the end-of-valley targets set for each Basin valley (catchment) for long-term salinity planning and management.

The following activities were undertaken in 2013-14:

- Salinity modelling tools were reviewed and updated to account for actions with significant salinity impacts in the salinity registers.
- Salt interception schemes were operated to divert salt away from the river system and keep river salinity levels at acceptable levels
- Salinity management in the Basin was reviewed to help prepare for the next Basin-wide salinity management strategy to 2030.

14.5.2. Summary of objectives, activities and achievements with regard to each measure implemented

Response

Achievements during 2013–14 included:

- the Basin salinity target of an average daily salinity of less than 800 EC for at least 95% of the time at Morgan in South Australia was achieved
- MDBA and independent auditors confirmed a net credit balance in the NSW, Victoria and SA salinity registers
- salt interception schemes diverted approximately 398,000 tonnes of salt from the River Murray
- outcomes of the general review of salinity management in the Basin were presented to Ministerial Council
- Ministerial Council agreed to develop an updated salinity management program for the next 15 years (up to 2030)
- reporting obligations were met, including the *Report of the Independent Audit Group for Salinity 2012–13* (MDBA 2014a) and the *Basin Salinity Management Strategy 2012–13 Annual Implementation Report* (MDBA 2014b)
- all Basin states and the ACT complied with the Basin Salinity Management Strategy (BSMS) including reporting activities at catchment scale which contribute to long-term salinity outcomes at end-of-valley target sites. The state reports include the annual assessment of recorded salinity at end-of-valley target sites against the target values. A summary of the measures implemented by states and the Authority and salinity outcomes at the end-of-valley target sites will be presented in the 2013-14 BSMS Annual Implementation Report to be published in mid-2015.