

South Australian Matter 12 Report 2020

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**Government
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1 Summary

The Basin states are required to report on Matter 12 every five years to evaluate progress towards water quality targets outlined Chapter 9 since Basin Plan implementation.

Water quality targets have been set in the Basin Plan for three purposes:

- Water quality targets to which entities must have regard for when performing functions, particularly in relation to the management of water flows;
- Water quality targets relating to fresh water-dependent ecosystems, irrigation water and recreational water that inform the development of certain measures required to be included in the Water Resource Plans; and
- Salinity targets for the purposes of long-term salinity planning and management.

An overall exceedance assessment of each of the characteristics within the relevant water quality targets has been undertaken. Targets were assessed annually, with the level of exceedance (i.e. percentage of days for salinity and dissolved oxygen assessments and the percentage of records within each year at each site for other water quality characteristics) for each target at each site assessed.

The assessment has found that the water quality targets for managing water flows, irrigation water, recreational water and the salinity targets for the purposes of long-term salinity planning and management are rarely exceeded.

South Australian Water Resource Plans have not identified specific water quality targets for declared Ramsar wetlands. Therefore the water quality targets for fresh water-dependent ecosystems are set out in Schedule 11 of the Basin Plan. Exceedances of these water quality targets are relatively common. This is likely due to the targets not being appropriate for the very ephemeral and estuarine water-dependent ecosystems prevalent in South Australia. This will be partly addressed through the development of a more appropriate set of water quality targets in the Coorong, Lakes Alexandrina and Albert Ramsar Management Plan in 2021.

2 Introduction

2.1 Basin Plan Schedule 12

The reporting requirements outlined in Schedule 12 of the Basin Plan provide the Murray-Darling Basin Authority (the Authority) with the information necessary to evaluate the effectiveness of the Basin Plan against the objectives and outcomes outlined in the Plan (s13.05).

Chapter 9 of the Basin Plan, the Water quality and salinity management plan, outlines a number of objectives and targets specific to water quality and salinity management for:

- water-dependent ecosystems, including declared Ramsar wetlands;
- raw water for treatment for human consumption;
- irrigation water;
- recreational water quality;
- maintaining good levels of water quality; and
- salt export from the River Murray system.

Schedule 12 outlines the reporting requirements for the MDBA and Basin states as either annual or five yearly obligations. The Basin states are required to report on Matter 12 every five years to evaluate progress towards water quality targets outlined Chapter 9 since Basin Plan implementation. The water quality targets are outlined below.

2.2 Water quality targets

Water quality targets have been set in the Basin Plan for three purposes:

- Water quality targets to which entities must have regard for when performing functions, particularly in relation to the management of water flows;
- Water quality targets that inform the development of certain measures required to be included in the Water Resource Plans; and
- Salinity targets for the purposes of long-term salinity planning and management.

2.2.1 Water quality targets for managing water flows

All river operators and environmental water managers must have regard to the targets relating to water flows when making decisions about the use of environmental water (Section 9.14 of the Basin Plan). The following targets apply:

- to maintain dissolved oxygen at a target value of at least 50% saturation (note: this equates to approximately 50% oxygen saturation at 25°C and 1 atmosphere of pressure);
- the targets for recreational water quality (as described in Section 9.18 of the Basin Plan); and
- the levels of salinity at the reporting sites set out in Table 1 should not exceed the values set out in the table, 95% of the time.

Table 1. Reporting sites and targets for managing water flows.

Item	Reporting site	Target value (EC $\mu\text{S/cm}$)
1	River Murray at Murray Bridge	830
2	River Murray at Morgan	800
3	River Murray at Lock 6	580
4 [#]	Darling River downstream of Menindee Lakes at Burtundy	830
5	Lower Lakes at Milang	1000

[#]This report assesses only sites within South Australia (e.g. excludes the Burtundy reporting site).

2.2.2 Water quality targets for water resource plans

These targets relate to fresh water-dependent ecosystems, irrigation water and recreational water and inform measures outlined in the South Australian River Murray, Eastern Mount Lofty Ranges and SA Murray Region and Water Resource Plans.

2.2.2.1 Water quality targets for fresh water-dependent ecosystems

South Australian Water Resource Plans have not identified specific water quality targets for declared Ramsar wetlands. Therefore the water quality targets for fresh water-dependent ecosystems (including fresh water-dependent ecosystems that are declared Ramsar wetlands) are set out in Schedule 11 of the Basin Plan. Table 2 outlines the characteristics and targets that will be measured in this report. Characteristics such as cyanobacteria and chlorophyll a and b (as in Schedule 11 of the Basin Plan) have not been assessed due to data not being available (and therefore are not shown in Table 2). Temperature has also not been assessed (and excluded from Table 2) because there is no release of stored water from large water storages with a thermocline in South Australia (DEW 2019).

Table 2. Basin Plan Schedule 11 targets for freshwater-dependent ecosystems.

Target application zones (Target assessment)	Water-dependent ecosystem	Ecosystem Type	Turbidity (NTU) (Annual median)	Total Phosphorus ($\mu\text{g/L}$) (Annual median)	Total Nitrogen ($\mu\text{g/L}$) (Annual median)	Dissolved oxygen (mg/L; or saturation (%)) (Annual median within the range)	pH (Annual median within the range)	Salinity
LM (Lower Murray)	Declared Ramsar wetlands	Streams and rivers	50	100	1000	85-110%	6.5-9.0	
		Lakes and wetlands	20	10	350	90-110%	6.5-8.0	
	Other water-dependent ecosystems	Streams, rivers, lakes and wetlands	50	100	1000	85-110%	6.5-9.0	End-of-Valley targets in Appendix 1 of Schedule B to the Agreement

2.2.2.2 Water quality targets for irrigation water

The water quality target for irrigation water in South Australia (Southern Basin Region - Murray River and tributaries) is as follows:

- salinity remains below 833 EC (the target value) 95% of the time over each period of 10 years that ends at the end of a water accounting period.

This target value applies at sites identified in the *South Australian River Murray Water Resource Plan* (DEW 2019; refer to Table 7) where water is extracted for irrigation purposes by an irrigation infrastructure operator between the South Australian Border and Wellington.

2.2.2.3 Water quality targets for recreational water

The water quality targets for water used for recreational purposes are that the values for cyanobacteria cell counts or biovolume meet the guideline values set out in Chapter 6 of the *Guidelines for Managing Risks in Recreational Water* (Table 3).

Table 3. National Health and Medical Research Council (2008) Guidelines for Managing Risks in Recreational Water, Australian Government.

Characteristic	Guideline	Supporting information
Cyanobacteria and algae in fresh waters	Fresh recreational water bodies should not contain: <ul style="list-style-type: none"> • >10 µg/L total microcystins; >50 000 cells/mL toxic <i>Microcystis aeruginosa</i>; or biovolume equivalent of >4 mm³/L for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume; or • >10 mm³/L for total biovolume of all cyanobacterial material where known toxins are not present; or • cyanobacteria scums consistently present. 	<p>A single guideline value is not appropriate.</p> <p>Instead, two guideline values have been established, based on known risks associated with known toxins and probability of health effects caused by high levels of cyanobacterial material.</p> <p>A situation assessment and alert levels framework for the management of algae/ cyanobacteria in recreational waters has been developed that allows for a staged response to the presence and development of blooms.</p>

2.2.3 Salinity targets for long-term salinity planning and management

Salinity targets for the purpose of long-term salinity planning and management for the Murray-Darling Basin are set out (as absolute values) in Appendix 1 of Schedule B to the Murray-Darling Basin Agreement (Schedule 1 of the *Water Act 2007*). The South Australian End-of-Valley Targets for salinity (from Appendix 1 of Schedule B) are listed in Table 4.

Table 4. End-of-Valley Targets for salinity in South Australia (*Water Act 2007*).

Valley	End-of-Valley Target (as % of baseline)
Basin salinity target	800 EC (95%)
SA Border	412 EC (80%)
Berri	543 EC (80%)
Below Morgan	770 EC (80%)

3 Methods

3.1 Assessment of progress towards water quality targets in South Australia

South Australia's Matter 12 reporting has undertaken an assessment of relevant water quality targets (as outlined in Section 1.2). This assessment includes a range of sites that are within each of South Australia's Water Resource Plan Areas; SA River Murray, Eastern Mount Lofty Ranges and SA Murray Region.

Data has been sought from relevant agencies, including the South Australian Environmental Protection Authority, SA Water, the South Australian Department for Environment and Water and Landscape Boards. Where possible, data since 2001 has been included in the assessments to present the decade before and after the adoption of the Basin Plan, and to include key events such as the Millennium Drought.

The method of assessment for each water quality parameter is not presented within this report, as the data have been captured and collected in a NATA (National Association of Testing Authorities) accredited manner by the agencies that have collected the raw data.

3.1.1 Exceedance evaluation

An overall exceedance assessment of each of the characteristics within the relevant water quality targets within the Water Quality and Salinity Management Plan (Chapter 9 of the Basin Plan) has been undertaken. Targets were assessed annually, with the level of exceedance (i.e. percentage of days for salinity and dissolved oxygen assessments and the percentage of records within each year at each site for other water quality characteristics) for each target at each site assessed. An exceedance table is presented for each parameter enabling a visual assessment of the trend over time. This evaluation provides an indication of temporal exceedance of a target rather than assessing a single median value per year. Analyses were conducted in R (R Core Team (2020)) using the formattable package (Ren and Russell, 2016).

The following level of exceedance and associated colour coding has been applied to all exceedance tables presented in this report:

- No colour: 0-5% exceedance;
- Yellow: 6-25% exceedance;
- Orange: 26-50% exceedance; and
- Red: >50% exceedance.

Specific sites and methods for assessments are presented below for the key areas of water quality target assessment.

3.1.2 Water quality targets for managing water flows

3.1.2.1 Assessment of dissolved oxygen target values

Data from SA Water from 2010 (as monitored consistently) has been used to assess the maintenance of dissolved oxygen (DO) at a target value of at least 50% saturation. The target value for assessment has been identified as 5 mg/L, as this is considered to equate to the 50% saturation target at a range of temperatures and elevations experienced at South Australian reporting sites. There is little consistent data available prior to 2010 meaning that an assessment of DO during the driest times (i.e. during the Millennium Drought) was not able to be undertaken.

3.1.2.2 Assessment of salinity target values

Salinity target values (as described in Table 1) for managing water flows were assessed using the reporting sites shown in Table 5. Assessment of exceedances of these target values were undertaken, with a 5% exceedance deemed acceptable, as the target values should not be exceeded for 95% of the time.

Table 5. Salinity (EC) target values for South Australian reporting sites used for the assessment.

Reporting site	Site number	Target value EC
River Murray at Murray Bridge (daily read)	A4261003	830
River Murray at Murray Bridge (sensor)	A4261162	830
River Murray at Morgan	A4260554	800
River Murray at Lock 6	A4260510	580
Lower Lakes at Milang	A4260524	1000

3.1.3 Water quality targets for Water Resource Plans

3.1.3.1 Assessment of target values for fresh water-dependent ecosystems

Data is not available for each characteristic in all assessment areas. Table 6 outlines the areas and sites assessed for each water quality characteristic, data used and description of the assessment undertaken. See Figure 1 for assessment sites in the SA River Murray, Figure 2 for assessment sites in the Eastern Mount Lofty Ranges and Figure 3 for sites in the Coorong.

Table 6. Key characteristics of the water quality and salinity targets used in this assessment. Assessment details such as areas, sites, data used and additional information are also described.

Characteristic	Unit	Assessment areas	Data source: data years	Additional information
Turbidity	NTU	Coorong	EPA and DEW: 2001-2019	Assessed Declared Ramsar wetlands (Lakes and Wetlands) target value (20 NTU).
Total Phosphorus (TP)	µg/L	River Murray	SA Water: 2001-2020	Lower Murray Target zone value assessed.
		Eastern Mount Lofty Ranges	EPA: 2001-2015	Data not consistently available. Records between 2001 and 2007 and within 2010 and 2015.
		Coorong	EPA and DEW: 2001-2019	Assessed the higher TP target value (100 µg/L) due to estuarine environment.
Total Nitrogen (TN)	µg/L	Eastern Mount Lofty Ranges	EPA: 2007, 2010, 2015	Assessment is limited with low number of data available.
		Coorong	EPA and DEW: 2014-16, 2018-19	Assessed the higher TP target value (1000 µg/L) due to estuarine environment.
Dissolved oxygen (DO)	mg/L	River Murray	SA Water: 2006-2020	Assessed percentage of days <7 mg/L (representing 85% saturation) and exceedance >9 mg/L (representing 110% saturation).
		Eastern Mount Lofty Ranges	EPA: 2001-2007, 2010, 2015	
pH	pH	River Murray	SA Water: 2001-2020	Assessed data below 6.5 pH and exceedance >9 pH.
		Eastern Mount Lofty Ranges	EPA: 2001-07, 2010, 2015	
		Coorong	EPA and DEW: 2001-2019	

The River Murray is within the South Australian River Murray Water Resource Plan. The Eastern Mount Lofty Ranges is within the Eastern Mount Lofty Ranges Water Resource Plan and the Coorong within the SA Murray Region Water Resource Plan.

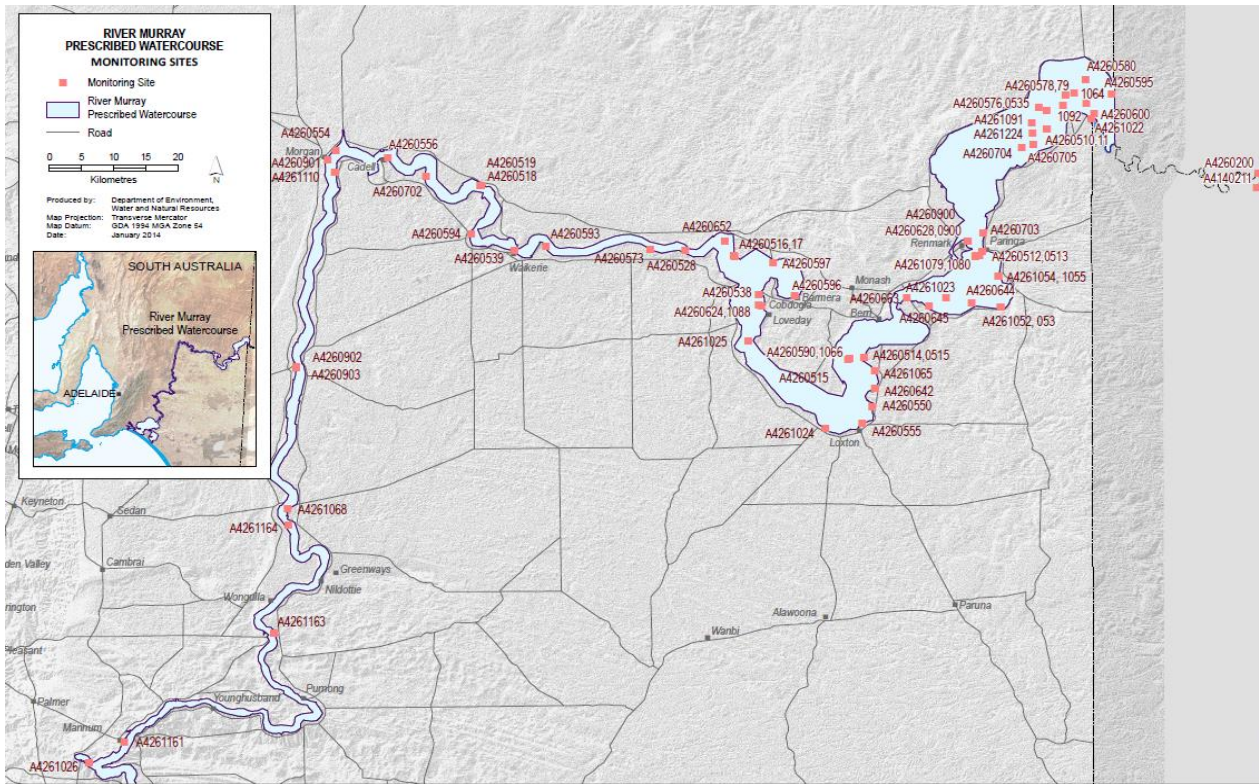


Figure 1. Sites used to assess the water target values for freshwater-dependent ecosystems in the SA River Murray.



Figure 2. Sites used to assess the water target values for freshwater-dependent ecosystems in the Eastern Mount Lofty Ranges.

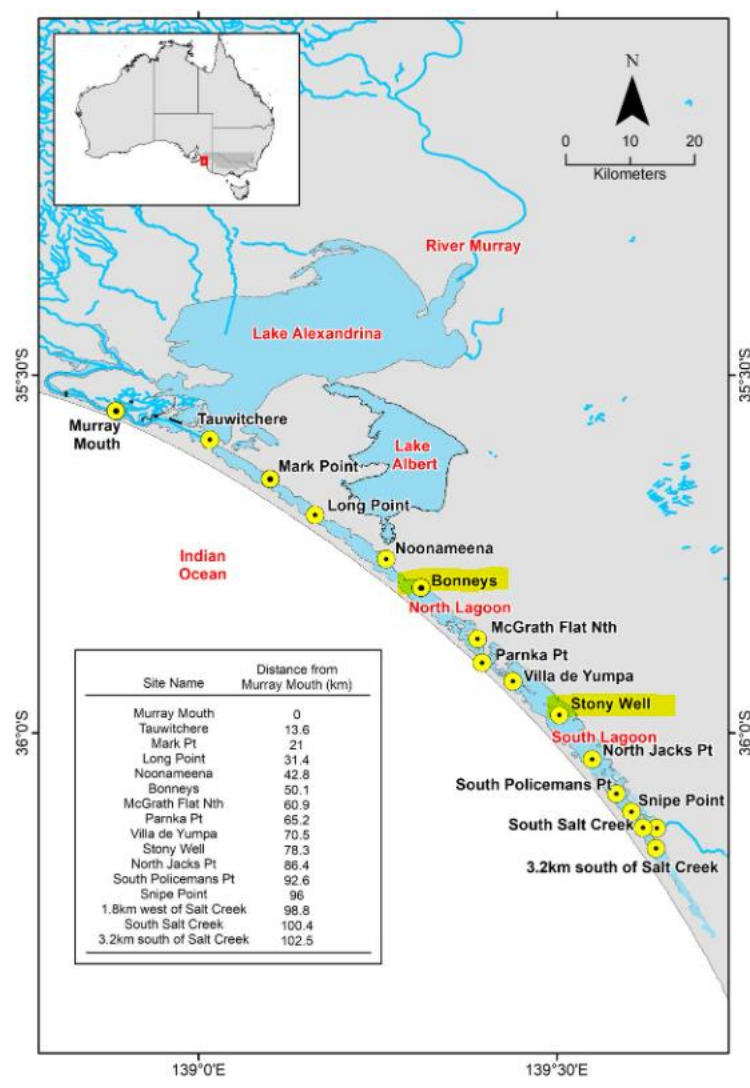


Figure 3. Sites used to assess the water target values for freshwater-dependent ecosystems in the Coorong.

The water quality targets for fresh water-dependent ecosystems (as set out in Schedule 11 of the Basin Plan) do not have specific salinity targets. As a result, no assessment of target values has been undertaken as part of this assessment. Information in relation to salinity (and other water quality) conditions in the South Australian River Murray and Coorong, Lower Lakes and Murray Mouth and the influence that these conditions have on environmental outcomes (including ecological indicators) can be found in the *South Australian River Murray Basin Plan Environmental Outcome Evaluation: Coorong, Lower Lakes and Murray Mouth (CLMM) Priority Environmental Asset* and *South Australian River Murray Basin Plan Environmental Outcome Evaluation: SA Channel and Floodplain Priority Environmental Assets* (DEW 2020a and b).

3.1.3.2 Assessment of water quality targets for irrigation water

The target value (i.e. salinity remains below 833 EC 95% of the time over each period of 10 years that ends at the end of a water accounting period) was assessed at the sites listed in Table 7. The water quality targets for irrigation water do not apply downstream of monitoring site A4261159 (River Murray 2 km downstream Wellington Ferry) as there are no sites identified where water is extracted by an irrigation infrastructure operator (as defined under the Basin Plan) from the Lower Lakes (DEW 2019).

Table 7. Water quality targets for irrigation water assessment sites. Note: all assessment sites are those outlined in the South Australian River Murray Water Resource Plan (DEW 2019).

Unique ID (AWRC)	Location	Latitude	Longitude
A4260510	River Murray at Lock 6 upstream (AMTD 619.8 km)	-33.996682	140.887411
A4260512	River Murray at Lock 5 upstream (AMTD 562.4 km)	-34.188728	140.766599
A4260518	River Murray at Lock 2 upstream (AMTD 362.1 km)	-34.077205	139.932137
A4260537	River Murray at Berri Irrigation PS (AMTD 525.7 km)	-34.288424	140.600392
A4260554	Morgan No. 1 Pump Station	-34.021444	139.688610
A4260556	River Murray at Cadell Irrigation PS (AMTD 332.8 km)	-34.034000	139.775300
A4260573	River Murray at Woolpunda Pump Station (AMTD 411.5 km)	-34.176550	140.216799
A4260593	River Murray at Holder (AMTD 392.0 km)	-34.170877	140.040216
A4260594	River Murray upstream Sunlands PS (AMTD 373.6 km)	-34.150000	139.915100
A4260642	River Murray upstream Rilli Island (AMTD 500.5 km)	-34.389000	140.594800
A4260652	River Murray upstream Overland Corner (AMTD 426.5 km)	-34.164663	140.342760
A4260702	River Murray downstream Hogwash Bend (AMTD 347.5 km)	-34.062186	139.839139
A4260705	River Murray upstream Chowilla Creek (AMTD 613.3 km)	-34.019639	140.863691
A4260902	River Murray at Lock 1 upstream (AMTD 274.3 km)	-34.349958	139.615551
A4261003	River Murray at Murray Bridge No.1 Pump Station Daily	-35.098745	139.289124
A4261022	River Murray upstream Old Customs House (AMTD 637.1km)	-33.979800	140.961500
A4261025	River Murray upstream Moorook	-34.316508	140.381047
A4261126	River Murray at Wood Point Pontoon (AMTD 96 km)	-35.213700	139.392500
A4261159	River Murray 2 km downstream Wellington Ferry	-35.347868	139.387509
A4261163	River Murray at Walker Flat	-34.753705	139.570753
A4261201	River Murray EC Pontoon at Tailern Bend	-35.281531	139.452498

3.1.3.3 Assessment of water quality targets for recreation

Water quality targets for recreation were assessed based on the exceedances of cyanobacteria concentrations (i.e. >50,000 cells per mL per year) at sites within the South Australian River Murray. There have been no alerts for known toxin producer cyanobacteria in the South Australian River Murray since the adoption of the Basin Plan.

3.1.4 Salinity targets for long-term salinity planning and management

Long-term salinity planning and management targets have been assessed using the End-of-Valley targets (Appendix 1 of Schedule B to the Murray-Darling Basin Agreement (Schedule 1 of the *Water Act 2007*)) and relevant valley reporting sites within South Australia (Table 8).

Table 8. End-of-Valley salinity targets and associated South Australian Valley reporting sites.

Valley	End of Valley Target (as % of baseline)	Valley Reporting Site
Basin salinity target	800 EC (95%)	Murray at Morgan (A4260554)
South Australian Border	412 EC (80%)	Murray at SA Border (A4261022)
Berri	543 EC (80%)	Murray at Berri (A4260537)
Below Morgan	770 EC (80%)	Murray at Murray Bridge (A4261162)

4 Results

4.1 Water quality targets for managing water flows

4.1.1 Assessment of the maintenance of dissolved oxygen (DO) of at least 50% saturation

Dissolved oxygen concentrations below 5mg/L are considered to equate to the 50% saturation target at the range of temperatures and elevations experienced at the South Australian reporting sites and were rarely below the target value. The high (unregulated) flow events of 2010/11 and 2016/17 created hypoxic blackwater conditions; i.e. caused dissolved oxygen levels to fall to zero in the Lower Murray for a short period (Ye et al. 2018). The highest percentage of time below this target was recorded during 2011 (Table 9).

Table 9. Percentage of days within each year where the dissolved oxygen concentration values were below the target value of 5 mg/L at key SA River Murray assessment sites. NA depicts that no data were available.

Site	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Renmark – River Murray Surface	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	NA	NA
River Murray Renmark Sample Pump	NA	NA	NA	NA	NA	0	0	0	0	0	13	2	0	0	0
Berri – River Murray Surface	NA	NA	NA	NA	NA	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Berri Surface Pump	NA	NA	NA	NA	NA	NA	NA	NA	0	0	13	0	0	0	0
Loxton – River Murray Surface	NA	NA	NA	NA	NA	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Loxton Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	0	0	12	4	0	0	0
Moorook – River Murray Surface	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Moorook Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	0	0	4	0	2	0	0
Cobdogla – River Murray Surface	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Cobdogla Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	0	0	10	0	2	0	0
River Murray Woolpunda	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Woolpunda Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	0	0	12	0	0	0	0
River Murray Waikerie	NA	NA	NA	NA	NA	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Waikerie Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	6	0	0	0
Cadell River Murray Surface	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Cadell Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	0	2	13	2	6	0	0
River Murray Morgan Sample Pump	NA	NA	NA	NA	8	17	0	0	0	0	16	0	0	0	0
River Murray Lock 1	NA	NA	NA	NA	NA	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Blanchetown Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	0	0	6	0	0	0	0
River Murray Swan Reach Sample Pump	NA	NA	NA	NA	0	11	0	0	0	0	6	0	4	2	0
River Murray Swan Reach Town Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	0	0	8	0	4	0	0
Swan Reach – River Murray Surface	0	0	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Mannum Sample Pump	NA	NA	0	0	0	21	0	2	0	0	16	4	0	0	0
Cowirra – River Murray Surface	NA	NA	NA	NA	0	4	2	2	0	NA	NA	NA	NA	NA	NA
River Murray Cowirra Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	0	2	7	4	2	4	0
River Murray Mypolonga	NA	NA	NA	NA	NA	7	18	12	0	NA	NA	NA	NA	NA	NA
River Murray Mypolonga Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	0	0	13	8	2	0	0
River Murray Murray Bridge Sample Pump	NA	NA	0	0	0	23	6	10	0	0	19	12	2	0	0
River Murray Murray Bridge Surface	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	NA	NA
River Murray Taillem Bend Sample Pump	NA	NA	NA	NA	0	27	6	2	4	0	12	8	0	0	0

4.1.2 Assessment of salinity target values

The percentage exceedance of the salinity target values for managing flows at the South Australian reporting sites is shown in Table 10. At sites in the South Australian River Murray (i.e. Murray Bridge, Morgan and Lock 6), there have been very minimal exceedances of target values, with only exceedances for 25% of days within 2008 recorded at the River Murray at Murray Bridge (daily read) assessment site. Most notably though, the salinity target value at the Lake Alexandrina (Milang) reporting site was exceeded between 33 and 100% of the time during the period within the Millennium Drought (i.e. between 2003 and 2010). Following the end of the Millennium Drought (post-2010), salinity within the Lake Alexandrina has been restored with minimal exceedances of target values at Milang in 2011, 2018 and 2019.

4.2 Water quality targets for Water Resource Plans

4.2.1 Assessment of water quality targets for fresh water-dependent ecosystems

4.2.1.1 Assessment of turbidity target values

Turbidity across all sites in the Coorong was variable in the percentage of exceedances of the turbidity target value of 20 NTU (Table 11). This variability is reflective of greater exceedances of the turbidity target value in some years followed by lower exceedances of the target value in the following year, for example those recorded at Tauwitchere and Villa de Yumpa between 2013 and 2019. Generally, turbidity was higher at sites within the Coorong North Lagoon compared to those within the South Lagoon. This is likely due to more turbid water inputs from the River Murray. Turbid conditions can reduce benthic light availability and impact the growth and reproduction of aquatic plant communities. In the southern North Lagoon and South Lagoon of the Coorong this reduced light availability in addition to shading from excess phytoplankton and filamentous algal growth may be impacting the keystone aquatic plant species, *Ruppia tuberosa* (DEW 2020a).

Table 10. Percentage of days within each year where the salinity target values were exceeded at the South Australian River Murray reporting sites. NA depicts that no data were available.

Site	Site number	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
River Murray at Murray Bridge (daily read)	A4261003	0	0	0	0	0	0	0	25	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA
River Murray at Murray Bridge (sensor)	A4261162	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
River Murray at Morgan	A4260554	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
River Murray at Lock 6	A4260510	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lower Lakes at Milang	A4260524	NA	NA	33	10	10	10	10	98	9	79	1	0	0	0	0	0	0	3	34	0

Table 11. Percentage exceedance of the turbidity target value (20 NTU) in the Coorong. NA depicts that no data were available.

Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2018	2019
Murray Mouth	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	50	0	NA	0	0	NA	NA
Tauwichee	50	33	22	17	0	50	0	0	25	25	10	NA	10	30	57	0	67	17
Mark Pt	50	33	20	17	0	NA	NA	NA	NA	NA	NA	0	33	0	0	0	NA	NA
Long Pt	25	33	10	17	0	0	0	0	25	25	0	0	17	10	0	0	0	7
Nonnameena	0	0	0	17	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bonneys	25	0	0	0	0	50	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA
McGrath Flat Nth	25	33	20	42	0	NA	NA	NA	NA	NA	NA	NA	NA	14	33	33	11	36
Parnka Pt	25	33	40	50	50	50	50	75	0	25	50	NA	NA	0	46	33	56	50
Villa de Yumpa	75	67	40	50	10	NA	NA	NA	NA	NA	NA	0	50	27	62	20	56	14
Stony Well	75	67	40	33	50	NA	NA	NA	NA	NA	NA	NA	NA	0	38	17	33	43
Nth Jacks Pt	50	0	10	25	0	50	0	0	25	0	0	0	50	9	21	17	44	36
South Policemans Pt	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA	0	0
Snipe Point	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0
South Salt Creek	0	0	0	8	0	50	0	0	0	0	0	0	0	0	25	0	NA	NA
1.8km west of Salt Creek	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	7
3.2 kmsouth of Salt Creek	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	33	21

4.2.2 Assessment of Total Phosphorus (TP) target values

4.2.2.1 River Murray

Total Phosphorus (TP) showed a relatively consistent pattern across the time period of assessment for the majority of the sites within the River Murray (Figure 4; Table 12). Greater exceedances of the TP target value were recorded in the time period between 2010 and 2013 for all sites within the River Murray (Table 14). Some of the lowest values of TP were recorded during the Millennium Drought (i.e. between 2006 and 2009; Table 14), potentially due to the reduction in runoff and inputs from upstream. During and following high (unregulated) flow events (e.g. 2010/11 and 2016/17) greater exceedances of the TP target value have been recorded (Table 14). Since 2016, continued exceedance values of the target value have been recorded. Exceedances of TP target values are likely influencing the lower trophic levels of the River Murray foodwebs, where for example elevated levels of TP can change phytoplankton communities and in turn impact the availability and quality of food resources for native fish and waterbird species, or provide favourable conditions for pest species such as carp.

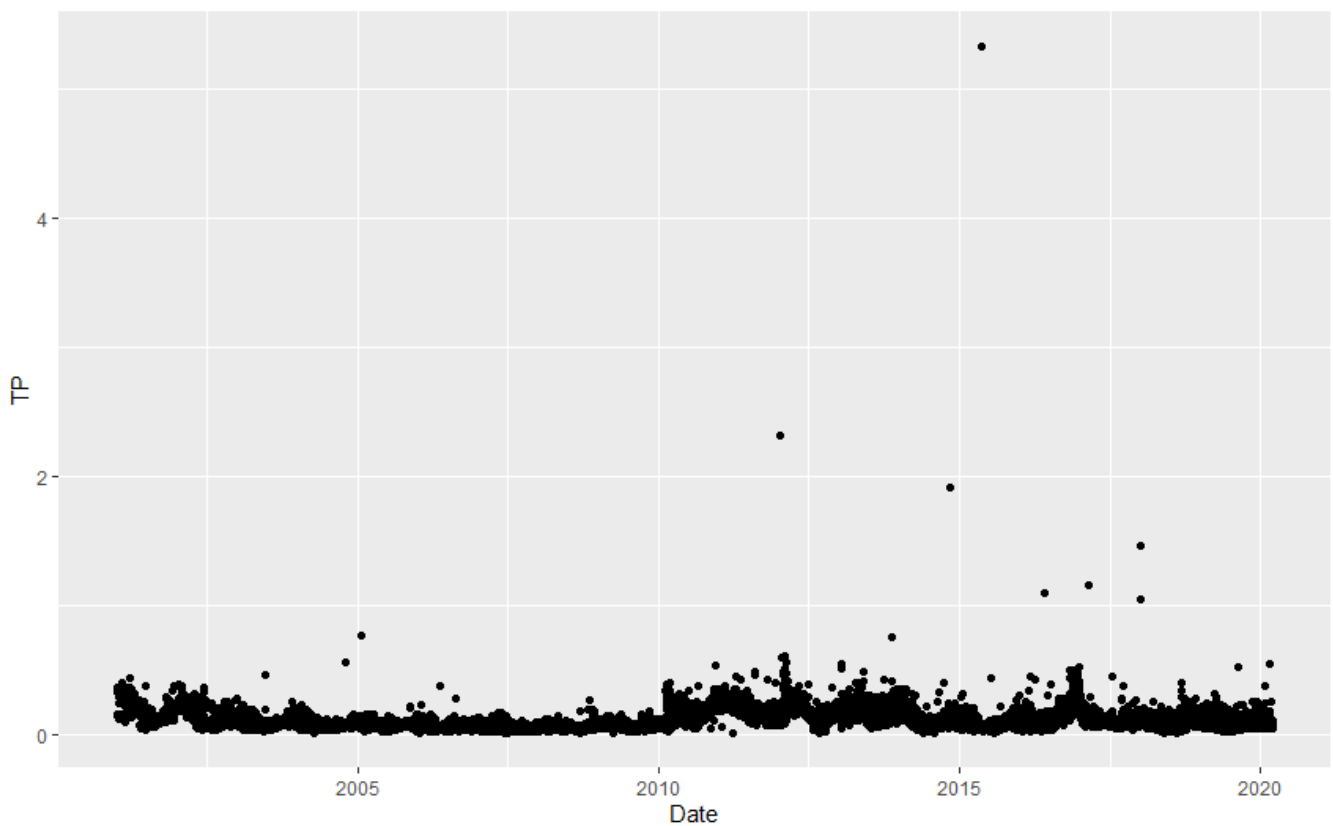


Figure 4. Total Phosphorus at all River Murray assessment sites across the assessment period (2001-2020)

Table 12. TP exceedance above the target value of 1000 µg/L at South Australian River Murray assessment sites.

Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
River Murray 8km downstream Lock 6	N A	N A	N A	N A	N A	N A	N A	N A	N A	90	84	84	94	29	0	6	N A	N A	N A	N A
River Murray 11km Downstream Lock 6	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	10 0	35	15	22	0
Renmark – River Murray Surface	N A	N A	N A	N A	N A	N A	N A	N A	0	0	N A	N A	10 0	N A	N A	N A	N A	N A	N A	N A
River Murray Renmark Sample Pump	N A	N A	N A	N A	N A	N A	N A	N A	0	96	92	75	10 0	62	21	56	67	49	52	36
River Murray Lock 5	84	60	28	8	8	4	2	8	23	89	81	84	96	33	8	40	50	27	32	27
Berri – River Murray Surface	N A	N A	N A	N A	N A	N A	N A	N A	0	89	85	77	10 0	N A	N A	N A	N A	N A	N A	N A
Loxton – River Murray Surface	N A	N A	N A	N A	N A	N A	N A	N A	0	83	77	77	10 0	10 0	N A	N A	N A	N A	N A	N A
River Murray Loxton Sampled Pump	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	54	19	54	46	26	46	40
Moorook – River Murray Surface	N A	N A	N A	N A	N A	N A	N A	N A	0	92	92	77	10 0	10 0	N A	N A	N A	N A	N A	N A
River Murray Moorook Sample Pump	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	57	3	46	65	22	12	40
Cobdogla – River Murray Surface	N A	N A	N A	N A	N A	N A	N A	N A	0	89	85	85	10 0	N A	N A	N A	N A	N A	N A	N A
Kingston-on-Murray – River Murray Surface	N A	N A	N A	N A	N A	N A	N A	N A	N A	40	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A
River Murray Lock 3	N A	N A	N A	N A	11	0	N A	N A	N A	80	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A
River Murray Woolpunda	N A	N A	N A	N A	N A	N A	N A	0	23	76	10 0	77	10 0	N A	N A	N A	N A	N A	N A	N A
River Murray Waikerie	N A	N A	N A	N A	N A	N A	N A	N A	33	82	10 0	83	96	10 0	N A	N A	N A	N A	N A	N A
River Murray Waikerie Sample Pump	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	77	22	50	69	41	65	60
Cadell River Murray Surface	N A	N A	N A	N A	N A	N A	N A	N A	0	65	85	85	10 0	N A	N A	N A	N A	N A	N A	N A
River Murray Morgan Sample Pump	84	60	33	10	6	1	0	0	0	73	94	90	98	41	0	41	65	27	34	27
River Murray Lock 1	N A	N A	N A	N A	N A	N A	N A	N A	N A	0	87	92	85	10 0	N A	N A	N A	N A	N A	N A
River Murray Swan Reach Sample Pump	N A	N A	N A	N A	N A	N A	N A	N A	0	91	10 0	85	10 0	72	44	59	87	56	36	42
Swan Reach – River Murray Surface	N A	N A	N A	N A	N A	N A	N A	N A	0	77	10 0	85	10 0	N A	N A	N A	N A	N A	N A	N A
River Murray Mannum Sample Pump	N A	N A	10 0	33	23	18	0	0	8	85	10 0	77	10 0	85	44	59	72	51	87	42
River Murray Mannum Surface	75	10 0	44	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A
Cowirra – River Murray Surface	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	10 0	77	86	N A	N A	N A	N A	N A	N A	N A
River Murray Mypolonga	N A	N A	N A	N A	N A	N A	N A	N A	50	77	92	67	10 0	N A	N A	N A	N A	N A	N A	N A
River Murray Bridge Sample Pump	N A	N A	67	46	29	19	6	0	4	76	98	87	98	83	31	52	65	43	90	45
River Murray Bridge Surface	86	10 0	63	N A	N A	N A	N A	N A	N A	N A	N A	N A	10 0	N A	N A	N A	N A	N A	N A	N A
River Murray Taillem Bend Sample Pump	N A	N A	60	56	46	32	8	2	6	75	10 0	87	98	67	31	92	50	44	78	58
River Murray Taillem Bend Surface	90	10 0	63	N A	N A	N A	8	4	6	75	92	91	N A	N A	N A	N A	N A	N A	N A	N A

4.2.2.2 Eastern Mount Lofty Ranges

The target value for TP was exceeded at approximately half of the sites across the assessment period (Table 13). Exceedances ranged from 8% in the Finniss River (at 4km east of Yundi site) in 2002 to 100% in the Bremer River (at near Hartley site) in 2007. Exceedances of the target value occurred consistently at all Eastern Mount Lofty Ranges sites between 2002 and 2007. Limited data is available post the adoption of the Basin Plan (in 2012), but the three sites with records post the adoption of the Basin Plan did not exceed the target value for TP.

Table 13. Total Phosphorus exceedance of the target value of 100 µg/L at the Eastern Mount Lofty Ranges assessment sites. NA depicts that no data were available.

Site	2001	2002	2003	2004	2005	2006	2007	2010	2015
Angas River – downstream Strath-albyn GS426564	NA	NA	17	25	0	17	33	NA	NA
Bremer River – Wandstead Road (7506)	NA	NA	67	27	15	23	60	NA	NA
Bremer River – near Hartley GS426533	0	25	33	8	42	33	100	NA	NA
Bremer River – at Jaensch Rd ford (1824)	NA	NA	NA	NA	0	0	17	0	0
Finniss River – 4kmeast of Yundi GS426504	45	8	27	38	25	8	12	NA	NA
Finniss River – Winery Road (7511) (c0163)	NA	NA	12	0	25	15	22	0	NA
Finniss River – east of Yundi at ford (3188) (c0145)	NA	NA	NA	NA	0	0	0	0	0
Marne River – Mannum Rd (3844) (c0147)	NA	NA	0	0	0	0	NA	0	NA
Marne River – south of Cambrai (3843) (c0146)	NA	NA	NA	NA	0	0	0	0	0

4.2.2.3 Coorong

A large percentage of sites regularly, and in some cases always, exceeded the current threshold of 100 µg/L (Table 14). Despite this, exceedances of the target value for TP have been variable in the Coorong, with sites such as Long Point (in the Coorong North Lagoon) showing a decline in exceedances of the target value particularly since 2008, compared to other sites such as Parnka Point (in the southern end of the North Lagoon) and North Jacks Point (in the Coorong South Lagoon) that have consistently exceeded the target value for TP over time. Sites within the Murray estuary (Murray Mouth) and the North Lagoon have recorded a general decline in the exceedance of the target value for TP target since the Millennium Drought (Table 14).

The southern Coorong is currently undesirably enriched with nutrients and algae, and is therefore considered to be in a hyper-eutrophic state (Mosley & Hipsey 2019). The primary driver of the hyper-eutrophic state is likely to be the lack of freshwater flows that flush the system (Mosley & Hipsey 2019). Research as part of the *Healthy Coorong, Healthy Basin Program* is investigating whether the loss of *Ruppia tuberosa* during the Millennium Drought has contributed to or exacerbated the hyper-eutrophic state of the southern Coorong whereby the slow growing *R. tuberosa* that retain nutrients for relatively long periods (weeks to months) have been replaced by fast-growing phytoplankton and filamentous algae that retain nutrients for short periods (days to weeks). Investigations as part of the *Healthy Coorong, Healthy Basin Program*, particularly the Trials and Investigations Project, seek to better understand the nutrient dynamics and identify options for the management of nutrients (as part of the long-term management) in the Coorong.

Table 14. Total phosphorous exceedance of the target value (100 µg/L) in the Coorong. NA depicts that no data were available.

Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2018	2019
Murray Mouth	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA	0	0	NA	NA
Tauwitchere	50	33	56	42	25	25	25	33	25	25	100	NA	75	60	57	50	78	17
Mark Pt	50	33	50	50	50	NA	NA	NA	NA	NA	NA	50	50	0	0	0	NA	NA
Long Pt	50	67	70	58	75	75	50	100	75	50	50	NA	50	40	0	0	0	14
Nonnameena	50	67	90	92	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bonneys	75	67	90	100	100	100	100	75	100	NA	NA	NA	NA	NA	NA	NA	NA	NA
McGrath Flat Nth	100	100	100	100	100	NA	NA	NA	NA	NA	NA	NA	NA	100	92	67	89	93
Parnka Pt	100	100	100	100	100	75	100	100	100	100	100	NA	NA	100	92	50	89	93
Villa de Yumpa	100	100	100	100	100	NA	NA	NA	NA	NA	NA	100	100	100	100	100	89	93
Stony Well	100	100	100	100	100	NA	NA	NA	NA	NA	NA	NA	NA	100	100	100	100	100
North Jacks Pt	100	100	100	100	75	100	100	100	100	100	100	NA	NA	100	100	100	100	100
South Policemans Pt	100	100	100	100	100	NA	NA	NA	NA	NA	NA	NA	NA	100	100	NA	100	100
Snipe Point	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	100	100	100	100	100
South Salt Creek	100	100	90	100	75	100	100	100	75	75	50	NA	NA	60	75	100	NA	NA
1.8km west of Salt Creek	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	100	100	100	100	100
3.2 kmsouth of Salt Creek	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	100	100	100	100	100

4.2.3 Assessment of Total Nitrogen (TN) target values

4.2.3.1 Eastern Mount Lofty Ranges

Total Nitrogen had a very low number of data points with the maximum number of records per site recorded as five (Table 15). A total of 48 of 121 (40%) samples exceeded the TP target value of 1000 µg/L.

Table 15. Percentage exceedance of the TN target value (1000 µg/L) in the Eastern Mount Lofty Ranges assessment sites. NA depicts that no data were available.

Site	2007	2010	2015
Bremer River – at Jaensch Rd ford (1824) (c0140)	100	0	50
Finniss River – 4kmeast of Yundi GS426504	0	NA	NA
Finniss River – Winery Road (7511) (c0163)	0	0	NA
Finniss River – east of Yundi at ford (3188) (c0145)	NA	0	0
Marne River – Mannum Rd (3844) (c0147)	NA	100	NA
Marne River – south of Cambrai (3843) (c0146)	NA	100	100

4.2.3.2 Coorong

The target value for TN has consistently been exceeded across the majority of reporting sites in the Coorong, particularly those within the southern Coorong (Table 16).

The southern Coorong is currently undesirably enriched with nutrients and algae, and is therefore considered to be in a hyper-eutrophic state (Mosley & Hipsey 2019). The primary driver of the hyper-eutrophic state is likely to be the lack of freshwater flows that flush the system (Mosley & Hipsey 2019). Research as part of the *Healthy Coorong, Healthy Basin Program* is investigating whether the loss of *Ruppia tuberosa* during the Millennium Drought has contributed to or exacerbated the hyper-eutrophic state of the southern Coorong whereby the slow growing *R. tuberosa* that retain nutrients for relatively long periods (weeks to months) have been replaced by fast-growing phytoplankton and filamentous algae that retain nutrients for short periods (days to weeks). Excessive phytoplankton and filamentous algal growth may have led to nitrogen limitation in *R. tuberosa* through competition for nutrients (Collier et al. 2017). Investigations as part of the *Healthy Coorong, Healthy Basin Program*, particularly the Trials and Investigations Project, seek to better understand the nutrient dynamics and identify options for the management of nutrients (as part of the long-term management) in the Coorong.

Table 16. Percentage exceedance of the TN target value (1000 µg/L) in the Coorong. NA depicts that no data were available.

Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2018	2019
Murray Mouth	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA	0	0	NA	NA
Tauwichee	50	33	56	42	25	25	25	33	25	25	100	NA	75	60	57	50	78	17
Mark Pt	50	33	50	50	50	NA	NA	NA	NA	NA	NA	50	50	0	0	0	NA	NA
Long Pt	50	67	70	58	75	75	50	100	75	50	50	NA	50	40	0	0	0	14
Nonnameena	50	67	90	92	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bonneys	75	67	90	100	100	100	100	75	100	NA	NA	NA	NA	NA	NA	NA	NA	NA
McGrath FlatNth	100	100	100	100	100	NA	NA	NA	NA	NA	NA	NA	NA	100	92	67	89	93
Parnka Pt	100	100	100	100	100	75	100	100	100	100	100	NA	NA	100	92	50	89	93
Villa de Yumpa	100	100	100	100	100	NA	NA	NA	NA	NA	NA	100	100	100	100	100	89	93
Stony Well	100	100	100	100	100	NA	NA	NA	NA	NA	NA	NA	NA	100	100	100	100	100
North Jacks Pt	100	100	100	100	75	100	100	100	100	100	100	NA	NA	100	100	100	100	100
South Policemans Pt	100	100	100	100	100	NA	NA	NA	NA	NA	NA	NA	NA	100	100	NA	100	100
Snipe Point	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	100	100	100	100	100
South Salt Creek	100	100	90	100	75	100	100	100	75	75	50	NA	NA	60	75	100	NA	NA
1.8km west of Salt Creek	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	100	100	100	100	100
3.2 kms south of Salt Creek	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	100	100	100	100	100

4.2.4 Assessment of Dissolved Oxygen (DO) target values in the Lower Murray

4.2.4.1 River Murray

Exceedances below the target of 7mg/L (approx. 85%) are of greater concern to the aquatic ecosystem (Table 17) than exceedances above the 9 mg/L target value (i.e. 110% saturation) (Table 18).

The high (unregulated) flow events of 2010/11 and 2016/17 created hypoxic blackwater conditions; i.e. caused dissolved oxygen levels to fall to zero below the 7mg/L target value in the Lower Murray for a short period (Ye et al. 2018). Across the assessment period, DO concentrations regularly exceeded the target value of 9 mg/L (approximately 110% saturation) across sites within the Lower River Murray (Table 18). Exceedances above the 9 mg/L target value (i.e. 110% saturation) in the ranges of 30-50% was common, but 2011 recorded the most consistently high exceedance values for DO for River Murray sites over the assessment period (Table 18).

Table 17. Percentage below the dissolved oxygen (DO) target value of 7 mg/L (85% saturation) at South Australian River Murray assessment sites. NA depicts that no data were available.

Site	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Renmark - River Murray Surface	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	NA	NA
River Murray Renmark Sample Pump	NA	NA	NA	NA	NA	0	13	11	12	12	27	13	12	12	42
Berri - River Murray Surface	NA	NA	NA	NA	NA	0	10	0	0	NA	NA	NA	NA	NA	NA
River Murray Berri Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	20	19	35	13	8	9	25
Loxton - River Murray Surface	NA	NA	NA	NA	NA	0	8	4	0	NA	NA	NA	NA	NA	NA
River Murray Loxton Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	8	12	23	19	8	15	25
Moorook - River Murray Surface	NA	NA	NA	NA	100	0	4	4	0	NA	NA	NA	NA	NA	NA
River Murray Moorook Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	6	6	19	4	6	4	17
Cobdogla - River Murray Surface	NA	NA	NA	NA	100	0	40	4	0	NA	NA	NA	NA	NA	NA
River Murray Cobdogla Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	12	4	25	8	13	6	25
River Murray Woolpunda	NA	NA	NA	NA	100	0	8	0	0	NA	NA	NA	NA	NA	NA
River Murray Woolpunda Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	8	6	25	4	19	4	33
River Murray Waikerie	NA	NA	NA	NA	NA	0	8	0	0	NA	NA	NA	NA	NA	NA
River Murray Waikerie Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	4	8	19	2	15	2	17
Cadell - River Murray Surface	NA	NA	NA	NA	100	0	8	0	0	NA	NA	NA	NA	NA	NA
River Murray Cadell Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	8	8	25	6	13	15	25
River Murray Morgan Sample Pump	NA	NA	NA	NA	25	29	6	0	2	0	22	0	4	2	8
River Murray Lock 1	NA	NA	NA	NA	NA	7	10	8	0	NA	NA	NA	NA	NA	NA
River Murray Blanchetown Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	6	4	19	10	8	6	17
River Murray Swan Reach Sample Pump	NA	NA	NA	NA	15	32	4	2	0	0	13	6	12	12	8
River Murray Swan Reach Town Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	4	4	19	8	15	12	15
Swan Reach - River Murray Surface	0	0	NA	NA	100	0	6	2	0	NA	NA	NA	NA	NA	NA
River Murray Mannum Sample Pump	NA	NA	0	3	15	52	35	35	34	13	39	43	17	24	23
Cowirra - River Murray Surface	NA	NA	NA	NA	100	30	37	30	50	NA	NA	NA	NA	NA	NA
River Murray Cowirra Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	31	16	38	33	19	24	42
River Murray Mypolonga	NA	NA	NA	NA	NA	44	59	60	75	NA	NA	NA	NA	NA	NA
River Murray Mypolonga Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	52	38	40	56	46	30	50
River Murray Murray Bridge Sample Pump	NA	NA	21	12	28	57	51	57	54	44	41	59	45	23	58
River Murray Murray Bridge Surface	NA	NA	NA	NA	NA	NA	NA	100	NA	NA	NA	NA	NA	NA	NA
River Murray Tailm Bend Sample Pump	NA	NA	NA	NA	38	58	50	55	48	31	38	42	23	27	46

Table 18. Exceedance above the dissolved oxygen (DO) target value of 9 mg/L (100% saturation) at South Australian River Murray assessment sites. NA depicts that no data were available.

Site	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Renmark - River Murray Surface	NA	NA	NA	NA	NA	NA	NA	57	NA	NA	NA	NA	NA	NA	NA
River Murray Renmark Sample Pump	NA	NA	NA	NA	NA	56	37	13	29	48	31	33	35	38	8
Berri - River Murray Surface	NA	NA	NA	NA	NA	52	41	38	0	NA	NA	NA	NA	NA	NA
River Murray Berri Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	33	42	33	40	48	47	8
Loxton - River Murray Surface	NA	NA	NA	NA	NA	74	45	46	0	NA	NA	NA	NA	NA	NA
River Murray Loxton Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	29	37	33	25	33	28	0
Moorook - River Murray Surface	NA	NA	NA	NA	0	63	37	49	0	NA	NA	NA	NA	NA	NA
River Murray Moorook Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	46	44	44	38	33	43	8
Cobdogla - River Murray Surface	NA	NA	NA	NA	0	63	37	48	0	NA	NA	NA	NA	NA	NA
River Murray Cobdogla Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	41	48	45	40	31	43	8
River Murray Woolpunda	NA	NA	NA	NA	0	74	47	73	75	NA	NA	NA	NA	NA	NA
River Murray Woolpunda Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	38	48	40	35	31	32	8
River Murray Waikerie	NA	NA	NA	NA	NA	70	40	60	0	NA	NA	NA	NA	NA	NA
River Murray Waikerie Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	38	46	44	44	46	45	8
Cadell - River Murray Surface	NA	NA	NA	NA	0	70	35	44	0	NA	NA	NA	NA	NA	NA
River Murray Cadell Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	22	54	31	35	33	36	8
River Murray Morgan Sample Pump	NA	NA	NA	NA	33	45	37	47	37	68	47	51	37	53	17
River Murray Lock 1	NA	NA	NA	NA	NA	52	37	27	0	NA	NA	NA	NA	NA	NA
River Murray Blanchetown Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	33	46	48	40	31	40	17
River Murray Swan Reach Sample Pump	NA	NA	NA	NA	35	43	40	41	45	60	52	46	35	31	8
River Murray Swan Reach Town Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	40	52	40	42	21	40	8
Swan Reach - River Murray Surface	67	50	NA	NA	0	70	40	44	0	NA	NA	NA	NA	NA	NA
River Murray Mannum Sample Pump	NA	NA	67	36	28	27	35	18	17	29	28	18	13	29	8
Cowirra - River Murray Surface	NA	NA	NA	NA	0	48	37	12	0	NA	NA	NA	NA	NA	NA
River Murray Cowirra Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	20	29	21	23	17	22	0
River Murray Mypolonga	NA	NA	NA	NA	NA	33	20	4	0	NA	NA	NA	NA	NA	NA
River Murray Mypolonga Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	15	13	23	10	10	9	0
River Murray Murray Bridge Sample Pump	NA	NA	24	19	22	26	22	2	14	10	28	11	14	12	0
River Murray Murray Bridge Surface	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	NA	NA
River Murray Tailm Bend Sample Pump	NA	NA	NA	NA	29	19	21	2	15	17	29	15	23	25	0

4.2.4.2 Eastern Mount Lofty Ranges

The lower range of the DO target value (85% saturation; 7 mg/L) was regularly exceeded at sites within the Eastern Mount Lofty Ranges (EMLR), with 51% of samples exceeding the value and some sites exceeding the value over 90% of the time assessed (Table 19). The upper limit of the DO target value (110% saturation; 9 mg/L) was exceeded in 24% of samples over the time assessed (Table 20). Despite these exceedances, there was a general decrease in the exceedance of the target value for DO in the EMLR sites since 2001.

Table 19. Percentage below the dissolved oxygen (DO) target value of 7 mg/L (85% saturation) at the Eastern Mount Lofty Ranges assessment sites. NA depicts that no data were available.

Site	2001	2002	2003	2004	2005	2006	2007	2010	2015
Angas River – downstream Strath-albyn GS426564	NA	NA	33	67	50	82	67	NA	NA
Bremer River – Wandstead Road (7506)	NA	NA	0	55	42	45	75	NA	NA
Bremer River – near Hartley GS426533	20	29	44	55	45	45	100	NA	NA
Bremer River – at Jaensch Rd ford (1824)	NA	NA	NA	NA	50	0	33	100	50
Finniss River – 4km east of Yundi GS426504	45	50	55	46	50	45	75	NA	NA
Finniss River – Winery Road (7511) (c0163)	NA	NA	29	67	50	50	33	0	NA
Finniss River – east of Yundi at ford (3188) (c0145)	NA	NA	NA	NA	50	50	0	0	50
Marne River – Mannum Rd (3844) (c0147)	NA	NA	50	100	100	80	NA	100	NA
Marne River – south of Cambrai (3843) (c0146)	NA	NA	NA	NA	50	0	0	0	100

Table 20. Exceedance above the dissolved oxygen (DO) target value of 9 mg/L (100% saturation) at the Eastern Mount Lofty Ranges assessment sites. NA depicts that no data were available.

Site	2001	2002	2003	2004	2005	2006	2007	2010	2015
Angas River – downstream Strath-albyn GS426564	NA	NA	33	8	0	9	0	NA	NA
Bremer River – Wandstead Road (7506)	NA	NA	60	27	33	36	0	NA	NA
Bremer River – near Hartley GS426533	40	29	11	18	36	36	0	NA	NA
Bremer River – at Jaensch Rd ford (1824)	NA	NA	NA	NA	50	100	0	0	0
Finniss River – 4km east of Yundi GS426504	36	30	36	38	42	27	25	NA	NA
Finniss River – Winery Road (7511) (c0163)	NA	NA	43	8	33	17	0	0	NA
Finniss River – east of Yundi at ford (3188) (c0145)	NA	NA	NA	NA	0	50	50	50	0
Marne River – Mannum Rd (3844) (c0147)	NA	NA	0	0	0	0	NA	0	NA
Marne River – south of Cambrai (3843) (c0146)	NA	NA	NA	NA	0	0	0	100	0

4.2.5 Assessment of pH target values in the Lower Murray target zone

4.2.5.1 River Murray

The River Murray sites recorded little exceedance of the target values for pH across the assessment period, including during years within the Millennium Drought (Tables 21 and 22).

Table 21. Percentage of samples below the pH target value of 6.5 pH units at the South Australian River Murray assessment sites. NA depicts that no data were available.

Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
River Murray 8km downstream Lock 6	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA
River Murray 11km Downstream Lock 6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0
Renmark – River Murray Surface	NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	0	NA	NA	NA	NA	NA	NA	NA
River Murray Lock 5	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
River Murray Lock 5 Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	4	0	0	0	2	0	0	0	0	0	0
Berri – River Murray Surface	NA	NA	NA	NA	NA	0	0	0	NA	0	5	0	0	0	NA	NA	NA	NA	NA	NA
Loxton – River Murray Surface	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Berri Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
River Murray Loxton Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
Cobdogla – River Murray Surface	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
Moorook – River Murray Surface	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
Moorook Raw Water	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA	NA	NA	NA	NA	NA
River Murray Cobdogla Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
River Murray Moorook Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
River Murray Lock 3	0	0	0	0	0	0	0	0	0	0	4	0	0	NA	NA	NA	NA	NA	NA	NA
River Murray Woolpunda	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Woolpunda Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
Woolpunda Raw Water	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA	NA	NA	NA	NA	NA
River Murray Waikerie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Waikerie Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
Cadell Raw Water	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA	NA	NA	NA	NA	NA
Cadell River Murray Surface	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Cadell Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
River Murray Morgan Sample Pump	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
River Murray Lock 1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
Blanchetown Raw Water	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA	NA	NA	NA	NA	NA
River Murray Blanchetown Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
River Murray Mannum Sample Pump	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
River Murray Mannum Surface	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
River Murray Swan Reach Sample Pump	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
River Murray Swan Reach Town Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0

Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Swan Reach – River Murray Surface	0	0	0	NA	NA	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
Cowirra – River Murray Surface	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Cowirra Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
River Murray Myponlonga	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Myponlonga Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
River Murray Murray Bridge Sample Pump	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
River Murray Murray Bridge Surface	0	0	0	NA	NA	0	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	NA	NA
River Murray Taillem Bend Sample Pump	NA	NA	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
River Murray Taillem Bend Surface	0	0	0	NA	NA	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lake Alexandrina Milang	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Alexandrina Goolwa Barrage US	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	2	0	0	0

Table 22. Exceedance above the pH target value of 9 pH units South Australian River Murray assessment sites. NA depicts that no data were available.

Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
River Murray 8km downstream Lock 6	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA
River Murray 11km Downstream Lock 6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0
Renmark – River Murray Surface	NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	0	NA	NA	NA	NA	NA	NA	NA
River Murray Renmark Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	2	0	0	0	0
River Murray Lock 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Berri – River Murray Surface	NA	NA	NA	NA	NA	0	0	0	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Berri Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
Loxton – River Murray Surface	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Loxton Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
Moorook – River Murray Surface	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
Moorook Raw Water	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA	NA	NA	NA	NA	NA
River Murray Moorook Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
Cobdogla – River Murray Surface	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Cobdogla Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
River Murray Lock 3	0	0	0	0	0	0	0	0	0	2	0	0	0	NA	NA	NA	NA	NA	NA	NA
River Murray Woolpunda	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Woolpunda Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
Woolpunda Raw Water	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA	NA	NA	NA	NA
River Murray Waikerie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Waikerie Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
Cadell Raw Water	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA	NA	NA	NA	NA	NA

Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cadell River Murray Surface	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Cadell Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
River Murray Morgan Sample Pump	0	0	0	0	2	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
River Murray Lock 1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
Blanchetown Raw Water	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA	NA	NA	NA	NA	NA
River Murray Blanchetown Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
River Murray Swan Reach Sample Pump	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	2	0	0
River Murray Swan Reach Town Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	7	0	0	0	0	0
Swan Reach – River Murray Surface	0	0	0	NA	NA	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA
River Murray Mannum Sample Pump	NA	NA	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0
River Murray Mannum Surface	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cowirra – River Murray Surface	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Cowirra Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
River Murray Mypolonga	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Mypolonga Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
River Murray Murray Bridge Sample Pump	NA	NA	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
River Murray Murray Bridge Surface	0	0	0	NA	NA	0	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	NA	NA
River Murray Taillem Bend Sample Pump	NA	NA	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
River Murray Taillem Bend Surface	0	0	0	NA	NA	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lake Alexandrina Milang	NA	NA	NA	NA	NA	0	0	0	0	2	0	2	0	2	0	2	0	0	0	0
Lake Alexandrina Goolwa Barrage US	NA	NA	NA	NA	NA	NA	0	0	0	2	0	0	14	0	0	0	0	0	0	0

4.2.5.2 Eastern Mount Lofty Ranges

Exceedances in target values were not recorded within the Eastern Mount Lofty Ranges (EMLR) despite most sites recording increases in pH since 2001 (Tables 23 and 24).

Table 23. Percentage of samples below the pH target value of 6.5 pH units at the Eastern Mount Lofty Ranges assessment sites. NA depicts that no data were available.

Site	2001	2002	2003	2004	2005	2006	2007	2010	2015
Angas River – downstream Strathalbyn GS426564	NA	NA	0	0	0	0	0	NA	NA
Bremer River – Wandstead Road (7506)	NA	NA	0	0	0	0	0	NA	NA
Bremer River – near Hartley GS426533	0	0	0	0	0	0	0	NA	NA
Bremer River – at Jaensch Rd ford (1824)	NA	NA	NA	NA	0	0	0	0	0
Finniss River – 4km east of Yundi GS426504	0	0	0	0	0	0	0	NA	NA
Finniss River – Winery Road (7511) (c0163)	NA	NA	0	0	0	0	0	NA	NA
Finniss River – east of Yundi at ford (3188) (c0145)	NA	NA	NA	NA	0	0	0	0	0
Marne River – Mannum Rd (3844) (c0147)	NA	NA	0	0	0	0	NA	0	NA
Marne River – south of Cambrai (3843) (c0146)	NA	NA	NA	NA	0	0	0	0	0

Table 24. Exceedance above the pH target value of 9 pH units at the Eastern Mount Lofty Ranges assessment sites. NA depicts that no data were available.

Site	2001	2002	2003	2004	2005	2006	2007	2010	2015
Angas River – downstream Strathalbyn GS426564	NA	NA	0	0	0	0	0	NA	NA
Bremer River – Wandstead Road (7506)	NA	NA	0	0	0	0	0	NA	NA
Bremer River – near Hartley GS426533	0	0	0	0	0	0	0	NA	NA
Bremer River – at Jaensch Rd ford (1824)	NA	NA	NA	NA	0	0	0	0	0
Finniss River – 4km east of Yundi GS426504	0	0	0	0	0	0	0	NA	NA
Finniss River – Winery Road (7511) (c0163)	NA	NA	0	0	0	0	0	NA	NA
Finniss River – east of Yundi at ford (3188) (c0145)	NA	NA	NA	NA	0	0	0	0	0
Marne River – Mannum Rd (3844) (c0147)	NA	NA	0	0	0	0	NA	0	NA
Marne River – south of Cambrai (3843) (c0146)	NA	NA	NA	NA	0	0	0	0	0

4.2.5.3 Coorong

Exceedances of the target values for pH in the Coorong have been rare (Tables 25 and 26), with sites generally recording pH within the ranges of 6.5 and 9.0. Only the reporting site of South Salt Creek (southern end of Coorong South Lagoon) recorded exceedances of the target values in 2015 and 2009, respectively (Tables 27 and 28).

Table 25. Percentage of samples below the pH target value of 6.5 pH units in the Coorong assessment sites. NA depicts that no data were available.

Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2013	2014	2015	2018	2019
Tauwitchere	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mark Pt	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	0	0	NA	NA
Long Pt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nonnameena	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bonneys	0	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA
McGrath FlatNth	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0
Parnka Pt	0	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	0	0
Villa de Yumpa	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	0	0	0	0
Stony Well	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0
North Jacks Pt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Policemans Pt	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0
Snipe Point	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0
South Salt Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	50	NA	NA
1.8km west of Salt Creek	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0
3.2 kms south of Salt Creek	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0

Table 26. Exceedance above the pH target value of 9 pH units at the Coorong assessment sites. NA depicts that no data were available.

Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2013	2014	2015	2018	2019
Tauwitchere	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mark Pt	0	0	0	0	0	NA	NA	NA	NA	NA	NA	0	0	0	NA	NA
Long Pt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nonnameena	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bonneys	0	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA
McGrath FlatNth	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0
Parnka Pt	0	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	0	0
Villa de Yumpa	0	0	0	0	0	NA	NA	NA	NA	NA	NA	0	0	0	0	0
Stony Well	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0
North Jacks Pt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Policemans Pt	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0
Snipe Point	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0
South Salt Creek	0	0	0	0	0	0	0	0	25	0	0	0	0	0	NA	NA
1.8km west of Salt Creek	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0
3.2 kms south of Salt Creek	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0

4.2.6 Water quality targets for irrigation water

The water quality target value for irrigation water (i.e. salinity remains below 833 EC 95% of the time) at South Australian River Murray reporting sites were rarely exceeded (Table 27). Exceedances of the target value were only recorded in 2008 and 2009 at the height of the Millennium Drought, at sites including the Wellington Ferry (Lake Alexandrina) and the Lower River Murray at Wood point (pontoon).

Table 27. Exceedance of salinity target values (833 EC) for irrigation water at South Australian River Murray assessment sites. NA depicts no data were available.

Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
River Murray upstream Old Customs House (AMTD 637.1km)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
River Murray at Lock 6 Upstream (AMTD 619.8km)	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0	0
River Murray upstream Chowilla Creek (AMTD 613.3km)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
River Murray at Lock 5 Upstream (AMTD 562.4km)	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0	0
River Murray upstream Rilli Island (AMTD 500.5km)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
River Murray upstream Moorook (AMTD 455.6 km)	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
River Murray upstream Overland Corner (AMTD 426.5km)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
River Murray at Woolpunda Pump Station (AMTD 411.5 km)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
River Murray at Holder (AMTD 392.0 km)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
River Murray upstream Sunlands PS (AMTD 373.6 km)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
River Murray at Lock 2 Upstream (AMTD 362.1km)	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0	0
River Murray downstream Hogwash Bend (AMTD 347.5km)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
River Murray at Morgan No1 Pump Station (AMTD 321.7km)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
River Murray Lock 1 Upstream (AMTD 274.3km)	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0	0
River Murray at Walker Flat	NA	NA	NA	NA	NA	NA	NA		0	0	0	0	0	0	0	0	0	0	0	0
River Murray at Wood Point Pontoon (AMTD 96km)	NA	NA	NA	NA	NA	NA	0	37	22	0	0	0	0	0	0	0	0	0	0	0
River Murray EC Pontoon at Tailm Bend	NA	NA	NA	NA	NA	NA	NA	NA	73	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
River Murray 2km downstream Wellington	NA	NA	NA	NA	NA	NA	NA	NA	96	1	0	0	0	0	0	0	0	0	0	0

4.2.7 Water quality targets for recreational use

4.2.7.1 Assessment of cyanobacteria concentrations

Exceedances of the target value of cyanobacteria concentrations were rarely recorded for sites within the South Australian River Murray (Table 28). As a result, water quality conditions in the River Murray have not posed any issues for recreation at these sites. There were sites within Lake Alexandrina (namely upstream of Goolwa barrage and Milang in Lake Alexandrina) where concentrations of cyanobacteria exceeded the target value during the Millennium Drought. Ongoing monitoring is in place to monitor cyanobacteria concentrations and species. If blooms occur it is standard practice for the Department for Health and Ageing or Local Government to issue information and advice to the public.

Table 30. Exceedances of the cyanobacteria target value of 50,000 cells per ml per year at South Australian River Murray assessment sites. NA depicts no data were available.

Site	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
River Murray 8km downstream Lock 6	NA	NA	NA	0	0	0	2	2	0	0	0	0	0	0	NA	NA	NA	NA
River Murray 11km Downstream Lock 6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0
Renmark – River Murray Surface	0	0	NA	0	0	0	0	NA	NA	NA	0	NA	NA	NA	NA	NA	NA	NA
River Murray Renmark Sample Pump	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	2	0	0
River Murray Lock 5	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lyrup Ferry – River Murray Surface	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Berri – River Murray Surface	0	0	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Berri Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
Loxton – River Murray Surface	0	0	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Loxton Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
Moorook – River Murray Surface	NA	NA	NA	NA	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Moorook Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	2	0	0	0	0
Cobdogla – River Murray Surface	0	0	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Cobdogla Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
Kingston-on-Murray – River Murray Surface	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA
River Murray Lock 3	NA	NA	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
River Murray Woolpunda	0	0	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Woolpunda Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	2	0	0	0	0
River Murray Waikerie	NA	0	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Waikerie Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
Cadell River Murray Surface	NA	NA	NA	NA	0	0	2	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Cadell Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
River Murray Morgan Sample Pump	0	0	0	0	4	14	4	0	2	0	2	0	14	4	0	12	0	0
River Murray Lock 1	NA	NA	NA	NA	2	2	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Blanchetown Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
River Murray Swan Reach Sample Pump		0	0	4	3	0	3	0	0	0	0	0	2	0	2	2	0	0
River Murray Swan Reach Town Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	2	2	0	0
Swan Reach – River Murray Surface	NA	NA	NA	NA	3	4	2	0	0	0	0	0	NA	NA	NA	NA	NA	NA
Walkers Flat – River Murray	NA	NA	NA	NA	0	0	4	0	0	0	0	NA	NA	NA	NA	NA	NA	NA
River Murray Mannum Sample Pump	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
River Murray Mannum Surface	0	NA	NA	NA	0	0	0	0	0		NA	NA	NA	NA	NA	NA	NA	NA
River Murray Wall Flat	NA	NA	NA	NA	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cowirra – River Murray Surface	NA	NA	NA	NA	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Cowirra Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	2	0	0	0
River Murray Mypolonga					0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA
River Murray Mypolonga Sample Pump	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0

Site	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
River Murray Murray Bridge Sample Pump	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
River Murray Murray Bridge Surface	0	NA	NA	NA	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA
Jervois – River Murray Surface	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lake Alexandrina Milang	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	81	94	100	100	100
River Murray Tailem Bend Sample Pump	0	0	0	0	0	0	2	4	0	0	0	0	0	0	0	0	0	0
River Murray Tailem Bend Surface	0	NA	NA	NA	0	0	6	4	0	0	0	0	0	NA	NA	NA	NA	NA
Lake Alexandrina Goolwa Barrage US	65	95	92	100	NA	NA	NA	NA	NA	NA	100	96	92	100	NA	NA	NA	NA

4.3 Salinity targets for long-term salinity planning and management

4.3.1 Assessment of End-of-Valley salinity target values

Exceedances of the End-of-Valley salinity target values at South Australian River Murray reporting sites were rare, including during the Millennium Drought (Table 29) due to salt interception schemes that divert groundwater away from rivers and into evaporating basins. The Basin salinity target of 800 EC was only exceeded in 1% of days within 2001 at the River Murray Morgan reporting site. The South Australian border reporting site recorded very minor exceedances in the SA border end of valley target value (412 EC), with 4% of days within 2013 representing the greatest exceedances of this target value over the assessment period. The Berri end of valley target value (543 EC) was only ever exceeded for 6% and 2% of days in 2002 and 2013, respectively. The target value of 770 EC (for the below Morgan Valley) was also rarely exceeded, with the greatest exceedance of 11% of days recorded at the Murray Bridge (daily read) reporting site in 2009 at the height of the Millennium Drought.

Table 29. Exceedances of End-of-Valley salinity target values at South Australian River Murray reporting sites.

Valley and End-of-Valley Target	SA Reporting Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Basin salinity target (800 EC)	Murray at Morgan	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SA Border (412 EC)	Murray at SA border	NA	0	0	1	0	0	0	1	0	0	1	0	4	2	0	0	0	0	0	NA
Berri (543 EC)	Murray at Berri	0	6	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Below Morgan (770 EC)	Murray at Murray Bridge	NA	NA	NA	NA	NA	NA	NA	NA	11	4	0	0	0	0	0	0	0	0	0	0

5 Key Findings

Water quality targets for managing water flows

Dissolved Oxygen rarely exceeds the target value. High unregulated events in 2010/11 and 2016/17 caused dissolved oxygen to fall in the Lower Murray for short periods of time.

Recreational water quality rarely exceeds the target value except in Lake Alexandrina where on-going monitoring is in place to continue to monitor cyanobacteria concentrations and species. If blooms occur it is standard practice for the Department for Health and Ageing or Local Government to issue information and advice to the public.

Salinity for long-term salinity planning and management rarely exceeds the target value due to the salt interception schemes that divert groundwater away from rivers and into evaporating basins.

Water quality targets for water resource plans

Fresh water-dependent ecosystems

- Turbidity exceedances vary spatially and temporally. Generally turbidity was higher at sites within the Coorong North Lagoon compared to those within the Coorong South Lagoon due to the more turbid water from the River Murray.
- Total Phosphorous shows a relatively consistent pattern across the assessment period. Some of the lowest values of total phosphorous were recorded due to the Millennium Drought, potentially due to the reduction in runoff and inputs from upstream. In the River Murray high unregulated events in 2010/11 and 2016/17 caused total phosphorous to increase and total phosphorous has remained high since 2016. These exceedances are likely influencing the lower trophic levels of the River Murray foodwebs where elevated levels of total phosphorous can change phytoplankton communities and in turn impact the availability and quality of food resources for fish and waterbirds.
- The Total Nitrogen target value has consistently been exceeded across the majority of the reporting sites in the Coorong, particularly those in the southern Coorong. The southern Coorong is currently undesirably enriched with nutrients and algae, and is therefore considered to be in a hyper-eutrophic state. The primary driver of the hyper-eutrophic state is likely to be the lack of freshwater flows that flush the system.
- Dissolved oxygen exceedances below the target of 85% saturation are common in South Australia. In the River Murray the percentage exceedance below the target of 85% saturation increases to >25 per cent downstream from Mannum. Likewise percentage exceedances of >25 percent above the target of 110% saturation are more likely above Mannum.
- pH rarely exceeds the target range.

Irrigation water

- The irrigation water quality target has rarely been exceeded.

Recreational water

- Refer above.

Salinity targets for long-term salinity planning and management

Exceedances are rare including during the Millennium Drought due to the salt interception schemes that divert groundwater away from rivers and into evaporating basins.

6 Units of measurement

6.1 Units of measurement commonly used (SI and non-SI Australian legal)

Name of unit	Symbol	Definition in terms of other metric units	Quantity
day	d	24 h	time interval
gigalitre	GL	10^6 m^3	volume
gram	g	10^{-3} kg	mass
hectare	ha	10^4 m^2	area
hour	h	60 min	time interval
kilogram	kg	base unit	mass
kilolitre	kL	1 m^3	volume
kilometre	km	10^3 m	length
litre	L	10^{-3} m^3	volume
megalitre	ML	10^3 m^3	volume
metre	m	base unit	length
microgram	μg	10^{-6} g	mass
microlitre	μL	10^{-9} m^3	volume
milligram	mg	10^{-3} g	mass
millilitre	mL	10^{-6} m^3	volume
millimetre	mm	10^{-3} m	length
minute	min	60 s	time interval
second	s	base unit	time interval
tonne	t	1000 kg	mass
year	y	365 or 366 days	time interval

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