Australian Government

MURRAY–DARLING BASIN AUTHORITY

# Basin Salinity Management 2030

## 2015–17 Biennial implementation report

March 2018

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GPO Box 1801, Canberra ACT 2601
1800 230 067
engagement@mdba.gov.au
mdba.gov.au



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**Acknowledgement of the Traditional Owners of the Murray–Darling Basin**

The Murray−Darling Basin Authority pays respect to the Traditional Owners and their Nations of the Murray−Darling Basin. We acknowledge their deep cultural, social, environmental, spiritual and economic connection to their lands and waters.

The guidance and support received from the Murray Lower Darling Rivers Indigenous Nations, the Northern Basin Aboriginal Nations and our many Traditional Owner friends and colleagues is very much valued and appreciated.

Aboriginal people should be aware that this publication may contain images, names or quotations of deceased persons.

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# Foreword

I have pleasure in releasing the 2015-17 biennial implementation report of the Basin Salinity Management 2030 Strategy (BSM2030), the first implementation report of the new strategy that came into effect in 2015.

The BSM2030 strategy builds on the successes of the former Basin Salinity Management Strategy (2001–2015) to deliver a strategic, cost-effective and streamlined program of coordinated salinity management.

Basin salinity management strategies have contributed to the progressive reduction in river salinity. Over the past 29 years, investment in salt interception schemes and improved land and water management practices by partner governments have made a real contribution to the improved water quality in rivers and waterways of the Basin, and wellbeing of the people who rely on them.

For the two years to 30 June 2017, and for the previous eight years, partner governments and the Murry-Darling Basin Authority (MDBA) have worked together to meet the basin salinity target of maintaining the average daily salinity at Morgan, South Australia, at less than 800 EC for at least 95% of the time. This is a model-based measure of performance simulated over a period that represents both wet and dry climatic sequences and reflects the successful actions taken by partner governments and communities in managing salinity in the basin.

The Independent Audit Group for Salinity (IAG-Salinity) conducted the first audit of the BSM2030 in November 2017, covering the first two years of the strategy. The auditors reviewed the implementation of the strategy by MDBA and the partner governments in accordance with Schedule B and associated protocols and procedures. The executive summary of the *Report of the IAG-Salinity 2015-17*, including their recommendations, is provided in this report.

The success of the BSM2030 is only possible with the cooperation of partner governments and the dedication of the people involved. In particular, the commitment by basin states to the delivery of salinity management activities in the valleys across the basin and the cooperation extended to the MDBA in maintaining a rigorous salinity accountability framework is commendable.

Although great progress has been made, managing salinity remains a challenge in the basin. The collective effort and commitment for salinity management in the strategy will take us through to 2030 and beyond. I look forward to continued achievement and further success with the partner governments working together to implement the BSMS2030 strategy.

**Phillip Glyde**
Chief Executive
Murray–Darling Basin Authority

# Abbreviations

| | |
|---|---|
| BOC | Basin Officials Committee |
| BSMS | Basin Salinity Management Strategy |
| BSM2030 | Basin Salinity Management 2030 |
| CEWH | Commonwealth Environmental Water Holder |
| CEWO | Commonwealth Environmental Water Office |
| CSG | Coal Seam Gas |
| CSIRO | Commonwealth Scientific and Industrial Research Organisation |
| Cwlth | Commonwealth |
| EC | electrical conductivity (measured as µS/cm) |
| EoVT | end-of-valley target |
| IAG–Salinity | Independent Audit Group for Salinity |
| LoH | Legacy of History |
| MDBA | Murray–Darling Basin Authority |
| MDBC | Murray–Darling Basin Commission |
| MSM–BigMod | daily flow and salinity model for the River Murray |
| RMIF | River Murray Increased Flows |
| SIS | Salt Interception Schemes |
| TLM | The Living Murray |

# Executive Summary

Basin Governments and the MDBA have been working together to implement strategies to manage salinity in the Basin for nearly 30 years. To continue the collective effort in salinity management for another 15 years (2016 to 2030), the Basin States and the Australian Government prepared the Basin Salinity Management 2030 (BSM2030) strategy. This was adopted by Ministerial Council in November 2015. The BSM2030 focuses on continuing to ensure salinity is kept at levels appropriate to protect economic, environmental, cultural and social values.

Basin landscapes will continue to export salt, and salinity is forecast to gradually increase as the delayed salinity impacts of land clearing and historical irrigation development impacts streams and rivers. Ongoing salinity management aims to strengthen past successes, continue to achieve the Basin salinity target at Morgan, manage risks and develop future management needs and strategies.

The BSM2030 is a strategy during a time of transition for the Basin, as water reforms continue to be implemented and become fully operational. It includes many initiatives that take salinity management to a new level—such as further optimising the operation of salt interception schemes (SIS) and incorporating contemporary issues relating to environmental water and Basin Plan flow management.

This report is the first of the biennial comprehensive implementation reports under BSM2030 prepared by the MDBA. The report provides an overview of outcomes and achievements against the key elements of BSM2030 and includes the executive summaries of each contracting government.

## Salinity accountability framework

The salinity registers have been a critical aspect of the salinity management accountability framework under the former Basin Salinity Management Strategy. The design of the salinity registers have been updated to accommodate new requirements under BSM2030. This includes incorporating the positive and negative salinity impacts associated with environment water management and the forecasted salinity for the year 2030.

The 2017 salinity registers indicate that the states of NSW, Victoria and South Australia (ACT and QLD do not have any register entries) are in a net credit positions as required under the BSM2030.

Under the BSM2030 and Schedule B, the key Basin salinity target has been established at Morgan in South Australia. The Basin salinity target aims to maintain the average daily salinity at Morgan at a simulated level of less than 800 EC for at least 95% of the time.

Comparing modelled salinity against the baseline, based on 2016–17 levels of land and water use, river salinity at Morgan was 725 EC for 95% of the time; hence the strategy is meeting the Basin salinity target.

This long term modelled outcome is supported by measured salinity levels which have remained below 800 EC since 1998.

# Management of Salt Interception Schemes (SIS)

The BSM2030 seeks to optimise the operations of the existing SIS and no additional investment in SIS construction is envisaged at this time. Management in 2015-17 centred on a trial that varied the level of scheme operations in response to salinity and flow conditions, addressing key knowledge gaps about system responses to the changing level of operations and minimising running costs where practical.

In 2016–17 more than 395,000 tonnes of salt was diverted away from the river system and nearby landscapes. The salt diversions were less than last year as a result of flooding in late 2016 which halted SIS operations due to the removal of infrastructure from bores within the susceptible flood zone.

A three-year responsive SIS management trial commenced in July 2016. The trial aims to optimise SIS scheme operations, ensuring the level of SIS response is proportionate to salinity risk and improving efficiency while avoiding impacts on environmental assets and water users. During periods of low salinity risk, the operation of responsive bores may be reduced to achieve cost savings, while continuing to manage risks. A review of the trial is scheduled for 2019.

A six-month salinity outlook tool has been developed to provide a forecast for the range of likely river salinities across the Basin. The tool is used to assist operational decisions that may be needed to mitigate forecasted salinity increases and to support responsive management of SIS.

# Salinity management

The BSM2030 supports operational salinity management of flow management salinity targets at Lock 6, Morgan, Murray Bridge, Milang and Burtundy under the Basin Plan. Over the reporting period, the Basin Plan salinity targets were met at all reporting sites except at Burtundy which was due to a lack of flow in the Lower Darling River.

In general, salinity levels along the River Murray system were relatively low during 2016–17. Continued operation of the SIS played a key role in maintaining river salinity at low levels. During the assessment period (July 2014 – June 2017) an estimated annual average of 0.87 million tonnes of salt was exported over barrages in South Australia

Under the BSM2030 jurisdictions continue to monitor flow and salinity for the nominated end-of-valley target sites. Across the Basin, salinities at these sites for 2015–17 were generally comparable with longer term statistics in most catchments.

# Efficient governance

The BSM2030 strategy retains the requirement for partner governments to review and report on salinity register entries and models, consistent with the principle of continuous improvement. However, the frequency of register entry and model reviews is now determined using a risk-based

approach and may occur at intervals of 5, 7 or 10 years. During 2016 a procedure for determining the frequency of register entry and model reviews was prepared and applied. This established the BSM2030 Review Plan which sets out the frequency and timing of reviews required for each register entry and model.

The MDBA is investigating adopting the SOURCE modelling platform as the MDBA river model for BSM2030. Further work is being progressed to support this transition.

Under BSM2030 governments are required to identify and nominate monitoring sites for inclusion in a new monitoring network, the Basin-wide core salinity monitoring network. The nominated sites will then be maintained for the life of the strategy, with the list to be reviewed every five years. Most jurisdictions are well advanced in providing details of sites nominated for inclusion in Basin-wide core salinity monitoring network to the MDBA.

# Strategic knowledge improvement

In 2016–17 progress was made on the BSM2030 knowledge priority for improving understanding of Mallee Legacy of History (LoH) salinity impacts due to increased recharge from land clearing and irrigation prior to 1988.

The key outcome from the review of Mallee LoH salinity impacts from vegetation clearing was that ongoing use of the established method for estimating root zone drainage and delayed recharge was recommended. The review found the established method was valid and has been applied appropriately in groundwater models. Observed groundwater trends across the Basin match the predicted trends showing stable levels with no widespread rises. Given that the salt loads attributed to dryland clearing are quite low (about 5 to 10% of total salt loads across all times through to 2100), the salt load risk context remains low and an adaptive management approach (continued monitoring and review) is warranted.

The Mallee LoH salinity impacts from irrigation report reviewed the different modelling approaches to estimate of LoH irrigation salinity impacts. It found that the different modelling approaches, when applied appropriately, can be used to develop valid and fit-for-purpose models to estimate Mallee LoH irrigation salinity impacts. A whole-of-system approach that uses as much data as possible was recommended as the means to advance a more consistent approach to modelling and to obtain a better understanding of uncertainty and to avoid bias. Development of a transfer function that connects irrigation accessions to groundwater recharge for situations where perching occurs was also recommended.

# Community engagement and communication

In May 2017, MDBA successfully launched *Salt of the Earth*, a video and a brochure that recognises the achievements and efforts of all those involved in the successful implementation of the SIS and improved land and water management practices in the Basin.

# Priorities for future work

In 2017–2019, priorities for implementing the BSM2030 include:

- finalising the amendments to Schedule B of the Murray–Darling Basin Agreement to enable implementation of the BSM2030 strategy
- developing Basin Salinity Management procedures that will replace the existing Basin Salinity Management Strategy Operational Protocols
- continuing to implement the trial of responsive management of the SIS and review the outcomes of the trial
- progressing projects related to the BSM2030 Knowledge Priorities
- progressing major reviews of actions with significant river salinity effects that are located in the South Australian river reaches and the Mallee and riverine plain regions of NSW and Victoria
- progressing updates to the MDBA river model for salinity accountability purposes
- completing the basin-wide core salinity monitoring network
- undertaking other activities in line with the BSM2030 implementation plan
- initiating a biennial salinity forum to promote discussion between Basin Government officials, river operators and other stakeholders to share lessons learnt and to support BMS2030 implementation.

# 1. Introduction

Basin governments have been working together with their communities for almost 30 years to manage salinity in the rivers and catchments of the Murray–Darling Basin. Building on this knowledge, the Basin Salinity Management 2030 (BSM2030) strategy will set the direction for the next 15 years.

BSM2030 is a strategy developed for a time of transition for the Basin, as water reforms are implemented and become operational. It includes many initiatives that take salinity management to a new level—such as further optimising the operation of SIS and incorporating contemporary issues relating to environmental water and Basin Plan flow management.

Reporting has been rationalised under the BSM2030. Given the progress in Basin salinity management over the period 2001 to 2015, and the maturity of the collaborative arrangements, reporting is now able to be streamlined under BSM2030 without risking strategy implementation or achievement of strategy objectives.

This report is the first of the biennial comprehensive implementation reports prepared under BSM2030.

# 2. Salinity Accountability Framework

One of the key elements for the success of salinity management in the Basin is the commitment of all jurisdictions involved to a strong salinity accountability framework implemented through the Basin salinity registers.

## 2.1 Status of the BSM2030 strategy salinity registers

The salinity registers are a critical aspect of the BSM2030 and are an effective environmental accountability framework. The registers provide the primary record of jurisdictional accountability for actions that affect river salinity.

The registers are an accounting tool providing a record of the debit and credit balance of accountable actions that significantly affect river salinity at Morgan. This accounting system provides a transparent basis for making decisions on basin-wide trade-offs on salinity management actions and investments in joint works and measures.

Actions that reduce river salinity are recorded as credits, while actions likely to increase river salinity are recorded as debits. Actions such as irrigation development may generate a debit because in some areas they may lead to increased salt loads to the River Murray. Actions such as constructing SIS and improvements in irrigation practices can generate a credit. In addition, actions such as permanent water transfers in or out of an irrigation area may result in either a credit or a debit.

State and territory governments report annually to the MDBA, providing new or updated information on accountable actions. This information is collated and analysed to update the registers each year. This enables changes in river salinity impacts to be tracked over time. It also provides estimates of the economic costs and benefits arising from these salinity effects. The updated registers are audited biennially by independent auditors and published.

There are two salinity registers, Register A and Register B:

- Register A records the impacts of each accountable action that occurred after the baseline date (1988 for New South Wales, Victoria and South Australia, 2000 for Queensland and the Australian Capital Territory) and includes jointly funded works and measures
- Register B accounts for LoH or delayed salinity impacts, which have an effect on salinity levels after 2000 but which are the result of actions taken before 1988 (2000 for Queensland and the Australian Capital Territory).

The success of past salinity strategies in delivering significant salinity improvements for the Basin stems from jurisdictional agreement both to be accountable for salinity debits and credits on the registers and to undertake collective actions that lead to material improvements in river salinity. Such collective actions include those jointly undertaken under MDBA–coordinated programs (joint

works and measures) and those undertaken by two or more states independently of MDBA (shared works and measures). 'Joint works and measures' and 'shared works and measures' are shown separately on the salinity registers, with the benefits shared between states. They are distinguishable from individual state actions for which the particular state gains either a debit or a credit.

The registers have been reviewed and amended as part of the development of BSM2030. A summary of the amendments are provided in **Appendix B**.

The updated 2017 salinity registers, including new and updated entries, are provided in **Appendix B** and summarised in Table 1.

The 2017 salinity registers indicate that the states of NSW, Victoria and South Australia are in a net credit positions as required under the BSM2030. ACT and QLD do not have any register entries.

Table 1: Summary of the 2017 salinity registers excluding provisional entries

| Actions | NSW ($m/year) | VIC ($m/year) | SA ($m/year) | QLD ($m/year) | ACT ($m/year) | Australian Government contribution (EC) |
|---|---|---|---|---|---|---|
| **Joint works and measures** | 3.297 | 3.297 | 1.509 | 0 | 0 | 37.3 |
| **State shared works and measures** | 0.188 | 0.188 | 0 | 0 | 0 | 0 |
| **State actions** | 3.477 | 2.523 | 3.061 | tbd | tbd | 1.0 |
| **Total register A** | 6.963 | 6.009 | 4.570 | tbd | tbd | 38.3 |
| **Transfers to register B** | 1.138 | 0.908 | 2.635 | 0 | 0 | 0 |
| **Total register B[a]** | 0.809 | -0.062 | 2.252 | 0 | 0 | 0 |
| **Balance — registers A and B** | 7.772 | 5.946 | 6.822 | 0 | 0 | 38.3 |

*Notes:*

*tbd* *to be determined.*

*a* *total includes transfers from Register A.*

*b* *Australian Government contributions are in modelled salinity reduction at Morgan, South Australia.*

# 2.2 Proposed or new Accountable Actions

In 2016, a new section was added to Register A to include two new provisional entries under the BSM2030 strategy:

1. Responsive management of SIS
2. Bridging the Gap dilution benefits from water delivery.

## Responsive management of Salt Interception Schemes

The responsive management of SIS are being trialled from 2016 to 2019, prior to considering its adoption as BSM2030 policy.

During periods of low salinity risk, operations may be reduced to achieve cost savings, while still managing risks to ensure that river salinity is kept at appropriate levels. The Basin Salinity Target at Morgan and the Basin Plan salinity targets for managing water flows guide management. The estimated potential long-term increase of river salinity due to responsive management of SIS (12 EC salinity effect at Morgan) was included in the 2016 and 2017 salinity registers as a provisional entry.

## Bridging the Gap dilution benefits

Dilution of river salinity due to the delivery of Basin Plan water (Commonwealth environmental water holdings or other environmental water held by a State to offset the reduction in the long-term average sustainable diversion limit set by the Basin Plan) is recorded as a provisional entry in the register as "Bridging the Gap" dilution benefits.

The estimated salinity benefit at Morgan of a 2,800 GL water recovery scenario for 2015 compared to 2015 Basin Plan Baseline Diversion Limit (BP BDL) was 58 EC (MDBA 2014[#]). It should be noted that this modelling provides indicative results of likely changes to long-term salinity levels against the benchmark period given early assumptions about patterns of water recovery and delivery.

Currently, 1,642 GL is actually held in environmental water entitlements and currently available for delivery. The 58 EC estimated salinity benefit based on the 2,800 GL water recovery scenario is adjusted using a pro rata approach to determine the salinity benefit from water recovered to-date. This provisional entry was first included in 2016 (- 34.7 EC) and updated for 2017 (- 36.7 EC) based on the increased level of water recovered.

# 2.3 Salinity outcomes relative to Basin salinity target

Under the BSM2030 and Schedule B to the Murray–Darling Basin Agreement, salinity targets have been established for the Basin in the River Murray at Morgan in South Australia and for major tributary valleys at end-of-valley target (EoVT) sites (see Section 4.2 for outcomes at EoVT sites).

The Basin salinity target is to maintain the average daily salinity at Morgan at a simulated level of less than 800 EC for at least 95% of the time. This is modelled over the benchmark period (1975–2000) under the current land and water management regime. The benchmark period provides a mechanism for consistently assessing river salinity outcomes over a climatic sequence that includes both wet and dry periods.

[#] General review of salinity management in the Murray–Darling Basin, MDBA 2014

# Performance against the basin salinity target at Morgan

Long-term salinity levels are being maintained below the Basin salinity target. Table 2 indicates that, based on 2016–17 levels of development (including salinity mitigation), river salinity at Morgan was less than 800 EC for 96% of the time—hence, the strategy is achieving the target. As a comparison, under baseline conditions salinity would have been less than 800 EC for only 72% of the time. This demonstrates that during benchmark period flow and climate the incidence of salinity exceedance of 800 EC at Morgan has substantially declined.

Table 2: Simulated salinity (EC) summary statistics at Morgan, South Australia, for baseline and 2017 conditions over the 1975 to 2000 climatic period

| Period | Time interval | Average | Median (EC) | 95 percentile (EC) | % time greater than 800 EC | % time less than 800 EC |
|---|---|---|---|---|---|---|
| **25 years** | Modelled 1988 conditions 1975–2000 | 665 | 666 | 1058 | 28 | 72 |
| **25 years** | Modelled 2017 conditions 1975-2000 | 481 | 476 | 725 | 4 | 96 |

*Note: Baseline conditions are set at 2000. However, salinity impacts arising from development activities between 1988 and 2000 in New South Wales, Victoria and South Australia are accountable under the BSMS and have been excluded from the baseline. Hence, for New South Wales, Victoria and South Australia, the baseline represents 1988 conditions.*

This outcome illustrates the success of current management interventions. Figure 1 illustrates that the modelled 95 percentile salinity progressively falls from 1988 to 2017 in response to the progressive implementation of mitigation works and measures. In addition, under these simulated conditions, the target of less than 800 EC for 95% of the time was first achieved in 2010 and has been maintained since then. This is a significant outcome and a tangible demonstration of the benefits that have accrued through substantial and cooperative salinity mitigation investment by the Australian, South Australian, Victorian and New South Wales governments.

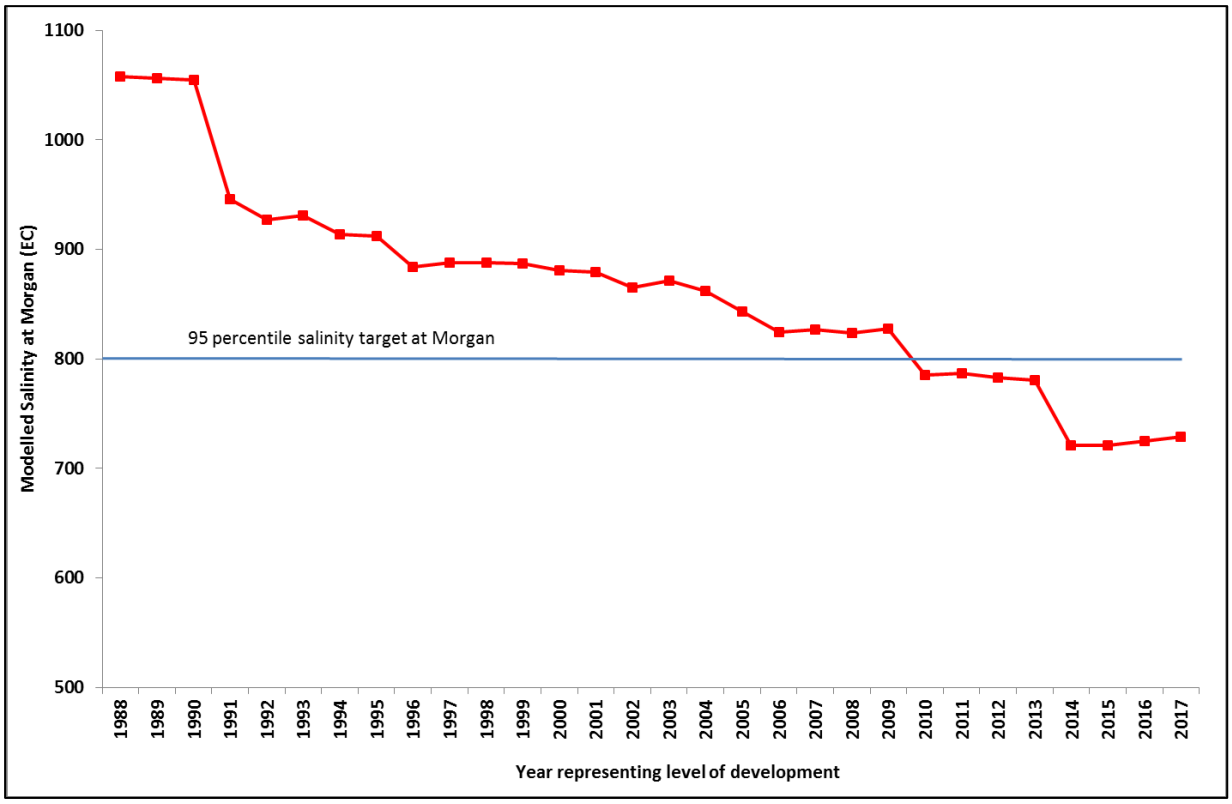



Figure 1. Modelled 95 percentile salinity over the 1975-2000 Benchmark period at Morgan in South Australia due to the implementation of salinity management programs from 1988 to 2017

# Measured salinity levels

While progress against BSM2030 salinity targets has been assessed based on modelled river salinity outcomes over the benchmark period, salinity management actions have had a notable positive impact on measured river salinity. Measured river salinity showed that salinity at Morgan remained below 800 EC in 2016 and 2017. The peak river salinity at Morgan has not exceeded 800 EC since 1998.

Table 3 provides statistics on salinity levels measured at Morgan over four time intervals (1, 5, 10 and 25 years) to June 2017 and enables a comparative assessment of average, median, 95 percentile and peak salinity outcomes for 2016–17.

The 2016–17 salinity statistics were slightly elevated compared to that achieved in 2014–15 and 2015-16. Average salinity in 2016–17 was higher than the 5 year average, while median salinity was above both the 5 and 10 year median values (Table 4 and Figure 2). These outcomes were influenced by the mobilisation of salts following the late 2016 floods, the prevailing climatic periods covered by the respective reporting periods and the progressive implementation of the salinity mitigation programs mentioned above.

Table 3: Summary of measured salinity levels (EC) at Morgan, South Australia

| Period | Time interval | Average | Median | 95 percentile | Peak | % time > 800 EC |
|---|---|---|---|---|---|---|
| **1 year** | July 2016 - June 2017 | 361 | 382 | 531 | 732 | 0% |
| **5 years** | July 2012 - June 2017 | 327 | 303 | 522 | 732 | 0% |
| **10 years** | July 2007 - June 2017 | 368 | 344 | 625 | 768 | 0% |
| **25 years** | July 1992 - June 2017 | 449 | 428 | 729 | 1087 | 2% |

# Impacts of salinity management actions

In addition to climatic factors and river conditions, the cumulative benefits of salinity mitigation works and measures, such as SIS and improvements in irrigation practices and delivery systems, have also contributed substantially to the low salinity levels summarised in Table 3. The SIS are highly beneficial to in-stream salinity outcomes during extended periods of low flows.

Figure 2 presents mean daily salinity levels for 2015–17 recorded at Morgan and simulated (modelled) salinity levels representing a 'no further intervention' scenario for the same period. The 'no further intervention' scenario estimates the river salinity levels that would have occurred if post-1975 SIS and improved land and water management actions were not undertaken. Figure 2 does not include the dilution benefits of "Bridging the Gap" and the Living Murray water.

The word 'further' is used because a number of SIS were operating before 1975, so their effects are not included in the simulated salinity levels. The simulated no further intervention salinity levels are derived from river model runs which can model historical salinity levels with and without intervention activities. The difference between the observed and the simulated no further intervention salinity levels are assumed to be the effect of management interventions.

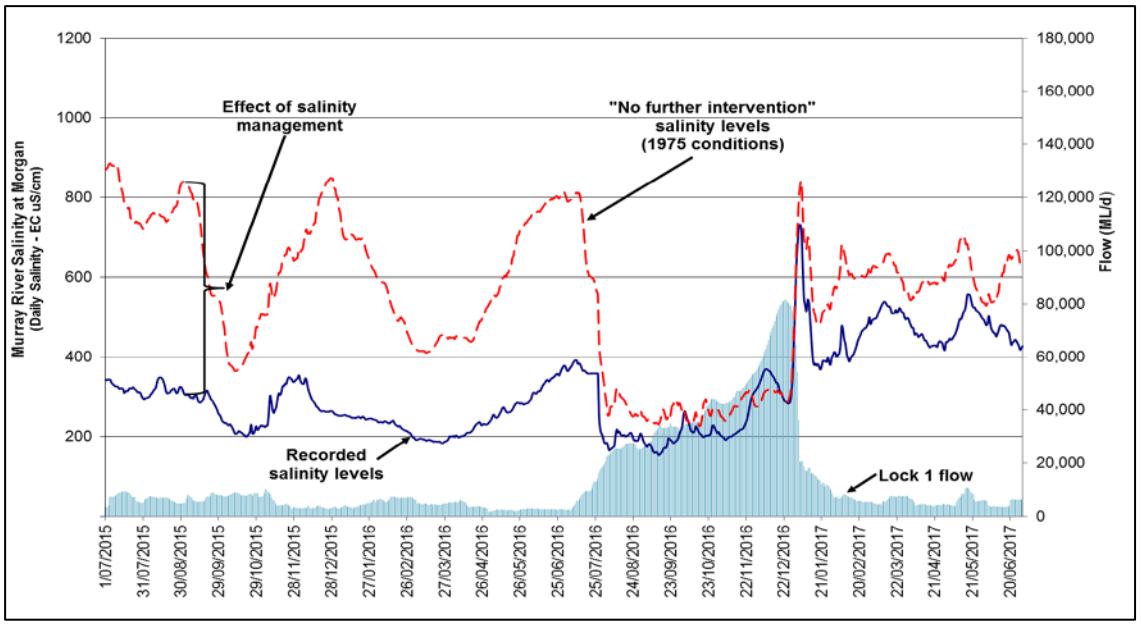



Figure 2. Comparison of mean daily recorded salinity levels at Morgan from July 2015 to June 2017 to modelled 1975 'no further intervention' salinity levels.

River salinity levels progressively increase downstream because of both natural groundwater discharge to the river and accelerated salt mobilisation caused by development activities. The cumulative effects of these factors result in higher salinity in the lower River Murray. Figure 3 demonstrates this progressive increase in salinity downstream with four datasets at specific reaches along the River Murray.

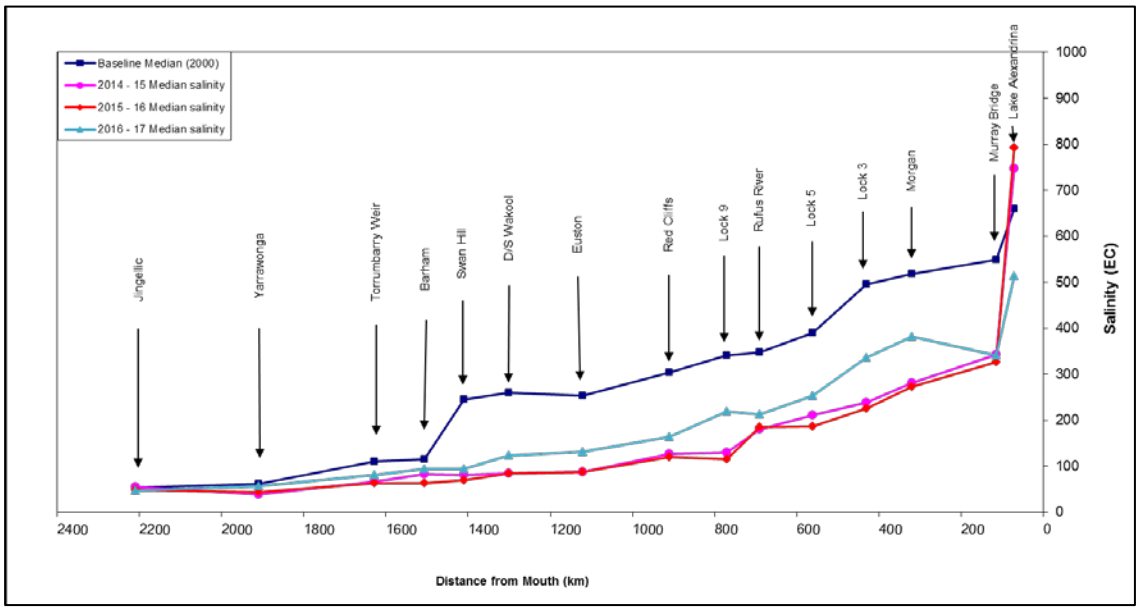



Figure 3. River Murray salinity profile: comparison of median salinity levels of 2016–17 with those of recent past years and the baseline median salinity level for the benchmark period (1975–2000).

# 3. Management of Salt Interception Schemes

## 3.1 Salt interception works

The Joint Works and Measures Program provided for under Schedule B focused on the ongoing efficient and effective management of SIS to maintain water quality in the River Murray for agriculture, environmental, urban, industrial and recreational uses.

New South Wales, Victoria and South Australia, together with the Australian Government, have constructed and managed 14 SIS.

The BSM2030 does not propose further construction of SIS but focuses on optimising scheme operations and investing in learning and knowledge development for SIS operations.

### Scheme operation and maintenance

Operation of the various SIS has continued to be highly successful in terms of in-river outcomes. During 2015-17, operation and maintenance of the existing joint SIS assets continued to focus on minimising running costs, in particular the energy costs associated with pumping.

Table 4 below details the performance of the joint SIS in 2016-17 while Table 5 compares salt diverted to previous (recent) years. The currently operational SIS diverted about 525,000 tonnes and 395,000 tonnes of salt away from the River Murray and adjacent landscapes in 2015-2016 and 2016-17 respectively. The reduction in diverted salt in 2016-17 is attributed to the impact of flooding in late 2016. Flooding temporarily halts SIS operations due to the removal of infrastructure from bores within the susceptible flood zone. Depending on the severity of flooding, significant time lag occurs before bores can be re-instated (in this case up to six months).

Table 4: Joint salt interception scheme performance report 2015-16 & 2016–17

| Salt interception scheme | Year | Volume pumped (ML) | Salt load diverted (tonnes) | Average salinity (EC units) | Actual target achieved (% of time) | Power consumption (kWh) |
|---|---|---|---|---|---|---|
| **Pyramid Creek** | 15/16 | 860 | 21,375 | 41,647 | 100 | 136,145 |
| | 16/17 | 1,083 | 26,762 | 41,299 | 100 | 176,282 |
| **Barr Creek** | 15/16 | 3,784 | 16,969 | 7,063 | 100 | 76,042 |
| | 16/17 | 2,721 | 14,828 | 12,658 | 100 | 36,372 |
| **Mildura-Merbein** | 15/16 | 1,050 | 48,286 | 79,546 | 86 | 189,282 |
| | 16/17 | 1,785 | 99,006 | 80,748 | 86 | 276,623 |
| **Mallee Cliffs** | 15/16 | 823 | 26,276 | 49,909 | 96 | 264,588 |
| | 16/17 | 1,894 | 63,044 | 52,000 | 100 | 494,749 |
| **Buronga** | 15/16 | 1,997 | 51,739 | 40,483 | 100 | 430,776 |
| | 16/17 | 2,093 | 57,104 | 42,640 | 100 | 431,448 |
| **Upper Darling** | 15/16 | 1,091 | 29,953 | 42,878 | 100 | 178,304 |
| | 16/17 | 1,439 | 34,144 | 37,062 | 100 | 272,132 |
| **Pike River** | 15/16 | 104 | 4,373 | 54,750 | NA | 36,454 |
| | 16/17 | 291 | 12,707 | 54,438 | NA | 73,689 |
| **Murtho** | 15/16 | 898 | 21,349 | 39,245 | 37 | 811,509 |
| | 16/17 | 968 | 24,285 | 39,612 | 24 | 368,319 |

| Salt interception scheme | Year | Volume pumped (ML) | Salt load diverted (tonnes) | Average salinity (EC units) | Actual target achieved (% of time) | Power consumption (kWh) |
|---|---|---|---|---|---|---|
| **Bookpurnong** | 15/16 | 334 | 8,535 | 42,155 | 80 | 126,638 |
| | 16/17 | 1,002 | 22,374 | 36,935 | 85 | 368,306 |
| **Loxton** | 15/16 | 356 | 5,719 | 23,444 | 92 | 139,877 |
| | 16/17 | 1,164 | 20,820 | 23,397 | 97 | 454,170 |
| **Woolpunda** | 15/16 | 5,281 | 104,383 | 30,973 | 95 | 3,195,110 |
| | 16/17 | 4,894 | 91,828 | 29,535 | 100 | 2,978,315 |
| **Waikerie** | 15/16 | 3,336 | 56,430 | 30,038 | 86 | 1,275,980 |
| | 16/17 | 3,100 | 56,726 | 31,201 | 87 | 1,241,249 |
| **Rufus River** | 15/16 | 0 | 2 | 42,348 | 100 | 1,016 |
| | 16/17 | 69 | 1,100 | 39,825 | 88 | 13,543 |
| **Totals** | 15/16 | 19,913 | 395,388 | | | 6,861,721 |
| | 16/17 | 22,504 | 524,728 | | | 7,185,196 |

Table 5 Total salt load diverted from the River Murray and adjacent landscapes from 2010-11 to 2016-17

| Reporting year | Salt load diverted (tonnes/annum) |
|---|---|
| **2016-17** | 395,388 |
| **2015-16** | 524,728 |
| **2014-15** | 432,454 |
| **2013-14** | 397,739 |
| **2012-13** | 322,686 |
| **2011-12** | 362,508 |
| **2010-11** | 324,164 |
| **2009-10** | 490,000 |

# 3.2 Progress of SIS responsive management

A three-year trial of responsive management of SIS commenced in July 2016 following the inaugural SIS Operators Workshop in May 2016. Responsive management of SIS seeks to operate SIS at the bore scale, at a level commensurate with the salinity risk outlook.

During the trial period a precautionary approach is being applied to ensure that to the extent reasonably and operationally possible, salinity is maintained at appropriate levels. The effectiveness of the trial will be reviewed at the end of the trial period in 2019 and the results of the trial will determine whether or not responsive management of SIS should continue and if so under what policy conditions.

SIS operations under responsive management are determined through an SIS Operators Workshop. Workshop participants include the SIS Managers from each State Constructing Authority, MDBA Senior Assets Engineer and MDBA River Operator. Workshops are convened quarterly. The workshops provide a forum for SIS Managers to draw on a range of information, including the monthly salinity outlooks, to provide a recommendation of SIS operations moving forward.

The trial is still in the early stages of development and the process and tools continue to be improved to adopt learnings from modelling, workshops and other related activities. Higher flows during 2016–17 limited implementation of the trial.

## Six-monthly salinity outlook tool to support responsive SIS decisions

The MDBA modelling team has developed a Salinity Outlook Tool for the River Murray and Lower Darling. The salinity outlook provides a range of likely river salinities at four of the Basin Plan reporting sites for a variety of flow scenarios. This information can be used as an 'early warning tool' to enable the MDBA and Basin States to implement actions if needed (for example, modify SIS operations).

Table 6 provides an example of the outlook as of June 2017. Here, the tool summarises the maximum modelled salinity over the period from June to December 2017, compared to the Basin Plan salinity target at the four reporting sites, under each flow scenario.

Results inform discussions on the need for changes to operations that may be needed ahead of salinity increase forecasts. When the outlook indicates that salinity at Morgan may rise above 600 EC, as far as operationally and practically possible, preparations can then be made to ensure adjustments to SIS operations such that the 600 EC at Morgan is not exceeded as a result of the trial of responsive management.

Table 6 Summary of maximum modelled salinity as at June 2017 for each flow scenario compared to the Basin Plan salinity targets

| Site | BP salinity target (EC for 95% of time) | Maximum modelled salinity (EC) for 50% AEP* | Maximum modelled salinity (EC) for 90% AEP | Number of days over 400 EC for 90% AEP | Number of days over 500 EC for 90% AEP | Number of days over 600 EC for 90% AEP |
|---|---|---|---|---|---|---|
| **River Murray at Lock 6** | 580 | 413 | 390 | 0 | 0 | 0 |
| **River Murray at Morgan** | 800 | 433 | 488 | 23 | 0 | 0 |
| **River Murray at Murray Bridge** | 830 | 592 | 603 | 64 | 44 | 0 |
| **Lake Alexandrina at Milang** | 1000 | 485 | 576 | 215 | 131 | 0 |

* AEP is the annual exceedance percentage of river flows (higher AEP means lower river flows)

# 4. Salinity management

## 4.1 Flow-based management

BSM2030 aims to facilitate continuous improvement in flow management by periodically reviewing and providing advice on flow management practices, particularly in response to elevated salinity events in the shared water resources.

The inclusion of flow management provides the opportunity to look at the effectiveness of in-river salinity management and the collective outcome for the shared water resource from individual actions and accountabilities.

### Outcomes for 2016–17

**Salinity targets for managing flows**

The salinity at the five Basin Plan reporting sites (Lock 6, Morgan, Murray Bridge, Milang and Burtundy) was monitored continuously over the five-year reporting period (July 2012 – June 2017). The targets at the reporting sites are deemed to have been met if the salinity was below the target for 95% of the time.

Over the reporting period, the target values were met at all reporting sites except at Burtundy (Flow and salinity charts for end-of-valley target sites are provided in Appendix D).

The target value at Burtundy is 830 EC. Over the reporting period, the salinity at Burtundy was above the target value for 36% of time. A record dry period in the Darling system led to low flows in the lower Darling, downstream of Menindee Lakes, resulting in over 1,500 EC salinity at Burtundy from early March to mid-August in 2016.

## Elevated salinity events

For the first three and a half months of 2016-17, salinity levels in the Lower Darling River remained above the Basin Plan target level of 830 EC at Burtundy. Following inflows to Menindee Lakes, in late July releases recommenced from Weir 32 to supply water users in the Lower Darling. These start up flows connected remnant saline pools, creating a salinity slug in the Lower Darling with salinity reaching 3,400 EC at Burtundy on 17 August (Appendix D). In September MDBA convened teleconferences to discuss lowering the Wentworth Weir pool to accelerate the draining of this saline water from the Lower Darling. Following these discussions, increased releases were made from Weir 32 and the Wentworth weir pool was lowered to 45 cm below full supply level (FSL). Communities were kept updated about the Wentworth Weir pool lowering through local agencies, MDBA's weekly reports, and three MDBA media releases.

In October the Wentworth Weir pool was raised back to FSL as the main salinity slug had exited the Lower Darling (EC< 400).

The other notable instance of high salinities was in the Lock 3 weir pool and below as natural flooding receded. During January 2017, an instream salinity peak was observed at Lock 3 on the River Murray. Review of the hydrometric data indicates that the salinity spike originated in South Australia at a location between Moorook and Lock 3, most likely Lake Bonney. Salinity had been building in the lake for many years. Salinity spikes often occur on receding limb of flood waters or high flows due to water draining from inundated backwaters and wetlands. A small increase in salinity was observed in the River Murray but this did not impact downstream Basin Plan salinity target values.

These events will be discussed as part of the review process during the salinity forum scheduled for 2017-18. The salinity forum is a newly created forum for jurisdictional representatives to come together to share knowledge and discuss salinity issues of mutual interest.

## The salt export objective

The Basin Plan includes a salt export objective which aims to ensure adequate flushing of salt from the River Murray system into the Southern Ocean. Achievement of the salt export objective is assessed each year by the MDBA. An early estimate of the annualised rate of salt export over the barrages was about 0.87 million tonnes during the 3-year assessment period (July 2014 – June 2017). This is less than the Basin Plan's indicative figure of two million tonnes per year.

Although the annualised salt export over the reporting period is less than the objective, the salt load that was passing Murray Bridge has gone over the Barrages, and Lake Alexandrina salinity remained low. This indicates that flushing of salt from the River Murray system has occurred.

# 4.2 End-of-Valley outcomes

End-of-valley targets (EoVTs) for major tributary valleys were introduced under the BSMS to serve as indicators of catchment health and to help assess and manage the impacts of salt movement from the catchments to the shared water resources.

Under BSM2030, the role of EoVTs is to provide a valley scale context to the identification and management of salinity risks. While there is no target compliance requirement, continued monitoring at EoVT sites in all valleys will inform understanding of changes in salinity risk to shared water resources and within-valley assets.

The performance of catchment salt loads against EoVTs requires complex modelling over the benchmark period. Therefore, EoVT outcomes are reviewed periodically as set out under the BSM2030 review plan. However, monitoring and reporting are useful to provide an indication of actual salinity outcomes over the reporting year for each of the valley sites.

Variability in hydrological conditions in catchments from year to year is a typical characteristic of the Basin. This variability has significant impacts on the amount of salt mobilised annually into tributaries and river systems.

Table 7 is a summary report card of flow and salinity data for each EoVT site for the years 2015–16 and 2016–17. The full details of state and territory government valley outcomes are provided in the individual governments' reports.

Graphs of flow and salinity at EoVT sites are provided in Appendix D while Appendix E compares salinity levels and salt loads in 2015–17 against long-term records. The length of the record varies from site to site. Owing to extended dry conditions across much of the Basin over the past two decades, there are some sites where river flows ceased for long periods. For those periods, measurements of salinity and flow are not accurate; therefore, salinity and salt load records may be incomplete.

Table 7: End-of-Valley summary report card 2015–16 & 2016–17

| Site | AWRC No. | Year | No. of days with salinity records | No. of days with flow records | Days with flow above zero | Mean salinity (µS/cm) | Median salinity (µS/cm) | 80%ile salinity (µS/cm) | Peak salinity (µS/cm) | Mean flow (ML/day) | Median flow (ML/day) | 80%ile flow (ML/day) | Peak flow (ML/day) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **All Partner Governments** | | | | | | | | | | | | | |
| **River Murray at Morgan** [a] | 426554 | 15/16 | 366 | 366 | 366 | 268 | 262 | 346 | 378 | 5123 | 4828 | 7230 | 10020 |
| | | 16/17 | 365 | 350 | 349 | 361 | 382 | 531 | 732 | 21,774 | 10,665 | 41,940 | 81,500 |
| **South Australia** | | | | | | | | | | | | | |
| **SA border** [b] | 426200 | 15/16 | 366 | 366 | 366 | 173 | 166 | 198 | 269 | 6798 | 6803 | 9112 | 11600 |
| | | 16/17 | 365 | 365 | 365 | 219 | 215 | 292 | 342 | 25,328 | 13,617 | 41,368 | 94,351 |
| **Lock 6 to Berri**[c] | 426514 | 15/16 | 366 | 365 | 365 | 221 | 211 | 252 | 303 | 6,057 | 6,040 | 8,622 | 10,065 |
| | | 16/17 | 365 | 263 | 262 | 289 | 289 | 399 | 473 | 12,264 | 8,557 | 20,066 | 36,088 |
| **River Murray at Murray Bridge** [d] | 426522 | 15/16 | 366 | NA | NA | 328 | 327 | 356 | 435 | NA | NA | NA | NA |
| | | 16/17 | 365 | NA | NA | 389 | 386 | 537 | 640 | NA | NA | NA | NA |
| **New South Wales** | | | | | | | | | | | | | |
| **Murrumbidgee at Balranald** | 410130 | 15/16 | 366 | 366 | 366 | 162 | 146 | 222 | 257 | 1724 | 1429 | 2354 | 6809 |
| | | 16/17 | 365 | 365 | 365 | 189 | 189 | 237 | 257 | 6,839 | 5,387 | 9,482 | 31,223 |
| **Lachlan at Forbes** | 412004 | 15/16 | 366 | 366 | 366 | 387 | 351 | 443 | 675 | 1,643 | 1,041 | 1,681 | 18,133 |
| | | 16/17 | 365 | 365 | 365 | 478 | 458 | 641 | 888 | 5,567 | 1,172 | 7,609 | 49,071 |

| Site | AWRC No. | Year | No. of days with salinity records | No. of days with flow records | Days with flow above zero | Mean salinity (µS/cm) | Median salinity (µS/cm) | 80%ile salinity (µS/cm) | Peak salinity (µS/cm) | Mean flow (ML/day) | Median flow (ML/day) | 80%ile flow (ML/day) | Peak flow (ML/day) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bogan at Gongolgon** | 421023 | 15/16 | 194 | 366 | 125 | 371 | 413 | 438 | 653 | 98 | - | 14 | 3,229 |
| | | 16/17 | 365 | 365 | 311 | 354 | 372 | 483 | 786 | 1,393 | 48 | 3,110 | 8,110 |
| **Macquarie at Carinda** | 421012 | 15/16 | 232 | 366 | 234 | 580 | 592 | 688 | 824 | 7 | 2 | 14 | 28 |
| | | 16/17 | 340 | 358 | 347 | 469 | 453 | 522 | 647 | 852 | 158 | 1,039 | 8,396 |
| **Castlereagh at Gungalman Bridge** | 420020 | 15/16 | 114 | 115 | 115 | 331 | 316 | 468 | 592 | 605 | 85 | 581 | 7179 |
| | | 16/17 | 172 | 173 | 173 | 301 | 294 | 347 | 458 | 1,965 | 797 | 2,452 | 12,100 |
| **Namoi at Goangra** | 419026 | 15/16 | 193 | 366 | 201 | 347 | 332 | 501 | 580 | 86 | 7 | 126 | 1921 |
| | | 16/17 | 365 | 365 | 365 | 395 | 375 | 472 | 848 | 1,292 | 193 | 1,090 | 17,582 |
| **Mehi at Bronte** | 418058 | 15/16 | 366 | 366 | 180 | 436 | 441 | 572 | 760 | 12 | 0 | 18 | 298 |
| | | 16/17 | 292 | 365 | 290 | 392 | 365 | 504 | 636 | 66 | 10 | 52 | 2,151 |
| **Barwon at Mungindi** | 416001 | 15/16 | 366 | 366 | 355 | 253 | 249 | 298 | 397 | 216 | 91 | 434 | 1131 |
| | | 16/17 | 365 | 365 | 362 | 246 | 246 | 304 | 381 | 1,089 | 598 | 1,276 | 8,844 |
| **Darling at Wilcannia** | 425008 | 15/16 | 302 | 366 | 302 | 722 | 760 | 973 | 1446 | 186 | 97 | 350 | 900 |
| | | 16/17 | 365 | 362 | 362 | 469 | 440 | 635 | 2048 | 5,829 | 1125 | 8033 | 27,984 |
| **River Murray at Heywoods** | 409016 | 15/16 | 366 | 366 | 366 | 46 | 49 | 51 | 52 | 10173 | 12292 | 14452 | 19854 |
| | | 16/17 | 365 | 365 | 365 | 46 | 47 | 49 | 61 | 13,289 | 11,492 | 17,311 | 78,095 |

| Site | AWRC No. | Year | No. of days with salinity records | No. of days with flow records | Days with flow above zero | Mean salinity (µS/cm) | Median salinity (µS/cm) | 80%ile salinity (µS/cm) | Peak salinity (µS/cm) | Mean flow (ML/day) | Median flow (ML/day) | 80%ile flow (ML/day) | Peak flow (ML/day) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **River Murray at Red Cliffs** [e] | 414204 | 15/16 | 52 | NA | NA | 127 | 123 | 150 | 222 | NA | NA | NA | NA |
| | | 16/17 | 48 | NA | NA | 170 | 164 | 202 | 307 | NA | NA | NA | NA |
| **Flow to SA** | 426200 | 15/16 | 366 | 366 | 366 | 173 | 166 | 198 | 269 | 6798 | 6803 | 9112 | 11600 |
| | | 16/17 | 365 | 365 | 365 | 219 | 215 | 292 | 342 | 25,328 | 13,617 | 41,368 | 94,351 |
| **Victoria** | | | | | | | | | | | | | |
| **Wimmera at Horsham Weir** | 415200 D | 15/16 | 366 | 366 | 336 | 1282 | 1467 | 1639 | 1844 | 9 | 1 | 7 | 190 |
| | | 16/17 | 365 | 365 | 365 | 1,030 | 1,025 | 1,188 | 2,988 | 371 | 44 | 137 | 11,958 |
| **Avoca at Quambatook** [f] | 408203 B | 15/16 | - | 366 | - | NA | NA | NA | NA | - | - | - | - |
| | | 16/17 | 153 | 365 | 129 | 3,830 | 3,785 | 6,182 | 8,842 | 102 | 0 | 10 | 3,368 |
| **Loddon at Laanecoorie** | 407203 B | 15/16 | 366 | 366 | 366 | 836 | 823 | 938 | 1230 | 94 | 86 | 124 | 417 |
| | | 16/17 | 298 | 363 | 363 | 607 | 538 | 776 | 1,456 | 845 | 108 | 396 | 37,753 |
| **Campaspe at Campaspe Weir** [g] | 406218 A | 15/16 | 366 | 366 | 366 | 630 | 646 | 669 | 704 | 72 | 46 | 61 | 1325 |
| | | 16/17 | 365 | 365 | 365 | 418 | 395 | 476 | 646 | 422 | 88 | 225 | 10,343 |
| **Goulburn at Goulburn Weir** [h] | 405259 A | 15/16 | 366 | 366 | 366 | 66 | 65 | 70 | 107 | 1115 | 759 | 910 | 7106 |
| | | 16/17 | 365 | 355 | 355 | 91 | 85 | 127 | 183 | 2,981 | 1,156 | 4,290 | 25,118 |

| Site | AWRC No. | Year | No. of days with salinity records | No. of days with flow records | Days with flow above zero | Mean salinity (µS/cm) | Median salinity (µS/cm) | 80%ile salinity (µS/cm) | Peak salinity (µS/cm) | Mean flow (ML/day) | Median flow (ML/day) | 80%ile flow (ML/day) | Peak flow (ML/day) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Broken at Casey's Weir** [i] | 404217 B | 15/16 | 366 | 366 | 366 | 170 | 180 | 194 | 268 | 105 | 47 | 123 | 2242 |
| | | 16/17 | 335 | 174 | 174 | 141 | 141 | 160 | 225 | 15 | 13 | 19 | 35 |
| **Ovens at Peechelba East** | 403241 | 15/16 | 366 | 366 | 366 | 67 | 61 | 79 | 164 | 1773 | 813 | 2867 | 12805 |
| | | 16/17 | 365 | 365 | 365 | 77 | 70 | 85 | 409 | 7,782 | 1,757 | 13,476 | 86,785 |
| **Kiewa at Bandiana** | 402205 | 15/16 | 366 | 366 | 366 | 45 | 41 | 52 | 104 | 1140 | 910 | 1802 | 5219 |
| | | 16/17 | 365 | 365 | 365 | 59 | 47 | 57 | 279 | 2,823 | 1,279 | 5,259 | 28,668 |
| **River Murray at Heywoods** | 409016 | 15/16 | 366 | 366 | 366 | 46 | 49 | 51 | 52 | 10173 | 12292 | 14452 | 19854 |
| | | 16/17 | 365 | 365 | 365 | 46 | 47 | 49 | 61 | 13,289 | 11,492 | 17,311 | 78,095 |
| **River Murray at Swan Hill** | 409204 | 15/16 | 366 | 366 | 366 | 71 | 68 | 76 | 177 | 6514 | 5951 | 8025 | 12050 |
| | | 16/17 | 365 | 365 | 365 | 113 | 94 | 136 | 293 | 11288 | 7551 | 20958 | 27203 |
| **Flow to SA** | 426200 | 15/16 | 366 | 366 | 366 | 173 | 166 | 198 | 269 | 6798 | 6803 | 9112 | 11600 |
| | | 16/17 | 365 | 365 | 365 | 219 | 215 | 292 | 342 | 25,328 | 13,617 | 41,368 | 94,351 |
| **Queensland** | | | | | | | | | | | | | |
| **Barwon River at Mungindi** | 416001 | 15/16 | 365 | 365 | 354 | 251 | 246 | 290 | 397 | 216 | 92 | 434 | 1,131 |
| | | 16/17 | 365 | 365 | 362 | 245 | 245 | 303 | 381 | 1,101 | 605 | 1,276 | 8,844 |

| Site | AWRC No. | Year | No. of days with salinity records | No. of days with flow records | Days with flow above zero | Mean salinity (µS/cm) | Median salinity (µS/cm) | 80%ile salinity (µS/cm) | Peak salinity (µS/cm) | Mean flow (ML/day) | Median flow (ML/day) | 80%ile flow (ML/day) | Peak flow (ML/day) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Moonie at Fenton** | 417204 A | 15/16 | 315 | 365 | 102 | 74 | 64 | 112 | 131 | 3 | 0 | 1 | 73 |
| | | 16/17 | 323 | 365 | 195 | 123 | 128 | 153 | 323 | 280 | 0 | 31 | 6,665 |
| **Ballandool at Hebel—Bollon Rd** | 422207 A | 15/16 | 176 | 365 | 201 | 100 | 162 | 192 | 399 | 6 | 0 | 3 | 168 |
| | | 16/17 | 259 | 365 | 230 | 130 | 178 | 279 | 462 | 16 | 0 | 11 | 236 |
| **Bokhara at Hebel** | 422209 A | 15/16 | 180 | 365 | 112 | 61 | 171 | 276 | 333 | 18 | 0 | 8 | 228 |
| | | 16/17 | 225 | 365 | 133 | 51 | 140 | 161 | 223 | 28 | 0 | 26 | 364 |
| **Briarie at Woolerbilla—Hebel Rd** | 422211 A | 15/16 | 70 | 365 | 19 | 3 | 77 | 92 | 162 | 0 | 0 | 0 | 67 |
| | | 16/17 | 193 | 365 | 45 | 15 | 128 | 139 | 160 | 1 | 0 | 0 | 193 |
| **Culgoa at Brenda** | 422015 | 15/16 | 337 | 365 | 150 | 181 | 183 | 217 | 254 | 50 | 0 | 17 | 2,750 |
| | | 16/17 | 330 | 365 | 155 | 226 | 183 | 355 | 499 | 196 | 0 | 43 | 3,960 |
| **Narran at New Angledool 2** | 422030 | 15/16 | 308 | 365 | 98 | 126 | 141 | 154 | 198 | 16 | 0 | 1 | 1,323 |
| | | 16/17 | 249 | 365 | 116 | 102 | 91 | 137 | 210 | 89 | 0 | 10 | 2,992 |
| **Paroo at Caiwarro** | 424201A | 15/16 | 195 | 365 | 181 | 32 | 65 | 78 | 115 | 471 | 0 | 61 | 29,127 |
| | | 16/17 | 173 | 365 | 242 | 41 | 57 | 65 | 108 | 459 | 18 | 229 | 15,011 |

| Site | AWRC No. | Year | No. of days with salinity records | No. of days with flow records | Days with flow above zero | Mean salinity (µS/cm) | Median salinity (µS/cm) | 80%ile salinity (µS/cm) | Peak salinity (µS/cm) | Mean flow (ML/day) | Median flow (ML/day) | 80%ile flow (ML/day) | Peak flow (ML/day) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Warrego at Barringun No 2** | 423004 | 15/16 | 66 | 365 | 79 | 125 | 146 | 172 | 201 | 40 | 0 | 0 | 1,232 |
| | | 16/17 | 153 | 365 | 151 | 106 | 96 | 126 | 248 | 217 | 0 | 251 | 5,426 |
| **Cuttaburra at Turra** | 423005 | 15/16 | 248 | 365 | 69 | 152 | 127 | 220 | 332 | 27 | 0 | 0 | 2,353 |
| | | 16/17 | 363 | 365 | 164 | 105 | 104 | 124 | 154 | 296 | 0 | 24 | 14,253 |
| **Australian Capital Territory** | | | | | | | | | | | | | |
| **Murrumbidgee at Hall's Crossing** | 410777 | 15/16 | 366 | 366 | 366 | 237 | 224 | 316 | 396 | 2,105 | 858 | 2,646 | 78,286 |
| | | 16/17 | 365 | 365 | 365 | 239 | 236 | 307 | 447 | 2,307 | 893 | 3,207 | 29,702 |

*a The 95%ile is reported here as the BSMS salinity target at Morgan. Also note that flow data is measured at site 426902 (River Murray at Lock 1)*

*b Salinity measured at site A4261022 (Murray @ Old Custom House)*

*c Salinity measured at site 426537(Berri pumping station)*

*d Site with no flow*

*e Flow data stops in October 1994*

*f Spot salinity data ends in Sep 2008 and continuous recording starts in Sep 2013*

*g Used flow data for 405200A (Campaspe at Rochester)*

*h Used flow data for 405200A (Goulburn River at Murchison*

*i Used salinity data for 404224B (Broken River at Gowangardie)*

*j Salinity data stops in September 2012*

*k Length of record data is from commencement of record until end June 2017*

*n/a Data not available*

*Salt load is determined using the following calculation: salt load (t/d) = flow (ML/d) x salinity (EC) x 0.0006*

# 5. Efficient governance

The governance of the salinity management program has been developed over 30 years and is now well understood and accepted. The opportunity exists to retain key functionality yet streamline its implementation in a way that reflects the maturity of the salinity management program.

BSM2030 aims to streamline the management program developed under BSMS by making it more risk-based and efficient. The monitoring, reporting, review and auditing arrangements will ensure transparency and compliance with the agreed actions and accountabilities of BSM2030. They will also help to continually improve the knowledge of salinity risks.

## 5.1 Improvements in modelling platforms and other technical elements

### Salinity models

The MDBA's salinity registers are informed by a suite of models that assist in assessing progress against salinity targets and estimating the salinity impacts of register entries. The models require periodic review by states, independent review and then accreditation by the MDBA to ensure improvement in predictions of the impacts of land and water management actions.

Basin states use surface water and groundwater models and other analytical techniques to estimate salinity, salt load and flow to the River Murray. Some of these models are used to determine the salinity, salt load and flow regimes at the EoVT sites (discussed in Section 3) and have established baseline conditions for the basin catchments (Appendix C: Baseline conditions). The MDBA uses these datasets as input to MSM–BIGMOD (the River Murray model). MSM–BIGMOD is used in the assessment of all register entries. With the aid of cost functions, MDBA is also able to provide estimates of the relative salinity cost effect of progressive increases in salinity along the river. The costs appear in the salinity registers as credits and debits in $m/year for each entry, and are used for determining the register balance of each of the jurisdictions.

### MSM–BIGMOD model

The MSM–BIGMOD model and its documentation was updated and peer reviewed in 2014 to include a number of policy changes and works and measures undertaken since 2003 when the model was last documented. The reviewer found that the basic structure and layout of the updated model is sound and is suitable for the development of baseline conditions and the assessment of various actions and impacts including environmental watering salinity impacts. However, the updated MSM–BIGMOD model was not adopted for BSM2030 purposes as the MDBA and Basin governments are working on adopting a more contemporary SOURCE modelling platform for water resource and salinity management.

## Transition to SOURCE model

The MDBA and jurisdictions are currently investigating the transition to the SOURCE modelling platform for BSM2030 purposes. The Technical Working Group for Salinity Modelling (TWGSM) was established to provide technical advice about suitability of the SOURCE model for BSM2030 salinity accountability purpose under Schedule B of the Murray–Darling Basin Agreement.

An independent peer review of the SOURCE model for BSM2030 purposes was completed in 2016. The review found the SOURCE model is "fit-for-purpose" to model flow and salt loads in the Murray. The independent peer reviewer endorsed the MDBA proposal to utilise SOURCE for the purposes of Schedule B and BSM2030. Currently, the MDBA and Basin governments are working on validation of salt load data to re-estimate the baseline using the SOURCE model. When all necessary steps are completed the SOURCE model will replace the MSM–BIGMOD model.

## Other Basin Salinity Management Strategy models

The Eastern Mallee — version 2.3 (EM2.3) numerical groundwater model was updated in 2015, forming version 2.4 (EM2.4). The update included addressing areas of uncertainty, incorporating new data and the running of future scenarios to estimate the salinity impacts. Peer review of the model was completed in 2016–17and found the model as suitable for assessing irrigation salinity impacts in Victoria.

Victoria completed the review of the Kerang Lakes mode in 2015-16. This model is used for estimating salinity impacts of several Victorian accountable actions, Pyramid Creek Salt Interception Scheme and The Living Murray water recovery.

# 5.2 Basin-wide Core Salinity Monitoring Network

The BSM2030 commits MDBA and partner governments to nominate key salinity monitoring sites for inclusion in the Basin-wide Core Salinity Monitoring Network (the monitoring network). The monitoring network will be maintained for the life of BSM2030. Monitoring sites will be reviewed at least every five years to ensure the network continues to provide a sound basis for salinity assessment in response to an improved knowledge of risk and uncertainty.

The sites for inclusion in the monitoring network will be those that MDBA and partner governments consider to be critical in providing information to support a range of activities under BSM2030. The key salinity monitoring sites will be determined by partner governments and the MDBA as appropriate to their responsibilities and accountabilities.

The Basin-wide core salinity monitoring network is currently being developed by Basin States and the MDBA.

Schedule B requires all states and the Australian Capital Territory to monitor EoVT sites. This monitoring supports reviews of targets and analysis of salinity risks arising from valleys. Generally, the required data includes, as a minimum, indicators of daily salinity and flow.

Additional monitoring at 'interpretation sites' are highly useful in supporting an understanding of the salt mobilisation and salinity dynamics across the Basin.

Over time, data from both end-of-valley sites and interpretation sites has informed the review of EoVTs and the Register B LoH impacts from tributary valleys.

Monitoring involves the collection, analysis, reporting and use of information to improve BSM2030 implementation. Monitoring of flow and salinity is critical for understanding real-time salinity outcomes at target sites.

Table 8 summarises progress in monitoring at BSM2030 sites over the 17 years from 2000 to 2017. The second column provides the percentage of days for which salinity (EC) measurements have been monitored for each site. The third column provides an indication of flow and available EC, and is expressed as a percentage of time that salt load can be calculated.

Table 8: Availability of monitoring data for all Basin Salinity Management Strategy end-of-valley and interpretation monitoring sites, 2000 to 2017

| Year | Aggregate % of days with EC records | Aggregate % of days with flow and EC records |
|---|---|---|
| **2000** | 68 | 55 |
| **2001** | 69 | 57 |
| **2002** | 77 | 72 |
| **2003** | 77 | 74 |
| **2004** | 85 | 87 |
| **2005** | 79 | 82 |
| **2006** | 84 | 88 |
| **2007** | 69 | 72 |
| **2008** | 78 | 83 |
| **2009** | 77 | 82 |
| **2010** | 80 | 85 |
| **2011** | 84 | 87 |
| **2012** | 84 | 88 |
| **2013** | 78 | 82 |
| **2014** | 68 | 72 |
| **2015** | 68 | 62 |
| **2016** | 77 | 71 |
| **2017** | 86 | 78 |

# 5.3 Basin Salinity Management 2030 Review Plan

The BSM2030 strategy retains the requirement for partner governments and the MDBA to review and report on salinity register entries and models, consistent with the principle of continuous improvement.

The BSM2030 also requires that Basin States will, within 10 years of commencing the strategy, review EoVTs, associated models and baseline data for each valley, and report on salinity trends, predictions and risk profile, and recommend changes to salinity targets (if appropriate).

Basin Officials Committee (BOC) endorsed the BSM2030 Review Plan in October 2016 which sets out the frequency of reviews for all salinity register entries and models over the next 10 years.

# 5.4 Reviews progressed by the MDBA in the preceding two financial years

The BSM2030 Review Plan requires the Basin States and the MDBA to review accountable actions, models and EoVTs. The joint scheme and model reviews progressed by the MDBA outlined below have been either completed or progressed in the last two reporting years.

- Pyramid Creek SIS
- Mildura - Merbein SIS
- MSM-BIGMOD model
- Waikerie to Morgan, Woolpunda and Pike-Murtho MODFLOW models

The details of reviews progressed by Basin States can be found in their respective BSM2030 biennial reports.

# 5.5 Contracting Governments' reported outcomes

Biennially the Contracting Governments provide a comprehensive report outlining progress made against BSMS2030 objectives, whereas the Commonwealth provides an annual report to the MDBA. Executive summaries of the Contracting Governments reports are included in Appendix G.

# 5.6 Outcomes from the audit and review report

Schedule B requires that the Independent Audit Group for Salinity (IAG–Salinity) be appointed by the MDBA to carry out an audit.

Auditing is an integral part of BSM2030, ensuring a fair and accurate assessment of the Contracting Governments' and MDBA's performance against the provisions of Schedule B to the Murray–Darling Basin Agreement.

Outcomes of the IAG-Salinity audit for 2015–17 are provided in Appendix A.

## 5.7 Response to 2014–15 audit recommendations

The IAG–Salinity audit of 2014–15 was the final audit under the BSMS. The audit report included an assessment of the Contracting Governments and the MDBA's implementation of the strategy and provided recommendations to support continuous improvement. Response to the audit recommendations were reported to the Ministerial Council in mid-2016.

During 2015–17, the MDBA, with advice from the Basin Salinity Management Advisory Panel (BSMAP), progressed some of the key recommendations in the Report of the Independent Audit Group for Salinity 2014-15 (MDBA 2016). The audit recommendations that are applicable to the MDBA are itemised and progress is reported in Table 9.

Table 9: The MDBA's response and progress to the 2014–15 audit recommendations

| IAG–Salinity recommendations | MDBA response to Ministerial Council | Progress |
|---|---|---|
| **Recommendation 1: Communication**<br><br>**The IAG-Salinity recommends that, in transitioning to BSM2030, jurisdictions and the MDBA should clearly communicate the success of salinity management to date, emphasizing that, whilst there is no longer an impending salinity crisis, it is an issue that requires careful, ongoing management and the maintenance of current management arrangements to ensure that it remains under control.** | The MDBA supports this recommendation. | Prior to the approval and release of the BSM2030 strategy by Ministerial Council, a package of communications material was prepared by the MDBA in consultation with jurisdictions. This included some key messages and a series of questions and answers. These were prepared to assist Basin jurisdictions and relevant regional stakeholders with getting a consistent message out following the release of the strategy.<br><br>The MDBA is acutely aware of the need to balance the success of salinity management to date with the message that careful ongoing salinity management is required to maintain the quality of the Basin's water resources. This message was communicated via the 'Salt of the Earth' video published by the MDBA and will continue to be reflected in other MDBA communications including the MDBA website, publications, conferences and briefings to stakeholders. |
| **Recommendation 2: Capability**<br><br>**The IAG-Salinity recommends that the MDBA and jurisdictions understand the capability required to implement BSM2030 across the areas of policy, technical modelling, river operations and regional implementation and ensure that capability and resources are maintained in these key areas over future years. Where required, succession plans need to be developed and implemented.** | The MDBA supports this recommendation. | The MDBA has sought the financial resources required to retain the necessary capabilities though the MDBA's annual corporate planning process, and the Basin governments budget discussions for the Joint Venture.<br><br>The need for an appropriate level of capability and capacity in Basin jurisdictions to provide for regional implementation of the strategy is also acknowledged. |

| IAG–Salinity recommendations | MDBA response to Ministerial Council | Progress |
|---|---|---|
| **Recommendation 3: Inter-jurisdictional knowledge exchange**<br><br>**The IAG-Salinity recommends that, biennially, the MDBA hold a salinity forum where jurisdictional policy, technical and regional staff and river operators share experiences and transfer knowledge of best practices.** | The MDBA supports this recommendation. | The MDBA holds various workshops on special topics with staff from Basin jurisdictions depending on the need. These workshops are organised in consultation with the Basin Salinity Management Advisory Panel which advises the MDBA on matters related to the implementation of BSM2030 strategy.<br><br>The MDBA and Basin Governments will be holding the first biennial salinity forum on 14 November 2017 to share the knowledge and experiences to support BSM2030 implementation. |
| **Recommendation 4: Four year model and Accountable Action review plan**<br><br>**The IAG-Salinity recommends that, in the development of the BSM2030 Rolling Four Year Model and Accountable Action Review Plan, jurisdictions and the MDBA plan strategically, considering all reviews, BigMod review, and transition to Source modelling platform, and that they schedule reviews and consequent register adjustments to ensure efficient use of resources and maximised register stability.** | The MDBA supports this recommendation. | MDBA and partner governments through the Basin Salinity Management Advisory Panel prepared a draft procedure develop the 4-year register entry and model review plan. Subsequently, the 4-year register entry and model review plan, now named as BSM2030 Review Plan, was developed. The Review Plan was endorsed by Basin Officials Committee in October 2016.<br><br>The MDBA and Basin states will be progressing reviews in line with the Review Plan. The IAG-Salinity will be informed at biennial audits if there is any significant variations to the review plan. |

| IAG–Salinity recommendations | MDBA response to Ministerial Council | Progress |
|---|---|---|
| **Recommendation 5: Mallee Investigations and Reviews**<br><br>**The IAG-Salinity recommends that the reviews of the Victorian and South Australian Mallee accountable action and the further work on the Mallee Legacy of History projections should be scoped together before any work is undertaken on any of them, to ensure complementarity and avoid duplication.** | The MDBA supports this recommendation. | MDBA will implement this recommendation with partner governments while developing the scope and schedule for progressing the BSM2030 knowledge priority - Mallee LoH or delayed salinity impacts from past land management activities in the Mallee region.<br><br>An expert report was prepared July 2017 in relation to understanding of salinity risks from Mallee LoH actions. The recommendations of this report will assist the reviews of accountable actions in the Mallee region are done in a coordinated way to avoid any duplication. |
| **Recommendation 6: Primary Purpose of Models**<br><br>**The IAG-Salinity recommends that, in the development of BSM2030 Operational Procedures, the MDBA and jurisdictions should make a policy decision on the primary purpose of models and the requirements for use in register accountability.** | The MDBA supports this recommendation. | The BSM2030 Operating Procedures will primarily be developed for implementing BSM2030 elements that will be included in the revised Schedule B to the Murray–Darling Basin Agreement. Primarily, the models referred to in Schedule B and the BSM2030 Operating Procedures will be for the purpose of register accountability. However, the MDBA will be upgrading and using models for making operational decisions for salinity management. The policy decisions relating to the purpose(s) of these models will be taken either in relation to implementation of BSM2030 or the Basin Plan. Depending on the relevance of models to the BSM2030 implementation, such policy decisions will be considered while developing BSM2030 Operating Procedures. |
| **Recommendation 7: The IAG-Salinity recommends that the MDBA ensure that Water Resource Plans assess salinity risk of all water use within the catchment.** | The MDBA supports this recommendation. | The MDBA has processes in place to ensure that risk assessments carried out for the purpose of Water Resource Plans for catchments are consistent with the Basin Plan and consider all water quality risks including risks from salinity. |

# 6. Strategic knowledge improvement

The key knowledge gaps identified by BSM2030 are:

- Mallee Legacy of History LoH – improved understanding of risk associated with the projected impacts of historic land clearing and water use in the Mallee regions of NSW, South Australia and Victoria will help to reduce the uncertainty surrounding the future magnitude and timing of salinity risks to the shared water resources
- improved understanding of environmental water management and watering practices will help to better assess the salinity impacts of environmental watering in the shared water resources including:
    i. environmental watering and floodplain dynamics – development of the next generation groundwater models to assess and predict potential salinity impacts from environmental watering
    ii. the cumulative, system-scale salinity impacts arising from environmental watering regimes (salinity accountability for environmental water management)
- predictive forecasting for in-river salinity – improved surface water models to support predictions and forecasting of salt loads and river salinities will help to reduce the risks associated with responsive SIS management and inform other management actions
- responsive SIS management – improved understanding of the salinity impacts associated with responsive SIS management, with particular focus on the floodplain and in-river responses will help the potential to further reduce operating costs and improve SIS operations.

## BSM2030 Knowledge Priorities

In 2017 an investigation into salinity impacts from pre-1988 irrigation and dryland vegetation clearance in the Mallee was completed.

The key outcome from the review of Mallee LoH salinity impacts from vegetation clearing was that ongoing use of the established method for estimating root zone drainage and delayed recharge was recommended. The review found the established method was valid and has been applied appropriately in groundwater models. Observed groundwater trends across the Basin match the predicted trends showing stable levels with no widespread rises. Given that the salt loads attributed to dryland clearing are quite low (about 5 to 10% of total salt loads across all times through to 2100), the salt load risk context remains low and an adaptive management approach (continued monitoring and review) is warranted.

The Mallee LoH salinity impacts from irrigation report reviewed the modelling approaches to estimate LoH irrigation salinity impacts. It found that the different modelling approaches, when applied appropriately, can be used to develop valid and fit-for-purpose models to estimate Mallee

LoH irrigation salinity impacts. The review recommended a whole-of-system approach that uses as much data as possible as the means to advance a more consistent approach to modelling and to obtain a better understanding of uncertainty and to avoid bias. Development of a transfer function that connects irrigation accessions to groundwater recharge for situations where perching occurs was also recommended.

# 7. Community engagement and communication

## 7.1 Community engagement and education

The responsibility for community engagement and communication rests with the Basin States who report on community engagement and communication activities undertaken through their salinity management programs as part of their comprehensive reports to Ministerial Council.

From time to time the MDBA provides specific engagement and education support.

## 7.2 Communication activities

It is important that communities understand that salinity risk has been reduced through past investment and environmental water recovery under the Basin Plan. Similarly, it is important that they understand that salinity risks remain and that river salinity levels still require careful management to ensure the Basin Salinity Target is achieved.

In May 2017, MDBA launched Salt of the Earth, a video that recognises the achievements and efforts of all those involved in one of the country's most successful schemes, the Salt Interception Scheme , in South Australia, Victoria and New South Wales.

The film is a celebration of the success of initiatives to tackle salinity in Australia, in particular the SIS and improved land and water management practices across Basin States.

In addition, the MDBA released several salinity related publications from 2015-2017. They include:

- Basin Salinity Management 2030 strategy
- 'Salt of the Earth' brochure
- Assessments of the salt export objective and salinity targets for flow management 2016-17
- BSM2030 2015-16 status report
- BSM2030 2015-16 summary report.

# 8. Priorities for future work

In 2017–19, priorities for implementing the BSM2030 strategy include:

- finalising the amendments to Schedule B of the Murray–Darling Basin Agreement to enable implementation of the BSM2030 strategy
- developing Basin Salinity Management procedures that will replace the existing Basin Salinity Management Strategy Operational Protocols
- continuing to implement the trial of responsive management of the SIS and review the outcomes of the trial
- progressing projects related to BSM2030 Knowledge Priorities identified
- progressing major reviews of actions with significant river salinity effects that are located in the South Australian river reaches and the Mallee and riverine plain regions of NSW and Victoria
- progressing updates to the MDBA river model for salinity accountability purposes
- completing a basin-wide core salinity monitoring network
- undertaking other activities in line with the BSM2030 strategy implementation plan
- initiating the Salinity Forum to promote discussion between Basin Government officials, river operators and other stakeholders to share lessons learnt and to support BMS2030 implementation.

# Appendix A: Extract from the Report of the IAG–Salinity 2015–17

## Executive summary and recommendations

### Introduction

The Basin Salinity Management 2030 (BSM2030) strategy was agreed by the Murray-Darling Basin Ministerial Council (MDBMC) in 2015 and commits the partner governments to accept shared responsibility for continuing action to manage salinity in the shared water resources of the Basin. The strategy provides a framework to deliver a strategic, cost-efficient and streamlined program of coordinated salinity management for the next 15 years. The mandatory elements of BSM2030 are currently being incorporated into Schedule B to the Murray-Darling Basin Agreement (Schedule 1 to the Water Act 2007 (Commonwealth)). Draft Clause 34 of Schedule B (Annexure A) specifies that the Authority must appoint independent auditors to carry out an audit.

Under the BSM2030 strategy, audit and reporting has been streamlined now that the program has matured. Commencing in 2017, auditing will now occur biennially to align with the comprehensive biennial reporting by jurisdictions and the MDBA. This process ensures a fair and accurate assessment of the Contracting Governments' and Authority's performance against Schedule B. The auditors are called the Independent Audit Group for Salinity (IAG-Salinity).

This report presents the consensus view that the IAG-Salinity has reached in undertaking the Audit covering the 2015-16 and 2016/17 financial years (noting the BSM2030 was endorsed by the Murray Darling Basin Ministerial Council in November 2015). The State Contracting Governments, and the ACT and the Murray Darling Basin Authority (MDBA) submitted reports on their activities, end of valley reports, the status of the register entry reviews and BSM2030 Salinity Register entries or adjustments. The Australian Government also submitted a brief report related to environmental watering activities.

The audit process adopted by the IAG-Salinity included a review of the jurisdiction reports and the Salinity Registers. This was followed by firstly a forum attended by all jurisdictions and a number of external experts and secondly by individual meetings with representatives of the jurisdictions and with members of the MDBA office. Jurisdictions were given an opportunity to comment on the draft text of the audit report containing the recommendations and suggestions from them have been included where appropriate.

### The 2015-17 Context for BSM2030 Implementation

In 2015-17 the high rainfall in 2016 across the Basin resulted in significant flooding and this meant that an estimated 1.8m tonnes of salt flowed to the sea that is just below the salt export objective of a three-year average of 2.0m tonnes as set out in the Basin Plan. The use of environmental water to freshen the lower reaches of the Murray, coupled with cycling of water levels in the Lower Lakes, has

been successful in bringing Lake Albert salinity levels down to 1690 EC and maintaining Lake Alexandrina below the Basin Plan salinity objective at Milang of 1000 EC.

This is the eighth year in a row that the salinity at Morgan has been below 800EC. This is consistent with the Basin salinity target, as set out in Schedule B that is to maintain the average daily salinity at Morgan at a simulated level of less than 800 EC for at least 95% of the time. This has been achieved mainly through the operation of the extensive Salt Interception Schemes (SIS) along the River Murray. The BSM2030 established that it might be possible to reduce the time some of the pumps in the SIS are run and still not exceed the Morgan target. A three-year trial to examine a more flexible way of running the SIS has commenced. The trial however has been delayed by 12 months because the high river meant that SIS pumps on the floodplain had to be turned off. There may be some savings in operating costs by being able to reduce the pumping on normal river flows without increasing the salinity risk but it is important that the SIS be able to respond to years of low river flows when the risk of increased river salinity is high.

While at no time did the salinity levels in the River Murray at Morgan exceed the target of 800 EC, there were two elevated salinity events observed in the River during this audit period. The first was related to the re-establishment of a flow of water down the Lower Darling River, that resulted in a spike of salinity but the impact of the spike was limited partially due to the appropriate management of the Darling and partially due to a high river flow in the Murray at that time. Following the reconnection, the addition of environmental water to increase the flow down the Darling resulted in a significant spawning of Murray Cod and other native species.

An elevated salinity event also occurred in SA. It occurred after a natural high river flow (extended with additional environmental water), when the level of the River Murray fell quickly and brought water into the river from Lake Bonney. Lake Bonney is a terminal wetland with increasing salinity levels caused by water flowing in, evaporating and concentrating the salt. However, at no time did the River Murray exceed 800 EC (reached 775 EC) at Morgan mainly because the spike in salt load occurred while the river flow was still high. There were some lessons learnt from these events that need to inform the management of short-term salinity spikes in the future as the river is now managed in a different fashion for environmental purposes.

The use of environmental water on wetlands and floodplains does increase the risk of a salinity spike from short term watering actions. Improvements in the modelling of these reaches such as being developed for the Chowilla floodplain means that the salinity risks from environmental watering can be better understood and managed. The addition of the provisional credits from the environmental water use onto the registers now brings environmental water into the salinity accountability framework. With a range of new short-term activities (flexibility in SIS operations and environmental watering of floodplains) it is important that there is clear accountability for the overall responsibility of ensuring the cumulative salinity impacts of environmental watering, lock management and SIS operations are assessed and the river salinity managed.

A salinity risk in the northern Basin is the brine ponds that are being stored on the coal seam gas (CSG) fields in the headwaters of the Basin in Queensland. There is a strong regulatory framework imposed by Queensland to manage the risk but there has not been an industry solution to the long-term future of the brine ponds. It is important that Queensland and the industry find a solution. Until it is found the IAG Salinity needs to monitor progress biennially.

There is a significant amount of water being traded in the Basin and used to irrigate new sites, particularly on the Mallee region of the Basin. Water has been traded out of the traditional irrigation areas reducing the risk that these areas have on the Basin salinities. While the water has moved from these areas most of the site-use approvals are still in place. The models that underpin the register entries reflect the site-use approvals rather than the actual water applied for irrigation. This is necessary as potentially these site-use approval areas can be watered again often at lower intensities. The impact that new development may have on the River salinities is included in the registers annually but the retirement or reduced irrigation intensity is not necessarily accounted for. The movement of water across the Basin is becoming dynamic and while the registers need to be conservative and predict the long-term trends, it is important that both the changes in credits and debits reflect the more dynamic movement of water particularly in the southern connected basin.

Effective resourcing of the BSM2030 is essential to ensure continued assessment of risk as well as making informed decisions about the impacts of new developments, the winding down of irrigation areas and the impacts of environmental watering. The only outstanding model review is the Buronga SIS 5-year review led by NSW and was to be resolved by 2017. Also, NSW has a further 8 register reviews due by 2019 for register A and 4 register B entries due, 2 in 2018 and 2 in 2019. The IAG-Salinity is concerned that NSW does not have the resources allocated to meet the agreed schedule of reviews of register entries.

The review date for the BSM2030 is in 2026 and it is essential that the models that underpin the register entries be updated with the best information available. It is proposed that the registers calculations move to the SOURCE modelling framework, a framework that is already used for the Sustainable Diversion Limit (SDL) assessment for Basin Plan. There are some technical issues that need to be resolved before this can be done and when it is there will be changes to the register entries. There are also some outstanding register entries from SA reaches that will make significant changes to the registers. It would be preferable if both the movement to SOURCE and the changes from SA state actions is included on the registers together as both actions will affect the register calculations and it would be simpler to explain those changes at one time.

It is also important that work continue on improving the certainty around the LoH register B items. The land-clearing based items have been investigated and there is now increased confidence around the modelling. However, the LoH irrigation items that predict a significant increase in salinity over time, have a high level of uncertainty that needs to be investigated.

In summary, over the next two years there needs to be a concentrated effort on establishing a modelling framework in preparation for the 2026 review.

The IAG-Salinity considers that the BSM2030 and its predecessors, the BSMS and S&DS to be one of the best examples of a successful, long-term natural resource management program in the world. During the interviews of jurisdictions there were a number of examples given where overseas visitors were impressed with what has been achieved. The MDBA has produced a video and information on the success of the program to date but the public does need to be reminded from time to time that there is a salinity risk and that it is currently being well managed and needs ongoing resources.

**Figure A1: Comparison of mean daily-recorded salinity levels at Morgan from July 2015 to June 2017 to the modelled 1975 'no further intervention' salinity levels**, demonstrates the success of the

program. It shows that if there had not been the management interventions taken over the past 30 years, the predicted levels without these interventions would have exceeded the target of 800 EC at Morgan in the past two years on a number of occasions.

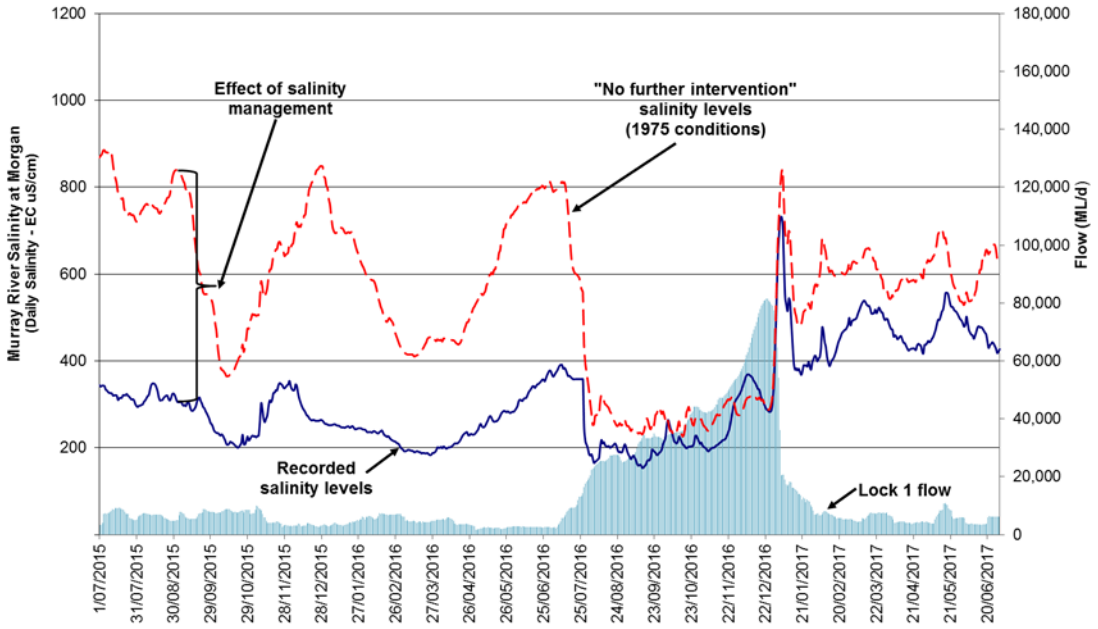



Figure A1: Comparison of mean daily-recorded salinity levels at Morgan from July 2015 to June 2017 to the modelled 1975 'no further intervention' salinity levels

# Statement on Register entries

The IAG–Salinity's opinion on the balance of salinity credits and debits for each state as at 30 June 2017(see below).

Schedule B, Clause 16 (1) provides as follows:

16(1) A State Contracting Government must take whatever action may be necessary (a) to keep the total of any salinity credits in excess of or equal to the total of any salinity debits attributable to Register; and (b) to keep the cumulative total of all salinity credits in excess of, or equal to, the cumulative total of all salinity debits attributed to it in both Register A and Register B.

Register A currently shows NSW, Victoria and South Australia to be in net credit, while Register B shows NSW and South Australia to be in net credit with Victoria slightly in debit but close to neutral. For the combined registers, all three States are in credit. Queensland and the ACT do not have register entries

***Opinion on register balances***

The IAG–Salinity has examined the register as provided for this audit and has come to the opinion that NSW, Victoria and South Australia are in a net credit position.

***Opinion on MDBA's accuracy in maintaining the registers***

The IAG-Salinity found no inaccuracies in MDBA's maintenance of the registers.

While the Auditors did not identify any requirement to update individual register entries at this time, it encourages firstly the MDBA take a lead role to finalise the entries relating to the update of the 3 model reviews conducted by SA for Waikerie to Morgan, Woolpunda and Pike-Murtho Salt Interception Schemes and secondly for NSW to provide a report that indicates to BSMAP that it can meet the register reviews over the next few years that it has agreed to.

**IAG-Salinity recommendations:**

The IAG-Salinity made its recommendations with the 2026 review date of the BSM2030 in mind and was conscious that some issues that are required for this review need to be progressed immediately, while there are other issues that can take some time to develop. Consequently, the recommendations have been grouped into short-term and longer-term actions.

The recommendations are:

**Short term:**

*Recommendation 1*: That MDBA work closely with South Australia, New South Wales and Victoria to finalise the reviews of the South Australian register entries derived from the Waikerie to Morgan, Woolpunda and Pike-Murtho ground water models and ensure the registers are adjusted in a principled and timely manner.

*Recommendation 2*: New South Wales as a matter of urgency should ensure it has the dedicated resourcing required to meet its obligations to conduct the reviews of salinity entries on the registers.

*Recommendation 3:* BSMAP should work with the Commonwealth to determine how it can continue to be actively involved in BSMAP in an efficient and effective manner.

*Recommendation 4:* The MDBA and jurisdictions should learn from unexpected short term in-river salinity spikes from events such as occurred at Lake Bonney and the lower Darling, review where these may occur in the Basin in the future, and develop mitigation strategies to reduce the future risk of spikes occurring.

*Recommendation 5:* The MDBA, in conjunction with the jurisdictions, should develop a clear procedure setting out the roles and responsibilities of all parties for resolving the risks to river salinities associated with the cumulative impacts of environmental watering and other actions.

*Recommendation 6:* The work required to set the framework for introducing the SOURCE Model for BSM2030 purposes be progressed urgently so that the SOURCE Model can be introduced in 2018.

*Recommendation 7:* Given the range of modelling issues that need to be resolved quickly and efficiently under the BSM2030 transition, there is a need for an expansion of the role of the Technical Working Group for Salinity Modelling or for similar committee(s) be set up to aid the facilitation of modelling issues in a planned way.

**Longer term**

*Recommendation 8:* The MDBA and jurisdictions should consider the development of an approach to assessing the salinity impacts of irrigation that better represents actual water use; particularly in relation to the reduction in irrigation water use in some established irrigation areas in the southern basin.

*Recommendation 9:* The economic impacts of the salinity management program in the MDB should be reviewed and updated before 2026 as an input to the strategic review of the BSM2030.

*Recommendation 10:* The jurisdictions and the MDBA should develop a strategic approach to management and oversight of the BSM2030 implementation program, with a view to ensuring that all necessary actions can be delivered to support achievement of the strategy objectives, and to enable the 2026 review to be undertaken in an effective, timely manner.

# Appendix B: Basin Salinity Management 2030 - salinity registers 2017

The BSM2030 salinity registers 2017 present individual accountable actions as credits and debits expressed both in EC impacts and as cost effects in dollar values.

Register A includes accountable actions taken after the baseline conditions date (1988 for New South Wales, Victoria and South Australia, 2000 for Queensland and the Australian Capital Territory) and joint-funded works and measures. Accountable actions that are predicted to cause increases in salinity are referred to as debits and are shown in as a positive number. Accountable actions that result in a decrease in salinity levels are referred to as salinity credits and are shown as a negative number. Salinity debits can be offset by credits arising from joint works and other credit generating actions, such as improved land and catchment management practices.

Register B accounts for 'LoH' or delayed salinity impacts that continue to appear after the baseline conditions were adopted but are the result of actions that occurred before the date of baseline conditions. As with Register A, salinity debits can be offset by salinity credits (green).

## Changes to the registers to accommodate the new requirements under BSM2030

The flow regime of the Murray–Darling Basin is changing as a result of environmental water recovery, delivery and use under the Basin Plan. Environmental watering is estimated to have a net long-term salinity benefit for the shared water resources due to the substantial dilution benefits from delivering the water. However there may also be some environmental watering actions that mobilise salt into the river system.

The expected salinity impacts (both positive and negative) from environmental water are accountable actions under Schedule B to the Murray–Darling Basin Agreement and as such are included on the BSM2030 Salinity Register(s).

The design of the salinity registers was changed in 2016 to accommodate the new requirements under BSM2030. The BSM2030 salinity accountability arrangements for environmental water require changes to the design of Register A. Changes include new Commonwealth and Collective columns to indicate the salinity cost effect. The amendments to Schedule B also include a requirement to forecast the salinity effect (EC at Morgan) at the year 2030 for all register entries to coincide with the end of the BSM2030. This change requires a new 2030 column for both Register A and Register B.

A new section for Register A has been created to group actions arising from BSM2030 including those associated with Bridging the Gap water (Basin Plan water) and the changed operation of SIS under the trial of responsive management.

Other changes under the BSM2030 include that the Basin States have agreed to pool the credits associated with their other environmental water holdings (including the net balance of The Living Murray (TLM), Register A salinity credits not required to offset TLM debits) in the Collective column of Register A. Basin States will be able to access their share of the collectively held credits for their individual use if required. These do not necessitate further changes to the design of Register A other than those already outlined above.

The Commonwealth credits from the dilution benefits associated with delivering Bridging the Gap water will offset the debits from any accountable actions associated with the recovery of Bridging the Gap water, Sustainable Diversion Limits (SDL) adjustment works and measures, the use of environmental water (excluding TLM), and any changes to river operations (that are not part of the SDL adjustment mechanism), and in addition the trial of salt interception scheme responsive management. This is done through the inclusion of an additional row to show the offsets provided by the Commonwealth, and the offsets are also shown in the total of the Commonwealth column.

# Explanation of the BSM2030 salinity registers

Table 1 (in Section 1 - Accountability Framework) is a summary of the BSM2030 salinity registers for 2017. Table  and Table 11: are the actual salinity registers, which provide more detail on the credits and debits of specific actions. This section explains the broad groups of register entries.

## Joint works and measures

The first line summarises the economic benefits in the river arising from joint works and measures for each state and the Australian Government.

Joint works and measures refer to SIS constructed as part of the Salinity and Drainage Strategy (MDBC 1989) and those developed under the BSMS and BSM2030. The registers demonstrate the benefits of the shared schemes between the investing states. The Australian Government has provided significant financial input to the schemes, which is reflected in the right-hand column showing a salinity benefit equivalent to that contribution. A proportion of credits generated by the joint works and measures program is assigned to individual states to offset the debts recorded in Register B. In the registers summary (Table 1), these transfers are shown as ‘Transfers to Register B’.

## State shared works and measures

Some states have carried out actions, such as adopting targeted river operating rules that provide downstream salinity benefits. These benefits are shown as ‘shared measures’ in the salinity registers.

## State actions

The individual state actions reflect the land and water use salinity costs and benefits to the river. Typical examples of activities that increase salinity costs include new irrigation developments, the construction of new drainage schemes that mobilise salt to the river and wetland flushing. Offsetting activities include improved irrigation efficiencies and improved river operations.

# Total Registers A and B

The overall cumulative accountability for salinity impacts on the river in 2016–17 is summarised in the 'Total Register A' and 'Total Register B' rows. Register A maintains accountability for actions after 1 January 1988 for New South Wales, Victoria and South Australia, and after 1 January 2000 for Queensland and the Australian Capital Territory. The 'Total for Register A' reflects the sum of the salinity cost of the state actions offset by 'Joint works and measures' or 'State shared works and measures' shown in the preceding lines.

Register B accounts for actions that occurred before the baseline year but for which the impacts were not experienced until after the baseline year because of the slow movement of groundwater and salt to the river. There have been significant improvements in confidence ratings for Register A items in recent years; however, many of the Register B items continue to have medium or low confidence ratings. This suggests relatively wide uncertainty bands around the Register B totals compared with Register A totals.

# Balance Register A and B

The register balance provides an overall assessment of whether each basin partner is in net credit or debit. This balance needs to be interpreted in the light of the different levels of confidence in individual register entries provided by Register B. Uncertainty bands associated with the lower confidence in the Register B entries are incorporated into the overall balance for Register A and Register B items.

Table 10: 2017 Salinity Register A

| | AUTHORITY REGISTER A (Accountable Actions) | Type | Date Effective | Provisional Salinity Credit ($m/yr) | Current Impact on Morgan 95%ile Salinity (EC) | Impact on Flow at Mouth (GL/y) | Salinity Effect^ (EC at Morgan) | | | | | | Salinity Credits# (Interpolation to Current Year Benefits $m/year) | | | | | | | | | Commonwealth Contribution (EC) | 5 Year Rolling Review | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 2000 | 2015 | 2030 | 2050 | 2100 | Modelled Current Conditions (Interpolation to Current Year) | NSW | Vic | SA | Qld | ACT | Collective Actions | Commonwealth | Total | | | Latest Review | Next Review | Status |
| | **JOINT WORKS & MEASURES** | | | | | | | | | | | | | | | | | | | | | | | | |
| | **Former Salinity & Drainage Works** | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | Woolpunda SIS | SDS | Jan 1991 | | -87 | 0 | -47.4 | -47.4 | | -47.4 | -47.4 | -47.4 | 0.729 | 0.729 | | | | | | 3.890 | 1 | 11.8 | 2007 | 2017 | In Progress |
| 2 | Improved Buronga and Mildura/Merbein I | SDS | Jan 1991 | | -6 | 0 | -3.0 | -3.0 | | -3.0 | -3.0 | -3.0 | 0.140 | 0.140 | | | | | | 0.748 | 2 | 0.8 | 2005 | 2017 | |
| 3 | New Operating Rules for Barr Creek Pumps | SDS | Jul 1991 | | -8 | 0 | -4.9 | -4.9 | | -4.9 | -4.9 | -4.9 | 0.225 | 0.225 | | | | | | 1.198 | 3 | 1.2 | 2011 | 2018 | |
| 4 | Waikerie SIS | SDS | Dec 1992 | | -19 | 0 | -12.8 | -12.8 | | -12.8 | -12.8 | -12.8 | 0.198 | 0.198 | | | | | | 1.057 | 4 | 3.2 | 2007 | 2017 | In Progress |
| 5 | Changed MDBC River Operations 1988 to 200 | SDS | Apr 1993 | | -1 | 4 | -1.6 | -1.6 | | -1.6 | -1.6 | -1.6 | 0.150 | 0.150 | | | | | | 0.797 | 5 | 0.4 | 2005 | 2017 | |
| 6 | Mallee Cliffs SIS | SDS | Jul 1994 | | -17 | 0 | -11.4 | -11.3 | | -11.3 | -11.3 | -11.3 | 0.514 | 0.514 | | | | | | 2.740 | 6 | 2.8 | 2013 | 2019 | |
| 7 | Changed Operation of Menindee and Lower Darlin | SDS | Nov 1997 | | 3 | 8 | 0.9 | 0.9 | | 0.9 | 0.9 | 0.9 | -0.146 | -0.146 | | | | | | -0.776 | 7 | -0.2 | 2005 | 2017 | |
| 8 | Waikerie Phase 2A SIS | SDS | Feb 2002 | | -14 | 0 | -8.0 | -8.2 | | -10.7 | -8.9 | -8.4 | 0.115 | 0.115 | | | | | | 0.615 | 8 | 2.1 | 2007 | 2017 | |
| 9 | Changed MDBC River Operations 2000 to 200 | SDS | Feb 2002 | | -3 | -1 | -1.4 | -1.4 | | -1.7 | -1.9 | -1.4 | -0.138 | -0.138 | | | | | | -0.734 | 9 | 0.4 | 2006 | 2017 | |
| | **Sub Total - Former Salinity & Drainage Works** | | | | **-152** | **11** | **-89.6** | **-89.8** | **0.0** | **-92.6** | **-91.0** | **-90.0** | **1.788** | **1.788** | **0.000** | **0.000** | **0.000** | **0.000** | **0.000** | **9.535** | | **22.5** | | | |
| | **Basin Salinity Management Strategy** | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | Changed MDBC River Operations after 200 | BSMS | Dec 2003 | | 1 | 7 | -0.2 | -0.2 | | -0.4 | -0.4 | -0.3 | 0.022 | 0.022 | 0.022 | | | | | 0.132 | 10 | 0.1 | 2005 | 2017 | |
| 11 | Pyramid Ck GIS | BSMS | Mar 2006 | | -5 | -3 | -3.6 | -3.5 | | -3.5 | -3.4 | -3.5 | 0.135 | 0.135 | 0.135 | | | | | 0.821 | 11 | 0.9 | 2016 | 2021 | |
| 12 | Bookpurnong SIS | BSMS | Mar 2006 | | -20 | 0 | -8.2 | -11.2 | | -16.0 | -17.0 | -11.5 | 0.214 | 0.214 | 0.214 | | | | | 1.306 | 12 | 2.9 | 2013 | 2019 | |
| 13 | Improved Buronga SIS | BSMS | Mar 2006 | | -1 | 0 | -0.6 | -0.5 | | -0.5 | -0.5 | -0.5 | 0.021 | 0.021 | 0.021 | | | | | 0.127 | 13 | 0.1 | 2006 | 2017 | |
| 14 | Loxton SIS | BSMS | Jun 2008 | | -17 | 0 | -10.5 | -10.8 | | -11.1 | -12.0 | -10.8 | 0.206 | 0.206 | 0.206 | | | | | 1.255 | 14 | 2.7 | 2013 | 2019 | |
| 15 | Waikerie Lock 2 SIS | BSMS | Jun 2010 | | -17 | 0 | -12.7 | -10.3 | | -11.3 | -11.8 | -10.3 | 0.114 | 0.114 | 0.114 | | | | | 0.698 | 15 | 2.6 | 2010 | 2017 | |
| 16 | Upper Darling SIS | BSMS | Jun 2014 | | -4 | 0 | -4.5 | -4.6 | | -4.5 | -4.5 | -4.6 | 0.241 | 0.241 | 0.241 | | | | | 1.470 | 16 | 1.1 | 2014 | 2019 | |
| 17 | Murtho SIS | BSMS | Jun 2014 | | -52 | 0 | -13.7 | -17.3 | | -29.8 | -31.1 | -18.0 | 0.557 | 0.557 | 0.557 | | | | | 3.399 | 17 | 4.5 | 2014 | 2017 | In Progress |
| | **Sub Total Joint Works under BSMS** | | | | **-114** | **4** | **-54.0** | **-58.4** | **0.0** | **-77.1** | **-80.7** | **-59.4** | **1.509** | **1.509** | **1.509** | **0.000** | **0.000** | **0.000** | **0.000** | **9.209** | | **14.9** | | | |
| | **Joint Works Sub Total** | | | | **-267** | **15** | **-143.6** | **-148.2** | **0.0** | **-169.7** | **-171.8** | **-149.4** | **3.297** | **3.297** | **1.509** | **0.000** | **0.000** | **0.000** | **0.000** | **18.744** | | **37.3** | | | |
| | **The Living Murray Works and Measures and Water for Rivers**[*] | | | | | | | | | | | | | | | | | | | | | | | | |
| 18 | TLM-RMIF 570 GL | TLM | Jun 2014 | 3.696 | -47 | 346 | -24.4 | -24.4 | -24.4 | -24.4 | -24.4 | -24.4 | | | | | | | | | 18 | | 2014 | | |
| 19 | TLM Works and Measures | TLM | Jun 2014 | -0.902 | 5 | 0 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | | | | | | | | | 19 | | 2014 | | |
| | **TLM Sub Total** | | | **2.794** | **-42** | **346** | **-19.8** | **-19.8** | **-19.8** | **-19.8** | **-19.8** | **-19.8** | | | | | | | | | | | | | |
| | **BSM2030** | | | | | | | | | | | | | | | | | | | | | | | | |
| 20 | Responsive Management SIS | BSM2030 | Jun 2016 | | | | | | | | | 12.0 | | | | | | | | | 20 | | | | |
| 21 | BtG Dilution benefits from deliver[$] | BSM2030 | Jun 2015 | | | | | | | | | -36.7 | | | | | | | | | 21 | | | | |
| | **Sub Total under BSM2030** | | | | **0** | **0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **-24.7** | | | | | | | | | | | | | |
| | **BSM2030 and TLM Sub Total** | | | | **-42** | **346** | **-19.8** | **-19.8** | **-19.8** | **-19.8** | **-19.8** | **-44.5** | | | | | | | | | | | | | |
| | **STATE WORKS & MEASURES** | | | | | | | | | | | | | | | | | | | | | | | | |
| | **Shared New South Wales and Victorian Measures** | | | | | | | | | | | | | | | | | | | | | | | | |
| 22 | Permanent Trade Accounting Adjustment - NSW to Victori | 50N50V | Jun 2006 | | 0 | 0 | 0.0 | -0.1 | | -0.1 | -0.1 | -0.1 | 0.001 | 0.001 | | | | | | 0.002 | 22 | 0 | 2006 | 2017 | |
| 23 | Barmah-Millewa Forest Operating Rule | 50N50V | Mar 2002 | | -2 | 33 | -1.9 | -2.0 | | -1.9 | -2.3 | -2.0 | 0.187 | 0.187 | | | | | | 0.374 | 23 | 0 | 2006 | 2017 | |
| | **Shared Measures Sub Total** | | | | **-2** | **33** | **-2.0** | **-2.1** | **0.0** | **-2.0** | **-2.3** | **-2.1** | **0.188** | **0.188** | **0.000** | **0.000** | **0.000** | **0.000** | **0.000** | **0.376** | | **0** | | | |
| | **New South Wales** | | | | | | | | | | | | | | | | | | | | | | | | |
| 24 | Boggabilla Weir | NSW | Dec 1991 | | 0 | 0 | -0.1 | -0.1 | | -0.1 | -0.1 | -0.1 | 0.042 | | | | | | | 0.042 | 24 | 0 | 2007 | 2020 | |
| 25 | Pindari Dam Enlargement | NSW | Jul 1994 | | 0 | -17 | 0.7 | 0.7 | | 0.7 | 0.7 | 0.7 | -0.121 | | | | | | | -0.121 | 25 | 0 | 2007 | 2020 | |
| 26 | Tandou pumps from Lower Darlin | NSW | Sep 1994 | | 2 | -3 | -0.1 | -0.1 | | -0.1 | -0.1 | -0.1 | 0.034 | | | | | | | 0.034 | 26 | 0 | 2005 | 2017 | |
| 27 | NSW MIL LWMP's | NSW | Feb 1996 | | -4 | 57 | -4.0 | -4.0 | | -4.0 | -4.0 | -4.0 | 0.684 | | | | | | | 0.684 | 27 | 0 | 2010 | 2017 | |
| 28 | NSW Changes to Edward-Wakool and Escapes | NSW | Jan 1990 | | -2 | 4 | -2.0 | -2.1 | | -2.0 | -2.0 | -2.1 | 0.367 | | | | | | | 0.367 | 28 | 0 | 2005 | 2017 | |
| 29 | Permanent Trade Accounting Adjustment - NSW to SA | NSW | Jun 2006 | | -3 | 1 | -0.5 | -0.4 | | -0.4 | -0.5 | -0.4 | 0.108 | | | | | | | 0.108 | 29 | 0 | 2005 | 2017 | |
| 30 | NSW Sunraysia Irrigation Development 1997 to 200 | NSW | Jul 2003 | | 2 | 0 | 0.0 | 0.9 | | 4.5 | 6.1 | 1.1 | -0.245 | | | | | | | -0.245 | 30 | 0 | 2007 | 2019 | |
| 31 | RISI Stage 1 | NSW | Jun 2010 | | -5 | 0 | -2.7 | -3.9 | | -4.1 | -4.1 | -3.9 | 0.845 | | | | | | | 0.845 | 31 | 0 | 2016 | 2019 | |
| 32 | RISI Stage 2 | NSW | Jun 2014 | | -4 | 0 | -3.6 | -3.8 | | -3.9 | -3.9 | -3.8 | 0.853 | | | | | | | 0.853 | 32 | 0 | 2014 | 2019 | |
| 33 | NSW S&DS Commitment Adjustment | NSW | Nov 2002 | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0.910 | | | | | | | 0.910 | 33 | 0 | | | |
| | **New South Wales Works and Measures** | | | | **-15** | **43** | **-12.4** | **-12.9** | **0.0** | **-9.4** | **-8.0** | **-12.7** | **3.477** | | | | | | | **3.477** | | **0** | | | |
| | **Victoria** | | | | | | | | | | | | | | | | | | | | | | | | |
| 34 | Barr Creek Catchment Strategy | Vic | Mar 1991 | | -12 | 0 | -7.7 | -7.7 | | -7.7 | -7.7 | -7.7 | | 1.963 | | | | | | 1.963 | 34 | 0 | 2013 | 2018 | |
| 35 | Tragowel Plains Drains at 2002 leve | Vic | Mar 1991 | | 1 | 1 | 0.2 | 0.2 | | 0.2 | 0.2 | 0.2 | | -0.022 | | | | | | -0.022 | 35 | 0 | 2013 | 2017 | |
| 36 | Shepparton Salinity Management Plar | Vic | Mar 1991 | | 0 | 24 | 1.4 | 1.4 | | 1.5 | 1.5 | 1.4 | | -0.381 | | | | | | -0.381 | 36 | 0 | 2008 | 2017 | |
| 37 | Nangiloc-Colignan S.M.P. | Vic | Nov 1991 | | -1 | 1 | 0.4 | 0.4 | | 0.4 | 0.4 | 0.4 | | -0.102 | | | | | | -0.102 | 37 | 0 | 2013 | 2023 | |
| 38 | Nyah to SA Border SMP - Irrigation Developmen | Vic | Jul 2003 | | 25 | 0 | 17.0 | 16.9 | | 16.9 | 16.9 | 16.9 | | -3.958 | | | | | | -3.958 | 38 | 0 | 2014 | 2018 | |
| 39 | Kerang Lakes/Swan Hill Salinity Management Plar | Vic | Jan 2000 | | 1 | 4 | 1.1 | 1.6 | | 1.1 | 0.9 | 1.6 | | -0.368 | | | | | | -0.368 | 39 | 0 | 2010 | 2017 | |
| 40 | Campaspe West SMP | Vic | Aug 1993 | | 1 | 0 | 0.4 | 0.3 | | 0.4 | 0.3 | 0.3 | | -0.078 | | | | | | -0.078 | 40 | 0 | 2010 | 2017 | |
| 41 | Psyche Bend | 50V50C | Feb 1996 | | -4 | 0 | -2.1 | -2.1 | | -2.1 | -2.1 | -2.1 | | 0.237 | | | | | | 0.474 | 41 | 1 | 2017 | 2022 | |
| 42 | Permanent Trade Accounting Adjustment - Victoria to SA | Vic | Jun 2006 | | 0 | 2 | -0.7 | -0.8 | | -0.8 | -1.0 | -0.8 | | 0.184 | | | | | | 0.184 | 42 | 0 | 2005 | 2017 | |
| 43 | Woorinen Irrigation District Excisior | Vic | Sep 2003 | | 0 | -2 | 1.3 | 0.8 | | 1.0 | 1.2 | 0.8 | | -0.227 | | | | | | -0.227 | 43 | 0 | 2010 | 2017 | |
| 44 | Sunraysia Drains Drying up | Vic | Jun 2004 | | -2 | -4 | -2.1 | -2.2 | | -2.1 | -2.1 | -2.2 | | 0.638 | | | | | | 0.638 | 44 | 0 | 2017 | 2022 | |
| 45 | Lamberts Swamp | Vic | Jun 2004 | | -5 | 0 | -3.0 | -3.0 | | -3.0 | -3.0 | -3.0 | | 0.624 | | | | | | 0.624 | 45 | 0 | 2017 | 2027 | |
| 46 | Church's Cut decommissioning | Vic | Mar 2006 | | 0 | 0 | -0.2 | -0.3 | | -0.2 | -0.2 | -0.3 | | 0.048 | | | | | | 0.048 | 46 | 0 | 2016 | 2021 | |
| 47 | Mallee Drainage bore decommissioning | Vic | Jun 2008 | 0.063 | 0 | 0 | -0.1 | -0.3 | | -0.3 | -0.3 | -0.3 | | | | | | | | | 47 | 0 | 2013 | 2018 | |
| 48 | RISI Stage 1 | Vic | Jun 2010 | | -9 | 0 | -2.0 | -5.5 | | -6.8 | -7.1 | -5.6 | | 1.302 | | | | | | 1.302 | 48 | 0 | 2016 | 2019 | |
| 49 | RISI Stage 2 | Vic | Jun 2014 | | -6 | 0 | -4.4 | -4.7 | | -5.0 | -5.1 | -4.7 | | 1.063 | | | | | | 1.063 | 49 | 0 | 2014 | 2019 | |
| 50 | Victorian S&DS Commitment Adjustment | Vic | Nov 2002 | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | | 1.600 | | | | | | 1.600 | 50 | 0 | | | |
| | **Victoria Works and Measures** | | | | **-12** | **25** | **-0.5** | **-4.7** | **0.0** | **-6.7** | **-7.2** | **-4.8** | | **2.523** | | | | | | **2.760** | | **1.0** | | | |
| | **South Australia** | | | | | | | | | | | | | | | | | | | | | | | | |
| 51 | SA Irrigation Development Based on Footprint Data | SA | Jul 2003 | | 11 | 0 | -3.6 | 5.8 | | 33.9 | 72.8 | 7.4 | | | -0.886 | | | | | -0.886 | 51 | 0 | na | 2020 | |
| 52 | SA Irrigation Development Due to Water Trade | SA | Jun 2006 | | 2 | 0 | 0.1 | 0.5 | | 16.2 | 32.2 | 1.4 | | | -0.291 | | | | | -0.291 | 52 | 0 | na | 2018 | |
| 53 | SA Irrigation Development Based on Site Use Approval | SA | Jun 2010 | | 2 | 0 | -0.1 | 0.3 | | 19.0 | 111.9 | 1.4 | | | -0.206 | | | | | -0.206 | 53 | 0 | na | 2018 | |
| 54 | SA Component of Bookpurnong SIS | SA | Mar 2006 | | -7 | 0 | -3.0 | -4.1 | | -5.9 | -6.3 | -4.3 | | | 0.475 | | | | | 0.475 | 54 | 0 | 2013 | 2019 | |
| 55 | SA Component of Loxton SIS | SA | Jun 2008 | | -1 | 0 | -0.8 | -0.8 | | -0.8 | -0.9 | -0.8 | | | 0.095 | | | | | 0.095 | 55 | 0 | 2013 | 2019 | |
| 56 | SA component of Waikerie Lock 2 SIS | SA | Jun 2010 | | -1 | 0 | -1.2 | -0.7 | | -2.0 | -2.6 | -0.8 | | | 0.051 | | | | | 0.051 | 56 | 0 | 2010 | 2017 | |
| 57 | SA Improved Irrigation Efficiency and Scheme Rehabilitation Reg | SA | Jan 2000 | | -37 | 0 | -20.2 | -22.1 | | -26.3 | -21.3 | -22.4 | | | 2.981 | | | | | 2.981 | 57 | 0 | 2012 | 2020 | |
| 58 | Qualco Sunlands GWCS | SA | Sep 2004 | | -5 | 0 | -1.8 | -4.0 | | -6.5 | -7.5 | -4.1 | | | 0.280 | | | | | 0.280 | 58 | 0 | 2007 | 2017 | |
| 59 | Pike Stage 1 SIS | SA | Jan 2012 | | -5 | 0 | -1.4 | -3.2 | | -3.3 | -3.4 | -3.2 | | | 0.491 | | | | | 0.491 | 59 | 0 | 2012 | 2017 | In Progress |
| 60 | SA Component of Murtho SIS | SA | Jun 2014 | | -1 | 0 | -0.3 | -0.4 | | -0.6 | -0.6 | -0.4 | | | 0.069 | | | | | 0.069 | 60 | 0 | 2014 | 2017 | |
| | **South Australia Subtotal** | | | | **-43** | **0** | **-32.2** | **-28.7** | **0.0** | **23.6** | **174.2** | **-25.7** | | | **3.061** | | | | | **3.061** | | **0** | | | |
| | **Balance - Register A** | | | | **-338** | **116** | **-190.8** | **-196.6** | **0.0** | **-164.1** | **-15.1** | **-239.2** | **6.963** | **6.009** | **4.570** | **0.000** | **0.000** | **0.000** | **0.000** | **23.738** | | **38.4** | | | |
| | | | | | | | **Factors for allocating transferred credits to Register B** | | | | | | **0.243** | **0.194** | **0.563** | **0.000** | **0.000** | | | | | | | | |

Table 11: 2017 Salinity Register B

| | AUTHORITY REGISTER B (Delayed Salinity Impacts) | Type | Year of Predictions | Provisional Salinity Credit ($m/yr) | Current Impact on Morgan 95%ile Salinity (EC) | Impact on Flow at Mouth (GL/y) | 2000 | 2015 | 2030 | 2050 | 2100 | Modelled Current Conditions (Interpolation to Current Year) | Salinity Credits (Interpolation to Current Year Benefits $m/year) NSW | Vic | SA | Qld | ACT | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Transfers from Register A** | | | | | | | | | | | | 1.138 | 0.908 | 2.635 | 0.000 | 0.000 | 4.681 |
| | **New South Wales** | | | | | | | | | | | | | | | | | |
| 61 | Darling Catchment Legacy of History - Macquarie | NSW | Jan 2000 | | 0 | 0 | 0 | 0.1 | | 0.3 | 0.4 | 0.1 | -0.036 | | | | | -0.036 |
| 62 | Darling Catchment Legacy of History - Macintyre | NSW | Jan 2000 | | 0 | 0 | 0 | 0.0 | | 0.0 | 0.0 | 0 | 0.000 | | | | | 0.000 |
| 63 | Darling Catchment Legacy of History - Gil Gil Cl | NSW | Jan 2000 | | 0 | 0 | 0 | 0.0 | | 0.0 | 0.0 | 0.0 | -0.001 | | | | | -0.001 |
| 64 | Darling Catchment Legacy of History - Gwydi | NSW | Jan 2000 | | 0 | 0 | 0 | 0.0 | | 0.0 | 0.0 | 0.0 | -0.002 | | | | | -0.002 |
| 65 | Darling Catchment Legacy of History - Namo | NSW | Jan 2000 | | 0 | 0 | 0 | 0.2 | | 0.4 | 0.5 | 0.2 | -0.052 | | | | | -0.052 |
| 66 | Darling Catchment Legacy of History - Castlereagh | NSW | Jan 2000 | | 0 | 0 | 0 | 0.0 | | 0.0 | 0.1 | 0.0 | -0.007 | | | | | -0.007 |
| 67 | Darling Catchment Legacy of History - Bogar | NSW | Jan 2000 | | 0 | 0 | 0 | 0.1 | | 0.2 | 0.3 | 0.1 | -0.026 | | | | | -0.026 |
| 68 | Lachlan Legacy of History | NSW | Jan 2000 | | 0 | 0 | 0 | 0.0 | | 0.0 | 0.0 | 0 | 0.000 | | | | | 0.000 |
| 69 | Murrumbidgee Catchment Legacy of History | NSW | Jan 2000 | | 0 | 0 | 0 | 0.1 | | 0.2 | 0.2 | 0.1 | -0.019 | | | | | -0.019 |
| 70 | NSW Mallee - dryland | NSW | Jan 2000 | | 0 | 0 | 0 | 0.3 | | 1.3 | 3.6 | 0.3 | -0.080 | | | | | -0.080 |
| 71 | NSW Mallee - Pre 88 Irrigation | NSW | Jan 2000 | | 0 | 0 | 0 | 0.4 | | 1.2 | 2.3 | 0.4 | -0.107 | | | | | -0.107 |
| | **Victoria** | | | | | | | | | | | | | | | | | |
| 72 | Campaspe Catchment Legacy of History | Vic | Jan 2000 | | 0 | 0 | 0 | 0.1 | | 0.2 | 0.3 | 0.1 | | -0.027 | | | | -0.027 |
| 73 | Goulburn Catchment Legacy of History | Vic | Jan 2000 | | 1 | -5 | 0 | 0.5 | | 1.1 | 1.6 | 0.6 | | -0.122 | | | | -0.122 |
| 74 | Loddon Catchment Legacy of History | Vic | Jan 2000 | | 1 | -1 | 0 | 1.0 | | 1.5 | 2.3 | 1.0 | | -0.250 | | | | -0.250 |
| 75 | Kiewa Catchment Legacy of History | Vic | Jan 2000 | | 1 | 0 | 0 | 0.1 | | 0.0 | 0.0 | 0.1 | | -0.036 | | | | -0.036 |
| 76 | Ovens Catchment Legacy of History | Vic | Jan 2000 | | 0 | 0 | 0 | 0.0 | | 0.6 | 1.3 | 0 | | -0.009 | | | | -0.009 |
| 77 | Victorian Mallee - dryland | Vic | Jan 2000 | | 1 | 0 | 0 | 0.6 | | 2.2 | 5.9 | 0.7 | | -0.159 | | | | -0.159 |
| 78 | Victorian Mallee - Pre 88 Irrigation | Vic | Jan 2000 | | 3 | 0 | 0 | 1.4 | | 4.7 | 8.3 | 1.5 | | -0.368 | | | | -0.368 |
| | **South Australia** | | | | | | | | | | | | | | | | | |
| 79 | SA Mallee Legacy of History - Dryland | SA | Jan 2000 | | 8 | 0 | 0 | 4.1 | | 14.5 | 32.8 | 4.7 | | | -0.490 | | | -0.490 |
| 80 | SA Mallee Legacy of History - Irrigation | SA | Jan 2000 | | 88 | 0 | 0 | 46.6 | | 86.9 | 113.3 | 48.9 | | | -6.455 | | | -6.455 |
| 81 | SA Improved Irrigation Efficiency and Scheme Rehabilitation Reg I | SA | Jan 2000 | | -94 | 0 | 0 | -49.6 | | -93.8 | -115.4 | -52.1 | | | 6.562 | | | 6.562 |
| | **Queensland** | | | | | | | | | | | | | | | | | |
| 82 | Queensland Legacy of History | Qld | Jan 2000 | TBA | | | | | | | | | | | | | | |
| 83 | Queensland Irrigation Development pre 1 Jan 200( | Qld | Jan 2000 | TBA | | | | | | | | | | | | | | |
| | **Balance - Register B** | | | **0.000** | **10** | **-6** | **0.0** | **6.0** | **0.0** | **21.5** | **57.9** | **6.8** | **0.809** | **-0.062** | **2.252** | **0.000** | **0.000** | **2.999** |
| | **Balance - Registers A & B** | | | | **-328** | **110** | **-190.8** | **-190.6** | **0.0** | **-142.6** | **42.8** | **-232.4** | **7.772** | **5.946** | **6.822** | **0.000** | **0.000** | **26.737** |
| | **Modelled Current Status** | | | | **729** | **5,030** | **471** | **472** | | **535** | **710** | **481** | | | | | | | |

**Registers Explanatory Notes**

TBD - To be determined

^Salinity Effect - Increase or decrease in average salinity at Morgan in EC

#Salinity Credits - Unit of account of Salinity and Drainage Strategy = Reduction in Salinity Costs ($m/year March 2005 values)

* These entries are comprised of multiple MODFLOW model outputs accredited at various times. As such they are not reviewed and updated in their entirety in one year but the component models are updated in line with their 5 year review dates. The review year reflects the latest model review. Some of the totals are affected by rounding

** Assessments based on preliminary reports. Further work is required on how these assessments are presented in the register. Salinity impacts not included in the totals.

& Based on 1734 GL representing the LTDLE volume of all HEW entitlements

# Appendix C: Baseline conditions

The BSM2030 baseline conditions are the agreed suite of conditions in place within the catchments and rivers of the basin on 1 January 2000. They include land use (level of development); water use (level of diversions); land and water management policies and practices (including the Murray–Darling Basin cap agreements); river operating regimes; SIS; run-off generation; salt mobilisation processes; and groundwater status and condition.

The baseline conditions have been set for all end-of-valley target sites as shown in Table 12.

Table 12: Basin Salinity Management Strategy end-of-valley baseline conditions

| Valley | Salinity (EC) mean (50%ile) | Salinity (EC) peak (80%ile) | Salt load (t/y) mean | Valley reporting site | Aust. Water Resources Council site number |
|---|---|---|---|---|---|
| **All partner governments** | | | | | |
| **Murray–Darling Basin** | 570 | 920 (95%ile) | 1,600,000 | Murray R at Morgan (Salinity) | 426554 |
| | | | | Murray R at Lock 1 (Flow) | 426902 |
| **South Australia** | | | | | |
| **SA Border** | 380 | 470 | 1,300,000 | Flow to SA | 426200 |
| **Lock 6 to Berri** | 450 | 600 | 1,500,000 | Murray R at Lock 4 (Flow) | 426514 |
| **Below Morgan** | 600 | 820 | 1,600,000 | Murray R at Murray Bridge | 426522 |
| **New South Wales** | | | | | |
| **Murrumbidgee** | 150 | 230 | 160,000 | Murrumbidgee R d/s Balranald Weir | 410130 |
| **Lachlan** | 430 | 660 | 250,000 | Lachlan R at Forbes (Cottons Weir) | 412004 |
| **Bogan** | 440 | 490 | 27,000 | Bogan R at Gongolgon | 421023 |
| **Macquarie** | 480 | 610 | 23,000 | Macquarie R at Carinda (Bells Bridge) | 421012 |
| **Castlereagh** | 350 | 390 | 9,000 | Castlereagh R at Gungalman Bridge | 420020 |
| **Namoi** | 440 | 650 | 110,000 | Namoi R at Goangra | 419026 |

| Valley | Salinity (EC) mean (50%ile) | Salinity (EC) peak (80%ile) | Salt load (t/y) mean | Valley reporting site | Aust. Water Resources Council site number |
|---|---|---|---|---|---|
| **Gwydir** | 400 | 540 | 7,000 | Mehi R at Bronte | 418058 |
| **NSW Border Rivers** | 250 | 330 | 50,000 | Barwon R at Mungindi | 416001 |
| **Barwon–Darling** | 330 | 440 | 440,000 | Darling R at Wilcannia Main Channel | 425008 |
| **NSW Upper Murray** | 54 | 59 | 150,000 | Murray R at Heywoods | 409016 |
| **NSW Riverine Plains** | 310 | 390 | 1,100,000 | Murray R at Red Cliffs | 414204 |
| **NSW Mallee Zone** | 380 | 470 | 1,300,000 | Flow to SA | 426200 |
| **Victoria** | | | | | |
| **Wimmera** | 1,380 | 1,720 | 31,000 | Wimmera R at Horsham Weir | 415200 |
| **Avoca** | 2,060 | 5,290 | 37,000 | Avoca R at Quambatook | 408203 |
| **Loddon** | 750 | 1,090 | 88,000 | Loddon R at Laanecoorie | 407203 |
| **Campaspe** | 530 | 670 | 54,000 | Campaspe R at Campaspe Weir | 406218 |
| **Goulburn** | 100 | 150 | 166,000 | Goulburn R at Goulburn Weir | 405259 |
| **Broken** | 100 | 130 | 15,000 | Broken Ck at Casey's Weir | 404217 |
| **Ovens** | 72 | 100 | 54,000 | Ovens R at Peechelba East | 403241 |
| **Kiewa** | 47 | 55 | 19,000 | Kiewa R at Bandiana | 402205 |
| **Vic. Upper Murray** | 54 | 59 | 150,000 | Murray R at Heywoods | 409016 |
| **Vic. Riverine Plains** | 270 | 380 | 630,000 | Murray R at Swan Hill | 409204 |
| **Vic. Mallee Zone** | 380 | 470 | 1,300,000 | Flow to SA | 426200 |
| **Queensland** | | | | | |

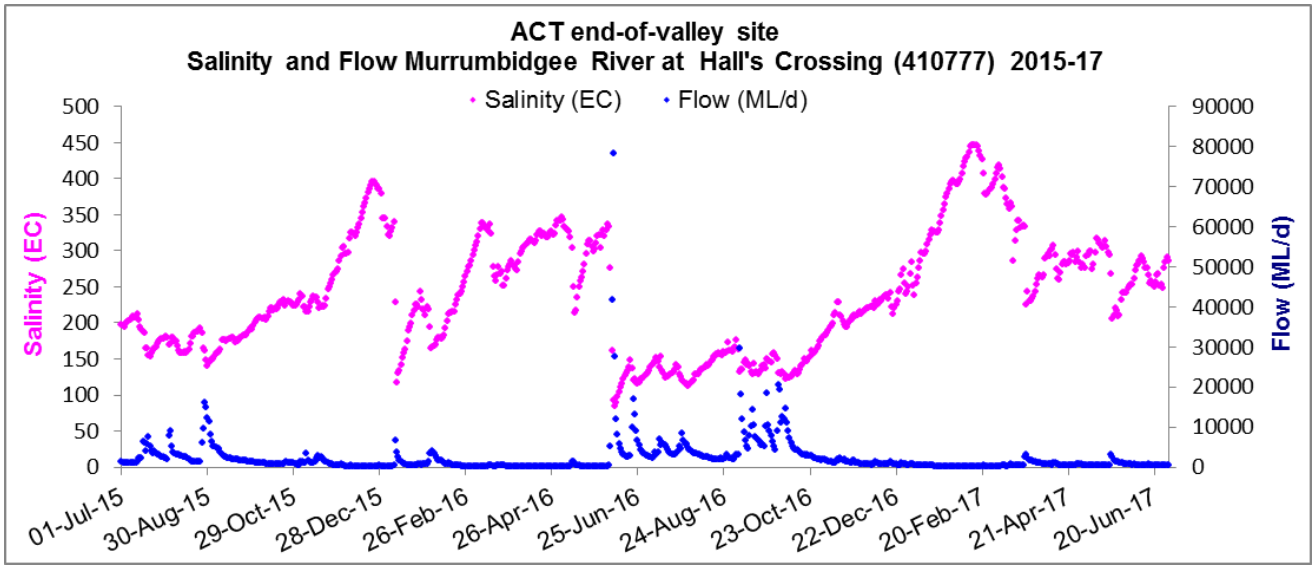
| Valley | Salinity (EC) mean (50%ile) | Salinity (EC) peak (80%ile) | Salt load (t/y) mean | Valley reporting site | Aust. Water Resources Council site number |
|---|---|---|---|---|---|
| **Queensland Border Rivers** | 250 | 330 | 50,000 | Barwon R at Mungindi | 416001a |
| **Moonie** | 140 | 150 | 8,700 | Moonie R at Fenton | 417204A |
| **Condamine–Balonne** | 170 | 210 | 4,200 | Ballandool R at Hebel—Bollon Rd | 422207A |
| | 170 | 210 | 5,000 | Bokhara R at Hebel | 422209A |
| | 150 | 280 | 6,500 | Braire Ck at Woolerbilla—Hebel Rd | 422211A |
| | 170 | 210 | 29,000 | Culgoa R at Brenda | 422015a |
| | 160 | 210 | 10,000 | Narran R at New Angledool | 422030a |
| **Paroo** | 90 | 100 | 24,000 | Paroo R at Caiwarro | 424201A |
| **Warrego** | 101 | 110 | 4,800 | Warrego R at Barringun No.2 | 423004a |
| | 100 | 130 | 5,500 | Cuttaburra Ck at Turra | 423005a |
| **Australian Capital Territory** | | | | | |
| **ACT** | 224 | 283 | 32,700 | Murrumbidgee R at Hall's Crossing | 410777 |

***a These sites are operated by New South Wales for Queensland***

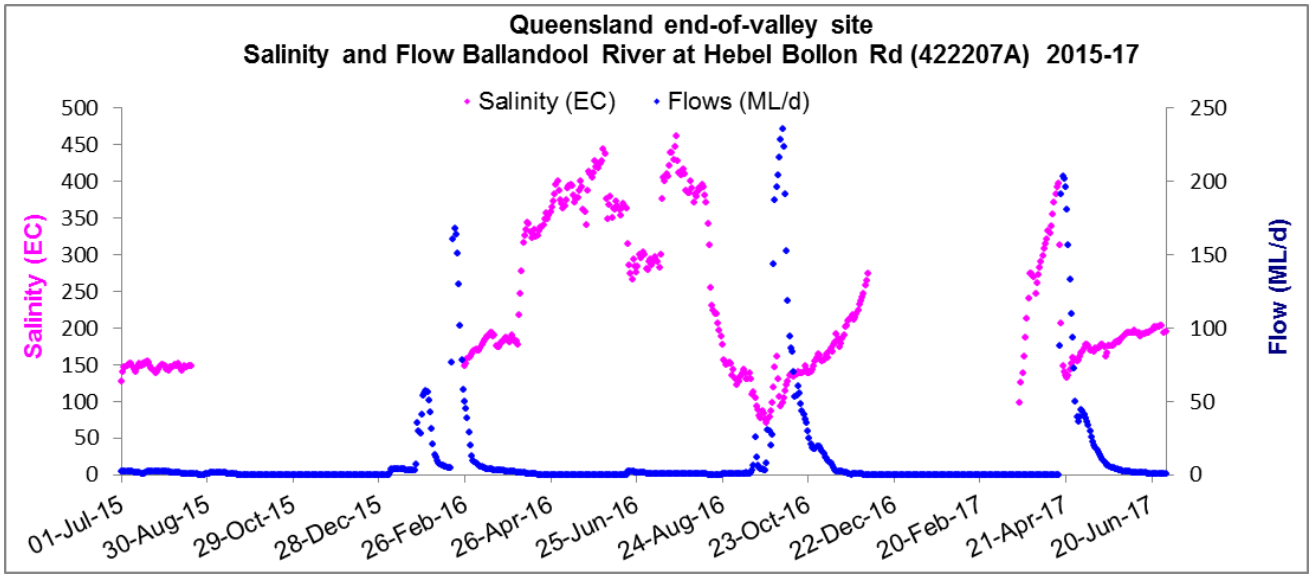
# Appendix D: Flow and salinity for end-of-valley target sites 2015–17

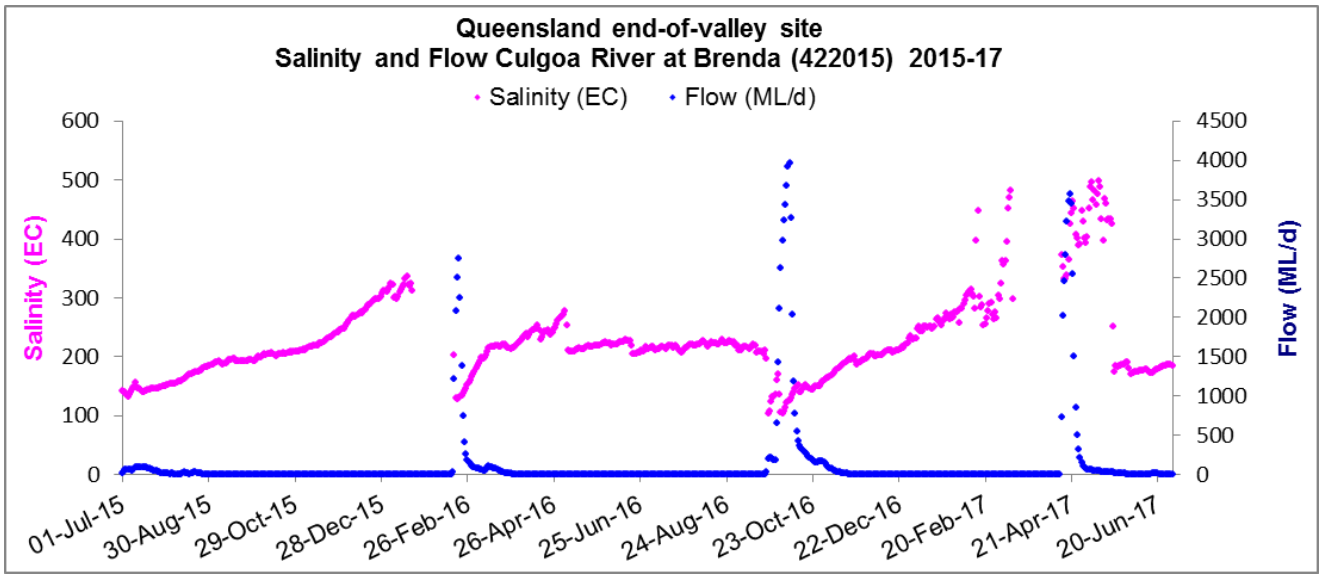
The graphs presented in the following pages are related to the end-of-valley target sites and illustrate flow and salinity for the 2015–17 reporting period.

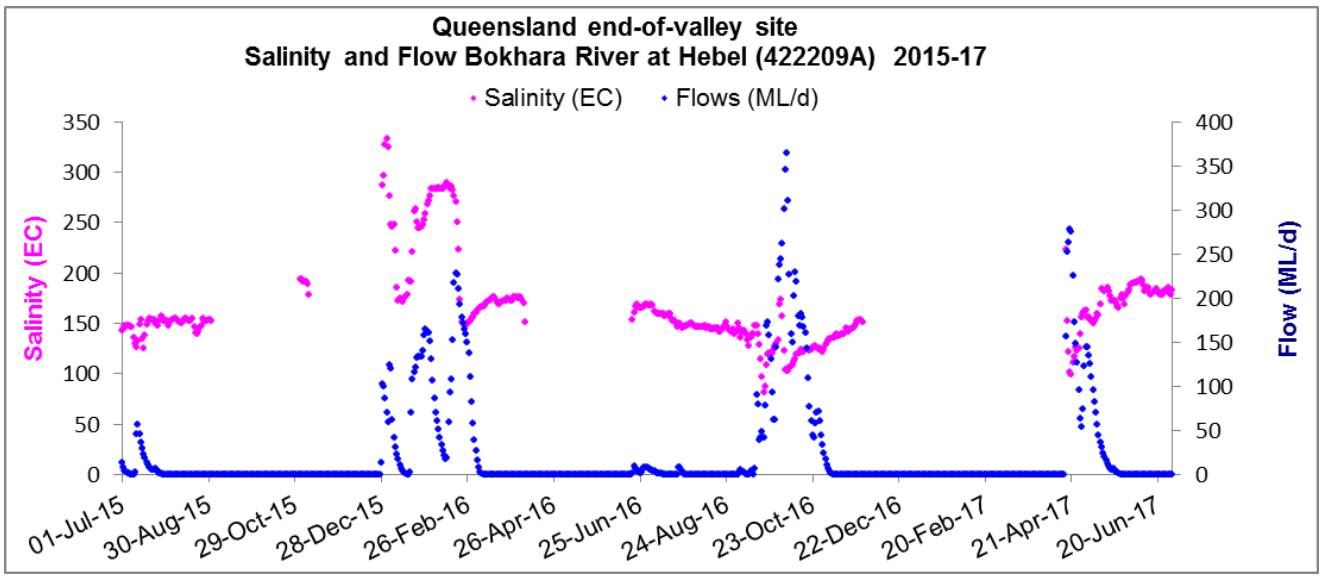
## Australian Capital Territory

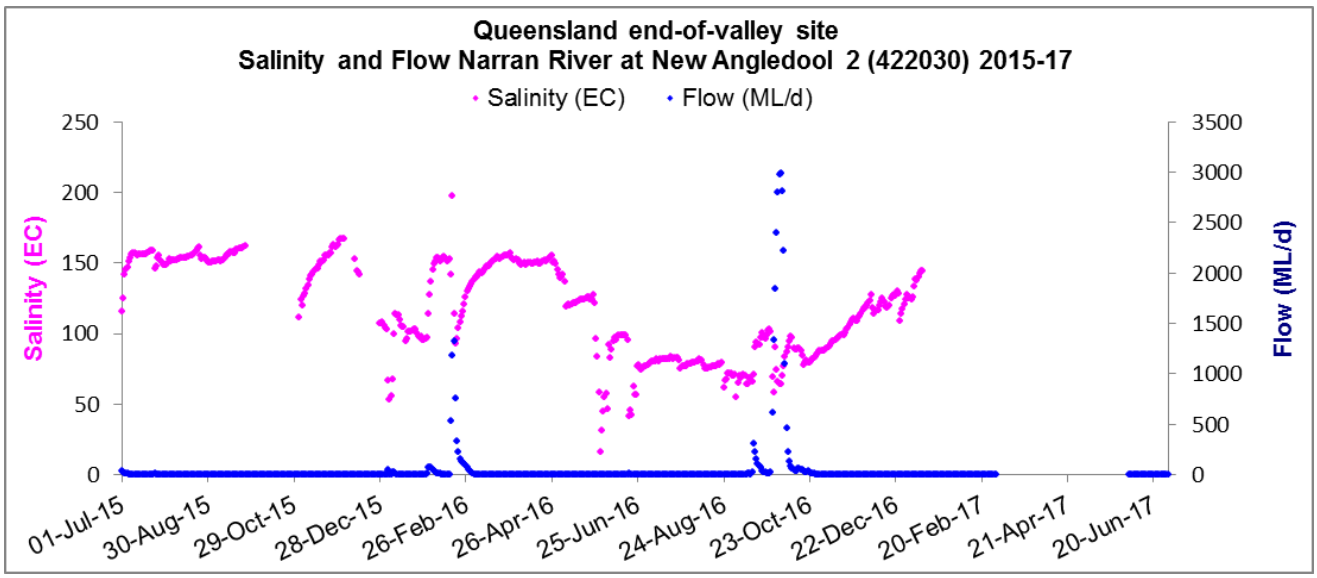


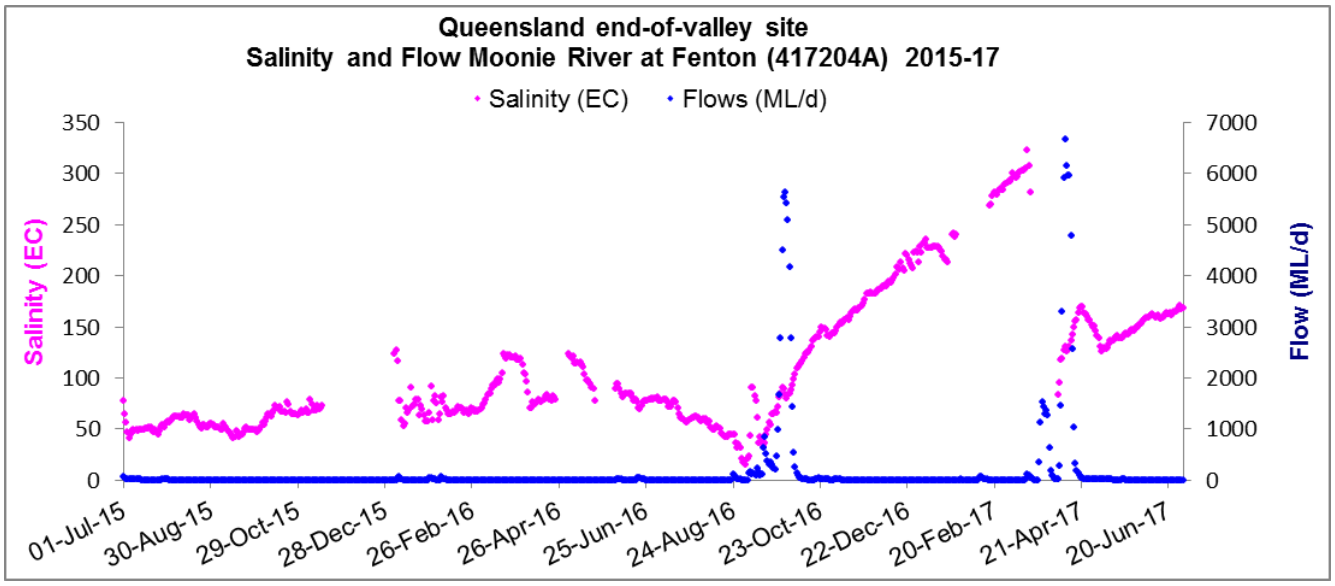

## Queensland

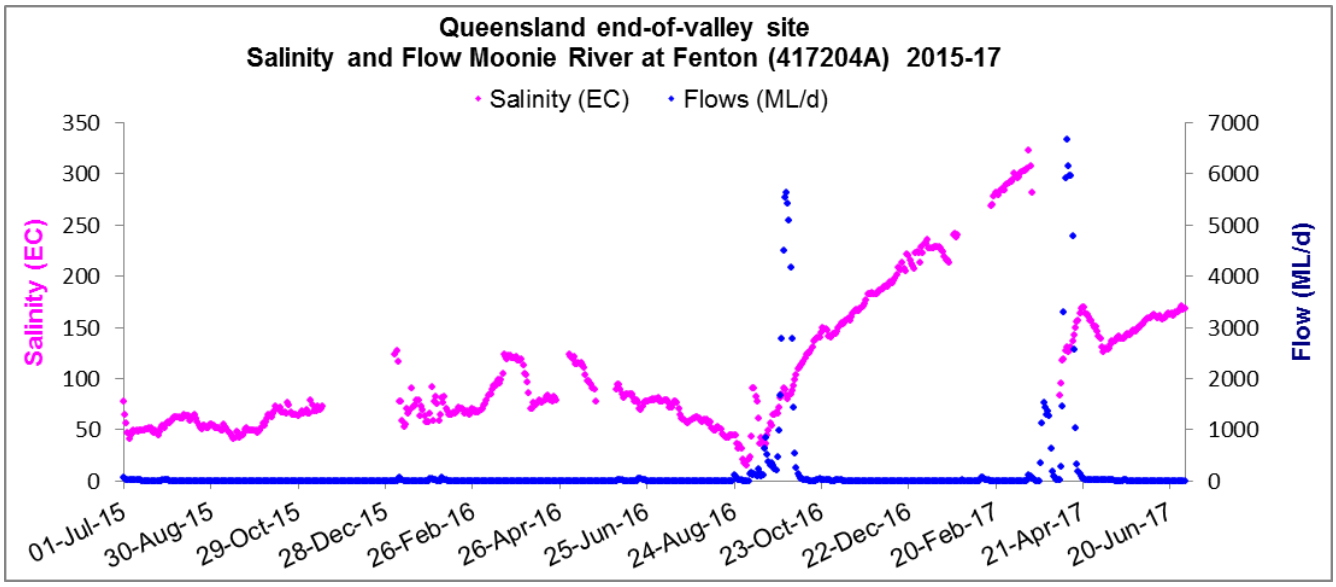


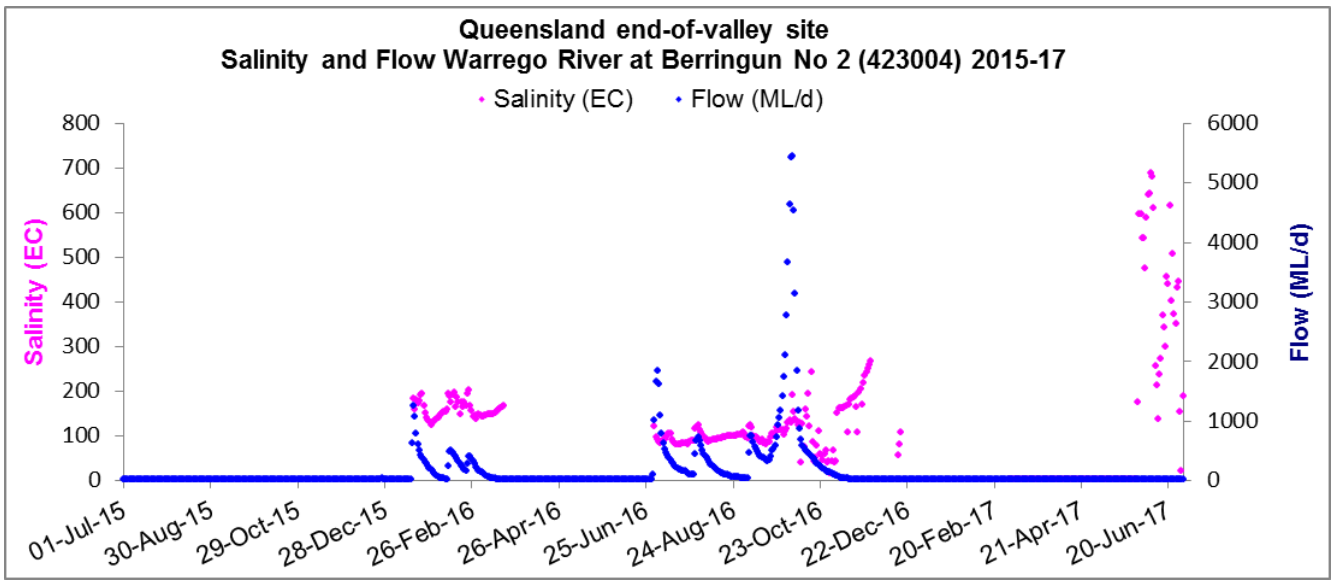

Queensland end-of-valley site
Salinity and Flow Culgoa River at Brenda (422015) 2015-17
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
600
500
400
300
200
100
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17

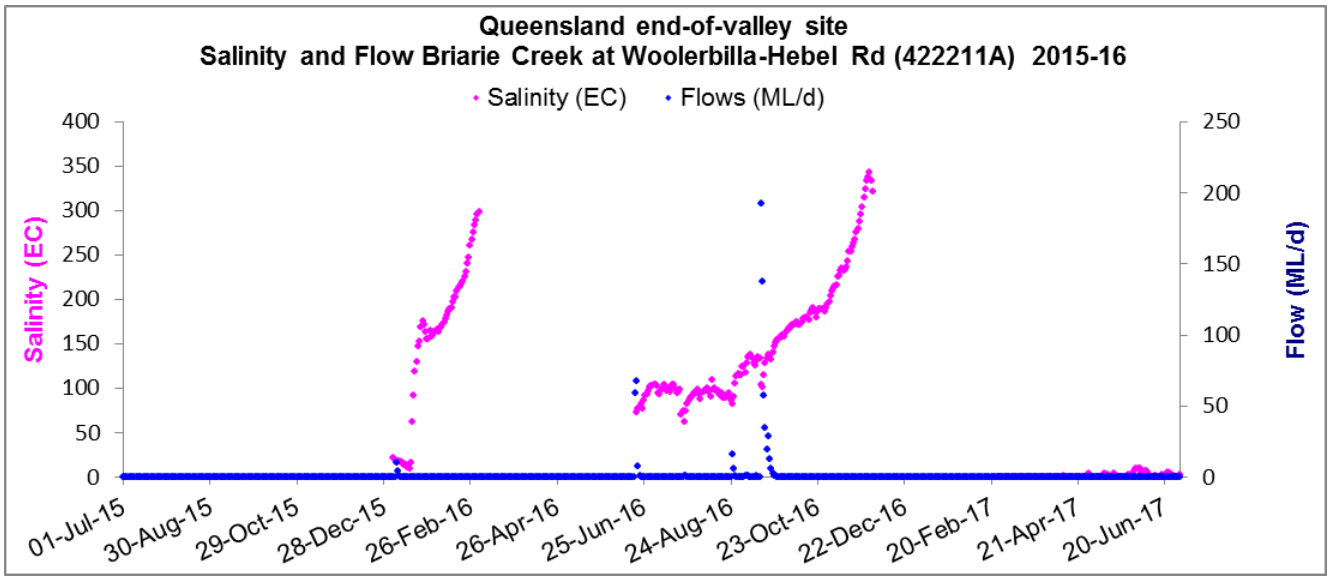

Queensland end-of-valley site
Salinity and Flow Bokhara River at Hebel (422209A) 2015-17
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
350
300
250
200
150
100
50
0
400
350
300
250
200
150
100
50
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17

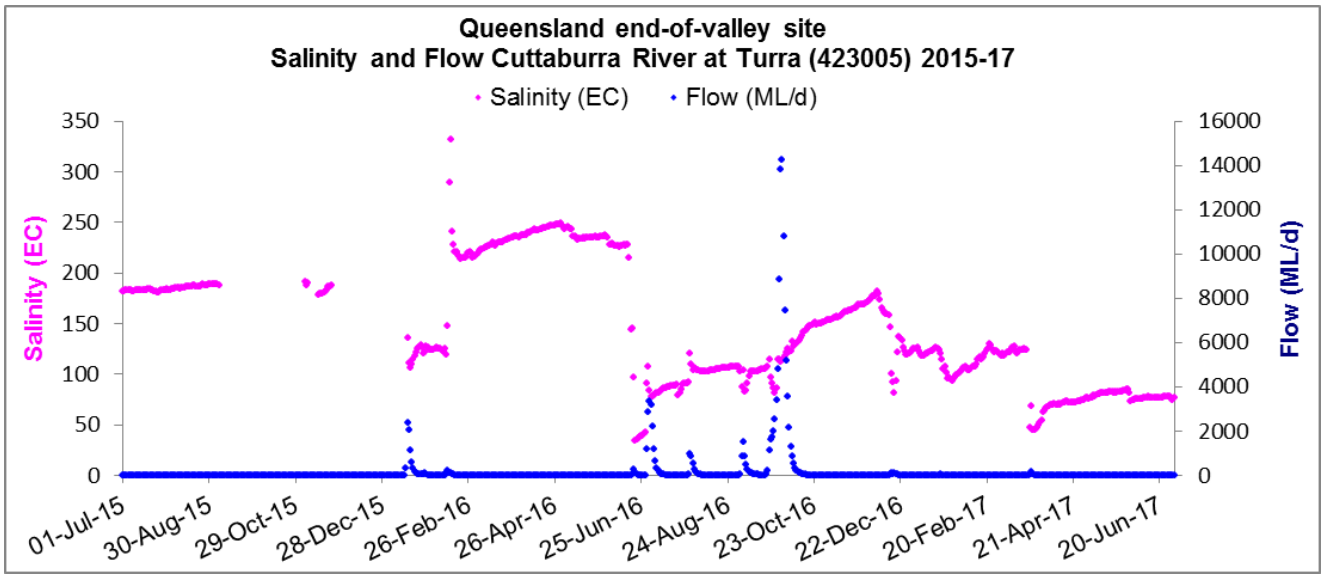

Queensland end-of-valley site
Salinity and Flow Narran River at New Angledool 2 (422030) 2015-17
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
250
200
150
100
50
0
3500
3000
2500
2000
1500
1000
500
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17

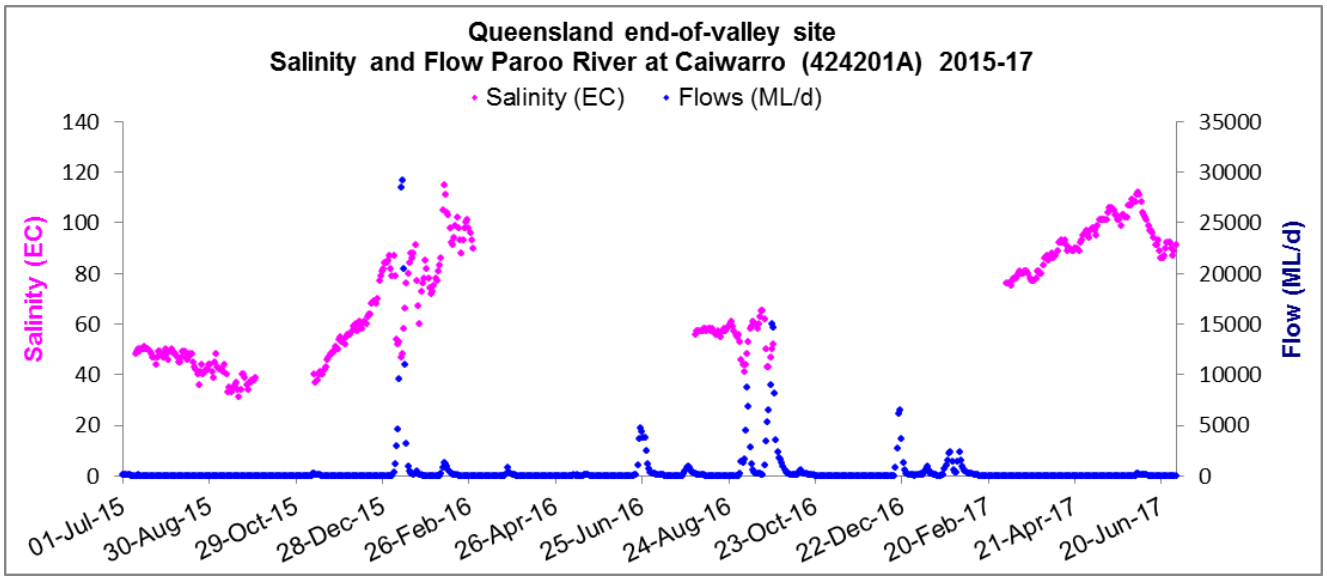

Queensland end-of-valley site
Salinity and Flow Moonie River at Fenton (417204A) 2015-17
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
350
300
250
200
150
100
50
0
7000
6000
5000
4000
3000
2000
1000
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17


Queensland end-of-valley site
Salinity and Flow Moonie River at Fenton (417204A) 2015-17
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
350
300
250
200
150
100
50
0
7000
6000
5000
4000
3000
2000
1000
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17

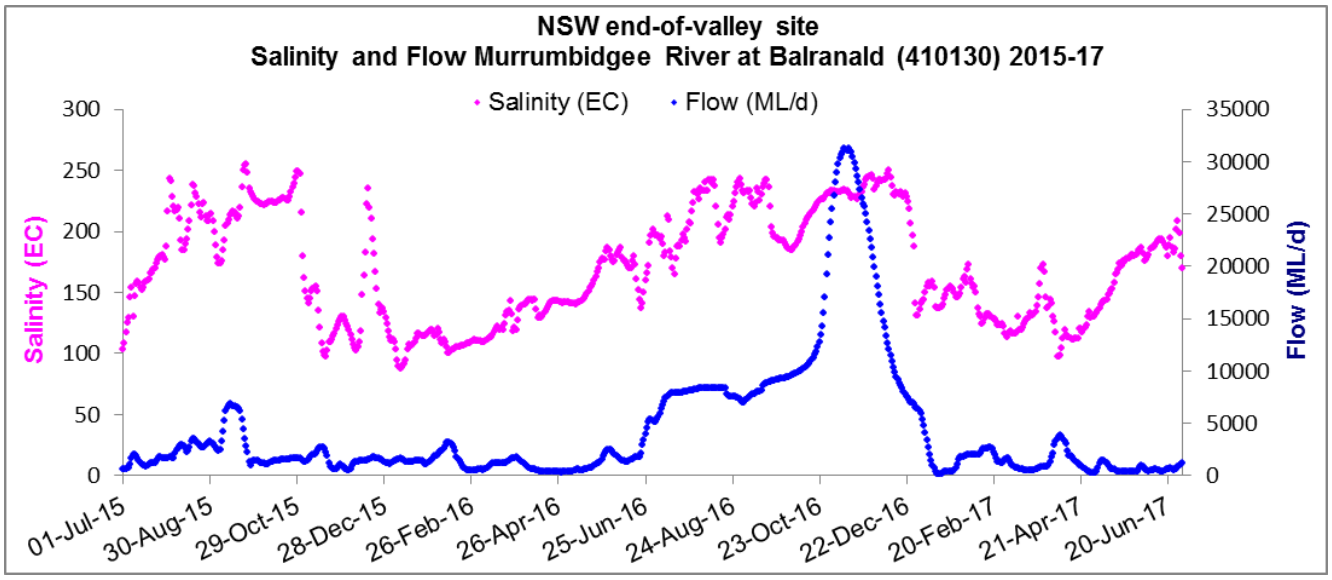

Queensland end-of-valley site
Salinity and Flow Warrego River at Berringun No 2 (423004) 2015-17
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
800
700
600
500
400
300
200
100
0
6000
5000
4000
3000
2000
1000
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17

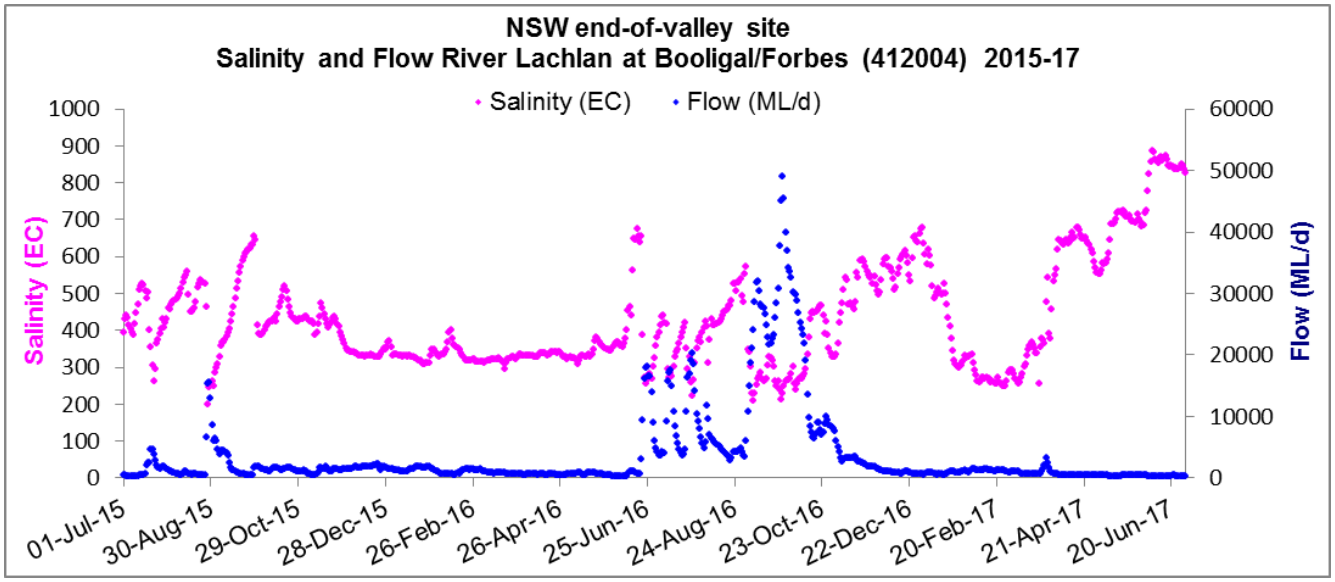

Queensland end-of-valley site
Salinity and Flow Briarie Creek at Woolerbilla-Hebel Rd (422211A) 2015-16
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
400
350
300
250
200
150
100
50
0
250
200
150
100
50
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17

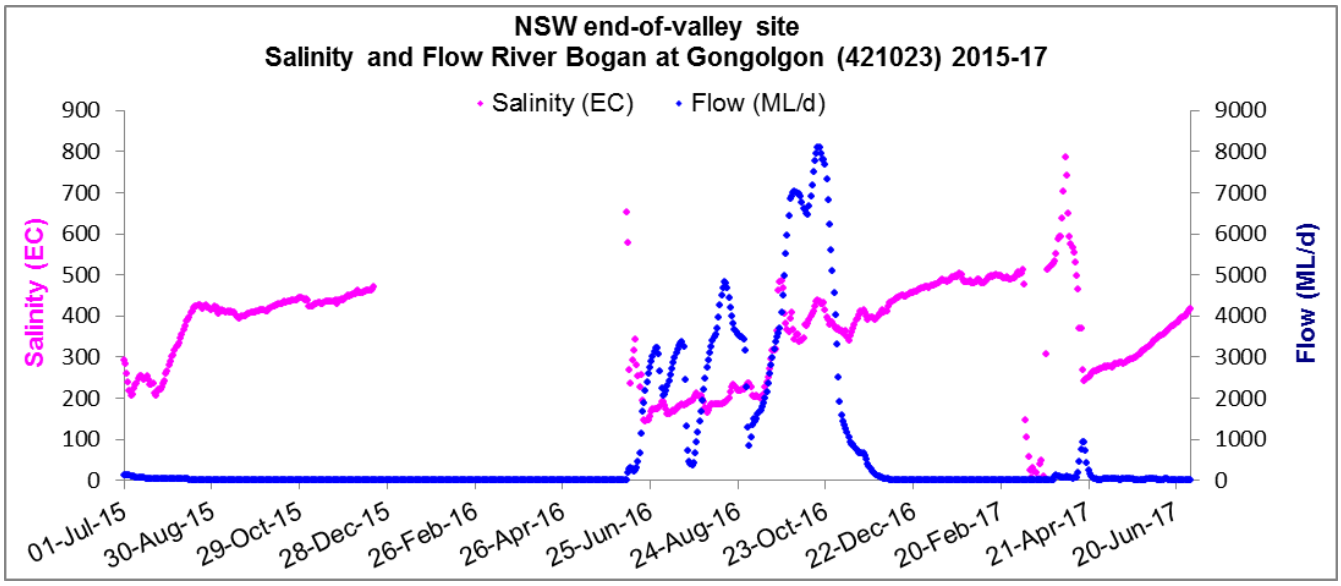

Queensland end-of-valley site
Salinity and Flow Cuttaburra River at Turra (423005) 2015-17
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
350
300
250
200
150
100
50
0
16000
14000
12000
10000
8000
6000
4000
2000
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17

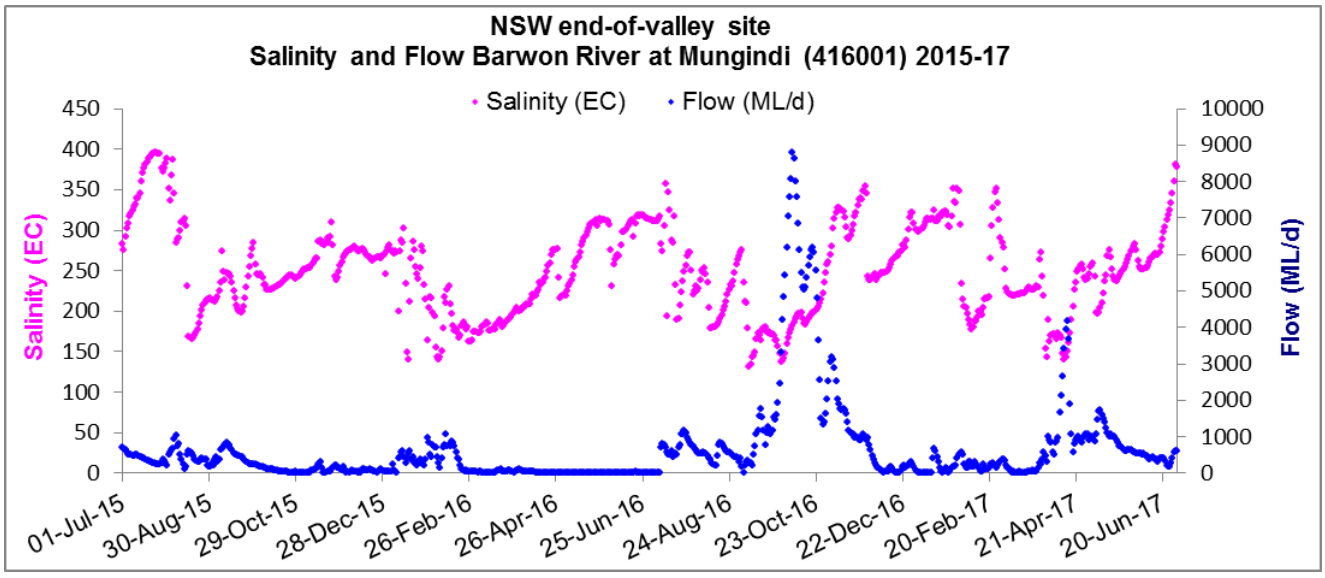

Queensland end-of-valley site
Salinity and Flow Paroo River at Caiwarro (424201A) 2015-17
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
140
120
100
80
60
40
20
0
35000
30000
25000
20000
15000
10000
5000
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17

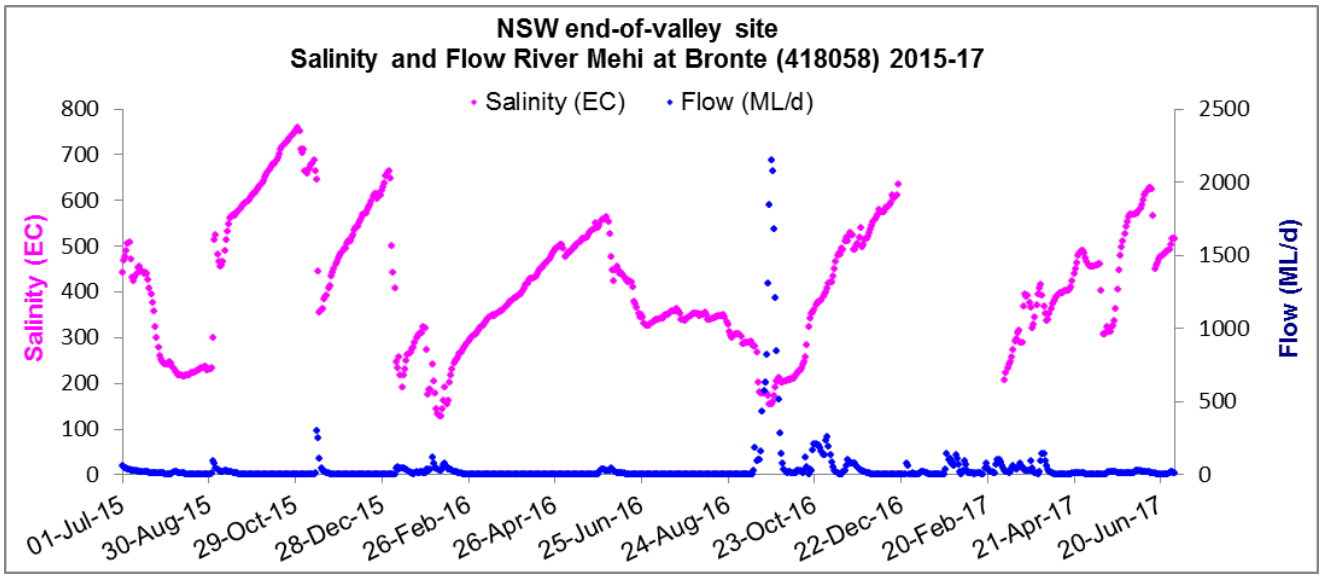
# New South Wales

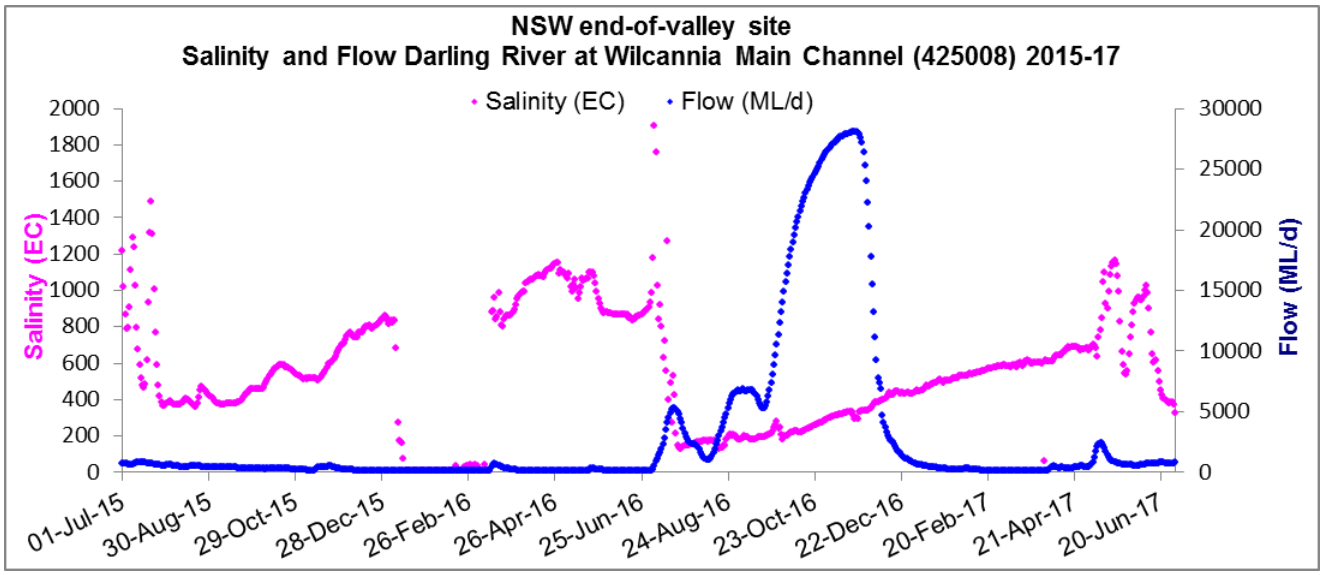


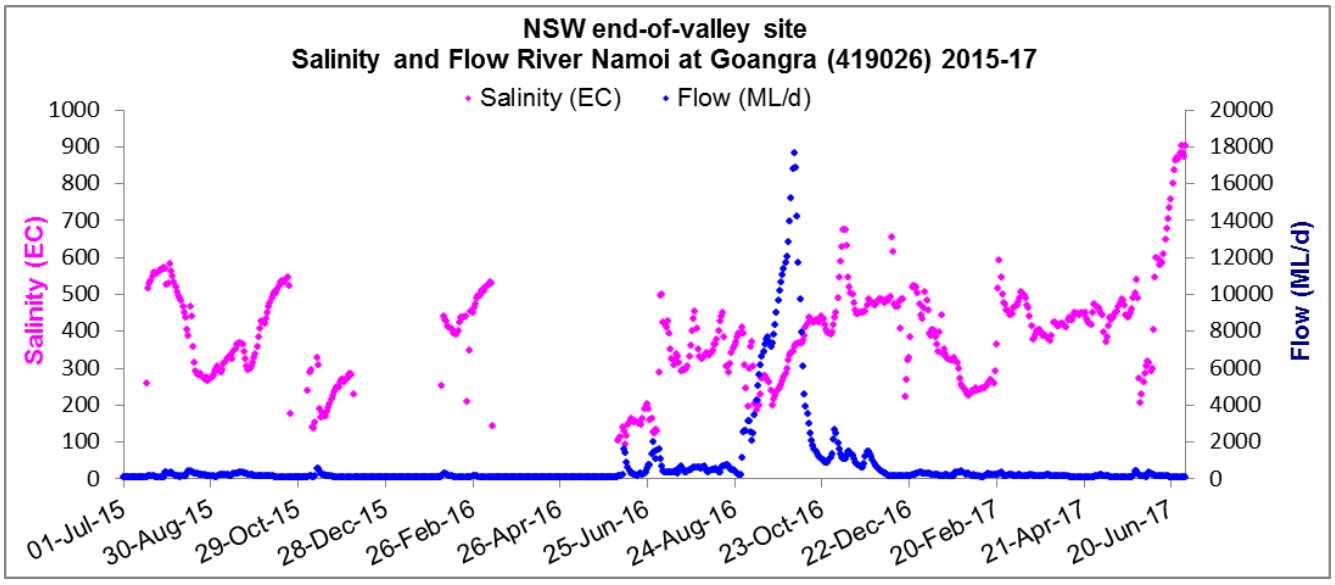




NSW end-of-valley site
Salinity and Flow River Bogan at Gongolgon (421023) 2015-17
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
0
100
200
300
400
500
600
700
800
900
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17


NSW end-of-valley site
Salinity and Flow Barwon River at Mungindi (416001) 2015-17
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
0
50
100
150
200
250
300
350
400
450
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17


NSW end-of-valley site
Salinity and Flow River Mehi at Bronte (418058) 2015-17
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
0
100
200
300
400
500
600
700
800
0
500
1000
1500
2000
2500
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17


NSW end-of-valley site
Salinity and Flow Darling River at Wilcannia Main Channel (425008) 2015-17
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
30000
25000
20000
15000
10000
5000
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17


NSW end-of-valley site
Salinity and Flow River Namoi at Goangra (419026) 2015-17
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
1000
900
800
700
600
500
400
300
200
100
0
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
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25-Jun-16
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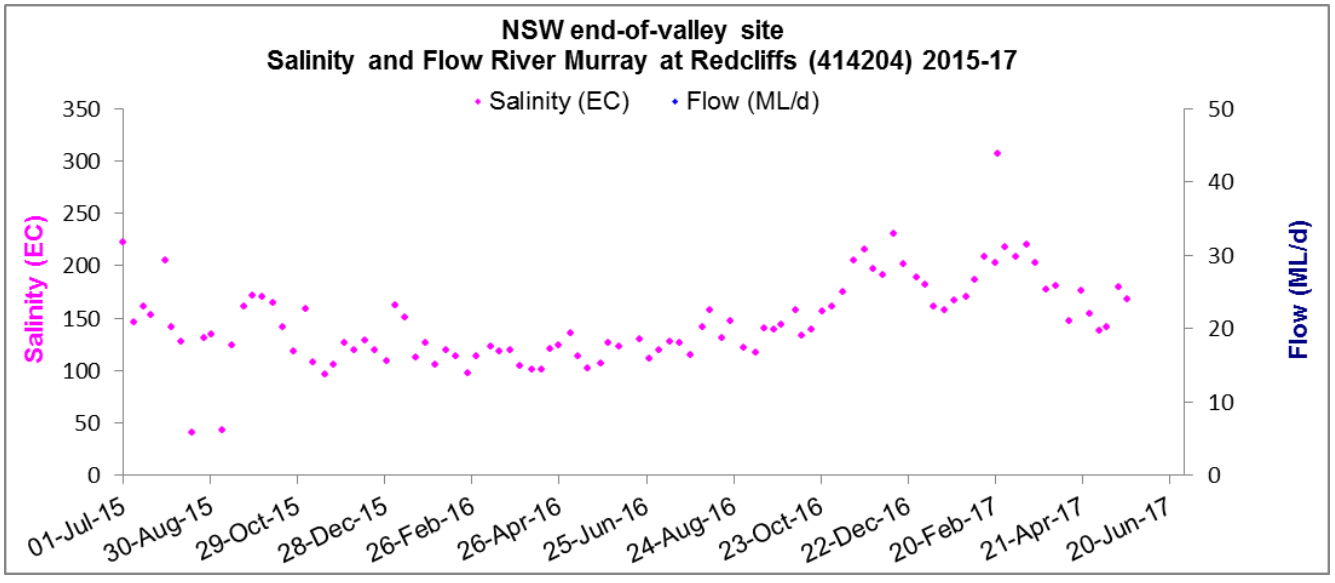
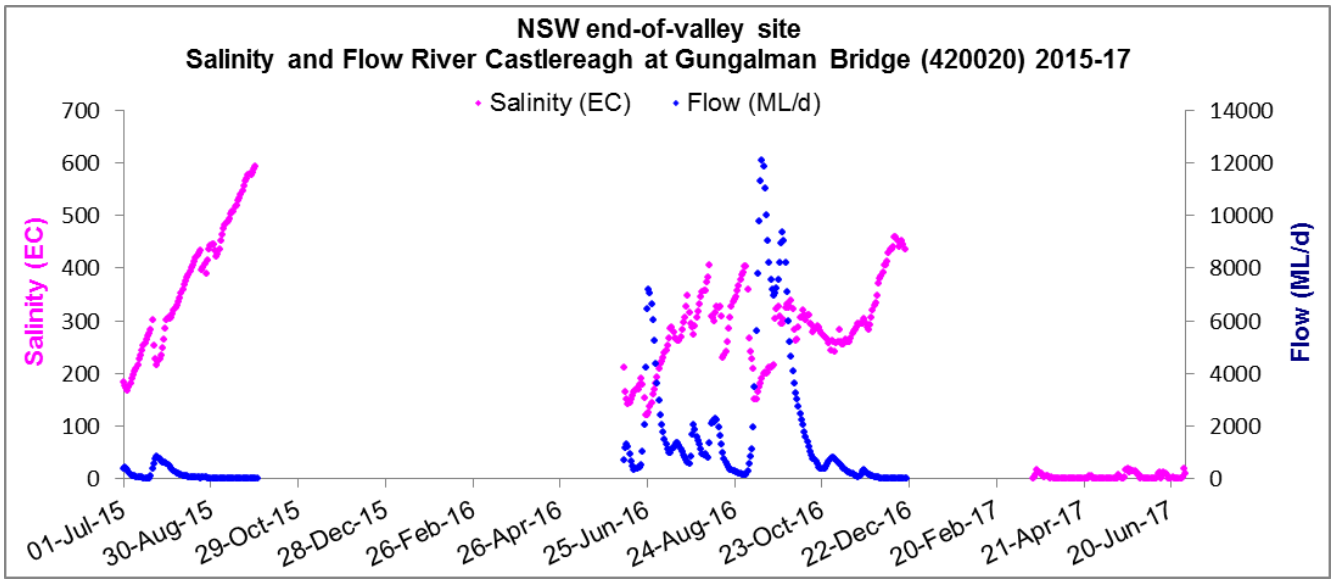
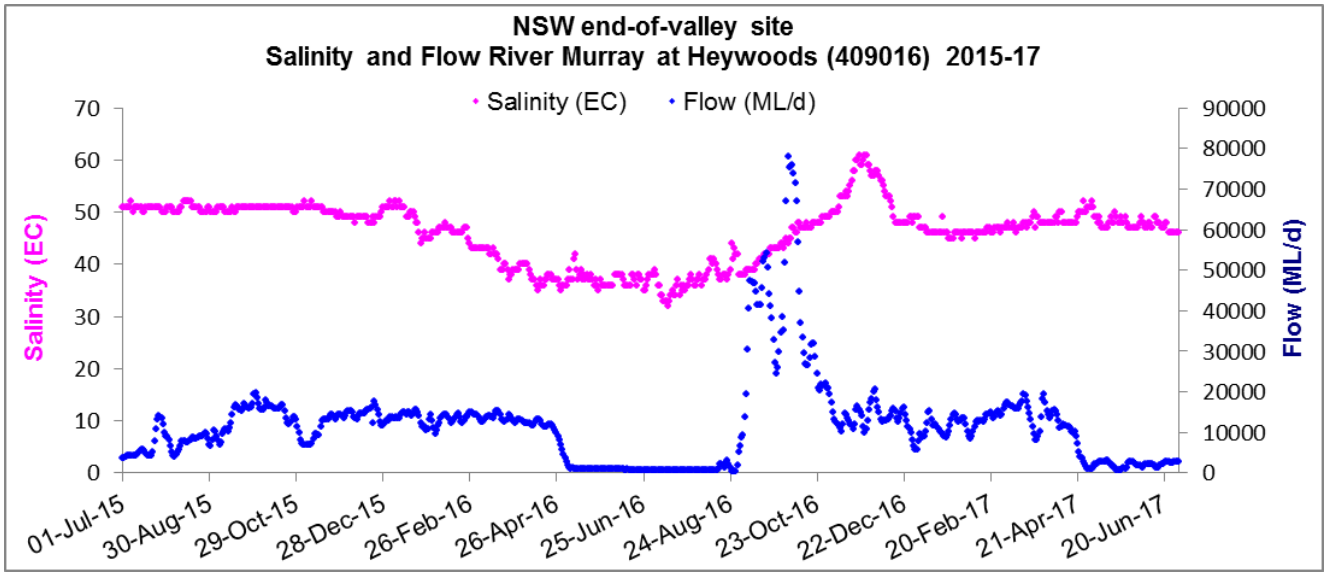
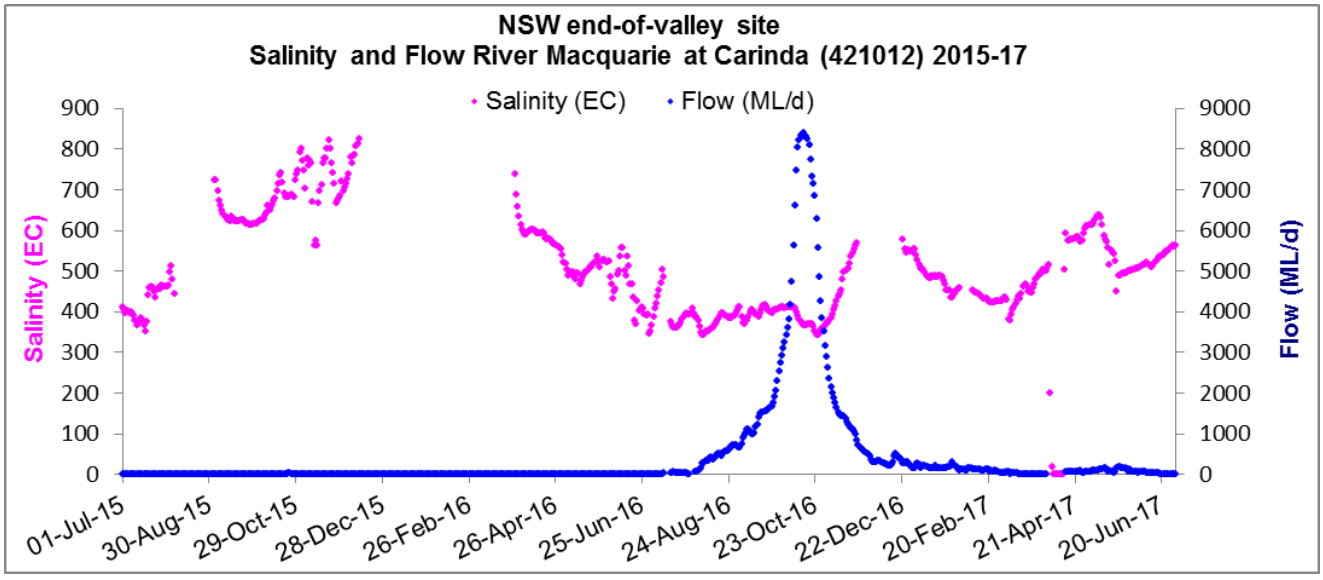
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17

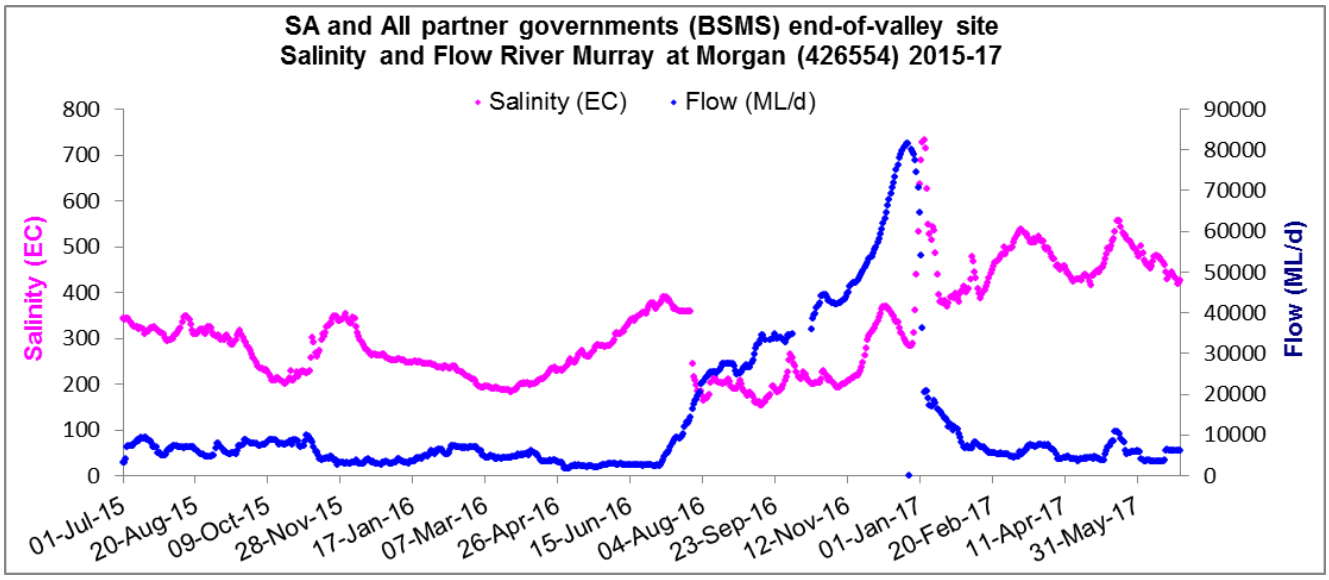

NSW end-of-valley site
Salinity and Flow River Murray at Redcliffs (414204) 2015-17
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
350
300
250
200
150
100
50
0
50
40
30
20
10
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17

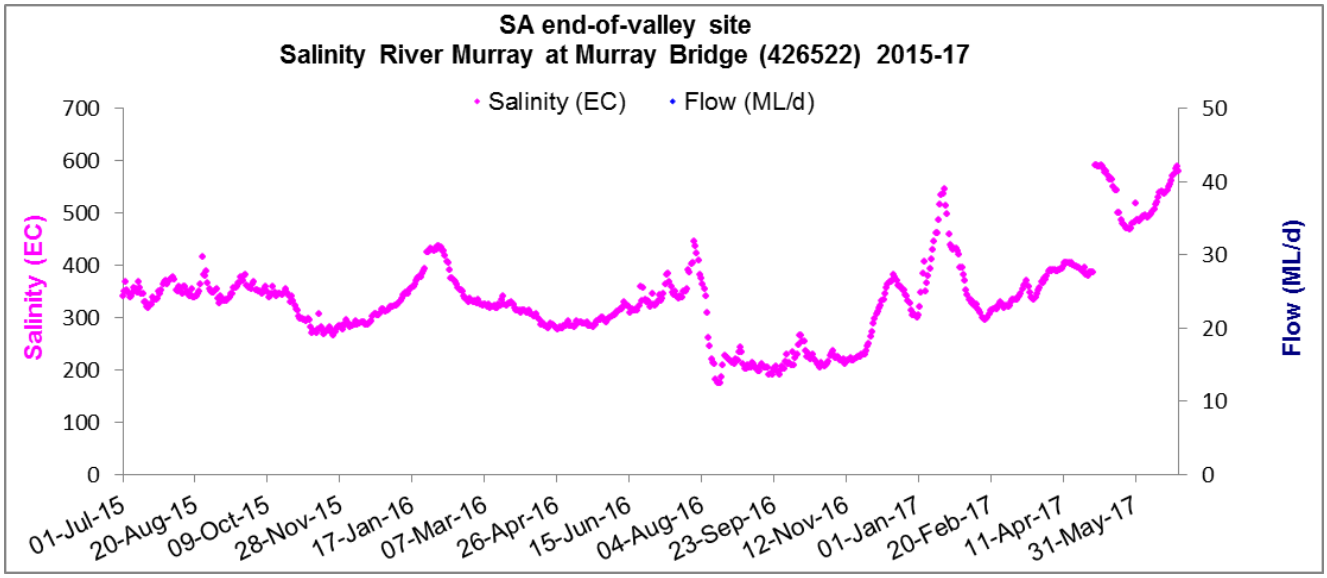

NSW end-of-valley site
Salinity and Flow River Castlereagh at Gungalman Bridge (420020) 2015-17
Salinity (EC)
Flow (ML/d)
700
600
500
400
300
200
100
0
14000
12000
10000
8000
6000
4000
2000
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17

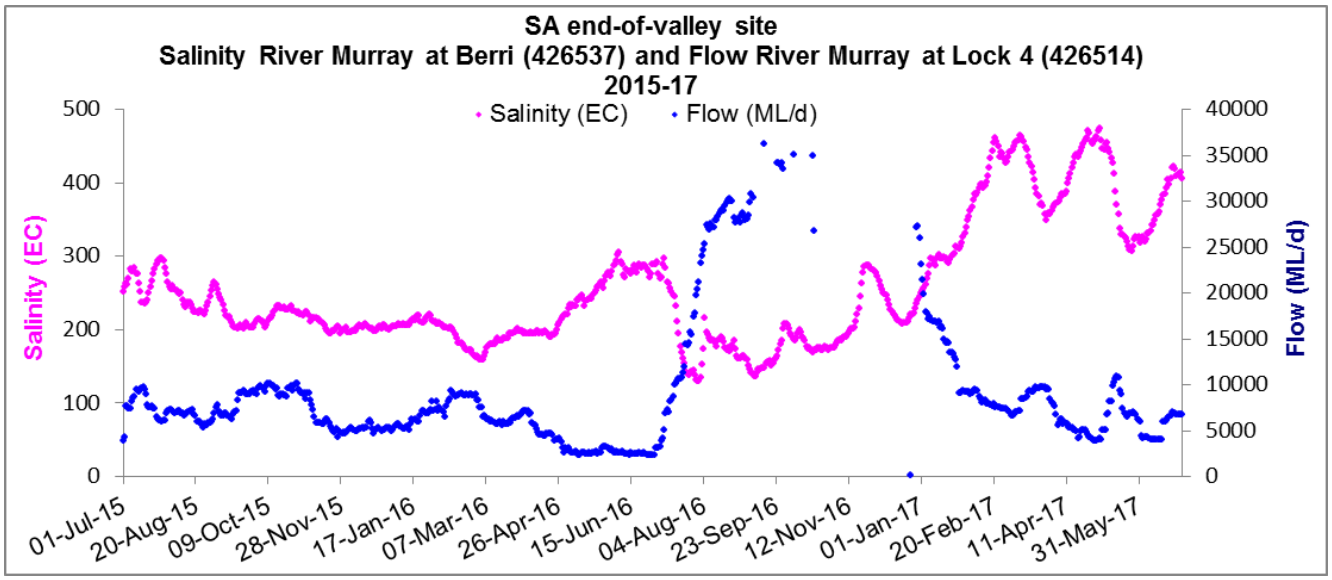

NSW end-of-valley site
Salinity and Flow River Murray at Heywoods (409016) 2015-17
Salinity (EC)
Flow (ML/d)
70
60
50
40
30
20
10
0
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17

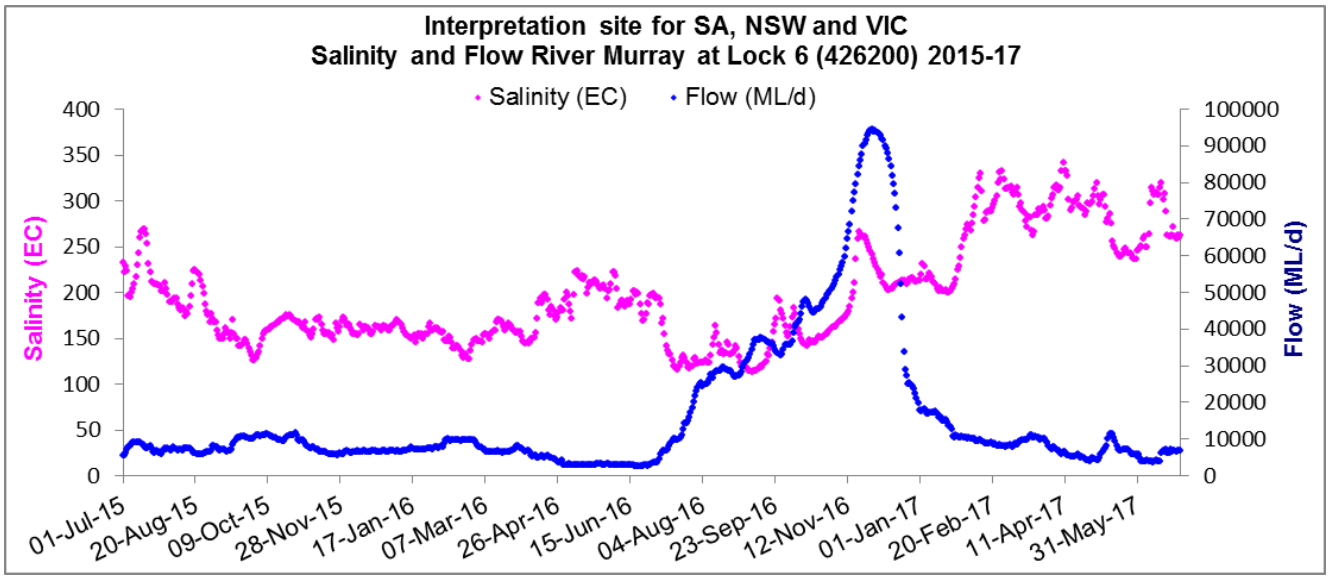

NSW end-of-valley site
Salinity and Flow River Macquarie at Carinda (421012) 2015-17
Salinity (EC)
Flow (ML/d)
900
800
700
600
500
400
300
200
100
0
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17

# South Australia

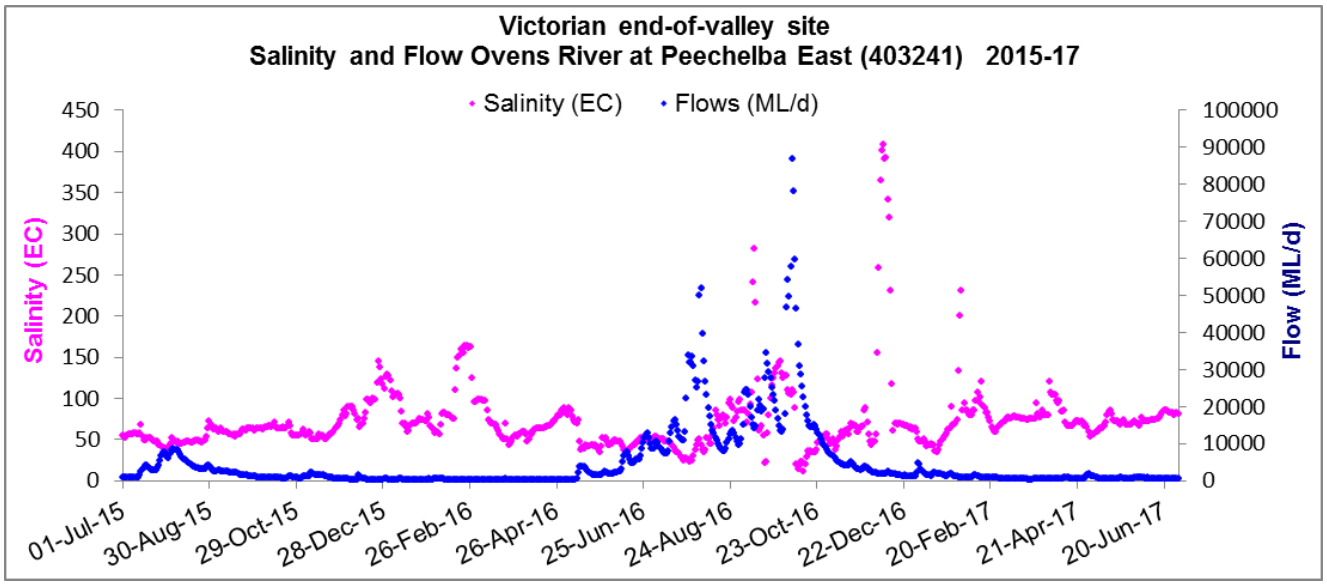


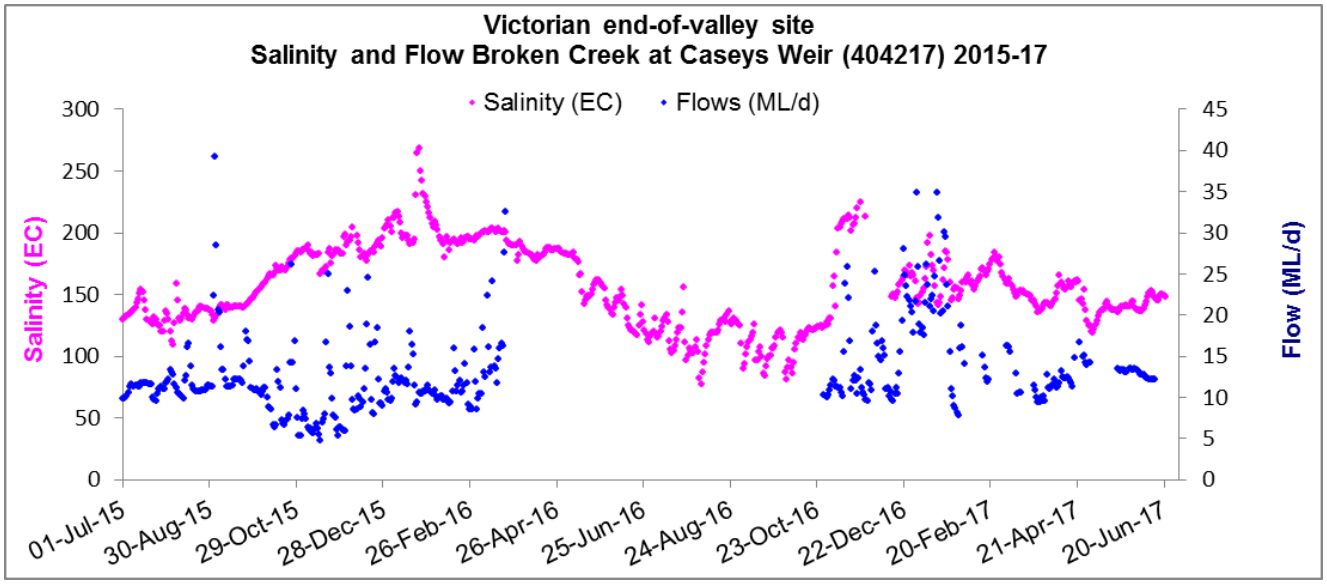



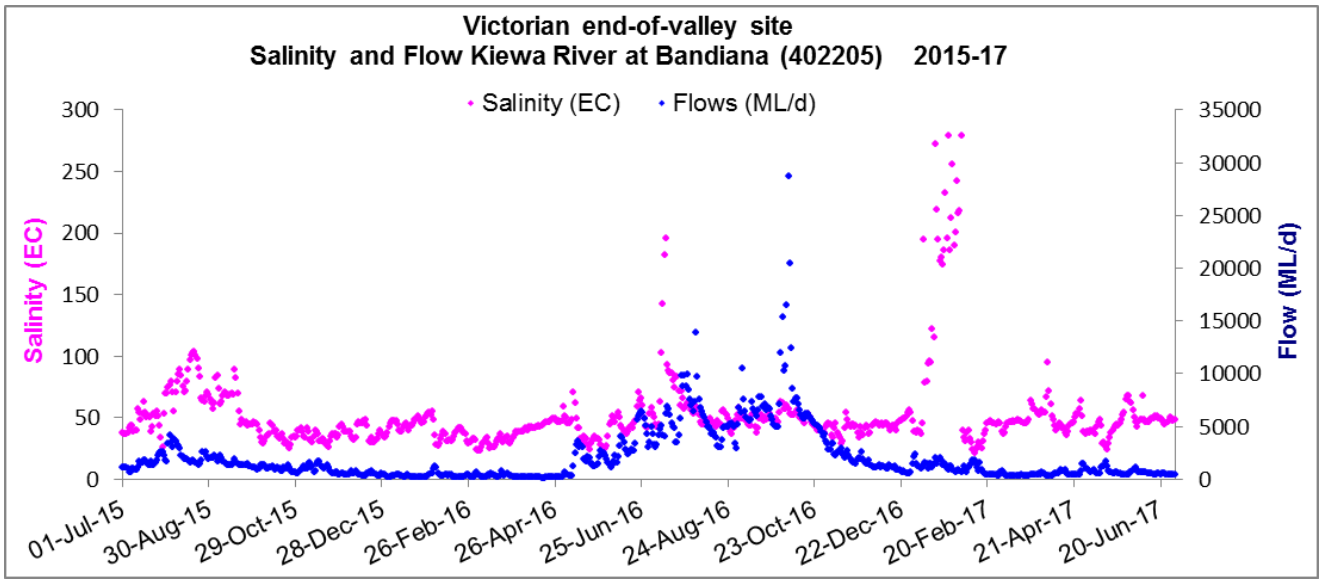

SA end-of-valley site
Salinity River Murray at Berri (426537) and Flow River Murray at Lock 4 (426514)
2015-17
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
500
400
300
200
100
0
40000
35000
30000
25000
20000
15000
10000
5000
0
01-Jul-15
20-Aug-15
09-Oct-15
28-Nov-15
17-Jan-16
07-Mar-16
26-Apr-16
15-Jun-16
04-Aug-16
23-Sep-16
12-Nov-16
01-Jan-17
20-Feb-17
11-Apr-17
31-May-17

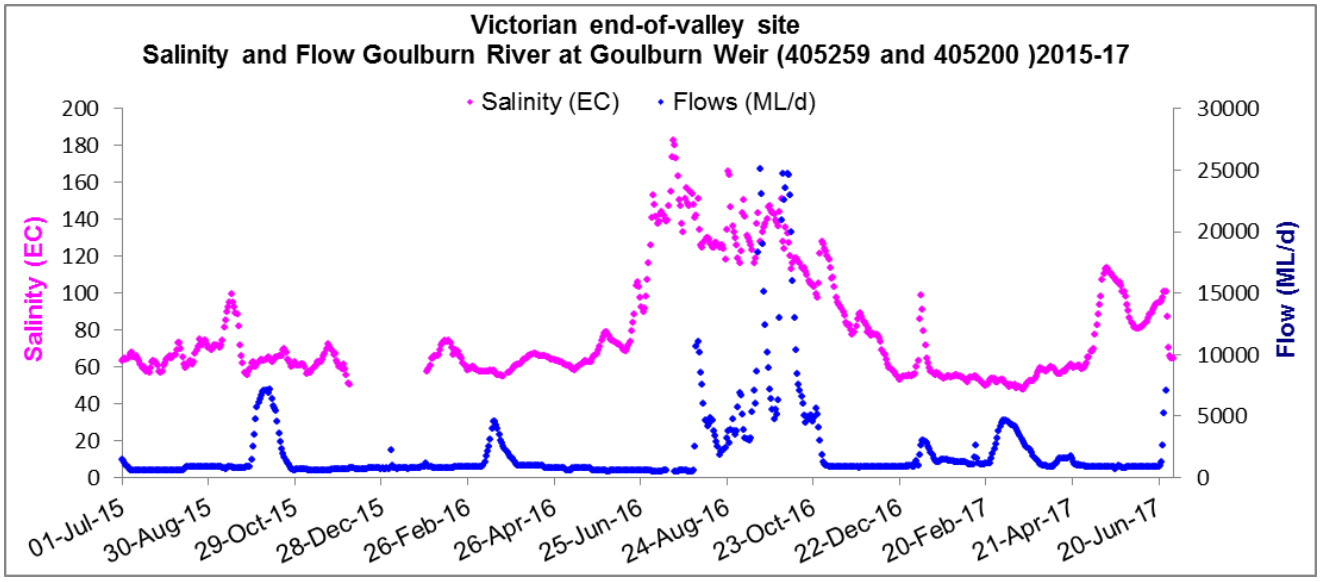

Interpretation site for SA, NSW and VIC
Salinity and Flow River Murray at Lock 6 (426200) 2015-17
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
400
350
300
250
200
150
100
50
0
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
01-Jul-15
20-Aug-15
09-Oct-15
28-Nov-15
17-Jan-16
07-Mar-16
26-Apr-16
15-Jun-16
04-Aug-16
23-Sep-16
12-Nov-16
01-Jan-17
20-Feb-17
11-Apr-17
31-May-17

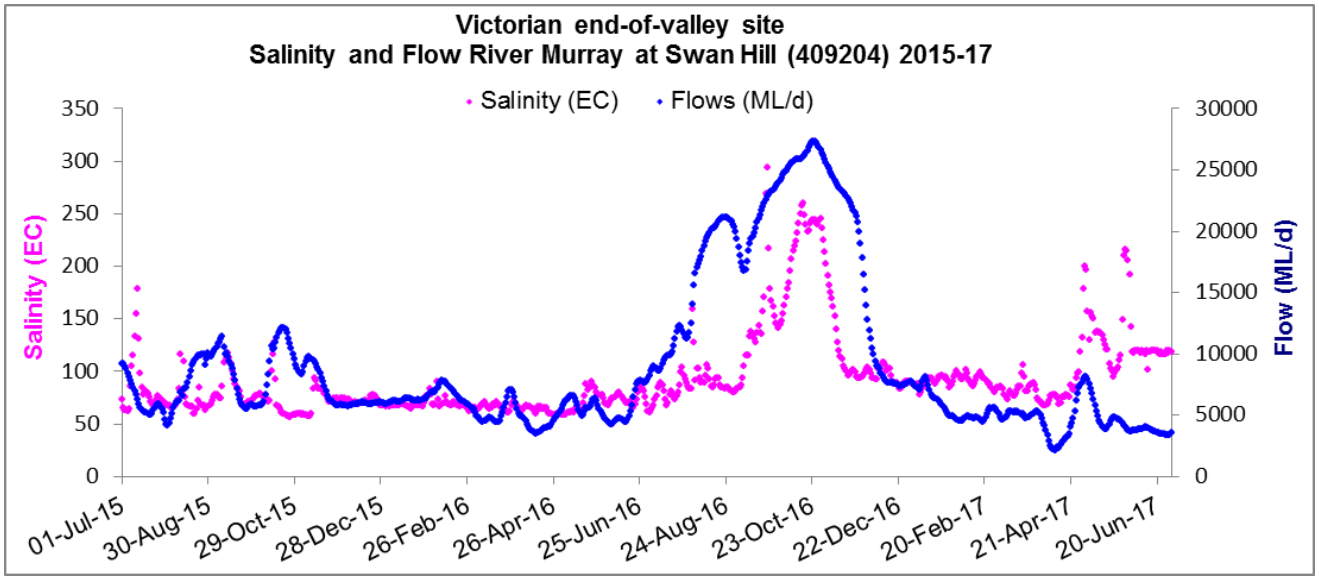
# Victoria

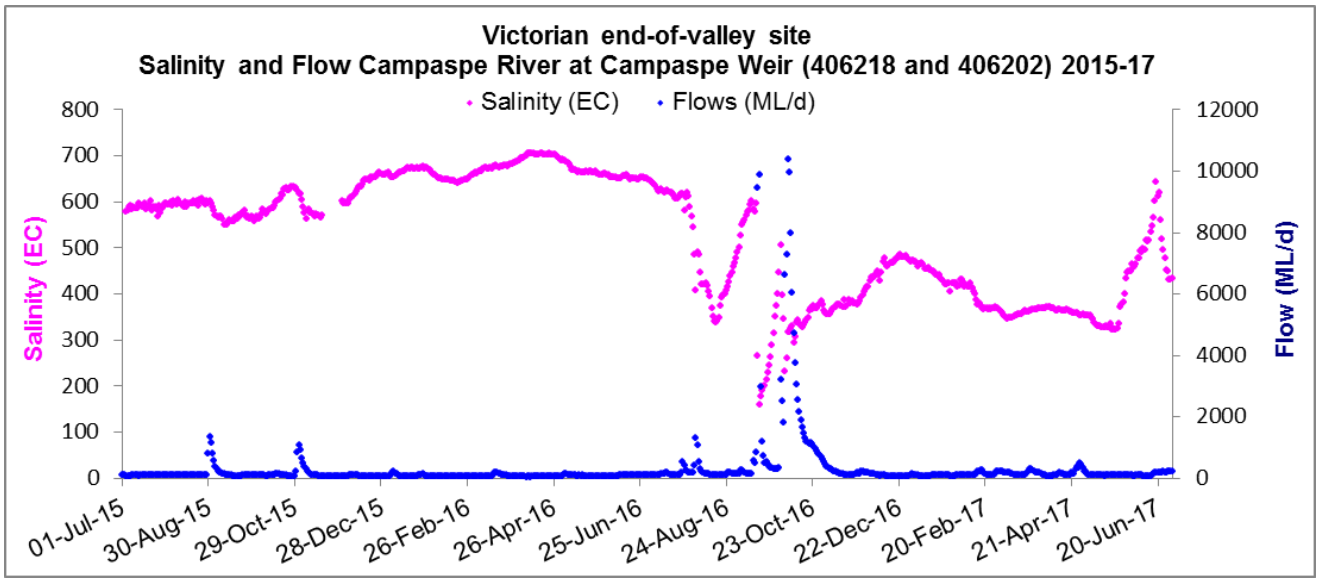

Victorian end-of-valley site
Salinity and Flow Ovens River at Peechelba East (403241) 2015-17
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
450
400
350
300
250
200
150
100
50
0
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17

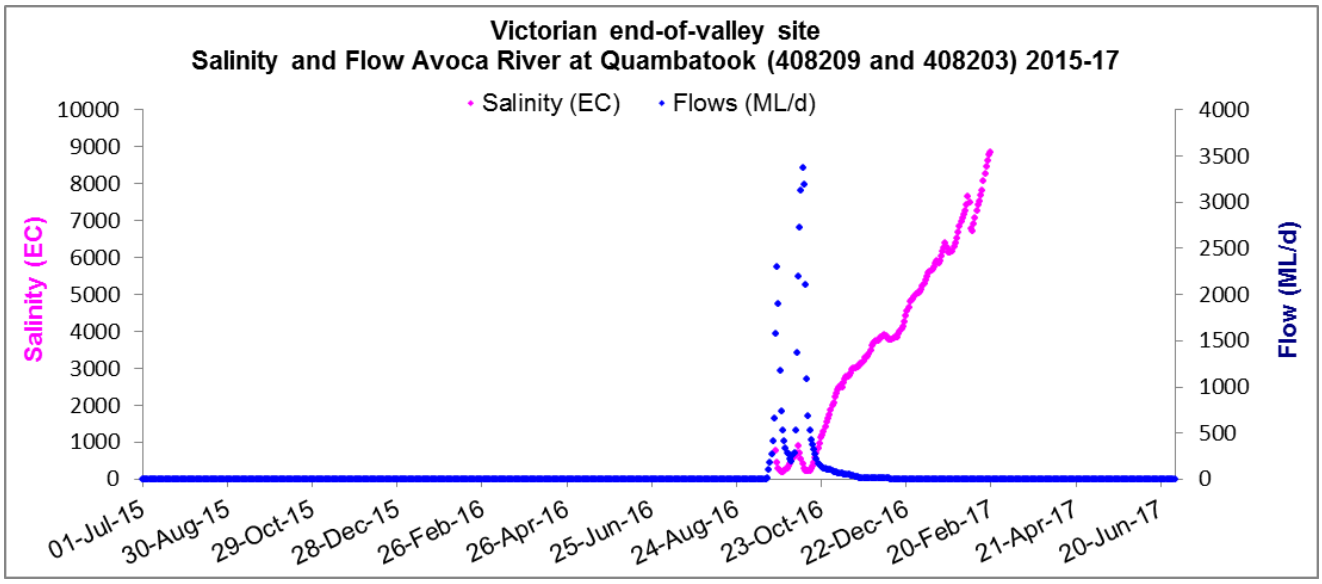

Victorian end-of-valley site
Salinity and Flow Broken Creek at Caseys Weir (404217) 2015-17
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
300
250
200
150
100
50
0
45
40
35
30
25
20
15
10
5
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17

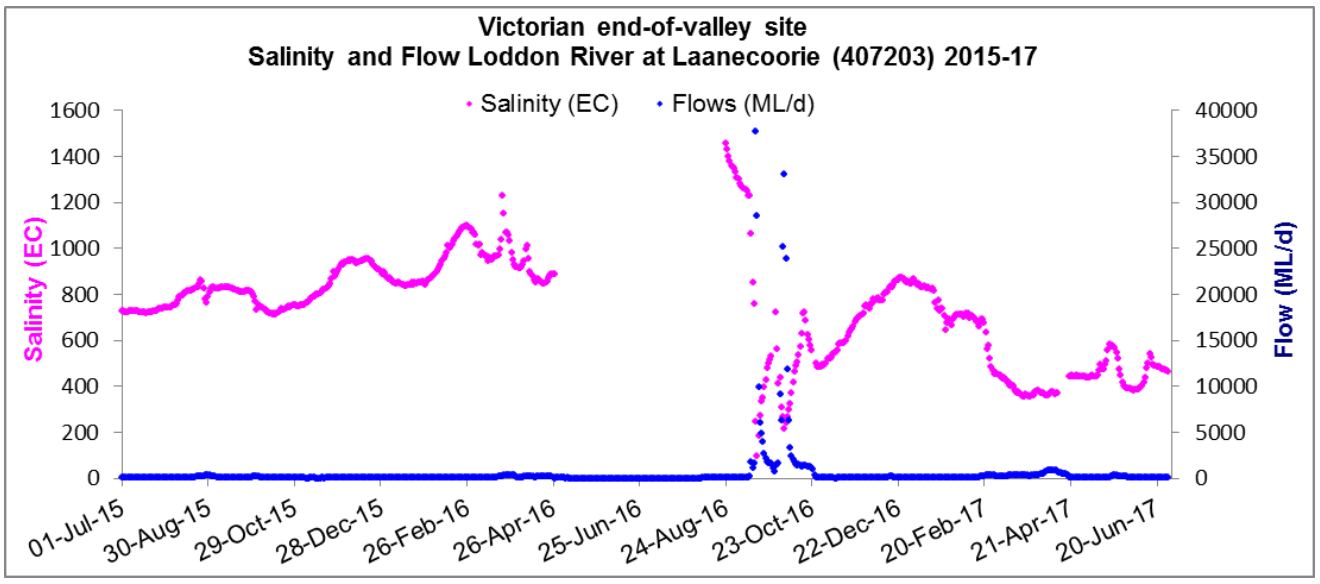

Victorian end-of-valley site
Salinity and Flow Kiewa River at Bandiana (402205) 2015-17
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
300
250
200
150
100
50
0
35000
30000
25000
20000
15000
10000
5000
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17

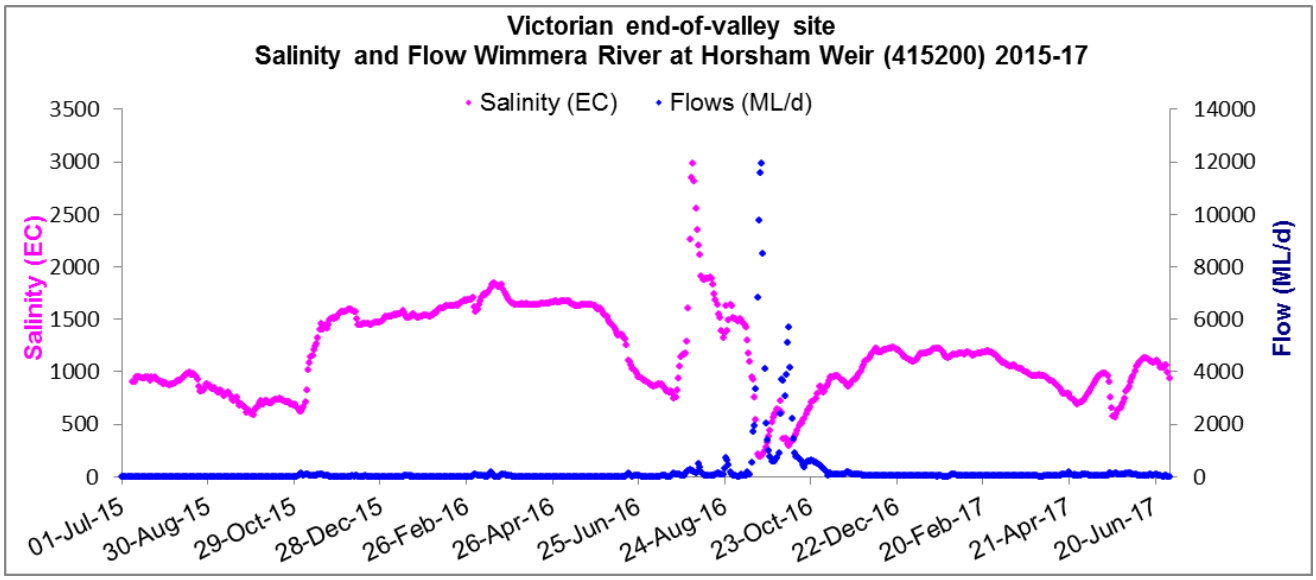

Victorian end-of-valley site
Salinity and Flow Goulburn River at Goulburn Weir (405259 and 405200 )2015-17
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
200
180
160
140
120
100
80
60
40
20
0
30000
25000
20000
15000
10000
5000
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17


Victorian end-of-valley site
Salinity and Flow River Murray at Swan Hill (409204) 2015-17
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
350
300
250
200
150
100
50
0
30000
25000
20000
15000
10000
5000
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17


Victorian end-of-valley site
Salinity and Flow Campaspe River at Campaspe Weir (406218 and 406202) 2015-17
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
800
700
600
500
400
300
200
100
0
12000
10000
8000
6000
4000
2000
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17


Victorian end-of-valley site
Salinity and Flow Avoca River at Quambatook (408209 and 408203) 2015-17
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
4000
3500
3000
2500
2000
1500
1000
500
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17


Victorian end-of-valley site
Salinity and Flow Loddon River at Laanecoorie (407203) 2015-17
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
1600
1400
1200
1000
800
600
400
200
0
40000
35000
30000
25000
20000
15000
10000
5000
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17


Victorian end-of-valley site
Salinity and Flow Wimmera River at Horsham Weir (415200) 2015-17
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
3500
3000
2500
2000
1500
1000
500
0
14000
12000
10000
8000
6000
4000
2000
0
01-Jul-15
30-Aug-15
29-Oct-15
28-Dec-15
26-Feb-16
26-Apr-16
25-Jun-16
24-Aug-16
23-Oct-16
22-Dec-16
20-Feb-17
21-Apr-17
20-Jun-17

# Appendix E: Comparison of 2015–16 and 2016–17 in-stream salinity outcomes with long-term trends for end-of-valley sites

Under the BSM2030 strategy there is a continued requirement to monitor EoVT sites, but there is no longer a compliance requirements associated with achieving targets at these sites. Jurisdictions monitor flow and salinity for the nominated EoVT sites and also, where applicable, for the interpretation sites (sites for shared rivers or valleys that cross state boundaries).

Table 13 summarises the in-stream EC at each monitored site in the Basin. Records indicate the 50th and 80th percentile for 2015-16 and 2016-2017 respectively, as well as the long-term 50th and 80th percentile EC values against baseline values. The length of the long-term record is also indicated.

At the basin scale, the 50th and 80th percentile salinities for 2015-16 were generally comparable with longer term statistics in most catchments. No clear pattern is apparent as the longer term tends are variable across the Basin. A full understanding of why short-term salinity outcomes vary from longer term trends requires a detailed analysis for the specific catchment - a process undertaken as part of the review of end-of-valley outcomes.

Estimates of salt load were calculated for records having both EC and flow data. Table 14 compares mean annual salt loads for 2015-16 and 2016-17, along with long-term mean annual loads against baseline values.

Salt load exports for 2015-16 across the Basin were generally lower than the long-term averages because of limited salt export during periods of low flows. Salt load exports for 2015-16 were also substantially lower than the baseline salt load values with the exception of a few sites in the ACT and in New South Wales.

Salt load exports for 2016-17 across the Basin were generally lower than the long-term averages in Queensland, however more often above the long term average in Australian Capital Territory, South Australia, New South Wales, and Victoria. Comparisons of 2016-17 data against the baseline values generally followed a similar trend to that observed in the comparison against long term averages.

Table 13: Comparison of salinity data with long–term records for 2015–16 & 2016–17 (units: EC)

| Site | AWRC Site Number | Length of record (years) | 50%ile Baseline | 80%ile Baseline | Year | 50%ile All data | 50%ile Year | 80%ile All data | 80%ile Year |
|---|---|---|---|---|---|---|---|---|---|
| **Basin target site** | | | | | | | | | |
| **River Murray at Morgan** [a] | 426554 | 79 | 570 | 920 | 15/16 | 481 | 262 | 1042 | 319 |
| | | | | | 16/17 | 478 | 382 | 1039 | 479 |
| **South Australia** | | | | | | | | | |
| **Berri Pumping Station** | 426537 | 75 | 450 | 600 | 15/16 | 393 | 211 | 579 | 252 |
| | | | | | 16/17 | 391 | 285 | 576 | 403 |
| **River Murray at Murray Bridge** | 426522 | 83 | 600 | 820 | 15/16 | 507 | 327 | 579 | 252 |
| | | | | | 16/17 | 505 | 341 | 576 | 403 |
| **NSW/Victoria shared** | | | | | | | | | |
| **River Murray at Lock 6** [b] | 426510 | 55 | 380 | 470 | 15/16 | 320 | 166 | 441 | 198 |
| | | | | | 16/17 | 317 | 179 | 439 | 249 |
| **NSW** | | | | | | | | | |
| **Murrumbidgee R at Balranald Weir** | 410130 | 51 | 150 | 230 | 15/16 | 167 | 145 | 226 | 210 |
| | | | | | 16/17 | 167 | 187 | 226 | 231 |
| **Lachlan R at Forbes (Cottons Weir)** | 412004 | 18 | 430 | 660 | 15/16 | 437 | 351 | 598 | 443 |

| Site | AWRC Site Number | Length of record (years) | 50%ile Baseline | 80%ile Baseline | Year | 50%ile All data | 50%ile Year | 80%ile All data | 80%ile Year |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 16/17 | 437 | 458 | 601 | 641 |
| **Bogan R at Gongolgon** | 421023 | 17 | 440 | 490 | 15/16 | 365 | 413 | 560 | 438 |
| | | | | | 16/17 | 366 | 372 | 548 | 483 |
| **Macquarie R at Carinda (Bells Bridge)** | 421012 | 25 | 480 | 610 | 15/16 | 578 | 592 | 683 | 688 |
| | | | | | 16/17 | 564 | 438 | 676 | 524 |
| **Castlereagh R at Gungalman Bridge** | 420020 | 16 | 350 | 390 | 15/16 | 630 | 316 | 919 | 468 |
| | | | | | 16/17 | 566 | 256 | 897 | 321 |
| **Namoi R at Goangra** | 419026 | 25 | 440 | 650 | 15/16 | 389 | 136 | 543 | 407 |
| | | | | | 16/17 | 390 | 412 | 540 | 476 |
| **Mehi R at Bronte** | 418058 | 16 | 400 | 540 | 15/16 | 425 | 441 | 634 | 572 |
| | | | | | 16/17 | 422 | 365 | 627 | 504 |
| **Darling R at Wilcannia Main Channel** | 425008 | 52 | 330 | 440 | 15/16 | 385 | 582 | 553 | 900 |
| | | | | | 16/17 | 386 | 441 | 557 | 633 |
| **River Murray at Heywoods** | 409016 | 44 | 54 | 59 | 15/16 | 52 | 49 | 57 | 51 |
| | | | | | 16/17 | 52 | 47 | 57 | 51 |
| **River Murray at Red Cliffs** | 414204 | 50 | 310 | 390 | 15/16 | 280 | 123 | 373 | 150 |
| | | | | | 16/17 | 280 | 164 | 372 | 202 |

| Site | AWRC Site Number | Length of record (years) | 50%ile Baseline | 80%ile Baseline | Year | 50%ile All data | 50%ile Year | 80%ile All data | 80%ile Year |
|---|---|---|---|---|---|---|---|---|---|
| **Victoria** | | | | | | | | | |
| **Wimmera R at Horsham Weir** | 415200 | 25 | 1380 | 1720 | 15/16 | 1190 | 1477 | 1613 | 1640 |
| | | | | | 16/17 | 1170 | 1025 | 1591 | 1188 |
| **Avoca R at Quambatook** [c] | 408203 | 31 | 2060 | 5290 | 15/16 | 0 | 0 | 0 | 0 |
| | | | | | 16/17 | 0 | 0 | 0 | 0 |
| **Loddon R at Laanecoorie** | 407203 | 9 | 750 | 1090 | 15/16 | 736 | 845 | 951 | 947 |
| | | | | | 16/17 | 727 | 534 | 922 | 776 |
| **Campaspe R at Campaspe Weir** | 406218 | 27 | 530 | 670 | 15/16 | 590 | 647 | 796 | 669 |
| | | | | | 16/17 | 582 | 395 | 786 | 476 |
| **Goulburn R at Goulburn Weir** | 405259 | 28 | 100 | 150 | 15/16 | 70 | 64 | 116 | 71 |
| | | | | | 16/17 | 70 | 85 | 117 | 127 |
| **Broken Ck at Casey's Weir** | 404217 | 25 | 100 | 130 | 15/16 | 179 | 180 | 240 | 194 |
| | | | | | 16/17 | 176 | 141 | 238 | 160 |
| **Ovens R at Peechelba East** | 403241 | 38 | 72 | 100 | 15/16 | 62 | 61 | 89 | 79 |
| | | | | | 16/17 | 63 | 70 | 89 | 85 |
| **Kiewa R at Bandiana** | 402205 | 44 | 47 | 55 | 15/16 | 42 | 41 | 51 | 51 |
| | | | | | 16/17 | 42 | 47 | 51 | 57 |

| Site | AWRC Site Number | Length of record (years) | 50%ile Baseline | 80%ile Baseline | Year | 50%ile All data | 50%ile Year | 80%ile All data | 80%ile Year |
|---|---|---|---|---|---|---|---|---|---|
| **River Murray at Heywoods** | 409016 | 44 | 54 | 59 | 15/16 | 52 | 49 | 57 | 51 |
| | | | | | 16/17 | 52 | 47 | 57 | 51 |
| **River Murray at Swan Hill** | 409204 | 50 | 270 | 380 | 15/16 | 216 | 68 | 338 | 76 |
| | | | | | 16/17 | 212 | 94 | 335 | 136 |
| **Queensland** | | | | | | | | | |
| **Barwon R at Mungindi** [g] | 416001 | 22 | 250 | 330 | 15/16 | 253 | 249 | 315 | 298 |
| | | | | | 16/17 | 253 | 247 | 314 | 302 |
| **Moonie R at Fenton** | 417204A | 14 | 140 | 150 | 15/16 | 129 | 68 | 171 | 84 |
| | | | | | 16/17 | 131 | 148 | 172 | 207 |
| **Ballandool R at Hebel—Bollon Rd** | 422207A | 15 | 170 | 210 | 15/16 | 200 | 206 | 302 | 369 |
| | | | | | 16/17 | 198 | 186 | 300 | 291 |
| **Bokhara R at Hebel** | 422209A | 15 | 170 | 210 | 15/16 | 186 | 169 | 223 | 246 |
| | | | | | 16/17 | 183 | 147 | 221 | 172 |
| **Braire Ck at Woolerbilla—Hebel Rd** | 422211A | 14 | 150 | 280 | 15/16 | 245 | NA | 312 | NA |
| | | | | | 16/17 | 230 | NA | 305 | NA |
| **Culgoa R at Brenda** [g] | 422015 | 15 | 170 | 210 | 15/16 | 183 | 213 | 222 | 244 |
| | | | | | 16/17 | 186 | 216 | 225 | 277 |

| Site | AWRC Site Number | Length of record (years) | 50%ile Baseline | 80%ile Baseline | Year | 50%ile All data | 50%ile Year | 80%ile All data | 80%ile Year |
|---|---|---|---|---|---|---|---|---|---|
| **Narran R at New Angledool** [g] | 422030 | 15 | 160 | 210 | 15/16 | 184 | 149 | 236 | 154 |
| | | | | | 16/17 | 180 | 87 | 233 | 116 |
| **Paroo R at Caiwarro** | 424201A | 13 | 90 | 100 | 15/16 | 79 | 50 | 108 | 81 |
| | | | | | 16/17 | 79 | 86 | 107 | 99 |
| **Warrego R at Barringun No.2** [g] | 423004 | 16 | 101 | 110 | 15/16 | 142 | NA | 210 | NA |
| | | | | | 16/17 | 137 | NA | 206 | NA |
| **Cuttaburra Ck at Turra** [g] | 423005 | 16 | 100 | 130 | 15/16 | 135 | 215 | 210 | 236 |
| | | | | | 16/17 | 129 | 105 | 201 | 129 |
| **ACT** | | | | | | | | | |
| **Murrumbidgee R at Hall's Crossing** | 410777 | 27 | 224 | 283 | 15/16 | 234 | 224 | 234 | 316 |
| | | | | | 16/17 | 234 | 236 | 234 | 307 |

*a 95 percentile for BSMS target at Morgan*
*b Salinity measured at site A4261022 (Murray @ Old Custom House)*
*c Spot salinity data ends in Sep 2008 and continuous starts in Sep 2013 from 408209 (Avoca River at Sandhill Lake Road)*
*d Used flow data for 406202 (Campaspe at Rochester)*
*e Used flow data for 405200A (Goulburn River at Murchison)*
*f Used salinity data for 404224B (Broken River at Gowangardie)*
*g Operated by New South Wales on behalf of Queensland*
*h Length of record data is from commencement of record until end June 2017*
*NA data not available*

Table 14: Comparison of salt load data with long–term records for 2015–16 & 2016–17

| Site | AWRC Site Number | Length of record (years) | Mean baseline salt load (t/y) | Year | Mean annual salt load (tonnes) All data | Mean annual salt load (tonnes) |
|---|---|---|---|---|---|---|
| **Basin target site** | | | | | | |
| **River Murray at Morgan** | 426554 | 50 | 1,600,000 | 15/16 | 1,429,400 | 297,400 |
| | | | | 16/17 | 1,430,000 | 1,462,800 |
| **South Australia** | | | | | | |
| **Berri Pumping Station** | 426537 | 23 | 1,500,000 | 15/16 | 528,600 | 287,900 |
| | | | | 16/17 | 534,800 | 702,600 |
| **River Murray at Murray Bridge** | 426522 | NA | 1,600,000 | 15/16 | NA | NA |
| | | | | 16/17 | NA | NA |
| **NSW/Victoria shared** | | | | | | |
| **River Murray at Lock 6** | 426200 | 55 | 1,300,000 | 15/16 | 1,171,700 | 251,600 |
| | | | | 16/17 | 1,169,700 | 667,400 |
| **NSW** | | | | | | |
| **Murrumbidgee R d/s Balranald Weir** | 410130 | 51 | 160,000 | 15/16 | 118,000 | 64,700 |
| | | | | 16/17 | 122,800 | 322,200 |
| **Lachlan R at Forbes (Cottons Weir)** | 412004 | 18 | 250,000 | 15/16 | 116,500 | 125,300 |
| | | | | 16/17 | 132,500 | 395,900 |

| Site | AWRC Site Number | Length of record (years) | Mean baseline salt load (t/y) | Year | Mean annual salt load (tonnes) All data | Mean annual salt load (tonnes) |
|---|---|---|---|---|---|---|
| **Bogan R at Gongolgon** | 421023 | 17 | 27,000 | 15/16 | 14,100 | 7,500 |
| | | | | 16/17 | 20,000 | 95,500 |
| **Macquarie R at Carinda (Bells Bridge)** | 421012 | 25 | 23,000 | 15/16 | 19,200 | 1,400 |
| | | | | 16/17 | 23,500 | 82,700 |
| **Castlereagh R at Gungalman Bridge** | 420020 | 16 | 9,000 | 15/16 | 35,100 | 22,800 |
| | | | | 16/17 | 41,300 | 111,800 |
| **Namoi R at Goangra** | 419026 | 25 | 110,000 | 15/16 | 69,500 | 5,000 |
| | | | | 16/17 | 70,700 | 92,700 |
| **Mehi R at Bronte** | 418058 | 16 | 7,000 | 15/16 | 7,400 | 900 |
| | | | | 16/17 | 7,200 | 3,900 |
| **Darling R at Wilcannia Main Channel** | 425008 | 52 | 440,000 | 15/16 | 369,900 | 23,600 |
| | | | | 16/17 | 369,800 | 364,100 |
| **River Murray at Heywoods** | 409016 | 44 | 150,000 | 15/16 | 131,300 | 105,300 |
| | | | | 16/17 | 131,400 | 120,400 |
| **River Murray at Red Cliffs** | 414204 | 34 | 1,100,000 | 15/16 | 1,236,400 | NA |
| | | | | 16/17 | 1,236,400 | NA |

| Site | AWRC Site Number | Length of record (years) | Mean baseline salt load (t/y) | Year | Mean annual salt load (tonnes) All data | Mean annual salt load (tonnes) |
|---|---|---|---|---|---|---|
| **Victoria** | | | | | | |
| **Wimmera R at Horsham Weir** | 415200 | 25 | 31,000 | 15/16 | 13,800 | 2,800 |
| | | | | 16/17 | 15,300 | 41,200 |
| **Avoca R at Quambatook** [b,h] | 408203 | 31 | 37,000 | 15/16 | 32,010 | Limited data |
| | | | | 16/17 | 37,798 | Limited data |
| **Loddon R at Laanecoorie** | 407203 | 9 | 88,000 | 15/16 | 32,000 | 21,900 |
| | | | | 16/17 | 37,800 | 76,900 |
| **Campaspe R at Campaspe Weir** [c] | 406218 | 50 | 54,000 | 15/16 | 24,500 | 10,500 |
| | | | | 16/17 | 24,700 | 32,600 |
| **Goulburn R at Goulburn Weir** | 405259 | 28 | 166,000 | 15/16 | 49,300 | 17,600 |
| | | | | 16/17 | 50,300 | 76,000 |
| **Broken R at Casey's Weir** | 404217 | 25 | 15,000 | 15/16 | 1,600 | 500 |
| | | | | 16/17 | 1,600 | 600 |
| **Ovens R at Peechelba East** | 403241 | 38 | 54,000 | 15/16 | 44,000 | 21,500 |
| | | | | 16/17 | 47,900 | 126,400 |
| **Kiewa R at Bandiana** | 402205 | 44 | 19,000 | 15/16 | 15,800 | 13,700 |
| | | | | 16/17 | 17,000 | 37,700 |

| Site | AWRC Site Number | Length of record (years) | Mean baseline salt load (t/y) | Year | Mean annual salt load (tonnes) All data | Mean annual salt load (tonnes) |
|---|---|---|---|---|---|---|
| **River Murray at Heywoods** | 409016 | 44 | 150,000 | 15/16 | 131,300 | 105,300 |
| | | | | 16/17 | 131,400 | 120,400 |
| **River Murray at Swan Hill** | 409204 | 50 | 630,000 | 15/16 | 591,300 | 109,500 |
| | | | | 16/17 | 586,000 | 346,400 |
| **Queensland** | | | | | | |
| **Barwon R at Mungindi** [f] | 416001 | 22 | 50,000 | 15/16 | 46,000 | 11,300 |
| | | | | 16/17 | 46,200 | 30,700 |
| **Moonie R at Fenton** | 417204A | 14 | 8,700 | 15/16 | 14,700 | 100 |
| | | | | 16/17 | 14,200 | 9000 |
| **Ballandool R at Hebel—Bollon Rd** | 422207A | 15 | 4,200 | 15/16 | 8,400 | 100 |
| | | | | 16/17 | 7,800 | 800 |
| **Bokhara R at Hebel** | 422209A | 15 | 5,000 | 15/16 | 10,400 | 2,300 |
| | | | | 16/17 | 9,900 | 1600 |
| **Braire Ck at Woolerbilla—Hebel Rd** [h] | 422211A | 14 | 6,500 | 15/16 | 64,900 | 0 |
| | | | | 16/17 | 54,200 | 100 |
| **Culgoa R at Brenda** [f] | 422015 | 15 | 29,000 | 15/16 | 61,400 | 2,000 |

| Site | AWRC Site Number | Length of record (years) | Mean baseline salt load (t/y) | Year | Mean annual salt load (tonnes) All data | Mean annual salt load (tonnes) |
|---|---|---|---|---|---|---|
| | | | | 16/17 | 57,600 | 13,100 |
| **Narran R at New Angledool** [f] | 422030 | 15 | 10,000 | 15/16 | 21,300 | 700 |
| | | | | 16/17 | 20,200 | 2,400 |
| **Paroo R at Caiwarro** | 424201A | 13 | 24,000 | 15/16 | 30,900 | 9,200 |
| | | | | 16/17 | 29,700 | 6,700 |
| **Warrego R at Barringun No.2** [f] | 423004 | 16 | 4,800 | 15/16 | 34,500 | NA |
| | | | | 16/17 | 31,700 | NA |
| **Cuttaburra Ck at Turra** [f] | 423005 | 16 | 5,500 | 15/16 | 29,000 | 1,700 |
| | | | | 16/17 | 27,300 | 9300 |
| **ACT** | | | | | | |
| **Murrumbidgee R at Hall's Crossing** | 410777 | 27 | 32,700 | 15/16 | 75,100 | 75,400 |
| | | | | 16/17 | 75,400 | 82,200 |

*a Flow data stops in October 1994*
*b Spot salinity data ends in Sep 2008 and continuous starts in Sep 2013 from 408209 (Avoca River at Sandhill Lake Road)*
*c Used flow data for 406202 (Campaspe at Rochester)*
*d Used flow data for 405200A (Goulburn River at Murchison)*
*e Used salinity data for 404224B (Broken River at Gowangardie)*
*f Operated by New South Wales on behalf of Queensland*
*g Length of record data is from commencement of record until end June 2017*
*NA = data not available*
*Salt load is determined using the following calculation: salt load (t/d) = flow (ML/d) x salinity (EC) x 0.0006 except Queensland where the factor EC/TDS varies for each sit*

# Appendix F: BSM2030 operational process during 2015–17

BSMAP meetings between July 2015 and June 2017

| Meeting Number | Date | Location |
|---|---|---|
| **25** | 21 July 2015 | Melbourne |
| **26 (Registers)** | 30 September 2015 | Teleconference |
| **27** | 27 October 2015 | Teleconference |
| **28** | 23 February 2016 | Melbourne |
| **29** | 20 July 2016 | Adelaide |
| **29a** | 29 August 2016 | Teleconference |
| **30 (Registers)** | 5 October 2016 | Teleconference |
| **31** | 15 November 2016 | Melbourne |
| **32** | 22 February 2017 | Adelaide |
| **33** | 20 July 2017 | Sydney |

Schedule B amendments consultation meetings

| Location | Date |
|---|---|
| **Qld (phone)** | 17 March 2016 |
| **NSW (Sydney)** | 18 March 2016 |
| **SA (Adelaide)** | 23 March 2016 |
| **ACT (Canberra)** | 1 April 2016 |
| **C'th (Canberra)** | 1 April 2016 |
| **MDBA (Canberra)** | 5 April 2016 |
| **Vic (Melbourne)** | 24 April 2016 |

Salt Interception Scheme Operators Workshops

| Meeting Number | Location | Date |
|---|---|---|
| **Workshop 1** | Buronga | 6 May 2016 |
| **Workshop 2** | Buronga | 23 August 2016 |
| **Workshop 3** | Canberra | 9 November 2016 |
| **Workshop 4** | Buronga | 23 February 2017 |
| **Workshop 5** | Phone Conference | 9 November 2017 |
| **Workshop 6** | Buronga | 5 September 2017 |

BSM2030 Steering Committee Meetings

| Meeting | Location | Date |
|---|---|---|
| **South Australia bilateral meeting** | Adelaide | 13 July 2015 |
| **Victoria bilateral meeting** | Melbourne | 16 July 2015 |
| **Steering committee meeting 9** | Melbourne | 22 July 2015 |
| **Bilateral meetings** | Various | 4, 5, 6, 7 August 2015 |
| **Steering committee meeting 10** | Melbourne | 26 August 2015 |
| **Steering committee teleconference** | | 1 September 2015 |
| **Steering committee meeting 11** | Melbourne | 10 September 2015 |
| **Steering committee meeting (BOC paper)** | Teleconference | 17 September 2015 |
| **Steering committee meeting 12** | Canberra | 22 September 2015 |
| **Steering committee teleconference** | | 13 October 2015 |
| **Steering committee meeting 13** | Melbourne | 17 November 2015 |
| **Steering committee teleconference** | | 25 November 2015 |
| **Steering committee teleconference** | | 9 December 2015 |
| **Steering committee meeting 14** | Melbourne | 16 February 2016 |

# Appendix G: Contracting Government reports - executive summaries

*Disclaimer: Information contained in Appendix G was provided to the MDBA by each of the Contracting Governments as part of their BSM2030 reporting obligations. The executive summary from each Contracting Government biennial comprehensive report was extracted for inclusion in this appendix and reformatted to meet MDBA styles for consistency. The MDBA does not hold responsibility for the accuracy of data and information contained within Appendix G.*

# Executive Summary: Victoria's BSM2030 Biennial Report 2017

This Biennial Report presents Victoria's accountability and achievements in implementing the new salinity strategy *Basin Salinity Management 2030* (BSM2030) over 2015/16 and 2016/17.

This report was written by the Department of Environment, Land, Water and Planning (DELWP), the Goulburn Broken Catchment Management Authority (CMA), North Central CMA, North East CMA, Mallee CMA and Wimmera CMA, Goulburn-Murray Water and Agriculture Victoria.

## Salinity Accountability Framework

Victoria remains compliant with Schedule B to the Murray–Darling Basin Agreement (Schedule 1 to the *Water Act 2007*). Victoria's net balance of salinity credits as of 30 June 2017 is **-32.33 EC** or **6 million/yr** which remain unused (Table G 0-1).

Table G 0-1: Victoria's Register A balance sheet summary

| | Balance at 12 September 2016 | | Change in 2016/17 Reporting Period | | Balance at 30 June 2017 | |
|---|---|---|---|---|---|---|
| | Salinity Effect (EC at Morgan) | Salinity Cost Effect ($/yr) | Salinity Effect (EC at Morgan) | Salinity Cost Effect ($/yr) | Salinity Effect (EC at Morgan) | Salinity Cost Effect ($/yr) |
| **Credits** | -53.99 | 11,256,300 | 0 | 0 | -53.99 | 11,256,300 |
| **Debits** | 21.27 | -5,158,000 | 0.39 | -91,100 | 21.66 | -5,249,100 |
| **Total** | **-32.72** | **6,098,300** | **0.39** | **-91,100** | **-32.33** | **6,007,200** |

The only change to Victoria's Register A balance was a debit of **0.39 EC** attributed to the Nyah to the South Australian Border Salinity Management Plan (SMP), which accounts for irrigation development in the Victorian Mallee region. The progressive total salinity impact for the Nyah to the South Australian Border SMP is estimated to be 16.79 EC as of 30 June 2017[1].

During the reporting period Victoria progressed work to assess new Accountable Actions. This included an upgrade of the Kerang Lakes Model (KLM) to enable estimation of the Victorian Mid-Murray Storages (VMMS), salinity impacts of the Goulburn-Murray Water Connections Project and a preliminary salinity impact assessment of the Benwell Surface Water Management System.

Environmental watering activities such as Sustainable Diversion Limit (SDL) offset projects are being incorporated into Victoria's accountability framework as projects are approved and implemented. Preliminary salinity investigations indicate that two Victoria SDL offset projects may result in new accountable actions.

## Management of SIS

The three Victorian salt interception schemes (SIS): Barr Creek Drainage Diversion Scheme, Mildura-Merbein Salt Interception Scheme and Pyramid Creek Groundwater Interception Scheme, continued

[1] Reflects increase in irrigation development for Nyah to SA Border Salinity Management Plan reported by Mallee CMA using the accredited model to calculate impacts. This total may not reflect the debit recorded on the MDBA 2016 register.

to operate in accordance with operating rules over the reporting period. Victoria also worked with the MDBA to refine the operation of SIS in response to forecast river flow and salinity conditions.

Table G 0-2 presents a summary of SIS operations for the reporting period. A total of 227,226 tonnes of salt was diverted from the Murray River. The Mildura-Merbein SIS was turned off for four months in 2016/17 in response to high Murray River flows in compliance with SIS operating rules.

Table G 0-2: Summary of Victorian Salt Interception Scheme operations

| Salt Interception Scheme | 2015/16 | | | 2016/17 | | |
|---|---|---|---|---|---|---|
| | Volume Pumped (ML) | Salt Load Diverted (Tonnes) | Average Salinity (EC) | Volume Pumped (ML) | Salt Load Diverted (Tonnes) | Average Salinity (EC) |
| **Barr Creek** | 2,721 | 14,828 | 12,658 | 3,784 | 16,969 | 7,063 |
| **Mildura-Merbein** | 1,785 | 99,006 | 80,748 | 1,050 | 48,286 | 79,546 |
| **Pyramid Creek** | 1,083 | 26,762 | 41,299 | 860 | 21,375 | 41,647 |

A register review for the Pyramid Creek Groundwater Interception Scheme was completed in 2016, as well as a review of the operations of the SIS and a review of the Mildura Merbein Salt Interception Scheme commenced in 2016/17. A register review for the Barr Creek Drainage Diversion Scheme will be undertaken alongside the Barr Creek Catchment Strategy Register Entry, due in 2018.

# Salinity Management

In the reporting period, the Victorian Government released *Water for Victoria*, a strategic plan for managing the state's water resources. *Water for Victoria* sets a new long-term direction for managing water resources in the context of climate change and a growing population. Through the new water plan, Victoria reconfirmed its commitment to salinity management in the Murray–Darling Basin.

Victoria manages its BSM2030 obligation '*to maintain a net credit balance in Salinity Register A and the sum of Registers A and B'* by allocating salinity credits to the CMAs. CMAs are responsible to ensure that salinity debits in their region do not exceed their credit allocation.

Regional implementation is a key element of Victoria's approach to salinity management. Victoria's five Basin CMAs continued to implement their Regional Catchment Strategies (RCS) and Land and Water Management Plans (LWMP) for irrigation areas, which provide the strategic framework and key actions for natural resource management in Victoria. In addition, CMAs have developed over 48 long-term Environmental Water Management Plans (EWMP) to guide environmental watering activities across the state. These EWMPs are developed under partnership arrangements with the community and government agencies, such as the Victorian and Commonwealth environmental water holders and MDBA, and incorporate consideration and management of salinity impacts.

In the reporting period, CMAs delivered a wide range of on-farm planning and works, including irrigation and dryland whole farm plans, upgrades to irrigation systems for water use efficiency and salinity benefits, as well as protection of remnant vegetation and target re-vegetation activities.

Salinity and salt loads at End-of-Valley-Target (EoVT) sites were monitored and evaluated over the reporting period for each Victorian valley for which an EoVT has been set. Results are provided in this report for reference.

# Governance of Victoria's Salinity Register

Victoria delegates regional responsibilities to the five Basin CMAs boards, which oversee development and implementation of strategies, plans and programs to monitor, manage and mitigate salinity impacts in partnership with local communities.

Victoria's CMAs continued to support efficient Basin-wide governance of BSM2030 through monitoring which helps to support the assessment of salinity impacts and periodic reviews of register entries. Victoria also actively participates in the audit process which tracks the performance of partner governments and the MDBA in implementing BSM2030 and identifies areas of improvement.

BSM2030 identifies the need for partner governments and the Murray–Darling Basin Authority (MDBA) to maintain key salinity monitoring sites by forming a Basin-wide Core Salinity Monitoring Network (BCS Monitoring Network).

In 2016/17, DELWP worked closely with regional partners including CMAs, GMW and Agriculture Victoria to develop a draft Victorian contribution to the BCS Monitoring Network which identifies all surface and groundwater sites which are used to monitor and review Victorian Register Entries. The final list of Victoria's salinity monitoring sites will be submitted to the MDBA in 2017/18.

In the reporting period, CMAs progressed several register reviews of state Accountable Actions, summarised in Table G 0-3. Five register reviews were completed, with no change to the MDBA Salinity Register.

Table G 0-3: Victorian Register A Accountable Action Reviews progressed in 2015/16 and 2016/17

| In progress | Completed |
|---|---|
| **Barr Creek Catchment Strategy** | Church's Cut Decommissioning |
| **Tragowel Plains Drains at 2002 Level** | RISI Stage I – Vic |
| **Campaspe West SMP** | Lamberts Swamp |
| **Shepparton Irrigation Region SMP** | Psyche Bend Lagoon Diversion Scheme |
| | Sunraysia Drains Drying Up |

# Strategic Knowledge Improvement

DELWP, Agriculture Victoria and CMAs continued to increase state-wide capacity for managing salinity in the Murray–Darling Basin in the reporting period by progressing a number of research and investigation projects. Including:

The Goulburn Broken CMA and GMW continued to work on delivering the final stage of the SIR Salt Water Balance Project (SWBP), developing user-friendly information for irrigators to understand and mitigate salinity impacts in their region. The SIR Public Pump Triggers Optimisation Project commenced in partnership with Macquarie University to improve adaptive management of GMW Public Groundwater Pumps.

The Mallee CMA progressed the Mallee Model Refinement Project, which will replace the current analytical approach to modelling with an upgraded numerical approach to support more accurate reviews of accountable actions. The Satellite Based Estimation of Root Zone Drainage project continued, building knowledge and confidence in estimates of root zone drainage which are critical to quantifying the impacts of irrigation on Murray River salinity.

The North Central CMA developed their North Central Victoria Regional Sustainable Agriculture Strategy to enhance regional farming viability, with a focus on an integrated approach to managing salinity threats. Drainage reviews for the Loddon Murray region and Benwell catchment have commenced, to assess the contemporary drainage needs for irrigation and better understand the nature of drainage in key sub-catchments.

Agriculture Victoria Research participated in collaborative research project to develop a flexible statistical tool called Hydrosight to improve interpretation of groundwater monitoring data. The tool assists in infilling gaps in monitoring records and removing possible monitoring errors for time-series groundwater data. Hydrosight is being used to assist understanding and assessment of Northern Victoria's dryland salinity impacts.

# Community Engagement and Communication

Community engagement, education and communication are central to the implementation of Victorian CMAs' RCS and subordinate strategies and plans, including LWMPs and Waterway Strategies. Local ownership of the challenges and opportunities of salinity management has been a long-standing and successful approach in Victoria.

Many CMA boards use community-based advisory groups to gain community and expert input into projects and strategies, and to help inform communities, agencies and land managers about natural resource management in the region. These groups are central to effective management of salinity in Victoria, particularly in irrigation areas.

CMAs, GMW and Agriculture Victoria continued to engage with local communities on salinity management over the reporting period, with a focus on communicating key salinity threats and mitigation options through watertable maps, Landcare Groups and field days. Waterwatch remains an important tool for educating Victorian's about the importance of water quality and salinity management to environments, communities and agriculture.

# Priorities for Future Work

In coming years, Victoria will continue to implement BSM2030 in co-operation with the MDBA and Basin states. Key projects include: finalising the VCS Monitoring Network, including monitoring sites for SIS, providing input into the review and amendment of Schedule B and updating Victoria's manual for salinity management to support effective implementation of BSM2030.

These actions will be supported by the delivery of key actions in *Water for Victoria*, including management of salinity and waterlogging and improving the management of salinity in the Mallee. Regional partners will focus on reviews of strategies and plans to support salinity management, including the SIR LWMP and Loddon Campaspe Irrigation Region (LCIR) LWMP, as well as North Central CMA drainage reviews.

SIS will continue to be operated adaptively in accordance with the BSM2030 adaptive management approach. The Barr Creek Drainage Diversion Scheme Accountable Action review will be commenced alongside the Barr Creek Catchment Strategy register review. CMAs and Agriculture Victoria will continue to implement RCS, Waterway Strategies and LWMPs with a focus on delivering on-farm works to mitigate environmental and third-party impacts, community engagement and best practice of water and land management activities.

CMAs will undertake Register A Accountable Action reviews in-line with the MDBA Register Review Plan, while Agriculture Victoria will work with CMAs to deliver the five Register B LoH reviews due in 2018. Victoria will continue to focus on capacity building and strategic knowledge improvement in managing salinity across the state, particularly by delivering key projects including the Mallee Model Refinement Project, Satellite Estimation of Rootzone Drainage Project and the SIR SWBP.

# Executive Summary: Queensland BSM2030 Biennial Report 2017

This report has been compiled by the Department of Natural Resources and Mines to report to the Murray–Darling Basin Ministerial Council on how Queensland is implementing Basin Salinity Management 2030 (BSM2030). It summarises Queensland's actions with respect to the key elements of BSM2030 and provides statistics of stream flow and salt load at Queensland's ten End- of-Valley (EoV) reporting sites. The Queensland Government has continued its commitment to implementing the objectives of BSM2030 and adhering to the guiding principles underpinning BSM2030.

A summary of 2016–17 results compared to the long-term target values for Queensland's EoV reporting sites is given below:

| Catchment | Median EC (µS/cm) | Salt load (t/yr) | Total flow (ML/yr) | Load/flow (t/ML) |
|---|---|---|---|---|
| **Condamine-Balonne (five EoV sites)** | Three below, two above target | All below mean load | All below mean flow | Three below, two above target |
| **Border Rivers (one EoV site)** | Below | Above | Below | Above |
| **Moonie (one EoV site)** | Below | Below | Below | Above |
| **Warrego (two EoV sites)** | One below, one above | Both above | One below, one above | Both above |
| **Paroo (one EoV site)** | Below | Below | Below | Below |

The following investigations in priority areas continued over the last 12 months, further clarifying the level of salinity risk in these areas:

- the role of floods on recharging soil water and groundwater in the Lower Balonne
- the presence of shallow groundwater and groundwater dependent ecosystems in the Lower Balonne
- regolith architecture, hydrogeology and water balance in an irrigation development in the Condamine catchment to calculate salinity risk and likelihood of discharge to stream
- understanding the risks posed by groundwater recharge and the use of marginal quality groundwater in the cotton-growing lands of the QMDB

Investigations will continue in the Border Rivers and Condamine catchments during the next 6–12 months. Ecohydrological work for water resource planning processes (e.g. assessment of groundwater dependent ecosystems) has significantly increased our knowledge in the Lower Balonne but also highlighted that the knowledge gaps remaining are spatially large.

# Executive Summary: South Australia's BSM2030 Biennial Report 2017

Salinity is a significant challenge and poses ongoing risks to the Murray–Darling Basin. If left unmanaged, salinity has adverse implications for water quality, biodiversity, agricultural productivity, the supply of water for critical human needs and industry. For the past thirty years South Australia has actively contributed to the management of salinity in collaboration with partner governments across the Murray–Darling Basin.

The Basin Salinity Management 2030 strategy (BSM2030) provides a framework for continued joint government investment and collective action to continue to meet the Basin Salinity Target. The BSM2030 strategy supports regulatory settings and management arrangements that complement salinity and water quality provisions in the Basin Plan to underpin Basin salinity management. The implementation of BSM2030 strategy will be critical to continue to protect the environment, irrigated agriculture, industry and critical human water supplies from adverse effects of high salinities.

The BSM2030 strategy requires partner governments to implement eight key elements which are reported on in the biennial report. This is South Australia's first biennial report under BSM2030.

South Australia remains committed to the ongoing delivery of salinity management obligations under Schedule B and BSM2030. South Australia's key achievements and outcomes over the past two years under the eight elements of BSM2030 are outlined below.

## Accountability framework

South Australia remains compliant with Schedule B to the Murray–Darling Basin Agreement with a Salinity Register net salinity credit of $7.035 million.

## Salinity accountability for environmental management

The South Australian Government notified the Murray–Darling Basin Authority (MDBA) of actions proposed to be undertaken as a part of the South Australian Riverland Floodplains Integrated Infrastructure Program (SARFIIP) that are likely to have a Significant Effect[1]. Groundwater models and methodologies were developed to assess the potential salt loads that may be discharge to the River Murray from actions undertaken as part of SARFIIP.

Modelled salinity impacts of the Chowilla regulator were validated using monitoring data gathered during the testing of the regulator and ancillary structures.

## Responsive management of salt interception schemes

Salt Interception Schemes located in South Australia intercepted more than 430,000 tonnes of salt over the past two years.

# Flow Management

Salinity levels at reporting sites identified in the Basin Plan and South Australian River Murray Operating Plan were maintained below the identified targets for 100 percent of the time during 2015–16 and 2016–17.

The Department of Environment, Water and Natural Resources (DEWNR) developed and implemented the 2016–17 and 2017–18 South Australian River Murray Operating Plans that assisted DEWNR to meet Basin Plan salinity and water quality targets while managing river flows.

Fifty three River Murray Action Requests relating to flow and wetland management were assessed for potential impacts on salinity and water quality parameters.

Coordinated lake water level fluctuations assisted to reduce the average salinity in Lake Albert decreasing by approximately 220 EC during 2016–17.

The continued discharge of salt from the Basin was enabled by dredging operations combined with delivery of unregulated flow and environmental water that maintained an open Murray Mouth for 100 percent of the time.

# Salinity management in catchments

In 2015–16 and 2016–17 monitored daily salinity remained below the target levels at all End-of-Valley Target sites (see Table G E1).

Table GE1. End-of-Valley report card

| Valley | End of Valley Target | Valley Reporting Site | 2015–16 monitoring (Daily Mean EC) | | 2016–17 monitoring (Daily Mean EC) | |
|---|---|---|---|---|---|---|
| Basin salinity target | 800 EC (95 %ile) | Murray at Morgan (A4260554) | EC (Max)<br>EC (Avg)<br>EC (95 %ile) | 378<br>268<br>344 | EC (Max)<br>EC (Avg)<br>EC (95 %ile) | 732<br>363<br>533 |
| SA Border | 412 EC (80 %ile) | Murray at SA Border (A4261022) | EC (Max)<br>EC (Avg)<br>EC (80 %ile) | 269<br>173<br>198 | EC (Max)<br>EC (Avg)<br>EC (80 %ile) | 342<br>219<br>293 |
| Berri | 543 EC (80 %ile) | Murray at Berri (A4260537) | EC (Max)<br>EC (Avg)<br>EC (80 %ile) | 303<br>221<br>252 | EC (Max)<br>EC (Avg)<br>EC (80 %ile) | 473<br>289<br>402 |
| Below Morgan | 770 EC (80 %ile) | Murray at Murray Bridge (A4261162) | EC (Max)<br>EC (Avg)<br>EC (80 %ile) | 435<br>328<br>356 | EC (Max)<br>EC (Avg)<br>EC (80 %ile) | 640<br>389<br>537 |

Draft Water Quality Management Plans have been developed for South Australia's water resource plan areas that identify causes of water quality degradation, risks to water quality, water quality and salinity targets and measures that will contribute to the achievement of the water quality objectives.

A review of irrigation salinity management policies commenced in late 2016, in consultation with irrigation stakeholders and the broader community, to ensure that the policy settings are appropriate for contemporary irrigation and salinity management requirements.

On-farm efficiency measures were implemented for 186 South Australian River Murray-based irrigators that will help reduce salinity discharge to groundwater and the River while also delivering 35 GL of water entitlements for environmental use.

Construction of the South-East Flows Restoration Project commenced to help manage high salinity levels in the Coorong South Lagoon in conjunction with improved environmental flows from the River Murray.

## Efficient governance

DEWNR identified a network of 435 regional and floodplain groundwater monitoring wells to be nominated as part of the Basin-wide core monitoring network to inform monitoring and salinity register models. DEWNR has worked with the MDBA and the Basin Salinity Management Advisory Panel (BSM AP) to progress the reviews of groundwater models which underpin the assessment of 16 accountable actions on the Salinity Registers.

Run of river salinity surveys were conducted from Lock 7 to Morgan in June 2016 and 2017 to improve knowledge of the impact of salt management actions undertaken along the river

## Strategic knowledge improvement

South Australian officials have actively contributed to work to improve our knowledge of salinity impacts and management in the mallee regions of the Murray–Darling Basin.

## Community engagement and communication

Community consultation was undertaken as part of the Review of Irrigation Salinity Management project in South Australia.

## Priorities for future work (2017–18)

1. Applying new groundwater numerical models to improve our understanding of the influence of evapotranspiration, changing river levels, inundation recharge and solute transport processes within floodplains and their effect on salt fluxes to the river.
2. Development of Basin Salinity Management (BSM) Procedures to update and replace the Basin Salinity Management Strategy (BSMS) Operational Protocols.
3. Review and update of groundwater models and register entries in accordance with the BSM2030 review plan approved by the Basin Officials Committee in December 2015, including shifting existing models to new software platforms, undertaking data-gap analysis of existing models and updating our estimates of irrigation extent.
4. Finalise the Review of Irrigation Salinity Management in South Australia.
5. Continue development of Water Quality Management Plans for South Australia's three water resource plan areas: South Australian Murray Region, Eastern Mount Lofty Ranges and the South Australian River Murray

# Executive Summary: NSW BSM2030 Biennial Report 2017

Salinity remains an issue in NSW and requires on-going management. The MDBA Basin Salinity Management Strategy Annual Audit (2014-15) made the following recommendation to Basin States:

*The IAG-Salinity recommends that, in transitioning to BSM2030, jurisdictions and the MDBA should clearly communicate the success of salinity management to date, emphasizing that,* ***whilst there is no longer an impending salinity crisis, it is an issue that requires careful, ongoing management and the maintenance of current management arrangements to ensure that it remains under control.***

NSW has continued to address the ongoing challenge of salinity through a variety of measures in 2015/16 and 2016/17. Outcomes and achievements for this period are listed in line with the eight 'key elements'[2] of the Basin Salinity Management 2030 (BSM2030) Strategy, grouped into the following key topics agreed by the Basin Salinity Management Advisory Panel (BSMAP) as reportable in this 2016/17 comprehensive annual report.

1) Salinity accountability framework
2) Management of SIS
3) Salinity management
4) Efficient governance
5) Strategic knowledge improvement
6) Community engagement and communication
7) Priorities for future work

NSW maintained a credit balance on the Salinity Register in 2015/16 and 2016/17, in a continued commitment to Schedule B of the Murray–Darling Basin Agreement.

NSW actively participated in the Salt Interception Scheme (SIS) Responsive Management trial and was the driver for flow-based management trials through manipulation of weir infrastructure to achieve weir pool drawdowns.

An innovative approach to land-based salinity undertaken in 2015/16 and 2016/17 was the Hydrogeological Landscapes (HGL) framework, to characterise landscapes and spatially define risk and associated management actions. This framework underpins the salinity technical reports required under the Basin Plan and NSW has also assisted other states through the provision of this framework.

Although the 2009 Salinity Audit changed the thinking about 'achieving' End of Valley Targets[3], analysis of salinity data at target sites demonstrate that outcomes were generally achieved during 2015/16 and 2016/17, with the exception of the Macquarie River (minor exceedance) and a more significant exceedance in the Darling River.

No major reviews of Accountable Actions were listed for completion during 2015/16 or 2016/17 however several are forthcoming and will be the focus of future priority works.

[2] Some key elements have been merged as per the Table of Contents provided in the Draft BSM Procedure: Guideline for BSM2030 Reporting
[3] As listed in Table 1 in Appendix 1 of Schedule B of the Murray–Darling Basin Agreement

# Executive Summary: ACT BSM2030 Biennial Report

The ACT conducted its performance of salt load and salinity entering and leaving the ACT in 2016-17 against the 2000 baseline for the ACT end of valley target. The results for 2016-17 show that the salt load has increased considerably from the previous year level and is also above the baseline conditions. The salinity level (EC) result at Halls Crossing (leaving the ACT) was just above the 80$^{th}$ percentile peak and the median percentile peak. However, it should be noted that the ratios of outcomes of salinity at Halls Crossing were quite small compared to those entering the ACT via the Murrumbidgee River. This is a trend over the last six years (sine the Millennium Drought).

In other activities the ACT has developed a new SOURCE model which can be used to develop a new model in understanding salt load dynamics and to review existing targets. The ACT is pursuing its Healthy Waterways Project which aims to improve water quality across a range of sub-catchments in the Territory through a range of measures. The ACT is also developing an integrated water quality monitoring framework.

# Executive summary: Australian Government BSM2030 Annual Report 2016-17

Current Commonwealth interaction with BSM 2030 occurs primarily through the CEWO and the interactions of delivery of environmental water. In 2016-17, approximately 160 GL of Commonwealth environmental water, delivered through the Lower Darling River in December 2016, contributed to maintaining decreased salinity levels. Approximately 89 GL of Commonwealth environmental water was delivered through the Great Darling Anabranch from February – May 2017. Evidence after the event has indicated there were no significant adverse impacts to water quality in the River Murray.

As with previous years, Commonwealth environmental water also continued to be delivered to the Lower Murray through 2016-17, contributing to improving water quality and exportation of salt through the Murray Mouth.

In 2016-17, risk assessments were undertaken for all Commonwealth environmental water use actions. No Commonwealth environmental watering actions were found to have resulted in adverse water quality impacts.

The Commonwealth will continue to prioritise building knowledge regarding the long-term impacts of Commonwealth environmental water in maintaining salinity levels throughout the Murray Darling Basin. The Commonwealth is continuing to work on the amendments to Schedule B of the Murray Darling Basin Agreement to implement the BSM2030 agreement.