BASIN SALINITY MANAGEMENT STRATEGY- SOUTH AUSTRALIA'S ANNUAL REPORT 2014-15

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Preferred way to cite this publication:

Department of Environment, Water and Natural Resources , 2015, Basin Salinity Management Strategy-South Australia's Annual Report 2014-15, Government of South Australia, through Department of Environment, Water and Natural Resources, Adelaide

Download this document at: www.environment.sa.gov.au

Acknowledgements

This report has been compiled by the Department of Environment, Water and Natural Resources (DEWNR) with significant contributions from other agencies and organisations reflecting the cross-agency approach to managing salinity in the South Australian Murray-Darling Basin.

The Water and Climate Change Branch of DEWNR would like to acknowledge and thank the following organisations and work groups from DEWNR for their contribution to this report:

- SA Water
- Environment Protection Authority
- Primary Industries and Regions SA
- Science, Monitoring and Knowledge Branch
- Natural Resources SA Murray-Darling Basin
- Customer and Corporate Services Group
- River Murray Operations and Major Projects Branch

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1. INTRODUCTION

Good low salinity water is essential to support all users of the River Murray, including irrigators, urban water supplies, industry, the environment, and the people of South Australia. South Australia has actively contributed to the management of salinity in collaboration with partner governments across the Murray-Darling Basin since the 1980's.

For the past thirty years, the salinity threat has been successfully managed across the Murray-Darling Basin (MDB). Schedule B of the Murray-Darling Basin Agreement (Schedule 1, *Water Act 2007 (Cth)*) has provided the legislative obligation for all Basin States to manage the salinity risk. Both the Salinity and Drainage Strategy (1988-2000) and the current Basin Salinity Management Strategy (2001-2015) (BSMS) have provided the frameworks for investment and collective action to achieve the Basin Salinity Target[1].

Within South Australia key achievements under the fifteen year BSMS that have contributed to improved salinity management include:

- Development and implementation of the South Australian River Murray Salinity Strategy.
- Co-investment in salt interception scheme investigation, design, construction and operation.
- Development of a Riverland salt disposal management plan to set the direction for the management and disposal of saline water intercepted by salinity mitigation works.
- Development of a complete set of groundwater models to assess accountable actions with South Australia.
- Rehabilitation of the Loxton irrigation scheme infrastructure.
- Development and implementation of the *River Murray Act 2003* and *Natural Resources Management Act 2004* including separation of water rights.
- Implementation of an extensive irrigation efficiency program to assist irrigators to reduce water use, improve farming practices and reduce drainage and salinity impacts.
- Development and implementation of the South Australian River Murray Salinity Zoning Policy to minimise the salinity impacts associated with irrigation development.
- Extensive revegetation and land management through the Bush Bids and River Murray Forest programs.
- Development of salinity accountability tools including SIMRAT and Trades Assessment Database to monitor and record salinity impacts associated with new irrigation development.
- Investigation of innovative solutions for using salt including salt harvesting and saline aquaculture.
- Development and implementation of regional Natural Resource Management Plans and Land and Water Management Plans.

[1] 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 percent of the time, during the Benchmark Period (1 May 1975 to 30 April 2000) (Schedule B, Murray-Darling Basin Agreement).

- Investigation and development of innovative salinity monitoring techniques including run of river and Nanotem surveys.
- Assessing the potential salinity impacts of operating the Chowilla regulator and associated structures on River Murray salinity.

The conclusion of the BSMS in 2015 comes at a time when contracting governments are maintaining positive balances on the Salinity Registers, salinities in river are currently low, and there is an improved understanding of the drivers and implications of salinity across the MDB. Further improvements to in river salinities are likely through implementation of the Basin Plan, however salinity remains an ongoing risk to the health of the Murray-Darling Basin and the communities and industries that rely upon it.

South Australia remains committed to the ongoing delivery of salinity management obligations under Schedule B of the Murray-Darling Basin Agreement and the development and implementation of the proposed Basin Salinity Management 2030 (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.

Key Achievements

This report documents South Australia's accountability and delivery against the BSMS elements, and Schedule B in 2014-15, including the key salinity management activities and achievements:

- Delivery of State obligations under Schedule B of the Murray-Darling Basin Agreement, including annual report, update of BSMS Salinity Registers entries and participation in the annual independent audit.
- Groundwater modelling to support annual update of entries on the BSMS Salinity Registers.
- Development of the 2015-16 South Australian River Murray Operating Plan.
- Implementing the Sustainable Rural Water Use and Infrastructure Programs and South Australian River Murray Sustainability Program to improve irrigation efficiency and return water to the environment.
- Working with the Murray-Darling Basin Authority (MDBA) to explore options for future Basin salinity management beyond 2015 and to develop a new salinity strategy (BSM2030).

Future Work

In 2015-16, effort will be directed towards:

- Implementation of the Water Quality and Salinity Management Plan within the Basin Plan.
- Delivering the State's obligations and reporting requirements under Schedule B of the Murray-Darling Basin Agreement.
- Contributing to the review and amendment of Schedule B of the Murray-Darling Basin Agreement.
- Commencing implementation of BSM2030.
- Engaging and communicating with stakeholders.
- Reviewing South Australia's future salinity risk.

2. NINE ELEMENTS OF THE BASIN SALINITY MANAGEMENT STRATEGY

The following sections highlight actions taken within South Australia in 2014-15 to implement each of the nine elements of the BSMS:

1. **Developing capacity to implement the Strategy**
2. **Identifying values and assets at risk**
3. **Setting salinity targets**
4. **Managing trade-offs with the available within-valley options**
5. **Implementing salinity and catchment management plans**
6. **Redesigning farming systems**
7. **Targeting reforestation and vegetation management**
8. **Constructing salt interception works**
9. **Ensuring Basin-wide accountability: monitoring, evaluating and reporting**

2.1 Developing Capacity to Implement the Strategy

The Commission and partner Governments will administer a comprehensive 'knowledge generation' program to support Basin and within valley planning and implementation. The partner Governments will assist catchment communities to implement national, Basin and State initiatives by improving access to and use of the knowledge and decision tools generated by investigations and salinity research and development. This process will be supported by further capacity building for catchment planning, including communication and education. (BSMS 2001–2015)

Various initiatives are undertaken in South Australia to develop and maintain capacity to implement the BSMS. Developing capacity occurs at different levels including within local communities and groups focused towards on ground actions and within South Australian government agencies.

Groundwater Modelling

To meet obligations under the BSMS, the Department of Environment, Water and Natural Resources (DEWNR) maintains and updates a suite of accredited MODFLOW groundwater models to bring entries forward to the Salinity Registers.

The four main tasks undertaken in 2014-15 using the South Australian Salinity Register groundwater models are described below.

Chowilla Model - updated to simulate the salt load impact of operation of the Chowilla Regulator on the River Murray for four scenarios (in-channel rise only, low floodplain inundation, medium floodplain inundation and maximum floodplain inundation). The revised model reflects the current operations plan and recent surface water modelling of inundation. Improvements were also made in how the river levels and inundation were simulated.

South Australian Salinity Register models - updated to incorporate updated irrigation data. This includes revisions to the Pike-Murtho, Berri-Renmark, Loxton-Bookpurnong, Pyap-Kingston, Woolpunda, Waikerie to Morgan, and Morgan to Wellington models. This is the first time these models have been updated simultaneously. The updated models were used to estimate the salt load resulting from salinity impacts of past and future irrigation development and the salinity benefit associated with operating salt interception schemes.

Berri-Renmark model - revision of the Berri-Renmark model commenced. The model was updated to reflect improved understanding of the hydrogeology defined in previous years, principally the revised geology of the Pike-Murtho model update of 2013-14, and changes in the method of simulating the river and other features. A study was commissioned to review the irrigation history of the study area, and to develop estimates of irrigation application over time.

Groundwater flux - work commenced to summarise the model estimates of groundwater flux to the river across all models, river kilometres, scenarios, and simulated years. Once completed, the project report will also include calculations of regional groundwater flux to the floodplain aquifer for all scenarios and simulated years.

Dynamics and management of riverine freshwater lenses

The Australian Research Council Linkage project, 'Dynamics and management of riverine freshwater lenses', is a collaboration between Flinders University, DEWNR and Monash University. The project is funded by the Australian Research Council and the South Australian Riverland Floodplain Integrated Infrastructure program. The aim is to investigate the dynamics of riverine freshwater lenses using data analysis, hydrogeochemistry, and numerical modelling. The fundamental drivers of creation and degradation of lenses will be investigated under both natural conditions and various management options. It is expected to provide insight into the management of floodplain ecosystem health and into the impact on freshwater lenses on salt movement into the River Murray.

The main tasks of the project are:

- To review data from key freshwater lens field sites (including Pike, Katfish and potentially Chowilla, Bookpurnong, and Mallee Cliffs), representative of both natural and managed conditions, to determine how freshwater stored in the floodplain aquifer changes over time.
- To learn more about freshwater lens growth and decay using geochemical sampling and analysis.
- Development of a generic floodplain numerical groundwater model.
- Extensive testing of the model under different conditions against the field site data.
- Simulation of different management scenarios, including river weir pool manipulation, environmental watering and engineering works, to evaluate their impact on the freshwater lenses.
- Development of management guidelines for the freshwater lenses.

The project commenced in May 2015 and will be run for three years. There is an opportunity for this work to assist with salt interception scheme trials to determine the impacts of reduced pumping on the floodplain.

River Murray Floodplain Salinity Modelling Project

The 'Modelling salt dynamics on the River Murray floodplain in South Australia' project was a partnership between the Goyder Institute, DEWNR, Flinders University and CSIRO. The project commenced in March 2014 and was completed by May 2015. The final reports have been published and are available on the Goyder Institute website (www.goyderinstitute.org).

The first report describes a conceptual model of floodplain salinity dynamics, prioritising and locating the processes and drivers most likely to contribute to the mobilisation of floodplain salt. It includes a detailed list of relevant datasets available for the SA River Murray floodplain, an initial analysis of a new key dataset including actual evapotranspiration (from the MODIS satellite) and a review of risk methodologies for river and floodplain salinity.

The second report considers how to model floodplain salinity dynamics and reviews prior approaches to modelling groundwater and surface water processes, tests different approaches to simulating key groundwater processes and explores the use of a modified version of Source model and FORTRAN routines to model surface water.

Pike River Salt Management Field Trials

As part of the Riverine Recovery project, DEWNR has been coordinating field trials on the Pike floodplain. The aim of the trials is to test the effectiveness of a range of different measures to improve and reclaim saline and sodic soils.

Field trials were set up in late 2013 near the junction of Snake Creek and Mundic Creek, an area previously identified as having high soil salinity and sodicity. The trials are testing a range of remediation measures on a series of plots that have been planted with native seedlings. Preliminary findings identified that:

- Mulch has a clear benefit to plant establishment, growth and survival.
- Initially mulch altered soil pH from an acidic to neutral pH, however this process has now reversed with pH returning back to baseline levels for all plots.
- Mulch has led to a decrease in soil salinity in some of the plots.
- There is no evidence that watering alone leads to a long lasting reduction in soil salinity.
- Soil sodicity varies seasonally by a considerable amount with none of the treatments leading to a reduction.
- Mulch has led to an increase in soil moisture.

It is hoped that the trials on the Pike floodplain will influence the large-scale treatment of salt affected soils across floodplains in the lower River Murray. The three year project is a collaborative effort with the community, the Aboriginal Learning on Country Team and the Pike River Land Management Group.

Run of River

A closed space run of river salinity survey was conducted from Lock 7 to Lock 1 between 7-11 July 2014. Run of river surveys measure salinity at each kilometre along a river reach on (nominally) five consecutive days. The difference in electric conductivity (EC) of a parcel of water on consecutive days is assumed to be due to saline inflow.

The data from the 2014 survey has been analysed by Australian Water Environments (AWE) to compare results with previous surveys and assess salt loads to indicate Salt Interception Scheme (SIS) performance. The findings of the Run of River have aligned with previous surveys and confirmed the effectiveness of SIS in reducing salt loads to the River Murray. Figure 1 below shows the cumulative Run of River Salt inflows for Lock 5 to Lock 7.

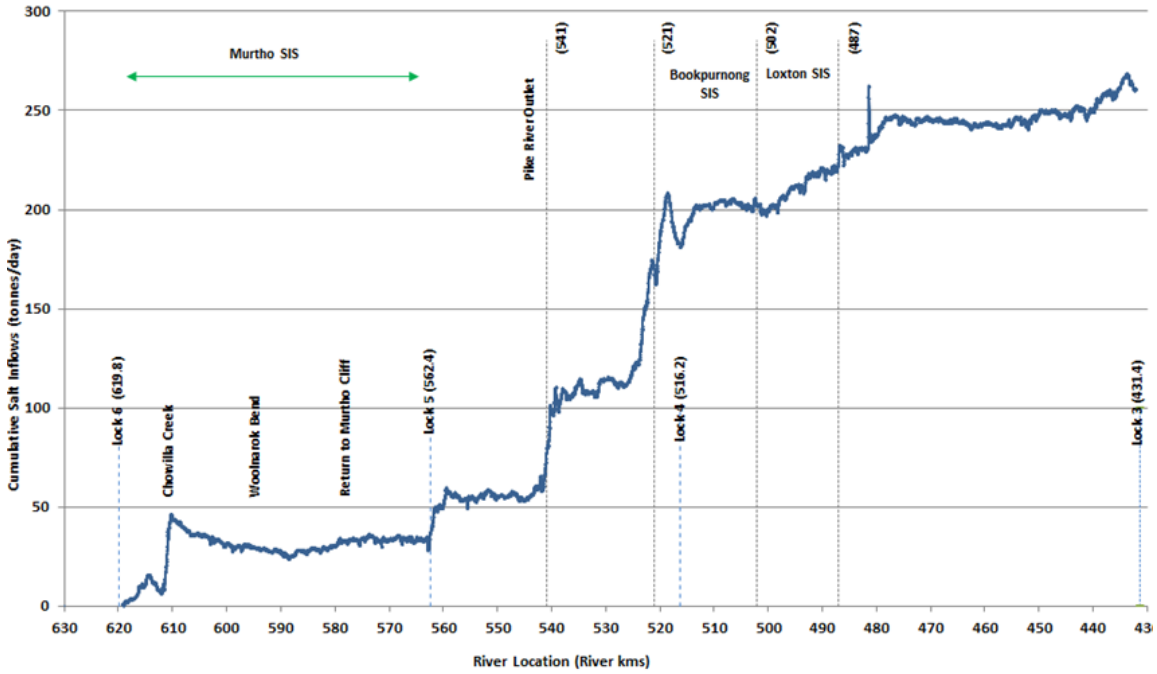

Figure 1- Run of River Cumulative Salt inflows Lock 5 to Lock 7

2.2 Identifying Values and Assets at Risk

The partner Governments will work with catchment communities to identify important values and assets throughout the Basin at risk of salinity, and the nature and timeframe of risk. This Strategy emphasises the triple-bottom-line approach, requiring a balance between economic, environmental and social values. It necessarily recognizes that living with salinity is the only choice in some situations.

(BSMS 2001–2015)

South Australia recognises that an emerging issue is ensuring mitigation and management of any adverse salinity impact associated with environmental watering.

Chowilla Icon Site Operation and Monitoring

The Chowilla floodplain is one of the six icon sites under The Living Murray (TLM) program. It is recognised that managed inundation of the floodplain via operation of the Chowilla environmental regulator will reduce soil salinity, thereby improving vegetation health and providing an environmental benefit to the Chowilla region.

This inundation may result in discharge of salt into the Chowilla Creek and ultimately to the River Murray and so work has been undertaken to assess both long term and short term salinity impacts associated with operation of the Chowilla regulator structures. This work has informed the development of an operating strategy for the regulator which includes actions to mitigate salinity risks associated with operation through adaptive management of the operational extent, duration and rate of drawdown.

Initial testing of the regulator and ancillary structures was undertaken during spring 2014 and provided an opportunity to commence validation of the modelled salinity impacts and assess risk mitigation measures. The testing involved mid-level operation of the Chowilla regulator to 19.1 mAHD resulting in a floodplain inundation of approximately 2,300 hectares of wetlands and floodplains.

The surface water monitoring network indicated only a slight increase in salinity (20 EC) in the River Murray during, and on recession of the testing event. This increase in salinity is similar to the typical background increase in salinity downstream of Chowilla Creek in the Murray River, and the salinity levels recorded during and following the testing are relatively low in comparison to averages recorded over previous 12 months. Work to assess the impacts of the testing against the modelled salinity impacts is ongoing.

South Australian Riverland Floodplains Integrated Infrastructure Program

The South Australian Riverland Floodplains Integrated Infrastructure Program has commenced and has initially focused on the Pike and Katarapko floodplains. The program aims to construct environmental regulators and levee banks to inundate large areas of floodplains, and salt interception and groundwater management schemes to address salinity issues in the area.

The project is currently in the feasibility and investigations phase to determine a preferred option for proposed works and prepare investment proposals for government consideration prior to proceeding to the detailed design and construction phase.

In 2014-15 the program investigations have included on-ground, in-stream and aerial groundwater surveys at the Pike and Katarapko floodplains. This information has improved the understanding of the

influence of groundwater salinity on existing floodplain vegetation. Investigations have also been undertaken to assess how surface water and groundwater management actions may impact real time and long term salinity.

A floodplain groundwater model is also being developed for the Pike floodplain. This model will be used to refine the quantification of the salinity impacts of floodplain management actions and assist in the evaluation of groundwater management options for achieving both ecological and salinity benefits for the floodplain and South Australia.

South East Flows Restoration Project

The South East Flows Restoration Project (SEFRP) aims to help prevent excessive salinity levels in the Coorong South Lagoon. The project is jointly funded under the Australian Government's Sustainable Rural Water Use and Infrastructure Program and South Australia's Murray Futures program, and is part of the Coorong, Lower Lakes and Murray Mouth Recovery Project.

The SEFRP seeks to assist in maintaining salinity in the Coorong South Lagoon within the target range of 60 g/L to 100 g/L (93,600 - 156,000 EC) by restoring inflows from the South East of South Australia. The flows to the South Lagoon from the South East will complement River Murray Flows over the barrages in maintaining salinity levels, but not water levels, in the South Lagoon. Water levels in the Coorong South Lagoon are dependent upon barrage flows.

The SEFRP comprises a package of infrastructure works and an accompanying environmental program. The following progress was made on the project in 2014-15:

- Concept design for the southern section of the channel alignment was completed.
- Detailed design commenced following community and land holder engagement.
- Ongoing water quality risk analysis and monitoring commenced.
- Onsite vegetation and fauna surveys were completed.

Disposal Basin Management

Drainage water from the former South Australian Government irrigation areas in the Riverland, is disposed to 17 basins, principally on the river floodplain, close to the river edge. Historically DEWNR and its forerunners have managed infrastructure (e.g. earth banks, and inlet and outlet structures) or engaged Central Irrigation Trust and SA Water personnel to operate infrastructure at 16 of the basins to permit the drainage water to be discharged to high rivers and flush the basins.

As a consequence of the rehabilitation of irrigation water supply systems, improved water management, improved irrigation practices and changes in crop types, the volume of drainage water has declined over the last decade to the point where most if not all of the drainage water is lost to evaporation. This trend is expected to continue for the foreseeable future thus reducing the need for those floodplain basins to dispose of drainage water to the river.

The reduced need for the floodplain disposal basins provides opportunities to identify options for the future management and rehabilitation of the disposal basins (e.g. by management of their water regime). Berri Barmera Council has taken over full responsibility and management of the Berri Stormwater basin while Loveday Disposal Basin and Mussel Lagoons Wetland Complex are being managed as part of an Integrated Management Plan for ecological benefits.

There is opportunity for similar arrangements to be put in place for other floodplain drainage basins that are no longer required. This process will need to:

- Determine the ongoing management objectives for drainage basin infrastructure.
- Negotiate transfer of infrastructure to appropriate alternative bodies if it is no longer needed by DEWNR to meet objectives.
- Ensure development of management plans for basins where required, including, if necessary, guidelines for flushing them.

Some floodplain disposal basins remain critical to divert saline groundwater from salt interception scheme operations to the inland disposal basin at Noora.

Murray Mouth Dredging

The Murray Mouth, near Goolwa in South Australia, is a dynamic system influenced by the flow of River Murray water through the barrages and tidal movement from the Southern Ocean. When River Murray flows to South Australia and barrage releases are low, sand deposits may occur inside the mouth causing restrictions and increasing the risk of closure.

Maintaining an open mouth is a key objective under the Murray-Daring Basin Plan, which was adopted in 2012. An open Murray Mouth is important to maintain connectivity between the river, the Coorong and the Southern Ocean, to discharge salt and other nutrients out to sea, and to maintain healthy ecosystems in the Coorong.

Recently flows with the River Murray have been insufficient to provide for scouring flows at the mouth and dredging operations have been undertaken (since 9 January 2015) to maintain connectivity (exchange of water) between the river and the Southern Ocean.

At 5 July 2015, a total of approximately 590 000 cubic metres of sand had been removed. Routine monitoring has confirmed an improvement in the condition of both channels as a result of dredging. The cost of implementing the dredging program is being shared equally between the Commonwealth, South Australian, Victorian and New South Wales governments.

2.3 Setting Salinity Targets

The Ministerial Council will adopt end-of-valley targets to protect values and assets while providing for targets to be revised, as new information becomes available. The partner Governments will empower catchment management organisations to advise on end-of valley targets and determine within-valley targets and monitoring arrangements, under salinity and catchment management plans.

(BSMS 2001–2015)

In 2014-15 South Australia has contributed towards the review of the role and basis for End of Valley Targets as part of the development of the Basin Salinity Management 2030 strategy.

End of Valley Targets

The end of valley targets have formed an important element of the BSMS and have been influential in supporting ongoing monitoring, investigation and model development to improve the understanding of salt processes and sources within catchments.

South Australia supports the retention of the end of valley targets as a risk management mechanism for the catchments. Continued salinity monitoring at all end of valley sites will contribute to the continued improvement of knowledge and understanding of salinity processes and to provide an early warning mechanism should salinity increase within a catchment.

2.4 Managing Trade-offs with the Available Within-Valley Options

The States will analyse and review the best mix of land management, engineering, river flow, and living with salt options to achieve salinity targets while meeting other catchment health targets and social and economic needs. The States will assist communities to understand and agree the options with affected groups, industries and people through best practice planning processes.

(BSMS 2001-2015)

The Government of South Australia is working with local communities, scientists, technical experts and engineers to address tradeoffs and develop long-term sustainable solutions through the development environmental watering plans and annual operating strategies.

Annual and Long-Term Environmental Watering Planning

The 2015-16 Annual Environmental Watering Plan for the River Murray was developed during 2014-15 to document the South Australian priorities for environmental water delivery for the 2015-16 water year. It identifies the annual environmental watering priorities as required by the Basin Plan and aims to ensure that the best environmental outcomes are achieved for the South Australian stretch of the river and its floodplains and wetlands.

The annual environmental watering priorities must identify salinity risks associated with delivery of environmental water and ensure that due regard is given to the requirement to not exceed salinity targets specified in the Water Quality and Salinity Management Plan (Chapter 9 of the Basin Plan).

The watering priorities included in the Annual Environmental Watering Plan for the River Murray in 2015-16 while focused on environmental outcomes also have potential to reduce salinity, for example:

- provision of water to the Lower Lakes, Coorong and Murray Mouth to enable connectivity between the Lakes, Coorong and ocean, keep the Murray Mouth open and help to reduce salinity levels in the Lakes and Coorong
- provision of water to connected evaporation basins to reduce salinities and maintain and enhance threatened populations of Murray hardyhead fish.

DEWNR is also working on the development of long term watering plans for the three water resource planning areas. A draft of the South Australian River Murray Long Term Watering Plan has been prepared and targeted community consultation undertaken. The Plan is due for submission to the MDBA in November 2015.

SA River Murray Annual Operating Plan

South Australia's River Murray Annual Operating Plan (SA Operating Plan) guides transparent and coordinated River Murray operational decisions in South Australia. The 2014-15 SA Operating Plan seeks to integrate and optimise the delivery and management of water to, and within, South Australia consistent with relevant policy and agreements including the Basin plan and Murray Darling Basin Agreement. This includes assessing and managing salinity risks.

Key salinity outcomes in 2014-15 include:

- Salinity was maintained below the identified targets at locations identified in the Basin Plan and 2014-15 SA Operating Plan for 100 per cent of the time during 2014-15 (refer to Table 1).
- Coorong South Lagoon average daily salinity was maintained below 100 parts per thousand (ppt) in accordance with ecosystem resilience requirements for 363 days (average salinity for remaining two days was 102 ppt).

Table 1- Basin Plan Targets for Reporting Sites - Salinity in 2014-15

Location	Target (EC) (µS/cm)	Max (EC) (µS/cm)	Min (EC) (µS/cm)	Ave (EC) (µS/cm)
Lock 6	580	410	110	180
Morgan	800	576	222	298
Murray Bridge	830	581	298	354
Milang	1 000	890	600	750

River Murray Decision Support System

The Goyder Institute for Water Research is currently undertaking a project to extend and enhance the River Murray Source model from the South Australian border down to the barrages. The intent of the Decision Support System is to provide the DEWNR River Murray Operations and Major Projects Unit with a tool to assess the salinity, water quality and flow implications of potential river infrastructure operational scenarios, using a range of hydrological and ecological assessment metrics.

2.5 Implementing Salinity and Catchment Management Plans

This Strategy acknowledges gains made by existing plans, but requires that actions in existing and new plans, or the plans themselves, will need to be assessed and reported against the end of-valley and Basin targets and recorded on Salinity Registers.

The partner Governments will continue and enhance support for land and water management plans (LWMPs) in irrigation regions.

The partner Governments will enhance support for development and implementation of ICM Policy-compliant salinity and catchment management plans in dryland regions.

(BSMS, 2001-2015)

The significance of River Murray salinity as an issue for South Australia is reflected in it being recognised through key State level and regional strategies and plans. The aim is to facilitate management action within South Australia that contributes to improved salinity outcomes locally and thus assists in meeting BSMS objectives.

South Australian State Natural Resources Management (NRM) Plan

The blueprint for managing South Australia's natural resources 'Our Place Our Future': State Natural Resources Management Plan, South Australia 2012 – 2017, was released by the Minister for Sustainability, Environment and Conservation on 5 June 2012.

The Plan contains policy for the overarching management of South Australia's natural resources. It provides a framework for all natural resources management initiatives and takes into account the objectives of South Australia's Strategic Plan.

Management of salinity and water quality is recognised under guiding target 6 - 'maintain the productive capacity of our natural resources'. A key measure for this target is trends in water quality including salinity in the River Murray.

Water for Good - A plan to ensure our water future to 2050

The relevant Water for Good action (Action 56) is to 'Maintain a positive balance on the MDBA's Salinity Register, and continue to implement strategies and actions to ensure the real time management of salinity in the lower reaches of the River Murray so that water quality remains at levels suitable for human consumption'.

The desired outcome is that the entire length of the River Murray is a healthy, working waterway that continues to provide critical human water needs for Adelaide and regional South Australia, irrigation requirements and water for the environment. Key performance indicators include measurement of salinity and water quality levels in the Lower Murray.

DEWNR is currently undertaking an initial five year review of Water for Good.

South Australia's Strategic Plan

Management of salinity in the MDB continues to be recognised in the South Australian Strategic Plan (SASP) with a specific salinity target: River Murray Salinity – South Australia maintains a positive balance on the MDBA's Salinity Register (T.77).

To assist in achieving the target four key strategies are implemented and reported on annually. The four key strategies are:

- Develop and implement salinity management policies, including influencing the national Murray-Darling Basin legislative and policy agenda.
- Reduce salt loads to the River Murray through constructing, operating and maintaining infrastructure to intercept the salt.
- Partner with the irrigation community to reduce the salinity impacts of irrigation on the River Murray.
- Ensure that South Australia's salinity accountability is accurate and transparent.

Water Allocation Plan for the River Murray Prescribed Watercourse

The South Australian Murray-Darling Basin Natural Resources Management (SA MDB NRM) Board, in accordance with the *Natural Resources Management Act 2004*, (NRM Act) is responsible for developing Water Allocation Plans for the South Australian MDB region in partnership with DEWNR.

The Water Allocation Plan for the River Murray Prescribed Watercourse (River Murray WAP) is a statutory document that sets out the rules for managing the take and use of prescribed water resources. The River Murray WAP contains principles that minimise the salinity impact associated with irrigation, promotes efficient irrigation and require annual irrigation reporting.

A formal amendment process for the River Murray WAP is currently underway. The draft revised River Murray WAP released for public consultation in late 2014, includes the South Australian Salinity Zoning Policy and water use efficiency principles within the River Murray WAP.

SA MDB NRM Plan

A revised South Australian Murray-Darling Basin Regional Natural Resources Management Plan (Regional NRM Plan) was adopted by the Hon. Ian Hunter MLC, Minister for Sustainability, Environment and Conservation in January 2014. The relevant resource condition targets for salinity management include:

W1: All water resources are managed sustainably by 2030

W2: Improve water quality to meet regional water needs by 2030

W3: Water is available and managed to enhance and maintain the ecological function and resilience of water dependent ecosystems by 2030.

River Murray Act

The *River Murray Act 2003* provides for the protection and enhancement of the River Murray and related areas and ecosystems. The *River Murray Act 2003* has two specific objectives which relate to the management of salinity in the river, these are:

- water quality within the River Murray system should be improved to a level that sustains the ecological processes, environmental values and productive capacity of the system

- the impact of salinity on the ecological processes and productive capacity of the River Murray system is to be minimised.

Water Resource Plans

A key element of Basin Plan implementation in South Australia is the development and implementation of Basin Plan compliant Water Resource Plans for each of the State's three Water Resource Plan areas. Water Resource Plan requirements are set out in Chapter 10 of the Basin Plan, with specific water quality provisions included in Part 7.

The water quality provisions, require that Water Resource Plans establish a Water Quality Management Plan that has been developed with consideration of the impacts of wider natural resource management and land management on water quality within the Water Resource Plan area.

The development of South Australian Water Quality Management Plans progressed well in 2014-15 with a risk assessment undertaken for the SA Murray Region Water Resource Plan area and the submission of a development program and draft Water Quality Management Plan to the MDBA for comment. In 2015-16 the draft SA Murray Region Water Quality Management Plan will be finalised for consultation and work will commence on the development of a Water Quality Management Plan for the Eastern Mount Lofty Ranges.

2.6 Redesigning Farming Systems

The partner Governments will coordinate and enhance research and development into new farming and forestry systems that deliver improved control of groundwater recharge in the high rainfall grazing, winter rainfall cropping, and summer rainfall cropping zones. Over and above current programs the Commission will enhance research and development into new industries based on salinised resources, such as broadacre saltland agronomy, saline aquaculture, and salt harvesting.

(BSMS, 2001-2015)

Minimising the salinity impact of irrigation actions remains of critical importance. By improving irrigation efficiency and applying the latest irrigation technology on farm the sustainability of irrigation developments is enhanced while minimising discharge of saline groundwater to the River Murray.

Sustainable Rural Water Use and Infrastructure Programs

During 2014-15 the SA MDB NRM Board formally executed a funding agreement through Round 4 of the Australian Government's On-Farm Irrigation Efficiency Program. The agreement will provide funding of over $30 million and support approximately 90 on farm irrigation projects.

The Round 4 On-Farm Irrigation Efficiency Program projects will increase the efficiency and productivity of rural water use in the Murray-Darling Basin and aims to deliver water savings exceeding 12.5GL, of which approximately 8.4GL of water entitlement will be returned to the environment.

The types of works to be funded under the program, and delivered by the SA MDB NRM Board, include conversion from sprinklers to drip irrigation, modernising existing drip irrigation, laser levelling of paddocks, converting to centre pivot irrigation systems and the installation of on-farm automation, monitoring and control technologies.

The execution of the Round 4 funding agreement follows the previous successful applications by the SA MDB NRM Board through the first three rounds of the On-Farm Irrigation Efficiency Program. The first three rounds of the program supported 293 on farm irrigation efficiency projects and achieved total water savings of 16GL of which approximately 11.3GL of water entitlement has been returned to the Australian Government for environmental purposes.

South Australian River Murray Sustainability Program

In August 2013 a National Partnership Agreement between the South Australian and Australian Governments was signed allocating $265 million to the South Australian River Murray Sustainability Program (SARMS).

The Program aims to recover 40GL of water access entitlements from participating irrigators through the upgrading of irrigation infrastructure to ensure irrigators remain at the forefront of irrigation practice. Improvements in irrigation efficiency will reduce drainage and thus salinity impact on the River Murray.

A range of innovative and progressive projects designed to contribute to the SARMS Irrigation Efficiency Improvement Program (SARMS-3IP) objectives and Basin Plan targets, ranging from technical improvements to irrigation infrastructure through to entirely new business propositions were received under rounds one and two of SARMS-3IP.

Successful projects for 3IP Round One were announced on 21 July 2014. 3IP Round One has delivered $102.5 million in funding offers to 108 projects, and secured 20 GL of water access entitlements to return to the environment under the SARMS Program.

Successful projects for 3IP Round Two were announced on 20 May 2015, with $66.3 million offered to 60 projects that will return a further 14 GL of water access entitlements.

New Horizons

The New Horizons program aims to improve poor quality soils and increase broad acre crops and pasture production. Trials conducted as part of the New Horizons research program will identify cost effective techniques that can deliver positive changes to the productivity of soils. The treatments being compared include non-wetting being addressed through the addition of clay, compaction treated with a spader, nutrient and water holding capacity being addressed by mixing clay and organic matter and using organic matter to stimulate microbial activity.

The adoption of these practices would represent a revolution in farm management, from managing the top ten centimetres to managing the top fifty centimetres of soil. By modifying the top soil it is expected that root growth, plant vigour and water use efficiency is improved.

This will lead to increased fertility, long term storage of carbon, reduced soil erosion risk, improved water use efficiency and hence a large increase in productivity and profitability for farmers. In the Mallee region these improvements are also likely to result in improved water utilisation and decrease deep drainage to underlying saline aquifers.

The first trial site in Karoonda, hosted by the Mallee Sustainable Farming Group is a collaborative project with PIRSA, DEWNR, NRM Boards, the University of South Australia and University of Adelaide.

Mallee Dune Seepage

Mallee dune seeps have emerged as an issue affecting grain growers across the Murray Mallee. Seeps are generally caused by lower water use on sand dunes which results in increased discharge to adjacent swales that are underlain by Blanchetown clay. The discharge areas start as non-saline wet areas, which over time become waterlogged and eventually become saline as water evaporates.

The SA Murray-Darling Basin NRM Board is supporting a project to investigate methods for identifying areas at risk from dune seepage and to help choose appropriate management options that can be strategically implemented.

The project is utilising electromagnetic (EM) survey to measure the electrical conductivity of the soil, drilling exploratory wells to examine soil layers, satellite imagery to identify the direction of spread of existing seeps and soil moisture probes to help understand the nature of these seepages. Piezometers are also being installed at sites to measure groundwater pressure deep in the soil.

The project will also trial a number of management options including the use of high water use plants such as Lucerne, perennial salt tolerant shrubs and strategic tree planting. For solutions to be effective it is essential that environmental and agronomic solutions are practical and cost effective.

2.7 Targeting Reforestation and Vegetation Management

The partner Governments recognise the necessity for landscape change specifically targeted at salinity control. In order to facilitate such targeted change, where changed farming systems are not adequate, the Commission will further develop the concept of a vegetation bank to have the capacity to finance extension of forestry outside of traditional forestry areas.

The partner Governments will further consider the financing of native vegetation management, rehabilitation and land stewardship, and the commercialisation of short rotation tree crops, particularly for the wheatbelt.

(BSMS, 2001-2015)

Reforestation and vegetation management activities are significant in promoting overall catchment health and land management. Reforestation can also provide long-term benefits in terms of stabilising groundwater movement and thus discharge of saline groundwater to the river.

BushBids

BushBids is an ecosystem services payment scheme focused on protecting and managing existing native vegetation. The program complements investment in biodiversity conservation through projects such as landscape scale feral animal control programs, wetland management, NatureLinks, Regent Parrot and other threatened species recovery projects.

Bush Bids is designed to ensure that:

- Landholders can determine the suite of management services they wish to offer, and bid for the payment of costs associated with providing those services.
- Landholders can determine the price for implementing the management plan for conservation of native vegetation.
- The quality and extent of native vegetation improves and contributes to the health of the whole catchment.
- Public funds are spent on achieving the highest biodiversity gain per unit cost.

The South Australian Murray-Darling Basin NRM Board has been successfully implementing BushBids projects since 2005 to maintain and enhance the biodiversity values across the region, with over 22,000 Hectares of native vegetation under comprehensive management. An overview of BushBids programs undertaken across the region is included below.

Eastern Mount Lofty Ranges BushBids

The project ran two tender rounds in 2005 and 2006, with successful landholders currently contracted to undertake action from 2006 until 2016. The project includes 70 sites across 39 properties throughout the EMLR region.

River Bend BushBids

The program successfully established conservation agreements over 5,757 ha of native vegetation on private land in the northern Murray Plains, Northern Mallee and the southern Rangelands of the South Australian Murray-Darling Basin region. River Bend BushBids followed the conservation tender methodology of previous successful BushBids programs.

Southern Mallee BushBids

Conservation agreements for over 1,218 ha of native vegetation were established on private land in the southern mallee area as part of the program. The project exceeded most targets, with more than one-hundred and twenty per cent of the expected area contracted for conservation management.

Woodlands BushBids

The Woodlands BushBids program was successful in contracting 70 sites for five years of active management. The project will ensure that 5,337 hectares of woodlands in the western Murray Mallee is protected and managed with comprehensive management plans created for 12,207 hectares of native vegetation.

South Eastern BushBids

The South Eastern BushBids project has been delivered in partnership with Natural Resources, South East. Close to 8,000 hectares of native vegetation is being managed with the guidance of 10 year agreements. Landholders are implementing comprehensive management actions across the SA Murray-Darling Basin and South East regions.

River Murray Forest

The River Murray Forest Project is a pioneering project, initiated by the State Government in 2006 with the aim of linking biodiversity assets, and offsetting greenhouse gases through carbon sequestration. Approximately 1,500 hectares of native vegetation has been established on both private and public land within the project area.

As part of the final stage of the River Murray Forest Project, native vegetation will be established across 6 additional public land sites. Significant planning works have been undertaken with the aim of achieving an additional 240 hectares of revegetation within the project area. In 2014-2015, the first phase of revegetation works were undertaken at 4 sites, including:

- Marne Valley Conservation Park- 8 km east of Cambrai (29 hectares of direct seeding will be undertaken adjacent the Marne River on previously cleared land).
- Lowan Conservation Park 30 km east of Mannum (47 ha block of cleared and previously cropped land to be revegetated).
- Ettrick Conservation Park – 15 km east of Mannum, a newly proclaimed conservation park. (15 ha of cleared/previously cropped land for revegetation).
- 'The Lunettes' – Crown Land adjacent Katarapko Conservation Park (30 ha of degraded sand dunes).

Noora Disposal Basin

Noora Basin covers approximately 3,600 hectares and was commissioned in 1982 as an evaporation basin originally designed to receive drainage water from the Berri and Renmark irrigation area drainage

disposal schemes. Later the Bookpurnong, Loxton, Murtho and Pike Salt Interception Schemes were added.

During 2010 to 2011, additional areas of previously privately–owned land (approximately 546 hectares) were acquired by DEWNR to expand the potential drainage disposal capacity and to create a buffer zone around the basin boundary.

Increased inundation by saline water will result in the destruction of pockets of native vegetation in low lying areas. To manage this impact a Significant Environmental Benefit (SEB) was undertaken to offset the clearance of native vegetation by inundation. The SEB requires the revegetation of those areas of the basin that will not be inundated.

The SEB has been achieved through revegetation works coordinated by Rural Solutions SA during 2011, and has continued in 2014 and 2015 under arrangements negotiated through the South Australian No-Till Farming Association, resourced through the Federal Biodiversity Fund. During the last two years a combination of direct seeding and planting of seedlings has introduced approximately 100,000 direct seedlings plus in excess of 500 km of direct seed-drilling. This will considerably improve the terrestrial landscape and biodiversity at this site.

Figure 2- 2015 revegetation works at Noora disposal basin.

2.8 Constructing Salt Interception Works

The Commission will construct and operate new joint (partner Government funded) salt interception works to protect Basin-wide assets and values, including the shared water resources of the Murray and Darling Rivers. This will provide protection beyond the benefits from simply meeting end-of valley targets, based upon agreed cost sharing and benefit allocation principles. The benefits will continue to include salt disposal entitlements to offset the impacts of future actions that aggravate salinity.

(BSMS, 2001-2015)

Salt interception remains a key salinity mitigation strategy for the River Murray. Salt interception has proven invaluable in providing a reduction of saline groundwater flows to the River Murray, thereby reducing in-river salinity and protecting water quality for all water uses.

A key element of the BSMS has been the implementation of the joint works program to offset a predicted 61 EC future increase in average salinity at Morgan. Since the BSMS came into effect, the partner governments of New South Wales, Victoria, South Australia and the Australian Government have invested in the construction, operation and maintenance of Salt Interception and Drainage Disposal Schemes to meet the salinity targets of the BSMS.

As part of the 61 EC joint works program the Bookpurnong, Loxton, Waikerie Lock 2 and Murtho Salt Interception Schemes (SIS) were constructed in South Australia. These SIS complement the Waikerie and Woolpunda SIS constructed under the Salinity and Drainage Strategy and the Qualco-Sunlands and Pike SIS which are South Australian state actions.

The SIS located within South Australia prevent on average 200,000 tonnes of salt per year from reaching the River Murray and have shown to significantly contribute to the achievement of the Basin Salinity Target as assessed by the modelled long-term average salinity outcome of less than 800 EC for 95% of the time at Morgan and the maintenance of acceptable salinity levels above lock 1 during low flows.

An overview of SIS located within South Australia is provided below.

Woolpunda SIS

Woolpunda SIS is a highland scheme with rows of bores located 0.5-1 km back from the cliffs on either side of the river between Lock 2 and Lock 3. The scheme is the largest and oldest in South Australia, consisting of 49 production bores distributed over 33 km. The scheme has been continually operational for over 20 years.

Waikerie SIS

The Waikerie SIS operates between Lock 2 and the Holder settlement, east of Waikerie. The scheme was developed in stages; Waikerie Stage 1 consisting of 17 bores was commissioned in 1992, Waikerie Stage IIA consisting of 12 bores was commissioned in September 2003, and Waikerie Lock 2 consisting of seven bores was commissioned in 2009.

Bookpurnong SIS

The Bookpurnong SIS is located on the eastern side of the River Murray, 8 km south of Berri and is comprised of 15 floodplain bores (typically pumping groundwater from a depth of 7 metres) and seven

highland bores (typically pumping from a depth of 45 metres). The purpose of the scheme is to intercept saline groundwater from the Bookpurnong Irrigation District.

The Bookpurnong SIS was the first scheme designed to provide additional environmental benefit to the floodplain. The highland borefield has been specifically located to hold back the regional groundwater flow to allow natural flooding of the floodplain to occur.

Loxton SIS

The Loxton SIS is located adjacent to the Loxton Township and was approved for construction by the MDBA as a joint works scheme under the BSMS in 2003. The purpose of the scheme is to intercept saline groundwater from the Loxton Irrigation District.

The scheme was constructed in two stages, a floodplain and a highland scheme. Due to the complex hydrogeology in this region a number of unique interception techniques were developed in addition to the standard type of production bores. The Loxton Floodplain SIS, which has been operational since 2009, comprises 28 production wells, and a 285 metre Cliff Toe Drain. The Loxton Highland SIS, comprises 21 convention production bores, five low yielding airwell production bores and a horizontal well with 250 metres of production zone. The scheme disposes the intercepted saline groundwater to the Noora Basin, located approximately 20 km east of Loxton.

Pike SIS

The Pike SIS is approximately 5 km south-west of Renmark, between Lock 5 and Berri in the Pike River Region. An approval submission for the Pike SIS was submitted to the MDBA in April 2009 for consideration. The scheme was recognised by the MDBA as a technically sound proposal; however a decision regarding arrangements for cost sharing for construction and operation and maintenance was deferred.

In order to utilise available funding South Australia constructed a portion of the Pike SIS (four production bores), which was commissioned in 2011. South Australia continues to investigate opportunities to expand the Pike SIS through the South Australian Riverland Floodplain Integrated Infrastructure Program.

Qualco-Sunlands Ground Water Control Scheme

The Qualco-Sunlands Ground Water Control scheme consists of 12 bores dedicated to reducing the water logging risk in the irrigation area and three salt interception bores designed to prevent saline groundwater entering the River Murray. The three salt interception bores align with the Waikerie Lock 2 SIS.

Murtho SIS

The Murtho SIS was the last scheme to be completed under the 2001 Basin Salinity Management Strategy 61 EC joint program. Construction of the Murtho Scheme commenced in 2008 and was completed in June 2013.

The Murtho Salt Interception Scheme consists of 23 production bores (21 on highland locations and two on the floodplain). In addition a total of 40 observation bores have been constructed to assist with the operation of the scheme. Typically the production bores on the floodplains will pump groundwater from about 10 metres in depth while the highland bores will pump groundwater from up to 62 metres.

2.9 Ensuring Basin-Wide Accountability: Monitoring, Evaluating and Reporting

The partner Governments will demonstrate accountability by reporting to the Commission and Council through State end-of-valley Report Cards and Commission Salinity Registers that record the salinity effects of actions, including salt interception schemes and salinity and catchment management plans. The Council will receive audits every five years for each valley and Commission Register entry, assessing impacts on river salinity and progress towards targets, with the provision to require further action as necessary.

(BSMS, 2001-2015)

South Australia undertakes a number of salinity monitoring, evaluating and reporting programs. These programs help support South Australia to meet long-term accountability requirements under Schedule B (BSMS Salinity Registers entries) as well as providing a basis for understanding the short-term variations in river salinity to guide real-time management actions.

Groundwater Models in South Australia

A series of accredited groundwater models span the length of the River Murray in South Australia, as shown in Figure 3. The models include the MDBA's analytical rapid assessment tool SIMRAT and the South Australian complex numerical groundwater models (MODFLOW). The models underpin the estimation of salt loads entering the River Murray from the South Australian border to Wellington and are the basis for Joint Works and South Australia's accountable action entries on the BSMS Salinity Registers.

The SIMRAT model is utilised as a rapid assessment tool to report on estimated salinity impacts of annual increases to licensing approvals. The following entries on the Salinity Registers are informed directly by the SIMRAT model:

- SA Irrigation Development Due to Water Trade
- SA Irrigation Development Based on Site Use Approvals

From 1988 to 2009, changes to water trade were the basis for these annual assessment (summarised in the first entry above). Following the separation of water rights for the River Murray in South Australia on 1 July 2009, increases to Site Use Approval variations have become the basis for annual assessments and are summarised in the second entry listed above on the Salinity Register.

Both these entries are considered short term Salinity Register entries as they are gradually replaced by the output of the more sophisticated regional numerical groundwater models (entry titled SA Irrigation Development Based on Footprint Data).

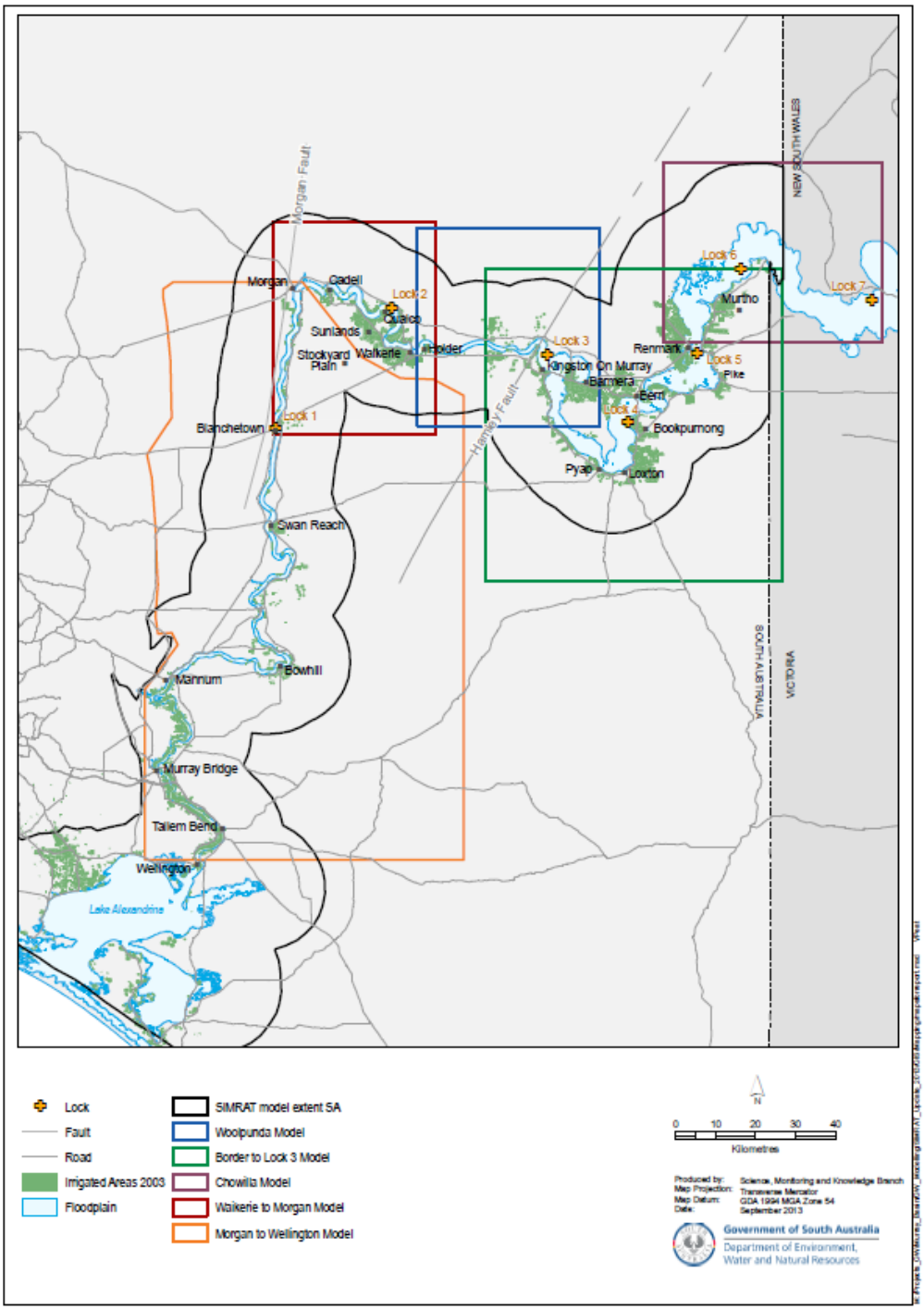

Figure 3- Coverage of Groundwater Models in South Australia

While SIMRAT is accredited to inform the salinity impacts of irrigation development, the South Australian MODFLOW models have been accredited to simulate multiple actions for entry on the salinity registers, including mallee clearance, irrigation development, improved irrigation practices and rehabilitation of irrigation infrastructure, groundwater control and salt interception schemes. These actions are simulated in a range of scenarios within each model. The models inform actions on the salinity register, as described in Table 2, and underpin the calculation of the sharing arrangements for shared works salt interception schemes in South Australia. The sharing ratios estimated by the models are applied to operations and maintenance costs and salinity credits.

Table 2- Source of 2014 Salinity Register entries

Source	Salinity Register Entries
SIMRAT	- SA Irrigation Development Due to Water Trade - SA Irrigation Development Based on Site Use Approvals
Individual MODFLOW Model Output	- Waikerie Phase 2A SIS - Bookpurnong SIS - Loxton SIS - Waikerie Lock 2 SIS - SA Component of Bookpurnong SIS - SA Component of Loxton SIS - SA Component of Waikerie Lock 2 SIS - Qualco Sunlands GWCS - Pike Stage 1 SIS
Collective MODFLOW Model Output	- SA Irrigation Development Based on Footprint Data - SA Improved Irrigation Efficiency and Scheme Rehabilitation Reg A - SA Mallee Legacy of History - Dryland - SA Mallee Legacy of History – Irrigation - SA Improved Irrigation Efficiency and Scheme Rehabilitation Reg B
In-river assessment	- Woolpunda SIS - Waikerie SIS

South Australian Reviews

An important BSMS salinity registers process is the review of entries and the models which underpin them. Salinity register entries require review every five years (Schedule B, clause 33 (1b)) while models are required to be reviewed before 31 December 2014 and thereafter at intervals of not more than seven years (Schedule B, clause 39 (1a)).

As the MODFLOW models have been developed and accredited at different times, with their outputs contributing to multiple entries on the BSMS salinity registers, the timing for the 5 year review of each of South Australia's BSMS salinity register entries is not a single date. Accordingly, entries will be updated as the individual MODFLOW models that contributed to the entry are updated.

South Australia has recently conducted reviews and updates of Waikerie to Morgan, Woolpunda and Pike-Murtho MODFLOW models. The Waikerie and Woolpunda SIS have also undergone technical review, as per Schedule B (clause 33 (4 and 5)). The resulting salinity register updates from these model reviews and technical SIS reviews will be progressed in 2015-16.

Accountable Actions for 2015 BSMS Salinity Registers Update

South Australia's updates for the 2015 salinity register are derived from SIMRAT based assessments for Site Use Approvals for 2014-15. A Site Use Approval (SUA) represents the permission to use water at a site for a specific purpose and is used as the basis for accounting for the salinity impacts of irrigation development using the SIMRAT model in South Australia. The salinity impacts, summarised in Table 3, will apply to the register entry *SA Irrigation Development Based on Site Use Approvals*.

Table 3- 2015 Salinity Register Updates, SA Irrigation Development Based on Site Use Approvals

			Salt load (tonnes/day)		
Lock Reach Location	**# of Assessments**	**Volume (ML)**	**2015**	**2050**	**2100**
Lock 6 to Lock 5	-	-	-	-	-
Lock 5 to Lock 4	3	13,752	0.00	6.88	61.56
Lock 4 to Lock 3	1	8,374	0.00	0.00	1.64
Lock 3 to Lock 2	-	-	-	-	-
Lock 2 to Morgan	-	-	-	-	-
Morgan to Lock 1	-	-	-	-	-
Lock 1 to Murray Bridge	1	312	0.00	0.01	0.37
Murray Bridge to Mouth	-	-	-	-	-
Total	**5**	**22,438**	**-**	**6.88**	**63.57**

In 2014-15 there were five SIMRAT assessments of Site Use Approval variations in South Australia. Two assessments related to the low salinity impact zone, two related to the Bookpurnong high salt interception scheme zone and one related to the high salinity impact zone (Table 4).

Table 4- 2015 SIMRAT assessments by Salinity Impact Zone

			Salt load (tonnes/day)		
Salinity Impact Zone	**# of assessments**	**Total Volume (ML)**	**2015**	**2050**	**2100**
Low	2	8,686	0.00	0.01	2.01
High SIS (Bookpurnong)	2	13,377	0.00	3.08	57.13
High	1	375	0.00	3.80	4.43
Total	5	**22,438**	**0.00**	**6.88**	**63.57**

The South Australian Salinity Zoning Policy includes transitional measures to ensure that any entities with commitments to developments within the high salinity zone, prior to the implementation of the Salinity Zoning Policy in June 2003, were not unduly disadvantaged by the policy.

The transition measure, referred to as 'Prior Commitment', has exempted eligible irrigators from the restrictions to develop in the high salinity impact zone. Where this claim is approved for new irrigation developments the salinity impacts are included on the Salinity Registers, within the entry 'SA Irrigation

Development Based on Site Use Approvals'. In 2014-15 there was one claim for Prior Commitment for 375ML within the high salinity impact zone (Table 4).

Site Use Approval Transactions

The South Australian Salinity Zoning Policy provides for the movement of water between Site Use Approvals within the high salinity impact zone and increases to Site Use Approval volumes to meet the water requirements of crops planted prior to June 2003. These transactions are not assessed using SIMRAT as the salinity impacts of irrigation development from 1988 to 2003 has been sourced from the MODFLOW suite of models which is based on the 2003 irrigation footprint.

In 2014-15 there were 10 applications approved to move water between site use approvals in the high salinity impact zone totalling 4,375ML, and six claims for increased Site Use Approval volume to meet 2003 crop water requirements totalling 5,694ML.

3. VALLEY REPORTS

3.1 End of Valley Report Card

The Independent Audit Group - Salinity has previously acknowledged that the End-of-valley Summary Report Card is not entirely suitable for South Australia, as it does not make provision for downstream targets, actions or reporting. However, South Australia has completed the relevant fields of the End-of-valley Summary Report Card using 2014-15 monitoring data, refer Table 5.

Table 5- End-of-Valley 2014-15 summary report card

Valley	Target/ Monitoring site	End of Valley Target (as a percentage of baseline)	Valley Reporting Site	2014-15 Monitoring data (Daily Mean EC)
Basin salinity target	Lock 6 to Morgan	800 EC (95%ile)	Murray at Morgan	576 EC (Max) 222 EC (Min) 298 EC (Avg) 467 EC (95 %ile) 312 EC (80 %ile)
South Australia	SA Border	412 EC (80%ile)	Murray at SA Border	468 EC (Max) 134 EC (Min) 190 EC (Avg) 258 EC (95 %ile) 202 EC (80 %ile)
	Berri	543 EC (80%ile)	Murray at Berri	415 EC (Max) 160 EC (Min) 236 EC (Avg) 369 EC (95 %ile) 254 EC (80 %ile)
	Below Morgan	770 EC (80%ile)	Murray at Murray Bridge	581 EC (Max) 298 EC (Min) 354 EC (Avg) 487 EC (95 %ile) 373 EC (80 %ile)

4. RESPONSE TO 2013-14 INDEPENDENT AUDIT GROUP RECOMMENDATIONS

Recommendation 1: Communication

In the final year of the BSMS, in the lead-up to the endorsement by the Ministerial Council of the new BSMS 2030, jurisdictions and the MDBA should:

a) develop a succinct summary of the success of the BSMS covering both environmental benefits and the economic benefits including the level of regional development which was made possible by the BSMS; and

b) hold a forum where the MDBA, jurisdictions and their delivery partners can showcase key achievements of their BSMS implementation programs.

The proposed approach to promote BSMS achievements by the MDBA and jurisdictions is supported. However the implementation of these activities should not detract from the current focus, the development of the BSM2030 by October 2015.

It is suggested that promoting the achievements of the BSMS in conjunction with the release of the new BSM2030 strategy will provide a better opportunity to inform communities and stakeholders, publicise the need for ongoing salinity management and to foster support for the new strategy.

Recommendation 2: General Approach to BSMS 2030

In the development of BSMS 2030, the following key points should be considered:

a) The benefits provided by the BSMS should be built upon and not lost.

b) The BSMS 2030 should be built around the Basin salinity target at Morgan as a target for the shared water resources with the End of Valley Targets acting as watch points for tributary inflows and incorporated into Water Resource Plans (WRPs).

c) A risk-based, cost-effective and adaptive approach should be undertaken in reviewing BSMS elements including:

- ***i. SIS operations***
- ***ii. continuous improvement arrangements for modelling, data and knowledge generation***
- ***iii. audit and reporting.***

d) The salinity registers are the agreed 'point of truth' providing a clear statement of the agreed impacts of measures and actions taken by jurisdictions that will either mitigate salinity or increase it and its likely future effects. They should be retained in Schedule B as a key element in the BSMS 2030 and include all relevant and material actions

e) In designing reporting, review and auditing arrangements, consideration should be given to ensuring these are cost-effective but frequent enough to require knowledgeable and ongoing capability within jurisdictions and the MDBA, providing the basis for 'institutional memory' given the long term cyclical nature of salinity

f) Uncertainty in our knowledge of the salinity and management processes should be recognised and where cost-effective, knowledge should be improved.

This recommendation is supported.

The next salinity strategy must build on the gains of the BSMS and continue to guide salinity management across the Basin. Ongoing investment is critical to improve knowledge, maintain effective accountability processes and continue coordination between jurisdictions.

In addition to the recommendation above, South Australia considers that the future salinity management strategy must integrate the implementation of the operational and long term requirements for salinity management for both the Basin Plan and Schedule B of the Murray-Darling Basin Agreement.

Recommendation 3: BSMS 2030 Operational Protocols

Following the development of BSMS 2030, the BSMS Operational Protocols are revised to ensure they give effect to the new policy framework. In this revision, particular attention should be given to the appropriateness of the benchmark period, the baseline, the use of models and defining risk and uncertainty.

This recommendation is supported.

The protocols must be consistent with the Murray-Darling Basin Agreement and any changes to the benchmark period, the baseline, the use of models and defining risk and uncertainty as part of the development of BSM2030 and the review of Schedule B should be reflected in the BSMS Operational Protocols.

Recommendation 4: Environmental Water

a) separate register entries on Register A for all Basin Plan water recovery projects which are likely to have a salinity impact as per the normal processes under the BSMS
b) a provisional entry on Register A for the delivery of environmental water recovered to date under the Basin Plan. Further work would then be undertaken over the next five year period to finalise the register entry including updating the final volume as required
c) a process for adding separate register entries for any additional significant environmental works that are built as a result of the operation of the adjustment mechanism
d) that BSMS 2030 includes the policy framework for the ownership and accounting of salinity debits and credits associated with environmental water recovery, delivery and works operation.

This recommendation is supported.

The development of a policy framework to assess and account for the salinity impacts of environmental watering is supported by South Australia and is considered as a high priority that should be resolved prior to including individual entries on the salinity registers.

The policy needs to recognise that water recovery, delivery and use of environmental water are complex actions with a high degree of interconnectivity that potentially cover large geographical areas. Environmental watering is episodic by nature and the policy framework will need to recognise that salinity impacts associated with environmental watering have a different temporal and spatial scale to the land based actions previously assessed for the Salinity Registers.

South Australia advocates for a Basin wide approach to the management of salinity credits and debits associated with the delivery and use of environmental water. Taking this Basin wide approach acknowledges that managed environmental watering is premised on improving the health of the system for water users across all jurisdictions and that the need for managed environmental watering is due to a history of shared decision making regarding river regulation.

Recommendation 5: Salt Interception Schemes

In the development of BSMS 2030, consideration is given to taking a risk-based, responsive approach to the management of SISs that aims to reduce the operational costs of the management of SISs whilst still providing confidence in meeting the Morgan target over the long-term. This should take into account:

- ***the efficiency of schemes and the consequences of closing systems down for periods of time;***
- ***the costs of running the scheme versus its effectiveness in reducing salinity impacts;***
- ***the costs and timeliness of restarting systems versus the potential impacts over time of not operating the system; and***
- ***the practicality of running SIS in a responsive way.***

South Australia is supportive of this recommendation in principle, but notes that any reduction in SIS effort ultimately impacts on South Australia in the form of increased salinity in the River Murray and greater costs to all water users.

The salt interception schemes managed by South Australia operate to management targets which can be adapted as river conditions change. While the investigation into opportunities for adaptive management of salt interception schemes is supported it is further suggested to pursue opportunities to improve operational effectiveness without reducing interception effort. For example, improving scheduling of maintenance to reduce replacement costs and ensuring that all schemes are operating to clearly defined operating targets.

The 2014 General Review of Salinity Management found that additional SIS infrastructure will be required to manage increasing salt loads in the future. Therefore, the implementation of any adaptive management arrangement for SIS must be precautionary, include adequate safeguards, monitoring, reporting and decision making frameworks to prevent adverse outcomes, and agreed to by all Basin States through MDB Ministerial Council.

The investigation of adaptive management arrangements should consider the following:

- environmental and/or third party benefits of SISs
- State components and shares of SISs that are operated as shared schemes
- broader economic impacts
- the ability of the MDBA and Basin Jurisdictions to manage short term salinity impacts including having regard for Basin Plan Targets for Managing Water Flows.

Recommendation 6: Redefining End of Valley Targets (EoVTs) for BSMS 2030

The EoVTs provide useful reference points for salinity management and understanding and:

a) EoVTs should continue into the future but should be revised for BSMS 2030 in light of a better understanding of salinity within valleys and where appropriate should be linked to requirements of local assets, which is consistent with a risk based approach

b) The EoVTs should be included, in some form, in water resource plans

c) The protection of local catchment assets should be considered in WRPs. Assets located in high salinity impact sub-catchments should be identified and included as part of the reporting process, noting that additional salinity monitoring sites may need to be included to support this reporting

d) The effectiveness of EoVTs should be reviewed on a 5 yearly basis and where required adjusted.

This recommendation is supported in principle. It is noted that the implications of including assets in the WRP reporting process are unclear and will need to be assessed in relation to the cost-benefit of the action.

The EoVTs are an important element of MDB salinity management that should be retained to support monitoring, evaluation and long term salinity management planning. The EoVTs have a focus on longer term impacts for downstream water users and can be a key linkage between Schedule B and Basin Plan implementation. They are useful in that they provide a basin-wide context for in-catchment planning and action.

Recommendation 7: Implementing a risk-based approach to Register entries

a) To support a risk based salinity assessment, register entries should include a qualitative uncertainty assessment

b) Recognising the uncertainty in register entries, new register entries including their supporting models should be reviewed in 5 years

c) Review of established debit and credit register entries (post initial 5 year review) including their supporting models should be reviewed on the following basis:

- ***i. For high risk entries (i.e. entries with high impact (1 EC or more) and high uncertainty) where there is a change in salinity processes or there is new data - retain the 5 year review***
- ***ii. For high risk entries (i.e. entries with high impact (1 EC or more) and high uncertainty) where there is no change in salinity processes or no new data - move to a 7 year review***
- ***iii. For all other entries (i.e. low risk entries with small impact (<1 EC) or high risk entries with low uncertainty) – require internal reporting and consider the need for reviews as part of a major program review of BSMS 2030.***

d) Consolidation of small stable register entries

The implementation of a risk based approach to reviewing register entries and models is supported, however, it is considered that there may be another approach to consider. For example, retain existing review timeframes for models and register entries and require jurisdictions to provide justification if a less comprehensive review is required, i.e. where there is limited new data or understanding.

Review and reporting requirements should still involve an independent peer reviewer to ensure a rigorous and transparent process and to identify if a comprehensive review is required where there is either a high risk, high uncertainty or significant new information available.

Recommendation 8: Benchmark period

The BSMS benchmark period should be reviewed prior to the commencement of BSMS 2030 and a decision made by BOC as whether the benefits of changing the benchmark period outweigh the costs.

South Australia supports a review of the benchmark period but consideration should be given to whether this is done under BSM2030 rather than prior to commencement, recognising that this is important but not urgent.

Consideration should also be given to undertaking this work to coincide with the development and implementation of the eWater Source modelling platform, should this be considered necessary.

Any assessment of the suitability of the current benchmark period should also consider modelled and recorded salinities below Lock 1 to ensure that the conditions experienced during the millennium drought are accurately represented.

Recommendation 9: BigMod model review

In the review of BigMod:

(a) The MDBA provide advice on the way that cumulative actions are configured in BigMod. Particular consideration should be given to:

i. The chronological order of entries and alignment with the current BSMS operational protocols (MDBC, 2005)

ii. Detail how reviews in register entries are implemented in the model.

(b) Given that the BSMS Operational Protocols (March 2005) are not clear on how to include reviews of salinity actions in the register, the model review should consider the sensitivity to the following interpretations of how to implement the register review changes:

i. Initial entry updated for the change (Chronological order not changed)

ii. Change included at the time of the review (Chronological order maintained for the change)

iii. Revised salinity included at the time of the review (Chronological order changed to review date).

(c) Given the likelihood of changes to operational practices of SISs in the future, the model review should provide advice on the adequacy of BigMod to be used for operational decisions, in particular the adequacy of the results from the model to inform the operation of salinity interception schemes

(d) The BigMod Review should be made transparent to the IAG-Salinity auditors.

This recommendation is supported.

South Australia proposes establishing a technical working group under the BSMAP or it successor, to provide advice and resolve these technical issues. The technical working group should include MDBA modellers, jurisdictional representatives and external technical experts as required.

The multi-jurisdictional technical forum should consider:

a) The current process to include cumulative and reviewed actions in the MDBA's BigMod model interpreted from the BSMS Operational Protocols. It would be useful to document this current interpretation and identify areas of concern and uncertainty.

b) The process of modelling entries for the Salinity Registers. This process introduces significant variations to the entries themselves and should be considered in the current Bigmod review. The results should then be considered by the technical forum before the model is accredited as appropriate for use in determining future Salinity Register entries.

c) The adequacy of the SIS modelling for the Salinity Registers for assessment of operational decisions like adaptive SIS management. This requires investigation as this information may not be suitable due to the long term average assumptions required for the Salinity Registers.

Recommendation 10: BSMS Baseline

In the development of BSMS 2030, consideration is given as to whether there is a need to set a new baseline date at the commencement of BSMS 2030, and potentially at the commencement of any future BSMS stages.

This recommendation is supported.

The implications of changing the Baseline date and conditions should be considered by a technical working group under the BSMAP or it successor.

Recommendation 11: Coordinated development of models to support BSMS 2030

BSMS 2030 provides some overall direction on the development of the next generation of models for salinity management to facilitate a consistent approach to model development and their underlying conceptual basis.

This recommendation is supported.

Modelling provides the foundation of the BSMS Salinity Register entries and is used to predict future salinity trends. Considerable efforts have been expended on improving the ability of models to simulate irrigation and land based actions and their effects on the river. A similar level of effort is required to model the interaction of the floodplain with the regional groundwater and the river.

Guidelines for a consistent approach to simulating the highland and floodplain processes in models would provide greater confidence and ensure similar levels of accuracy in reviews of salinity actions.

Recommendation 12: Monitoring

In the development of BSMS 2030, consideration is given to requiring jurisdictions to identify monitoring stations that are critical in providing data for:

- ***BSMS 2030 reporting***
- ***Modelling reviews***
- ***Improving understanding of salinity processes in high priority areas of the Basin and that these stations are provided with policy status to ensure they are maintained as jurisdictions review their monitoring networks in the future.***

This recommendation is supported.

Monitoring salinity across the Murray-Darling Basin is integral to reporting and the development and review of models. South Australia is committed to working with other jurisdictions to ensure that an adequate and cost effective monitoring network is maintained for the purpose of salinity management. Adequate monitoring of salinity should be targeted across the Basin to ensure there are no unexpected increases in salinity in low risk areas, as well as monitoring areas of higher risk, particularly considering impacts are cumulative.

It is suggested that any review of the monitoring framework undertaken for BSM2030 should also consider the Basin Plan water quality and salinity monitoring requirements.

Recommendation 13: Audit and Reporting Processes

In the development of BSMS 2030, consideration is given to:

- ***Maintaining annual reporting on the registers through to the Ministerial Council***
- ***Moving, in principle, to a biennial Independent Audit process (noting there may be utility in some annual audits over the early transition period)***
- ***Changing the format of the audit process to provide a shared jurisdiction session for continuous improvement processes***
- ***Holding a jurisdictional workshop biennially to share information, issues and best practice***
- ***Stream-lining reporting between the BSMS 2030 and the Basin Plan.***

This recommendation is supported noting that consideration is being given to these matters in developing BSM2030 and a number of streamlining options may be available.

Recommendation 14: 2015 BSMS Audit

a) ***the Terms of Reference for the final audit in 2015 should ensure that it is aimed only at closing off the BSMS and is not as detailed as previous audits; and***

b) ***consideration be given to linking it to a forum where the MDBA, jurisdictions and their delivery partners can showcase key achievements of their BSMS implementation programs.***

This recommendation is supported.

Opportunities to coordinate release of the final audit report with the release of the BSM2030 strategy could also be explored.

Recommendation 15: Maintaining Institutional Memory, Capacity and Capability

The IAG-Salinity recommends that in the development of the BSMS 2030, consideration is given to embedding processes and incentives that will ensure that capacity and capability in salinity management is maintained within the MDBA and the jurisdictions.

This recommendation is supported.

South Australia remains committed to salinity management in the Murray-Darling Basin. This is recognised through the inclusion of targets and objectives in South Australia's Strategic Plan and the State's 'Water For Good' program.

To ensure ongoing effective salinity management across the MDB it will be necessary for the MDBA and Basin jurisdictions to commit to the provision of adequate financial arrangements to ensure adequate capacity is maintained to manage salinity into the future.

Recommendation 16: Coal Seam Gas Salinity Impacts

a) ***in BSMS 2030, potential is provided to ensure that the impacts of CSG development on salinity within the Basin are broadly monitored and if and where necessary, are able to be managed within the new framework for salinity management***

b) ***with respect to CSG water in Queensland***

- ***In the next review of their Beneficial Use policy, Queensland should address a policy gap that omits salinity from consideration in approvals of new irrigation development.***
- ***Queensland should adequately monitor potential salinity hazards arising through irrigation associated with CSG which will require a better combined monitoring database.***
- ***The potential cumulative impacts of irrigation associated with CSG in Queensland needs to be assessed to determine if it is a threat to the Basin salinity program.***

This recommendation is supported.

To determine if regulation and safeguards are effective in mitigating any threats to water quality and salinity adequate monitoring must be implemented and maintained.

5. REFERENCES

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6. GLOSSARY

AHD - Australian Height Datum

AWE – Australian Water Environments

BSMS - Basin Salinity Management Strategy

CEWH - Commonwealth Environmental Water Holder

CLLMM - Coorong, Lower Lakes and Murray Mouth

COAG - Council of Australian Governments

CSG – Coal Seam Gas

CSIRO - Commonwealth Scientific and Industrial Research Organisation

DEWNR - Department of Environment, Water and Natural Resources

EC - Electrical Conductivity - µS cm^{-1} EC

EoVTs – End of Valley Targets

GL - Gigalitre (1 000 000 000 litres)

IAG - Independent Audit Group

km – Kilometres

m - Metres

LWMP - Land and Water Management Plan

MDB - Murray-Darling Basin

MDBA - Murray-Darling Basin Authority

ML - Megalitre (1 000 000 litres)

NRM - Natural Resources Management

NVC – Native Vegetation Council

ppt – Parts per thousand

SA MDB - South Australian Murray-Darling Basin

SA MDB NRM Board- South Australian Murray-Darling Basin Natural Resources Management Board

SIS - Salt Interception Scheme

t - Tonne

TDS - Total Dissolved Solids

TLM - The Living Murray

WAP - Water Allocation Plan

Government of South Australia

Department of Environment,
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