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# BASIN SALINITY MANAGEMENT STRATEGY- SOUTH AUSTRALIA'S ANNUAL REPORT 2013-14

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- Natural Resources SA Murray-Darling Basin
- Customer and Corporate Services Group
- River Murray Operations and Major Projects Branch.

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# Contents

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- Acknowledgements ..... iii
- 1. INTRODUCTION..... 3
- 2. NINE ELEMENTS OF THE BASIN SALINITY MANAGEMENT STRATEGY ..... 5
  - 2.1 Developing Capacity to Implement the Strategy ..... 6
  - 2.2 Identifying Values and Assets at Risk..... 9
  - 2.3 Setting Salinity Targets.....11
  - 2.4 Managing Trade-offs with the Available Within-Valley Options.....12
  - 2.5 Implementing Salinity and Catchment Management Plans .....14
  - 2.6 Redesigning Farming Systems.....17
  - 2.7 Targeting Reforestation and Vegetation Management.....19
  - 2.8 Constructing Salt Interception Works.....21
  - 2.9 Ensuring Basin-Wide Accountability: Monitoring, Evaluating and Reporting .....22
- 3. VALLEY REPORTS.....26
  - 3.1 End of Valley Report Card .....26
- 4. RESPONSE TO 2012-2013 INDEPENDENT AUDIT GROUP RECOMMENDATIONS.....27
- 5. REFERENCES.....31
- 6. GLOSSARY .....32

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# List of Figures

---

Figure 1- Hydrogeological conceptual model of the Pike-Murtho region.....6

Figure 2- Coverage of Groundwater Models in South Australia ..... 23

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# List of Tables

---

Table 1- Source of 2013 Salinity Register entries..... 24

Table 2- 2014 Salinity Register Updates, Entry 45, SA Irrigation Development Based on Site  
Use Approvals ..... 25

Table 3- Monitoring sites ..... 26

Table 4- End-of-Valley summary report card ..... 26

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# 1. INTRODUCTION

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South Australia is committed to delivering salinity management obligations under the Basin Salinity Management Strategy (BSMS), and Schedule B of the Murray-Darling Basin Agreement (Schedule 1 of the *Water Act, 2007* (Cth)). South Australia recognises the importance of salinity management through key State level strategies and plans, including:

- Water for Good (Action 56): Maintain a positive balance on the Murray-Darling Basin Authority'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
- South Australia's Strategic Plan Target (T.77): River Murray Salinity – South Australia maintains a positive balance on the Murray-Darling Basin Authority's Salinity Register
- 'Our Place Our Future' State Natural Resources Management Plan, South Australia 2012-2017, guiding Target 6- maintain the productive capacity of our natural resources
- South Australian River Murray Salinity Strategy 2001-2015
- Objectives in the River Murray Act 2003
- South Australian Murray-Darling Basin Natural Resources Management Plan.

The implementation of the BSMS and its predecessor the Salinity and Drainage Strategy have been successful in driving the coordinated management of salinity across the Murray-Darling Basin (MDB) since 1989. The adoption of the Basin Plan in November 2012 builds on the successes of the MDB salinity strategies including through the introduction of targets for managing water flows and a salt export objective.

The General Review of Salinity Management undertaken by the MDBA and contracting governments during 2013-14 has identified that the ongoing successful management of salinity across the Basin will require the continued development and implementation of programs under Schedule B of the Murray-Darling Basin Agreement and the Basin Plan.

The development of the Basin Salinity Management 2030 strategy in 2014-15 will build upon the achievements of the BSMS and previous salinity strategies and ensure that the management of salinity across the MDB continues to be a priority to protect the environment, irrigated agriculture and critical human water supplies.

This report documents South Australia's accountability and delivery against the BSMS, and Schedule B of the Murray-Darling Basin Agreement (Schedule 1 of the *Water Act 2007* (Cth)) in 2013-14.

## **Key Achievements**

Key South Australian salinity management activities and achievements in 2013-14 include:

- 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 2014-15 South Australian River Murray Operating Plan.

- Attracting investment into the South Australian Murray-Darling Basin region on behalf of irrigators to improve irrigation efficiency.
- Review of the Salinity Impact Rapid Assessment Tool (SIMRAT) on behalf of the Murray-Darling Basin Authority (MDBA)
- Working with the MDBA to explore options for future Basin salinity management beyond 2015.
- Providing strategic policy advice and input to the 'General Review' of salinity as initiated by the Basin Officials Committee.
- Development of guidelines to ensure South Australia can demonstrate compliance with Basin Plan 'targets for Managing Water Flows'

## **Future Work**

In 2014-15, effort will be directed towards:

- Working with river operators and the environmental watering program to ensure that operational plans for environmental regulators are cognisant of salinity impacts and contain appropriate options for operational responses.
- Implementing the Water Quality and Salinity Management Plan contained within the Basin Plan.
- Delivering the State's obligations and reporting requirements under Schedule B of the Murray-Darling Basin Agreement reporting requirements.
- Providing strategic input into the development of the new Basin Salinity Management 2030 (BSM 2030) strategy and review of Schedule B.
- Working with the Murray-Darling Basin Authority (MDBA) to develop an accounting framework for the assessment of environmental watering actions for entry onto the salinity registers.

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## 2. NINE ELEMENTS OF THE BASIN SALINITY MANAGEMENT STRATEGY

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The following sections highlight actions taken within South Australia in 2013-14 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.

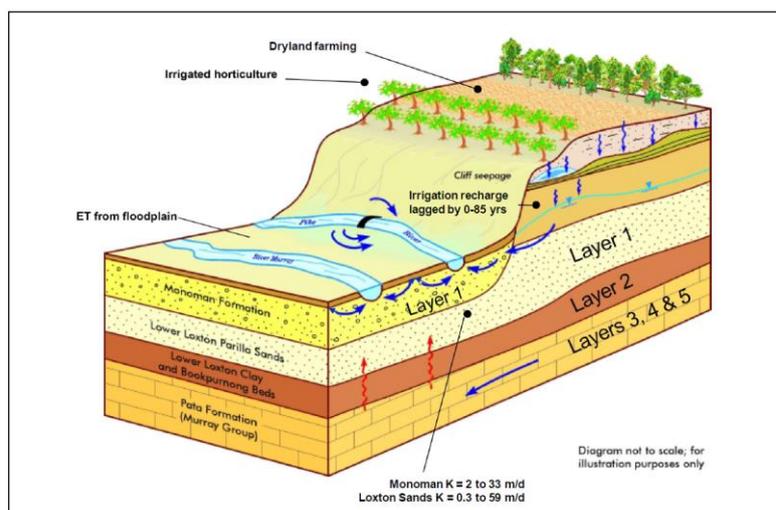
The partner Governments will assist catchment communities to implement national, Basin and State initiatives by improving access to and use of the knowledge and decision tools generated by investigations and salinity research and development. This process will be supported by further capacity building 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. Through the groundwater modelling process, scenarios are established to assist in determining the origin and volume of salt entering the River Murray from groundwater sources.

During 2013-14, DEWNR revised and updated the MODFLOW numerical groundwater flow model of the Pike-Murtho reach. It replaces the previous accredited model and incorporates the latest hydrogeological information and understanding. Since the 2006 model was developed, the Murtho Salt Interception Scheme (SIS) and elements of the Pike SIS have been built. The model now includes the SIS as constructed and incorporates information on geology and aquifer parameters gathered as part of the investigation and construction of the SIS (Figure 1). Recharge rates were also updated, based on detailed irrigation surveys.



**Figure 1- Hydrogeological conceptual model of the Pike-Murtho region**

## **Review of SIMRAT Model**

During 2014, on behalf of the Murray-Darling Basin Authority (MDBA), DEWNR commenced a review of the Salinity Impact Rapid Assessment Tool (SIMRAT). SIMRAT was developed for the Murray-Darling Basin Commission (MDBC) and accredited in 2005 as a rapid assessment tool to assess the salinity impacts of new irrigation.

The key findings of the review were that SIMRAT's underlying conceptualisation, simplifications and assumptions are sound and the tool continues to be fit for purpose as a rapid assessment tool to estimate salinity impacts of new irrigation development.

A number of recommendations have been made to make minor improvements to the model. The most critical recommendation is to rewrite the model in an updated software code, as the current model platform is now obsolete. Completion of the SIMRAT review, including update of the model platform, is anticipated to occur in 2014-15, subject to funding by MDBA.

## **Modelling salt dynamics on the River Murray floodplain in South Australia**

The 'Modelling salt dynamics on the River Murray floodplain in South Australia' project is a partnership between the Goyder Institute, DEWNR, Flinders University and CSIRO. The project commenced in March 2014 and is due to be completed by May 2015.

The project will assist in describing, prioritising and locating the processes most likely to contribute to the mobilisation of floodplain salt and will identify ways to consistently model key floodplain processes. The project has two key components:

- Characterisation of salinity mobilisation processes: this builds on the work by the MDBA and Australian Water Environments (AWE) on characterising and prioritising the processes which contribute to the mobilisation of salt to the river.
- Modelling of priority salinity mobilisation processes – this task will aim to determine which model techniques are most appropriate to represent priority salt mobilisation processes (identified in task 1).

## **Pike River salt management field trials**

As part of the Riverine Recovery project DEWNR are coordinating field trials on the Pike River 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.

The field trials have been set up 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. Trial methods will include watering, mulching, gypsum and a combination of these. During the trial the condition of the plants will be monitored to test the effectiveness of the applied treatments.

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

## Lake Albert Scoping Study

The Lake Albert Scoping Study commenced in January 2013 and has investigated a range of potential management actions to reduce and maintain salinity in Lake Albert.

Lake Albert lies to the south-east of Lake Alexandrina at the end of the River Murray. It is connected to Lake Alexandrina via a narrow channel known as the Narrung Narrows.

While Lake Albert is naturally saltier than Lake Alexandrina due to its shallower form and terminal nature, salinity in the lake increased as a result of the 2006-2010 drought. Since the drought, salinity levels have reduced but are still above the historical range of 1,500-1,800 EC.

The aims of the study were to:

- investigate potential management actions with the involvement of the local community, including the Ngarrindjeri Aboriginal community
- build environmental resilience to better cope with water level variability.

The Project has been directed by an intergovernmental Steering Committee with technical input from a State Government Project Advisory Group. A Community Reference Group has met approximately monthly throughout the project and acted as a conduit between the community and government.

More information regarding the project and its findings is available from <http://www.naturalresources.sa.gov.au/samurraydarlingbasin/projects/all-projects-map/lake-albert-scoping-study>

## 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 Operating Plan**

The Chowilla floodplain is one of the six icon sites under The Living Murray (TLM) program. The floodplain is underlain by a shallow highly saline aquifer and is well documented as a source of saline groundwater discharge into the River Murray.

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. However, it is understood that inundation also results in discharge of salt into the Chowilla Creek and ultimately to the River Murray.

Significant work to assess both long term and short term salinity impacts associated with operation of the Chowilla regulator structures was completed in 2012-13. The information from the salinity assessments 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. The Operations Plan provides thresholds for operating dependent upon the flows to South Australia and ambient water quality.

Testing of the regulator and ancillary structures will commence during spring 2014 and provide an opportunity to commence validation of the modelled salinity impacts and assess risk mitigation measures.

It is acknowledged that changes in water use associated with TLM may cause a change in the long-term salinity levels in the Murray River. Accordingly TLM partner governments have informed the MDBA of the potential salinity impacts (both positive and negative outcomes) arising from actions as required by Schedule B, clause 17(1).

To estimate the salinity effect of TLM actions and determine salinity register entries it will be necessary for partner governments to work together to develop a procedure for accurately assessing the accumulated effect of actions across the Basin. The development of a procedure will ensure that there is a consistent approach to assessing salinity impacts and that partner governments have a clear understanding of the data and information outputs required from individual salinity assessments.

### **South Australian Riverland Floodplains Integrated Infrastructure Program**

The South Australian Riverland Floodplains Integrated Infrastructure Program is a large-scale infrastructure project to enable floodplain inundation for the South Australian Riverland region between the border and Lock 1 with a particular focus on the Pike and Katarapko floodplains.

A century of river regulation and increasing consumptive use of water, principally for irrigation, has resulted in a dramatic reduction in overbank flows in the Riverland, deteriorated the health of the River Murray floodplain and elevated the salinity of groundwater.

The program will involve the construction of environmental regulators and levee banks to inundate large areas of floodplains and explore the need for and possibly construct salt interception and other saline groundwater management works to address salinity issues.

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.

### **South East Flows Restoration Project**

On the 12 June 2014 the Australian and South Australian Governments announced a \$60 million South East Flows Restoration Project (SEFRP) to help prevent excessive salinity levels in the Coorong South Lagoon. The project is part of the Coorong, Lower Lakes and Murray Mouth Recovery Project, and is jointly funded under the Australian Government's Sustainable Rural Water Use and Infrastructure Program and South Australia's Murray Futures program.

By restoring inflows from the South East of South Australia, 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) and preventing ecological degradation during periods of low flows from the River Murray. 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. Barrage flows also impact the River Murray Mouth which is ecologically significant to the Coorong South Lagoon.

The SEFRP comprises a package of infrastructure works and an accompanying environmental program. The SEFRP project will construct the SEFRP channel which will use a combination of widened existing drains (totalling approximately 81 kilometres) and newly constructed drains (totalling approximately 12 kilometres) to divert additional water from the Upper South East Drainage Network into the Coorong South Lagoon.

Project implementation will be overseen by a Steering Committee and will have representation from the South Eastern Water Conservation and Drainage Board, Commonwealth, local and state government and the South East Natural Resources Management Board.

## 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 2013-14 South Australia has put in place processes to have regard to the Basin Plan targets for managing water flows. The inclusion of these targets in the Basin Plan complement the existing Basin Salinity Target and End-of-Valley Targets.***

### **Targets for Managing Water Flows**

The adoption of the Basin Plan establishes the immediate obligation for all river operators and holders of environmental water to have regard to the targets for managing water flows (Basin Plan, s.9.14) when making flow management decisions.

The inclusion of targets for managing water flows in the Basin Plan addresses a major recommendation of the BSMS Mid Term Review that targets should be developed to provide for adaptive real time salinity outcomes.

To ensure that South Australian river operators and managers of environmental water give consideration to the targets for managing water flows, guidelines were developed by DEWNR in 2013-14. The guidelines establish principles to be considered when developing plans and strategies and making flow management decisions.

Incorporation of the guidelines into key South Australian River Murray environmental and operating plans has commenced and will be progressively rolled out as plans are reviewed and updated. The inclusion of the guidelines into key plans will help ensure that South Australia can demonstrate that procedures and tools are in place as part of Basin Plan monitoring and evaluating.

It is planned that the guidelines will be reviewed regularly to ensure they are effective and align with any guidelines developed by the MDBA to provide guidance to the MDBA, Basin Officials Committee, Commonwealth Environmental Water Holder and Basin States when making flow management decisions.

## 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 of Water Allocation Plans, Water Resource Management Plans, environmental watering plans and annual operating strategies.***

### **SA River Murray Annual Operating Plan**

South Australia's River Murray Annual Operating Plan 2013-14 (2013-14 SA Operating Plan) is the key document that guides transparent and coordinated River Murray operational decisions. The 2013-14 SA Operating Plan sought to integrate and optimise the delivery and management of water to, and within, South Australia to:

- accommodate the needs of all water users within system constraints to the extent that is practically possible
- outline preferred environmental watering priorities and urban and irrigation water delivery requirements under a range of inflow and water availability scenarios
- provide for operational arrangements to underpin the security of supply for all consumptive uses
- ensure that requirements are fulfilled under the:
  - Murray-Darling Basin Agreement 2008 (Cwlth)
  - *Water Act 2007* - Basin Plan 2012 (the Basin Plan)
  - MDBA's River Murray System Annual Operating Plan 2013-14
  - Basin Officials Committee Objectives and Outcomes Document for River Operations for 2013-14.
- provide a documented and transparent rationale for South Australian River Murray operational decisions made in 2013-14.

Key salinity outcomes in 2013-14 include:

- salinity was maintained below the identified targets at locations identified in the Basin Plan and 2013-14 SA Operating Plan for 100 per cent of the time during 2013-14
- salinity levels in Lake Albert decreased by approximately 900 EC to 2,100 EC in June 2014
- average daily salinity in the Coorong South Lagoon was maintained below 100 ppt.

## **Annual and Long-Term Environmental Watering Planning**

Broad scale environmental watering measures are extremely beneficial to the health of floodplains and wetlands. They also have the potential to mobilise significant volumes of salt to the river, which may result in accountable actions under Schedule B to the Murray-Darling Basin Agreement. Hence planning and decision making needs to consider salinity risk and any mitigation and management actions required.

Both the annual environmental watering priorities and long term environmental watering plans under the Basin Plan 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 2014-15 Annual Environmental Watering Plan for the River Murray was developed during 2013-14 to document the desired South Australian program for environmental water delivery for the 2014-15 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.

The watering priorities included in the Annual Environmental Watering Plan for the River Murray in 2014-15 while focused on environmental outcomes also have benefits for reducing 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, which will be required in November 2015 (within 12 months of the MDBA publishing the Basin-Wide Environmental Watering Strategy, expected in November 2014).

## 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 River Murray Salinity Strategy**

The fifteen-year vision of the South Australian River Murray Salinity Strategy (2001-2015) is to maintain salinity in the River Murray in South Australia at current levels (i.e. when the Strategy commenced). The need for a revised strategy to guide salinity management in South Australia post 2015 will be considered following the finalisation of the BSM 2030.

### **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.

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.

## **South Australia's Strategic Plan**

An updated South Australian Strategic Plan (SASP) was released in September 2011. The plan reflects the input of thousands of South Australians and responds to what the community viewed as most important for our future.

Management of salinity in the MDB continues to be recognised in 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.

Fact sheets relating to SASP targets can be downloaded at: <http://saplan.org.au/targets/77-river-murray-salinity>

## **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 Allocation Plan for the River Murray Prescribed Watercourse**

The 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 legal 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. As part of the River Murray WAP amendment, it is proposed to include the South Australian Salinity Zoning Policy and water use efficiency principles within the River Murray WAP.

## **SA MDB NRM Plan**

In January 2014 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. The revised Regional NRM Plan was developed in partnership with the community and key stakeholders utilising the 2009 Regional NRM Plan as a foundation and integrating new scientific information.

The Regional NRM Plan retains the asset classes and their associated visions from the 2009 plan which were reviewed in 2013 to apply an agreed criterion of being specific, time bound, appropriate and aspirational for the South Australian MDB NRM region. The resource condition targets included in the 2014 Regional NRM Plan that are relevant to salinity 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.

To assist with implementation of the Regional NRM Plan a regional action plan that determines what activities are needed to implement the regional NRM Plan and who needs to be involved is being developed. The South Australian Murray-Darling Basin NRM Board (SA MDB NRM Board) will work with all its stakeholders including industry, local government and community to ensure everything that people are currently doing and new things that need to be instigated are captured in the regional action plan.

## 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.***

### **Water for the Future - Sustainable Rural Water Use and Infrastructure Programs**

During 2013-14 the SA MDB NRM Board was successful in attracting in-principle funding approval through Round 4 of the Australian Government's On-Farm Irrigation Efficiency Program. It is likely that a funding agreement will be signed with the Commonwealth towards the end of 2014 and will provide funding in excess of \$30 million. To date 150 projects have passed the value for money process which represent farmers across the southern connected system of the Murray-Darling Basin.

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 could potentially save approximately 17GL, of which approximately 11.5GL 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 installation of on-farm automation, monitoring and control technologies.

The incorporation of the latest on farm technology through the program is not only providing water savings but also reducing off farm environmental impacts and improving productivity. The adoption of new irrigation systems is enabling irrigators to more closely match real time crop water requirements, which in turn is reducing deep drainage below the root zone and minimising the discharge of saline groundwater to the River Murray.

The projects delivered by the SA MDB NRM Board are part of a \$158 million Australian Government investment in irrigation infrastructure across southern New South Wales, South Australia and Victoria to return more than 60 billion litres of water to the Murray-Darling Basin 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 SARMS is a multi-faceted approach comprising of an Irrigation Industry Improvement Program (SARMS-3IP) and a Regional Economic Development program.

The 3IP program will deliver improved irrigation efficiencies through the upgrading of irrigation infrastructure and ensure irrigators remain at the forefront of irrigation practice whilst meeting the water return targets specified by the Basin Plan. 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 3IP objectives and Basin Plan targets, ranging from technical improvements to irrigation infrastructure through to entirely new business propositions were received under round one of 3IP.

The Regional Economic Development component includes funding the Loxton Research Centre infrastructure redevelopment and innovation project. The redeveloped centre will facilitate improved outcomes for irrigation businesses and ensure advanced and contemporary irrigation research will be easily accessible to South Australian irrigators.

## 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. 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 tender assessment has been completed for Round 1 of the South Eastern BushBids project and successful landholders have been notified and signed up to 5 year management agreements. The expression of interest period for Round 2 has closed and site assessments and the development of management plans are currently being undertaken with the tender assessment to be run in 2014.

## 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.***

### **Murtho**

The Murtho salt interception scheme is the last scheme to be completed under the 2001 Basin Salinity Management Strategy 61 EC joint program of salt interception scheme works. 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.

The production bores are linked to the Disher Creek disposal basin by 45 kilometres of pipeline. A relift pump on Disher Creek basin transports this saline water to the Noora Disposal basin some 20 kilometres east of the township of Loxton. In addition to reducing in stream salinity of the River Murray, the scheme aims to enhance the environmental management of Disher Creek, a River Murray wetland and habitat for the endangered Murray Hardyhead fish species.

The Department of Environment, Water and Natural Resources, as the representative of the constructing authority for Murray-Darling Basin Authority works in South Australia, had the overall responsibility for delivery of the project.

Capital funding of \$30.2 million for the construction of the Murtho scheme was shared between the Murray-Darling Basin Authority (MDBA) and the South Australian Government through the National Action Plan for Salinity and Water Quality.

## 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**

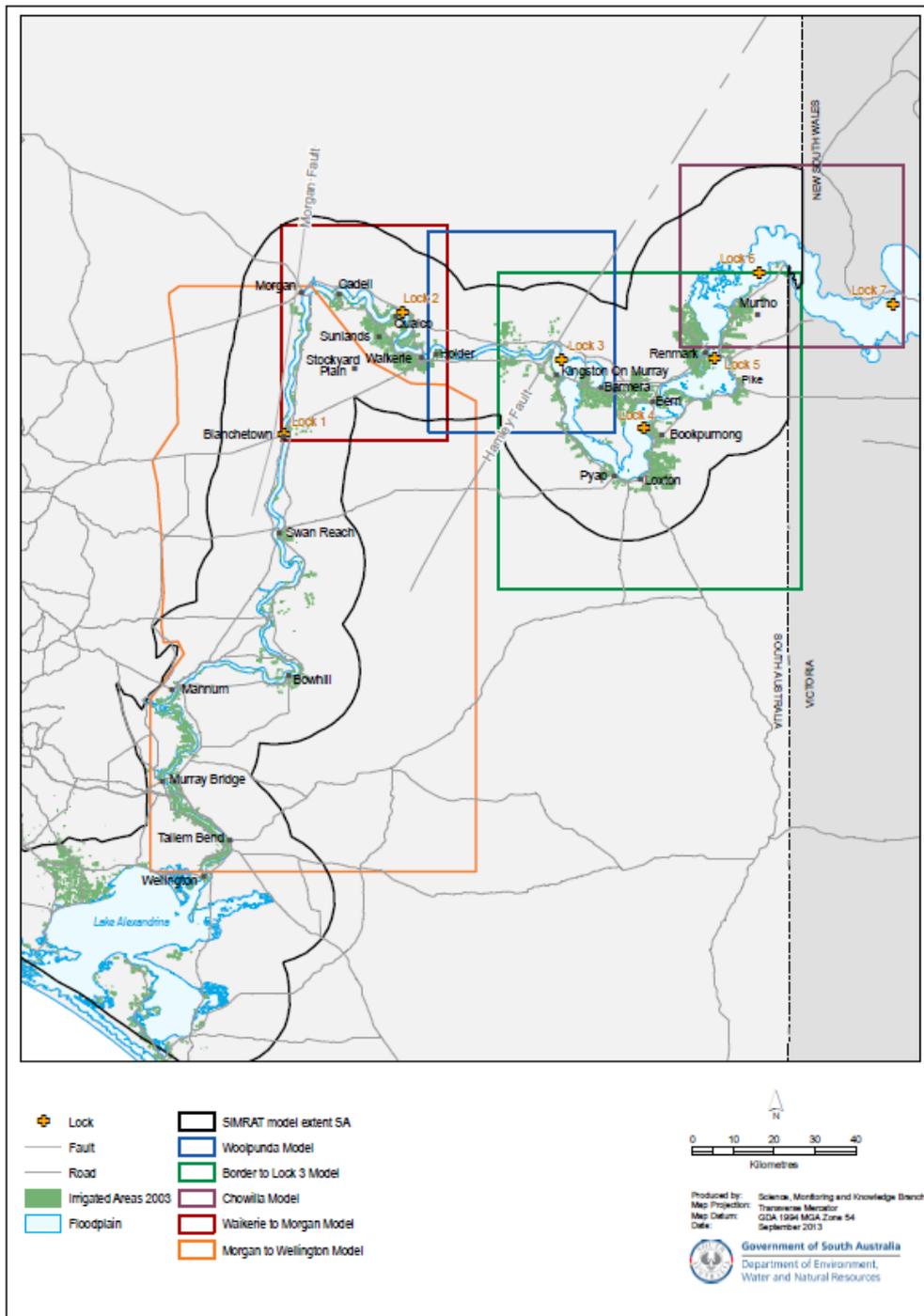
A series of accredited groundwater models span the length of the River Murray in South Australia, as shown in Figure 2. The models include the MDBA's analytical rapid assessment tool SIMRAT and the South Australian complex numerical groundwater models (MODFLOW). The models underpin the estimation of salt loads entering the River Murray from the South Australian border to Wellington and are the basis for 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:

- Entry 44, SA Irrigation Development Due to Water Trade
- Entry 45, 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 Entry 44). 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 Entry 45 on the Salinity Register.

Entry 44 and 45 are considered short term Salinity Register entries as they are gradually replaced by the output of the more sophisticated regional numerical groundwater models (Entry 43, SA Irrigation Development Based on Footprint Data).



**Figure 2- 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 1, 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 1- Source of 2013 Salinity Register entries**

<b>Source</b>	<b>Salinity Register Entries</b>
<b>SIMRAT</b>	<ul style="list-style-type: none"> <li>- Entry 44, SA Irrigation Development Due to Water Trade</li> <li>- Entry 45, SA Irrigation Development Based on Site Use Approvals</li> </ul>
<b>Individual MODFLOW Model Output</b>	<ul style="list-style-type: none"> <li>- Entry 12, Bookpurnong SIS</li> <li>- Entry 14, Loxton SIS</li> <li>- Entry 15, Waikerie Lock 2 SIS</li> <li>- Entry 46, SA Component of Bookpurnong SIS</li> <li>- Entry 47, SA Component of Loxton SIS</li> <li>- Entry 48, SA Component of Waikerie Lock 2 SIS</li> <li>- Entry 50, Qualco Sunlands GWCS</li> <li>- Entry 51, Pike Stage 1 SIS</li> </ul>
<b>Collective MODFLOW Model Output</b>	<ul style="list-style-type: none"> <li>- Entry 43, SA Irrigation Development Based on Footprint Data</li> <li>- Entry 49, SA Improved Irrigation Efficiency and Scheme Rehabilitation Reg A</li> <li>- Entry 72, SA Mallee Legacy of History - Dryland</li> <li>- Entry 73, SA Mallee Legacy of History – Irrigation</li> <li>- Entry 74, SA Improved Irrigation Efficiency and Scheme Rehabilitation Reg B</li> </ul>
<b>In-river assessment*</b>	<ul style="list-style-type: none"> <li>- Entry 1, Woolpunda SIS</li> <li>- Entry 4, Waikerie SIS</li> <li>- Entry 8, Waikerie Phase 2A SIS</li> </ul>

\* Entries to be updated with South Australian MODFLOW groundwater models in 2014/15

## **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.

Over the past three years South Australia has 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)). It is intended to progress the resulting salinity register updates from these model reviews and technical SIS reviews as a package in 2014-15.

## Accountable Actions for 2014 BSMS Salinity Registers Update

South Australia's updates for the 2014 salinity register are derived from SIMRAT based assessments for Site Use Approvals for 2013-14. 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 2, will apply to *Entry 45, SA Irrigation Development Based on Site Use Approvals*.

**Table 2- 2014 Salinity Register Updates, Entry 45, SA Irrigation Development Based on Site Use Approvals**

Lock Reach Location	# of Assessments	Volume (ML)	Salt load (tonnes/day)		
			2015	2050	2100
Lock 6 to Lock 5	1	222	0.11	1.09	1.56
Lock 5 to Lock 4	1	6,878	0.00	3.46	45.64
Lock 4 to Lock 3	1	802	0.00	0.01	0.71
Lock 3 to Lock 2	4	23,426	0.02	4.71	73.09
Lock 2 to Morgan	n/a	n/a	n/a	n/a	n/a
Morgan to Lock 1	n/a	n/a	n/a	n/a	n/a
Lock 1 to Murray Bridge	2	1,091	0.00	0.10	0.94
Murray Bridge to Mouth	1	300	0.00	0.56	0.60
<b>Total</b>	<b>10</b>	<b>32,719</b>	<b>0.14</b>	<b>9.92</b>	<b>122.53</b>

The South Australian Salinity Zoning Policy included transitional measures at the commencement of the policy, 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, at Entry 45.

Where this claim is based on existing plantings requirements at commencement of the Salinity Zoning Policy in 2003 the salinity impacts are not included in Entry 45 as they are already represented in *Entry 43, SA Irrigation Development Based on Footprint Data*. This is due to the salinity impact of irrigation development from 1988 to 2003 being sourced from the MODFLOW suite of models which is based on the 2003 irrigation footprint.

# 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 2013-14 monitoring data, refer Table 4.

**Table 3- Monitoring sites**

Monitoring site	Target EC *	Description
Border (downstream of Rufus River)	412	This site near the SA/NSW border effectively provides the salinity of water entering South Australia
Berri (Irrigation Pump Station)	543	This site has good long-term data and a continuous data recorder
Murray Bridge (Pump Station)	770	This site is a major off-take, and is downstream of the major urban off-take. The installation of a continuous recorder will ensure data quality will be maintained.

\*Target EC for 80 percent of the time

**Table 4- End-of-Valley summary report card**

Valley	Target site	End of Valley Target (as a percentage of baseline)	Valley Reporting Site	2013-14 Monitoring data (Daily Mean EC)
Basin salinity target	Lock 6 to Morgan	800 EC (95%ile)	Murray at Morgan	650 EC (Max) 590 EC (95 %ile) 439 EC (80 %ile)
South Australia	SA Border	412 EC (80%ile)	Murray at SA Border	520 EC (Max) 350 EC (95 %ile) 296 EC (80 %ile)
	Berri	543 EC (80%ile)	Murray at Berri	587 EC (Max) 507 EC (95 %ile) 372 EC (80 %ile)
	Below Morgan	770 EC (80%ile)	Murray at Murray Bridge	666 EC (Max) 593EC (95 %ile) 508 EC (80 %ile)

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# 4. RESPONSE TO 2012-2013 INDEPENDENT AUDIT GROUP RECOMMENDATIONS

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## Recommendation 1: BSMS Review

*In regards to the General Review of Salinity Management, the IAG–Salinity considers that the following features should be continued in the future salinity management arrangements:*

- *The Basin Salinity Target at Morgan is a target connected to assets at risk and agreed actions are implemented to ensure the target is met.*
- *There is a Basin-wide focus for salinity management as a major water quality issue for the Basin.*
- *The data and knowledge of the system continually improves and supports good decision making.*
- *The knowledge of the system and the models are upgraded every seven years through 'fit-for-purpose' model development providing increasing surety about the outcome.*
- *The intent of Schedule B in providing the register system is maintained given that it focuses the management of salinity and provides for trade-offs that cater for changing circumstances in each jurisdiction.*
- *The SISs provide surety in meeting the salinity target at Morgan.*
- *The governance arrangements for the BSMS have worked well i.e. annual reviews, the joint jurisdictional programs and advisory group, the mid-term review and the independent audit of the registers and activities.*

*There are areas of the BSMS that could not deliver as originally expected and need further consideration:*

- *The upstream EoVT were unrelated to upstream assets and were set as targets relevant to the Morgan target. However, there was little upstream community ownership or agreed management actions in the catchments to achieve those targets.*
- *The broad-acre agriculture and re-vegetation elements, while delivering local benefits, have not provided joint outcomes at Basin-scale that could be accounted for at Morgan.*

South Australia supports this recommendation.

The BSMS and its predecessor the Salinity and Drainage Strategy (S&DS) have provided the impetus for Basin-wide salinity management for over two decades and resulted in major advancements in the management of salinity at a Basin scale.

While the Basin Plan builds upon the successes of the S&DS and BSMS through the inclusion of a salt export objective and targets for managing short-term water quality, it does not replace the roles of the BSMS or Schedule B of the Murray–Darling Basin Agreement.

The future management of Basin-wide salinity will be reliant on continued coordination and it is critical that the next generation salinity strategy and investment program is developed to build on the gains of the BSMS and guide implementation of salinity management across jurisdictions.

In addition to the features identified in the recommendation, South Australia considers that future salinity management arrangements should:

- secure and build upon past achievements
- integrate Basin Plan and Schedule B requirements for salinity management
- replicate the inter-jurisdictional cooperation for ongoing salinity management
- clearly identify the requirement for and purpose of salinity management
- share accountability and responsibility between jurisdictions
- support ongoing operation of salt interception schemes (SIS) that manage salinity levels in the River Murray
- consider operational strategies to manage short-term salinity fluctuations in line with new Basin Plan targets
- prioritise resources to manage salinity risks that pose the greatest environmental, economic and social threats.

## **Recommendation 2: Environmental Water**

- a. **Three new register items should be added to the registers with notional values to cover:**
  - i. **Environmental Water Recovery**
  - ii. **Use of Water for Environmental Purposes**
  - iii. **Environmental Works and Measures (covering initially the TLM works).**
- b. **The policy principles for environmental watering and use of environmental works should be evaluated through modelled scenarios of salinity and dilution impacts and be undertaken by the Commonwealth Environmental Water Office (CEWO), the Basin States/Territory and the MDBA.**
- c. **The Basin-wide plan and policy framework for managing impacts and responsibility for reporting the accountable actions from environmental watering and use of environmental works as required under Schedule B be settled between the Commonwealth, the MDBA and the operating jurisdictions.**

South Australia supports the recommendation however the value of including notional values is queried. It is recommended that part (b) and (c) of the recommendation should be progressed as a matter of priority.

South Australia advocates a Basin-wide approach to the management of salinity impacts associated with the delivery and use of environmental water. This acknowledges that environmental watering actions are premised on improving the health of the system for water users across all jurisdictions.

The complex nature of environmental watering actions and the spatial extent of the actions will require the assessment of salinity impacts at a whole of Basin scale as an accumulated effect. Environmental watering actions cannot be assessed in isolation as it is the accumulated salinity impact of environmental water use at multiple sites which will ultimately impact on Basin Plan and BSMS targets.

### **Recommendation 3: Monitoring Reviews**

- a. In reviews of monitoring sites conducted by jurisdictions, the reviews:**
  - **Need to be made available to the IAG–Salinity.**
  - **Show they meet the jurisdictional BSMS reporting obligations.**
  - **Be based on a risk approach to match the management regime for data collection and improvement in models.**
  - **Adopt a scientific approach to minimise the loss of information content in the monitoring network.**
- b. The agreed protocols for collecting salinity data need to be updated and adopted.**
- c. Queensland has salinity hazards arising from CSG and irrigation and requires a better combined monitoring network if it is to analyse them.**

South Australia supports this recommendation.

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.

It is acknowledged that budgetary pressures may result in a decrease in monitoring undertaken and South Australia agrees that a scientific approach must be used as the basis for any review to ensure the effectiveness of monitoring networks.

### **Recommendation 4: CSG water in Queensland**

- a. Queensland adequately monitor salinity hazards arising through CSG and associated irrigation which will require a better combined monitoring database.**
- a. The potential cumulative impacts of CSG and any associated irrigation in Queensland needs to be assessed to determine if it is a threat to the Basin salinity program.**

This recommendation is supported by South Australia.

To ensure the future risk of salinity is managed it is critical that contracting Governments and the MDBA determine whether CSG is likely to have a significant effect, assess salinity impacts and attribute accountable actions to relevant salinity registers if required.

### **Recommendation 5: End-of-Valley Target**

- a. In the future salinity arrangements, catchment End-of-Valley Targets should be based on requirements of upstream and downstream assets (as detailed in the End-of-Valley Target Review). On this basis targets should be representative of the salinity regime that will impact on the agreed assets, which should not be constrained to the threshold and exceedance percentiles. This will assist in making the link between targets and community driven management of potential asset impacts.**
- b. Salt load requirements should only be required as part of End-of-Valley Targets where they are relevant to assets.**

This recommendation aligns with the findings of the end-of-valley targets review and is supported by South Australia.

### **Recommendation 6: Outstanding Register Items**

- a. Queensland should provide written evidence to the MDBA of the low salinity risk catchments that will not impact on the Morgan target and do not require any further work to assess them for a register entry.**
- b. Queensland, with the assistance from the MDBA, should undertake an analysis to determine at what level of salinity threat the Border Rivers catchment would need to be to consider it as a significant item for the salinity register purposes.**
- c. NSW should formally advise the Murray–Darling Basin Authority of its schedule for its upcoming salinity register reviews.**

This recommendation is supported by South Australia.

### **Recommendation 7: Modelling**

- a. By the end of the BSMS, the MDBA should assess how closely the benchmark period matched the 2000–2015 actual climate (on average), and the magnitude of the difference between recorded and dynamically modelled Morgan salinity.**
- b. A risk-based approach should be applied to model improvement as part of the seven year review process with the principle that further investment in model development should be driven by the salinity risk and the level of data available.**
- c. That priority be given to understanding and modelling physical linkages between river, floodplains and groundwater.**

South Australia supports this recommendation.

Modelling is an essential element of the BSMS that is utilised to determine salinity register entries and predict future salinity impacts. South Australia has invested significant resources into groundwater modelling to improve accuracy and confidence as part of implementation of the BSMS and Schedule B.

However, the requirement to regularly review and update groundwater models is resulting in diminishing returns where there is limited new monitoring or hydrogeological understanding. To ensure that resources are utilised effectively it is important that a risk based approach to modelling is applied.

Specific responses to each element of the recommendation are included below:

- a) Any assessment of the suitability of the current benchmark period should consider modelled and recorded salinities below Lock 1 to ensure that the conditions experienced during the millennium drought are accurately represented.
- b) Any risk based approach should also consider the uncertainty and confidence associated with the model and any recommendations included in peer review reports.
- c) The interaction between the river, floodplain and groundwater is currently a significant gap in conceptual and numerical groundwater models. South Australia is currently investigating the physical linkages between these elements to improve future salinity assessment and projections.

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# 6. GLOSSARY

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**AHD** - Australian Height Datum

**BSMS** - Basin Salinity Management Strategy

**CEWH** - Commonwealth Environmental Water Holder

**CLLMM** - Coorong, Lower Lakes and Murray Mouth

**COAG** - Council of Australian Governments

**CSIRO** - Commonwealth Scientific and Industrial Research Organisation

**DEWNR** - Department of Environment, Water and Natural Resources

**DFW** - Department for Water

**EC** - Electrical Conductivity -  $\mu\text{S cm}^{-1}$  EC

**GL** - Gigalitre (1 000 000 000 litres)

**IAG** - Independent Audit Group

**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

**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,  
Water and Natural Resources