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MURRAY–DARLING BASIN AUTHORITY

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Report of the Independent Audit Group for Salinity

2011–12

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Cover Image: Murray River in Hattah-Kulkyne National Park, Arthur Mostead, 2008

AUDITORS' FOREWORD

February 2013

Chairperson
Murray-Darling Basin Authority
GPO Box 1801
CANBERRA ACT 2601

Dear Chairperson,

We have pleasure in submitting to you the Report of the Independent Audit Group for Salinity, 2011–12.

This, the tenth such audit of the Basin Salinity Management Strategy, 2001–2015, covering the fifth year of Phase 2, has been carried out in accordance with the provisions of Schedule B to the Murray-Darling Basin Agreement, (Schedule 1 to the *Water Act 2007* (Commonwealth)).

This year the modelled Morgan target of 800 EC for 95% of the time was reached for the third time since it was set. This is a significant achievement for the Basin Salinity Management Strategy. The continuous river flows over the year allowed a significant amount of salt to flow to the sea without any peaks in salinity that could have been expected if the flow following the flood had quickly reduced back to entitlement.

The predicted increases in salinity in the out-years, while expected to be lower, is still a risk and management actions developed during the implementation of the Basin Salinity Management Strategy are essential particularly in low flow years to keep the salinity in the rivers at agreed levels.

The Basin Salinity Management Strategy continues to be supported by an excellent framework of responsibilities and a common commitment by the agencies and officers to make it work. This model of action is to be commended and while strained during the preparation of the Basin Plan appears to be again working well. It is important that current changes in funding arrangements being negotiated between the jurisdictions still provides the resources required to continue the excellent gains made in salinity management in the Basin.

We are impressed with the collective commitment of staff from all jurisdictions including the MDBA to the Basin Salinity Management Strategy and extend our thanks for their cooperation and assistance.

Yours sincerely,

ROGER WICKES
Lead Auditor

NOEL MERRICK
Auditor

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ABBREVIATIONS

BSMS	Basin Salinity Management Strategy
BSM AP	Basin Salinity Management Advisory Panel
CAP	Catchment Action Plan
CEWH	Commonwealth Environmental Water Holder
CMA	Catchment Management Authority
CPI	Consumer Price Index
CSG	Coal Seam Gas
EC	Electrical Conductivity expressed in units of mS/cm
EOV	End of Valley Target
GL	Gigalitre (1 000 ML)
GSWIT	Groundwater-Surface Water Interaction Software Tool
HGL	Hydrogeological Landscapes
IAG-Salinity	Independent Audit Group for Salinity
INFFER	Investment Framework for Environmental Resources
IQQM	Surface water model software (Integrated Quantity and Quality Model)
MDB	Murray-Darling Basin
MDBA	Murray-Darling Basin Authority
MDBMC	Murray-Darling Basin Ministerial Council
MODFLOW	Groundwater model software [MODular FLOW model]
ML	Megalitre (1 000 m3)
MSM-BigMod	River Murray model software (Monthly Simulation Model – Big Model)
NAP	National Action Plan for Salinity and Water Quality
NRC	Natural Resource Commission
NRM	Natural Resource Management
PCF	Policy Choice Framework
REALM	Surface water model software (REsource ALlocation Model)
SAR	Sodium Adsorption Ratio
SISs	Salt Interception Schemes
SIMRAT	Salinity Impact Rapid Assessment Tool
Source	Water quantity and quality model software (eWater Ltd)
TLM	The Living Murray program

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EXECUTIVE SUMMARY

Introduction

In August 2001, the Murray-Darling Basin Ministerial Council (MDBMC) launched the Basin Salinity Management Strategy (BSMS)[1]. In December 2008 the Murray-Darling Basin Commission was succeeded by the Murray-Darling Basin Authority (MDBA). Schedule C to the Murray-Darling Basin Agreement, which set down the legislative framework for the implementation of the BSMS, became Schedule B to the Murray-Darling Basin Agreement, which is Schedule 1 to the *Water Act 2007* (Commonwealth).

Schedule B provides for the appointment of "independent auditors for the purpose of carrying out an annual audit", whose task is to review progress on implementing the BSMS. The three members of the present Independent Audit Group for Salinity (IAG-Salinity) were appointed in October 2008.

The Terms of Reference for the IAG-Salinity and Schedule B require the IAG-Salinity to review progress on the BSMS both broadly and in terms of the steps laid down in the Schedule. The Terms of Reference also require the audit to focus on the specific measurement and recording of progress with the BSMS, and the outcomes at 30th June each year.

This report presents the consensus view that the IAG-Salinity has reached in undertaking the Audit covering the 2011–12 financial year. The state contracting governments, the Australian Capital Territory and the MDBA submitted reports on their activities, valley reports, the status of 5-year rolling reviews and BSMS Salinity Register entries or adjustments. The Australian Government Department of Sustainability, Environment, Water, Population and Communities also submitted a brief report related to environmental watering activities.

The audit process adopted by the IAG-Salinity included a review of these reports and the Salinity Registers. This was followed by meetings with representatives of the jurisdictions and with members of the MDBA. The recommendations were developed and jurisdictions given an opportunity to provide comments on the draft text of the audit report.

The 2011–12 Context for BSMS Implementation

In 2011–12 the high rainfall across the Basin, significant flooding and recovery of the water levels in the River Murray and its storages meant that 1.7 million tonnes of salt passed Morgan and around 2.0 million tonnes of salt flowed to the sea. This was about 70% of the previous year's salt transport to the sea. The continuous flow and slow flood recession meant that the expected high salinities on a post-flood recession did not occur in the lower Murray but increased Electrical Conductivity (EC) was observed in the unregulated rivers in a number of the northern catchments. The completion of the Basin Plan has resolved a number of contentious issues raised in previous Audits, in particular the idea of a salinity target below Morgan. The resource requirements of preparing the Basin Plan had delayed a number of critical issues associated with the BSMS but these were now progressing. While there was high co-operation between the jurisdictions, the uncertainty surrounding the funding of the joint program of works is an ongoing concern for the future of the program.

This is the third year that the Basin Salinity Target, at Morgan of 800 EC for 95% of the time, as defined in Schedule B, during the benchmark period has been reached. Work undertaken to understand post flood salinity peaks has demonstrated that the salt interception schemes (SISs) and high flows in the lower end of the river have minimised any salinity peaks.

The high flows have reduced salinities in the lower lakes (although Lake Albert salinity is still high) and the higher rainfall is again resulting in rises in water tables within dryland catchments and in irrigation areas. The jurisdictions are closely monitoring the situation and keeping the public informed about trends. The expression of dryland salinity in the landscape is cyclical and related to rainfall patterns.

1 Murray-Darling Basin Ministerial Council, 2001. *Basin Salinity Management Strategy 2001–2015*, MDBC, Canberra.

It is evident from the substantial increase in knowledge of the salinity processes and trends in the Basin, the projected 2050 levels of salinity predicted in 1999 were over-estimated. The IAG-Salinity heard from all jurisdictions that funding pressures will result in the funders seeking increased efficiencies in the program and a rationalisation of effort particularly in the monitoring of salinity trends. It is very important that the projected salinity risk and its likely impacts are re-evaluated with all relevant information so that future initiatives can be best targeted to ensure significant gains in salinity management over the last several years are maintained.

The purchase of water by the Commonwealth from irrigation entitlements, the improvement of irrigation practice and the use of that water for ecological purposes is strongly supported but the need to manage the salinity impacts of use of this water for environmental purposes is critical. While the principles for accounting for the salinity impacts of using environmental water have been drafted by the Environmental Water Salinity Accountability Taskforce, there is not yet an agreement on the accountability of any salinity impacts or dilution benefits and the responsibilities for notifying the MDBA of any reportable actions that may have an effect on salinity outcomes within the Basin. Much more still needs to be done and the Commonwealth Environmental Water Holder (CEWH) should develop the proposals for the management of salinity risks posed by the use of the water in consultation with the BSM AP. Suggested steps are:

- Determine the change in salinity risk from retiring some irrigation activity from areas where there is a high groundwater mounding so the register entries can be adjusted.
- Model the manipulation of flow regimes with the volumes of water purchased for environmental watering to determine the positive impact on in-river salinity if the flow is provided at the appropriate time and the impact of watering icon sites additional to those identified under The Living Murray (TLM) program.
- Develop scenarios that will help inform the application of the Environmental Water Salinity Accountability Taskforce agreed principles and proposed responsibilities when managing environmental water.
- Decide on the jurisdictional responsibilities and accountability for salinity register entries under Schedule B of the *Water Act 2007* and determine how they will be recorded.

While the BSMS has some three more years to run, circumstances have changed from when it was first conceived. These include reduced funding, the significant volume of environmental water available, improvement in irrigation practices, a prioritisation of at-risk upstream catchments, the coal seam gas industry, the increasing number of coal mines and the pending implementation of the Basin Plan. It is important that work commence as soon as practical to re-assess the predicted salinity impacts and the management and funding required to retain the gains that have been made through the implementation of the BSMS.

The SISs have been the primary source of salinity credits that appear in the registers. The cost of running and maintaining the infrastructure is high and there may be opportunities to make some efficiency without compromising the gains made. A review of the SISs is underway and it is critical the review consider the operations required to meet the revised salinity risk for the Basin for 2050 as discussed above rather than focussing on short term savings.

Progress in implementing Schedule B – Items for special mention

Implementation of the BSMS

It is evident that the implementation of the BSMS has been undertaken in two main areas of activity.

(1) The first area has been a very successful works and measures program where the SISs are nearing completion and have delivered the majority of the salinity credits. In 2011–12 the SISs diverted approximately 363 000 tonnes of salt away from the river. This together with continuing model development by the jurisdictions has decreased the uncertainty in the salinity registers. The works and measures program and the rehabilitation of irrigated landscapes to reduce salt accessions (and manage for other salinity benefits) have been highly successful. The SISs alone (those established under the BSMS) will deliver a salinity reduction of greater than 61 EC at Morgan by 2012 and a benefit of $17.7 million per year (in 2005 dollars) out of a total of $23.8 million benefit obtained from the BSMS implementation.

(2) The second area of activity consists of the remaining elements of the BSMS which relate to land based salinity mitigation. Further studies of the upland catchment areas has demonstrated that there are fewer high risk catchments than originally predicted and the high risk catchments can have management actions applied, appropriate to the soil and land system that can moderate the salinity risk. Analysis of data collected during the recent wet period that followed the drought confirms a cyclic salinity problem related to the level of the water table that rises in wet years both in irrigation and dryland districts. The development of the coal seam gas (CSG) industry and the increase in coal mines, which have a by-product of significant amounts of water and salt, will also add a new dimension to the prioritisation of catchments at risk.

An activity unforseen when the BSMS was articulated, but raised in the Mid-Term-Review, is the development of the allocation of water for the environment. This has commenced through TLM program and the salinity impacts of this program have been analysed and are ready to be accounted for. The purchase of large quantities of water by governments in the lead up to the Basin Plan, while welcomed, still requires some work to be undertaken in accounting for the salinity impacts of the use of this water.

Current salinity Management in the Basin

The modelled salinity target at Morgan over the benchmark period, i.e. below 800 EC for 95% of the time, has been met for the third year in a row. The SIS program has contributed to this success in low river flow years by reducing highly saline groundwater accessions to the river. Dilution from high river flows over the last few wet years has had a significant effect also. Table 1 shows that the model predictions for river salinity at Morgan over the Benchmark period (1975-2000), are less than 800 EC for 96% of the time.

Table 1: The modelled salinity levels (EC) at Morgan, South Australia for baseline year 1988 and the 2012 year, incorporating the implemented salinity managements based on the 1975 to 2000 benchmark period.

Time interval	Average (EC)	Median (EC)	95 Percentile (EC)	% time over 800 EC	% time less than 800 EC
Modelled Baseline (1988) conditions over benchmark period (1975–2000)	665	666	1058	28	73
Modelled 2012 conditions over benchmark period (1975–2000)	506	480	781	4	96

The effect of salinity management in the MDB on salinity at Morgan based on actual measurements and modelled salinity if management had not occurred is shown in Figure 1 for the duration of the BSMS. Without salinity management, salinity at Morgan would have exceeded the 800 EC target continuously from June 2007 to January 2009 with occasional breaches in other years. The continuous high flows in the River Murray over the past two years (i.e. August 2010 until June 2012) have been considerably larger than the salt inflows into the river. The significant reduction in salinity at Morgan in the dry years, particularly 2006 to 2010 shows the relevance of the actions under the BSMS in reducing the salinity in the lower Murray. It is important to continue to monitor this target as irrigation footprints and river flows change under the implementation of the Basin Plan.

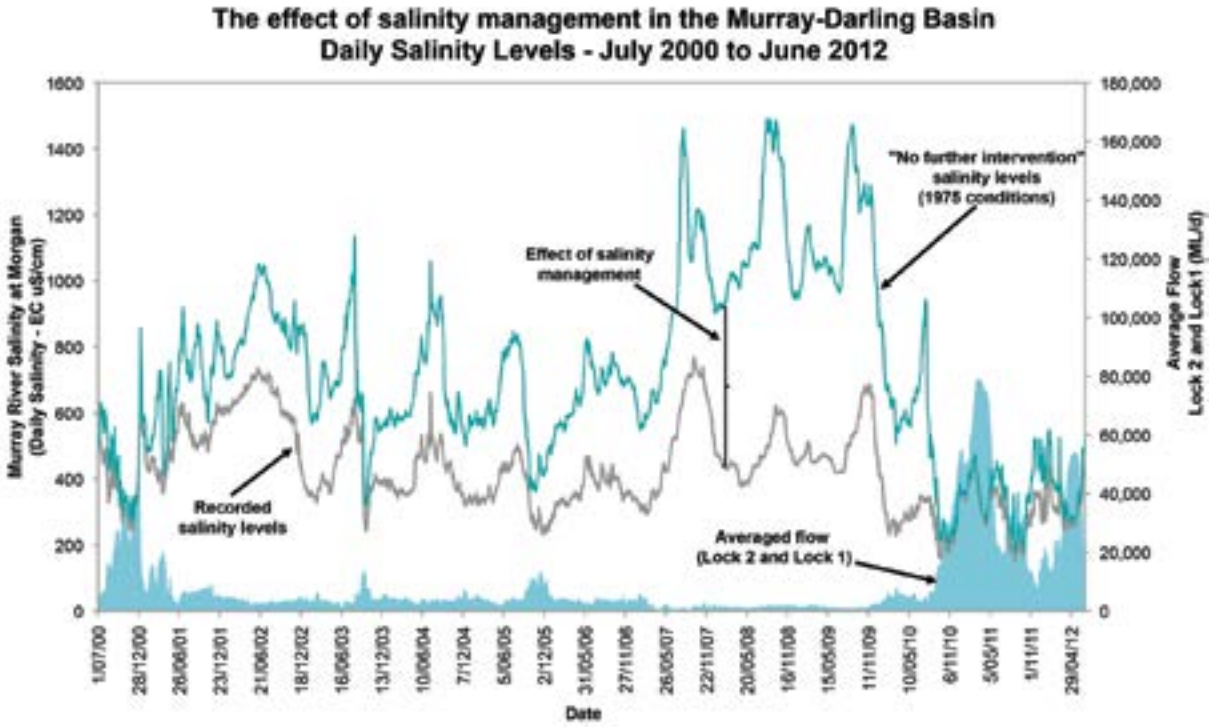

Figure 1: Mean daily salinity levels at Morgan from July 2000 to June 2012 (grey line) compared to modelled salinity levels without salt interception schemes improved land and water management actions and additional dilution flows ('no further intervention' senario) (green line), and average daily Murray river flow (blue) between Lock 1 and Lock 2. The difference is attributed to salinity management actions.

Salinity Outlook

The BSMS forward predictions of salt mobilisation in the upland catchments stated in the BSMS in 2001 are expected to have been an over-estimation given the improved information now available about the upland catchments, the current buy back of water for environmental use and the impending impact of climate change.

It is important to again determine the Basin salinity risk particularly given the budget pressures facing governments and the need to maintain the gains that have been made in managing salinity risks in the Basin.

While the SISs have been highly successful, further consideration should be given to bore-field optimisation to ensure the best outcome for the river and its environments at the lowest operational cost. In particular, the dilution resulting from some environmental watering activities, such as increased river flows when sending water downstream to environmental sites, may allow SIS pumping to be delayed in the short-term, but the SIS infrastructure will be required in the long-term to counter projected erosion of salinity credits. A revised assessment will ensure future budget decisions are based on the best information available.

Flood Recession Salt Risks

The first phase of the impact of flood recession on the salt risk project has been completed and the second phase of the project which examines options for operating the system to reduce the risk will be undertaken in 2012/13. While the River Murray did not experience increased salinity because of the continuous flow of water, a number of unregulated streams in the northern upland catchments were affected. This demonstrates the risks still exist.

Environmental Watering

Progress is being made on the understanding of the salinity impacts and the accountability for salinity impacts with the analysis of TLM program where a number of iconic sites will be watered. This experience still needs to be translated into the recently purchased environmental water held by the Commonwealth. It is important that this is done in collaboration with the states through BSM AP and responsibilities accounted for in the registers.

Coal Seam Gas and Coal Mines

Queensland and New South Wales have been developing regulatory and compliance monitoring regimes to manage the significant expansion in CSG exploration and development that is occurring. In New South Wales the expansion in open cut and underground coal mines are adding additional risks associated with the disposal of groundwater from the mine sites. While it is not known with any certainty how much water will be produced, the potential salt that will come with the water extracted to release the gas in Queensland alone is expected to be in the order of about 8 million tonnes in total or up to 400 000 tonnes annually. This is slightly more than all the SIS bore fields in the MDB capture each year. While there has been significant action in both Queensland and New South Wales to manage the storage of brine on the land, if salt does make its way to the waterways then it will need to be considered as an accountable action under the BSMS salinity registers.

End of Valley Targets

The EOV targets are an under-rated but critical component of the management of salinity in the Basin. New South Wales has indicated that the target levels set in 1999 are no longer appropriate. The review requested by the IAG-Salinity to refine the EOV targets will be undertaken in 2012/13.

Land Management Strategies

Conceptual models have continued to be used for prioritising sub-catchments which yield saline water. The recent wet period has raised water table levels in dryland salinity areas and the degree is determined largely by rainfall cycles.

The Monitoring Framework

The monitoring of sites in the Basin to meet EOV targets and the compilation of data to support models and evaluate trends is essential if the Basin is to be managed in a sustainable way. The significant loss of staff from jurisdictions across the Basin has put in doubt the adequate management of salinity instrumentation particularly in the upstream catchments after flood events and extended dry periods. While efficiencies can be made in the number of sites and bores monitored, it should be undertaken strategically so that the core sites are adequately measured and maintained. A review of the appropriate sites would better inform this process.

The IAG-Salinity's opinion regarding the balance of salinity credits and debits for each state

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

16. (1) A State Contracting Government must take whatever action may be necessary:

(a) to keep the total of any salinity credits in excess of, or equal to, the total of any salinity debits, attributed to it in Register A; and

(b) to keep the cumulative total of all salinity credits in excess of, or equal to, the cumulative total of all salinity debits, attributed to it in both Register A and Register B.

Register A currently shows New South Wales, Victoria and South Australia to be in net credit, while Register B shows New South Wales and South Australia to be in net credit, and Victoria slightly in debit. For the combined registers, all three states are in credit.

Opinion on Register balances:

The IAG-Salinity has examined the Registers as provided for this audit, and has come to the opinion that New South Wales, Victoria and South Australia are in a net credit position.

Opinion on the MDBA's accuracy in maintaining the Registers:

The IAG-Salinity found no inaccuracies in the MDBA's maintenance of the Registers, as provided for incorporation into this report.

The Audit did not identify any requirement to update individual entries in the Registers incorporated in this report.

Recommendations

The following are the recommendations of the IAG-Salinity in descending order of priority.

The Independent Audit Group-Salinity recommends:

1. **Redefinition of the salinity risk expected in 2050 to guide future program development**

   The BSM AP update the projected salinity risk for the Basin in 2050 as a basis for prioritising future actions and funding and based on past trends, works and measures, impacts, environmental watering, possible reduced irrigation footprint, possible increased agricultural production and emerging salinity risks.

2. **Accountability for salinity impacts of environmental watering**

   (a) The policy principles for environmental watering be evaluated through modelled scenarios of salinity and dilution impacts, including lag times, of various watering options for selected icon sites outside TLM program and be undertaken by the Commonwealth Environmental Water Holder, the Basin Salinity Management Strategy Advisory Panel and the Murray-Darling Basin Authority.

   (b) The Basin wide plan and policy framework for managing the potential impacts and responsibility for reporting the accountable actions from environmental watering as required under Schedule B be settled between the Commonwealth Environmental Water Holder and the operating jurisdictions.

3. **Outstanding submission of Salinity Register reviews**

   (a) New South Wales should develop and submit to the Murray-Darling Basin a schedule for the up-coming Salinity Register reviews;

   (b) Queensland should formally submit the three outstanding Salinity Register reports.

4. **The Basin Salinity Management Strategy (BSMS) model success story**

   The success of the BSMS is promoted to demonstrate how good multi-government programs can work when roles, responsibilities and accountabilities are well developed, an adaptive management framework used and where excellent jurisdictional collaboration and commitment to progressing the strategy occurs.

5. **Review of the monitoring framework for the Basin Salinity Management Program**

   Review the monitoring framework to ensure spatial distribution, priority salinity risk areas and environmental watering sites are all adequately assessed. The review to include confirmation of the monitoring protocol, maintenance of instrumentation, the handling of missing data and the selection of data to meet the requirements for real-time data analysis and predictive modelling of salinity impacts.

Determination of priorities

The recommendations in this report were arrived at through a review of the reports of the jurisdictions, the annual BSMS implementation reports, and past IAG-Salinity reports, followed by discussion with representatives of the jurisdictions and the Catchment Management Authorities (CMAs) (where present).

Recommendations of Previous IAG-Salinity Reports Not Considered Elsewhere

Many of the important recommendations from the 2010–11 and 2009–10 reviews have been progressed but not completed. Rather than bringing these recommendations forward as new recommendations they have been classified as continuing or completed. The 2013–14 audit will be seeking a report on the continuing recommendations.

Recommendations being Progressed:

1. **Priority for upland catchment actions (Rec 6, 2011):** Prioritisation for Natural Resource Management (NRM) investment in management actions for high salinity risk sub-catchments be further developed by synthesising data from the recent wet and dry periods, reviewing conceptual models and tools and approaches being used and preparing guidelines on preferred approaches and effective management options. The guidelines are to include emerging salinity risks. **Progressing** (New South Wales, Queensland and Victoria are defining priority catchments and monitoring water table changes with the return of wet seasons).
2. **Targets and Monitoring sites review (Rec 7, 2011):** A review process be established that combines EOV salinity targets over the benchmark period with real-time targets that can account for local high risk salinity processes operating and provide feedback to local communities. **Progressing** (MDBA reviewing during 2012–13).
3. **Salt Interception program review (Rec 8, 2011):** The salt interception program is reviewed to consider optimising the system taking into account the increasing maintenance requirement and the operational costs and capital investment made. **Progressing** (MDBA reviewing during 2012–13).
4. **Updated economic valuations in the registers and forward projections based on salinity risk (Rec 9, 2011):** The registers be interpreted annually for policy makers providing a current and forward economic valuation based on the values in the registers but which are in current dollars and the level of credits needed into the future taking into account any increase in credits to meet the target at Morgan. **Progressing** (To be undertaken in the register review 2012–13).
5. **Flood recession salinity risks (Rec 1, 2010):** That the MDBA with support from the BSM AP continue this program as a matter of urgency and prepare the operational plan required to manage the salinity risks. **Progressing** (MDBA is preparing a brief for Stage 2).
6. **Irrigation Salinity Accountability Framework (Rec 10, 2010):** That BSM AP, with support from the MDBA, to facilitate the development of a consistent framework for the accountability of irrigation salinity impacts including improved knowledge of district-scale irrigation related groundwater recharge; MDBA should continue capturing the irrigation improvement measures and unbundling of water from lands to inform this process; and MDBA should promote irrigation as a special application case in revised groundwater modelling guidelines being prepared by the National Water Commission. **Progressing** (The Mallee BSMS models were complete and the MDBA and NSW are drafting a project brief for the Riverine Plains; irrigation was not included as a focus topic in the Australian Groundwater Modelling Guidelines issued in June 2012 despite MDBA hosting a workshop for the benefit of the authors of the new guidelines).
7. **Salinity expertise for the Commonwealth Environmental Water Holder (Rec 11, 2010):** To facilitate appropriate salinity accounting and operating conditions for environmental watering activities, CEWH should consider including skills in floodplain salt mobilisation on the CEWH Environmental Water Scientific Advisory Committee. Increased collaboration is also required with partner governments to incorporate the considerable existing knowledge and expertise available. **Progressing**.
8. **Alignment of BSMS with Catchment Action Plans (Rec 11, 2009):** That NSW seek closer alignment between BSMS obligations and regional Catchment Action Plans with a transparent role for Catchment Management Authorities in meeting targets particularly for catchments with EOV targets through the development of within valley targets, and that the CMAs be supported in upgrading data management and reporting. **Progressing**. (Progress has been made in New South Wales and is expected to be completed in 2012–13 with the finalisation of the Catchment Action Plans).

Recommendations Completed or Not Progressed:

1. **Salinity Impact Zoning for Sunraysia NSW (Rec 10, 2011):** New South Wales reports a low risk with little new development. **Not Progressed.**
2. **Resourcing the Basin Salinity Management Strategy (BSMS) (Rec 5, 2011):** This has been overtaken by the Basin Plan and now the need is to resource the implementation of the Plan appropriately. **Completed.**
3. **Consistent Basin-wide land use databases (Rec 12, 2010):** While this recommendation is supported by most jurisdictions each jurisdiction has a data base where integration could be tested rather than creating a Basin-wide data base. **Not Progressed.**
4. **Science skills audit to support the salinity program (Rec 13, 2010):** The BSMS program is based on good science and the organisations to date have been able to source the relevant expertise primarily from consulting firms. Given the reduction of staff that is occurring in the jurisdictions it is hoped that the expertise to manage the contracts will still be available in the jurisdictions. **Not Progressed.**
5. **Defining the uncertainty in the register items (Rec 15, 2010):** While this has been widely supported it has been too complex to achieve using the suite of models employed. **Not Progressed**
6. **Recording the mitigation decisions required during the drought (Rec 16, 2010):** South Australia has developed a set of draft operating protocols for managing the River and Lakes below Lock 1 which has drawn heavily on the experiences of the drought. **Completed.** (The International Centre of Excellence in Water Resources Management (ICE WaRM) facilitated two workshops in Adelaide under the Living Laboratories program: *Response to Drought in South Australia: A Case Study in Adaptive Management on 7 December 2011 and River Infrastructure and Risk Management – Response to the Millennium Drought* on 13 December 2012).
7. **Salinity targets below Morgan (Rec 4, 2009):** Targets below Morgan have been considered in the development of the Basin Plan. **Completed.**
8. **Pike River SIS (Rec 9, 2009):** South Australia has funded part of this scheme and the remainder of the construction program is not necessary for BSMS outcomes but will be considered as part of the environmental management of the Pike River floodplain. **Completed.**

BSMS Mid-Term Review

Develop methods to account for and achieve environmental outcomes from salinity mitigation actions through integration across MDBA programs.

This is a component of the new recommendation 2 of this report.

Increased emphasis on catchment actions to address salt mobilisation and more innovative measures to deal with the effects such as real time operation.

This recommendation has been completed with excellent work in New South Wales, Victoria and Queensland. The option of real time targets has been considered under the Basin Plan.

1. INTRODUCTION

Objectives and Structure of the Basin Salinity Management Strategy

The BSMS provides a framework for communities and Governments to work together to control salinity and protect key assets and natural resource values in the Murray-Darling Basin (MDB). Its objectives are to:

1. Maintain the water quality of the shared water resources of the Murray and Darling Rivers for all beneficial uses – agricultural, environmental, urban, industrial and recreational.
2. Control the rise in salt loads in all tributary rivers of the MDB, and through that control, protect their water resources and aquatic ecosystems at agreed levels.
3. Control land degradation and protect important terrestrial ecosystems, productive farm land, cultural heritage, and built infrastructure at agreed levels Basin-wide.
4. Maximise net benefits from salinity control across the Basin.

The obligations that provide for the implementation of the BSMS are set down in Schedule B to the Murray-Darling Basin Agreement, which is Schedule 1 to the *Water Act 2007* (Commonwealth).

Schedule B supports effective salinity management by:

- promoting joint works, measures and other action to reduce or limit the rate at which salinity increases within the MDB
- providing for the adoption of salinity targets
- establishing salinity registers to record salinity impacts and to allocate salinity credits and salinity debits to contracting governments
- providing for monitoring, assessing, auditing and reporting on progress in implementing the strategy.

Achievement of the BSMS objectives is measured not only through the Salinity Registers, but also through the degree of achievement of EOV targets and the Basin Salinity Target at Morgan. Progress towards meeting the agreed EOV targets and the land management objectives is assessed through annual reports from the contracting governments and MDBA. These reports include valley reports for the catchments where an EOV target has been adopted. An independent annual audit of the reports and Register entries, and of the performance of the contracting governments and MDBA, is provided by the Independent Audit Group for Salinity (IAG-Salinity).

A key driver of the BSMS is the principle of "capping" increases in salinity of the MDB by a system of salt credits and debits, managed by the participating governments through two major thrusts. One is joint investment in SISs and associated infrastructure, and the other is investment in target setting and monitoring systems at the end-of-valleys in concert with plans and actions to improve land management practices across the Basin. Victoria has set sub-targets for irrigation areas and upland systems so that they can monitor the effect of these on the EOV targets.

The nine implementation elements of the BSMS are:

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.

The BSMS commenced in 2001–02, and is scheduled for completion in 2015.

Terms of Reference

The Terms of Reference of the IAG-Salinity of the BSMS are attached as Appendix 1. A summary of Schedule B, including its provisions concerning audit of the BSMS, is attached as Appendix 2.

Development of the annual audit and reporting process has been a significant achievement for the BSMS. However, increasing sophistication of the program, the Mid-Term Review and recent audits have signalled the need for a more rational reporting and audit approach. As a consequence, revised audit Terms of Reference were developed and approved by Commission (MDBC 95 – 22 Apr 2008) and transitioned to the MDBA on 15 December 2008 which includes:

- the development of an annual audit plan
- a requirement that the audit is more closely focussed on the specific Schedule B provisions
- the potential for the auditors to provide the MDBA and the BSM AP with a short commentary on issues with implications outside a strict interpretation of Schedule B.

As set down in the Audit Plan, priority areas for review in this audit included:

1. Registers: those Schedule B accountabilities required to be reported to the Authority and Legislative and Governance Forum on the Murray-Darling Basin, particularly the auditors' assessment of whether the BSMS Salinity Registers are a fair and accurate recording of the salinity impacts of actions;
2. Reviews: those Rolling 5-Year Reviews which are due to be completed and assessed. However, where the reviews have not been completed within the timeframes set down by Schedule B, some comment should be provided on:
    - the potential for improved estimates given the available data and development of analytical tools since the last assessment
    - the relative risks in terms of likelihood and consequence, as compared with other salinity assessments that have been, or should be, undertaken by the contracting governments.
3. 2011–12 IAG-Salinity Recommendations: The recommendations made by the IAG-Salinity are based on the draft 2011–12 Annual Implementation Reports provided by each contracting government and the MDBA, and the auditors' assessment of progress made against the 2009–10 and 2010–11 recommendations. This may include a statement about progress made to date by the BSMS program as a whole on the Mid-Term Review recommendations and directions noting that some of those recommendations have been considered in the Basin Plan.

The steps taken by the IAG-Salinity in carrying out the 2011–12 audit included:

- assessing the annual reports of the jurisdictions
- reviewing Registers A and B with MDBA staff
- travelling to each jurisdiction, meeting with the representatives of the contracting governments and the MDBA. These were essentially all-day meetings with the contact officers, their teams of managers and specialists and in some cases, managers of Regional Catchment Management Authorities
- discussing technical, scientific and policy issues with specialist staff from the jurisdictions and the MDBA, seeking clarification or correction of misunderstandings
- providing the main draft text to jurisdictional contact officers for factual comments.

2. IMPLEMENTATION OF THE BSMS

Background

The reporting of progress is organised under the nine BSMS Elements. The IAG-Salinity's assessment of the needs for action under different elements sometimes leads to the same recommendation. In the interests of readability, where a recommendation arises a second time, it is repeated.

The relative priorities of the recommendations are shown in the Executive Summary. In this Chapter, each recommendation is accompanied by its priority number.

Overview

The BSMS, which is now in its twelfth year, has been highly successful as has been demonstrated by the Morgan target being met for the past three years. With the negotiations required for the Basin Plan, the IAG-Salinity noted last year that the cooperative arrangements that led to the success of the BSMS were under strain but was now pleased that the cooperative arrangements have been rebuilt over the past few months and a great deal of good will exists. Consequently it is again recommended that the success of the strategy and the operating model be promoted so that those not directly involved in the program can also understand what has been achieved and how that came about. The model of cooperation that is operating for the implementation, management and accountability of the BSMS should be looked upon favourably by the MDBA when establishing the successor to the BSMS and for other requirements under the Basin Plan arrangement.

Recommendation 4: The Murray-Darling Basin Salinity Management Strategy (BSMS) model success story. *The success of the BSMS be promoted to demonstrate how good multi-government programs can work when roles, responsibilities and accountabilities are well developed, an adaptive management framework used, and where excellent jurisdictional collaboration and commitment to progressing the strategy occurs.*

It is noted that the pressure on all jurisdictions to make wise funding decisions is paramount at present. The Basin Plan will lead to different priorities and arrangements if the jurisdictions are to implement the Plan. While great progress has been made in managing salinity in the Basin, there has also been an improvement in the knowledge of the salinity processes and an increase in the water available for the environment. Both of these put in doubt the high projections for salinity risk in the Basin as predicted by the year 2050 in the original basis for the BSMS . Any future program and program efficiency measures need to be made in the knowledge of the risk. Consequently the IAG-Salinity considers that the risk needs to be urgently evaluated so that future decisions on the program can be made in full confidence that the risks will continue to be managed into the future.

Recommendation 1: Redefinition of the salinity risk expected in 2050 to guide future program development. *The BSM AP update the projected salinity risk for the Basin in 2050 as a basis for prioritising future actions and funding and based on past trends, works and measures, impacts, environmental watering possible reduced irrigation footprint, possible increased agricultural production and emerging salinity risks.*

The issues that are influencing the level of salinity risk that have changed since the BSMS was developed are:

- The purchase of irrigation water and using it for environmental watering.
- The increased knowledge of the impact of upland catchments on river salinity.
- The salinity impact in streams from changing the timing of water delivery for environmental watering to a possible spring peak from a previous summer peak for irrigation.
- The risk posed by brine storage in the landscape as a by-product from managing the large quantities of groundwater extracted to release coal seam gas, de-water coal mines, the need for modifying associated valley targets and the accountability for any unforseen salinity exceedences caused by those industries.
- The policies of the National Water Initiative and the Basin Plan on the operation of the River systems.
- The impact of climate change on water yield in the system.
- The increased understanding of the debits in the salinity registers over time caused by legacies of history.
- The increasing maintenance and operating costs of the salt interception infrastructure.
- The possible impacts of carbon credits in increasing vegetation in high water yielding catchments changing surface flows and possible base-flow stream salinity levels.

Observations from the Past Five years of BSMS audit reviews

This year the audit group took the opportunity to take an overview of the last five years. BSMS has been highly regarded as a very successful approach both by those jurisdictions involved and others outside the process. Some of the reasons given for the success are:

- The accountability of salinity actions by each jurisdiction through the registers.
- The annual reviews of progress on the BSMS and review by the independent audit team.
- The process of 5 year review and accreditation of models to estimate salinity impacts at Morgan introduced a rigorous process and allowed adjustment as circumstances changed and trends emerged.
- The collegiate mode of operation has mostly fostered joint approaches and debate between jurisdictions.
- The emphasis on continual improvement of actions and on-ground works through investigations, education programs and funding initiatives, and the implementation of the principles of adaptive management, that is plan-do-review-act approach ensuring that actions follow the review phase.

Some BSMS achievements and difficulties

The states were asked in the interviews for their views on the achievements and the difficulties they saw in implementing the BSMS.

Some of the achievements identified were:

- The successful collegiate approach to salinity management across the jurisdictions.
- Joint governance deciding and undertaking the important priorities in salinity management.
- Progress of the 9 elements from concept to implementation.
- The ability to raise issues for the northern part of the Basin to achieve a more holistic Basin-wide approach.
- Implementing the cap and trade approaches to water management.
- Whole farm planning with proper land management and with community commitment.
- The range of necessary groundwater models developed and certified.
- Setting the scene so operational targets and a target below Morgan could be considered in the Basin Plan.

- Irrigation salinity risk reduced in a range of areas.
- The near finalisation of the SIS and the recognition of the need for salt export from the Basin while maintaining water quality targets in the river.

Some issues considered too difficult to achieve were:

- Taking a forward looking view for the Basin has taken much longer than expected.
- Securing resources to complete the necessary activities in a reasonable time period.
- Integration of data sources and breaking down of 'data silos' for ready access to necessary data.
- The development of the Rapid Assessment Tool for floodplain management.
- The useful and transparent database behind the salinity registers being available to a wider group to allow tracking of decisions and activities.

Element 1: Developing capacity to implement the BSMS

The MDBA 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.

Catchments

Increasing the knowledge of salinity processes has continued with the near completion of significant research into the alluvial salinity processes in the Condamine River catchment in Queensland. The complexity of groundwater interactions and the re-emergence of shallow water tables in the upland areas where the Basalts overlie the Walloon Coal Measures have been examined. The extensive groundwater irrigation in the catchment has resulted in a net reduction of salt leaving the catchment through storage in the unsaturated zone.

New South Wales has applied the hydrogeological landscapes (HGL) concepts to the lands in the Central West CMA and identified a number of high salt areas around which the CMA can develop management plans. The HGL concept is focussed on salinity risk management. The Catchment Action Plans (CAPs) in New South Wales are continuing to be upgraded under the guidelines of the Natural Resources Commission (NRC). An active process of peer review of some of the targets and expected benefits would seem appropriate.

Victoria has again offered many workshops (for example Waterwatch, whole-farm planning. improving land management practices, irrigation shed meetings, and irrigator field tours) and some CMAs have established working groups jointly with community members to foster and develop activities including whole farm planning, groundwater and salinity management and farm and environment groups.

South Australia has focussed on irrigation and has implemented annual irrigator reporting, Land and Water Management Planning groups and a draft Irrigation Code of Practice which is currently being trialled. During 2011–12, South Australia collaborated with the University of Naples (Italy) for a trial of high resolution satellite data for the IRRI-EYE Irrigation Advisory Service which aims to provide near-real-time advice on agricultural water management and irrigation efficiency.

Flood Management

Progress on the post-flood salt recession project has been slow since the release of the phase 1 project report. The current post-flood recession has been different from previous floods with a very long post-flood recession with continuing relatively high flows in the Murray until around September 2012, thus reducing the magnitude of salt accession. Completion of phase 2 with recommended action plans to address salt accession is expected

to be completed in 2012–13. Forecasting of salt impacts is possible for the southern Basin areas allowing for the possibility of real time salinity management.

The floods in the northern parts of the Basin have sometimes shown significant increases in stream salinity in post flood periods. This seems to be caused by higher groundwater levels and contribution to the streams. Some of the principles of phase 1 of the project could be considered for applicability to the northern parts of the Basin.

Environmental Water

The ongoing collaborative work between the CEWH and the BSM AP has improved communication and allowed a wider and appropriate consultation with the jurisdictions on salinity and environmental watering issues. Environmental watering if significant is a notifiable action under the current BSMS protocols. Currently CEWH makes the decision to water an environmental site in communication with a state. While CEWH and BSM AP have collectively considered the high level principles for accounting for salinity impacts of environmental watering, there are issues still to be resolved on whether the CEWH or the relevant state (or states for joint works or measures) has to account for the salinity credits and debits.

The audit report for the last two years has recommended the addition of skills in salt dynamics, salt transport and floodplain salinity to the advisory committee of the CEWH. The Windsor inquiry has recommended improving knowledge and developing scientific and engineering expertise as well as changes to accountability and transparency for the CEWH.

Also since the Windsor Inquiry – the House of Representatives Standing Committee report *Of Drought and Flooding Rains: Inquiry into the Impact of the Guide to the Murray-Darling Basin Plan in Regional Australia*, the Government has:

- established a separate Commonwealth Environmental Water Office to support the CEWH
- continued to work with the Basin states on an implementation strategy for the Basin Plan and river management
- established and appointed the Commonwealth Environmental Water Stakeholder Reference Panel
- established the Commonwealth Environmental Water Advisory Council (members yet to be appointed)
- re-named the Commonwealth Environmental Water Scientific Advisory Panel (formerly known as the Environmental Water Scientific Advisory Committee).

Ongoing good collaborative relationships with the BSM AP are required if the salinity consequences of environmental watering are to be effectively addressed. There are a number of outstanding issues to do with salinity management which still concern the jurisdictions involved.

Modelling

The partner governments have been participating in the development of the National Hydrological Modelling Platform, which heralds the eventual replacement of MSM-BigMod, IQQM and REALM river models by "Source" software for consistent modelling of river basins and salt transport. A Groundwater-Surface Water Interaction software Tool (GSWIT) provides some degree of river/aquifer interaction but not to the degree that can be achieved with MODFLOW based groundwater models.

Communication

All states have processes for communication with CMAs or regional groups including various newsletter and technical and web communications. However with the drastically reduced staffing levels in state agencies, some of these roles may be rationalised. Past IAG-Salinity recommendations on maintaining salinity skills and expertise have now been overtaken by state government budget reductions.

Element 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 recognises that living with salinity is the only choice in some situations.*

The modelled salinity target at Morgan has been achieved for the third year in a row assisted by the actions taken under the BSMS. However the return of the wet seasons following the drought has raised water tables again and the jurisdictions are closely monitoring the rise to follow the trend and inform landowners of the salinity risk it poses to their assets.

Built assets

New South Wales has used the HGL process to identify the risk areas for urban salinity development and has had this analysis included in the local development plans. A PhD student is currently examining the cost of urban salinity in New South Wales.

Coal Seam Gas Water

CSG water contains significant but variable concentrations of salt, with dissolved solid values typically ranging from 2 000 to more than 10 000 mg/l. It also has a high Sodium Adsorption Ratio (SAR) and may contain hydrocarbons that have the potential to cause environmental harm. Both Queensland and New South Wales have developed policy frameworks to ensure the salt produced does not cause environmental harm and encourages the beneficial use of treated CSG water. It is proposed to treat most CSG water by reverse osmosis. A substantial amount of the treated water will most likely be used for irrigation and it is essential that its use is strictly controlled as it will probably continue for 20 or more years.

In Queensland the industry so far has been for domestic use but overseas exports will commence when the Gladstone Liquid Natural Gas project comes on line in 2014. It is expected the industry will then increase 10-fold with an obvious significant increase in water and salt disposal. The Queensland Water Commission estimates an average of 125 000 ML per year. The brine can cause significant environmental harm if not managed properly. Overall about 8 million tonnes of salt will be produced over the life of the projects in Queensland. While there are a number of options for its disposal, the base case is to store it in secure land-fills reducing the risk of it entering the MDB Rivers. The water from the reverse osmosis plants can be used for irrigation or delivered to the streams where local water quality guidelines will be established to ensure the community environmental values are protected.

Biodiversity

The impacts of dryland salinity on biodiversity are high. Across the Victorian area of the MDB, the predicted rise in groundwater levels is not as high as was originally predicted. However the increased rains since the drought have raised groundwater levels again putting many of the biodiversity values and aquatic ecosystems at risk. Victoria will continue to monitor the rise in groundwater levels and keep the community informed of the risk this imposes.

Irrigation

The irrigation areas are also at risk. The Goulburn-Broken CMA for example reported that, the groundwater levels are rising in irrigation areas as a result of the increased rainfall following the drought. It will continue to monitor groundwater levels as there is a potential for severe widespread salinisation to occur, resulting in significant loss to irrigation assets and degradation of most major wetlands in the area.

Below Morgan

There are significant environmental, agricultural and public water supply assets requiring a water allocation from the River below Morgan and these need protection. The IAG-Salinity understands that this has been recognised in the Basin Plan with salinity objectives and targets proposed for assets below Morgan. The ecology of many of the floodplains and wetlands in South Australia are declining because of the high soil salinity and lack of flooding events. The recent continuous high river flows has taken a lot of salt out of the system. The use of environmental water in these wetlands will be beneficial but will also mobilise significant quantities of salt to the river. The implementation of TLM provides a model on how the watering of icon sites may be managed in the salinity registers. The Chowilla Floodplain Icon Site is the first to be managed and the first draft of an operating strategy is expected to be completed in 2012-13. Initial studies on the effect of applying environmental water to the Pike River floodplain expect the short term impacts may be significant and require advanced planning and decision making to minimise salinity impacts on the River.

An overall environmental watering plan for the Basin and scheduling of the watering is required to ensure that the different actions along the river do not accumulate and cause a salinity issue. The whole area of the provision of Register entries and the responsibility for notifying the MDBA when accountable actions will occur is required.

Recommendation 2: Accountability for salinity impacts of environmental watering.

(a) The policy principles for environmental watering be evaluated through modelled scenarios of salinity and dilution impacts, including lag times, of various watering options for selected icon sites outside TLM program and be undertaken by the Commonwealth Environmental Water Holder, the Basin Salinity Management Strategy Advisory Panel and the Murray-Darling Basin Authority.

(b) The Basin-wide plan and policy framework for managing the potential impacts and responsibility for reporting the accountable actions from environmental watering as required under Schedule B be settled between the Commonwealth Environmental Water Holder and the operating jurisdictions.

Benefits of the BSMS

The IAG-Salinity in the last audit realised that the assets being protected were undervalued on the registers as they are presented in 2005 dollars and made a recommendation to update them. However attempting to update to 2012 dollars has proven difficult as the basis on which the values in the original comparison may have changed over time. Just using Consumer Price Index (CPI) will not reflect the true value of the assets protected by reductions in salinity and make it difficult to compare changes over time. It has been agreed that when the review of the EOV targets is complete, the registers will be reviewed and the valuation algorithms updated to be able to reflect current values.

Element 3: Setting salinity targets

This element requires the adoption of 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.

The review of EOV targets as required under BSMS is currently out to tender given the previous report did not deal adequately with all the issues. The need for developing a process based understanding of EOV monitoring as mentioned in the last two IAG-Salinity audit reports is becoming increasingly relevant. Environmental watering, discharge of salt to rivers in NSW associated with CSG and extractive industries under the new Strategic Lands policy is being finalised and optimisation of releases of water in the lower Murray, will require a process understanding to predict impacts of management. Such an interpretation will be useful in the transition to real-time targets under the Basin Plan and the river operations strategy being developed in phase 2 of the post-flood salt-recession project expected to be completed in 2013.

Salt load (calculated as water flow multiplied by salt concentration) is often reported for EOV monitoring sites when in fact it is the EC that is the accountable value. Salt loads cannot be controlled in unregulated catchments where high rainfall events, floods and flood recessions can cause significantly higher salt loads due to high flows (and also higher EC values) as occurred in the northern part of the Basin over the last two years. This means that salt load data needs to be interpreted in relation to natural and episodic events.

The considerably reduced reliability in daily EC and flow measurements at EOV sites as a result of flood events recorded this year is of concern. The daily monitoring records for EC has dropped from 92% in 2011 to 78% for 2012. The MDBC protocol for EOV monitoring in *Appendix 2* of the *Basin Salinity Management Strategy, Operational Protocols, version 2 March 2005*, sets the minimum standards for EOV monitoring indicating that "95% data capture shall be maintained for each parameter at each site". The reduced number of days of record can be attributed to the:

- difficulty of estimating flows over the floodplains during flood flows
- fouling of EC sensors from turbidity in high flows and algae growth
- non-specificity of temperature correction of EC to 25° C at some sites
- possible lack of awareness by hydrographers or contracted third parties of the monitoring protocol
- lack of an agreed process to correct for missing data values
- protocols for accessing appropriate sources of data
- reduced budget and available staff for routine monitoring.

Some action to optimise the location of monitoring sites and making sure the agreed protocols are current and are met is needed. South Australia appears to have the best continuity of records. Some collaboration across the states with operational staff would seem to be a worthwhile investment in the near future to allow the refinement of operational protocols.

Recommendation 5: Review of the monitoring framework for the Basin Salinity Management Program. *Review the monitoring framework to ensure spatial distribution, priority salinity risk areas and environmental watering sites are all adequately assessed. The review to include confirmation of the monitoring protocol, maintenance of instrumentation, the handling of missing data, and the selection of data to meet the requirements for real time data analysis and predictive modelling of salinity impacts.*

A revision of the 2050 salinity risk prediction is needed. Victoria has recently considered the Goulburn-Broken dryland salinity impact and reduced the impact of dryland salinity in that catchment at Morgan down from 12.3 EC to 1.1 EC based on more realistic projections of dryland salinity and the available data over the last several years. The provisional assessment of the salinity impact at Morgan of the use of 500GL of TLM water over the BSMS benchmark period is approximately 4.6 EC debit, coupled with a dilution benefit of 24.4 EC giving a net credit of 19.8 EC. The environmental watering initial investigation shows the impact could be a 72 EC credit compared with the SIS schemes which have provided a 133 EC credit. Of the 190 EC reduction achieved at Morgan, 133 (70%) has come directly from SIS schemes with other credits from irrigation efficiency, salinity zoning and water buy back.

Thus the direct contribution of dryland salinity in upland catchments to in-steam salinity is relatively small. Given that many dryland salinity outbreaks often show evidence of significant historic salting, then natural groundwater and unsaturated zone salt loads were high before land development. Land development activities have probably enhanced salt mobilisation to the soil surface in most incidences but will probably have had little impact on the historic mass of salt present in the landscape. The re-assessment of the risks and contribution of dryland salinity to the salinity at Morgan is needed. New South Wales is evaluating its modelled predictions of the effects of landscape management investments on river salinity in the Murrumbidgee catchment in which the highly saline Jugiong catchment is located.

Recommendation 1: Redefinition of the salinity risk expected in 2050 to guide future program development. *The BSM AP update the projected salinity risk for the Basin in 2050 as a basis for prioritising future actions and funding and based on past trends, works and measures impacts, environmental watering and emerging salinity risks.*

Element 4: Managing trade-offs with 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.*

The IAG-Salinity is impressed with the approaches that have been developed to assess salinity targets as part of the catchment health, social and economic values. In Victoria these decisions are based on using the Investment Framework for Environmental Resources (INFFER) and some CMAs include the Policy Choice Framework (PCF). This allows them to focus on assets with high salinity risk and make investment decisions based on a range of options.

New South Wales used the SIMRAT model to assess river salinity impacts for a development proposal in the Sunraysia region and concluded that it was in a low impact zone.

In Queensland the Condamine Alliance is also using a spatially prioritising method to guide investment decisions. The salinity risk in 43 sub-catchments has been assessed and recommended practices to minimise salinity promoted. A similar tool has been used in the Border Rivers, Moonie and Maranoa catchments. A salinity risk assessment framework and accompanying guidelines have been developed for the use of CSG water for irrigation and is consistent with how salinity risk is assessed for accountable actions under Schedule B of the *Water Act 2007*.

South Australia with its greater focus on the valley of the River Murray is concentrating on the management of environmental water and the operating protocols of the locks and barrages to achieve both a reduction in salinity impacts and the ecological health of the wetlands and Coorong. One new program is examining options for improving the ecological health of the Pike River floodplain. The tradeoffs include the location of irrigation extractions, watering of the floodplain and salt interception. Another new program is diverting water currently going out to sea into the southern connection of the Coorong to reduce salinity in the southern lagoon.

The irrigation regions in the lower River Murray can have significant impact on river salinity and SISs have been developed to protect the River from drainage from these regions. In South Australia and Victoria, salinity impact zones have been developed and refined to guide the development of irrigation. This has resulted in Victoria having a significant shift of water from the high to the low impact zones and there has been 35 000 ha of mostly new development in the low impact zone. There has not been the same movement in the NSW Sunraysia region with only one new development occurring recently. While the Salinity Zoning has not been formalised in the Sunraysia region as recommended in a number of previous IAG-Salinity reports, the level of development is low and New South Wales expects it to remain this way.

Element 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 Integrated Catchment Management (ICM) Policy-compliant salinity and catchment management plans in dryland regions.*

Catchment Plans

The Natural Resources Commission (NRC) in New South Wales is revising the CAPs of CMAs. The relationship between the plans and the BSMS is difficult to determine because the outcomes proposed in this year's reports are quite broad across natural resources.

Victoria is continuing in its update of the draft Dryland Salinity Strategy as mentioned in the IAG-Salinity audit report a couple of years ago. While the draft has not yet been released, the move towards salinity as a component within an overall natural resource management approach, the emphasis on landscape provinces, the focus on discharge area management rather than recharge area management, a recognition that many salinity areas are an enhancement of natural salinity rather than secondary salinity are all very worthwhile directions. This change should achieve improved salinity symptom management since the underlying causes of the salinity are largely historic and extensive in magnitude.

Irrigation

On-ground works through various programs and initiatives have progressed strongly in most states with particular success in Victoria through their CMAs, to a lesser extent in New South Wales and through state initiatives on irrigation in South Australia. The recording of progress on planning and on-ground works in Victoria is impressive and while some overlapping initiatives occur, it offers an excellent opportunity to evaluate the benefits and costs of the initiatives and what outcomes have been achieved for the ecosystems for communities and social change and for the economy. While it may be complex to identify the benefits, it is suggested that Victoria through a joint CMA initiative fund the stipend and operating for PhD students under joint CMA supervision, to investigate the benefits and costs of the very significant and well documented activities that have been undertaken over the years. This activity would be a fitting additional evaluation of the success story of BSMS.

The detailed monitoring of water tables in the Shepparton Irrigation Region has shown interesting trends with rainfall and irrigation water allocations. The highest water table levels occurred in the mid 1990s. The drought and reduced allocations in the mid-2000s are very evident in lower groundwater levels with the return of wetter years beginning to show a rise in water levels. The strategy of conjunctive water use for irrigation to manage water tables is an effective strategy and can result in storing salt in the unsaturated zone. Victoria is encouraged to incorporate the irrigation water quality guidelines from the ANZECC and ARMCANZ (2000) guidelines to ensure the soils are not degraded through a moderate to high SAR of the groundwaters used for irrigation. The SAR is expected to gradually increase under a conjunctive use strategy because of the precipitation of calcium and magnesium as the soil solution concentrates under evapotranspiration.

Coal Seam Gas

New South Wales has a new Aquifer Interference policy and associated regulations to deal with the water and salt issues associated with CSG. The policy will allow some discharge of salt to streams provided the increase from each project is less than 1% of average stream salinity levels.

- Machinery of government changes in Queensland has altered the functions of some departments and this has meant a change in responsibilities for CSG approvals and compliance.
- IAG-Salinity will continue a watching brief on the progress with CSG, its policy implications and potential impacts on the Basin.

Element 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 MDBA will enhance research and development into new industries based on salinised resources, such as broad acre salt land agronomy, saline aquaculture, and salt harvesting.

A range of training programs in irrigation and dryland farming techniques has continued. The Water for the Future initiative by the Commonwealth has led to some significant improvements in irrigation water use efficiency as reported by all contracting governments. This is resulting in an increasing level of water savings being accumulated by the CEWH. There is expected to be some salinity benefit from improved efficiency or retiring of irrigation lands over time as groundwater mounding levels decrease. The likely net balance on salinity from environmental watering is not yet resolved.

In Victoria, the five CMAs have again reported works to improve farm practices in their region particularly in the irrigation section. Whole farm plans are the basis of any investment on properties and 300 were undertaken across the irrigation and dryland areas of Victoria in the past year. The Goulburn-Broken CMA reported that 80% of irrigation properties had a whole farm plan and these were being updated as salinity and water delivery arrangements were changing. Goulburn-Murray Water is adjusting its channel systems to avoid having to manage 'lazy infrastructure'.

In Queensland the Healthy Headwaters Water Use Efficiency program funded by the Commonwealth is expected to result in water savings of 10,000 ML/year. There are a number of projects conducted with the cotton industry looking to maximise profitability with limited water and includes lysimeter studies to manage root zone water and salinity and deep drainage. Also in the Lockyer Valley the movement of salt into the groundwater and into deep drainage has been explored. It concluded that improvements in irrigation water use efficiency should be considered by irrigators as a means of reducing groundwater use and preserving it for drought periods.

New South Wales CMAs have continued to invest in restoring and managing saline lands and also in planting perennial plants in recharge landscapes. Most CMAs have a program to improve soil condition and improve the condition of riverine ecosystems which includes targets for salinity and water quality levels in streams. However none recognise the EOV targets set by the BSMS and targets are more generic for soil health and water efficient farming systems.

South Australia reported that an Australian Government On-farm Irrigation Efficiency Program project will support 120 individual irrigators and deliver 6.5 GL of water savings. Research into fertiliser applications has shown that fertiliser is often applied at the wrong time and techniques of monitoring soil solution in the root zone can assist in fertiliser application and salinity management thus avoiding the potential for negative outcomes from poorly managed fertiliser and accumulated salts in the root zone.

The impact of this work on the salinity targets is difficult to quantify but improved landscape management and irrigation efficiency is expected to result in reduced mobilisation of salt as well as water recovery. Much of the salt arises from primary sources as again confirmed by work in Victoria. It is important that those lands with high risks of mobilising salt are managed well.

Element 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 consideration may be given to financing native vegetation management, rehabilitation and land stewardship, and the commercialisation of short rotation tree crops, particularly for the wheat belt.*

The continuing investment is securing an increase in vegetation in the catchments and each jurisdiction has reported the actual areas. However it is difficult to quantify the impact this is having on salinity. Most of the plantings are for multiple benefits as defined in the catchment plans and includes a salinity benefit.

Queensland has increased the area of vegetation managed outside the reserve system across the three catchments raising the area of protected threatened communities to 80%. The area protected through the Land for Wildlife Program is 113 000 ha in the MDB and a further 11 677 ha is under voluntary agreements. A review of vegetation clearing post-2000 conducted by the Queensland Government has shown that clearing has been minor and the change in attitude to clearing has resulted in low future salinity risks in the region.

In Victoria the CMAs have continued to undertake reforestation and revegetation works for dryland salinity management. In all about 6 000 ha has been re-established in the past year which includes trees, vegetation and salt bush plantings.

In South Australia there has been a range of projects to protect the grass and woodlands between Mannum and Morgan where contracts have been made with private landholders to protect and improve threatened ecological communities. In addition a number of Local Action Planning groups have provided technical advice to 137 landholders and over 500 community members. The River Murray Forests project funded by the state government has contracted 1420 ha of private land to be revegetated along the Murray Valley Corridor.

New South Wales has a number of management actions, including the planting of trees that can reduce the mobilisation of salt if a strategic approach to plantings according to soil type and underlying bedrock is taken in priority catchments. This is delivered through Property Vegetation Plans which are voluntary plans delivered through the CMAs and supported by incentives funded by the state and Commonwealth which has protected 720 000 hectares to June 2012.

Element 8: Constructing salt interception works

> *The MDBA 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.*

SISs have been constructed and operate along the length of the Murray River in three states and are recognised as major contributors to the success of the BSMS.

This program of works is drawing to a close, as the targeted 61 EC reduction at Morgan will be reached in mid-2013 when construction of the Murtho SIS is completed. At present Register A includes a benefit of about 40 EC Salinity Effect at Morgan for the schemes established under the BSMS. A final benefit of about 73 EC salinity effect is expected when the Murtho, Upper Darling and Mildura-Merbein rehabilitation schemes are operational (Figure 2). These benefits are in addition to a benefit of about 85 EC salinity effect due to SIS joint works and measures communicated under the Salinity and Drainage Strategy that pre-dated the BSMS.

During the 2011–12 year, the Pike River Stage 1 SIS was commissioned as a state (South Australia) work. Severe flooding caused damage to the Pyramid Creek Scheme and delayed commissioning of the completed Upper Darling Scheme and delayed work on Murtho and Mildura-Merbein Schemes.

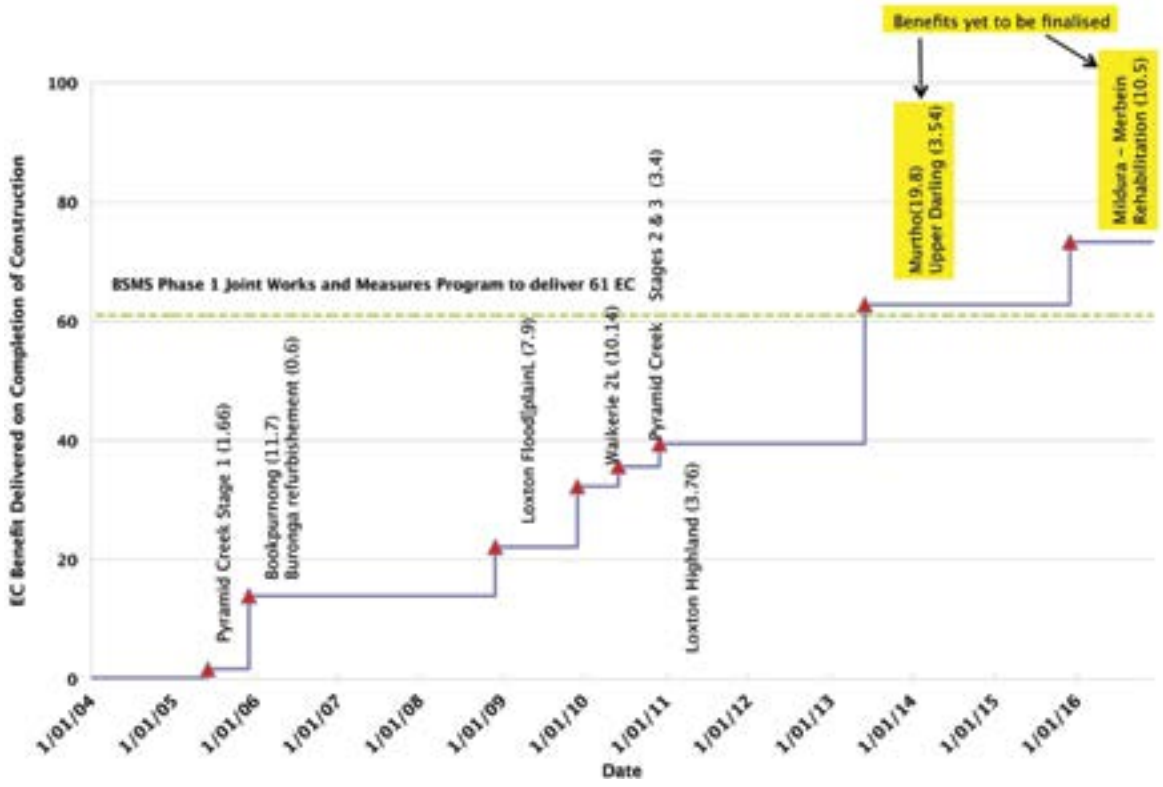

Figure 2: Design EC Benefits and timeline of implementation for BSMS Salt Interception Schemes

The operating joint schemes account for 72% of the credit balance (interpolation to current year) on the 2012 Salinity Register A; about 32% of the credits accrued by the schemes are attributable to the BSMS (previously 32% also); the remainder is attributed to the earlier Salinity & Drainage Strategy and is embodied in the BSMS baseline conditions.

The 2011–12 year saw an increase in salt tonnage production from the SIS schemes of about 12% to about 363,000 tonnes. Despite natural interruptions from flooding, all but one of the schemes achieved target salt load diversions at least 95% of the time during 2011–12. The Pyramid Creek Scheme had a reduced duty cycle of 70% due to flood damage to production bores and switchboards.

The IAG-Salinity 2010-11 report included a recommendation that *"The salt interception program is reviewed to consider optimising the system taking into account the increasing maintenance requirement and the operational costs and capital investments made."*

In response to this recommendation, the MDBA is ranking schemes for effectiveness and identifying core schemes in the light of increasing budgetary constraints and escalating power costs. The onset of enhanced river flows due to environmental watering also opens up the opportunity to discharge stored salt into the river at times of high flow. For this reason, scour valves have been installed in the Murtho and Woolpunda Schemes. This practice would provide operational savings and extend the life of the disposal basins.

The IAG-Salinity offers a note of caution over the potential "mothballing" of some schemes, as the SIS installations will be required in the long-term to offset the projected erosion of credits in future decades.

The program of 5 year reviews of the schemes, commenced in 2010–11, continued in 2011–12 with commencement of reviews at five of the schemes. A cross-jurisdictional Task Team has been established to oversee the reviews.

Element 9: Basin-wide accountability

The partner governments will demonstrate accountability by reporting to the MDBA and Ministerial Council through state end-of-valley Report Cards and MDBA Salinity Registers that record the salinity effects of actions, including salt interception schemes and salinity and catchment management plans.

The Ministerial Council will receive audits every five years for each valley and Authority Register entry, assessing impacts on river salinity and progress towards targets, with the provision to require further action as necessary.

Annual Reports of the Contracting Governments

The state contracting governments and Australian Capital Territory each provided draft annual reports that contained the necessary information for the IAG-Salinity to make an assessment. The Australian Government provided a summary of the work they have undertaken in progressing the recommendations from the previous audit particularly the assessment of environmental watering of wetlands on the salinity of the River Murray through contracts by the Department of Sustainability, Environment, Water, Population and Communities.

Each upstream state reported rising water tables in dryland and some irrigation areas following the increased rainfall seen across the Basin in the past three years. There was continuing commitment to the BSMS and a concern that salinity, as an issue, needs to continue to be given the appropriate attention in the implementation of the Basin Plan.

Valley reports

Contracting governments must prepare an annual report for each valley for which an EOV target has been adopted as outlined in Schedule B clauses 29 and 30. A protocol has been established for information to be presented in the form of summary report cards. The reports are to set out how the contracting governments are implementing actions to meet the targets and impacts on the targets. As the EOV targets pertain to the benchmark period, direct performance measures cannot be reported annually. Instead, statistics for real-time salinity and flow measurements are reported.

The valley reports for 2011–12 again indicated varying levels of action and achievement. An increased flow on most valleys has shown an increase in salt loads but a reduction of in-stream EC readings, except in northern New South Wales and Queensland. Each jurisdiction was attempting to maintain the program from their own resources but budget pressure was being felt by most jurisdictions. Some of the impacts of the budget changes such as reducing generalist staff in more remote areas, who had maintained monitoring sites, requires alternative ways of servicing monitoring installations.

Report cards in a standard format were prepared by Victoria, South Australia and Queensland. New South Wales again foreshadowed the need to revise its EOV targets set in 1999 based on improved understating of upland salinity behaviour.

Accountability for salinity under the BSMS and the Basin Plan

The BSMS system of accountability is undergoing continuous improvement each year and the jurisdictions and the MDBA have high confidence in it and are strongly committed to it. It provides a framework of continuing incentives for each state to manage salinity in a manner that is beneficial to the whole Basin. The level of confidence in the Registers is due to the clear and transparent method of debating entries by the BSM AP, the quality of the scientific work that has gone into the development and use of the models, meticulous documentation and record keeping on the part of the MDBA, and the scrutiny given annually to each entry by the IAG-Salinity. The contracting governments can see that each of them is contributing to salinity management in a balanced way without an inequitable burden falling on any one of them.

The *Water Act 2007* proposes that the water allocation and quality issues are set for each area in the Basin by Water Resource Plans. Since the Act does not have power over the land management areas, the implementation of the Basin Plan will require a similar commitment and collaborative process that exists for the BSMS between the MDBA and the contracting governments.

The Basin Plan will provide guidance for the future and while there is a great deal of detail to be decided, the IAG-Salinity was assured that Schedule B of the Murray-Darling Basin Agreement (*Commonwealth Water Act 2007*) has been reviewed from a legal perspective and is consistent with the Basin Plan. The excellent work required to implement Schedule B will continue.

The BSMS Mid-Term Review

The recommendations of the Mid-Term Review (relevant to this discussion), followed by IAG-Salinity comment on each in italics, and are:

Policy recommendations

1. Develop methods to account for and achieve environmental outcomes from salinity mitigation actions through integration across MDBA programs;

   The Living Murray program has been able to put this recommendation into action and salinity register items are currently under consideration. The environmental water held by the Commonwealth is furthering the intent of this recommendation.

2. Support integration and alignment of national funding initiatives and reporting with regional catchment strategies that reflect BSMS objectives and integrated catchment management outcomes;

   While this recommendation is still relevant, the system has matured where CMAs consider a range of outcomes in a catchment management outcome when making investment decisions.

3. Increase emphasis on catchment actions to address the causes of salt mobilisation and more innovative and sustainable measures to deal with the effects, such as real-time operations;

   The IAG-Salinity is of the opinion that in the past few years significant work has been done in this area so that there is now a better knowledge of the natural processes and the required management actions to deal with these effects. The real time targets have been considered in the Basin Plan.

Operational recommendations

1. The MDBA should complete the existing 61 EC joint works program;

   The MDBA is on track to achieve this by 2013.

2. By June 2008, the MDBA develop a new Works and Measures Program (provisionally estimated to be in the order of 40 EC) to offset anticipated increases in River salinity;

   The effect of the increase in environmental water, not envisaged at the time of the Mid-Term Review, has offset the need for this recommendation at this time.

3. By December 2008, the MDBA should investigate options for:
   - real-time river operations that manage large salt loads mobilised to the river
   - real-time in-stream targets that are integrated with the accountability framework

   The continuing work by the BSM AP over the 2012–13 year should complete these investigations.

Science and technical understanding recommendations

1. Hydrological data sets that reflect the latest research on climate change and climate variability should be developed and applied to modelling scenarios so as to ensure the best possible tools for predicting long term salinity impacts;

   MDBA has completed this work and a report has been published.

2. The Basin Salinity Target should be reviewed with consideration given to a recommendation on replacement or complementary salinity targets that link more closely to the Salinity Registers and allows for adaptive real time salinity outcomes;

   This work is underway and is expected to be completed by June 2013.

3. The MDBA should develop a robust and transparent investment framework that enables environmental and social impacts to be assessed in the evaluation of benefits and dis-benefits of salinity management measures, particularly joint works and measures proposals;

   This is being used by MDBA in preparing the joint works and measures program which is now almost complete.

4. The MDBA should review the Salinity Registers with the objectives of making them easier to understand, including consideration of environmental and social impacts (in addition to the economic impacts), and making them relevant to real time salinity management;

   Registers A and B were adjusted in 2010 by using harmonised methods of calculating entries. The economic impacts will be updated in the next review of the registers. The impacts of environmental watering on the register entries are currently under consideration.

Progress in Improving Salinity Registers

Last year's IAG-Salinity report (2011) made two recommendations designed to improve accountability through the Salinity Registers:

- Recommendation 1: Accountability for salinity impacts of environmental watering
- Recommendation 9: Updated economic valuations in the registers and forward projections based on salinity risk.

The MDBA, in association with the contracting governments through the Environmental Watering Salinity Accountability Taskforce, has developed a set of Guiding Principles to be followed when accounting for the salinity impacts of environmental watering. As yet there is no agreement on institutional responsibilities and the role of the Commonwealth. Last year the CEWH delivered 680 GL of water for this purpose in the Murray, Murrumbidgee, Macquarie and Gwydir systems but has not advised the MDBA of actions that may have a significant impact as required under Section 4 (1) of Schedule B. One jurisdiction, where the water has been applied, advised the MDBA. The IAG-Salinity recognises that the responsibility for the use of environmental water and its accountability on the salinity registers is far from clear.

Recommendation 2: Accountability for salinity impacts of environmental watering.

(a) The policy principles for environmental watering be evaluated through modelled scenarios of salinity and dilution impacts, including lag times, of various watering options for selected icon sites outside the TLM program and be undertaken by the Commonwealth Environmental Water Holder, the Basin Salinity Management Strategy Advisory Panel and the Murray-Darling Basin Authority.

(b) The Basin wide plan and policy framework for managing the potential impacts and responsibility for reporting the accountable actions from environmental watering as required under Schedule B be settled between the Commonwealth Environmental Water Holder and the operating jurisdictions.

While action has not yet been taken on presenting register Salinity Credits in current dollars, it is a relatively simple matter to apply CPI-corrected valuations. However an overhaul of the salinity cost functions (tied to 2005 assumptions on land use, gross margins, and urban/industrial use) would be a major undertaking that would require funding commitments by all parties.

Status of Registers A and B

The MDBA, in conjunction with the jurisdictions, prepared a revised version of Registers A and B dated 30 October 2012 (see Appendix 3).

Schedule B (within Schedule 1 *Water Act 2007*) provides that two Salinity Registers, Registers A and B, must be established as the primary record of the accountability for river salinity of each of the jurisdictions, and of the Basin overall. Register A records the salinity credits/debits of the jurisdictions since the baseline date. This date is 1 January 1988 for New South Wales, Victoria and South Australia, and 1 January 2000 for Queensland. Register B records any salinity impacts arising from actions prior to the baseline date, and the predicted future effects of actions aimed at delayed salinity impacts.

In 2011–12, other than changes due to annual increments, there were no significant changes to Registers A and B in jurisdictions other than South Australia. The nine South Australian accountable actions in Register A at 6 October 2011 were renamed and reorganised into eight actions in Register A at 30 October 2012. All changes are documented thoroughly and transparently. The changes were due primarily to updating of 2005 Loxton/Bookpurnong model results with those produced by the 2011 MODFLOW model, and retirement of earlier SIMRAT model estimates.

One new item was added to Register A

- Item 51: Pike Stage 1 SIS (-2.9 EC, interpolation to current year EC at Morgan).

In 2011–12, two South Australian accountable actions were combined into one item on Register B:

- Item 74: South Australia Improved Irrigation Efficiency and Scheme Rehabilitation Reg B (-41.3 EC, interpolation to current year EC at Morgan).

No new items were added to Register B.

There are three changes to Register A that are 0.5 EC or more in magnitude due to updating the Loxton/Bookpurnong MODFLOW model (Item 43: South Australia Irrigation Development Based on Footprint Data), a change in annual increment (Item 46: South Australia Component of Bookpurnong Scheme), and one new entry (Item 51: Pike Stage 1 SIS). There are two changes to Register B of about 4 EC resulting from updating the Loxton/Bookpurnong MODFLOW model (Item 73: South Australia Mallee Legacy of History – Irrigation; Item 74: South Australia Improved Irrigation Efficiency and Scheme Rehabilitation Reg B).

Significant progress has been made with completion, submission or scheduling rolling reviews for completion. Victoria submitted five reviews for accountable actions for Register A and three reviews for Register B (by June 2012). New South Wales submitted seven reviews for accountable actions for Register B but three reviews for Register A are overdue and a further three due in 2012 have not yet been scheduled for completion. None of the reviews resulted in material changes to the register entries.

As South Australia's entries depend on the net outputs from a number of contiguous groundwater models, which are to be reviewed at different times, there is a range of dates for model review timing that is reflected in the timing of register entry reviews. Queensland has not provided any entries to the register as yet and these entries need to be completed.

Recommendation 3: Outstanding submission of register reviews:

(a) New South Wales should develop and submit to the Murray-Darling Basin Authority a schedule for the up-coming Salinity Register reviews;

(b) Queensland should formally submit the three outstanding Salinity Register reports.

Net Debit/Credit Status of the Jurisdictions

As stated in Schedule B, a state contracting government must take whatever action may be necessary:

(a) to keep the total of any salinity credits in excess of, or equal to, the total of any salinity debits, attributed to it in Register A; and

(b) to keep the cumulative total of all salinity credits in excess of, or equal to, the cumulative total of all salinity debits, attributed to it in both Register A and Register B.

The definition of credits in Schedule B is salinity benefits in $m/year values. The Salinity Registers dated 30 October 2012, as provided to the IAG-Salinity, show that New South Wales, Victoria and South Australia are in net credit on Register A (5.558, 5.109 and 4.110 $m/year respectively). There has been an increase in the South Australia credit balance by about 18%, while New South Wales and Victoria changed by less than 0.05% each.

On Register B, two of the three jurisdictions are in credit and one (Victoria) slightly in debit (0.388, -0.117 and 1.186 $m/year respectively). For the combined registers, all three states are in credit (5.946, 4.992 and 5.296 $m/year for New South Wales, Victoria and South Australia respectively). The combined net credit in terms of Salinity Effect is 169 EC, an increase of 2.4% over the previous year.

The IAG-Salinity 2009-10 report noted that the 2009-10 year was the first year in which the 95-percentile EC target at Morgan had been met. This prompted the IAG-Salinity to make a recommendation that *"The consistency between the credit and debit balances of the registers and the target at Morgan needs to be established"*.

The IAG-Salinity 2010–11 report included Table 2 and Figure 3 (reproduced here) to highlight the need for vigilance in adoption and maintenance of accountable actions with a view to their long-term effects. Table 2 and Figure 3 show the results of scenario modelling by MDBA to assess the likely mean EC, and 95-percentile EC Morgan values in future years by forcing net Salinity Credits to be close to zero, without consideration of any beneficial effects from environmental watering. This scenario was instigated by the view of IAG-Salinity (2010) that a net credit of about 150 salinity effect EC units would be required to satisfy the 800 EC target at Morgan into the future.

Table 2: Modelled projections of Morgan EC for current registers and future balanced registers.

YEAR	STATUS	REGISTER A [$m/year]	REGISTERS A & B [$m/year]	MEAN MORGAN EC [mS/cm]	95-PERCENTILE MORGAN EC [mS/cm]
1988	Benchmark			665	1058
2011	2011 Registers	13.824	15.202	508	786
2000	Balanced	0.005	2.774	570	825
2011	Balanced	0.187	1.803	576	833
2015	Balanced	0.253	1.450	578	836
2050	Balanced	6.247	0.111	581	874
2100	Balanced	13.563	0.003	541	862

The 95-percentile Morgan salinity is below the 800 EC target for the 2012 registers. For 2011, if all the current credits are used up, the 95-percentile salinity would be 833 EC which exceeds the target. The study also shows that in the future, maintaining the registers in credit balance as required under Schedule B, will not ensure that the 800 EC target will be achieved (in the absence of environmental watering). However, the projected 95-percentile values are about 20% better than the 1988 benchmark value.

Figure 3 shows that past registers have exceeded, and future registers are expected to exceed, the Morgan target by less than 100 EC. From 2015 onwards, the 95-percentile EC Morgan target will be breached in each case if all net credits are taken up by the contracting governments (in the absence of environmental watering).

Although the 95-percentile EC values are expected to be higher than the 800 EC target from 2015 onwards, the mean salinities at Morgan are predicted to remain less than 600 µS/cm well into the future.

The analysis confirms the general conclusion that the current requirement for contracting governments to maintain a net positive credit on the registers is not necessarily consistent with future compliance with the Morgan target.

Given the expectation of substantial short-term credits from environmental watering dilution flows, there might be a temptation to reduce the commitment to SIS actions. However, Figure 3 should serve as a reminder that the SIS actions are necessary for long-term compliance with the Morgan EC target.

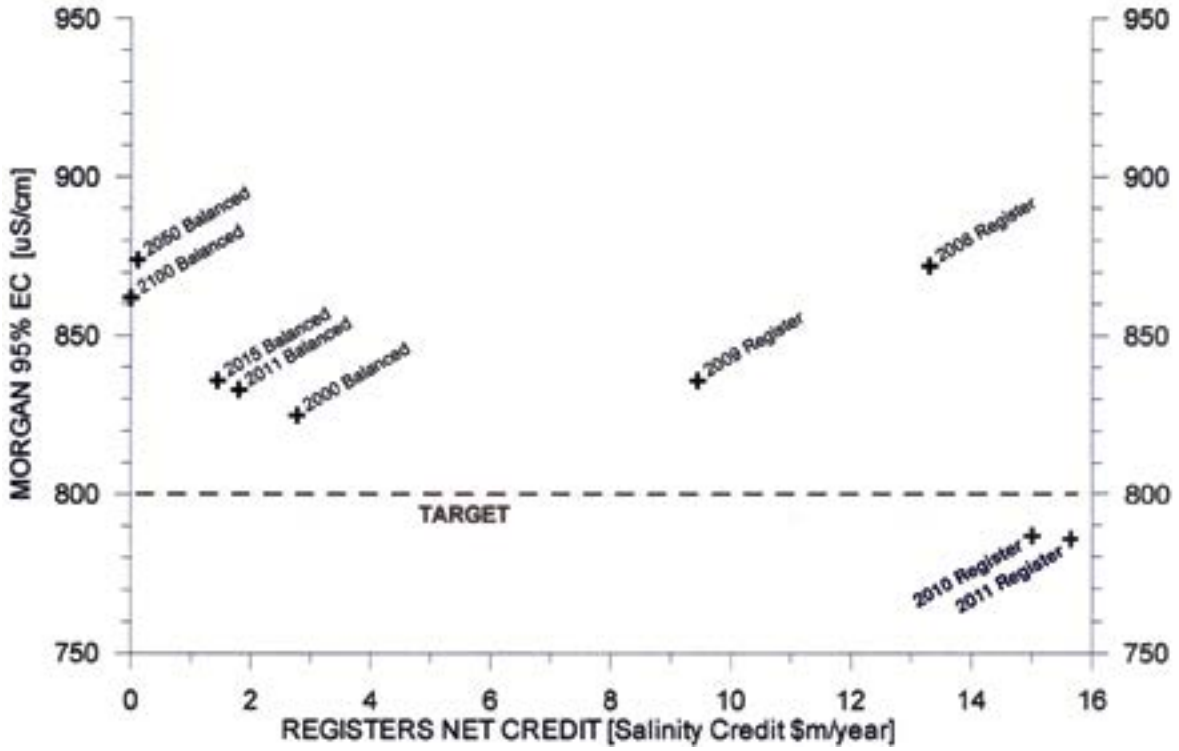

Figure 3: Modelled projections of Morgan 95% EC versus net Salinity Credit on the registers

Uncertainty in Register Entries

The Salinity Registers include a qualitative Confidence Rating in terms of "very low", "low", "medium" and "high". The distribution of ratings is summarised in Table 3.

For Register A, the only changes have arisen from consolidation of two low-confidence South Australia accountable actions into one low-confidence item, and the addition of a new entry (Item 51: Pike Stage 1 SIS) with a high-confidence rating.

For Register B, two low-confidence South Australia accountable actions have been consolidated into one low-confidence item.

There are still no clear definitions for these ratings and MDBA should address this issue to ensure consistency in reporting of entries.

Table 3: Percentage of entries in the registers with confidence ratings of "high" to "very low" and provisional entries with "low" ratings.

RATING	REGISTER A [%]					REGISTER B [%]				
	2008	2009	2010	2011	2012	2008	2009	2010	2011	2012
High	60	60	69	71	74	0	0	0	0	0
Medium	23	23	21	19	18	83	88	69	68	71
Low	12	11	6	10	8	11	0	15	32	29
Very Low	5	0	0	0	0	6	0	0	0	0
Provisional	0	6	4	0	0	0	12	15	0	0

Reference

Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council af Australia and New Zealand (ARMCANZ) 2000, Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Volume 1, Chapter 4 (Primary Industries) and Volume 3 Primary Industries – Rationale and background information. National Water Quality Management Strategy. Canberra. http://www.environment.gov.au/water/policy-programs/nwqms/

APPENDICES

APPENDIX 1: INDEPENDENT AUDIT GROUP FOR SALINITY – TERMS OF REFERENCE

Preamble

The Basin Salinity Management Strategy (BSMS) provides a framework for communities and governments to work together to control salinity and protect key natural resource values in the Murray-Darling Basin.

The Basin Salinity Management Advisory Panel (BSM AP) oversees the monitoring, evaluation and reporting components, essential to ensure accountability of the partner governments and the MDBA under Strategy implementation.

Auditing is an integral part of the BSMS in that it ensures a fair and accurate annual assessment of the partner governments and MDBA's performances against Schedule B to the Murray-Darling Basin Agreement. The Schedule specifies that an Independent Audit Group must be appointed by the MDBA for the purpose of carrying out an annual audit. The responsibilities and process for the Audit are set out in Clauses 29 to 34 – Part VII – Reporting, Audit and Review, and the scope of the audit is specified at Clause 34 (3) to (6).

Management of the audit each year will be directed through the preparation of an Annual Audit Plan which will also identify priorities for that year.

Principles for the Audit

For the purpose of the annual audits, the following principles are to apply:

1. Independence – the IAG-Salinity will reach a view by consensus. The findings and recommendations of the IAG-Salinity will be entirely those of the IAG-Salinity.
2. Support – administrative support will be provided by the Authority.
3. Provision of information – the IAG-Salinity shall base the audit on the information provided by the partner governments and the MDBA.
4. Quality assurance – the quality assurance in relation of the information provided is the responsibility of the information provider.
5. Timeliness – the timely provision of information by the partner governments and the MDBA is required if the audit is to progress satisfactorily.
6. Justification – the findings shall include a supporting rationale.
7. Prioritisation – the recommendations shall include a priority classification.
8. Continuous improvement – the IAG-Salinity shall encourage improvement through independent assessment of compliance against Schedule B obligations whilst acknowledging that priority activities should be targeted towards areas of highest salinity risk.
9. Accountability – the IAG-Salinity will work as a team with a Lead Auditor responsible for the conduct of the audit and completion of the auditors' report. The Lead Auditor will provide the primary contact between the IAG-Salinity, the partner governments and the MDBA.

Annual Audit Plan

By 1 August each year, the MDBA shall prepare, in consultation with the IAG-Salinity and the BSM AP, an Annual Audit Plan which involves the following steps:

1. The MDBA requests and collates, within advised timeframes, appropriate information as specified in the Annual Audit Plan from the partner governments and the MDBA, and provides the collated information to the IAG-Salinity.
2. The IAG-Salinity consults with partner governments and the MDBA, with the role of chair to be undertaken by the Lead Auditor, or as determined by the Lead Auditor.
3. The IAG-Salinity prepares and circulates, within advised timeframes, its draft Audit Report to the partner governments and the MDBA for clarification and correction of facts.
4. The IAG-Salinity prepares and submits its final Audit Report to partner governments and the MDBA, within advised timeframes.
5. The partner governments and the MDBA provide formal responses to the IAG-Salinity recommendations, which are collated by the MDBA as part of reporting to Ministerial Council, and also provided to the IAG-Salinity, within advised timeframes.
6. The Lead Auditor attends the relevant meeting of the BSM AP at the time of its consideration of the final Audit Report and the formal responses.

Outputs of the audit report

The IAG-Salinity shall:

1. Provide an Annual Audit Report in accordance with the requirements of Schedule B, Clause 34.
2. If required, provide a separate, brief report on any key issues arising from the audit beyond the explicit audit requirements of Schedule B.

Independent audit group membership

The IAG-Salinity is to be a skills-based group with appropriate qualifications and experience in NRM and auditing processes. The Group is to consist of up to 3 members, each of which must demonstrate independence from the work that is being audited. It is envisaged that the IAG-Salinity will consist of one Lead Auditor and up to two other members. Conditions of appointment are set out in Clause 34 (1) and (2) of Schedule B.

Selection Criteria

The following criteria are to be applied in appointing members to the IAG-Salinity so that collectively the team meets the criteria to the maximum extent practicable:

Essential Criteria – preference is to be given to candidates with experience in the following areas:

1. The hydrological and hydro-geological behaviour of the Basin's catchments and their connectivity within the Basin.
2. The application of analytical models to natural resource management.
3. The legislative frameworks that govern water and salinity management in the Basin.
4. The processes within the Basin involved in the development, implementation, monitoring, evaluation and reporting of salinity policy and management;

Desirable Criteria are:

1. An understanding of auditing NRM processes, policies and programmes.
2. An active professional network and rapport with institutional structures of relevance to salinity management in the Basin.
3. Familiarity with the technical assessment of salinity processes and impacts.
4. An understanding of quality assurance processes for natural resource management information, policies and programs.
5. Experience in providing quality written reports and meeting deadlines.

Time Commitment

The IAG-Salinity is expected to spend 3–4 weeks (generally during October and November) to undertake the annual audit under the following indicative timeframes:

1. Up to one week for familiarisation with the available documentation.
2. Up to two weeks for consultation with state contracting and Australian Governments, and the MDBA.
3. Up to one week to prepare and refine the IAG-Salinity report.
4. The Lead Auditor may be required to commit to providing an additional 5 days service to fulfil other accountability responsibilities.

APPENDIX 2: BASIN SALINITY MANAGEMENT — SCHEDULE B

For purposes of this report, a summary and a key section from Schedule B of the Murray Darling Basin Agreement which is Schedule 1 to the *Water Act 2007* (Commonwealth) have been included.

The purpose of Schedule B is to implement certain aspects of the BSMS; it consists of 12 Parts.

Structure of Schedule B

PART	
Part I — Preliminary	1. Purpose 2. Definitions 3. Application to Queensland
Part II — Accountability for salinity impacts	4. Accountability of impacts 5. Determining Baseline Conditions 6. Meeting EOV targets
Part III — Salinity targets	7. Basin Salinity Target, 8. EOV targets 9. Review and amendment of EOV targets
Part IV — Joint works and measures	10. Joint program 11. Attribution of credits or debits 12. Authorisation 13. Participation by Queensland and Australian Capital Territory 14. Coordination
Part V — The Registers	15. Establishment 16. Obligations 17. Operating 18. Determining whether a proposal has a significant effect 19. Assessing salinity impacts 20. Estimating credits and debits 21. Attribution of credits and debits 22. Timing of entry onto the register 23. Trading and transfers between registers 24. Review and amendment of entries
Part VI — Monitoring	25. Obligations 26. EOV targets 27. Program to monitor Accountable Actions
Part VII — Reporting audit and review	28. State Contracting Governments 29. Valley reports 30. Commonwealth 31. Authority 32. Rolling five year reviews 33. Audit 34. Review of Schedule
Part VIII — Models	35. Models developed by Authority 36. Models developed by State Contracting Governments 37. Assessment and approval of certain models 38. Review of models

PART	
Part IX — Protocols	39. Authority's power to make protocols 40. Examples
Part X — Default	41. Relationship with Part XI of the Agreement 42. Default by a State Contracting Government 43. Exception reports 44. Proposal for remedial action 45. Action by State Contracting Government
Part XI — Finance	46. State actions 47. Joint works or measures
Part VII — Transitional provisions	48. Former salinity and drainage works

Part VII of Schedule B requires that each partner government prepare an annual report based on the following essential elements:

1. Accountable actions, proposals and joint works and measures.
2. Valley reports for each valley were an EOV target has been adopted.
3. Rolling 5 year reviews of valleys and actions undertaken in the last year.
4. Other activities to support BSMS implementation.

Part VII also provides for Auditing. Subclauses 34 (3) to (6) provide the basic terms of for the annual auditing of the BSMS, as follows:

34 AUDIT

...

...

(3) The independent auditors must together carry out an annual audit of:

(a) the report of each review conducted in the preceding financial year by each State Contracting Government and by the Authority under sub-clause 33(1) and 33(3), respectively; and

(b) Register A and Register B.

(4) The independent auditors must, in each audit, reach a view by consensus about:

(a) The performance of each State Contracting Government and of the Authority in implementing the provisions of this Schedule in the relevant year; and

(b) Whether the Authority has fairly and accurately recorded the salinity impacts of each action entered in Register A or Register B during the relevant year.

(5) The independent auditors must prepare a report setting out:

(a) The findings of each audit; and

(b) Any recommendations made by the independent auditors arising from that audit.

(6) Without limiting sub-clause 34(5), a report:

(a) must set out the view reached on each of the matters referred to in sub-clause 34(4); and

(b) may recommend to the Authority that the salinity impacts entered in Register A or Register B for an Accountable Action be varied; and

(c) may set out a finding that the total salinity credits are not equal to, or do not exceed, the total salinity debits attributed to a State Contracting Government in Register A, contrary to paragraph 16(1)(a).

Protocols

Part IX of the Schedule provides powers for the Authority to make Protocols "desirable or convenient to give effect to this Schedule". The Authority has accordingly prepared and promulgated a set of Protocols. These provide procedures and guidelines to assist the participating jurisdictions in implementing the BSMS.

APPENDIX 3: SALINITY REGISTERS (AS AT 30 OCTOBER 2012)

Salinity Register A

Register Database unique number	Real Register number		AUTHORITY REGISTER A (Accountable Actions)	Type	Date Effective	Provisional Salinity Credit ($m/yr)	Current Impact on Morgan 95%ile Salinity (EC)	Impact on Flow at Mouth (GL/y)	Salinity Effect (EC at Morgan)				
									2000	2015	2050	2100	Modelled Current conditions (Interpolation to Current Year)
			JOINT WORKS & MEASURES										
			Former Salinity & Drainage Works										
RU000001	1	1	Woolpunda SIS	SDS	Jan 1991		-87	0	-47.4	-47.4	-47.4	-47.4	-47.4
RU000002	2	2	Improved Buronga and Mildura/Merbein IS	SDS	Jan 1991		-6	0	-3.0	-3.0	-3.0	-3.0	-3.0
RU000003	6	3	New Operating Rules for Barr Creek Pumps	SDS	Jul 1991		-8	0	-4.9	-4.9	-4.9	-4.9	-4.9
RU000004	9	4	Waikerie Interception Scheme	SDS	Dec 1992		-19	0	-12.8	-12.8	-12.8	-12.8	-12.8
RU000058	18	5	Changed MDBC River Operations 1988 to 2000	SDS	Apr 1993		-1	4	-1.6	-1.6	-1.6	-1.6	-1.6
RU000005	12	6	Mallee Cliffs Salt Interception Scheme	SDS	Jul 1994		-21	0	-13.3	-13.3	-13.3	-13.3	-13.3
RU000007	19	7	Changed Operation of Menindee and Lower Darling	SDS	Nov 1997		3	8	0.9	0.9	0.9	0.9	0.9
RU000026	23	8	Waikerie SIS Phase 2A	SDS	Feb 2002		-14	0	-8.0	-8.2	-10.7	-8.9	-8.2
RU000059	25	9	Changed MDBC River Operations 2000 to 2002	SDS	Feb 2002		-2	-1	-1.4	-1.4	-1.7	-1.9	-1.4
			Sub Total – Former Salinity & Drainage Works				**-154**	**11**	**-91.6**	**-91.8**	**-94.6**	**-93.0**	**-91.8**
			Basin Salinity Management Strategy										
RU000060	31	10	Changed MDBC River Operations after 2002	BSMS	Dec 2003		1	7	-0.2	-0.2	-0.4	-0.4	-0.2
RU000115	37	11	Pyramid Ck GIS	BSMS	Mar 2006		-6	0	-5.1	-5.1	-5.2	-5.2	-5.1
RU000028	40	12	Bookpurnong Joint Salt Interception Scheme	BSMS	Mar 2006		-21	0	-13.6	-11.7	-11.2	-11.3	-12.0
RU000096	41	13	Improved Buronga Scheme	BSMS	Mar 2006		-1	0	-0.6	-0.5	-0.5	-0.5	-0.5
RU000108	49	14	Loxton SIS	BSMS	Jun 2008		-18	0	-12.3	-11.5	-9.7	-9.0	-11.7
RU000114	53	15	Waikerie Lock 2 SIS	BSMS	Jun 2010		-17	0	-12.7	-10.3	-11.3	-11.8	-10.7
			Sub Total Joint Works under BSMS				**-63**	**6**	**-44.4**	**-39.3**	**-38.4**	**-38.2**	**-40.2**
			Joint Works Sub Total				**-217**	**17**	**-136.1**	**-131.2**	**-133.0**	**-131.3**	**-132.0**
			STATE WORKS & MEASURES										
			Shared New South Wales and Victorian Measures										
RU000064	20	16	Permanent Trade Accounting Adjustment – NSW to Victoria	50N50V	Jun 2006		0	0	0.0	-0.1	-0.1	-0.1	-0.1
RU000066	24	17	Barmah-Millewa Forest Operating Rules	50N50V	Mar 2002		-2	33	-1.9	-2.0	-1.9	-2.3	-2.0
			Shared Measures Sub Total				**-2**	**33**	**-2.0**	**-2.1**	**-2.0**	**-2.3**	**-2.1**
			New South Wales										
RU000009	44	18	Boggabilla Weir	NSW	Dec 1991		0	0	-0.1	-0.1	-0.1	-0.1	-0.1
RU000010	56	19	Pindari Dam Enlargement	NSW	Jul 1994		0	-17	0.7	0.7	0.7	0.7	0.7
RU000062	14	20	Tandou pumps from Lower Darling	NSW	Sep 1994		2	-3	-0.1	-0.1	-0.1	-0.1	-0.1
RU000011	16	21	NSW MIL LWMP's	NSW	Feb 1996		-4	57	-4.0	-4.0	-4.0	-4.0	-4.0
RU000063	17	22	NSW Changes to Edward-Wakool and Escapes	NSW	Jan 1990		-2	4	-2.0	-2.1	-2.0	-2.0	-2.0
RU000065	21	23	Permanent Trade Accounting Adjustment - NSW to SA	NSW	Jun 2006		-2	1	-0.5	-0.4	-0.4	-0.5	-0.4
RU000067	29	24	NSW Sunraysia Irrigation Development 1997 to 2006	NSW	Jul 2003		1	0	0	0.9	4.5	6.1	0.7
RU000172	55	25	RISI NSW	NSW	Jun 2010		-5	0	-2.7	-3.9	-4.1	-4.1	-3.7
RU000097	26	26	NSW S&DS Commitment Adjustment	NSW	Nov 2002		0	0	0	0	0	0	0
			New South Wales Works and Measures				**-11**	**43**	**-8.8**	**-9.1**	**-5.5**	**-4.0**	**-9.0**

Salinity Register A (continued)

Salinity Credits (Interpolation to Current Year Benefits $m/year)							Commonwealth Contribution (EC)	5 Year Rolling Review			Confidence	
NSW	Vic	SA	Qld	ACT	Total			Latest Review	Next Review	Status	Rating	Comment
0.729	0.729				3.890	1	11.8	2007	2012		High	Based on Salt loads in river
0.140	0.140				0.748	2	0.8	2005	2010		Medium	Based on Salt loads in river
0.225	0.225				1.198	3	1.2	2011	2016		High	Rules need to be revisited 2007
0.198	0.198				1.057	4	3.2	2007	2012		High	Based on Salt loads in river
0.150	0.150				0.797	5	0.4	2005	2010		High	
0.603	0.603				3.216	6	3.3	2005	2010		Medium	Based on Salt loads in river
-0.146	-0.146				-0.776	7	-0.2	2005	2010		High	
0.112	0.112				-0.599	8	2.0	2007	2012		High	
-0.139	-0.139				-0.743	9	0.3	2006	2011		High	
1.872	1.872	0.000	0.000	0.000	9.986		22.9					
0.021	0.021	0.021			0.129	10	0.1	2005	2010		High	
0.228	0.228	0.228			1.391	11	1.3	2010	2015		High	Remodelled 2010
0.224	0.224	0.224			1.368	12	3.0	2006	2011		Low	Salt load continue to rise with scheme in
0.021	0.021	0.021			0.126	13	0.1	2006	2011		High	Remodelled 2006
0.223	0.223	0.223			1.363	14	2.9	2008	2013		High	Floodplain and highland
0.119	0.119	0.119			0.723	15	2.7	2010	2015		High	Salt loads continue to rise with scheme in
0.836	0.836	0.836	0.000	0.000	5.100		10.0					
2.708	2.708	0.836	0.000	0.000	15.086		33.0					
0.001	0.001				0.002	16	0	2006	2011		High	No permanent trade since 2006
0.189	0.189				0.378	17	0	2006	2011		High	
0.190	0.190	0.000	0.000	0.000	0.379		0					
0.041					0.041	18	0	2007	2012		Medium	Remodelled 2007
-0.121					-0.121	19	0	2007	2012		Medium	
0.034					0.034	20	0	2005	2010		Medium	
0.684					0.684	21	0	2010	2015		High	
0.368					0.368	22	0	2005	2010		High	
0.107					0.107	23	0	2005	2010		High	No permanent trade since 2006
-0.161					-0.161	24	0	2007	2012		High	
0.799					0.799	25	0	2010	2015		Medium	
0.910					0.910	26	0					
2.660					2.660		0					

Salinity Register A (continued)

Register Database unique number	Real Register number		AUTHORITY REGISTER A (Accountable Actions)	Type	Date Effective	Provisional Salinity Credit ($m/yr)	Current Impact on Morgan 95%ile Salinity (EC)	Impact on Flow at Mouth (GL/y)	Salinity Effect (EC at Morgan)				
									2000	2015	2050	2100	Modelled Current conditions (Interpolation to Current Year)
			Victoria										
RU000013	3	27	Barr Creek Catchment Strategy	Vic	Mar 1991		-12	0	-7.7	-7.7	-7.7	-7.7	-7.7
RU000069	4	28	Tragowel Plains Drains at 2002 level	Vic	Mar 1991		1	1	0.2	0.2	0.2	0.2	0.2
RU000070	5	29	Shepparton Salinity Management Plan	Vic	Mar 1991		0	24	1.4	1.4	1.5	1.5	1.4
RU000071	50	30	Nangiloc-Colignan S.M.P.	Vic	Nov 1991		1	1	0.5	0.3	0.4	0.3	0.4
RU000072	10	31	Nyah to SA Border SMP — Irrigation Development	Vic	Jul 2003		20	0	13.3	13.3	13.2	13.3	13.3
RU000073	35	32	Kerang Lakes/Swan Hill Salinity Management Plan	Vic	Jan 2000		2	4	1.1	1.6	1.1	0.9	1.5
RU000074	11	33	Campaspe West SMP	Vic	Aug 1993		1	0	0.4	0.3	0.4	0.3	0.3
RU000019	15	34	Psyche Bend	50V50C	Feb 1996		-4	0	-2.1	-2.1	-2.1	-2.1	-2.1
RU000076	22	35	Permanent Trade Accounting Adjustment – Victoria to SA	Vic	Jun 2006		0	2	-0.7	-0.8	-0.8	-1.0	-0.7
RU000078	30	36	Woorinen Irrigation District Excision	Vic	Sep 2003		0	-2	1.3	0.8	1.0	1.2	0.9
RU000034	32	37	Sunraysia Drains Drying up	Vic	Jun 2004		-2	-4	-2.1	-2.2	-2.1	-2.1	-2.2
RU000077	33	38	Lamberts Swamp	Vic	Jun 2004		-5	0	-3.0	-3.0	-3.0	-3.0	-3.0
RU000105	36	39	Church's Cut decommissioning	Vic	Mar 2006		1	0	-0.4	-0.3	-0.3	0.0	-0.3
RU000109	46	40	Mallee Drainage bore decommissioning	Vic	Jun 2008		0	0	-0.1	-0.3	-0.3	-0.3	-0.2
RU000173	54	41	RISI Vic	Vic	Jun 2010		-7	0	-2.0	-5.5	-6.8	-7.1	-4.9
RU000098	27	42	Victorian S&DS Commitment Adjustment	Vic	Nov 2002		0	0	0	0	0	0	0
			Victoria Works and Measures				**-7**	**26**	**0.1**	**-3.8**	**-5.5**	**-5.7**	**-3.1**
			South Australia										
RU000099	28	43	SA Irrigation Development Based on Foot Print Data*	SA	Jul 2003		6	0	-3.6	5.8	33.9	72.8	4.2
RU000185	57	44	SA Irrigation Development Due to Water Trade*	SA	Jun 2006		0	0	0.1	0.5	16.2	32.2	0.4
RU000187	59	45	SA Irrigation Development Based on Site Use Approvals*	SA	Jun 2010		0	0	-0.1	0.3	14.0	61.2	0.2
RU000116	39	46	SA Component of Bookpurnong Scheme	SA	Mar 2006		-5	0	2.6	-4.5	-11.6	-12.3	-3.3
RU000117	48	47	SA Component of Loxton SIS	SA	Jun 2008		0	0	0.1	-0.1	-1.4	-2.5	0
RU000174	52	48	SA component of Waikerie Lock 2 SIS	SA	Jun 2010		-1	0	-1.2	-0.7	-2.0	-2.6	-0.8
RU000157	42	49	SA Improved Irrigation Efficiency and Scheme Rehabilitation Reg A*	SA	Jan 2000		-36	0	-20.2	-22.1	-26.3	-21.3	-21.8
RU000098	34	50	Qualco Sunlands GWCS	SA	Sep 2004		-4	0	-1.8	-4.0	-6.5	-7.5	-3.6
RU000???	??	51	Pike Stage 1 SIS	SA	Jan 2012		-4	0	-1.4	-3.2	-3.3	-3.4	-2.9
			South Australia Subtotal				**-45**	**0**	**-25.4**	**-28.0**	**13.0**	**116.6**	**-27.5**
			Queensland										
RU000175		52	Land Clearing Post 2000	Qld	Jul 2005	TBA							
RU000176		53	Irrigation Development Post 2001	Qld	Jul 2005	TBA							
			Queensland Subtotal				**0**	**0**					
			Balance – Register A				**-282**	**119**	**-172.1**	**-174.1**	**-133.0**	**-26.7**	**-173.7**

Salinity Register A (continued)

Salinity Credits (Interpolation to Current Year Benefits $m/year)							Commonwealth Contribution (EC)		5 Year Rolling Review				Confidence	
NSW	Vic	SA	Qld	ACT	Total				Latest Review	Next Review	Status		Rating	Comment
	1.963				1.963	27	0		2006	2011			High	Reviewed 2006
	-0.022				-0.022	28	0		2006	2011			High	Reviewed 2006
	-0.383				-0.383	29	0		2008	2013			Low	Exclude private pumps
	-0.100				-0.100	30	0		2008	2013			High	Remodelled 2009
	-3.141				-3.141	31	0		2008	2013			High	Data updated to 2011
	-0.352				-0.352	32	0		2010	2015			High	Remodelled 2006
	-0.076				-0.076	33	0		2010	2015			High	5 year review
	0.237				0.474	34	1.0		2011	2016			Medium	
	0.183				0.183	35	0		2005	2010			High	No permanent trade since 2006
	-0.244				-0.244	36	0		2010	2015			High	5 year review
	0.634				0.634	37	0		2011	2016			Medium	Reviewed 2010
	0.624				0.624	38	0		2011	2016			High	Reviewed 2010
	0.098				0.098	39	0		2010	2015			High	Remodelled 2010
	0.054				0.054	40	0		2008	2013			High	
	1.137				1.137	41	0		2010	2015			Medium	
	1.600				1.600	42	0							
	2.211				2.448		1.0							
		-0.499			-0.499	43	0		2011	2016			Low	Adjusted for 2011 Loxton/Bookpurnong model
		-0.130			-0.130	44	0		2003	2008			High	Removed Loxton/Bookpurnong SIMRAT entries
		-0.037			-0.037	45	0		2011	2016			High	Based on Site Use Approval up to 2012
		0.369			0.369	46	0		2006	2011			High	
		0.004			0.004	47	0		2008	2013			High	
		0.052			0.052	48	0		2010	2015			High	
		2.825			2.825	49	0		2011	2016			Low	Include IIP and RH from 2011 Loxton/ Bookpurnong model
		0.246			0.246	50	0		2007	2012			High	
		0.444			0.444	51	0		2012	2017			High	
		3.274			3.274		0							
						52				2012				
						53				2011				
5.558	5.109	4.110	0.000	0.000	23.848		34.0							

Registers Explanatory Notes

TBA – To be assessed

Salinity Effect – Increase or decrease in average salinity at Morgan in EC

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

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

Some of the totals are affected by rounding

Salinity Register B

Register Database unique number	Real Register number		AUTHORITY REGISTER B (Delayed Salinity Impacts)	Type	Year of Prediction	Provisional Salinity Credit ($m/yr)	Current Impact on Morgan 95%ile Salinity (EC)	Impact on Flow at Mouth (GL/y)	Salinity Effect (EC at Morgan)				
									2000	2015	2050	2100	Modelled Current conditions (Interpolation to Current Year)
			Transfers from Register A										
			New South Wales										
RU000043	200	54	Darling Catchment Legacy of History – Macquarie	NSW	Jan 2000		0	0	0	0.1	0.3	0.4	0.1
RU000087	201	55	Darling Catchment Legacy of History – Macintyre	NSW	Jan 2000		0	0	0	0	0	0	0
RU000088	202	56	Darling Catchment Legacy of History – Gil Gil Ck	NSW	Jan 2000		0	0	0	0	0	0	0
RU000044	203	57	Darling Catchment Legacy of History – Gwydir	NSW	Jan 2000		0	0	0	0	0	0	0
RU000042	204	58	Darling Catchment Legacy of History – Namoi	NSW	Jan 2000		0	0	0	0.2	0.4	0.5	0.1
RU000048	205	59	Darling Catchment Legacy of History – Castlereagh	NSW	Jan 2000		0	0	0	0	0	0.1	0
RU000047	206	60	Darling Catchment Legacy of History – Bogan	NSW	Jan 2000		0	0	0	0.1	0.2	0.3	0.1
RU000089	207	61	Lachlan Legacy of History	NSW	Jan 2000		0	0	0	0	0	0	0
RU000046	208	62	Murrumbidgee Catchment Legacy of History	NSW	Jan 2000		0	0	0	0.1	0.2	0.2	0.0
RU000159	215	63	NSW Mallee – dryland	NSW	Jan 2000		0	0	0	0.3	1.3	3.6	0.2
RU000160	217	64	NSW Mallee – Pre 88 Irrigation	NSW	Jan 2000		0	0	0	0.4	1.2	2.3	0.3
			Victoria										
RU000050	209	65	Campaspe Catchment Legacy of History	Vic	Jan 2000		0	0	0	0.1	0.2	0.3	0.1
RU000051	210	66	Goulburn Catchment Legacy of History	Vic	Jan 2000		0	0	0	0.6	12.3	12.3	0.5
RU000052	211	67	Loddon Catchment Legacy of History	Vic	Jan 2000		0	0	0	0.3	4.9	10.0	0.3
RU000091	212	68	Kiewa Catchment Legacy of History	Vic	Jan 2000		0	0	0	0.1	0	0	0.1
RU000049	213	69	Ovens Catchment Legacy of History	Vic	Jan 2000		0	0	0	0	0.6	1.3	0
RU000161	214	70	Victorian Mallee – dryland	Vic	Jan 2000		1	0	0	0.6	2.2	5.9	0.5
RU000162	216	71	Victorian Mallee – Pre 88 Irrigation	Vic	Jan 2000		2	0	0	1.4	4.7	8.3	1.1
			South Australia										
RU000092	218	72	SA Mallee Legacy of History – Dryland*	SA	Jan 2000		6	0	0	4.1	14.5	32.8	3.4
RU000093	219	73	SA Mallee Legacy of History – Irrigation*	SA	Jan 2000		67	0	0	46.6	86.9	113.3	38.8
RU000165	220	74	SA Improved Irrigation Efficiency and Scheme Rehabilitation Reg B*	SA	Jan 2000		-71	0	0	-49.6	-93.8	-115.4	-41.3
			Queensland										
RU000167	???	75	Queensland Legacy of History	Qld	Jan 2000	TBA							
RU000168	???	76	Queensland Irrigation Development pre 1 Jan 2000	Qld	Jan 2000	TBA							
			Balance – Register B			**0.000**	**6**	**0**	**0**	**5.3**	**36.0**	**76.3**	**4.4**
			Balance – Registers A & B				**-275**	**119**	**-172.1**	**-168.7**	**-97.0**	**49.6**	**-169.3**
			Basin Salinity Target (Morgan) – Modelled Current Status				**781**	**5,090**	**493**	**503**	**585**	**734**	**501**

Salinity Register B (continued)

Salinity Credits (Interpolation to Current Year Benefits $m/year)							Commonwealth Contribution (EC)		Latest Review	Next Review	Status		Rating	Comment
NSW	Vic	SA	Qld	ACT	Total									
0.630	0.503	1.459	0.000	0.000	2.592									
-0.028					-0.023	54			2010	2015	In Progress		Medium	
0.000					0.000	55			2010	2015	In Progress		Medium	
-0.001					-0.001	56			2010	2015	In Progress		Medium	
-0.001					-0.001	57			2010	2015	In Progress		Medium	
-0.041					-0.041	58			2010	2015	In Progress		Medium	
-0.005					-0.005	59			2010	2015	In Progress		Medium	
-0.021					-0.021	60			2010	2015	In Progress		Medium	
0.000					0.000	61			2010	2015	In Progress		Medium	Little connection to Murrumbidgee
-0.014					-0.014	62			2010	2015	In Progress		Medium	
-0.053					-0.053	63			2010	2015			Low	
-0.078					-0.078	64			2010	2015			Low	
	-0.021				-0.021	65			2011	2016			Medium	
	-0.109				-0.109	66			2003	2008			Medium	
	-0.076				-0.076	67			2003	2008			Medium	Remodelled 2006
	-0.032				-0.032	68			2011	2016			Medium	
	0.000				0.000	69			2011	2016			Medium	
	-0.115				-0.115	70			2010	2015			Low	
	-0.266				-0.266	71			2010	2015			Low	
		-0.345			-0.345	72			2011	2016			Medium	Adjusted for 2011 Loxton/Bookpurnong model
		-5.101			-5.101	73			2011	2016			Low	Adjusted for 2011 Loxton/Bookpurnong model
		5.172			5.172	74			2011	2016			Low	Include IIP and RH from 2011 Loxton/ Bookpurnong model
						75			2007	2012	In Progress			Low Impact – Long lag times
						76				2011				Modelling required
0.388	-0.117	1.186	0.000	0.000	1.458									
5.946	4.992	5.296	0.000	0.000	25.305									

Registers Explanatory Notes

TBA – To be assessed

Salinity Effect – Increase or decrease in average salinity at Morgan in EC

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

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Some of the totals are affected by rounding

Australian Government