

Executive summary

The Murray–Darling Basin is geologically and climatically prone to concentrating salt in the landscape.

Land use changes since European settlement mean that less of the rainfall that soaks into the ground is used by vegetation, in dryland areas, causing a gradual filling of shallow aquifers, bringing this natural salt to the land surface and to the rivers.

Meanwhile, problems of rising water tables and soil salinisation arose soon after the establishment of the first irrigation schemes in the 1890s. By 1987 it was estimated that 96,000 hectares of the Basin's irrigated land were salt-affected and 560,000 hectares had water tables within 2 metres of the land surface.

Because of its pervasiveness in the landscape, salinity is more than just a threat to water quality. It also impacts on environmental values for rivers and wetlands. It causes damage on the land — to built infrastructure, agricultural production and the environment.

This Salinity Audit establishes a trend, river valley by river valley, for salt mobilisation in the landscape and its expression in rivers and at the land surface. It provides predictions for increases in salinity if there are no new management interventions to prevent them.

The Audit enlarges and refines existing knowledge of the threat of salinity, building on a range of studies commissioned by State and Commonwealth governments.

One very important finding of this Audit is the estimation that much of the salt mobilised does not get exported through the rivers to the sea. It stays in the landscape or gets diverted into the irrigation areas and floodplain wetlands.

Previously, salinity of rivers was considered to be a problem for the lower River Murray. A major conclusion of this Audit is the extent to which salinity levels are rising in tributaries of the Murray–Darling system. A further very significant outcome of this Audit is the recognition that future salt exports will shift from irrigation-induced sources to dryland catchment sources. Of the projected increase in River Murray salinity at Morgan, South Australia, about 40 per cent will come from the nearby Mallee dryland zone and 25 per cent from tributary catchments upstream.

It is important not only to estimate the salt load involved but also the time over which salinisation will occur. The Salt Loads studies by the States, a major data source for the Audit, provide estimates for the years 2020, 2050 and 2100. The average salinity of the lower River Murray (monitored at Morgan) will exceed the 800 EC threshold for desirable drinking water quality in the next 50–100 years. By 2020 the probability of exceeding 800 EC will be about 50 per cent.

At the downstream end of several tributary river valleys, rising salinity will be even greater, threatening consumptive use of water resources and in-stream environmental values. The Macquarie, Namoi and Bogan Rivers will exceed the 800 EC threshold within 20 years, and exceed the 1,500 EC threshold for irrigation crop and environmental damage within 100 years. The Lachlan and Castlereagh Rivers will exceed 800 EC within 50 years. The Condamine–Balonne, Warrego and Border Rivers will exceed 800 EC before 2020. The Avoca and Loddon Rivers already exceed 800 EC on average. Some reaches of these rivers will rise to higher salinity levels again.

As part of the Salinity Audit, the Salinity and Drainage Strategy is being reviewed. The Audit has updated the future salinity trend line for the River Murray used in the Salinity and Drainage Strategy. The review has estimated the achievements of the Strategy and updated the costs associated with rising salinity.

The two most common types of cost from salinity are those associated with the use of saline river water in irrigated agricultural land and in urban areas, and those associated with rising water tables under land, in both urban and rural areas. The 1999 costs functions study commissioned by the Murray–Darling Basin Commission found that under current conditions, the cost of one EC unit increase in river salinity at Morgan in South Australia lies in the range of \$93,000 to \$142,000 per year. Already the total economic impact is estimated at \$46 million a year, and will rise further with the projected 330 EC increase over the next century. This study also found that the cost to agricultural users, especially horticulturalists,

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is much higher than previously estimated, while domestic and industrial costs are lower than previous estimates.

Salinity impacts on the environment in a number of ways. The Audit distinguishes between the riverine environment and the terrestrial environment, and focuses on what is known or can reasonably be predicted about loss of biodiversity. The major wetlands of the Basin — Macquarie Marshes, Great Cumbung Swamp, Avoca Marshes and Chowilla Floodplain — are likely to suffer additional impacts.

In response to the earlier understanding of the salinity threat, governments and communities have invested heavily in salinity management. Under the Salinity and Drainage Strategy there has been an improvement in River Murray salinity without limiting the rehabilitation of degraded lands and the undertaking of drainage works to control the rise of groundwater tables. This was made possible by reducing the amount of salt entering the river through construction of salt interception schemes and from implementation of the salinity and land and water management plans by the States.

Salinity levels in the lower Murray have been much lower in the post-strategy period than the pre-strategy period. Between 1993 and 1999 the salinity at Morgan has been less than 800 EC 92 per cent of the time. However, an increase from an average salinity of 570 EC to 790 EC in 50 years and 900 EC in 100 years indicates that the outcomes of the strategy will be overtaken unless new action is taken.

There has been significant improvement in our understanding of the challenges salinity presents to public policy. There is a better capacity to predict future impacts of salinity on a Basin and catchment scale. There is accumulated knowledge that points to the limits of most current farming systems to control salinity, even at the level of best practice. There is a greater appreciation of economic and social impediments to the scale of land use change now advocated for dryland catchments and there is a track record of policy initiatives, such as the Salinity and Drainage Strategy.

The Salinity Audit is a major advance in our predictive capacity. It provides the basis for framing a Basin-wide salinity management strategy. What has the Audit told us?

- The salt mobilisation process across all the major river valleys is on a very large scale. The annual movement of salt in the landscape will double in the next 100 years.
- There is a future hazard for some rivers and those people dependent on them as a source of water. Average river salinities will rise significantly, exceeding the desirable thresholds for domestic and irrigation water supplies in many tributaries and exceeding critical levels in some reaches.
 - Sources of salt that impact on the Murray–Darling system are better identified and quantified but our capacity to estimate land areas impacted by future salinity is inadequate and current understanding of environmental impacts is inadequate.
 - There is a priority for investment in better estimation of cost impacts and the benefit: cost ratios of taking action.

The Salinity and Drainage Strategy has gained us a 20-year reprieve against rising salinity in the lower Murray. Land and Water Management plans and adoption of best practices in irrigated agriculture have brought a level of salinity control. There is a sound basis for deciding on future investments in associated engineering works.

The Murray–Darling Basin Commission is preparing a draft Basin Salinity Management Strategy for Ministerial Council consideration by June 2000.

The Salinity Audit clearly identifies the severity and scale of the salinity threat to the Murray–Darling Basin if there are no new management interventions. The Audit has identified where improvements can be made and the National Land and Water Resources Audit's dryland salinity monitoring program will provide further guidance. Across the Basin the government support for integrated catchment management, including regulatory and financial capacity, offers a path forward for a Basin Salinity Strategy.

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Figure 1. Key Geographical features and locations referred to throughout this publication



Areas Studied for the Audit

- Salt loads study based on groundwater rise
- Land & Water Management Plans SA
- Salt loads study based on groundwater flow

Areas Excluded

- NSW Alluvial areas
- Other areas

- Irrigation Areas
- Wetlands of Importance
- Murray–Darling Basin

Conclusion

Salt is a natural part of the Australian landscape. The Murray–Darling Basin, over geological time, has been a natural salt trap. The clearing of native vegetation and its replacement with annual crops and pastures, irrigated agriculture, town gardens and lawns has unleashed a hydrological disequilibrium that brings this vast salt store to the land surface and increases its seepage to river systems.

The impact on streams and rivers is exacerbated by the reduction in flow resulting from the high rates of diversion for irrigation, urban and industrial water supply.

The cause and nature of the impacts of salinity have been known for decades. Policy and management responses, supported by major funding programs from Commonwealth and State governments, have been in place for 20 years. They range from the Murray–Darling Basin Commission's Salinity and Drainage Strategy to catchment management and Landcare initiatives.

In very recent times there has been significant and relevant improvement in our understanding of the challenges salinity presents to public policy.

- There is a better capacity to predict future impacts of salinity on a Basin and catchment scale
- There is accumulated knowledge that points to the limits of current farming systems in most zones to control salinity, even at the level of best practice
- There is a greater appreciation of economic and social impediments to the scale of land use change now advocated for dryland catchments
- There is a track record of policy initiatives, such as the Salinity and Drainage Strategy that are now under review.

The Basin Salinity Audit was born out of the latter review. Indications are that river salinity in the lower River Murray would be increasingly impacted by salt exports from the dryland catchments. This shifted the focus on salinity hazard to a Basin-wide approach, and led to the agreement by States to participate in a new Salt Loads study to predict salinity impacts up to 100 years into the future.

WHAT HAS THE AUDIT TOLD US?

The salt mobilisation process across all the major river valleys is on a very large scale. The annual movement of salt in the landscape will double. The salt load exported to and through rivers will double.

There is a critical future hazard for some rivers and the people dependent on them as a source of water. Average river salinities will rise significantly, exceeding the critical thresholds for domestic and irrigation water supplies, and the riverine environment. The Macquarie, Namoi, Lachlan, Castlereagh and Bogan Rivers of New South Wales and the Condamine–Balonne, Border and

Warrego Rivers of Queensland will experience drainage salinity rises. The Avoca and Loddon Rivers of Victoria already exceed a critical threshold, on average. Within 20 years the river salinity at the key monitoring station at Morgan in South Australia will have returned to the levels experienced in the 1970s and 1980s, overtaking the achievements of the Salinity and Drainage Strategy. The importance of variability of salinities over time and periodic exceedances of critical water thresholds, such as for irrigation water and ecosystem maintenance, is now better appreciated. This quantification of estimated salinities and their variability, and identification of river reaches most at risk, allows for better targeting of policy responses.

Sources of salt that impact on the Murray–Darling system are better identified and quantified. About half of the impacts in EC terms at Morgan will derive from salt movement from irrigation developments before the Salinity and Drainage Strategy together with salt from the dryland Mallee zone, and one-quarter from tributary catchments. The distribution of sources between irrigation areas and dryland catchments, and between and within river valleys clearly points to the need for a Basin-wide salinity management strategy that incorporates a revised Salinity and Drainage Strategy.

The importance of salinity variability over time in relation to exceedances of critical water salinity thresholds, such as for drinking water, has been brought out and is now appreciated.

The capacity to estimate land areas impacted by future salinity is inadequate. The Salt Loads study has identified land units with rising saline groundwater, and the rate of rise. Yet, due to lack of monitoring data and surface contour data, the size and location of saline discharge areas cannot be reliably predicted. This is being corrected with initiatives in New South Wales, where predictive capacity is weakest.

There is a priority for investment in better estimation of cost impacts and the benefit:cost ratios of taking action. There is adequate current and historical knowledge of the costs and potential benefits of incremental changes in salinity of the lower Murray. The same cannot be said for other river valleys and dryland catchments. Inevitably, there will be trade-offs in policy responses and priorities for public investment. This is being addressed in a major 'cost project' by the Commission.

Current understanding of environmental impacts is inadequate. While there is some scope for estimating losses to floodplain wetlands and riparian values, on the basis of projected river salinities, the scale and nature of threats to terrestrial environments cannot be gauged. There have been no broad-scale studies. There is no basis for setting priorities or targeting investment.

There is some knowledge of the achievements of management interventions to date. The Salinity and Drainage Strategy has gained us a 20-year reprieve against rising salinity in the lower Murray. Land and Water Management Plans and adoption of best practices in irrigated agriculture has brought a level of salinity control. There is a sound basis for deciding on future investments, typically salt interception schemes. On the other hand, the prognosis for dryland catchments is not as good. Despite major investment in the development of improved farming systems and in catchment management programs, for some rainfall zones there are currently no farming systems capable of controlling salinity. The scale of land use change needed to address the hydrological imbalance, for instance forestry and revegetation, is beyond current resources and raises other dilemmas, including trading off salinity control and water yield.

WHAT ARE THE NEXT STEPS?

The Murray-Darling Basin Commission is preparing a draft Basin Salinity Management Strategy for Ministerial Council consideration by June 2000. The Commission is giving priority to refining the current framework for integrated catchment management to better accommodate a decade of evolution in catchment management organisations and government-community partnerships. The Basin-wide salinity threat is a major reason for updating the Natural Resource Management Strategy. The new integrated catchment management framework will include the following features:

- Adoption of the national principles of natural resource management
- Strengthening regional catchment planning, implementation and accountability
- Development of a long-term investment program, better suited to the nature of dryland salinity
- Evaluation of a range of policy options for government.

The draft Basin Salinity Management Strategy is likely to extend the principles of the Salinity and Drainage Strategy so that they apply Basin-wide. The key current feature of the Strategy is that States are accountable for actions that impact on salinity and there are incentives to take measures to achieve a common, agreed target. This approach could be applied to river valleys, beyond the River Murray 'main-stem', where 'end-of-valley' targets would be established. Integration of river valley and Basin salinity outcomes would be essential.

Clearly, broad-scale land use change has to be considered if there is to be salinity control that improves on the projected trends. At the national and state levels, consideration is being given to the multi-functional benefits of forestry and revegetation, the stimulation of

innovation and development of new sustainable industries, assistance with rural adjustment in some regions and better application of planning principles. These are highly relevant to the prospective Strategy.

The Commission has already taken steps to improve the predictive capacity and decision support for the new Strategy. The Audit has identified where improvements can be made, and the National Land and Water Resources Audit's dryland salinity monitoring program will provide further guidance. An integrating model is under development; one that can accommodate the trade-offs between Basin and river valley salinity targets to achieve optimum natural resource, economic and social outcomes. Better decision support at the regional level, including environmental impacts and benefit:cost analyses, is needed.

The Murray-Darling Basin Commission is a party to a number of national incentives on salinity and can work closely with them:

- The Commonwealth Government's response to the PMSEIC report on dryland salinity
- The ARMCANZ policy framework on dryland salinity
- The mid-term review of the Natural Heritage Trust, regarding dryland salinity
- The National Dryland Salinity Program.

The Salinity Audit clearly identifies the severity and scale of the salinity threat to the Murray-Darling Basin if there are no new management interventions. Yet it does not pre-empt what might be the Murray-Darling Basin Salinity Management Strategy. Rather, the Commission has identified a path forward for integrating the Strategy it will recommend to the Ministerial Council within the evolving integrated catchment management framework and national initiatives in dryland salinity.

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