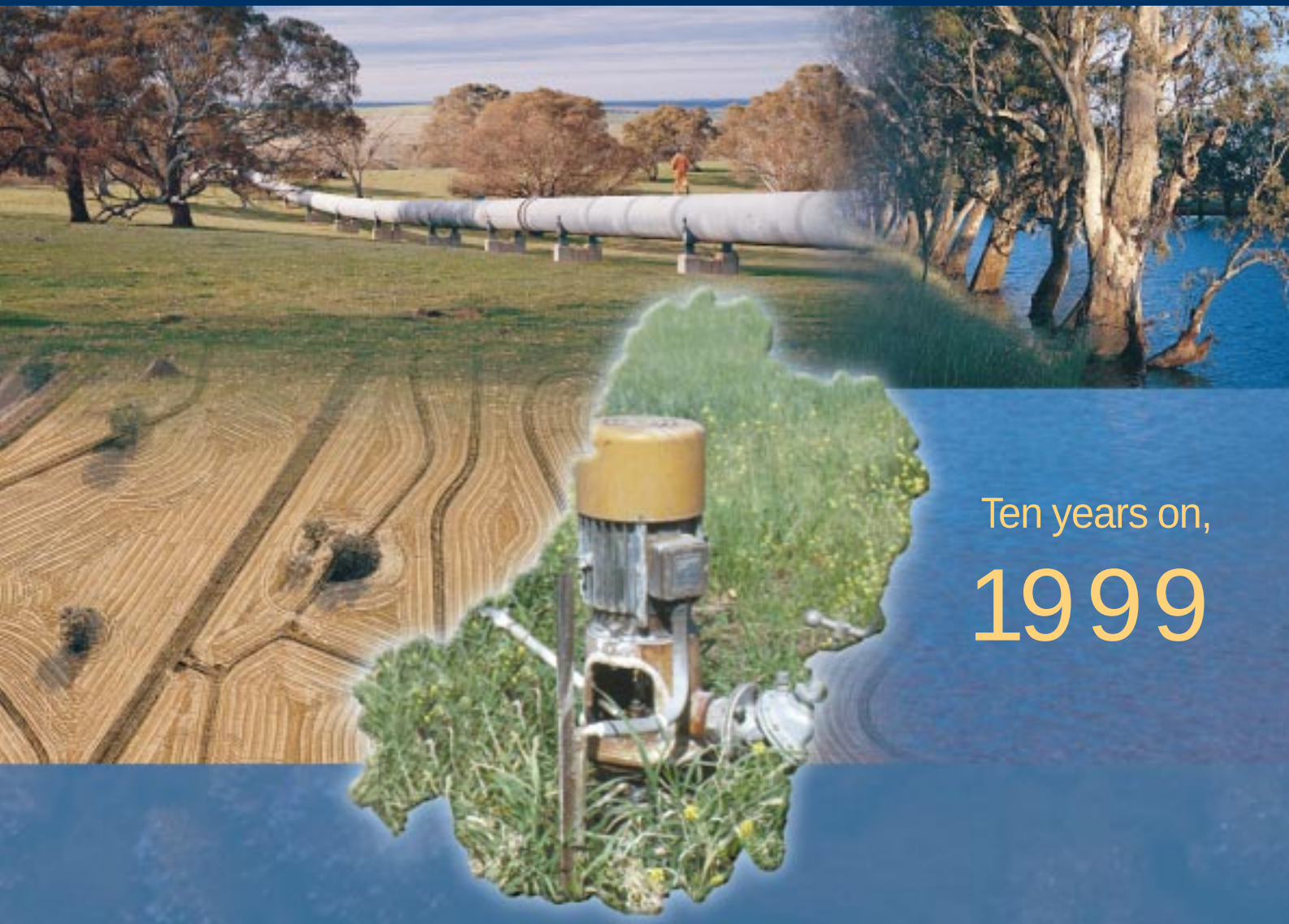
Salinity and Drainage Strategy

THE MURRAY-DARLING BASIN COMMISSION



Ten years on,

1999

SIX GOVERNMENTS WORKING IN PARTNERSHIP WITH THE COMMUNITY

THE COMMONWEALTH • NSW • VIC • SA • QLD • ACT

Murray–Darling Basin Location Map

- Major Irrigation Areas
- Irrigated Crops and Pastures x 5 000 Hectares
- Irrigated Crops and Pastures x 22 000 Hectares
- Wetlands of Importance
- Murray–Darling Basin

Prepared by the Salinity and Drainage Assessment and Salt Interception Working Groups.

Contents

Introduction

In 1988, the Murray Darling Basin Ministerial Council adopted the Salinity and Drainage Strategy. The Strategy sets out a specific salinity reduction target against benchmark conditions. It is an ambitious Strategy, set within a framework of joint action by the Commonwealth government and the State governments of New South Wales, South Australia and Victoria.

The Strategy has achieved a net reduction in River Murray salinity without jeapordising the undertaking of land protection works, new irrigation and water resources developments in the three States.

Despite the undeniable gains of the Strategy, salinity in the Murray Darling Basin remain a pressing issue. A decade on, the time has come to evaluate the achievements of the Salinity and Drainage Strategy, to identify the work that remains and to map the pathway for the future.

High Salinity not only reduces agricultural yields but also imposes additional costs to urban and industrial water users

Background

The Murray–Darling Basin is one of Australia's most productive agricultural areas and is estimated to contribute $8.6 billion a year to the economy. This represents about 41 per cent of the nation's total gross value of agricultural production. The total area devoted to agriculture in the Basin is 84.6 million hectares, of which 1.47 million hectares is irrigated. Apart from the Basin's economic significance, it is well endowed with nature's bounty in the form of wetlands, forests and a large number of species of flora and fauna.

In view of its economic, environmental and social importance, it is imperative that economic activities and natural resource management in the Basin are sustainable. A major challenge is the exacerbation of the naturally occurring salinity in the Basin caused by land and water use changes over the last two centuries.

High salinity not only reduces agricultural yields, especially for horticultural crops, it also imposes additional costs on urban residents and industrial water users. Increased costs are mainly due to the need for frequent repair and replacement of hot water systems and water supply infrastructure, and damage to houses, roads and other infrastructure as a result of rising water tables and salinity. Increased salinity also affects the sustainability of flora and fauna of the floodplains and wetlands.

The Need for the Salinity and Drainage Strategy

In the mid-1980s studies showed that 96,000 hectares of irrigated land in the Basin were showing visible signs of salinisation and it was estimated that the irrigation areas affected by high water tables could increase from 559,000 hectares in 1985 to 869,000 hectares in 2015 (MDBMC, 1987).

According to these estimates, average salinity at Morgan in South Australia would have increased by 30–75 EC.[1] This increase in river salinity was estimated to be largely due to contributions from an increase in groundwater mounds under irrigation areas, and surface and sub-surface drainage from the high water table areas. The relative contribution from the dryland areas was considered to be very small.

In 1985 the Ministerial Council of the Murray–Darling Basin assigned a high priority to the coordinated management of salinity and waterlogging problems in the Basin and directed an Inter-governmental Working Group to prepare a Salinity and Drainage Strategy.

1 An EC is a measure of electrical conductivity of water in micro siemens/cm at 25^{0}C and is used as an indicator of total dissolved solids (TDS). 1 EC is approximately equal to 0.6 mg/litre of total dissolved solids.

Salinity and Drainage Strategy

The Salinity and Drainage Strategy of the Murray–Darling Basin Commission (MDBC) was adopted by the Ministerial Council in April 1989. The rules for implementation of the Strategy were subsequently formalised as Schedule C to the Murray–Darling Basin Agreement (MDBC, 1992) in amendments proclaimed on 6 October 1993.

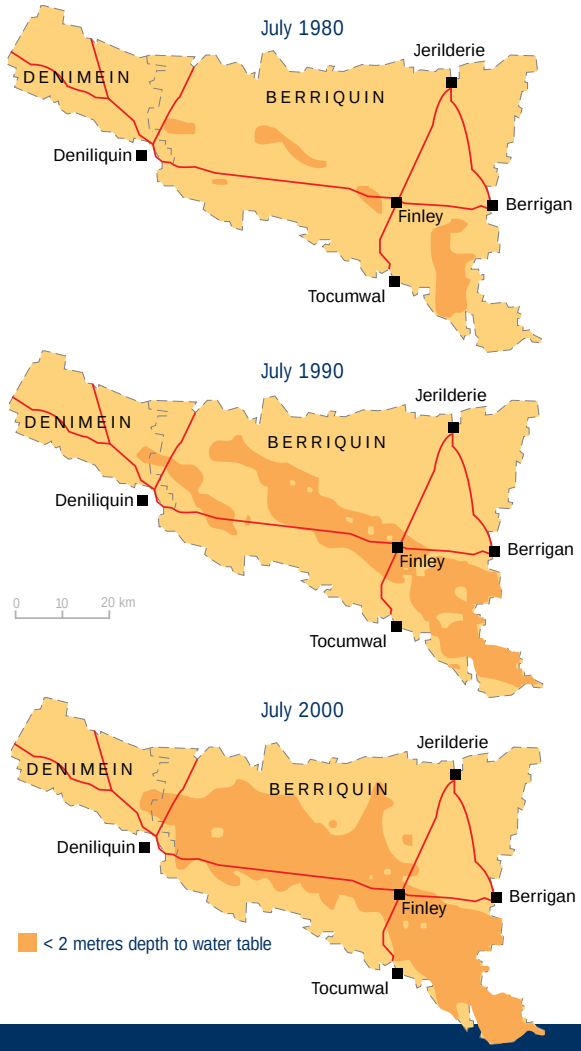
The key elements of the Strategy that define the rights and responsibilities of the Governments are:

- Each State is responsible for actions significantly affecting river salinity taken within its jurisdiction since 1 January 1988.
- The impacts of actions are quantified by evaluating them against a set of benchmark conditions. Benchmark conditions are those existing in the Basin on 1 January 1988 and include the effects of all past actions and commitments made by the States prior to 1988.
- The Commonwealth, New South Wales, Victorian and South Australian Governments are to undertake a program of joint works to reduce average salinity at Morgan by 80 EC and, to this end, 15 EC credits each are provided to New South Wales and Victoria. Morgan is located just upstream of the pipeline off-takes for Adelaide's water supply, and its use as an indicator site emphasises the relative importance of river salinity impacts on all water users in the system.
- The three States are also allowed to undertake salinity reduction schemes outside the 80 EC target and to use the resulting credits for further actions that may lead to increases in river salinity.
- Each State is entitled to proceed with actions that increase river salinity, provided that the salinity impact of those actions is not greater than the balance of their salinity credits.
- Responsibility for the administration of land management and development proposals within an individual State remains with the State.

This Strategy provides a framework for joint action by the New South Wales, Victorian, South Australian and Commonwealth Governments to effectively manage the pressing problems of river salinity, waterlogging and land salinisation in the Murray Valley. The Strategy is based on the concept of reducing river salinity through cost-effective salt interception and drainage diversion schemes. It permits New South Wales and Victoria to discharge an agreed amount of salt back into the river to allow rehabilitation of the waterlogged and salinised irrigated areas in those States.

In the short to medium term, reduction in river salinity is achieved through salt interception schemes. In the long term land, water and salinity management plans are being developed to tackle both river salinity and land salinisation issues.

Under the Strategy, a Register is maintained by the Commission to record the various schemes and projects undertaken since adoption of the Strategy and their salinity impacts. The Salinity and Drainage Assessment Working Group of the MDBC oversees the maintenance of this Register. Salinity credits or debits are assigned to a project on the basis of the estimated economic impacts resulting from salinity changes caused by the project on River Murray water users. These economic costs or benefits include downstream salinity impacts on irrigators, and domestic and industrial water users. The rules for allocating credits and debits for a project and its inclusion in the Register are formalised in Schedule C of the Murray–Darling Basin Agreement.



Strategy Objectives

The objectives of the **Strategy** are to:

- improve water quality in the River Murray for all beneficial uses — agricultural, environmental, urban, industrial and recreational
- control existing land degradation, prevent further land degradation and, where possible, rehabilitate land resources to ensure the sustainable use of the resources of the Murray and Murrumbidgee valleys
- conserve the natural environment of these valleys and preserve sensitive ecosystems with respect to salinity (MDBMC, 1988).

To determine an appropriate salinity objective and to identify what would be achievable over a ten-year period with a balanced program of works and measures, the River Murray Commission, the predecessor to the MDBC, adopted an interim objective to assist development of the Strategy:

"to support an economically, socially and environmentally acceptable package of works and measures comprising salt interception, dilution, enhanced river regulation and land management which will result in the salinity of the River Murray at Morgan being reduced so that by 1995 it will be less than 800 EC for 95% of the time" (MDBMC, 1987).

Implementation

The policies and approach for the implementation of the Strategy, including allocation of salinity credits to various projects and assessment of proposals by the States and the MDBC, are set out below.

Victoria & New South Wales

In Victoria and New South Wales, the State pays for the interception schemes that generate credits and then allocates these credits to land and water salinity management plans at the time of their approval. However, the operational and maintenance component is expected to be recovered from the Plan beneficiaries according to a 'Plan-specific' formula. The Plan implementors do not own the credits unless they have contributed to the capital as well as the operational and maintenance costs of achieving the credits.

In Victoria the allocation of salinity credits to the Plans is based on recommended cost-sharing arrangements and considerations of public and private good. The credits may be allocated either as a one-off allocation or as an initial quota for (say) five years, if the Plan has a phased implementation.

In New South Wales, allocation of credits is based on an assessment of whether a work or measure is in the public interest and has an acceptable benefit:cost ratio. The environmental impacts of the proposed measure or work, including salinity, need to be considered acceptable following an Environmental Impact Statement (EIS) and monitoring commitments should be acceptable to the State agencies and the MDBC.

In one Plan (Nyah-to-the-Border), salinity credits were allocated by Victoria to offset the salinity effect of groundwater displacement by new development. This development was seen as being a private benefit, but because of the economic boost to the region and the nation, credits were made available. In this case, developers were required to pay the capital as well as the operational and maintenance components for the credits.

Private investment to achieve salinity credits is limited to one instance, a project in the Sunraysia Region. Here, funds provided by the Government were invested in the Psyche Bend Interception Scheme, thereby acquiring 0.78 EC credits.

South Australia

When the Strategy was formulated, South Australia decided to allocate its share of the credits from joint works to improve River Murray salinity. This highlighted the importance to South Australia of actually achieving a net reduction in salinity in the river. It also indicated that South Australia would manage its new irrigation developments to ensure that it would remain salinity neutral.

To achieve the objective of salinity neutrality, South Australia elected to rigorously impose policies designed to improve the irrigation efficiency of existing developments and minimise the salinity impact of new developments. All River Murray water transfers in South Australia are subject to the minimum requirement of preparing and adopting an Irrigation and Drainage Management Plan. This is a property-based plan which identifies best practice irrigation and minimisation of irrigation drainage. For large developments, an agreement to quantify and mitigate the salt load induced by the new development is required.

Murray–Darling Basin Commission Office

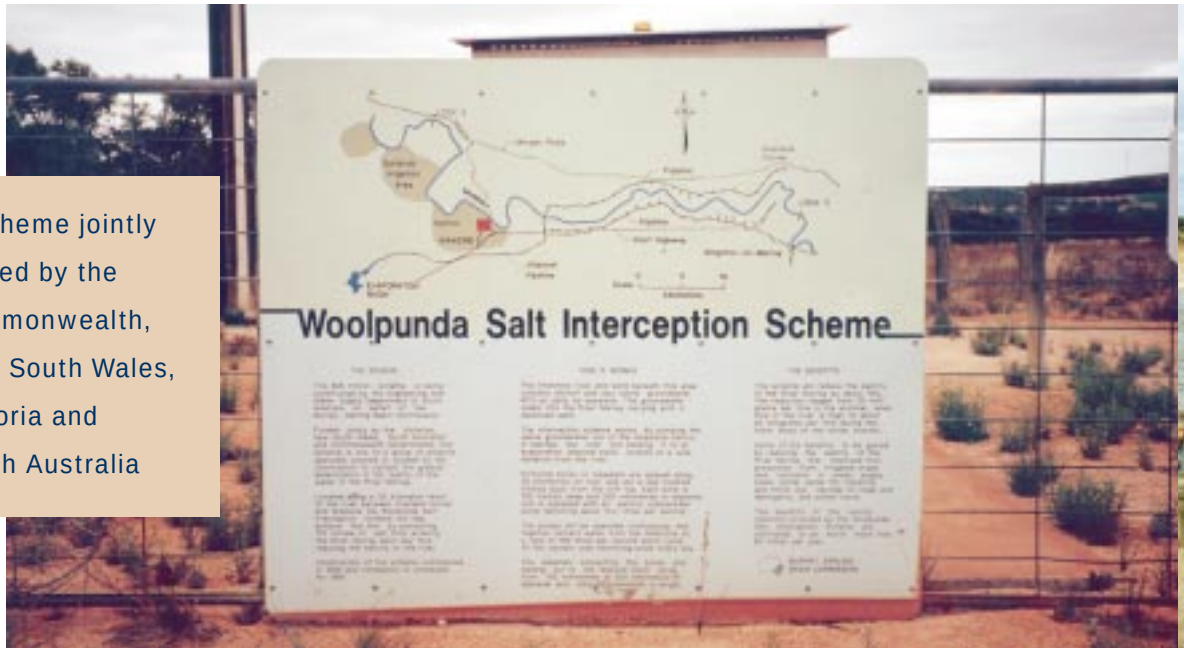
The MDBC Office provides technical support to the Salinity and Drainage Assessment Working Group and assesses the salinity costs and benefits due to proposals put forward by the State Agencies. These assessments, together with the Commission Office's views on the proposals, are considered by the Salinity and Drainage Assessment Working Group for recommendation to the Commission.

Assessment of costs and benefits is carried out using the Commission's computer flow and salinity models for the River Murray system. These models simulate water and salt balances in the River Murray and then estimate the costs and benefits of changes to the water and salt regime that would be caused by the proposal. The benchmark regime that the proposal is compared against is the 1975–85 observation period, which is representative of long-term climatic conditions in the valley and contains both droughts and floods. At the time of formulation of the Strategy, the benchmark period was limited to this short period due to limitations of data availability. It has been proposed that this period be extended to include the period since 1985.

Cost-Sharing Arrangements

The capital cost of construction of the jointly-funded Salt Interception schemes is shared equally by the Commonwealth, New South Wales, Victorian and South Australian Governments. However, the cost of operation, maintenance and monitoring of these schemes is shared by the three States.

Half of the total cost of investigations and designs for undertaking jointly-funded schemes is provided by the Commonwealth and the remaining half is shared equally among New South Wales, Victoria and South Australia. Currently, Queensland and the ACT are not signatories to the Salinity and Drainage Strategy and therefore do not contribute to the jointly-funded program. They are also not accountable under the Strategy.



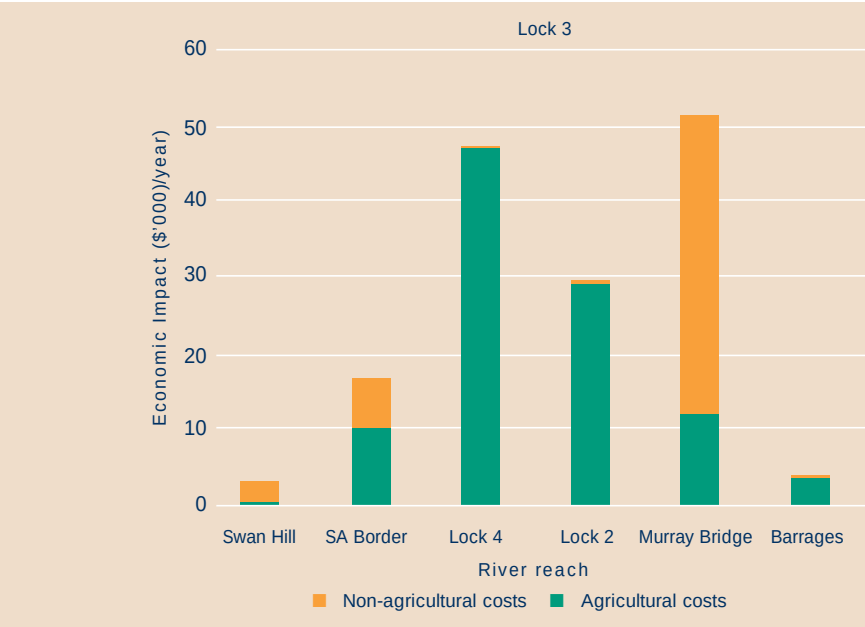
A scheme jointly funded by the Commonwealth, New South Wales, Victoria and South Australia

Salinity Costs Underpinning the Strategy

One of the key elements of the Strategy is to assess economic impacts on River Murray water users due to works or measures that increase or decrease river salinity and to attribute these costs or benefits to the States according to the agreed rules.

Figure 1: Cost per EC Increase in Salinity at Morgan due to Salt Discharge at Swan Hill and Lock 3

Figure 3: Economic Costs borne by River Murray Water users for 1 EC Increase in Morgan Salinity due to Salt Discharge near Swan Hill



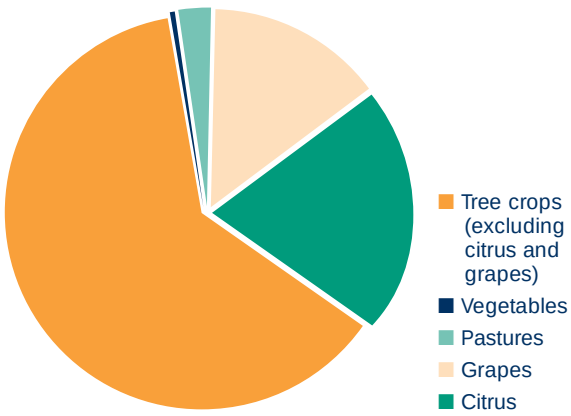
To date the economic impacts of salinity have been assessed using a study carried out by consultants in 1984. This study shows that each Unit increase in salinity at Morgan costs approximately $140,000 per year per EC to downstream users at current price levels. Eighty per cent of these costs are due to impacts on domestic and town water supplies in South Australia, including supplies to Adelaide from the River Murray.

As a component of the review of the Strategy, a new assessment of the economic impacts to River Murray water users has just been completed (GHD, 1999). This study found that the cost to agricultural users, especially horticulturalists, is much higher than previously estimated and domestic and industrial costs are lower than previous estimates. According to this new study, the total cost to the River Murray water users for an EC change in river salinity at Morgan varies significantly, depending on the location of the action that causes the change in river salinity (Figure 1). At current river salinity levels, the cost per EC could vary from $65,000 per year per EC if the increase is due to an action near Lock 3 (downstream of major irrigation areas) to $151,700 per year per EC for an increase caused by an action near Swan Hill. The variability in costs due to the location of the action that leads to a change in salinity is due to the number of downstream irrigators affected by the increase in river salinity.

Figure 1 also shows that the marginal cost per EC will increase in future if river salinity increases. With any increase in salinity, not only would crops currently affected by salinity be under increased stress but additional crops would also begin to be affected. The major crops affected by salinity and the proportion of total agricultural impacts borne by them are shown in Figure 2.

The distribution of economic impacts in various river reaches is shown in Figure 3. The ratio between agricultural and non-agricultural impacts can vary, depending on the location of the salt discharge. Similarly, the ratio between the impacts on various States varies, depending on the location of the salt discharge. For an increase in salinity at Morgan due to an action near Swan Hill, the agricultural impacts are 61 per cent of the total while non-agricultural costs amount to 39 per cent. More than 90 per cent of both agricultural and non-agricultural costs are borne by water users in South Australia.

Figure 2 : Agricultural costs by category due to a scheme at Swan Hill – GHD Study



Achievements to Date

The most significant achievement of the Strategy is the improvement in river salinity obtained without limiting the rehabilitation of degraded lands and undertaking of drainage programs to control the rise of saline groundwater. This has been made possible by reducing the amount of salt entering the River Murray through the construction of jointly-funded Salt Interception schemes with some of the salinity benefits used to offset the impacts of land, water and salinity management plans.

Managing Menindee Lakes and Lake Victoria for salinity improvement has led to a 28 EC reduction in Morgan salinity

SALINITY AT MORGAN

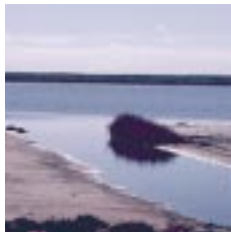
Reduction in Morgan Salinity due to the Strategy

The key performance Indicator of the Strategy is salinity at Morgan in South Australia. Jointly-funded and State-funded schemes undertaken since the implementation of the Strategy have reduced salinity at Morgan by 75.9 EC. On the other hand, land, water and salinity management plans and water management changes have resulted in an increase in salinity of 18.6 EC benefits, giving a net reduction in river salinity of 57.3 EC since adoption of the Strategy. Before adoption of the Strategy the contracting governments had agreed to changes in operating procedure for Menindee Lakes and Lake Victoria, providing a net salinity improvement of 28 EC at Morgan.

Recorded Salinity at Morgan

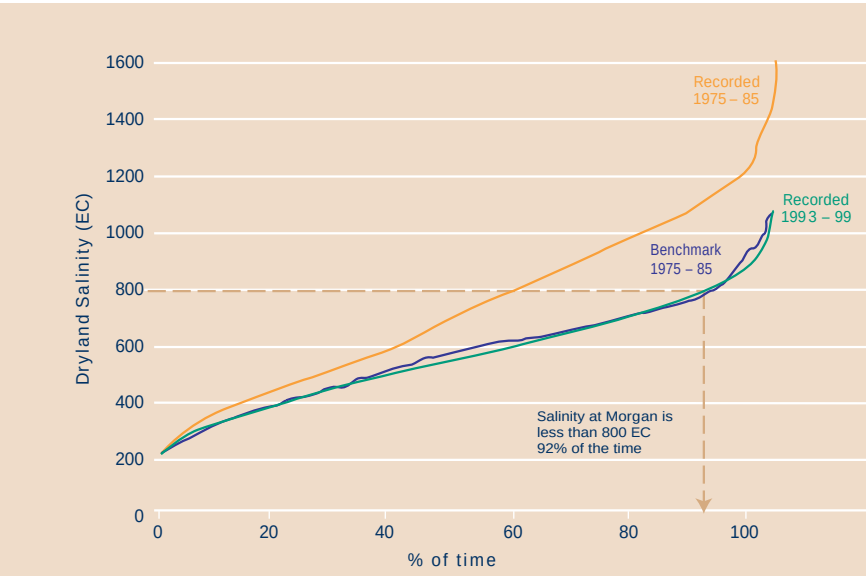
The frequency plot for salinity recorded at Morgan for the pre- and post-Strategy period and benchmark conditions adopted for the Strategy are shown in Figure 4. The post-Strategy period has been selected from 1993 onwards because two of the four joint schemes built under the Strategy were completed by end of 1992 and a third major scheme was completed during 1993. The benchmark conditions are indicative of the salinity conditions that would have been experienced at Morgan during 1975–85 if during this period:

- all salt interception schemes completed before 1988 had been operational
- South Australia had received increased entitlement flows due to completion of the Dartmouth Dam
- Menindee Lakes had been operated in accordance with the rules developed to maximise salinity benefits
- Lake Victoria had been flushed to manage its salinity levels.



Satellite image of Menindee Lakes

Figure 4: Frequency Plot of Morgan Salinity Before and After the Strategy



Barr Creek pumps prevent 58,000 tonnes of salt from entering the River Murray every year

Figure 4 and Table 1 show that the salinity levels experienced at Morgan have been much lower in the post-Strategy period then in the pre-Strategy period. The average salinity in the post-Strategy period is 152 EC lower than during the pre-Strategy period and 14 EC lower than the benchmark conditions, despite flows being 14 per cent lower.

On the basis of the above information, it can be concluded that the Strategy has been highly effective in achieving its stated aim of reducing the River Murray salinity at Morgan.

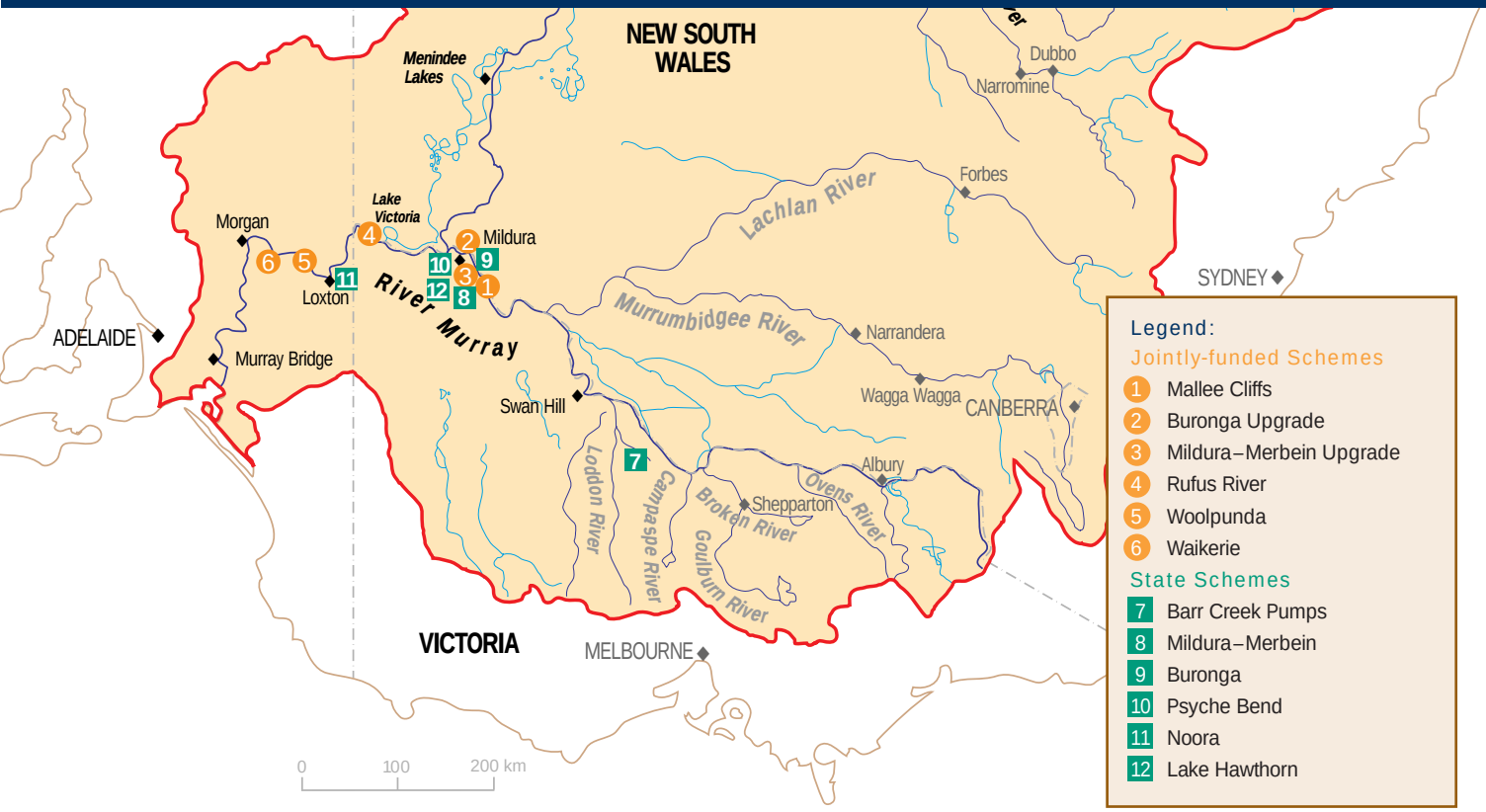
Morgan Salinity Trends

The historical and projected trends for River Murray salinity at Morgan are summarised in Figure 5. The increase in river salinity experienced since the late 1970s is mainly due to the growth in irrigation diversions during this period. However, in future the increase in river salinity is expected to be mainly due to increased salt contribution from dryland areas and pre-Strategy irrigation developments. The big success of the Strategy has been to improve river salinity from the late 1980s by measures such as dilution flows, building and operating salt interception schemes and putting in place accountability arrangements for future regional drainage constructions.

Lake Hawthorn

Table 1: Salinity at Morgan Before and After the Strategy

% of time	% of time River Murray (EC) is less than these values			
	Pre-Strategy Observed 1975–85	Benchmark (Modelled 1975–85)	Post-Strategy Observed 1993–99	Difference (Pre – Post)
95	1205	874	900	305
50	710	584	590	120
5	300	289	275	25
Average	721	583	569	152



ENGINEERING WORKS

Salt Interception Schemes

Large quantities of salt have always entered the River Murray from seepage of saline groundwater. This seepage is especially evident during low flows when big salinity increases are noticed over short stretches of the river. To reduce this inflow of salt, several schemes have been successfully undertaken by State Agencies and the MDBC with the objective of lowering the groundwater tables near the river in these river reaches or reducing the upward leakage of saline groundwater water from deeper aquifers. These schemes prevent about 400,000 tonnes of salt from entering the River Murray every year.

Salinity Benefits due to Jointly-funded Schemes

To date the States and the Commonwealth have funded the construction of three Salt Interception schemes and the upgrading of two State government schemes to achieve a 63.7 EC (Table 2) reduction at Morgan. Some benefits have been forgone due to changes in management of Menindee Lakes and the riparian flow releases into the Darling River. In summary, a 61.1EC reduction in river salinity has been achieved against the 80 EC target of the Strategy.

Since adoption of the Strategy, the MDBC has proposed a set of rules for the operation of Barr Creek pumps that increase the salt diverted from the Barr Creek to Lake Tutchewop system as distinct from the salt diverted under the

Figure 5: Forecast of Salinity at Morgan, November 1998

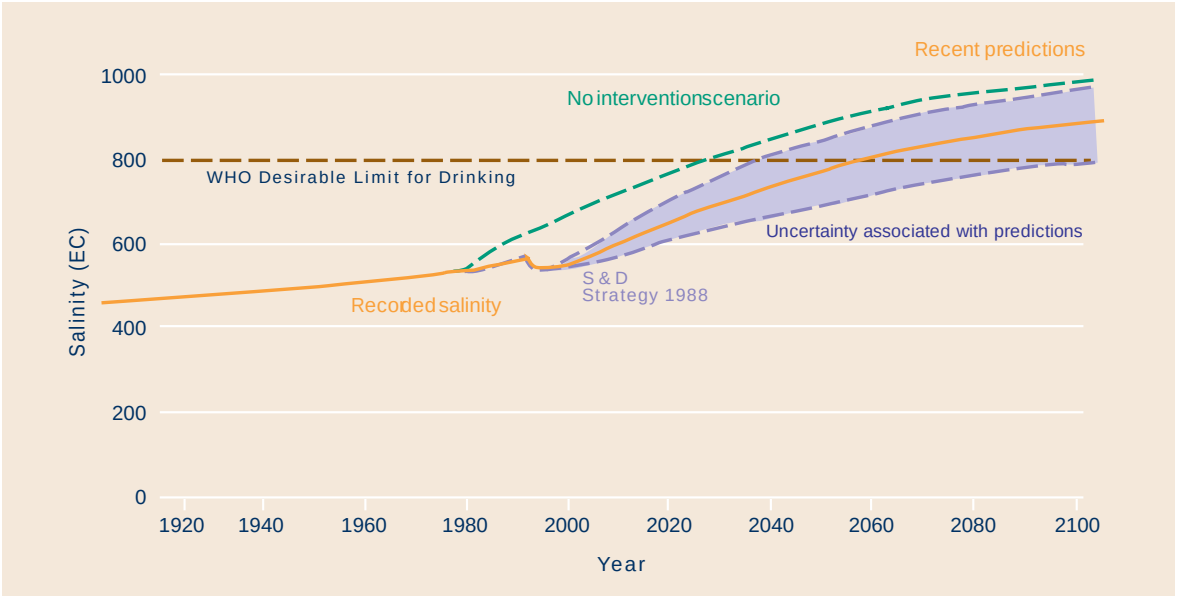


Table 2: Investments in Jointly-funded Salt Interception Schemes

Jointly-funded scheme	Year completed	Change in average salinity at Morgan (EC)	Salt kept out of the Murray (tonnes/ year)	Average operation & maintenance cost $000/year	Capital cost $000
Woolpunda Scheme	1992	-35.44	62,100	850	20,900
Waikerie Scheme	1993	-13.56	23,700	330	7,600
Mallee Cliffs Scheme	1995	-8.80	29,000	470	12,200
Upgrade of Mildura Merbein and Buronga Schemes	1991	-5.91	19,200	110	2,200
Total		63.71	134,000	1,760	42,900

Groundwater interception pump fitted with chlorination unit to control biofouling. Chlorination Unit design patented by SA Water

pre-Strategy operating rules. The increased salinity benefit from these revised rules amounts to 7.7 EC. Victoria has adopted these rules on a trial basis. In addition, prior to the Strategy agreement, a jointly-funded Rufus River Salt Interception scheme was built. This scheme prevents about 21,600 tonnes per year of salt from entering into the River Murray.

Total Investment & Benefits from Joint Schemes

The jointly-funded schemes constructed since adoption of the Strategy represent an investment of $43 million, and their operation and maintenance costs are about $1.8 million per year. Details of individual schemes are summarised in Table 2. A further $7 million has been invested in investigations of cost effective schemes to achieve the Strategy target.

Salinity Benefits from State Schemes

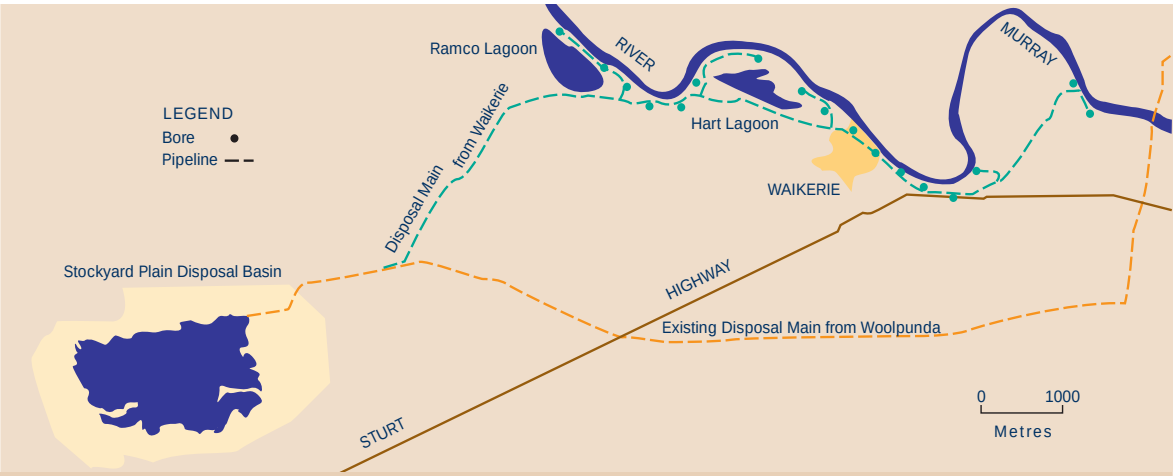
New South Wales, Victoria and South Australia have also constructed a number of Salt Interception and Drainage Diversion schemes. Most of these schemes predate the Strategy. The salinity benefits of various State schemes and the year of their construction are shown in Table 3. Since adoption of the Strategy, Victoria has undertaken two schemes, Psyche Bend Drainage Diversion scheme and Barr Catchment Management Plant.

Psyche Bend Drainage Diversion scheme with a salinity benefit of 1.14 EC has been constructed jointly by Victoria and the Commonwealth. The salinity benefits for the Commonwealth share were allocated for improvement of river salinity, while Victoria allocated its share of salinity credits to offset groundwater discharge to the River Murray near Mildura.

Barr Creek Catchment Plan with a salinity benefit of 3.32 EC to date, and an expected final salinity benefit of 6.63 EC has been funded by Victoria. This plan includes a range of catchment works which improve efficiency of Barr Creek Drainage Diversion Scheme.

Challenges

The construction and operation of these schemes have not been without challenges and problems. These include deposits of



Schematic for the Waikerie Salt Interception scheme in South Australia, jointly funded by New South Wales, Victoria, South Australia and the Commonwealth

iron and bio-fouling of pipe main and pumps, system malfunctions due to the extreme corrosiveness of the groundwater pumped, and the complex and incompletely understood hydrogeological conditions affecting the performance expectations of the schemes and their disposal basins.

Techniques developed by the South Australian Water Corporation have proved very effective in controlling 'iron bacteria' biofouling. One patented method employing in-situ generation of chlorine by electrolysis of pumped groundwater regularly disinfects the pumps and has eliminated iron bacteria fouling as a limiting factor in long-term pump performance. Some pumps fitted with chlorination systems have now operated continuously for up to six years since the last changeover with negligible loss of output attributable to iron bacteria fouling.

For pipelines prone to iron bacteria fouling, various cleaning methods using foam rubber swabs or 'pigs' are now used on a regular basis and these have proved very effective in maintaining acceptable pipeline performance. Other significant developments include the use of new epoxy protective coatings for pumps to reduce the corrosive effects of saline water on pump components.

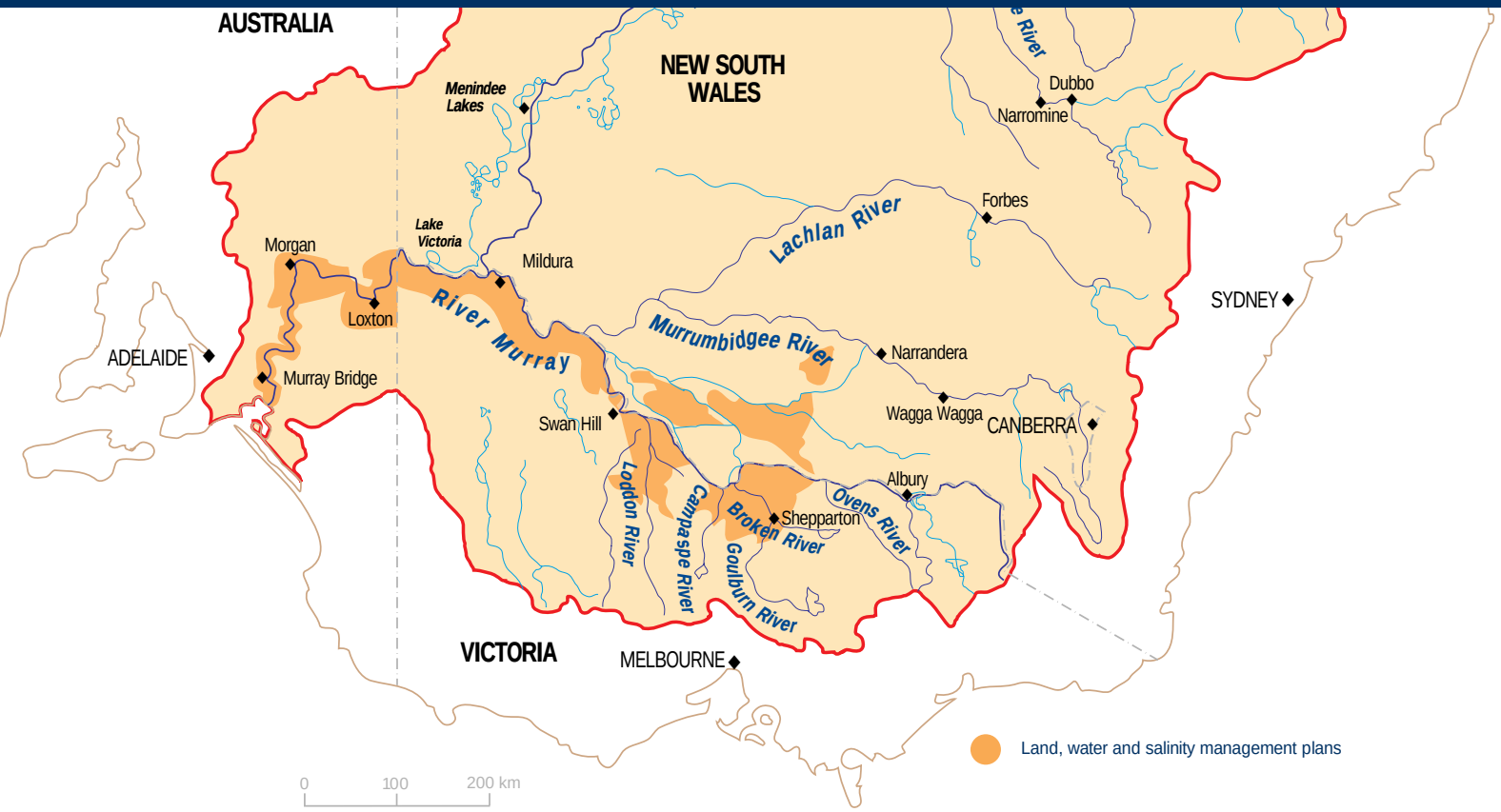
To minimise the impact on neighbouring land and sensitive ecologies and to enable preventative measures to be taken before any adverse impacts become significant, extensive monitoring of groundwater movement, soil salinity and flora and fauna is carried out. Buffer strips, interceptor drains and sub-surface bund walls have also been built around most of the schemes to minimise their impact on neighbouring areas.

Table 3: Summary of Major State Schemes

Scheme	Year completed	Salt kept out of the Murray (tonnes/year)
New South Wales	1979	36,500
Buronga salt interception scheme	1979	36,500
Curlwaa drainage and salt interception scheme	1974	2,020
Victoria		
Lake Hawthorn	1968	11,300
Barr Creek drainage diversion scheme (including Barr Creek Catchment Management Plan)	1968	58,000
Mildura Merbein salt interception scheme	1981	28,500
Psyche Bend*	1996	4,900
South Australia		
Noora drainage diversion scheme	1983	44,000
Salt kept out of the Murray (tonnes/year) by the State schemes		221,720

** This scheme was jointly funded by the Commonwealth and Victoria. Commonwealth shares of salinity benefits have been allocated for river salinity improvement.*

Areas covered by, water and salinity management plans.

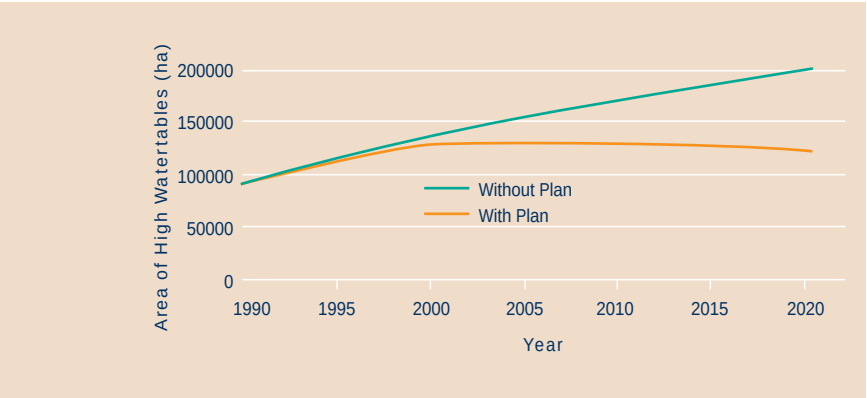


LAND, WATER & SALINITY MANAGEMENT PLANS

Overview of Various Plans

The provision of salinity credits within the Strategy has allowed the undertaking of land, water and salinity management works in irrigation districts (Land and Water Management Plans (LWMP) in New South Wales and South Australia and Salinity Management Plans (SMP) in Victoria) to improve the sustainability of these agricultural areas without jeopardising the environmental health of the River Murray. Since adoption of the Strategy, 14 plans have been initiated in New South Wales and Victoria. A further three plans in New South Wales and 16 in South Australia are in various stages of development and these have sustainable land and water management among their key objectives. The most advanced of the South Australian plans is the Qualco–Sunlands LWMP.

Figure 6: Berriquin LWMP – Areas of high Water Table, (With and Without Plan).



The areas covered, the extent of the waterlogging problems and major agricultural activity undertaken in each Plan area are summarised in Table 4. The total area covered by these Plans is about 1.97 million hectares (both irrigated and dryland), of which approximately 1.0 million hectares would otherwise have been affected by waterlogging. The emphasis of most of the Plans is to reduce the rate of groundwater table rise as much as possible and provide drainage works for areas already affected by high water tables to allow continued agricultural activity. The benefits expected due to Berriquin LWMP in controlling the rising water table are shown in Figure 6.

Major actions being undertaken under various plans include some or all of the following:

- surface drainage
- sub-surface drainage
- reducing seepage losses from irrigation channels
- re-use systems for drainage from farms
- land forming
- farm plans to assist adoption of best management practices
- groundwater table control by pumping
- improved water management of wetlands
- tree and deep-rooted vegetation planting.

The salinity credits allocated to various Plans and their uptake to date are summarised in Table 5.

Major Issues

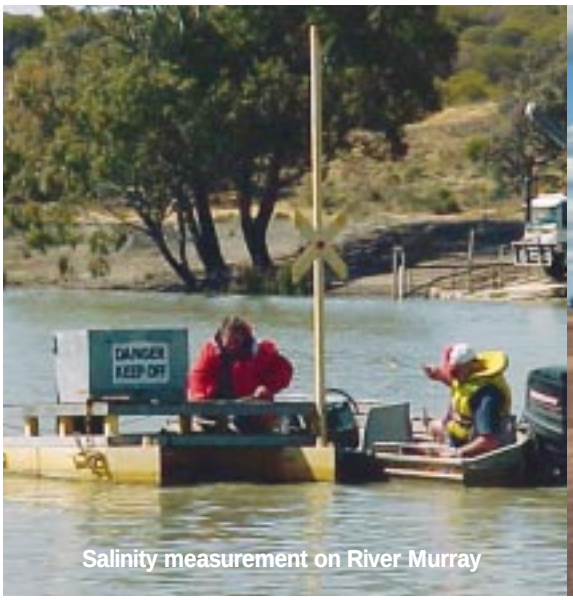
Major issues and lessons for the future of the Strategy that can be drawn from the construction of drainage schemes are:

- Analysis of monitoring data for some drains with long-term data availability shows trends towards increased salinity and salt load. The reasons of these increases need further investigation.

Table 4: Extent of Waterlogging and Salinisation Problems for Various Plans

Plan	Area covered (hectares)	Areas with water tables within 2 m		Major agricultural activity
		At the time of plan development	In 30–50 years if no plan had been developed	
New South Wales				
Berriquin LWMP	320,000	90,000	200,000	Rice, dairy and wool
Denimein LWMP	59,000	1,100	11,800	Rice, wool, vegetables & winter cereals
Cadell LWMP	322,000	11,900	77,000	Rice, wheat, oats, barley, dryland and irrigated grazing and vegetables
Wakool LWMP	250,000	24,000	42,200	Rice, wool, meat, cereals and dairy
Colleambally LWMP	79,000	30,000	60,000	
Victoria				
Shepparton SMP	500,000	188,000	277,000	Pasture and dairy
Boort West of Loddon SMP	89,000	20,000	89,000	Tomatoes and lucerne
Campaspe West SMP	5,700	3,400	3,400	Dairy
Tragowel Plains SMP	120,000	120,000	120,000	Meat and dairy
Torrumbarry East of Loddon (includes Barr Creek SMP)	130,000	107,900	123,500	Dairy and meat
Nyah to Border SMP*	17,000	Not applicable	Not applicable	Vines and citrus
Kerang Lakes SMP	110,500	45,000	45,000	Dairy, horticulture, dryland grazing and cropping
Sunraysia SMP*	17,400	Not applicable	Not applicable	Horticulture
Nangiloc Colignan SMP	39,000	2,208	Not available	Citrus, vines and vegetables
South Australia				
Qualco–Sunlands LWMP	2,500	200	940	Citrus and vines
Total	1,964,200	601,628	992,340	

* New/existing development. A major issue is management of accession of salt loads to the River Murray.



Salinity measurement on River Murray


Laser Grading

Table 5: Salinity Credits Allocated to Various Plans and Uptake to Date

Plan	Salinity impact/credits allocated (EC)
New South Wales	
Berriquin LWMP	5 EC allocated to the four Plans
Denimein LWMP	
Cadell LWMP	
Wakool LWMP	
Colleambally LWMP	0.7 proposed
Victoria	
Shepparton SMP	3.40
Boort West of Loddon SMP	0.11
Campaspe West SMP	0.50
Tragowel Plains SMP	1.50
Barr Creek SMP	-3.32
Nyah to Border SMP	1.40
Kerang Lakes SMP	0.91
Koondrook Murrabit drains	0.10
Nangiloc Colignan SMP	0.50
South Australia	
Qualco–Sunlands LWMP	To be assessed

Re-use schemes reduce drainage flows with consequent salinity benefits for the River Murray

Table 6: Water Management Changes Undertaken since Adoption of the Strategy

Water management action	Salinity impact (EC)
Enlargement of Pindari Dam on the Severn River in NSW	1.56
Construction of Boggabilla Weir on the Macintyre River in New South Wales	0.15
Issue of D Class licences in Barwon–Darling system	0.80

- A gradual increase in salt discharge has occurred from drains constructed prior to 1988. Although they affect the salinity outcome at Morgan, these increases are not accountable under the Strategy.
- The construction of drainage re-use systems and associated better on-farm management practices are reducing salt as well as nutrient and chemical exports from farms.
- The question of wether irrigation areas are accumulating salt or mobilising excess salt needs consideration.
- For the success of land, water and salinity management plans, there should be active community involvement in the development, implementation and cost sharing.

NEW IRRIGATION DEVELOPMENTS

The introduction of transferable water entitlements has led to redistribution of allocated water with some new irrigation development in most of the States. Some of the new developments may lead to increase in saline ground water or drainage flows to the River Murray. In the past trades were only carried out within State jurisdictions and each State is accountable for salinty implications. Recently, the Murray–Darling Basin Ministerial Council initiated interstate water trading on a trial basis in the predominantly horticultural Mallee border regions of New South Wales, Victoria and South Australia between Euston and Mannum. This trial was initiated so that a water trading system across State borders could be developed to enable water being used for low value returns to be traded to properties where it could generate greater economic and environmental benefits.

Victoria (Nyah to the South Australian Border)

This new irrigation development is being managed to minimise the impact on river salinity. The area has been categorised into two zones: a high river salinity impact zone and a low river salinity impact zone. These zones are based on an assessment of whether each megalitre of irrigation water applied would lead to mobilisation of more or less than 1 tonne of salt to the river. The plan includes constraints on water transfers and rules for new development in high and low impact zones to manage the river salinity impacts.

This Plan has been assigned 1.40 EC salinity credits by the Victorian Government. The estimated uptake of salinity credits to date is 1.24 EC.

South Australian Developments

All River Murray water transfers in South Australia are subject to a minimum requirement of preparing and adopting an Irrigation and Drainage Management Plan. Larger developments are also required to enter into an agreement to quantify and mitigate the salt load induced by the new development. It is estimated that new irrigation development of the order of 8,000 hectares has occurred since adoption of the Strategy. The South Australian Government is currently reviewing the salinity impacts of these developments to assess compliance with Strategy objectives.

WATER MANAGEMENT

The water management decisions accountable under the Strategy are those undertaken since 1 January 1988. Their salinity impacts are summarised in Table 6. The decisions to enlarge Pindari Dam, the construction of Boggabilla Weir and

issue of new 'D Class' licences in the Barwon–Darling system have led to reduced flows in the River Murray with consequent salinity impact at Morgan.

TEMPORARY SCHEMES

The salinity impacts of one-off or short-term discharge of saline water into the River Murray system are also assessed and included in the Register as temporary schemes. Before such a discharge is made, however, the concerned State Government must allocate the required salinity credits. Currently there are no temporary schemes on the Register but in the past, discharges by Australian Paper Mills, opportunistic discharge from Wakool evaporation basin and the Boomanoomana drainage discharge were assessed for salinity impacts and included as temporary schemes. These schemes have been removed from the Register since the discharges no longer occur.

EC credits available to New South Wales & Victoria

At the time of formulation of the Strategy, it was agreed that New South Wales and Victoria would each be allocated 15/80th of the salinity benefits from the jointly-funded schemes as salinity credits. These credits can be used by the States to offset the salinity costs due to drainage or development works. The EC credits available to New South Wales and Victoria in September 1999 are 2.46 and 6.66 EC, respectively. The credits allocated to the States and their uptake to September 1999 are summarised in Table 7.

Table 7: Summary of EC Credits Available to New South Wales and Victoria, September 1999.

EC Credits/Debits due to	NSW	Victoria
Joint works to date	12.40	12.40
Salinity mitigation schemes undertaken by State	0	4.96
Uptake for drainage or development	-8.98	-9.75
Balance credits available (September 1999)	2.46	6.66

Other Policy Initiatives

Since adoption of the Strategy in 1989, other policy initiatives with supplementary beneficial salinity impacts have been undertaken in the Murray–Darling Basin by State Agencies, the Commonwealth and the Commission. These include:

- The Murray–Darling Basin Ministerial Council's Cap on water diversions at the 1993–94 level of development in the Basin. This has restrained further growth in diversions from the river and has prevented a decrease in river flows and any further increases in river salinity.
- Environmental flow release policies have been adopted by the upstream States and, in some cases, explicit allocations for wetland management have been adopted. For example, the New South Wales Government has made water allocations for the Macquarie Marshes and Gwydir Wetlands and, in conjunction with Victoria, for the Barmah Millewa Forest.

Water allocations for environmental flow can improve river salinity

- Complex interactions due to the impacts of water reform, national competition policies, the general acceptance of the philosophy of ecologically sustainable development and greater availability and awareness of information on water quality and salinity are leading to significant behavioural changes that have a beneficial spin-off in terms of salinity management.
- Projects undertaken under Natural Heritage Trust programs such as Landcare, Bushcare, Murray–Darling 2001 and Farm Forestry will have positive outcomes in the long term for groundwater recharge reduction and salinity control in the Basin.
- Interstate water trading will enable water to be traded away from activities with low economic returns and/or degradation consequences to properties where it can generate greater economic and environmental benefits.

Evaluating the past and planning for the future

With a ten-year history of implementation, now is an opportune time to assess the achievements of the Salinity and Drainage Strategy and to consider the lessons that it offers for the development of a new Basin Salinity Management Strategy.

The Salinity and Drainage Strategy has provided State and regional communities a framework for joint action by the Basin States to manage river salinity. As a direct result of the Strategy, there has been an improvement in river salinity. Importantly, this has been achieved alongside continued agricultural and regional development and the rehabilitation of degraded lands in the Basin.

This has been accomplished, in part, because the Strategy does not dwell on past actions, but is forward-looking, with a well defined goal and action plan for the future. The success of the Strategy is also due to the fact that it is simple to understand and implement and sets out a logical and scientific approach to decision making.

As a result of the Strategy, there is now an improved understanding of the hydrogeological processes resulting in increases in river salinity and a better appreciation of the sustainability of irrigated areas in terms of salinity. There is also a greater willingness to undertake joint actions to address natural resource management challenges. Perhaps the most impressive aspect of the Strategy's implementation has been the increased awareness that it has generated of downstream salinity impacts due to actions upstream. There are clear signs that this has led to behavioural changes among water users in the Basin.

While the work of the Strategy has been path breaking, it may now be time to broaden the scope of our approach. The focus of the Strategy on salinity ignores other important environmental and social benefits or dis-benefits to the river system of a proposed action. The emphasis on salinity (EC) also ignores the variability in ionic composition of saline water from various sources. All ions contribute to the EC measurements, but some ions have less impact on water users.

Although the accountability mechanisms and cost-sharing arrangements for actions that result in increased or decreased river salinity are part of the Strategy and enshrined in legislation, the Strategy also relies on self-assessment and reporting by States. The changes in the water industry over the years have reduced the resources available for monitoring, reporting and analysis.

This is a threat to the Strategy since its implementation and accountability are data-hungry and the scientific modelling tools used for assessment need to be updated. The management of the works and measures on the Strategy Register could be improved if there was better feedback to the operators and managers on scheme performance. However, monitoring for compliance with salinity credits and debits on an annual basis is difficult due to variations in climate and the accuracy of measuring equipment.

Efficient salt harvesting may present sustainable management options for inland evaporation basins

New Opportunities

Research and development efforts have begun to show encouraging results for economically viable salt harvesting operations, saline water aquaculture and harvesting of precious metals such as magnesium. Industrial organisations involved in the manufacture and use of hot water systems, cooling systems, pipe materials and soap and detergents have made technological advances to minimise the impact of salinity. This was evident in a recent study assessing the cost of salinity to River Murray water users (GHD, 1999).

Agricultural management has responded to the challenge of rising salinity by adopting a range of measures to improve on-farm irrigation and drainage management practices, including conversions from overhead sprinkler irrigation to under-canopy irrigation methods, irrigation scheduling and the establishment of automated water supply systems. Channel seepage control measures and construction of shallow community drains have minimised seepage to groundwater. There has also been increased use of salt-tolerant root stocks for citrus and grapevines along with a greater preparedness to change crop, enterprise and production systems in response to market signals and information about resource conditions, including salinity.

Future Outlook

A decade of implementation of the Salinity and Drainage Strategy has shown that, with a cooperative and coordinated approach between the Basin States and the Commonwealth, River Murray water quality has been improved and sustainable agricultural practices and rehabilitation of salinity-affected land have been adopted. However, if no additional salinity management measures are undertaken, the gains in river water quality made under the Strategy could soon be overwhelmed by large increases in salinity contributions from the dryland areas and from drainage systems built prior to the Strategy.

For vibrant and flourishing regional economies and communities, a harmonious balance between sustainable land uses and a healthy river system is a must. To ensure the long-term future of agricultural activities, regional communities and the health of the river, a new Basin Salinity Management Strategy encompassing dryland as well as irrigated areas and with a balance between social, environmental, ecological and economical considerations is needed. The experience gained from a decade of the Strategy provides us with confidence that aspirations for such a goal are realistic and achievable.

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The Strategy has led to improvement in River Murray salinity with consequent economic benefits for irrigated agriculture

Further Information