A Review of Salinity Management Planning in Victoria

by

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1. Introduction

Salinity is often claimed to be Victoria's greatest environmental challenge. To meet this challenge, the Victorian Government is committed to a salinity management program, initiated in 1985. Under this program, 18 sub-regional plans are being prepared to address salinity throughout the State. This planning process is scheduled for completion at the end of the 1991/92 financial year. It is therefore, opportune to review the salinity management program in Victoria and to identify the key economic issues that the program will face in the future. The review is presented as follows.

Section 2 briefly traces the development of the salinity problem in Victoria and its relationship to past closer settlement and agricultural development policies. The history of attempts to overcome salinity and their culmination in the Mineral Reserves basin proposal are briefly discussed.

In section 3 we outline the basic philosophy behind the new approach to salinity management through community involvement. The basic premise is that the local conflicts which have dogged past attempts at salinity control will be resolved by the involvement of all community interest groups throughout the planning and implementation stages.

Section 4 presents an analysis of resource allocation in the salinity program over the period 1984/85 to 1991/92. This allocation was primarily of a centralised nature in the earlier years, although a process began to develop towards the end of the 1980's.

In sections 5 and 6 we argue that while community planning was a useful strategy as a means of resolving inter catchment resource allocation issues, there is a need for greater efficiency in resource allocation in future years. We outline a methodology developed to assist in this process.

The final section present an overview of some of the major challenges that confront Victoria's salinity program as it takes its next logical step towards an implementation phase.

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2. The development of induced salinity on Victorian farmland

2.1 The closer settlement legacy

For 90 years between 1870 and 1960 the State of Victoria implemented a series of 'closer settlement' policies for rural lands (Powell 1970, Lake 1987). Many closer settlement schemes were based upon the subdivision of large estates to create smaller selection properties. Others were based upon the development of unsettled land.

The first closer settlement schemes, the Selection Acts of 1870's, faltered from both economic and environmental shortcomings. Selection properties were generally too small to be financially viable (Powell 1973). In the north of the State this was compounded by the inability of the prevailing small farm systems to cope with dry summers and periodic drought. The government supported future closer settlement schemes and soldier settlement with public investment in irrigation works (Powell 1989).

Irrigation development for closer settlement has resulted in a more closely settled countryside, but history has also revealed the economic and environmental shortcomings of this policy. Government expectations that irrigation settlers would be capable of repaying the full cost of irrigation development were illusory. Unlike contemporary Californian irrigation development which inspired the Victorian 'irrigationists', Victorian irrigation farmers were half a world from major markets and could not rely upon summer river flows generated by a melting snow pack. This distance from markets meant farmers could grow only low value unperishable products. The limited summer river flows necessitated far greater per capita investment in major headwork (Powell 1989). For 70 years successive governments accepted an historic compromise that irrigation farmers paid only the operating and maintenance costs of public irrigation systems. It was not until the 1980's that this agreement between irrigation farmers and government was seriously questioned.

The major environmental failing of the irrigation schemes was rising water tables and subsequent soil salting. In some districts salting appeared soon after the arrival of irrigation water. Although worst in irrigation districts, soil salting was also to become a problem in some dryland farming areas. The destruction of native pastures and trees led to increased recharge of water tables and in some districts the eventual spread of dryland soil salting (Macumber and Fitzpatrick 1987).

2.2 Development of salinity control measures

Until the 1970's the Victorian Government treated outbreaks of salt on irrigated land on an *ad hoc* basis, generally through the construction of drainage schemes. The Victorian Government bore the capital costs of these schemes. By the 1960's there was a realisation by policy makers that rising water tables and declining water quality in the Murray River were a major catchment wide problem and lasting solutions could only be developed on a catchment wide basis. This realisation led eventually to the Murray Darling Basin Ministerial Council agreeing to the 'Draft Murray Darling Salinity and Drainage Strategy' (1987). This was essentially an agreement between the States and the Federal Government for joint funding of salt interception schemes to reduce River Murray salinity at Morgan.

More was needed than just agreement between governments for such a catchment wide strategy to be successful. In Victoria one major scheme was planned to create a series of evaporation basins in the lower Loddon catchment as a trade off for the export of salt from the upstream Goulburn catchment. The scheme imposed costs on one community to achieve benefits for another community. The scheme was partially implemented in the 1960's. Attempts to implement further works came to a halt in the 1980's as the State's major rural water instrumentality became bogged down in a class action suit by local land holders. The source of the grievance was a plan to build an evaporation basin in the land holders' district. The litigants feared a leaking evaporation basin would salt neighbouring land. These fears were further exacerbated by a planning approach which allowed little role for local land holders in the development of the project.

The controversy over the 'Mineral Reserves' evaporation basin was the catalyst for a reappraisal of planning methods used to develop salinity control projects. The rural water sector in Victoria adopted a new style of planning which relied upon community involvement in project design and implementation.

3. The new model of community planning

3.1 Community Working Groups

The key to the new planning model was direct community participation in the development of catchment plans to combat salinity. Community participation in the Victorian Salinity program was based around the work of community based regional or catchment working groups. In various sub regions of the Murray catchment small **'Community Working Groups'** (CWG) of community representatives were brought together to develop salinity management plans. Salinity control sub regions were to be

> 'areas in which salinity problems have a common cause, effect or downstream consequence and within which planned salinity control measures are likely to be effective'(Salt Action:Joint Action 1988).

This flexibility resulted in a great diversity in the size and nature of communities working in the program. There was less diversity in the membership of groups. Membership was often dominated by farmers, but often also included representatives of broader interests: local Shires, local environmentalists, urban water users and representatives of government departments.

The task of these groups was to develop a **'Salinity Management Plan'** for presentation to government. This plan was expected to have the support of the catchment community. It was obviously unrealistic to expect the CWG to achieve this unaided. The Government provided support to the groups through **'Technical Support Groups'** (TSG) composed of government scientists, planners and policy advisers. In theory this group has no power to make decisions about the content of salinity plans, merely to advise the CWG. Again, there were no definitive guidelines on membership of these groups. Membership was predominantly drawn from four government departments and instrumentalities: the Department of Water Resources, Department of Food and Agriculture and the Department of Conservation and Environment. The major skills represented were water engineers, agricultural scientists, hydrogeologists, environmental scientists and economists.

3.2 The salinity planning guidelines

The Government's invitation for the community to be involved in salinity planning was not an invitation without constraints. In 1988 the Government released planning guidelines for the working groups (Govt. of Victoria 1988a). These guidelines set out a format for salinity plans to follow. The guidelines required plans to evaluate proposals from economic, environmental and social perspective.

Two of the most crucial aspects of the guidelines were those relating to **'cost sharing'** and **'community support'**. Government expected salinity plans would be an outcome of local and regional communities taking responsibility for their problems and would have community support. The cost sharing guidelines were based upon the **'beneficiary pays'** principle, and to a lesser extent the **'polluter pays'** principle (Govt. of Victoria 1988b).

> 'While the State has an important role to play in providing resource for salinity control, regional an local communities must be prepared to help themselves.'
>
> Contributions by communities at local and regional levels should reflect both, the extent to which these communities derive benefit from salinity control and the relative inputs of local farming, water management and disposal systems to the worsening of the salinity problem' (Govt. of Victoria 1988c).

Those who were to benefit from the salinity control work would pay the cost of the necessary investments. This was a major departure from the old precedent of farmers paying the operation and maintenance and government paying capital costs of irrigation infrastructure investment. The interaction between these two major guidelines was to prove a crucial feature of the new participative planning process.

Community Working Groups were given deadlines within which to present their plans to the Government. On presentation the plans would be assessed by government according to whether the plan was compatible with guidelines, wider public comment and compatibility with the salt disposal guidelines of the Murray Darling Ministerial Council's Salinity and Drainage Strategy. The Government would then respond bearing these and other matters in mind.

The new rules for cost sharing were balanced against a new commitment to community involvement in planning for salinity control. This latter commitment was promoted under the title 'Salt Action: Joint Action'. *Salt Action: Joint Action* was written on the basic assumption that community participation in salinity management is essential to achieving a successful solution to the problem. The strategy stated that:

> 'The success of the program... will depend as much on community participation as on government resources: communities living in salt affected areas must be responsible for managing the problem and resolving issues at the regional level.'

There was also hope that community involvement would stimulate community 'ownership' of salinity problems and lead to increased adoption of farming methods which prevented further increases in salinity:

> 'The sub-regional planning process will bring different groups together, promote a better understanding of the problem and encourage effective co-ordination of action by groups across the sub-region. Community initiation of, and commitment to, sub regional planning will be essential if actions of local groups are to be lasting and 'effective' (Govt. of Victoria 1988c).

4. Resource allocation in the Victorian salinity program

4.1 Community Planning and inter-catchment competition

Salt Action: Joint Action was based on local ownership of problems and local involvement in developing management strategies. Government and planners hoped the new process would lead to better planning and implementation of salinity projects. The community now had responsibility for difficult local decisions. No unwanted solutions would be imposed upon the community.

What was less clear was how the new community planning process would resolve resource allocation issues between competing catchments. While the economic component of the guidelines clearly stated that consistent economic evaluation was required of all proposed salinity plans, government commitment to take account of social and environmental issues in resource allocation decisions introduced a degree of uncertainty into the process. Early in the life of the program, with rising budget allocations, there was minimal competition for resources between catchment groups. If anything, the groups were under pressure to complete plans to enable government to meet funding commitments to the program. Those heady days are long gone.

4.2 The salinity budget

The Victorian salinity budget is comprised of two funding elements: a State salinity budget and Commonwealth funding. Since the first co-ordinated salinity budget was prepared in 1984/85, a total of $ 177 million (1991/92 $) have been expended on the salinity program (Table 1). Sixteen percent of this budget has comprised of Commonwealth funds. However, there is an important third element in this budget; the inputs of the local community, much of which is not accounted in dollar terms. Figure 1 illustrates the total salinity funding over the period 1984/85 to 1991/92.

Table 1 Total (State and Commonwealth) salinity funding, 1984/85 to 1991/92 (in 1991/92 million $)

Source	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	Total
State	13.52	14.16	14.87	17.50	23.20	21.15	22.20	21.63	148.23
Comm	3.34	3.36	4.15	3.63	2.66	2.48	4.01	5.33	28.96
Total	16.86	17.52	19.02	21.13	25.86	23.63	26.21	26.96	177.19

4.3 The Un-completed Plans

It is clear from the table that the salinity budget has matured and is no longer in a growth phase. However, the salinity planning process is not yet completed. In the '*Salt Action: Joint Action*' statement the Government committed itself to develop 18 sub-regional salinity plans for all major catchments in the state. Seven sub-regional plans have been prepared to date, with the balance scheduled for completion in 1992. Four plans began implementation in 1990/91.

In the early phase of the salinity program the budgetary process was of a centralised nature, without any clear ground rules or basis for budget allocations. With regionalisation of the salinity program in 1987, the process of preparing a co-ordinated salinity budget began. This was done by requesting relevant agencies in each region to submit budget bids for regional and sub-regional projects. The priorities for sub-regional projects were determined by the sub-regional plan CWG, whilst regional priorities were identified by the relevant Government agencies. In 1990 Regional Salinity Forums were established. The role of these forums was to co-ordinate all the sub-regional and regional bids and to endorse them for Government funding. The Salinity Planning Working Group (SPWG) considers all the regional bids and makes recommendations to Government for funding.

Table 2 shows the budget allocations for each salinity region from 1987/88 to 1991/92[4] and appendix table 1 details the allocations by sub-regions.

The figures show that the Shepparton irrigation region has continued to attract the most funds over the years, its allocation increasing from 19% in 1988 to 32% in 1992. Next to Shepparton, the Loddon Avoca irrigation region has been the other main benefactor, with nearly 20% of the allocated budget. The five irrigation salinity management plans prepared in these two regions have commanded half of the total Victorian salinity budget over the years (appendix table 1), reflecting the magnitude of the salinity problem in these areas.

[4] A breakdown of budgetary expenditure on a regional/sub-regional basis is not available prior to 1987/88.

Table 2 - Total (State and Federal) Salinity Budget Allocation by Salinity Regions - 1988 to 1992 (in 1992 '000 $)

Region	87/88	%	88/89	%	89/90	%	90/91	%	91/92	%	Total	%
NORTH EAST	62.5	0.3	127.1	0.5	123.7	0.5	138.5	0.5	114.6	0.4	566.4	0.5
GOULBURN-BROKEN	4,856.4	23.0	7,814.7	30.2	7,552.8	32.0	9,267.5	35.1	10,322.2	38.1	39,813.6	32.1
Shepparton irrigation	3,978.3	18.9	6,636.7	25.7	6,265.8	26.5	7,416.7	28.1	8,555.4	31.5	32,852.9	26.5
Goulburn dryland	878.1	4.2	1,178.0	4.6	1,286.9	5.4	1,850.8	7.0	1,766.8	6.5	6,960.6	5.6
CAMPASPE	508.4	2.4	736.6	2.8	1,040.4	4.4	1,217.0	4.6	830.1	3.1	4,332.5	3.6
Campaspe west irrigation	74.6	0.4	242.9	0.9	540.8	2.3	693.6	2.6	477.6	1.8	2,029.5	1.7
Campaspe dryland	433.8	2.1	493.7	1.9	499.6	2.1	523.4	2.0	352.5	1.3	2,303.0	1.9
LODDON AVOCA	3,537.5	16.8	4,806.0	18.6	4,673.7	19.8	5,143.6	19.5	6,296.0	23.2	24,456.8	19.7
All irrigation	3,278.8	15.5	4,367.3	16.9	3,987.7	16.9	4,370.9	16.5	5,277.7	19.5	21,282.4	17.1
All dryland	258.8	1.2	438.7	1.7	686.0	2.9	772.7	2.9	1,018.3	3.8	3,174.5	2.6
MALLEE	1,325.6	6.3	1,522.4	5.9	1,408.5	6.0	1,385.2	5.2	1,613.1	5.9	7,254.8	5.8
All irrigation	208.1	1.0	666.9	2.6	711.9	3.0	939.0	3.6	1,228.3	4.5	3,754.2	3.0
Mallee dryland	1,117.5	5.3	855.5	3.3	696.6	2.9	446.1	1.7	384.8	1.4	3,500.5	2.8
WIMMERA#	195.6	0.9	446.9	1.7	508.1	2.2	698.5	2.6	1,005.0	3.7	2,854.1	2.3
GLENELG#	505.5	2.4	568.6	2.2	735.4	3.1	678.0	2.6	609.3	2.2	3,096.8	2.5
CORANGAMITE#	490.0	2.3	660.5	2.6	754.8	3.2	847.4	3.2	662.5	2.4	3,415.2	2.8
SOUTH EAST	100.0	0.5	187.1	0.7	293.3	1.2	445.7	1.7	495.6	1.8	1,521.7	1.3
Lake Wellington	51.3	0.2	163.7	0.6	127.0	0.5	228.8	0.9	367.5	1.4	938.3	0.8
South East other	48.8	0.2	23.4	0.1	166.3	0.7	217.0	0.8	128.1	0.5	583.6	0.5
RIVERINE PLAINS*	1,357.5	6.4	1,017.9	3.9	157.1	0.7	159.1	0.6	48.0	0.2	2,739.6	2.2
MURRAY DARLING BASIN	273.3	1.3	2,108.3	8.2	2,184.1	9.2	2,301.0	8.7	2,116.0	7.8	8,980.7	7.2
STATE WIDE	4,285.6	20.3	5,841.5	22.6	4,198.3	17.8	4,145.2	15.7	3,015.0	11.1	21,485.6	17.3
GRAND TOTAL	21,104.6	100.0	25,847.6	100.0	23,630.2	100.0	26,426.7	100.0	27,127.4	100.0	124,136.5	100.0

all sub-regional plans within these regions are dryland plans

* this expenditure is spread across four regions: North East, Goulburn-Broken, Campaspe and Loddon-Avoca

With the completion of the irrigation sub-regional plans in recent years, emphasis has shifted towards the preparation of sub-regional plans in the dryland catchments. This is reflected in the increased funding for the sub-regional plans in the Loddon-Avoca, Wimmera, Glenelg and Corangamite regions. The proportionate levels of funding for the sub-regional plans in dryland catchments are however, much lower than for the irrigation sub-regions.

On a State wide basis, funding for salinity activities have shown a decline from 25% in 1988 to 11% in 1992. This reflects the shift in focus towards individual sub-regional plans since 1987. This change in focus has necessitated targeting expenditure accordingly, with a move away from State wide salinity projects.

The community planning process is designed to resolve resource allocation issues within catchments, but it was not clear how it would resolve the inter catchment allocation of resources. Salinity plans have been completed first in those areas where local community concern about salinity was highest, predominantly irrigation areas in the north of the State. In other the dryland catchments the planning process was initially driven by a lower level of community pressure, but the planning process has fed expectations (Wilkinson and Barr 1992). As these dryland plans come to fruition, they will compete directly with existing plans for funds from the static salinity budget.

4.4 Cost sharing

Unlike the early days of the salinity program, community groups may soon begin to perceive themselves as bidding against each other for limited government funding. There are several strategies which a group may conceivably follow. All basically resolve around the claimed division of costs between government and the community. One strategy may be to minimise the extent of claims from government to ensure that the case presented by the group is seen as both reasonable and justifiable. It could be argued that this trend can be seen in the development of dryland salinity plans. The first dryland plan, for the Goulburn-Broken catchment, requested an 85 per cent incentive for tree planting on recharge areas, as well as an incentive for pasture establishment. The Avon-Richardson plan will soon be finalised. It appears that it will request little support for tree planting on recharge areas, concentrating instead extension and limited incentive support for pasture improvement on recharge areas. It will be easier to justify this strategy as both a better investment for the state and as a more appropriate 'cost sharing' in the current economic climate.

Another strategy, particularly for groups arguing for continued support for existing plans, is to demonstrate a significant community financial and 'in kind' investment in salinity control. This strategy shows that the government is not being asked to bear the cost alone and that there is a constituency vitally interested in the extent of the government's commitment to salinity control. Community groups developing salinity plans are put in a difficult position when they are asked to make a 'cost sharing' proposal to government. They are essentially making promises on behalf of the majority of their constituency who are uninvolved in the details of salinity planning. It seems their guesses have not been found wanting.

Some community groups have presented some very impressive figures to demonstrate the strength of their constituency's commitment to salinity control. The Tragowel Plains community has documented the community expenditure on salinity during 1990/91 as $2,518,200. The government commitment for the same period was $1,792,000 (Tragowel Plains Salinity Implementation Plan Management Group, 1991). The Shepparton Program Advisory Council estimates that in the same period the farmers of the Shepparton community expended $26 million on salinity control, compared with $9 million by government (Farmanco and Cary, 1991).

These levels of expenditure are clearly impressive and credible. What is less clear is the extent to which these expenditures can be truly ascribed to salinity control. For example, laser grading is claimed as a salinity control expenditure in Shepparton, but it is well documented that the main motivation for laser grading is labour efficiency (Ewers 1988; Barr and Cary 1992). Salinity control is claimed as an incidental benefit of laser. The same claims for incidental salinity benefits can be seen in productivity and aesthetic motivated tree planting (Barr, Wilkinson and Cary 1992).

4.5 Resource re-allocation

This expected competition will be partially resolved by re-allocation of expenditure away from investigation and planning to implementation. All salinity projects are categorised into 10 major groups and the level of expenditure over the years is illustrated in table 3. Investigation projects have attracted most of the funding, particularly in the early years. This reflects the emphasis that was placed during the planning phase for the need to generate information for the preparation of sub-regional plans. Ground water studies and agronomic research have been the primary focus of the investigation budget. With the completion of the irrigation salinity sub-regional plans, the allocations towards ground water research has declined accordingly.

By the end of the 1992 financial year all salinity management plans will be completed and the focus will shift towards an implementation phase. The decline in the Regional Planning budget reflects this change. However, it is doubtful that this redirection will resolve the competition between catchments.

In an attempt to provide some guidance on this mater, a working document has been prepared for the SPWG outlining an approach to estimate the economic impact of salinity. The interim results of this work are outlined below.

5. The Economic impacts of salinity

Salinity results in significant economic, environmental and social impacts. In addition it creates externalities by discharging saline effluent into water bodies imposing severe costs on downstream users. Determining the above impacts in dollar values is not easy in a non-point source of pollution such as salinity. Furthermore, the sub-regional plans use different methodologies to estimate the economic impact of salinity, making comparison across plans difficult. In the methodology outlined below the economic impact of salinity is estimated based on current and future production losses.

Table 3 - Total (State and Commonwealth) salinity budget allocation by project categories 1988 to 1992 (in 1992 dollars)

Project category	87/88	%	88/89	%	89/90	%	90/91	%	91/92	%	Total	%
Murray Darling Basin	283.8	1.3	2178.5	8.4	3359.9	12.2	2301.1	8.4	2116.0	7.8	10239.3	7.9
Environ Protection and Improvement	131.3	0.6	709.7	2.7	1085.5	3.9	1177.1	4.3	1118.2	4.1	4221.8	3.3
Public Works	2155.0	10.2	3035.0	11.7	3655.0	13.2	3358.9	12.3	3747.0	13.9	15950.9	12.4
Community Education	627.8	3.0	771.1	3.0	1012.1	3.7	1086.2	4.0	1066.2	3.9	4563.4	3.5
Farm Advisory Services/Demons	2771.3	13.1	3104.5	12.0	3522.3	12.8	4173.8	15.3	4580.8	16.9	18152.7	14.1
On-farm and Community Assistance	3660.0	17.4	4205.4	16.2	4428.5	16.0	4869.3	17.9	4447.2	16.5	21610.4	16.8
Program support	621.4	2.9	642.3	2.5	689.8	2.5	1427.7	5.2	1158.6	4.3	4539.8	3.5
Regional Planning and Co-ordination	2708.5	12.8	3076.6	11.9	2968.1	10.8	2688.0	9.9	2857.0	10.6	14298.2	11.1
Investigations	8132.0	38.6	8232.5	31.7	6883.6	24.9	6185.3	22.7	5553.9	20.6	34987.3	27.1
Agronomic/re-vegetation	1849.9	8.8	3267.6	12.6	3180.5	11.5	2867.3	10.5	3596.1	13.3	14761.4	11.4
Drainage/saline waste disposal	449.4	2.1	1233.8	4.8	670.9	2.4	628.3	2.3	870.3	3.2	3852.7	3.0
Groundwater	3895.3	18.5	3731.1	14.4	2859.4	10.4	2484.5	9.1	2070.3	7.7	15040.6	11.7
Improved water use					172.8	0.6	102.0	0.4	112.5	0.4	387.3	0.3
Monitoring									138.6	0.5	138.6	0.1
Other									242.5	0.9	242.5	0.2
grand total	21091.1	100.0	25955.6	100.0	27604.8	100.0	27267.4	100.0	27026.0	100.0	128944.9	100.0

5.1 The areal extent of salinity

The first step in determining the economic impact of salinity is to estimate the total areal extent of salinity. There are two components in this estimation: the current extent and the future extent of salinity. These two components have been estimated for the salinity sub-regions using different methodologies ranging from ground water models (Shepparton), EM 38 surveys (Tragowel Plains, Kerang Lakes and Boort), ISCON surveys (Lake Wellington Catchment), other sources of mapping (GIS) and estimates of visual occurrence of salting in regions. Whilst the use of different methodologies may raise the issue of consistency and reliability of estimates, they are the best available at present. The occurrences of future salinity in the regions/sub-regions are estimated over a thirty year period. Table 4 presents the areal extent of salinity in Victoria (see appendix table 2 for sub-region details).

Table 4 Estimate of current and future salinity in Victoria by salinity regions/sub-regions (in '000 ha)

Region	Total agric land (1)	Current salinity (2)	% land affected[1] (3)	Future salinity[2] (4)	Total salinity[3] (5)
North East	402	0.2	0.05	n.e.	?
Goul-Broken	900	83.3	9.3	137.8	221.1
Shep'ton irr	460	81.0	17.6	115.0	196.0
Goul'n dryland	440	2.3	0.5	22.8	25.1
Campaspe	192	6.9	3.6	33.1	40.0
Campaspe irr	6	1.8	30.7	2.2	4.0
Campaspe dryland	186	5.1	2.7	30.9	36.0
Loddon/Avoca	1,077	193.1	17.9	75.7	268.8
Irrigation	458	185.5	40.5	2[illegible]	211.2
Dryland	619	7.6	1.2	50.0	57.6
Mallee	1,716	9.8	0.6	20.0	29.8
Irrigation	372	0.8	0.2	0.0	0.8
Dryland	1,344	9.0	0.7	20.0	20.9
Wimmera	1,677	55.0	3.3	75.5	130.5
Glenelg	1,521	20.0	1.3	n.e.	?
Corangamite	855	12.0	1.4	5.0	17.0
South East	843	21.5	2.6	32.1	53.6
Total		401.8	100.0	379.2	760.8
All irrigation		269.1	67.0	142.9	412.0
All dryland		132.7	33.0	236.3	348.8

1/ calculated across the row: i.e. (2)/(1) 2/ estimated over a 30 year period
3/ potential problem in 30 years if current trends continue with no intervention

The figures show that irrigation salinity currently accounts for 67% of all the salinity in Victoria, primarily in the Shepparton and Loddon Avoca regions. Furthermore, 80% of future incidences of irrigation salinity are also predicted to occur in the Shepparton region. However, of the total incidence of all future salinity, 62% is predicted to occur in dryland catchments, mainly in the Loddon-Avoca, Wimmera and the Mallee.

5.2 Estimation of production levels

The gross value of production (GVP) is used as a measure of land productivity. Estimates of GVP per hectare are derived for each shire within a salinity region using ABS Agricultural Census Statistics for the year 1988/89. Estimates of current and future salinity losses are then determined by multiplying the above per hectare values with the areal extent of salinity in each shire. Salinity losses are determined for each sub-region separately. These figures are then aggregated to arrive at the total extent of salinity loss in dollars for each region and are presented in appendix table 3.

5.3 Estimation of salinity losses

In estimating losses due to (the cost of) salinity, historical losses should be ignored as they are "sunk costs". However, in the case of current and future losses some degree of production loss can be recovered and or avoided, if appropriate steps are taken. Therefore, a more meaningful approach to estimate the economic cost of salinity is to determine the interaction between two main variables: firstly, the extent to which current productivity losses can be recovered (recoverable loss); and secondly, the extent of future losses that can be prevented (preventable loss) through the adoption of salinity control measures. In other words, an estimate of total avoidable losses (recoverable loss plus preventable loss).

In this paper the following definitions are used:

a) ***Current productivity loss*** is defined as the total annual loss in GVP due to current incidence of salinity.[5]

b) ***Future productivity loss*** is defined as the total annual loss in GVP that will occur in the future (30 years) if nothing is done to control salinity.

c) ***Recoverable loss*** is defined as the proportion of current productivity loss which can be recovered by salinity control measures.

d) ***Preventable loss*** (risk factor) is defined as the proportion of future productivity loss from the spread of salinity which can be prevented by salinity control measures.

e) ***Total avoidable loss*** is defined as the sum of recoverable loss and preventable loss).

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[5] Current productivity losses due to salinity can vary from yield depression to total loss depending on the severity of the problem. This definition assumes the latter; i.e. a worse case scenario.

Estimates of the proportion of current salinity losses that can be recovered (recoverable loss), as well future losses that can be avoided (preventable loss) have been made by a team of technical experts (Fitzpatrick et al 1991a). It is assumed that based on the current level of technical knowledge, the above estimates are the most realistic from an economic viewpoint.

With the above assumptions, estimates of total avoidable annual economic loss (recoverable loss plus preventable loss) are made for each of the salinity sub-regions in Victoria. These figures are expressed in present value terms using a 4% real discount rate. The results are shown in Table 5 (see appendix table 4 for sub-region details).

Table 5 Estimates of annual recoverable and preventable losses due to salinity ($ mill)

Region	Recoverable loss (2)	Preventable loss (4)	Total avoidable annual loss (2)+(4) (5)	Present value of avoidable loss[1] (6)	As a % of total loss (7)
North east	0.06	n.e.	0.06	0.5	0.03
Goul-Broken	49.8	71.5	121.3	918.5	50.5
Irrigation	47.7	67.7	115.4	873.5	48.1
Dry land	2.1	3.8	5.9	45.0	2.5
Campaspe	2.2	1.7	3.9	29.7	1.6
Irrigation	1.4	1.7	3.1	23.6	1.3
Dry land	0.8	n.e.	0.8	6.1	0.3
Lod-Avoca	32.8	26.1	58.9	446.0	24.5
Irrigation	30.2	10.6	40.8	308.9	17.0
Dry land	2.6	15.5	18.1	137.1	7.5
Mallee	1.7	5.3	7.0	52.7	2.9
Irrigation	1.2	3.7	4.8	36.3	2.0
Dry land	0.5	1.7	2.2	16.5	0.9
Wimmera	4.2	7.0	11.2	84.7	4.7
Corangamite	9.3	1.2	10.5	79.5	4.4
Glenelg	6.0	n.e.	6.0	45.2	2.5
South East	8.1	13.1	21.2	160.3	8.8
All regions	114.1	125.6	239.7	1,817.1	100.0
Irrigation	86.5	88.1	174.6	1,321.0	72.7
Dryland	27.6	37.5	65.1	496.0	27.3

The present value of total avoidable losses are around $1.8 billion. Seventy three percent ($1.32 billion) of this loss is due to irrigation salinity and 27% ($0.5 billion) as a result of dryland salinity. The losses due to irrigation salinity are mainly in the Shepparton and Loddon Avoca regions, which together account for 65% of all salinity losses. Most of the dryland salinity losses occur in the Loddon-Avoca, Wimmera and Corangamite regions. This estimate excludes the cost imposed by salinity on environmental and social values as well as externalities.

6. Future resource allocation for salinity management in Victoria

It is important that scarce Government and land holder resources are allocated to projects and areas which will generate the greatest benefit from an economic, social and environmental perspective. This assumes greater importance in view of the fact that it is unlikely to be any increases in real terms to the salinity budget in future years. Furthermore, with the salinity program moving fully into an implementation phase, there will be greater competition for the limited resources available.

For efficient resource allocation across salinity sub-regions from an economic aspect, a 'priority' score can be developed using a rating scale. The benefits of salinity control are estimated based on [illegible] value of total avoidable losses as described above. The highest avoidable loss (benefit) is given a value of 10 and the benefits from each sub-regional plans are scaled accordingly. Table 6 shows the ratings given to the salinity sub-regions.

Productivity losses are a primary concern both from an individual farmer and the society's point of view. In addition, in most cases any investment to control and manage on-site salinity will have an impact in improving the environmental features such as wetlands and also contribute to reduce off-farm impacts. Where on-site salinity control has off-site effects; for e.g. disposal of ground water pumping to River Murray; these measures are controlled as part of the Murray Darling Basin Salinity and Drainage Strategy, which has taken into account net economic and environmental costs (benefits).

Figures in table 6 indicate that based on potential avoidable losses, the Shepparton sub-region has the highest rating. The Loddon-Avoca irrigation sub-regions rates second, although it's standing is nearly three times lesser than that of the Shepparton sub-region. The rest of the sub-regions rate very low on this scale. Although the above ratings are primarily based on the benefits derived from agriculture, given the distribution of high value wetlands in the salinity regions of Northern Victoria, Corangamite and the South East, it would be reasonable to expect that environmental considerations would tend to reinforce the priority ranking derived on economic grounds. In general terms it can also be expected that social impacts will tend to mirror trends in economic losses in the regions.

The last column in this table shows the rating of the sub-regions based on budget allocations made over the period 1988 to 1992. Comparing the two scales, it is clear that irrigation sub-regional plans have attracted most of the funding in the past, and will continue to do so in the future, particularly in the Shepparton and Loddon-Avoca regions.

There is also a clear need for greater resource allocation into the dryland sub-regional plans in the Loddon-Avoca, Wimmera, and Corangamite regions.

It is also important that attempts are made to include environmental and social values and give proper weights to each of these elements in relation to the economic factor to ensure that priorities for resources allocation are determined in the most efficient manner.

Table 6 Rating of salinity sub-regions according to degree of avoidable losses (benefits)

Sub-region	Present value of avoidable loss ($ mill)	Rating based on avoidable loss	Budget allocation 1988-1992 ($ '000)	Rating based on 1988-1992 budget allocation
North East	0.5	0.01	566.4	0.17
Goul-Broken	918.5			
Shep'ton irrigation	873.5	10.00	32,852.9	10.00
Goulburn dryland	45.0	0.52	6,960.6	2.12
Campaspe	29.7			
Irrigation	23.6	0.27	2,029.5	0.62
Dryland	6.1	0.07	2,303.0	0.70
Loddon-Avoca	446.0			
Irrigation	308.9	3.54	21,282.4	6.48
Dryland	137.1	1.56	3,174.5	0.97
Mallee	52.7			
Irrigation	36.3	0.42	3,754.2	1.14
Dryland	16.5	0.19	3,500.5	1.07
Wimmera	84.7			
Avon-Richardson	31.8	0.10	2,854.1	0.14
Wimmera other	53.0	0.32		0.72
Corangamite	79.5	0.91	3,096.8	1.04
Glenelg	45.2	0.52	3,415.2	0.94
South East	160.3			
LWC	78.8	0.90	938.3	0.29
South East other	81.5	0.93	583.6	0.18

7. Future challenges

From 1992/93 onwards the salinity program will move towards an implementation phase. This will bring about new challenges. It is therefore, important that we develop appropriate policies to meet these challenge to ensure that the salinity program will achieve its desired objectives. It is anticipated that some of the major challenges that will face the salinity program are: environmental valuation; water allocation policies such as transferable water entitlements and water pricing; sustainability of the agricultural sector; and monitoring and evaluation.

7.1 Environmental valuation

As demonstrated in the estimation of the total cost of salinity earlier, the environmental and external effects were not included. A major limitation of the sub-regional plans prepared so far has been the inability to account for the impact of salinity on the environment in monetary terms. While some of the environmental impacts of salinity may be real and could threaten environmental values, others may well be marginal. Hence, environmental values need to be costed/valued as a matter of urgency to aid in the allocation of scarce resources to saving/ protecting the highest value environmental areas.

There are a number of methodologies that can be used to determine environmental values. These methodologies attempt to "shadow price" or estimate approximate market values of environmental amenities. Methods such as Travel Cost and Contingent Valuation have been researched and have useful applications in the salinity program (Sappideen 1991).

A Contingent Valuation study of the Lake Wellington wetlands is currently under way. The Lake Wellington wetlands (some 32 in all) all have some zoological significance (water bird habitat). There is evidence to indicate that all are being threatened by increasing levels of salinity to varying degrees. This project is aimed at determining the environmental value of 4 of the key wetlands in the area. With a large number of wetlands in the other salinity sub-regions being threatened by salinity, the results from the above study will make a significant contribution to provide some monetary valuation for these environmental amenities.

7.2 Water allocation policies

One of the broad goals of economic reform in the Murray Darling Basin irrigation system is to increase efficiency of water use. Efficiencies in water uses are also a major thrust in the irrigation sub-regional plans. The existing system of water allocation in Victoria imposes a constraint on the efficient use of water and on economic growth. From an economic viewpoint, improved efficiency should allow water to move from uses which generate low returns to those which generate the highest returns.

7.2.1. Transferable water entitlements (TWEs)

The rationale for implementing a system of TWEs is that by breaking the traditional link between water and land, water can move under market forces to land where its productivity is the greatest. This occurs because users who place a low value on water will be able to trade their entitlements to those who place a high value on water availability. By allowing TWEs, there will be an improvement in efficiency of water use in Victoria resulting in higher average incomes for irrigation farmers. For example, in New South Wales the increase in rural incomes due to a limited transferability of water rights has been estimated at $32.5 million a year.

Temporary TWEs were introduced in major Victorian irrigation systems in 1987 on an annual (seasonal) basis. The system is at present applicable for three gravity supplied irrigation districts - Goulburn Murray, Campaspe and Macalister; private diversion licences throughout the State and for irrigation under annual permits in the Horsham area. Permanent TWEs began operating from September 1991.

TWEs will provide irrigators greater flexibility in water use. For example, if less irrigation is required by a farmer, part of the quota can be sold and the proceeds transferred into other farm investment. On the other hand, an increased need for irrigation can be met through the purchase of quota as in normal trading practice. This is just an example of trade within the farming sector. There is also potential for water transfers between sectors, such as from farming to urban, industrial, recreational or environmental uses. Such transfers can significantly improve farm financial structure through an injection of capital.

The implementation of TWEs raises a number of issues including: fears of rationalisation of water policy, security of water supply, tenure security, third-party effects and social impact on rural communities. These issues will have to be addressed adequately if TWEs are to achieve its desired objectives.

7.2.2 Water pricing

In a market based economy, prices represent a form of communication between suppliers and users of goods and services. The forum for this exchange of information is the market place which allows buyers and sellers to indicate their preferences and requirements. It is often argued that economic efficiency can be enhanced by adopting market based policies to determine the allocation of water within an irrigation system. However, because irrigation systems rarely have more than one supplier but many potential users of water, it is often necessary to set an administered price which reflects the costs involved in supplying water to various locations. There are three categories of costs to be considered in setting water prices:

- a **resource** cost;
- an **opportunity** cost; and
- a **social** cost.

Resource cost reflects the capital, maintenance and operating costs of the system. Opportunity cost (or economic cost) is the income or benefit forgone when water is not used in its most valuable alternative end use. Social cost is a measure of the total cost of water to the community, including economic, environmental and all other costs. It therefore follows that the true cost of water should reflect the full resource cost, the opportunity (or economic) cost as well as other social costs.

Currently, irrigators in Victoria pay less than the full resource cost of delivery, capital and maintenance. At present a shortfall in recurrent expenditure, estimated at $25 million in 1988-89, is covered by the Victorian government. State governments are moving away from subsidisation to a "user pays" principle. Pricing policies and management arrangements for the Victorian irrigation sector are currently the subject of two independent inquiries. Whilst these inquiries will be examining options for achieving cost efficiencies and changes to all levels of services, it appears inevitable that water charges will need to increase if the sector is to become more self sufficient.

One concern that has been raised by some irrigator groups is the apparent cross subsidisation of other irrigator groups. This occurs if there is a uniform delivery charge as at present. If the "user pays" principle is applied in a localised manner in the setting of delivery charges, irrigators further away from water sources would pay more thus reducing the demand for quotas in such areas. This will make more water available for other users.

As water has an opportunity cost it will be worth more to some users than to others. This will encourage users to whom water has a lower value to sell to those who have a higher value use for it. This is occurring in the Nangiloc-Colignan region where there is already some water trading; the final water price includes the resource cost (paid to the RWC) and an opportunity cost (paid to the selling farmer).

7.3 Structural adjustment

There is no doubt that irrigated agriculture in Victoria will change as a result of pressures to become more efficient and competitive in the future. Structural adjustment is an on-going process in the agricultural sector as people enter and leave the farming sector in response to opportunities and changing fortunes. Due to the dominance of irrigated agriculture in Victoria, reforms in water pricing resulting in re-allocation of water use will increase the pressure for structural adjustment. Water pricing reform will not only have short term impacts on farm viability, but in the long run will bring about significant changes in land use and enterprise patterns in Victoria's northern irrigation districts. As mentioned earlier, full cost recovery associated with TWEs will result in water being transferred to those enterprises which will generate the highest profit for water use. This would mean that the main buyers of water will be irrigators with high value dairy, horticultural or mixed enterprises, whilst sellers would be irrigators with primarily annual pasture-based enterprises.

Structural adjustment has been recommended as a preferred option to control salinity in the Tragowel Plains. This will take the form of land amalgamation to increase the number of viable units and shift resources from saline to more productive land. Already about 27,000 ha have been surveyed to facilitate this and will result in a concentration of water and other resources on lower salinity (class A and B) soils. Consequently, some land (class C - high salinity soils and D - extreme salinity soils) may no longer be irrigated. Provisions under the Rural Adjustment Scheme will be available to facilitate these changes.

7.4 Monitoring and evaluation of performance

Since the inception of the salinity program in 1984, around $177 million has been expended. With the completion of the planning process, the emphasis will largely shift toward implementation. Given that we are now moving toward implementation it is important to monitor the salinity management program to assess:

- progress in disbursement of funds
- if the smp's are achieving the desired objectives and targets
- the impacts of salinity management practices on farm incomes and/or land prices.

The first two objectives are monitoring the cost effectiveness of the program and the management of the program. The need for full financial accountability is essential. Guidelines for the accountability requirements for the implementation of salinity management programs have been developed and came into their first year of operation in 1990/91.

However, the key economic problem is to ensure or monitor the economic performance of the smp. This is a much more difficult problem as it revolves around measuring real changes in land holder incomes over time. Possibly the best measure of sub-regional plan performance may be real increases in land prices . As land price should reflect the net present value of future income streams it is a good proxy for income change.

Although significant changes will not occur in the first few years of implementation the program is long term (30 - 50 years). Hence, changes will only be able to be measured over such a time period. It is therefore, important to collect the base level data to ensure that any change can be studied in the future. The challenge to the economists within the program then, is to set up the data base so that the meaningful analysis can be conducted in the future.

Data collection must be easy to collect and simple to record and access without imposing a large bureaucratic burden on the regional planning groups. The possible adoption of remote sensing techniques could also be applied to this monitoring role. Such research is currently under way at the Institute of Sustainable Agriculture at Tatura.

8. Conclusion

The Victorian Salinity Program has been an innovative attempt by government to deal with a complex and 'wicked' environmental problem (Rittel and Webber 1973). The commitment to community based planning has allowed the fight against salinity to be continued after the shortcomings of more conservative planning strategies had been revealed by the failure of the Mineral Reserves evaporation basin scheme.

One of the characteristics of the 'wicked' problem is that each solution of a 'wicked' problem creates a new 'wicked' problem. In this case the solution (the success of community planning in resolving many local conflicts which have constrained government action to control salinity) has led to increasing calls to government from different catchment communities to share the cost of salinity control. As the proposals for salinity control place increasing demands upon declining government revenues, the Salinity Program has been transformed from an 'immature phase' when the challenge was to find worthwhile projects on which government could spend its fund, to a 'mature phase' when the challenge is to strategically allocate limited financial resources where they will achieve the greatest return, be that financial, environmental or social. This assumes greater importance as we move into an implementation phase.

It has been our contention that the community planning model which underpins the Victorian Salinity Program, is not as effective at achieving this task as it has been effective at resolving resource conflicts within catchments. We have proposed an alternative model which should give some guidance for policy makers facing inter-catchment resource allocation decisions. We recognise that this model is not 'value free'. We are beneficiaries of the current resource allocation and our model must be evaluated with our position in mind.

We acknowledge that resource allocation is an inherently political process, and that ad-hoc decision making is inevitable, and sometimes desirable in an unstable environment. We believe, however, that in any long term st[illegible] program policy makers should be committed to some degree of systematic decision making based upon explicit principles. In building this model we have clearly stated our principles and values. The results of the model have been derived from the principles, not the other way around.

We also recognise that the future challenges that will face the salinity program are not easy tasks. Changes in water pricing policy will inevitably lead to some structural adjustments in the irrigated farming sector. However, there will be other opportunities created by the process of change.

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Appendix Table 1 - Total (State & Federal) Salinity Budget Allocation by Salinity Sub-regions 1987/88 to 1991/92 (in 1992 $ '000)

SUB-REGION	87/88	%	88/89	%	89/90	%	90/91	%	91/92	%	Total	%
Campaspe dryland	433.8	2.1	493.7	1.9	499.6	2.1	523.4	2.0	352.5	1.3	2311.0	1.86
Campaspe west	74.6	0.4	242.9	0.9	540.8	2.3	693.6	2.6	477.6	1.8	2035.7	1.63
CAMPASPE	508.4	2.4	736.6	2.9	1040.4	4.4	1217.0	4.6	830.1	3.1	4346.7	3.49
CORANGAMITE	490.0	2.3	660.5	2.6	754.8	3.2	847.4	3.2	662.5	2.4	3426.5	2.75
GLENELG FORUM	505.5	2.4	568.6	2.2	735.4	3.1	678.0	2.6	609.3	2.2	3107.0	2.49
Goulburn dryland	878.1	4.2	1178.0	4.6	1286.9	5.4	1850.8	7.0	1766.8	6.5	6981.8	5.61
Shepparton	3978.3	18.8	6636.7	25.7	6265.8	26.5	7416.7	28.1	8555.4	31.5	32952.0	26.46
GOULBURN-BROKEN	4856.4	23.0	7814.7	30.2	7552.8	32.0	9267.5	35.1	10322.2	38.1	39933.8	32.06
Avoca dryland	142.5	0.7	260.9	1.0	313.2	1.3	346.2	1.3	617.7	2.3	1684.8	1.35
Loddon Avoca other	116.3	0.6	177.8	0.7	372.8	1.6	426.5	1.6	20.0	0.1	1117.8	0.90
Loddon dryland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	380.6	1.4	380.6	0.31
Barr Creek	905.0	4.3	1480.6	5.7	1488.1	6.3	1724.4	6.5	1592.0	5.9	7213.0	5.79
Boort west of Loddon	850.0	4.0	444.6	1.7	545.2	2.3	305.2	1.2	370.3	1.4	2524.5	2.03
Tragowel Plains	210.0	1.0	446.1	1.7	731.1	3.1	1733.6	6.6	2253.6	8.3	5386.7	4.33
Kerang lakes	1313.8	6.2	1995.9	7.7	1223.3	5.2	607.7	2.3	1061.8	3.9	6223.9	5.00
LODDON AVOCA	3537.5	16.7	4806.0	18.6	4673.7	19.8	5143.6	19.5	6296.0	23.2	24531.4	19.70
Mallee dryland	1117.5	5.3	855.5	3.3	696.6	2.9	446.1	1.7	384.8	1.4	3513.8	2.82
Nangiloc Colignan	118.8	0.6	284.3	1.1	387.7	1.6	311.0	1.2	398.0	1.5	1504.3	1.21
Nyah	0.0	0.0	0.0	0.0	0.0	0.0	36.7	0.1	69.7	0.3	106.6	0.09
Nyah to SA border	0.0	0.0	70.2	0.3	69.1	0.3	212.1	0.8	328.4	1.2	681.1	0.55
Sunraysia	89.4	0.4	312.4	1.2	255.1	1.1	379.2	1.4	432.2	1.6	1472.4	1.18
MALLEE	1325.6	6.3	1522.4	5.9	1408.5	6.0	1385.2	5.2	1613.1	5.9	7278.2	5.84
NORTH EAST	62.5	0.3	127.1	0.5	123.7	0.5	138.5	0.5	114.6	0.4	568.2	0.46
Lake Wellington	51.3	0.2	163.7	0.6	127.0	0.5	228.8	0.9	367.5	1.4	940.5	0.76
South East other	48.8	0.2	23.4	0.1	166.3	0.7	217.0	0.8	128.1	0.5	585.4	0.47
SOUTH EAST	100.0	0.5	187.1	0.7	293.3	1.2	445.7	1.7	495.6	1.8	1525.9	1.23
Wimmera dryland	175.0	0.8	425.9	1.6	455.2	1.9	0.0	0.0	683.2	2.5	1743.7	1.40
Wimmera other	0.0	0.0	0.0	0.0	0.0	0.0	633.7	2.4	32.5	0.1	668.6	0.54
Avon Richardson	20.6	0.1	21.1	0.1	52.9	0.2	64.8	0.2	289.3	1.1	449.3	0.36
WIMMERA	195.6	0.9	446.9	1.7	508.1	2.2	698.5	2.6	1005.0	3.7	2861.7	2.30
MURRAY DARLING BASIN	271.3	1.3	2108.3	8.2	2184.1	9.2	2301.0	8.7	2116.0	7.8	9008.1	7.23
RIVERINE PLAINS	1357.5	6.4	1017.9	3.9	157.1	0.7	159.1	0.6	48.0	0.2	2751.3	2.21
STATE WIDE	4285.6	20.3	5841.5	22.6	4198.3	17.8	4145.2	15.7	3015.0	11.1	21561.9	17.31
GRAND TOTAL*	21120.9	100.0	25837.6	100.0	23630.2	100.0	26426.7	100.0	27127.4	100.0	124542.7	100.00

* includes Federal component for 1987/88, but not allocated to sub-regions due to lack of data

Appendix Table 2 - Estimate of current and future salinitv in Victoria by salinity regions/sub-regions

	Region (a)	Total extent of agric land ('000 ha) (b)	Current Salinity ('000 ha) (e)	Percentage of land affected (f)	Future Salinity[1] ('000 ha) (g)
1	North East	402	0.2	0.05	n.e.
2	Goul/Broken	900	83.3	9.3	137.8
	Shepparton	460	81.0	17.6	115.0
	Goulburn dry land	440	2.3	0.5	22.8
3	Campaspe	192	6.94	3.6	33.14
	Campaspe West	6	1.84	30.7	2.24
	Campaspe dry land	186	5.10	2.7	30.90
4	Lodon/Avoca	1077	193.1	17.9	75.7
	Tragowel	125	88.0		14.1
	Kerang	244	13.8		11.6
	Boort	89	83.7		n.e.
	Irrigation[2]	458	185.5	40.5	25.7
	Dry land - Loddon) Avoca)	619	7.6	1.2	50.0
5	Mallee	1716	9.8	0.57	20.0
	Nangiloc	5	0.8		0
	Sunraysia[3]	) 367	n.e		
	Nyah to Border[3]	)			
	Irrigation[2]	372	0.8	0.22	
	Dry land	1344	9.0	0.67	20.0
6	Wimmera	1677	55.0	3.3	75.5
	Avon-Rich	435	19.9		28.7
	Wim. other	1242	35.1		46.8
7	Glenelg	1521	20.0	1.3	n.e.
8	Corangamite	855	12.0	1.4	5.0
9	South East	843	21.51	2.6	32.1
	LWC[4]	246	12.50	5.1	9.0
	South East other	597	9.01	1.5	23.1

1/ estimated over a thirty years period 2/ irrigation figures are sum of sub-regional plans
3/ future salinity benefits are estimated as reduction in River Murray salinity levels 4/ includes irrigation and dryland n.e. - not estimated

Appendix Table 3 - Agricultural losses due to salinity in Victoria by salinity sub-regions

	Region (a)	Total extent of agric land ('000 ha) (b)	Gross Value of Production ($ million) (c)	Gross Value of Prod/ha ($/ha) (d)	Current Salinity ('000 ha) (e)	Future Salinity ('000 ha) (f)	Current loss[1] ($ mill) (g)	Future loss[2] ($ mill) (h)
1	North East	402	181	450	0.2	n.e.	0.09	n.e.
2	Goul/Broken	900	618		83.3	137.8	82.10	117.65
	Shepparton	460	451	981	81.0	115.0	79.46	112.86
	Goulburn dry land	440	166	378	2.3	22.8	2.64	4.79
3	Campaspe	192	70		4.74	2.24	2.57	1.89
	Campaspe West	6	5	846	1.84	2.24	1.56	1.89
	Campaspe dry land	186	65	348	2.90	n.e.	1.01	n.e.
4	Lodon/Avoca	1077	415		193.1	75.7	78.96	29.98
	Tragowel	125	58	464	88.0	14.1	40.88	6.55
	Kerang	244	85	350	13.8	11.6	4.83	4.06
	Boort	89	32	358	83.7	n.e.	30.00	n.e.
	Irrigation[3]	458	175	383	185.5	25.7	75.70	10.61
	Dry land - Loddon)	619	240	387	7.6	50.0	3.26	19.38
	Avoca)							
5	Mallee	1716	527		9.8	20.0	3.79	9.22
	Nangiloc	5	8	1600	0.8	0	1.28	0
	Sunraysia	) 367	) 144	) 410	n.e			) 3.64[4]
	Nyah to Border	)	)	)				)
	Irrigation[3]	372	152		0.8		1.28	3.64
	Dry land	1344	374	279	9.0	20.0	2.51	5.58
6	Wimmera	1677	513		55.0	75.5	16.73	23.37
	Avon-Rich	435	136	313	[illegible]9.9	28.7	5.88	9.09
	Wim. other	1242	377	303	35.1	46.8	10.85	14.28
7	Gle[illegible]g	1521	1,135	746	20.0	n.e.	14.93	n.e.
8	Corangamite	855	650	760	12.0	5.0	23.21	3.03
9	South East	843	442		21.51	32.1	11.91	22.22
	LWC[4]	246	132	538	12.50	9.0	6.73	4.84
	South East other	597	310	519	9.01	23.1	5.18	17.38

1/ column (e) * (d) 2/ column (f) * (d) 3/ irrigation figures are sum of sub-regional plans
4/ estimated as reduction in River Murray salinity levels 5/ includes irrigation and dryland n.e. - not estimated

Appendix Table 4 - Estimates of current and future production losses and present value of total avoidable losses due to salinity ($ mill)

Region	Current annual loss[1] (1)	Recover x% of (1)[2] (2)	Future annual loss (3)	Prevent x% of (3)[2] (4)	Total avoidable annual loss (2)+(4) (5)	Present value of avoidable loss[3] (6)
North east	**0.09**	**0.063**	**n.e.**	**n.e.**	**0.063**	**0.48**
Goul-Broken	**82.10**	**49.79**	**117.65**	**71.55**	**121.34**	**918.47**
Irrigation	79.46	47.68	112.86	67.72	115.39	873.47
Dry land	2.64	2.11	4.79	3.83	5.94	44.99
Campaspe	**2.57**	**2.21**	**1.90**	**1.71**	**3.92**	**29.69**
Irrigation	1.56	1.40	1.90	1.71	3.11	23.57
Dry land	1.01	0.81		n.e.	0.81	6.12
Lod-Avoca	**78.96**	**32.81**	**29.98**	**26.11**	**58.92**	**445.99**
Tragowel	40.88	16.26	6.55	6.55	22.81	172.69
Kerang	4.83	1.93	4.06	4.06	5.99	45.36
Boort	30.00	12.00	n.e.	n.e.	12.00	90.84
Irrigation[4]	75.71	30.20	10.61	10.61	40.81	308.89
Dry land - Loddon) - Avoca)	3.26	2.61	19.38	15.50	18.11	137.10
Mallee	**3.79**	**1.65**	**9.22**	**5.31**	**6.97**	**52.74**
Nangiloc	1.28	1.15			1.15	8.72
Sunraysia[5]			3.64	3.64	3.64	27.55
Nyah[5]						
Irrigation[4]	1.28	1.15	3.64	3.64	4.79	36.27
Dry land	2.51	0.50	5.58	1.67	2.17	16.47
Wimmera	**16.73**	**4.18**	**23.37**	**7.01**	**11.19**	**84.73**
Avon-Rich	5.88	1.46	9.09	2.73	4.20	31.77
Wim. other	10.85	2.71	14.28	4.28	6.99	52.96
Corangamite	**23.21**	**9.28**	**3.03**	**1.21**	**10.50**	**79.45**
Glenelg[6]	**14.93**	**5.97**	**n.e.**	**n.e.**	**5.97**	**45.21**
South East	**11.91**	**8.13**	**22.22**	**13.05**	**21.18**	**160.29**
LWC	6.73	6.05	4.84	4.36	10.41	78.82
Dryland	5.18	2.07	17.38	8.69	10.76	81.46

1/ See appendix table 3, columns (g) & (h) for derivation of these figures.

2/ Estimates of these percentages used are;

Region/sub-region		Recoverable loss	Preventable loss
South East	- LWC	0.90	0.90
	- Dryland	0.40	0.50
Goul/Broken	- Irrigation	0.60	0.60
	- Dryland	0.80	0.80
Campaspe	- Irrigation	0.90	0.90
	- Dryland	0.80	0.80
Lod/Avoca	- Tragowel	0.40	0.90 *
	- Kerang	0.40	0.90 *
	- Boort	0.40	0.90 *
Mallee	- Irrigation	0.90	0.90
	- Dryland	0.20	0.30
Wimmera	- Avon/Rich	0.25	0.30
	- Dryland	0.25	0.30
Corangamite	-	0.40	0.40
Glenelg	-	0.40	0.40
North East	-	0.70	0.70

* These estimates are different from estimates made by Fitzpatrick et al (1991a). It is assumed that the benefits are prevention of further losses of class A & B (low to moderate salinity) soils to class C & D (severe to extreme salinity). It is assumed that 90% of this loss can be prevented.

3/ Calculated by discounting annual flow of benefits (total avoidable loss) over a thirty year period using a 4% real discount rate.

4/ Irrigation figures are sum of sub-region plans

5/ There is no actual salinity occurrence. The benefits are estimated as reduction in River Murray salinity levels.

6/ Does not include estimates of future salinity